

On harelip and cleft palate.

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ON
HARELIP AND CLEFT PALATE.

THE UNIVERSITY OF CHICAGO

ON

HARELIP AND CLEFT

PALATE.

BY

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TO THE MEMORY

OF

SIR WILLIAM FERGUSSON, BART., F.R.S., LL.D.,

SERGEANT-SURGEON TO THE QUEEN; PROFESSOR OF CLINICAL SURGERY IN KING'S
COLLEGE, LONDON, AND SENIOR SURGEON TO KING'S COLLEGE HOSPITAL, ETC.

IN GRATEFUL REMEMBRANCE

OF HIS

EXCEPTIONAL KINDNESS FOR MANY YEARS

BOTH AS A TEACHER AND PERSONAL FRIEND,

AND

IN HUMBLE RECOGNITION

OF HIS

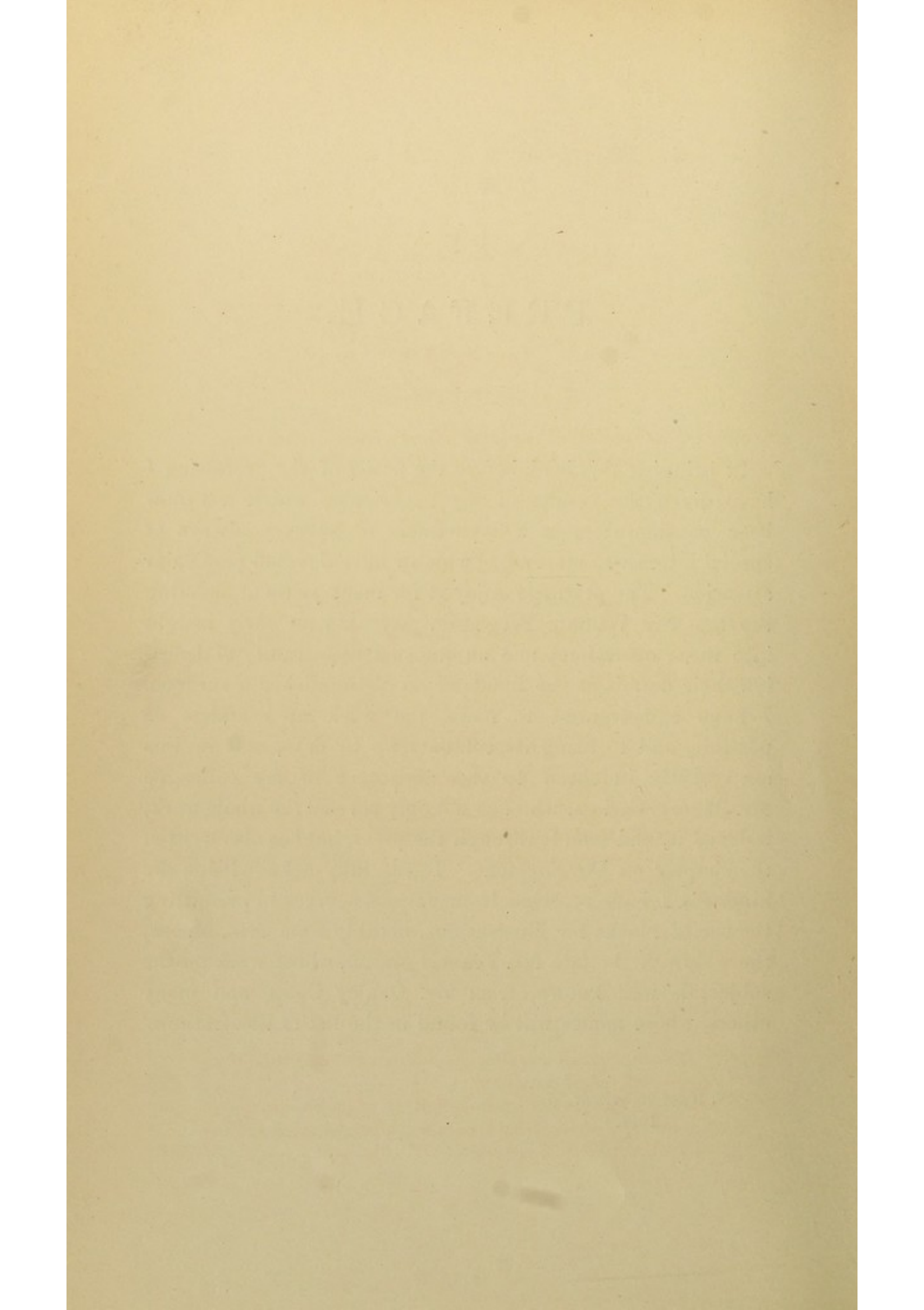
MASTERLY SKILL AS A SURGEON,

THIS SMALL VOLUME IS

AFFECTIONATELY DEDICATED.

P R E F A C E.

IN bringing this book before the notice of the profession I have given the results of my experience, which has now been considerable, in a department of surgery always of special interest to me, and to which I have devoted particular attention. The privilege enjoyed for many years of assisting the late Sir William Fergusson gave me an early insight into these operations, and an unusual opportunity of learning their details at the hands of so distinguished a surgeon. I have endeavoured to make the work as complete as possible, and to bring its contents up to date, and in this am greatly indebted to the assistance of my colleague Mr. Albert Carless, who has not only revised the whole work, indexed it, and seen it through the press, but has also written the chapter on Development. I gratefully acknowledge the kindness I have received from various sources in permitting the use of blocks for illustrations, notably from Mrs. Mason, the widow of the late Mr. Francis Mason, whose work on the subject is well known, from Mr. Oakley Coles, and many others, whose names will be found in the list of illustrations.



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ON HARELIP AND CLEFT PALATE.

CHAPTER I.

GENERAL INTRODUCTION.

Harelip—Cleft palate—Frequency—Occurrence in animals—Associated deformities—Median harelip—Facial clefts—Macrostoma—Mandibular clefts—Causes of these deformities.

THE congenital fissures and deformities of the mouth and lips form a group which is considerably larger than might be imagined from the scanty notice given them in ordinary text-books ; and although many are extremely rare, yet possibly if more attention were drawn to them, fresh cases would be noted and recorded, and the somewhat scanty materials from which we have to work out their development and characteristics would be increased. In order to facilitate subsequent description, I append a classified list of the deformities which we shall pass under notice, premising that the more practical part of this work will be occupied exclusively with two of them.

Six different classes may be described :—

- (1) Median harelip (inter-intermaxillary).
- (2) Ordinary harelip (intermaxillary).
- (3) Facial cleft (maxillo-intermaxillary).

- (4) Buccal cleft, or macrostoma (maxillo-mandibular).
- (5) Mandibular cleft, or median fissure of the lower lip.
- (6) Cleft palate.

Inasmuch as ordinary harelip and cleft palate are the conditions most commonly met with, it will be convenient to describe them first, alluding subsequently to the others.

HARELIP.

French, *bec-de-lièvre*. German, *Hasenscharte*—or if with complete cleft palate, *Wolfsrachen* (wolf-jaw).

Harelip is a congenital deformity of the upper lip, characterised by a cleft extending for a variable depth, either through the soft tissues of the lip only, or implicating in addition the alveolus, floor of the nose, and palate. No mention of this condition is made by Hippocrates, Galen, or any of the fathers of medicine; and so far as I can discover the name is first used by Ambrose Paré, who probably initiated the treatment by pin and figure-of-8 suture. The name is really a misnomer, in that the condition (as has been many

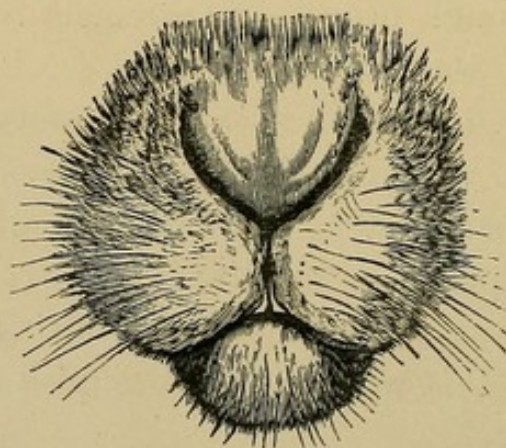
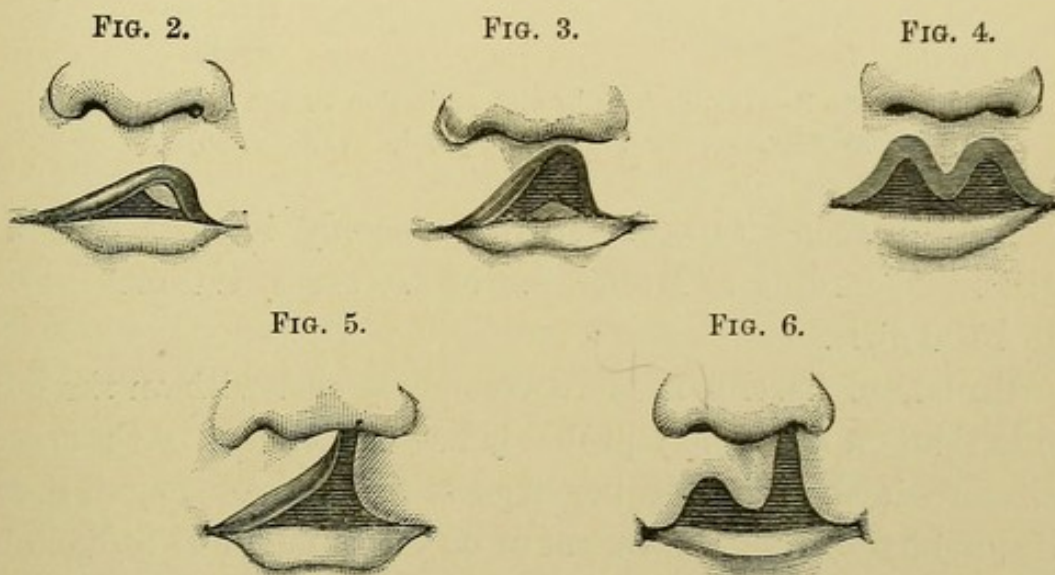


FIG. 1.—Hare's lip to show the median cleft in the lower part prolonged upwards into either nostril. (*Sutton.*)

times pointed out, but notably by Fergusson) does not simulate a hare's lip except in the fact of being cleft, for the natural

cleft in the animal's lip is always in the median line below, bifurcating above to reach either nostril (Fig. 1), whereas in the abnormal human lip the cleft lies to one or the other side. Instances of median defect are known, but they are extremely uncommon, and consist often of more than a simple fissure.

The deformity may exist as a simple notch in the soft tissues of the lip, unilateral (Figs. 2 and 3) or bilateral



(Fig. 4); when more decided, it may implicate one or both nostrils (Figs. 5, 6, and 7). In mild cases the alveolus is intact; in others, cleft, constituting the variety known as *alveolar harelip*, and the line of fissure may, or may not, extend backwards into the palate. In all cases of double alveolar cleft, the palate is also involved, and the central parts of the lip and intermaxilla tend to project forwards; in the severest forms these portions are completely isolated from the maxillæ, and, supported by the vomer and septum nasi, form a proboscis-like appendage to the end of the nose, which is excessively disfiguring. (Figs. 7 and 8 illustrate this deformity as seen from the front and in profile.)

The shape of the nose in unilateral harelip is very charac-

teristic, being broad and flattened out from the deficiency of the floor and posterior wall of the anterior nares.

FIG. 7.



FIG. 8.



FIGS. 7 AND 8.—Double harelip with projection of the os incisivum, as seen from the front and in profile. (*Fergusson.*)

Harelip seems to occur more commonly in boys than in girls. According to Müller, out of 270 cases, 170 were boys, and 100 girls.

Unilateral harelip is more commonly met with on the left side than on the right; probably 60—70 per cent. of the cases are left-sided. Thus Müller reports 142 left-sided against 62 right-sided clefts; Mason, out of 65 cases, found 54 to be unilateral, and of these 35 left-sided to 19 on the right; Kölliker mentions that in 165 unilateral clefts, 113 were on the left side, and 62 on the right. My own experience quite coincides with these figures. At present, no satisfactory explanation of this preponderance of left-sided clefts has been given. One solution suggests itself, but we have no facts of importance to support it, viz. that, inasmuch as the majority of people are from heredity or education right-handed, Nature devotes more energy to completing her developmental processes on that side than on the left, and any check to this would be more likely to happen on the left side. It would be valuable and interesting to know in what proportions other unilateral deformities occur on the left and right sides respectively.

Occasionally one sees in the upper lips of children a congenital red line *apparently* cicatricial, occupying the position of the normal harelip fissure, and which has been supposed to indicate a natural cure of a temporary defect of development. My colleague, Mr. Carless, has recently shown me a case of this character under his care in a child a few weeks old. There was a well-marked red line extending from the lip margin to the nostril; but there was no irregularity in the red border, and no evidence of cicatricial contraction; the tissue of the lip, moreover, seemed quite soft and normal, not fibrous or hard. These points seem to bear out fully Trendelenburg's opinion¹ that the name "intra-uterine cicatrisation or cure of a harelip" is incorrect, and that such cases are simply due to the raphe of union remaining evident instead of disappearing as usual; and he quotes the normal appearance of the raphes in the scrotum and perinæum as similar conditions. In this child there was no evidence of any groove or depression in the alveolus; but other deformities were present, viz. a very definite post-anal dimple, the cicatrix being adherent to the tip of the coccyx, a slight condition of hypospadias, and a congenital hydrocele. There was no history of deformity in the family, nor of maternal impression.

CLEFT PALATE.

This is a congenital deformity due to non-closure of the horizontal palatine outgrowths extending inwards from the maxillary processes. The name must not be applied to acquired fissures or defects of the palate due to injury or to disease of the bones later in life. (See Chap. IX.)

As with harelip, so with cleft palate, the extent of the defect varies greatly in different cases. Thus in the most severe forms, there is a total mesial longitudinal cleft,

¹ Trendelenburg, 'Deutsche Chirurg.,' Lief. xxxiii, Hälfte 1.

extending forwards from the tip of the uvula to the level of the anterior palatine canal, thence bifurcating to communicate anteriorly with a double alveolar harelip, the os incisivum or central portions of the intermaxilla being usually displaced forward (Fig. 9). Such a condition is known by German authors as "Wolfsrachen," or wolf-jaw. The vomer descends in the median line usually into close quarters with, but separate from the margins of the cleft, and the os incisivum is attached to its anterior extremity. When the vomer comes far down and is well developed and prominent, and the palatal outgrowths small, the cleft appears to be double, but is not so in reality (Figs. 9 and 10).

FIG. 9.

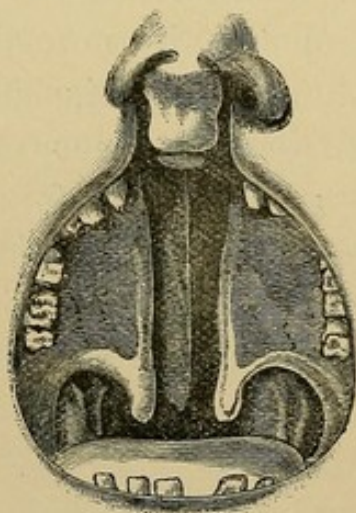


FIG. 10.

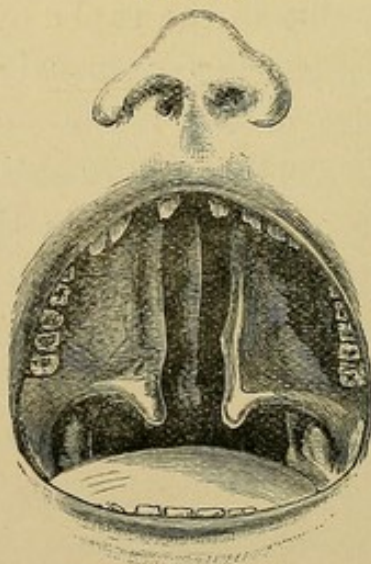


FIG. 9.—Complete cleft palate and double alveolar harelip; simulating a double lateral cleft, due to the vomer being seen free between the palatal segments. (*Mason.*)

FIG. 10.—Complete cleft palate without alveolar or labial deformity; the vomer is separate from the lateral segments. (*Mason.*)

Not unfrequently the vomer is attached to one of the margins of the cleft, this condition being usually associated with unilateral alveolar harelip. Such attachment always occurs on the side opposite to the fissure in the alveolus; that is to say, since unilateral harelip is more

common on the left, the vomer is usually attached to the right side of the cleft. Fig. 11 indicates the less common condition of attachment of the vomer to the left palatal segment. Rouge¹ and Oakley Coles² fully confirm this statement. The cleft may, however, merely implicate the soft and hard

FIG. 11.

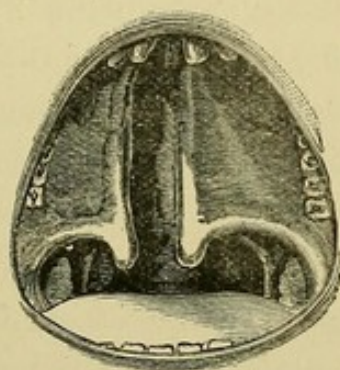


FIG. 13.

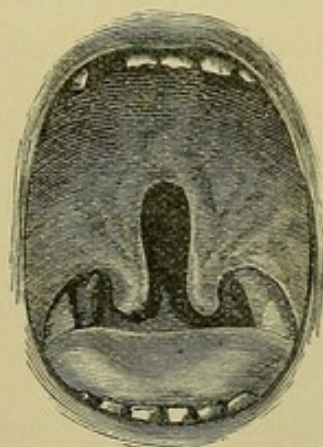


FIG. 12.

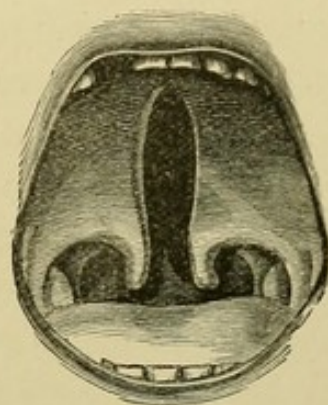


FIG. 14.

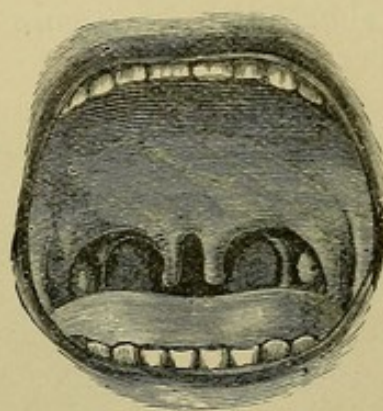


FIG. 11.—Complete unilateral cleft palate without alveolar deficiency; the vomer is attached to the left palatal segment. (*Mason.*)

FIGS. 12, 13, 14.—Various degrees of simple fissure of the palate. (*Mason.*)

palate, leaving the alveolus and lip perfect, and does not then extend further forward than the site of the anterior palatine canal, and is strictly median (Fig. 12); or it may be still

¹ Rouge, 'L'Uranoplastie et les divisions congénitales du palais.'

² Oakley Coles, 'Deformities of the Mouth' (Churchill).

more limited, involving more or less of the velum, perhaps only the uvula, or extending a variable distance into the hard palate (Figs. 13 and 14).

Other less common congenital deformities have been recorded, and amongst them may be noted a case lately seen by myself in a girl of four years, in whom there existed an oval opening at the junction of the hard and soft palate, separated by a narrow bridge of normal palatal tissue from a cleft of the posterior half of the velum and uvula, showing intermissions of development; a congenital aperture in the soft palate at its junction with the hard, or in any part of the velum, but with no defect of either uvula or palate bones (Dieffenbach¹); a defective development of the palate bones alone, the mucous membrane remaining intact from side to side, and hence no cleft resulting (Trélat, Notta, Langenbeck); or again, as in Fig. 15, a cleft only of the anterior portion of the palate, extending through the alveolus, and for a short distance behind it (Mason²). Inasmuch as the

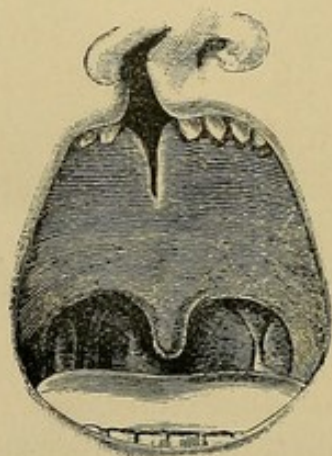


FIG. 15.—Unusual form of cleft involving the alveolar arch, and the anterior portion of the palate only. (*Mason.*)

union of the two halves of the velum occurs subsequently to that of the alveolar arch, it appears that this last rare

¹ Dieffenbach, 'Die operative Chirurgie' (1845).

² Mason, 'On Harelip and Cleft Palate' (Churchill), p. 54.

defect must have been due to an intermission of development, which was felt only at the anterior portion, whilst that of the posterior part proceeded normally at a later date.

Mason¹ records a curious case worth mentioning of a girl under his care in 1877, who had a fissure extending through the velum, and for a short distance into the hard palate, but there was no trace of uvula on either side, and the soft palate was continuous on both sides with the pharyngeal wall.

The width of the cleft varies as much as the extent, and is a matter of great importance prognostically, as the broader clefts are much more difficult to close. The direction or slope of the segments of the bony palate also differs considerably, in some instances being more or less horizontal and following the normal curve; in others one or both of the segments is much more nearly vertical, a condition which is not at all unsatisfactory, for, as will be explained hereafter, the more horizontal the palatal processes, the more difficult is it to gain satisfactory closure by operation (p. 65).

The frequency of the occurrence of harelip and cleft palate cannot accurately be ascertained, inasmuch as statistics are not readily to be found. In the 'St. Thomas's Hospital Reports' the number of malformations of the children born is noted in some of the years. Thus the aggregate number of living children born in their maternity department in the years 1875, 1877—1880, and 1883 was 10,653, and of this number there was only one case of harelip, with two cases of cleft palate, and three of the combined deformity, *i. e.* about one case in every 1800 infants born; but if the silence of the reports for subsequent years means absence of deformity, then this proportion may be much too great.

On the Continent some old records are obtainable. Thus, according to Grenser, of 14,466 infants born living at the

¹ Op. cit., p. 55.

Maternity at Dresden from 1816 to 1864 there were sixteen cases of simple harelip, and nine with fissures of the palate. Credé states that amongst 2044 infants examined at birth, only one case of simple harelip was observed, and one of complete division of the hard and soft palate.

OCCURRENCE IN ANIMALS.

These conditions obtain not only in the human subject, but also in animals, though not so commonly.

Thus Sutton figures a right-sided harelip in a slink calf, and mentions a specimen of a harelip in a lamb in the museum of the Odontological Society; and in our museum at King's College there is a specimen of a right-sided harelip in a kitten with a cleft alveolus, but the palate is intact.

Cleft palate occurs more frequently in animals, particularly in those born in a state of captivity. Thus it appears that from statistics taken ten years ago 99 per cent. of the lion cubs born in the London Zoological Gardens had cleft palates, indicating that either the food-supply of these animals was not all that was requisite for perfect development, or that enforced confinement has a deleterious effect upon the multiplication of the species. It is a curious fact that in the Dublin Zoological Gardens the deformity was rarely noticed amongst the lion cubs, and the reason for this was supposed to be the supply of such food that the mother could eat both flesh and bone. Since the same practice has been followed in London, viz. giving the lions twice a week a young goat which they can eat, bones and all, the proportion of cleft palates in the young subsequently born has become considerably diminished.

ASSOCIATION WITH OTHER DEFORMITIES.

Occasionally, besides the fissured palate or lip, other deformities are noted in the same patient, but not so often as one might be led to expect. Mason records two or three cases as having come under his notice, the coincident deformities being respectively fistulous openings of buccal glands in an everted lower lip, congenital fissure of the lobe of the right ear, congenital talipes calcaneus and hypospadias. Dr. F. Warner records in the 'Medical Times and Gazette,' January, 1882, some cases of cleft palate associated with congenital defects of the heart and smallness of head, and also notes in his more recent report¹ that in 117 cases of malformations of the palate, other than cleft, only 42 were not in combination with other defects. Thus in 55 cases there were abnormalities in the shape of the cranium, in 16 cases defective development of the ear, in 12 the existence of an epicanthic fold, and in 15 cases other defects not tabulated.

Clutton² records and pictures a curious development of a flap of mucous membrane on the lower lip of a woman with a cleft palate; it was triangular in shape, and with overhanging projecting angles. The teeth in this case were likewise badly developed, and were all extracted at the age of nineteen.

Binet³ reports a case of an old cured right-sided harelip in a man dead from apoplexy (æt. 53 years) with infantile genital organs.

Broca⁴ describes a much deformed foetus, stillborn at seven months, which he dissected, showing a double harelip and cleft palate, but the os incisivum retained its usual position, thanks to its mucous covering. The dentition,⁵ as noticed

¹ Warner, 'Brit. Med. Journ.,' 1889, July 27th.

² 'Trans. Path. Soc.,' xxxviii, p. 446.

³ 'Bull. de Soc. Anat. de Paris,' December, 1883.

⁴ Ibid., April, 1886.

⁵ See p. 52.

elsewhere, was also interesting, and the buccal deformity was associated with a congenital diaphragmatic hernia, and an abnormal condition of the heart and great vessels.

Other associated malformations are on record, *e. g.* an extra thumb on each hand; and Sir Morell Mackenzie has reported a case in which there was a congenital fissure between the arytaenoid cartilages with a trilobate epiglottis, occurring in conjunction with harelip and cleft palate.¹

The remaining deformities to be noticed here are much less common, but demand attention by their rarity and interest, and on account of the light they throw on the embryology of the lip and mouth.

MEDIAN HARELIP.

This is an exceedingly rare phenomenon, and for long the possibility of the existence of such a condition was doubted. Supposed cases were explained by imagining that from some unknown cause a lateral fissure had been drawn over to the median line. But at the present time there are records of several, mainly, however, in German works; in our own literature there are but few references to the subject. Two varieties of median defect have been described; and the distinction between these has been carefully and thoroughly made by Trendelenburg.²

1. *Double cleft of the upper lip with failure of development of the intermaxilla.* Some half-dozen cases of this are indicated in his work; but perhaps one of the best descriptions is that recently given by Bland Sutton,³ and

¹ 'Medical Times,' 1862, p. 402.

² Trendelenburg, 'Deutsche Chirurg.' (Billroth and Luecke), Lief. xxxiii, Hälfte 1.

³ 'Trans. Odont. Soc.,' vol. xx, p. 90.

from whose paper the accompanying picture is obtained (Fig. 16). It occurred in the practice of Mr. Treves, and died within a few weeks of birth. There was a broad median defect, flanked laterally by the curved convex borders of the maxillary processes; the intermaxillæ were entirely absent, and the nose quite flat. In addition to



FIG. 16.—Median harelip showing total absence of the central portion of the upper lip and of the intermaxillæ, and flattening of the nose from absence of the ethmo-vomerine plate. (*Bland Sutton.*)

this the eyes were affected with coloboma, the right eye presenting other serious defects. "On examining the child before its death," the author states, "I felt convinced that there was no ethmo-vomerine plate, and this conviction was strengthened by the peculiar shape of its forehead. When the child died, this opinion was fully confirmed; there was no ethmo-vomerine plate, consequently no nasal septum, and what is more important, the premaxillary bones were absent."

But according to the cases reported by Trendelenburg the

defects do not stop here. There is usually in addition a broad median palatal cleft, and an absence of nasal bones and muscles; but Kundrat records two cases where the palatal processes of the superior maxillæ and palate bones were well developed, and united in the middle line. The skull itself has been found defective occasionally, the whole cranial portion being small, and the lamina cribrosa and crista galli of the ethmoid absent; in place of these was a fossa between the orbital plates of the frontal bone with no bony basis, but only dura mater covered with mucous membrane. No openings for the passage of the olfactory nerves were found.

Hadlich has also described changes in the brain in two cases occurring in Langenbeck's clinique, consisting mainly in the amalgamation, more or less, of the two hemispheres; the corpora striata and optic thalami were united in the middle line, and the third ventricle, fornix, corpus callosum and olfactory nerves were absent. It is interesting to note the association of such an abnormal fusion of the lateral parts of the brain in the median line with the defective development of the median parts in the skull and face.

But the separation of the facial elements is not always maintained; sometimes they fall or are drawn together by the united palate, resulting in the so-called congenital atresia of the nose ("angeborene Atresia der Choanen"), cases of which have been recorded by Luschka, Bitot and Engel. The latter states that in an infant's skull examined, only 2 or 3 mm. of space existed between the orbits, and 4 mm. between the optic foramina.

2. *True median cleft of the upper lip* with development of the intermaxilla is an excessively rare occurrence, but a few cases have been now recorded.

The simplest type consists of a cleft in the soft portions of the upper lip with no other deformity, but a more complete variety of the defect includes a median division of the nose.

Mr. Pitts, in the Medical Society's 'Proceedings' (vol. xii, p. 304), reported a case in a boy aged five months (Fig. 17). The cleft was median, extending halfway up to the columna. The premaxilla was centrally grooved but otherwise perfect. The palate was normal.

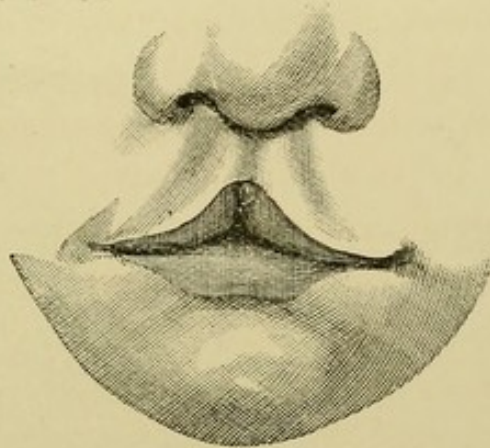


FIG. 17.—Median harelip, showing a mesial cleft in the soft structures of the upper lip. (*Pitts.*)

A more aggravated condition has been dissected by Witzel (in the Rostock Collection). Behind the cleft in the upper lip was found a median division of the premaxilla, each half of which was firmly united to the adjacent superior maxilla. The vomer was single, but broader than usual, and the palate cleft throughout; the two halves of the nose were bounded internally by separated plates of the divided cartilaginous nasal septum. There was also a defect of the frontal bone giving rise to a meningocele. This flattening of the nose, combined with separation of the anterior nares, gave such an appearance to the face as seemed to warrant the term "dog's nose" (*Doggennase*) which has been applied to it.¹

¹ Similar cases have been recorded by Von Ammon, Hippe, Liebrecht, Beely.

FACIAL CLEFTS (German, "*Schräge Gesichtsspalte*").

These are seldom seen, but a sufficient number are now recorded and figured to enable us to study the nature of the

FIG. 18.



FIG. 19.



FIG. 18.—Oblique facial cleft, or rather cicatricial deformity of face along the line usually traversed by such a cleft. (*Tillmanns*, after *Kraske*.)

FIG. 19.—Facial cleft in a child, implicating the lower lid and eye, and with a development of accessory teeth along the cleft margins. (*Tillmanns*, after *Hasellmann*.)



FIG. 20.—Double facial cleft with macrostoma. (*Tillmanns*, after *Guersant*.)

defect. Sir W. Fergusson seems the only English surgeon who has observed this rare condition, the majority of

recorded cases hailing from Germany or France. As we shall see hereafter, this defect is due to the non-closure of the cleft between the outermost part of the intermaxilla and the maxilla itself, and occupies the position which was claimed up to recent years as that of an ordinary harelip.

In several of the cases noted red cicatrices (Fig. 18) rather than actual clefts (Figs. 19 and 20) were present. The defect begins at the free margin of the upper lip, and usually at the spot whence starts the ordinary harelip cleft; but occasionally from the angle of the mouth. It then trends upwards and outwards, leaving the nose entire, and skirts round the ala nasi to reach its upper limit at the middle of the lower eyelid which is cleft, or at the inner canthus. The eye itself may show a coloboma iridis, usually downwards and inwards. The facial skeleton may be divided or not; sometimes a large opening into the antrum exists (Hasellmann,¹ Kraske²). No incisor teeth are developed on the outer side of the cleft, the first tooth seen being the canine. On the inner border of the cleft lip there is usually a marked frænulum, often smaller, however, than the normal median frænum.

This deformity may be unilateral or bilateral (Guersant, Meckel), more frequently the former; and is not uncommonly associated with macrostoma of the same or opposite side of the face (Guersant, Pelvet³), as seen in Fig. 20.

Albrecht⁴ records a most interesting case in a newly born pup (Fig. 21) of double clefts extending from the lip margin upwards not only into the nostril, but also towards the eye on either side, *i.e.* a double associated harelip and facial cleft. The specimen is taken from the Royal Veterinary College of Brussels.

¹ 'Archiv f. klin. Chir.,' xvi, p. 684.

² Ditto, xx, p. 396.

³ Pelvet, "Mémoires sur les fissures congénitales des joues," 'Gaz. méd. de Paris,' 3 s., xix, p. 417.

⁴ "Über die morph. Bedeut. der Kiefer, Lippen, und Gesichtsspalten," Langenbeck's 'Archiv,' xxxi, 2.

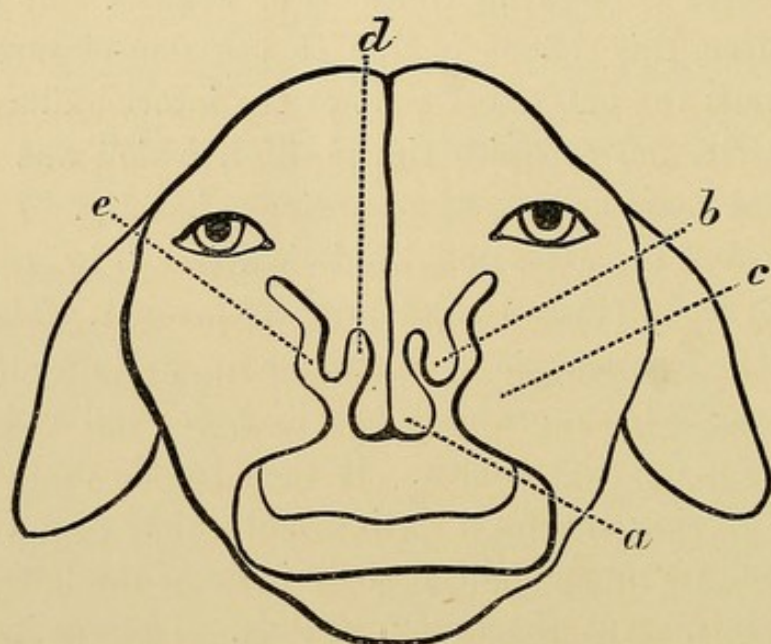


FIG. 21.—Front view of a young puppy's head from a preparation in the Veterinary College of Brussels, showing double harelip with double partial facial cleft. (After *Albrecht*.)

a. Central portion of upper lip, corresponding to internal nasal process. *b.* Ala nasi, corresponding to external nasal process. *c.* Outer portion of upper lip, from superior maxillary process. *d.* Harelip cleft. *e.* Facial cleft.

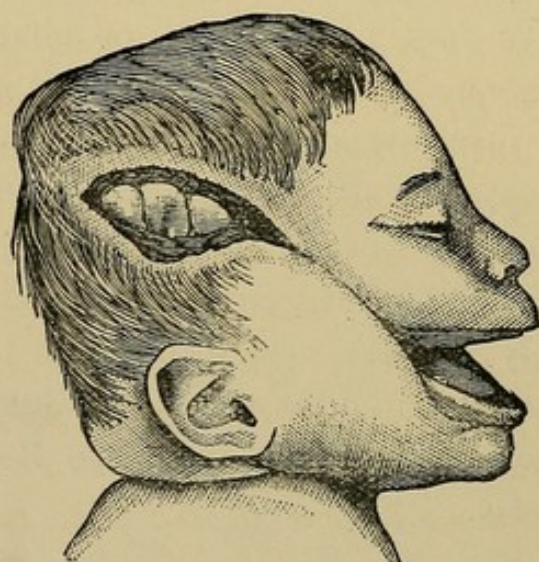


FIG. 22.—Macrostoma, showing the cleft in the cheek prolonged upwards and backwards by a reddish cicatrix to a lateral loss of substance of the cranial wall. (*Sutton*.)

MACROSTOMA

Or commissural harelip (French, *bec-de-lièvre genien* ; German, *Quere Gesichtsspalte*, *Wangenspalte*, or *Grossmaul*) is a less uncommon condition, evidenced by an increased transverse diameter of the mouth. The oral aperture extends into one or both cheeks, and, if unilateral, is more frequently on the right side. The cleft extends upwards and backwards towards the auditory meatus, and sometimes towards the temple to a variable extent. It may merely be manifested by a slight increase in the breadth of the mouth, or may extend to a considerable distance, as in a case reported by Rynd,¹ where the mouth-opening extended as far as the first molar on the right side, and to the last molar on the left. Sutton² has published drawings of a child (Fig. 22) in which a very large cleft existed, the angles of which gradually passed into a red cicatrix. This scar ended in a gaping recent wound over the temporal region, extending to the dura mater, and through this, after death, the convolutions of the brain were visible. The condition was symmetrical, and he suggests that the wound in the skull was probably brought about during parturition. The same author records a condition the very opposite of this, where the defective closure of maxillary and mandibular processes was reduced to a minimum, the deformity amounting to nothing more than a fistulous opening through the cheek, with a small tumour representing an accessory auricle just in front of the tragus.

Roulland³ has recently reported an instructive case in which double macrostoma existed with accessory auricular appendages, but this was also complicated with an entire absence of the middle ear and of the Eustachian tube, with defective

¹ 'Dublin Quart. Journ. of Med. Sci.,' 1862, xxxii, 15.

² 'Odontological Trans.,' 1887, p. 105.

³ 'Bull. de Soc. Anat. de Paris,' 1886, p. 599.

development and absence of the temporo-maxillary joint on the left side. Such a deformity is probably to be explained by an excessive obliteration or partial development of the maxillo-mandibular cleft at its posterior extremity, and a defective obliteration of the same anteriorly.

Associated with macrostoma is often to be noticed some abnormal condition of the external ear, either defective development or the production of accessory auricles (Figs. 23 and 24). In a case of bilateral macrostoma recently under my

FIG. 23.

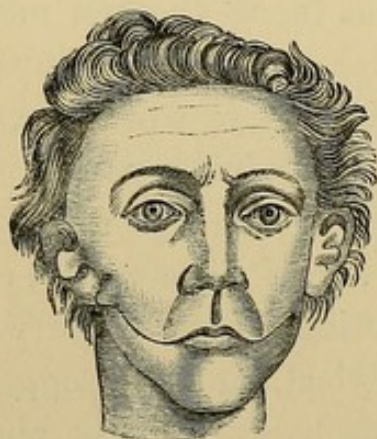


FIG. 24.



FIG. 23.—Double macrostoma, showing the presence of auricular appendages. (*Tillmanns.*)

FIG. 24.—Macrostoma with auricular appendages. (*Fergusson.*)

own care, there was a well-marked accessory auricle. This complication was first pointed out by M. Debout.

One or two observers (Morgan, Colson¹) have noticed a small papillary projection on the red margin of the cleft, indicating the position where the true mouth ended, and due to the insertion thereat of the divided orbicularis oris.

For long the very existence of this macrostomatous defor-

¹ 'Bull. de Soc. de Chir.,' 1860, ii, p. 642.

mity was doubted, but cases have been recognised more or less since 1715, when Muralt pictured it for the first time. A *résumé* of all the earlier cases has been made by M. Debout,¹ whilst Roulland² and Pilz³ have gathered together some of the later.

Macrostoma is not only attended by great disfigurement, but is also troublesome from the impossibility of the child retaining its saliva, and the food escaping during mastication. Suckling can be performed if the nurse's nipple be long, but is difficult otherwise. This deformity is, perhaps, more frequently associated with defective cerebral power than any other of the facial clefts, a large proportion of the subjects having been idiots.

MANDIBULAR CLEFT.

This condition is one of the rarest that we have had to describe, so much so that Roux and Cruveilhier denied its existence, and Fergusson had seen but one case. Bouisson⁴ in 1840 mentions some three or four earlier cases, and records one that he had seen *post mortem* himself. Since that date some six or eight instances have been noted, and the latest, with some excellent pictures, is described by Wölfler⁵ (Fig. 25).

The cleft extends in different cases to a variable extent. Thus Nicati, Couronne, F. Petit, and Ammon saw clefts implicating the lower lip alone. Ribell⁶ operated on a cleft extending to the chin, through which the saliva was con-

¹ 'Bull. Gén. de Thérapeutique,' 1862, lxii, pp. 13, 66.

² Op. cit.

³ 'Wien. klin. Wochen.,' 1889, ii, p. 520.

⁴ 'Dict. de Sci. Méd. de Paris,' viii, p. 642.

⁵ Wölfler, 'Langenbeck's Archiv,' 1890, xl, p. 795.

⁶ 'Gaz. des Hôpit.,' 1870, liv.

tinuously dribbling. Faucon (1868) and Lannelongue (1879) recorded clefts of the lip and mandible conjoined, and in both cystic swellings (presumably of the dermoid type) were found between the segments. Parisé's (1862)¹ and Wölfler's cases were also associated with cleft of the tongue, through its whole thickness in the former, and only at its tip in the latter.



FIG. 25.—Mandibular cleft, showing the divided lower lip, the segments being held together by cicatricial bands. (*Wölfler.*)

In Parisé's case the child was fourteen days old. The lower lip was cleft through its whole thickness in the median line. The free edges were rounded as in harelip, and the cleft was continued below as a cicatricial band in the middle line of the neck as far as the sternal notch. The mandible was in two portions, which were separated from one another by a distance of two or three millimetres, bridged across by connective tissue. The tongue was entirely divided, the cleft

¹ Parisé, 'Bull. Gén. de Thérapent. de Paris,' 1862, lxiii, p. 269.

extending back to the glosso-epiglottic ligament, and downwards between the genio-hyo-glossi muscles; each half was covered throughout with mucous membrane, and was bound to the corresponding side of the jaw by a mucous ligament or frænulum.

As to the *ætiology* of these defects, but little is known.

Heredity is an undoubted factor in their production, and an investigation of the family history will in many cases elicit a confirmation of such an idea. Thus in two instances in my own practice I have been able to determine that the father, grandmother, and great-grandfather had all suffered from harelip to a greater or less extent. Mason in his book mentions several other illustrations of this fact. Liston operated on four members of one family for harelip. M. Demarquay¹ related a case in the Surgical Society of Paris, in which, from the grandparents downwards, eleven children had been born with harelip. In the 'British Medical Journal'² a correspondent related his own family history, stating that it had occurred in some branch or other for the past hundred years.

An examination of the parents' mouths should always be made when possible, and very commonly it will be found that one or both possess a short upper lip, and a high arched narrow palate. In others there is a slight groove in the alveolar process between the central and lateral incisors. I have also observed a small symmetrical crease on either side of the median line in the upper lip, indicating a tendency to, if not a natural intra-uterine cure of, a double harelip.

In some instances the deformity dies out of families, possibly from the fact that the defective condition in one parent is remedied by a more perfect development in the

¹ Demarquay, 'Bull. de Soc. de Chir.,' Paris, 1869, 25, ix, p. 111.

² 'Brit. Med. Journ.,' 1863, i, p. 412.

other; whilst in others the tendency distinctly increases, and a father or a mother with harelip will beget a family where three out of the four or five children will be similarly affected. By a proper selection of mates this deformity could probably be bred out, as well as bred up to.

The so-called *Maternal Impression* is looked on, especially by the laity, as another common cause of these deformities. Medical men will usually receive histories of such with a smile of incredulity, and rightly so; but some recorded cases, if true, are so definite that to condemn such an explanation too dogmatically seems scarcely to indicate a scientific spirit. The usual type of history given is that *after* the mother has seen the defect in the newly-born infant, she looks back over the preceding nine months to see if there were any apparent cause for the trouble, and seeking out particularly some shock or fright produced by seeing something resembling the defect in her infant often selects something trivial and irrelevant. The following authentic case is worthy of mention:¹

A child was born deformed by a left unilateral harelip. The mother immediately asked to see the infant, declaring she was afraid it was marked, and on seeing it manifested no surprise at the appearance of its lip, stating that when about four months pregnant she received a fright, from the shock of which she had not yet fully recovered. Startled by a boy running almost into her arms, from whose face blood was streaming, she had seen a cut in the left side of the upper lip, extending through its substance into the nostril, laying bare the gums and teeth. She turned faint with fright, and could not banish the thought even after reaching home. The lad was subsequently examined, and the scar of a cut was found in that position.

In spite of such facts, however, one hesitates somewhat in accepting the antecedent alarm and the subsequent deformity

¹ Mauley, 'New York Med. Journ.,' June 15th, 1889.

in the relationship of cause and effect. The imaginary "maternal impression" probably in nine cases out of ten has nothing to do with the defect; whilst a real "maternal shock" which possibly led to the production of the deformity passes unnoticed. Mr. Carless tells me of a case recently seen by him of a cleft of the soft palate in a child, whose mother, without asking any leading questions, gave a history of a sharp attack of febrile disturbance keeping her in bed two or three weeks at a period when the foetus could not have been more than two months old. This is the type of maternal shock we should possibly look for, rather than the more out-of-the-way maternal impressions commonly suggested.

The union of the parts entering into the formation of the palate, alveolus, and lip is normally completed by the eighth to the tenth week, and when once this has occurred in these parts no maternal impression (such as seeing a gashed lip) could, as far as we know, bring about a retrogressive change. Should some shock occur to the mother prior to that period, we can fully appreciate the possibility of its interfering with the typical growth of the parts then being produced; and the fact that the due adjustment and union of so many component parts is requisite for the normal development of the mouth and face explains why these defects are relatively so common. That a severe shock to an infant may produce coincidentally a lamellar cataract and defective development of dentine is well recognised; that a similar type of shock acting on the mother should result in defective union of parts developing at that period in the foetus is not strange; but that the real shock and the so-called "Maternal Impression" are one and the same is more than doubtful.

CHAPTER II.

ANATOMY AND PHYSIOLOGY OF THE NORMAL PALATE.

The hard palate—The velum and its muscles—The mucous membrane—The blood supply—The shape and size of the hard palate—Functions.

THE palate is a more or less horizontal partition dividing the mouth from the nasal cavity, and consists of a firm bony plate in front (the hard palate) with a freely moveable membrano-muscular velum behind (the soft palate), which under varying conditions of muscular action can either open or close the communication between the nose and pharynx.

The bony palate forms the vaulted roof of the mouth, the central and posterior parts of which are nearly horizontal; and on all sides, except at the back, it is bounded by the alveolar ridge. Into its formation several bones enter; in the adult skull one usually sees posteriorly a cruciform suture indicating the limits of the superior maxillæ and palate bones; but even in the adult, evidence is forthcoming in the existence of traces of sutures to indicate that the anterior part of the palate is formed independently of the part immediately behind it. Thus Mr. Carless tells me that a cursory examination by him of a few dozen adult skulls picked up at random in the Museum of the College of Surgeons revealed the fact that in quite one half of them traces of sutures could be seen extending outwards from the posterior part of the anterior palatine canal; and a similar examination by him of 40 skulls from the Museum of King's College of many nations and various

ages showed a similar result. In almost all there was distinct evidence of the suture in the median line; in 21, the maxillo-intermaxillary suture was indicated; whilst in 10 skulls, representing the period from infancy to young adult life, both the above were seen in all, and 7 showed traces in addition of a suture placed between them on either side, and which we shall describe hereafter as the endo-mesognathic. Kölliker¹ similarly records that out of 325 adult

FIG. 26.

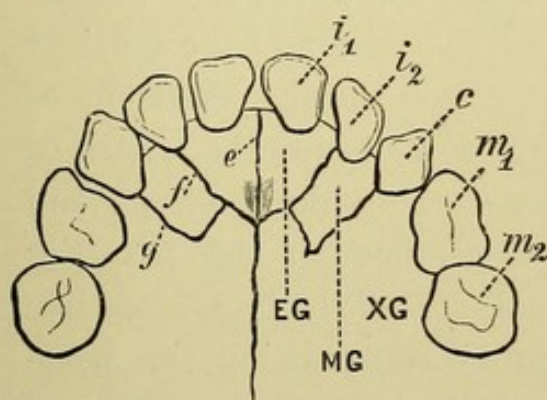
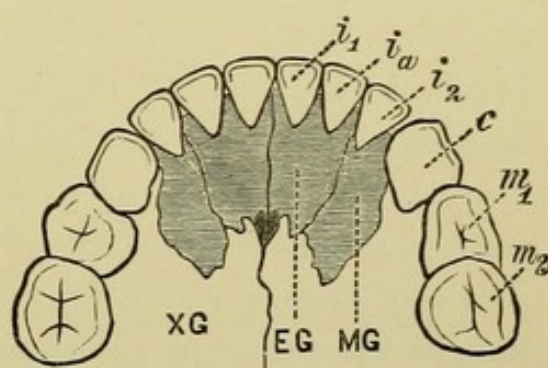


FIG. 27.



FIGS. 26 AND 27.—Diagrams to represent the normal human upper jaw of a child, with four and six incisors respectively, and also indicating the five intermaxillary sutures. (After Albrecht.)

EG, MG, XG. Endo-, meso-, and exo-gnathion. e . Inter-endognathic suture. f . Endo-mesognathic suture. g . Exo-mesognathic suture. i_1 . Central incisor. i_2 . Lateral incisor. i_a . Accessory incisor. c . Canine. m_1 . First temporary molar. m_2 . Second temporary molar.

skulls examined, 96 of them showed definite traces of the maxillo-intermaxillary suture. Albrecht² declares that nine tenths of the skulls in the Königsberg and Kiel Museums from children under five years of age reveal the existence of *five* intermaxillary sutures, proving that there are four separate portions to the so-called intermaxilla. Each portion carries an incisor tooth, and the canine is developed immediately at the junction between the outer portion and

¹ Kölliker, "Über das Os intermax., &c.," 'Nova Acta der Leopold Akad.,' Halle, 1882, p. 343.

² 'Deutsche Zeitsch. für Chirurg.,' 1885, p. 205.

the maxilla. Occasionally there are three incisors on each side, the jaw being then called hexaprodontous; the extra tooth is developed from the inner segment of the intermaxilla (or endognathion), the outer segment (or mesognathion) carrying as usual only the lateral incisor. The accompanying illustrations well indicate this arrangement of sutures and teeth (Figs. 26 and 27); the importance of these facts will be emphasized later. All traces of the facial aspect of these sutures disappear quite early in life.

The bony surface of the roof of the mouth is perforated by numerous small foramina for the transmission of the nutrient vessels to the body of the bone, pitted for the lodgment of mucous glands, and grooved longitudinally for the transit of vessels. At the postero-external corners the posterior and accessory palatine canals give entrance to the posterior palatine vessels, and nerves; and anteriorly in the median line is the anterior palatine canal transmitting the naso-palatine vessels and nerves.

The soft palate is a moveable curtain, consisting of a membranous expansion or aponeurosis attached to the posterior extremity of the hard palate by firm fibrous tissue. Incorporated with it are five pairs of muscles, controlling its movements; it is covered by a smooth thin mucous membrane, and terminates posteriorly in the uvula. The arrangement of these muscles is important, not only from their normal physiological functions, but also from their irregular action and effects in cases of cleft palate (Fig. 28). They may be arranged in groups: two, the levator and tensor palati, form a superior group; the azygos uvulæ is intermediate; and the palato-glossus and palato-pharyngeus form an inferior set. Arising from the extremity of the petrous bone, the levator passes downwards, and spreading out below unites with its fellow in the whole length of the median raphe. The tensor arises from the navicular fossa of the internal pterygoid plate, and after being reflected around

the hamular process, its action there being assisted by the interposition of a bursa, is attached to the anterior portion of the

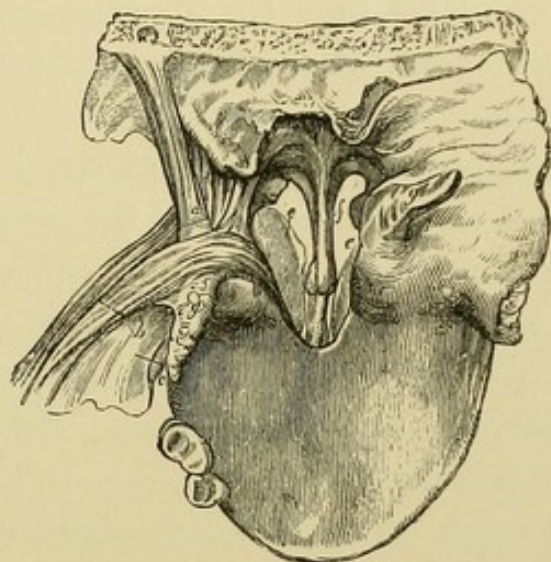


FIG. 28.—Muscles of palate dissected. The cut represents the posterior nares and upper surface of the soft palate.

a. The levator palati. *b.* The inner bundle of fibres of the palatopharyngeus, forming the posterior pillar of the fauces. *c.* The palatoglossus. *d.* The tensor palati; the cartilaginous extremity of the Eustachian tube is seen in front of this latter. *e.* The posterior extremity of the inferior turbinate bone. *f.* The septum. *g g.* The uvula on each side stretched apart. (*Fergusson.*)

aponeurosis and to the hinder part of the bony palate. The combined action of these muscles raises and makes tense the velum, and in addition influences the Eustachian tube; but the levator is by far the more important. The azygoi uvulæ muscles arising from the median raphe and spine of the hard palate descend to the tip of that process, and are thus able to regulate its length.

The two descending muscles are placed in the pillars of the fauces, forming the lateral prolongations of the velum, and the tonsils lie in a recess between them. The palato-glossi arising from the tongue ascend in the anterior pillars of the fauces, and spreading out on the anterior surface of the velum unite in the median raphe. The

palato-pharyngei start from the median raphe in two lamellæ enclosing the termination of the levator muscle ; they descend in the posterior pillars of the fauces, and being attached to the pharyngeal wall between the superior and middle constrictors, by their contraction assist in raising the pharynx during deglutition.

The nervous supply of these muscles requires little notice here; suffice it that the superior set and the azygos are supplied by the facial nerve, the inferior set from the pharyngeal plexus.

The *mucous membrane* of the hard palate is of the usual oral type, and only differs from that of the rest of the mouth in its close attachment to the periosteum, from which in fact it is almost impossible to separate it. It is thick, dense, rather pale and much corrugated, especially in front and at the sides, whilst behind over the velum it is smoother and thinner. In it are many small glands (palatine glands) which extend down to the periosteum. In the median line is a well-marked raphe, extending anteriorly to a prominence indicating the position of the anterior palatine canal. The rugose condition of the membrane over the hard palate is not seen in young children; it supervenes later in life.

The *vascular supply* of the palate is free and abundant, a circumstance which is of the greatest surgical importance in that it permits of the free detachment of the soft structures from the hard by long lateral incisions, and the necessary manipulation of these in uranoplastic operations without any fear of loss of vitality, provided that the patient's health and constitution are tolerably sound, and that sufficient pedicle is left in front and behind.

The mucous membrane of the hard palate derives its blood supply from two of the terminal branches of the internal maxillary artery. The naso-palatine descend through the anterior palatine canal, and entering the palate at the incisive foramen (foramina of Stenson) assist in supplying the anterior

portion, anastomosing with the terminations of the more important posterior or descending palatine, which find their way to the palate from the speno-maxillary fossæ through the posterior palatine canals. Each of the latter arteries on reaching the palate sends branches to the velum and tonsils, and its main twig runs onwards in a groove of the bone to supply the mucous membrane and glands of the hard palate and gums. Its usual position is parallel to the alveolar border, and about three quarters of an inch from it; but this varies considerably. The artery can often be felt pulsating as it emerges from the bone, and is very likely to be divided in the lateral incisions made during the operation of uranoplasty; but the knife should be carried external to it, if possible, so that the trunk of the vessel may be preserved in the flap. The bony palate derives its blood supply not only from its lower surface but also from its upper, and hence detachment of the inferior periosteal covering does not lead to death of the bone. The soft palate derives its blood from three sources, viz. the ascending palatine of the facial, the ascending pharyngeal, and the posterior palatine of the internal maxillary. The two former reach it through the sinus of Morgagni, *i. e.* over the upper border of the superior constrictor muscle, forming loops of anastomosis on its posterior aspect with similar branches on the opposite side; the last supplies the anterior palatal surface.

The normal shape of the palate is a regular arch, bounded laterally by the gums and alveoli into which the teeth are implanted so as to describe a parabolic curve, being normally uninterrupted at any spot by spaces or diastemata. The height and curvature of the palate vary considerably in different individuals, not only from inherited peculiarities, but also from acquired conditions dependent on the teeth. A person with a good set of sound teeth will probably own a regular well-formed palate; whilst if sundry of the upper permanent teeth are lost during the stage of adoles-

cence, the palate is likely to become high and narrow from the falling in of the jaw. This is especially the case if the incisor teeth are lost.

The shape of the palate in a child of two years does not differ so markedly as one would at first expect from that of an adult except in length, and the reason for this is plainly the existence in the latter of three additional teeth on each side. Its increase in length is from 20 to 30 millimetres, whilst its breadth is only augmented by 10 to 15 mm., and this mainly posteriorly. When once the permanent incisors, canines, and premolars are developed, the anterior portion of the palate alters but little in shape, unless any of these teeth be lost, and the gaps not artificially maintained.

Dr. Ehrmann¹ states that the alveolar border in front of the canine teeth forms a nearly regular semicircle, with a posterior transverse diameter of 22—26 mm.; thence the alveoli diverge regularly, adding to the diameter about 2—4 mm. for each tooth. He gives the following measurements as the mean of many observations :

	From 2—6 yrs.	From 7—10 yrs.	From 11 yrs.
Interval between canines . . .	22—25 mm.	23—27 mm.	25—28 mm.
„ 1st premolars . . .	24—29 „	25—30 „	27—30 „
„ 2nd „ . . .	26—31 „	28—32 „	31—34 „
„ 1st molars . . .	—	—	32—37 „

Oakley Coles² has carefully investigated the size of the palate in several series of skulls in the Museum of the College of Surgeons, and gives the results as follows :

Of 34 adult skulls of European origin, the average length was 49 mm., the average width at the second bicuspid was 35 mm., and the average height from the margins of the alveoli 9 mm.

Of 32 adult skulls of mixed races, the average length was 54 mm., the width 35 mm., and the height 12 mm.

¹ 'Congrès Franc. de Chir.,' 1888, p. 480.

² Op. cit., p. 5.

The frequent association of inherited mental and nervous weakness with a high arched palate is now a well-established clinical fact. Thus Savage states that in "Genetous Idiocy" (*i. e.* idiocy which starts in foetal life, and cannot be traced to any specific disease) the palate is usually keel-shaped, the molar teeth being closely approximated; they are also late in appearing and deficient in number. "Although this kind of palate may be present in healthy individuals or in those suffering from ordinary insanity, if it be associated with weak-mindedness or moral peculiarities in youth I believe one is justified in saying that the tendency to moral or intellectual deficiency is congenital."¹ Only recently Dr. F. Warner has reported² to the Psychological Section of the British Medical Association the results of an investigation as to the occurrence of deformities amongst school children, and their relationship to defective vital and mental conditions. Out of 5344 children examined, physical deformity was noted in 399 cases, and of these 274 were boys and 125 girls, *i. e.* in the proportion 9·8 per cent. and 5 per cent. respectively. It was found that of these 25 per cent. exhibited evidences of low nutrition, 36 per cent. evidences of nervous weakness, and 31 per cent. of mental dulness. 117 cases were noted of deformity of the palate, 77 boys and 40 girls; and of these 35 per cent. gave signs of low nutrition, 39 per cent. of nerve weakness, and 35 per cent. of mental dulness. These defects were more marked and more frequent in the pauper than in the elementary public schools, in the proportion of 4·2 to 2·2. As to the character of the malformations, the following are the numerical statistics: In 105 cases, the palate was arched, narrow, high or vaulted; in 8, it was V-shaped; in 4 it was of the flat type.

Dr. Langdon Down³ had previously noticed and pointed out this frequent relationship, remarking that as the result of a

¹ 'Insanity,' p. 442.

² 'Brit. Med. Journ.,' 1889, ii, 1272; 1890, ii, 447.

³ 'Trans. Odontological Soc.,' 1872, vol. iv.

large number of careful measurements of the mouths of the congenitally feeble-minded and of intelligent persons of the same age, he found with few exceptions a marked diminution in the transverse measurement between the posterior bicuspid, resulting in an inordinate vaulting of the palate. There was often noticed an actual deficiency in the bony structures of the posterior part of the hard palate, causing the velum to hang down abnormally, interfering with phonation.

The *function* of the hard palate is mainly mechanical. Acting as a partition between the nasal and buccal cavities, it prevents nasal mucus from falling into the mouth, and, by presenting an opposing surface to the tongue, allows of the production by the latter of the vacuum necessary for suction, and enables the tongue to direct the food towards the alveoli, and to disintegrate soft particles, thus assisting mastication. It is also an accessory to the development of taste by enabling particles to be evenly spread over the back of the tongue. For the production of articulate speech the hard palate is an indispensable factor, and the quality of the voice is much influenced by its contour.

The functions of the soft palate are mainly related to the acts of respiration, deglutition, phonation, and articulation.

1. *In respiration*.—If the mouth is closed, and the respiration purely nasal, the velum hangs loosely, and allows free passage of air through the posterior nares. If the mouth is open, the velum is raised, and air passes freely through the fauces to or from the larynx. When air passes simultaneously through nose and mouth, the velum hangs in a more or less flaccid condition midway between the two extremes, and sometimes, when absolutely relaxed, vibrates, giving rise to snoring or stertor.

2. *In deglutition*.—The passage of food into the nose is prevented by the closure of the posterior nares. This is effected by elevation and tension of the velum, the levator

and tensor muscles acting in unison, so that its position becomes almost horizontal. The raised velum meets the posterior wall of the pharynx, which advances as the result of the action of the upper horizontal fibres of the superior constrictor, and the closure is completed on either side by the approximation towards the median line of the posterior pillars of the fauces from the action of the palato-pharyngei muscles contained therein. These, acting from the soft palate as a fixed point, and raising the pharynx to grasp the bolus of food, straighten the walls of the sphincter-like isthmus faucium, and so guide the food as down an inclined plane. The tension of the velum also assists in this guidance. That the above is the action of the palatal structures is proved by the results of their imperfect development or paralysis, *e. g.* in post-diphtheritic paralysis, where the naso-pharyngeal cavities remaining unclosed, food (especially if fluid) regurgitates into the nose.

3. *In phonation and articulation.*—The soft palate is here of considerable importance, inasmuch as it is needed to cut off the naso-pharynx and nasal cavities from the oral pharynx. When defective or paralysed, a certain amount of nasal resonance is imparted to the voice, which, however, is less noticeable during vocalisation than in articulation. For the production of clear normal voice-sounds it is essential that the separation between nose and mouth should be absolute, except for the sounds *m*, *n*, and *ng*. The American twang is probably due to a slight relaxation of the soft palate, permitting a small percentage of voice-sounds to pass through the nose. Dr. N. W. Kingsley¹ has recently published some excellent diagrams illustrating the position of these parts during the production of definite sounds, and for all, except those mentioned above, the velum is horizontal, and in contact with the posterior pharyngeal wall.

¹ 'On Oral Deformities.'

CHAPTER III.

DEVELOPMENT.¹

Normal development of mouth, face, nose, and teeth—Ossification—Development of intermaxilla ; old ideas (Goethe's, &c.) ; Albrecht's theory—Harelip ; position of cleft in alveolus, and in lip—Dentition ; accessory teeth—Development of other deformities.

BEFORE discussing from an embryological standpoint the various deformities which we have already described, it is essential for us to consider the normal process of development of the parts entering into their formation.

About the end of the third week of intra-uterine life, the anterior cerebral vesicle becomes acutely bent over the end of the notochord, and a marked depression is seen on the ventral aspect of this, constituting what is known as the *Stomodæum*, or primary buccal cavity. This, however, is formed rather by the outgrowth of surrounding processes entering into the formation of the facial elements than by any definite or distinct involution of epiblast. The cavity is bounded posteriorly and superiorly by the cephalic flexure of the cerebral vesicles, and inferiorly is separated from the cephalic portion of the intestine by a septum. This becomes perforated at a slightly later date (eighth or ninth week), and communication is thus established between the stomodæum and intestine. Anteriorly, the opening is at first stellate in shape (Fig. 29),

¹ For this chapter I am indebted to the pen of my colleague, Mr. Carless.

but soon assumes the form of a transverse cleft by the union in the middle line of the first pair of post-oral branchial arches, in which are developed the primary cartilaginous bars on either side, known as Meckel's cartilage, the anterior part of which goes to form the inferior maxilla, and the posterior part the malleus. The soft parts around develop into the lower portion of the cheek, the lower lip and chin (Fig. 30).

FIG. 29.

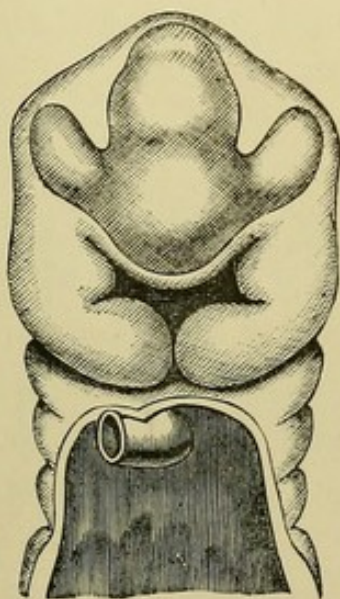


FIG. 30.

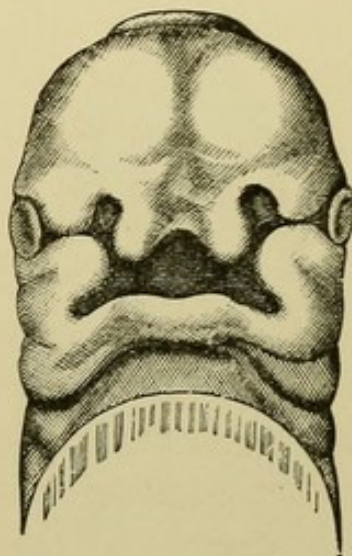


FIG. 29.—Head of fœtus, of about 5 weeks, from ventral aspect (after His), showing the primitive stomodæum bounded above by the undivided fronto-nasal process, laterally by the maxillary, and below by the still separate mandibular processes. The quinquerradiate appearance is well represented. (*Sutton.*)

FIG. 30.—Head of fœtus from ventral aspect of a little later date (6—7 weeks). The mandibular processes have now united; the orbito-nasal fissure has come in contact with the ocular vesicle, and the fronto-nasal process has developed into external and internal nasal (or globular) processes around the nasal fossæ (after His). (*Sutton.*)

At the same time that this mandibular arch is being developed, other changes are occurring around the upper part of the stomodæum, viz. the shutting off of sacs lined with epiblast to assist in the formation of the organs of special sense, and the

outgrowth between them of fleshy processes which by their later amalgamation form the facial skeleton and coverings. Three of these involutions of epiblast occur, two communicating more or less with the stomodæum, viz. the nasal and ocular; whilst the third, or auditory, is separate. Expansions from the cerebral vesicles meet them, and by further changes, unnecessary to particularize here, the organs of special sense are elaborated.

FIG. 31A.

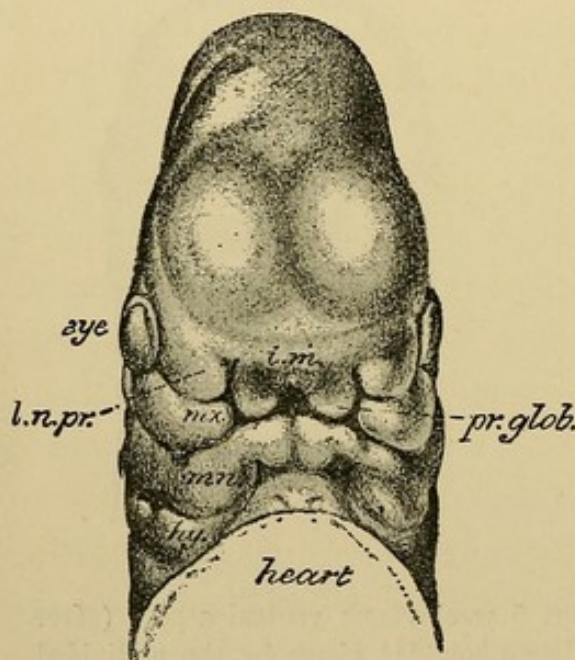


FIG. 31B.

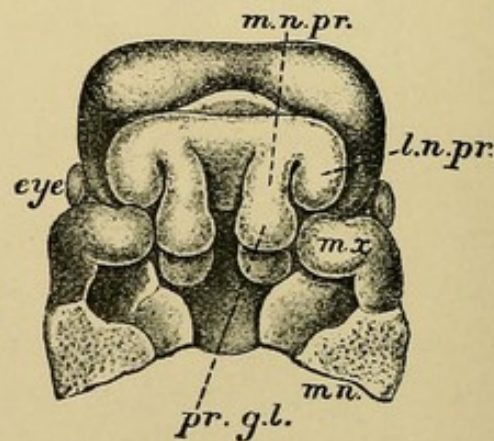


FIG. 31A.—Head of fœtus at a somewhat later date (8 weeks) as seen from the front, showing the nasal and maxillary processes in close apposition, and the clefts between them diminishing in size.

FIG. 31B.—The same, seen from below, the mandibular process having been removed.

i.m. Central portion of fronto-nasal process. *m.n.pr.* Internal nasal process. *pr.gl.* Globular process, or the lower rounded extremity of the former. *l.n.pr.* External nasal process. *mx.* Maxillary process. *m.n.* Mandibular process.

The most anterior of these depressions are the primary *Olfactory pits* which appear on either side on the lower surface of the wall of the anterior cerebral vesicle at a very early

date. They are at first merely depressions surrounded by a raised margin ; but subsequently they become pyriform by the extension of the lower end as a groove into the stomodæum. Each pit and groove is bounded laterally by thickened rounded outgrowths developed from a broad median fleshy protrusion from the same part of the cerebral vesicle, the fronto-nasal process ; these are termed respectively the external and internal nasal processes, the latter being also named by His the globular processes (Fig. 30).

These *Globular processes* are separated in the median line by a groove which is subsequently obliterated by their amalgamation to form the central portion of the upper lip ("Philtrum" of German authors), and from their deep aspect the inner segments of the intermaxilla (endognathia). Above this groove is a central flattened median portion of the fronto-nasal process, from which subsequently the prominence of the nose is developed (Figs. 31A, 32, and 33), a result of the continued growth from its deeper aspect of the ethmo-vomerine plate.

The *external nasal process* forms the ala nasi and the soft parts in its immediate neighbourhood, extending downwards a little distance, but probably not so far as the red margin of the lip. From its deeper aspect the outer portion of the intermaxilla (mesognathion) is developed, and in it appears the germ of the lateral incisor. It also serves to separate the nasal pit from the second epiblastic intrusion which assists in the formation of the eye. The lower boundary of the naso-orbital fissure which passes from the primary ocular involution to the stomodæum is formed by the *maxillary process*, which is usually described as an upward extension of the mandibular process, but which probably arises separately as a pre-oral branchial outgrowth. From this is developed the whole of the superior maxilla, except that portion which is intermaxillary, and also the greater part of the cheek.

About the sixth week the stomodæum shows signs of division into upper and lower segments by the outgrowth from

FIG. 32.

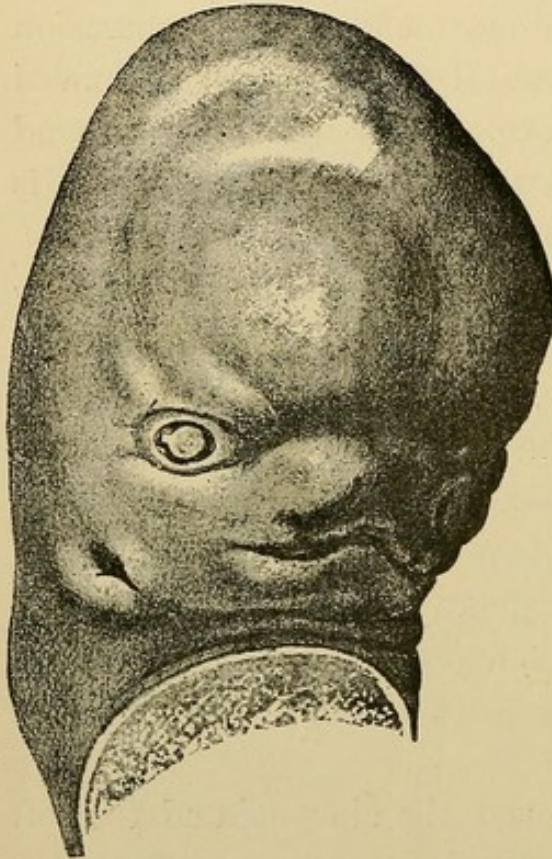


FIG. 33.



FIGS. 32 AND 33.—Later stages of development of foetal head.

the deep aspect of each maxillary process of horizontal *palatal plates*, which by their junction in the median line form the rudiments of the hard and soft palate, separating thus the nasal and buccal cavities. The anterior portion of these unite with the lateral aspects of the deeper parts of the fronto-nasal process, leaving a space of greater or less dimensions in the median line, known as the anterior palatine canal, which serves subsequently for the passage of nerves and vessels, and for the lodgment of the "organ of Jacobson" in animals in which it occurs.

The upper or nasal cavity is again subdivided into lateral halves by the growth downwards from the under surface of

the fronto-nasal process of a central vertical septum, to become in time the cartilaginous septum nasi and the bony ethmo-vomerine plate, uniting at its lower border with the primary fleshy palatine processes (Fig. 34).

The tongue grows as a fleshy protuberance from the floor of the stomodæum; antero-lateral segments on either side from the conjoined second and third branchial arches unite with a central posterior growth from the tuberculum impar in an inverted Y-shaped manner. At the point of junction of the segments is a depression from which the thyroid gland develops, indicated in later life by the foramen cæcum.

Each of these primary epiblastic pits is at a later date almost entirely cut off from its connection with the buccal cavity. The external and internal nasal processes of the

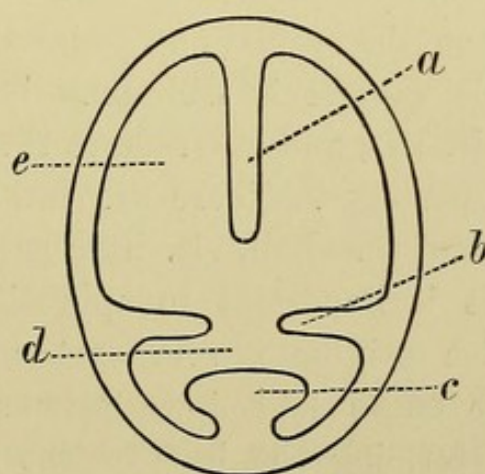


FIG. 34.—Diagrammatic representation of the development of the palatal processes and of the ethmo-vomerine plate, seen in vertical section. (After *Gegenbaur*.)

- a.* Ethmo-vomerine plate. *b.* Palate processes. *c.* Tongue.
d. Buccal cavity. *e.* Nasal cavity.

fronto-nasal outgrowth unite below the anterior olfactory pits, and thus surround the anterior nasal apertures, and separate the nares from the mouth. The external nasal and superior maxillary processes are also freely amalgamated except along one small deep track, which remains patent to form the nasal

duct and lachrymal passages ; and probably the internal nasal and maxillary processes unite below the external nasal process to establish the continuity of the red margin of the upper lip. The union of all these various parts has been completed by the sixth to the tenth week of normal foetal life ; the external nasal and superior maxillary processes unite first, and by the sixth week are becoming closely approximated to the central portion of the fronto-nasal process, a time when the palatal processes are only indicated as slight ridges. By the ninth week the alveolus and upper lip are complete, and union of the palate is commencing from before backwards, being usually completed even to an indication of the uvula by the tenth week.

Whilst the later stages of these developmental processes are in progress, points of *ossification* have been appearing in many places to form the cranial and facial skeleton. A full knowledge of this subject is still unattained, but the researches of Goodsir, His, and others have thrown much light on hitherto dark passages. There are two main sources of origin of the bones of the skull, viz. from cartilage and from membrane, and it is important to appreciate the portions of the skull which originate from each of these sources respectively. The bones laid down primarily in cartilage are mainly those forming the base of the skull and their anterior prolongations. Thus about the fourth week of intra-uterine life the basis cranii consists of a cartilaginous mass surrounding the upper end of the notochord, and prolonged anteriorly around the pituitary fossa as two cartilaginous bars, the *trabeculae cranii*, into the fronto-nasal process. From the anterior extremity of this the nasal bones and cartilages are developed, and from the under surface the ethmo-vomerine plate. The transformation of the primordial mesoblastic undifferentiated tissue into recognisable cartilage is occurring from about the fourth or fifth week until the

eighth, when ossification at different centres is apparent. To the development of the intermaxilla we shall refer in detail later; suffice it to say here that the ossifying centres appear about the eighth week, and by the twelfth to the fourteenth the whole process is ossified, and the space between the maxillæ closed except posteriorly, where the anterior palatine canal remains permanently patent; the component parts of the bone, however, are not united until a later date. There are two other cartilaginous foci from which ossification ensues, viz. the pterygo-palatine cartilage in the superior maxillary process, a delicate bar from which arise in part the pterygoid and palatine plates; and Meckel's cartilage in the mandibular process for the production of the mandible and malleus. All the other facial bones are developed from membrane, more or less in connection with these bars. The vomer is ossified from a single nucleus appearing in the upper part of the ethmo-vomerine plate, about the ninth week; from this two laminae are developed, which, passing downwards and forwards on either side of the middle line, embrace the septal cartilage. The amount of the osseous material increases from behind forwards, until at maturity a median osseous lamina remains which is grooved only anteriorly.

The palate bone develops from a single centre appearing about the eighth week at the junction of the horizontal and perpendicular portions. The superior maxilla is supposed to arise from four separate foci of ossification, viz. for the alveolar arch, for the palate, for the orbito-malar portion, and for the naso-facial segment. All these are united together by the third month.

It is unnecessary here to discuss the development of the *teeth* beyond stating that the thickening of the epiblast covering the gums, which occurs as the earliest sign of the production of the milk teeth, is to be seen about the forty-fifth day, when as yet there are no signs of ossification of the

maxilla, and by two and a half months a distinct involution filled with cells is evident. Calcification commences about the eighteenth week of intra-uterine life, and extending from crown to fang is usually not completed until from twelve to twenty months after birth.

By the fifteenth week of embryonic life preparation is being made for the development of the first four permanent molars, and soon afterwards in the sixteenth week occur the inflections of the mucous membrane giving rise to the enamel organs for the twenty anterior permanent teeth; and from this period until the birth of the infant the germs of the twenty-four permanent teeth are passing through the various stages preparatory to calcification, so that at birth the child has not only twenty milk teeth with calcification nearly complete, but also the germs of twenty-four permanent teeth. Calcification commences in twelve of these latter during the first year of life, viz. in the first molars and the incisors, and spreads from the crown in which it starts to the fang. In the case of the incisors this process is not completed until the tenth year.¹

The question as to the ossification of the intermaxilla has been purposely omitted hitherto, that the subject and its morphological relationship to congenital deformities might be more fully discussed.

In the time of Galen² the presence of the intermaxilla as a separate bone had been demonstrated in apes and lower animals, and its existence in man inferred, although probably not actually seen. This opinion held its ground till the sixteenth century, when Vesalius attacked it, maintaining that no such bone existed in man, and its absence was even claimed as a distinguishing feature from the lower animals. The first to actually discover and notify the separate exist-

¹ Sudduth, in 'American System of Dentistry,' vol. i, p. 648.

² Galen, 'De Usu Partium,' lib. ix, cap. 20; and 'De Ossium Naturâ,' cap. 3, p. 14.

ence of the bone in the human skull was Dr. Robert Nesbitt,¹ who, in a lecture before the Royal College of Surgeons in 1736, described and figured the suture crossing the anterior part of the palate at all times of life, and maintained that during intra-uterine life each superior maxilla "is generally divided into two distinct parts, the sutural line running from between the dentes canini and incisivi up to the bottom of the nose." But the merit of appreciating the importance of this fact belongs to Goethe² and Vicq d'Azyr,³ the former of whom, in the year 1779, demonstrated the existence of the intermaxilla in the human foetus, and, as the outcome of this discovery, promulgated in 1819 the theory that in alveolar harelip the cleft in the alveolus occurs at the maxillo-intermaxillary suture, *i. e.* between the lateral incisor tooth and the canine. This opinion has been believed and handed down through successive generations of surgeons until the present day, but more recent and exact research has so increased our knowledge that it cannot now be considered correct. Many painstaking embryologists have, during the last ten years, been investigating this subject; but the honour of raising the question as to the morphological position of the cleft in harelip lies with Professor Albrecht of Brussels, who in a masterly series of papers has fully established the fact, observed also by others, that the intermaxilla is not developed *en masse*, but is formed by the coalescence of *four* segments, two on either side; and he maintains that the cleft in alveolar harelip lies not between the maxilla and intermaxilla, but between the inner and outer intermaxillary segments. These have been named respectively the endo- and meso-gnathion, whilst the maxilla proper is called the exognathion. According to Albrecht, therefore, the cleft is

¹ Nesbitt, 'Human Osteogeny,' London, 1736, pp. 90, 91.

² Goethe, 'Sammtliche Werke,' in 36 vols., Cotta, 1868; vol. xxxii, p. 159.

³ Vicq d'Azyr, 'Œuvres,' iv, p. 159.

not situated along the exo-mesognathic, but along the endo-mesognathic suture.

Much controversy has been lighted up by this pronouncement, but here only a few of the points of interest and importance will be discussed.

The development of the intermaxilla from two centres on each side may be accepted as a proven fact. It was first maintained by the late Mr. Callender,¹ who stated that these bones have a lateral wedge-shaped sutural surface, fitting into a groove in either superior maxilla, and that the alveolar processes of the latter extend forwards, forming the anterior walls of the sockets of the central incisors, and so fix the bones in position. A confirmation of the idea that the anterior alveolar walls of the incisor teeth are formed in this way was sought in the well-established fact that these particular parts are very imperfectly developed in those cases of alveolar harelip in which the os incisivum is isolated from the superior maxillæ; but such is probably due to the abnormal condition and position in which the bone is developed, rather than to the loss of the maxillary "clip." And certainly the most recent researches tend to prove that the maxillæ have no share in the formation of the alveoli of the incisor teeth.

Sir William Turner and other anatomists have fully confirmed this method of development from four ossific centres, and important additions to our knowledge of the subject have been made recently. Thus M. Gilis² describes and figures the condition of the palate as seen in a six-months foetus, where it was clearly demonstrated that the intermaxillary portion formed a sort of lozenge-shaped prism fitting in between the two maxillæ, and consisting of four portions of bone, the sutures between these being perfectly clear and distinct (Fig. 35). The posterior extremity of the short axis of

¹ 'Philosophical Trans.,' 1869, p. 166.

² Gilis, 'Bull. de Soc. Anat. de Paris,' 1888, p. 372.

the intermaxillary segment corresponds to the anterior palatine canal, and the anterior surface forms the median anterior

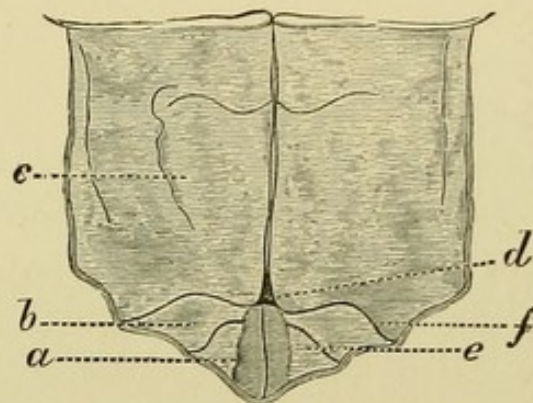


FIG. 35.—Bony palate of a fœtus of six months, showing the development of the intermaxilla in four portions.

a. Endognathion. *b.* Mesognathion. *c.* Exognathion. *d.* Anterior palatine canal. *e.* Endo-mesognathic suture.¹ *f.* Exo-mesognathic suture. (After *Gilis*.)

alveolar border, no process of the superior maxilla closing in the alveoli in front. The upper border of the bone forms the floor of the nasal apertures.

Biondi, of Breslau,² has completed the observations necessary for the establishment of this fact by demonstrating the four actual points of ossification in many fœtal skulls of different dates, which had been specially prepared for the purpose. Moreover, as mentioned before (p. 27), traces of the five intermaxillary sutures, when looked for, may be found in many adult and in the majority of young skulls.

The fourfold division of the intermaxilla being granted, it is obvious that a cleft through the alveolus such as that occurring in alveolar harelip happens at one of the two following situations, either along the endo-mesognathic, or through the exo-mesognathic suture, *i. e.* between the component elements of the intermaxilla, as Albrecht declares, or between the maxilla and intermaxilla, as Goethe suggested—a claim

¹ The dotted line from *e* is erroneously prolonged a little beyond the suture.

² 'Virchow's Archiv,' Bd. cxi, i, p. 125; 'Anat. Anzeiger' (Breslau), 1888, p. 577.

which has been vigorously defended by Kölliker against its newer rival.

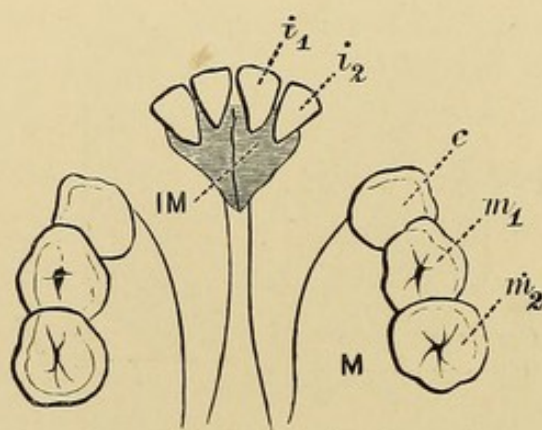


FIG. 36.—Diagram representing the old or "Goethe" theory of alveolar harelip, indicating both central and lateral incisors as developed from one intermaxilla on either side, and the alveolar cleft between the maxilla and intermaxilla.

M. Maxilla. IM. Intermaxilla. i_1 . Central incisor. i_2 . Lateral incisor. c. Canine. m_1 . First molar. m_2 . Second molar.

The relative position of the clefts is indicated in the diagrams appended (Figs. 36, 37, and 38).

FIG. 37.

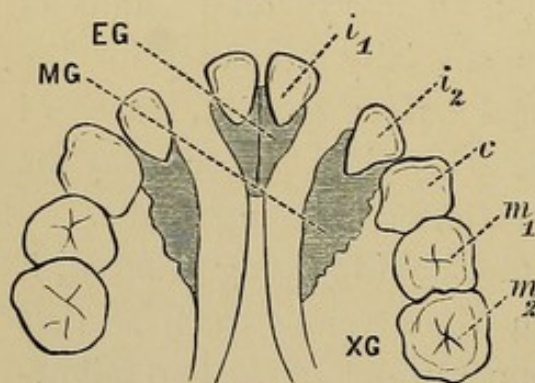
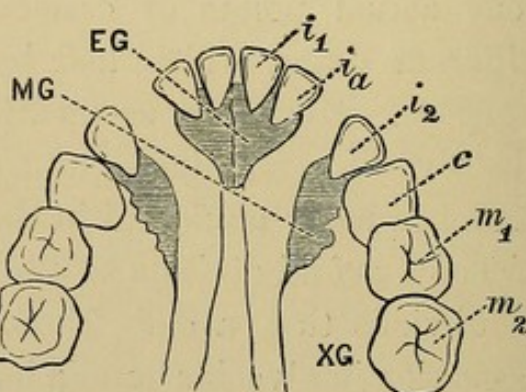


FIG. 38.



FIGS. 37 AND 38.—Diagrams to represent the "Albrecht" theory of harelip, in conditions where the alveolus contained four or six incisors respectively.

EG. Endognathion. MG. Mesognathion. XG. Exognathion. i_1 . Central incisor. i_a . Accessory incisor. i_2 . Lateral incisor. c. Canine. m_1 , m_2 . 1st and 2nd molars.

Albrecht's papers on the subject are numerous, and contain a large amount of interesting material which space forbids

us to introduce here; and one must refer readers, desirous of knowing more, to the appended list of his chief works.¹ But

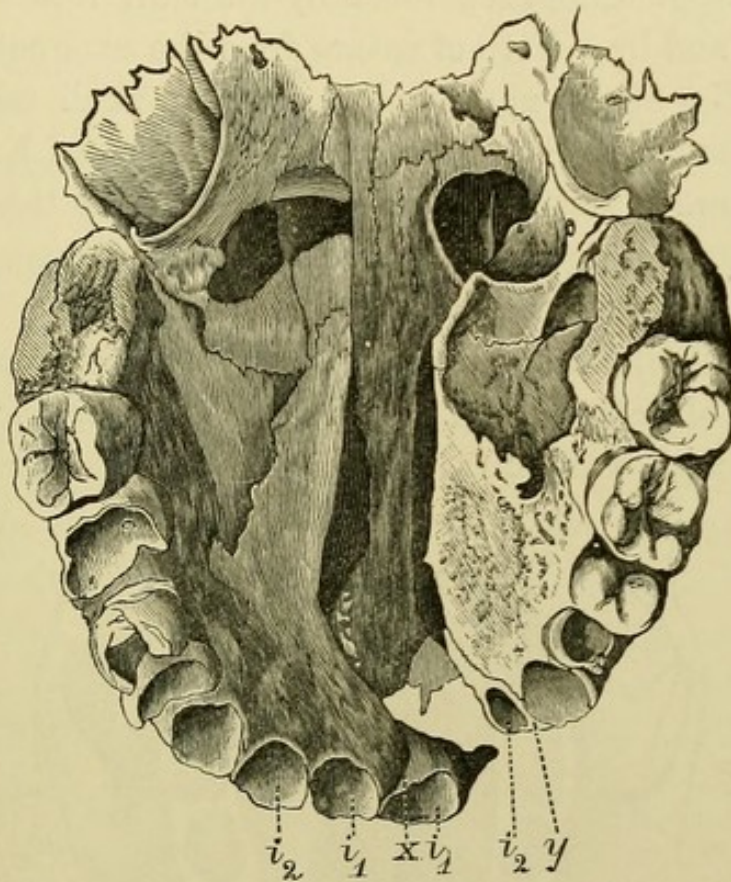


FIG. 39.—Drawing of an adult upper jaw with right-sided alveolar harelip and cleft palate, and the vomer attached to the left palatal margin. A rudimentary mesognathion bearing the stunted lateral incisor is shown on the outer side of the cleft.

i_1 , i_2 . Central and lateral incisors. x . Inter-endognathic suture. y . Exo-mesognathic suture. (After Albrecht.)

the arguments in favour of his theory may be briefly stated to be drawn from the following facts:

1. That in cases of alveolar harelip, a small portion of bone

¹ Albrecht: (1) "Die Morph. Bedeutung der seitliche Kieferspalte," 'Zool. Anzeig.,' 1879, p. 207. (2) 'Sur les 4 Intermaxillaires, &c.,' Soc. d'Anthropol. de Brux., 1883. (3) "Über die morph. Bedeutung der Kiefer-, Lippen-, und Gesichts-spalten," 'Lang. Archiv,' xxxi, 2; 'Centr. für Chirurg.,' 1884, 4. (4) "Zur Zwischenkieferfrage," 'Fortschritt d. Med.,' 1885, iii, 14. (5) "Über sechs-schneidezähne Gebisse beim normalen Menschen," 'Centr. für Chir.,' 1885, No. 24. (6) "Über den morph. Sitz der Hasenscharten Kieferspaltten," 'Biolog. Central.,' 1886, vi, 3, pp. 80 and 122.

has been found in many instances on the outer side of the cleft, quite distinct from the maxilla. This is claimed to be the mesognathion, separated by the cleft from the endognathion, and by a distinct suture from the exognathion. A picture (Fig. 39) is appended of an adult skull taken from the museum of the Royal Anatomical Institute of Kiel, which clearly shows a small distinct flake of bone in the required position, extending back as far as the ordinary site of the anterior palatine canal. Such has been also found in children's skulls, and very distinctly in a series of horses' skulls with alveolar harelip. (For figures of such, v. 'Langenbeck's Archiv,' xxxi, 2.) But this condition, indicating the

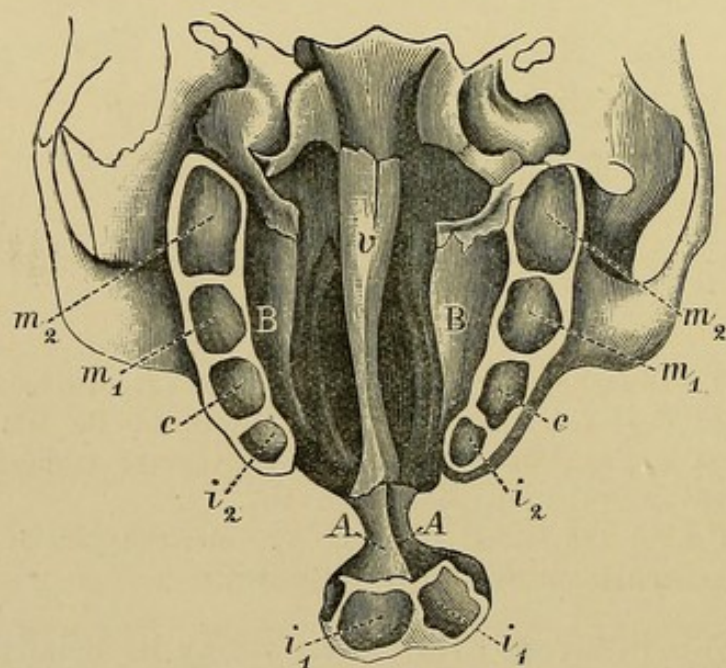


FIG. 40.—Drawing of a case of double alveolar and palatine cleft with projecting os incisivum, to show the lateral incisor on outer side of the cleft.

i_1, i_2, c, m, m_2 , represent the alveoli of the teeth as in Figs. 26 and 27. *v.* Vomer. *B.* Palatal process of superior maxilla united to the meso- and exo-gnathion. *A.* Os incisivum, consisting of the two endognathia, and bearing the alveoli of the central incisors. (After *Albrecht*.)

distinct entity of the mesognathion, is not very commonly to be demonstrated in human pathology, inasmuch as the

suture is early obliterated. But its existence is indicated by the dentition, to which we must now turn.

2. That in alveolar harelip there is in a large number of cases a distinct precanine or incisor on the outer side of the cleft. This is well shown in Figs. 39 and 40. In the former, an adult skull, the mesognathion is distinctly seen bearing the alveolus of a precanine tooth, the lateral incisor; whilst the central bony portion (the endognathion) bears but the socket for one tooth, the central incisor. The latter is a picture of a child's skull with double alveolar harelip and cleft palate; the os incisivum is seen separate and projecting forwards at the end of the nasal septum; it bears the sockets of the two central incisors. Outside the cleft the alveolus bears four teeth on either side, viz. two molars, one canine, and one precanine, which we cannot but recognise as the normal lateral incisor. So that the dental formula of the upper jaw might be represented thus:

In normal jaw—C I₂ I₁ I₁ I₂ C;

in double alveolar harelip—

$$CI_2=I_1 I_1=I_2C,$$

where C represents the canine, I₁ and I₂ the central and lateral incisors, and the double lines indicate the position of the clefts. Careful examination of a considerable number of skulls has brought much confirmatory evidence to light, indicating the truth of the above proposition. Thus, to pick out a few facts from the mass of material available:—Sabourand¹ records two cases of unilateral harelip with cleft palate, one of which died at the age of thirty-three days. In each the dentition was typically that described by Albrecht, viz. four teeth on the side of the cleft (two molar, one canine, and one precanine), and six on the opposite (two median incisors, one lateral incisor, one canine, and two molars).

¹ Sabourand, 'Bull. de Soc. Anat. de Paris,' 1890, No. 13, p. 270.

Broca¹ has reported a case of a much deformed foetus still-born at seven months. In this there was cleft palate and double harelip with the os incisivum freely moveable, but not displaced. The bone was found to consist of two little masses, mobile on each other, and each containing two incisor germs; and on each side external to the cleft there was a precanine similar in shape to the incisors. The middle one of these three incisors was distinctly the least developed.

Again, Sir William Turner² has carefully investigated the dentition, as seen in casts obtained from various hospitals, of fifteen specimens of alveolar harelip, eight of which were single left-sided, four single right-sided, and three double clefts. To these he adds the records of forty-nine preparations examined and reported on by Kölliker;³ we can here, therefore, discuss the dentition of sixty-four cases. They may be divided into two groups:

(a) In which no precanine intervened between the cleft and the canine—thirteen cases.

(β) In which a precanine existed between the cleft and the canine—fifty-one cases.

In not a few instances the os incisivum contained four teeth, and yet a precanine existed external to the cleft, *i. e.* in hexaprodontous jaws the cleft passed between the middle and outer precanines.

A similar condition is described by Albrecht⁴ as occurring in an adult human skull in the museum of the University of Kiel. In this a cleft palate exists, with the fissure extending through the alveolus of the right side, *i. e.* a right-sided alveolar harelip with cleft palate. The mesognathion is

¹ 'Bull. de Soc. Anat. de Paris,' 1886, p. 350.

² 'Journ. of Anat. and Phys.,' xix, p. 198.

³ "Über das Os intermax. des Menschen und die Anat. des Hasencharte und des Wolfsrachen," 'Nova Acta der Leopold Carol. Akad. der Naturforcher,' Halle, 1882, Bd. xliii, No. 5, p. 369.

⁴ "Über den morphol. Sitz der Hasencharten Kieferspalt," 'Biolog. Central.,' Bd. v, 13, pp. 80 and 122.

plainly seen on the outer side of the cleft, bearing an incisor tooth. On the inner side of the cleft (*i. e.* on the left side) are the alveoli for five incisors before reaching the canine socket of the left side, so that here is a skull with six incisor teeth, and with a cleft between the alveoli of the right middle and outer precanines. And not a few similar preparations are indicated by Biondi¹ as occurring in the Berlin and Breslau collections. The condition of parts is represented diagrammatically in Fig. 38. Albrecht's explanation is that the middle of the three precanines, *i. e.* the outer tooth in the os incisivum, is an accessory development; whilst that on the outer side of the cleft is the normal lateral incisor springing from the mesognathion.

With such facts one necessarily collates the accredited teaching respecting the number and character of the incisor teeth in man.

Normally one finds two incisors on each side, occupying the space between the canines, but it is a fact perfectly well recognised by dentists that occasionally an extra precanine or incisor is present (Fig. 27); and very rarely are there more than three incisors on either side. My colleague, Professor Underwood, tells me that once he has seen the cast of a jaw with at least five precanine teeth on one side only, but that was an absolute exception, and only to be explained as a vagary of nature. The more common existence of three incisors can scarcely be placed in the same category, especially when one considers that although not constant by any means throughout the series, yet amongst the mammalia one does find three incisors as an oft-repeated formula; and certainly the typical mammalian dental formula would indicate the occurrence of three incisors on each side. Hence it is possible that the occasional occurrence of three incisors in man is an illustration of the so-called "recurrence to type," and

¹ "Lippen und deren Complicationen," 'Virchow's Archiv,' cxi, p. 138.

that, under ordinary circumstances, one incisor has been suppressed; and the majority of anatomists fully concur in the belief that it is the middle one of the three which has disappeared. The occasional failure of the wisdom teeth to erupt, an occurrence which dentists tell us is increasing in frequency, is additional evidence as to the possibility of the disappearance of an incisor.

The accessory tooth in the os incisivum met with in some cases of alveolar harelip is maintained by Albrecht to be a reappearance of this lost middle incisor; and his explanation of such an occurrence seems very feasible, viz. that the existence of the alveolar cleft prevents the naso-palatine artery from anastomosing with the posterior palatine, and thus the vascular supply to the os incisivum is greater than it should be under normal circumstances; hence, there being a superabundance of nutrient material, nature uses such in the restoration of a structural unit ordinarily suppressed. The same fact (viz. the absence of the usual anastomosis) may explain why the mesognathion is (even when demonstrably present) always small and the lateral incisor not infrequently stunted or absent, and so answers the objection to this theory which has been raised on the ground that in cases of alveolar harelip an incisor external to the cleft is not invariably present.

Hence the dental formula in cases of alveolar harelip will vary as follows:

In tetraprodontous jaws—

$$\begin{aligned} CI_2 &= I_1 I_1 = I_2 C, \\ \text{or } C &= I_1 I_1 = C; \end{aligned}$$

in hexaprodontous jaws—

$$\begin{aligned} CI_2 &= I_a I_1 I_1 I_a = I_2 C, \\ \text{or } C &= I_a I_1 I_1 I_a = C, \end{aligned}$$

where I_a represents the accessory incisor, the other letters as on p. 51. The former of each of these pairs of formulæ

represent the mesognathion and lateral incisor as present, the latter as absent.¹

Notwithstanding the mass of positive evidence which is steadily accumulating in favour of Albrecht's theory, there are still some careful observers who will not admit its truth. Some attack it on the ground that the intermaxilla does not consist of four portions (Köl liker, &c.); with such we have already dealt. Others object to it on the ground that any teeth existing external to the cleft are merely accessory teeth, or due to a bifidity of the canine. The arguments with which they support their opinion are derived from the following considerations :

(i) That in normal development accessory teeth do certainly occur, as in the case mentioned above (p. 53), whilst in a few instances of abnormality the same condition has been noted (*e.g.* a few cases recorded by Köl liker;² see also Fig. 19, showing a facial cleft in which several accessory teeth are present along the inner margin). And the explanation given of such facts is that the involution of mucous membrane from which the teeth are developed is continuous along the alveolar ridge, and not localised to the definite spots from which the teeth subsequently erupt. This, however, is merely an opinion still *sub judice*, and not absolutely proven.

(ii) That in other defects accessory structures are sometimes produced in the neighbourhood, as if Nature, being balked in her efforts of development at one spot, expends her energies in some less useful addition elsewhere. The accessory auricles and auricular appendages seen in macrostoma are cited as illustrations of this; and any precanine external to the cleft is maintained to be of a similar character. Whilst fully admitting the plausibility of such teaching, I

¹ Occasionally the lateral or accessory incisor may be developed or suppressed on one side only, a fact explaining the occasional occurrence of cases with three or five incisors present.

² Köl liker, *op. cit.*, p. 369.

cannot see that it explains such osseous development as occurs in Albrecht's Kiel skulls, or such a regular appearance of an incisor external to the cleft as that indicated by the figures quoted above. The less frequent existence of an accessory tooth in the os incisivum seems much more readily explicable on such a ground.

To summarize the principal points as to the development of ordinary harelip :

1. That the intermaxilla is derived from the union of four ossific portions, two on either side of the median line, and that these are to be known respectively as the endo- and mesognathion, whilst the superior maxilla is termed the exognathion.

2. That these ossific portions are developed from the internal and external nasal projections of the fronto-nasal process respectively, and that ordinarily the central and lateral incisors are developed one from each segment. Occasionally an accessory incisor is developed between the other two from the endognathion.

3. That the external nasal process does not enter into the formation of the upper lip, but terminates superficially in the depression immediately below the ala nasi (see p. 57).

4. That simple harelip, where the cleft is limited to the soft parts, is due to the non-union of the superficial portions entering into the formation of the lip.

5. That in alveolar harelip the cleft passes between the endo- and mesognathion.

6. That the os incisivum consists merely of the two united endognathia, and normally carries only the two central incisors. Any additional tooth is not the normal lateral incisor, but an accessory one, probably due to the reappearance of an old suppressed member.

7. That any precanine existing on the outer side of the cleft

is the normal lateral incisor, springing from the mesognathion ; but that the latter portion of bone is rarely seen as a separate entity in human skulls possessing such deformity, from early obliteration of the suture between it and the maxilla, and that it is often badly developed and the lateral incisor stunted or undeveloped from defective vascular supply.

Having entered thus fully upon the question as to the situation of the cleft in alveolar harelip, we must now turn to the consideration of the morphological position of the oblique *facial clefts*, and their relations to the above.

It has been already pointed out that they commence at about the same spot in the lip margin as ordinary harelip, and thence run upwards and outwards clear of the ala nasi towards the centre of lower eyelid, following along the line of the naso-orbital fissure. Such a condition, coupled with the developmental facts already mentioned, viz. the existence of four segments in the intermaxilla and their relations to the internal and external nasal processes, suggests the following conclusions :

1. That the situation of the cleft in the lip margin is in all probability between the internal nasal and maxillary processes. The truth of this proposition depends on whether or not the external nasal process has any share in the formation of the lip. His, in his diagrams (Fig. 30), seems to indicate that it does not, whilst Biondi¹ claims that it does. The fact that these facial clefts commence at about the same spot in the lip margin as do the clefts in harelip seems distinctly to point to the conclusion that the superficial portion of the external nasal process is limited to the development of the ala nasi, and of the soft parts immediately around it. And this opinion goes far to explain the dimpling of the skin around and the consequent definition of the ala nasi.

¹ Biondi, op. cit.

2. That the situation of the cleft in the alveolus is between the meso- and exo-gnathion, so that the first tooth on the outer side, if developed, will be the canine.

3. That the upper extremity of the cleft should typically be located at either the inner canthus or about the middle of the lower eyelid ; but this is not always the case. The association with coloboma iridis is readily explained by an imperfect closure of the choroidal cleft which normally occurs at the lower and inner segment of the globe.

Median harelip in its two forms is readily explained. The true median cleft is due to the non-union of the two globular processes developed from the median portion of the fronto-nasal outgrowth. If prolonged between the bones, it occupies the position of the median inter-intermaxillary suture, and so passes between the two endognathia.

The more serious and complete form is due to the non-development of the globular processes, and hence absence of the central portion of the lip, the endognathia, and of the ethmo-vomerine plate. The contour and size of the alæ nasi in pictures of this deformity suggest strongly that the external nasal processes are developed, but no record of the dentition of these rare cases is to be found.

Macrostoma is due to the non-union of the maxillary and mandibular processes, or possibly in some instances to the imperfect development of the former.

Mandibular clefts are due to the non-union of the separately developed lateral segments of the mandibular process—a deformity which must result from an earlier interference with the normal conditions of development than any of the others. Prof. Wölfler has pointed out that at the period when the branchial arches are being formed, the aortic bulb lies between their ventral extremities, reaching up even as high as the mandibular processes. If from any cause the retrogression of the heart and aortic bulb into the thorax is interfered with,

then non-union of the visceral arches may result, and even a cleft mandible may thus be caused. This ingenious theory is stated only to apply to the more severe cases.¹

Cleft palate is due to non-union of the palatal outgrowths of the maxillary processes. When the cleft extends beyond the anterior palatine canal it may pass along any of the intermaxillary sutures, but usually between the endo- and meso-gnathion on one or both sides. Inasmuch as the palate closes normally from before backwards, it is most common to find the deficiencies at the posterior rather than at the anterior end.

¹ 'Langenbeck's Archiv,' xl, p. 795.

CHAPTER IV.

THE ANATOMY AND PHYSIOLOGY OF HARELIP AND CLEFT PALATE.

Harelip—Effect of labial muscles on deformity—Structure of os incisivum and labial segments.

Cleft palate—Arrangement and action of muscles—Shape of bony segments—Associated irregularity in shape of skull—Physiological effects in nutrition, articulation, &c.

THE short description of these congenital conditions given in Chapter I must be now supplemented by a little more exact account from an anatomico-physiological point of view.

With regard to harelip, if unilateral, but little remains to be said, except to emphasize the fact that the deformity is not altogether due to loss of substance, but to a considerable extent to the unbalanced action of muscles, the equilibrium of which has been disturbed by the fissure. Thus the orbicularis oris, which should have a sphincter-like action, has its continuity interrupted, so that when contraction occurs, the effect will be to widen and evert the edges of the cleft. The muscles acting upon the corners of the mouth, moreover, will tend to exaggerate the deformity, and thus all such actions as laughing and crying will have a similar result.

The margins of the cleft are rounded, and the red mucous border of the lip passes up for a variable distance on either side, but does not extend to the apex except in very slight fissures. The upper part of the cleft in the more serious

forms has its margin formed of skin, a fact which must not be overlooked in planning an operation for its cure, and which will be again alluded to in the next chapter.

The space between the segments of the lip is usually triangular in shape, and like an inverted V; it may or may not communicate with the nostril. In alveolar harelip the alveolus is cleft, as has been already described, along the endo-mesognathic suture; but the floor of the nose is not necessarily implicated.

The line of fissure in many instances passes through the maxillary attachment of the depressor alæ nasi, and the absence of the controlling influence of this muscle is an important element in the production of the broad flattened condition of nostril such a common accompaniment of this deformity, thus affording an explanation of the nasal distortion in cases where the alveolus is intact. If that structure be also implicated, then the floor of the nose will be deficient to a greater or less extent, and the tendency of the nostril to fall away increased.

On raising or making tense either segment of the cleft lip, the existence of strong reflections of the mucous membrane or frænula will become evident, in addition to the normal mesial frænum; these are sufficiently firm to limit the range but not to antagonise completely the action of the muscular contractions already alluded to. Moreover, unless freely divided by undercutting they will effectually prevent by their tension the parts being brought into a state of easy apposition, so necessary in order to gain primary union.

In bilateral or double harelip the maxillary segments on either side correspond in every particular with the outer segment in a unilateral cleft; but the central portion which is continuous with the columna nasi deserves special notice. It is usually ovoid in shape and stunted, appearing as if shrunk upwards from the absence of lateral support; its

breadth and length are nearly equal, and there is a small portion of the red labial margin at the lower part. It is attached on its deep aspect to the os incisivum by firm mucofibrous frænula, and in aggravated cases it appears to project amalgamated with the columna from the tip of the nose, forming the proboscis-like appendage already illustrated (Fig. 8).

The os incisivum has usually a larger superficial area than this "philtrum" of the upper lip, and hence protrudes beyond it in all directions. It forms a projecting tubercle, covered by smooth mucous membrane on its under side, with the central portion of the upper lip attached anteriorly. In a young child it consists of two little portions of bone, imperfectly united together, which in the fœtus are represented by two cartilaginous nodules, mobile on each other, and within each a separate ossific centre; in other words, it is formed by the two endognathia. Inside are found the rudiments of a variable number of teeth; ordinarily in a child's os incisivum, operated on at the usual age (*viz.* one to three months), one finds on laying it open the rudiments of four teeth, the temporary and permanent central incisors, arranged in pairs, one above the other. Occasionally, as has been already mentioned (p. 54), one finds evidence of the development of another incisor on one or both sides of the projecting tubercle, and directed towards the cleft; but



FIG. 41.—Os incisivum, consisting of two lateral bony segments, each bearing an incisor. (*Fergusson.*)

such is usually imperfectly developed and stunted. In fact, amongst all the ossa incisiva removed by Sir William Fergusson and now preserved in King's College Museum, but few

show any traces of the additional incisor, whilst the common arrangement is to find only the two central teeth (Fig. 41). In no case is there any evidence of the existence of more than two bony segments.

The anterior wall of the bone is always badly developed, and most commonly when displaced the growth of the whole projection is somewhat impeded, so that it is smaller than in the normal condition.

Its position may vary, being occasionally but little displaced anteriorly, though in consequence of its slight basis of support, viz. the antero-inferior extremity of the vomer, it is generally mobile; bands of muco-fibrous tissue are occasionally seen passing from it to the maxilla under such circumstances. Every variety of anterior displacement is met with, until the severest forms alluded to above are reached. If operative interference be delayed until late in life, the vomer becomes dense and hypertrophied, and the junction with the os incisivum much firmer, increasing the subsequent difficulties and dangers of treatment. More exact details as to the dentition in cases of alveolar harelip have been already given and discussed in a former chapter (p. 51). It is interesting to note here, however, that the temporary incisors, both in the intermaxilla and lower jaw, have a tendency to appear earlier than usual; I have many times seen incisors in such cases erupted at birth.

Amongst the many contributions to surgery which we owe to the late Sir William Fergusson, not the least is that interesting account given of the anatomy of cleft palate, derived from a minute dissection of a case which came under his observation in the dissecting room. The specimen was obtained from the mouth of an aged female.¹ The fissure in this case was one of medium severity, implicating the velum and the posterior portion of the hard palate. The upper horizontal fibres of

¹ 'Trans. Med.-Chir. Soc.,' 1845.

the superior constrictor were more fully developed than under ordinary circumstances, and would appear to have assisted in shutting off the posterior nares during deglutition and speech. The tensor and levator palati muscles were normally situated and developed, and it appeared from this dissection that the latter muscle was the main factor in drawing the velum upwards and outwards. Consequently the division of this muscle in some way or other is absolutely essential where any plastic operation is undertaken for the closure of the cleft. The palato-glossi and palato-pharyngei evidently possess the power of drawing the posterior part of the velum outwards and downwards, but they are by no means so powerful as the levator.

During muscular repose the edges of the cleft are considerably approximated to one another; indeed, the posterior halves of the velum may even touch, and the same condition to a limited degree obtains during deglutition. Fergusson rightly ascribed the latter effect to the contraction of the upper portion of the superior constrictor, which we have already mentioned is hypertrophied, the levator and tensor muscles being at the same time presumably relaxed. If the edges of the cleft be irritated, the lateral segment is instantly drawn upwards and outwards, and disappears as it were, an observation which emphasizes the necessity for the complete division of the levatores at some period of the operation.

Where the cleft extends into the bony palate, it is not uncommon to find the pitch of the palatal segments vary considerably. If the cleft be incomplete, the sides will be regularly sloped, although the vault may be higher than usual; whilst in cases of complete cleft, it is not uncommon to see an excessive upward slope of the bones like a Gothic arch, but not always symmetrical. Pollock states that "the more complete the cleft, the nearer the perpendicular are the sides of the palate;" and consequently when the soft tissues are

detached from the bone in uranoplasty the flaps will fall into position more readily, and in many cases meet without difficulty in the median line. The following diagrams (Figs. 42 and 43) indicate how much more advantageous such a condition is than when the palatal segments approach more nearly the horizontal.

My friend Mr. Oakley Coles has in his book on 'Deformities of the Mouth'¹ gone very fully into the question of the association of abnormalities in the shape of the cranium

FIG. 42.

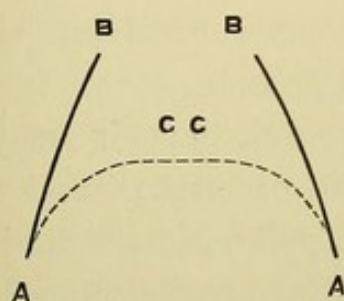
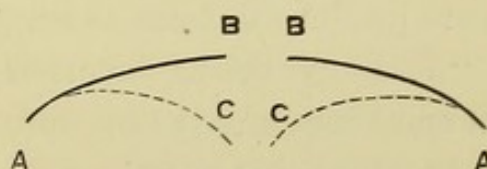


FIG. 43.



FIGS. 42 AND 43.—Diagrams representing the greater facility for bringing the muco-periosteal flaps together when the palatal segments are vertical rather than horizontal. (*Mason.*)

A B. Bony palatal segments.

A C. Muco-periosteal flaps.

with deformities of the palate, endeavouring to prove that the palatal defect is concurrent with, if not dependent upon, a non-development of the left lower parietal region of the cranium, *i.e.* of the portion of the skull overlying Broca's convolution, which governs the function of articulate speech. Into this question space forbids me to enter here, and I would refer my readers to his excellent book, merely quoting some of the conclusions at which he arrives :

"1. There seems a definite relation between palate and cranium ; certainly as to length and breadth, probably as to outlines.

¹ Churchill, 3rd edition, 1881, chap. vi.

"2. In palatal deformity or interference with the mechanism of speech, there seems to be in a large number of cases asymmetry of the brain-case.

"3. In strongly marked cases of malformation of the upper or lower jaws, there is equally well-marked asymmetry of the skull.

"4. In a notable number of cases this flattening of the cranium is on the left side.

"5. It is generally admitted that the language, speech, and sound centres are chiefly on the left side of the brain.

"6. Evidence is obtainable that structural defects, mechanical injuries, or pathological changes involving these parts produce defects of language and speech.

"7. In so far as functional activity and capacity may be taken as measures of organic perfection or otherwise, it may be assumed that certain cases of cleft palate, or the subjects of some other deformities in the maxillary region, who have also a deficiency in the articulate sound function are also deficient in the articulate sound nerve-centre.

"8. And as it has been shown that congenital structural defect of the brain is frequently associated with physical deformity of the skull, so it may be useful to regard the conformation of the skull as part of the evidence by which we may estimate the development of the brain.

"9. If it be possible to avail ourselves of the facts that are stated, and the inferences that are indicated, we may be able to prognose with a greater degree of certainty the future language and speech capacity of sufferers from palatal and maxillary deformities of congenital origin."¹

We must now turn to the functional results of these deformities, and trace out some of the effects which they produce on the economy.

¹ Op. cit., p. 109.

We necessarily place in the front rank the serious difficulties met with in the administration of *nutrition*. Where the lip alone is involved, and that only to a slight degree, but little difficulty arises, as the child is usually able to suck; but in the severer cases of cleft lip, involving also the alveolus and palate, the child's life may be endangered from the inability to take or to swallow sufficient food. For as the cleft alveolus and lip seriously impair the power of suction, so the cleft palate allows the fluid which has found its way into the mouth to regurgitate through the nose. In many such cases spoon-feeding is the only chance for the child. To carry this out successfully the head must be thrown well back, so that the fluid may pass directly into the pharynx; in fact, the child is often obliged to drink like a bird, in which, as is well known, the communication between the mouth and nose through the non-union in the median line of the palate bones necessitates a similar manœuvre. But even when this precaution is taken, there is no doubt that many infants with fissured palate die of sheer starvation. Mr. Mason suggested the use of an apparatus such as that figured below (Fig. 44).



FIG. 44.—Soft metal cover to teat of feeding bottle, which can be moulded to the infant's mouth, and act as an obturator during suction. (*Mason.*)

It consists of an ordinary india-rubber teat attached to a feeding bottle. Over the teat is a very thin plate of soft metal, which can be readily moulded to fit the infant's mouth, and so act as a temporary obturator. It may be used with advantage in some cases, but I have not employed it largely, preferring to trust to careful spoon-feeding. A similar

contrivance in india-rubber which can be fitted to a Maw's feeding bottle has been successfully used. A covered spoon with apertures left at either end is, in the hands of an intelligent nurse, an efficient contrivance.

Coles has devised an artificial palate attached to a shield to go over the mother's breast (Fig. 45) in order to enable the infant to take its natural nourishment. It is made of thin elastic rubber, is not uncomfortable, can be kept perfectly

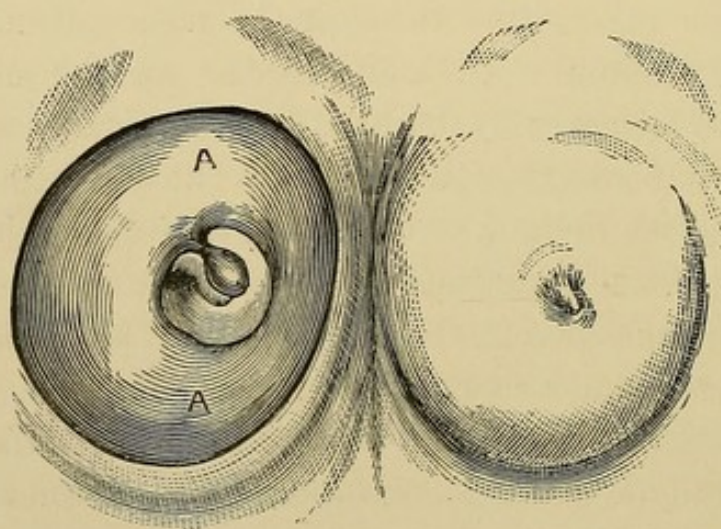


FIG. 45.—Nipple shield suggested by O. Coles for use in cases of cleft palate. A is the apparatus fitted to the breast, and prolonged anteriorly so as to form a shield, which projects over the nipple. When in the child's mouth it acts as an obturator, partly shutting off the nasal cavity. (Coles.)

clean, and from the shape in which it is made can be used for either breast. In exceedingly delicate children the employment of this device may be advisable.

In the severer cases it must not be forgotten that it is quite possible that some other factor is engaged in the production of the rapid wasting which in spite of every precaution may ensue, such as mesenteric tuberculosis, or some congenital intestinal or vascular defect. Whether such exist or not, the child quickly emaciates, the face becomes pinched and old-

looking; the skin has an earthy appearance and hangs in wrinkles, lax and inelastic; and death, practically from starvation, soon ends the chapter.

When our patient survives the dangers of infancy and arrives at boyhood or girlhood, the regurgitation of food through the nostrils ceases, except under occasional circumstances or in very severe cases; and although the difficulties of infant nutrition are often manifested in a much retarded growth, yet there is no reason why the physical constitution of the patient should ultimately suffer. Again, the knowledge of such visible and audible defects before operative treatment has been undertaken has a decidedly depressing influence upon the mind. The subjects of this deformity, from evident consciousness of their repulsive aspect, shun the observance of others as they grow older; and so strong is the sentiment which prevails as to maternal impressions that they are studiously avoided by women in the earlier stages of pregnancy. I have often noticed a distressed or hunted expression on the face of those who had attained to adult life before surgical treatment had been undertaken; and its disappearance after a successful operation has been equally marked.

Defective *articulation* is another serious accompaniment of these deformities. Although this may be present to a slight degree as a result of a simple cleft in the lip, yet it is only when the palate is imperfect that the trouble is obviously manifest. The defect consists in the inability to articulate distinctly any but the open vowel sounds, and those few consonants which do not require the nasal cavity to be entirely shut off from the buccal. For the production of the labials, dentals, and gutturals, it is essential that there be a complete closure of the posterior nares; and as the mechanism for effecting this is imperfect, the production of the sounds must be similarly defective. In spite of these difficulties, it is

extraordinary how adults suffering in this way can by practice make themselves understood. This inability to completely shut off the nose from the mouth is undoubtedly the primary cause of the nasal twang imparted to the voice. Even a small aperture is sufficient to give rise to a marked defect in speech ; whilst cases are recorded where without any actual cleft the velum from deficient antero-posterior length could not be approximated to the posterior pharyngeal wall, and a similar condition of speech has resulted. Indeed, in many instances where a scanty palate has been successfully sutured, the cacophonic sounds may for a time persist, though to a less degree than before the operation, a result either of inability to make this contact through an uncorrected faulty habit or tension of the velum, or due to the presence of some small opening. The peculiarity of the twang imparted to the voice varies according to the amount of communication between the mouth and nose, the size of the nasal cavities, and the shape of the nostril aperture. Where the tonsils are enlarged, and adenoid vegetations exist in considerable numbers on the pharyngeal wall, the size of the communication may be reduced, and articulation thus rendered more distinct. It is a question, therefore, whether these growths should be removed unless for some pressing reason.

Singing is interfered with, though to a much less degree than is ordinary speech, although the words sung will be indistinct. Whispering, moreover, is impossible ; but most of these conditions will not be very manifest if the velum alone be fissured. Mason notes that it is very difficult, and in some cases impossible, for the patients to blow out a candle ; and similarly they cannot perform on wind instruments.

The passage of air into the mouth and over the tongue tends to produce dryness of the latter organ, and consequently excessive thirst. The abnormal exposure of the parts to the unwarmed air produces a tendency to nasal catarrh

which is very decided ; and, in fact, it is very common to find a condition of chronic granular pharyngitis present, associated with adenoid vegetations and chronic enlargement of the tonsils. Patches or crusts of dried mucus may be observed clinging to the mucous membrane, and these have occasionally been mistaken for sloughs. From these arises a peculiar odour, which, however, cannot be quite accurately described as fœtor. The falling of mucus into the mouth is another unpleasant result, and the loss of the faculty of smell is in some cases most distinct.

The sense of taste is very defective in all severe cases, from the fact that the tongue cannot be applied to the palatal surface in such a way as to bring the food successively in contact with the organs of taste ; moreover, as is well known, the senses of smell and taste are closely correlated, and where smell is absent, taste is deficient. This was very well illustrated in one of my cases, where the operation for closure of a complete cleft was not undertaken until the girl was twenty-five years of age ; it was entirely successful, and she told me subsequently that the ability to appreciate the tastes of different foods in a way of which she had no idea previously was not one of the least of the advantages derived from the operation.

CHAPTER V.

OPERATIVE TREATMENT OF HARELIP.

Period of operation—Statistics—Precautions to be adopted.

Operation for single harelip: incisions; sutures; dressing; after-treatment—Various plans adopted.

Operation for double harelip: treatment of os incisivum—extirpation or reposition; treatment of soft parts.

IN discussing the period in the infant's life when a harelip should be operated on, it may be laid down as a general rule that the sooner an operation is performed for the repair of the abnormal condition *per se* the better; but other co-existent conditions have to be taken into consideration, such as the amount of vitality, the degree of deformity, and its association or not with cleft palate; and these may lead us to postpone the operation.

A low state of vitality may be due either to a general inherited weakness, or possibly to some associated deformity in another part of the body interfering with nutrition; or, again, simply to difficulties attending the administration of nourishment owing to the cleft lip and palate; for, as has been already pointed out, suction, and therefore breast-feeding, are impossible (p. 67). The problem that the surgeon has to solve lies in deciding to which of these causes the asthenic condition is mainly due, and whether the infant has sufficient strength to withstand the shock of the operation, and is in a state favorable for the occurrence of primary union. If due to some inherited weakness, or associated deformity else-

where, immediate operation would be rash in the extreme, for the child is very likely to succumb. In any such case, careful hand-feeding is alone practicable; if a steady improvement is manifested, the operation may be undertaken later. But if, on the other hand, the asthenia is evidently due to the inability to take nourishment, the child gradually getting thinner and looking half starved (as I have seen in many cases), then the first opportunity should be taken of closing the lip, as such treatment holds out the only prospect of saving the child's life. The greater the deformity, the more difficult will the question be to decide, for with the higher degrees of malformation the operation necessarily increases in severity. If associated with cleft palate this should be performed as early as possible, as the closure of the lip enables nourishment to be taken when administered in the way indicated above (p. 67).

It would be well here to call attention to the fact that the early closure of the lip by the insensible and yet constant pressure brought to bear on the separated maxillæ has a most beneficial effect in narrowing the alveolar cleft. In my own experience I can testify to the decided diminution which has occurred in the width of many clefts when the lip had been closed by me some years previously, the patients having subsequently returned for operative treatment on the palate. Passavant¹ relates a case of a child whose harelip was closed at the age of nine weeks, and a year later the palate was found to be approximated without further operation, so that it merely presented a fissure. Some surgeons have attempted to gain a similar result by prolonged compression of the maxillæ. Trendelenburg,² on the other hand, casts doubt on this explanation of the narrowing of the palatal cleft, the existence of which he fully admits, stating he has seen the same occur in children who have not been operated

¹ 'Archiv f. klin. Chirurg.,' v, p. 52.

² Trendelenburg, 'Deutsche Chirurg.,' Lief. xxxiii, Hälfte 1.

on, and suggesting that it is due to the inward growth of the bones.

Three different periods have been suggested for the operation, viz. :

(a) The immediate operation—within two or three weeks of birth.

(b) The early operation—from three weeks to six months.

(c) The deferred operation—from six months to two years.

Statistics do not favour the immediate operation, for although some surgeons have obtained good results, the mortality with others has been considerable. Thus König,¹ on the one hand, records seventy cases operated on in the first month with but one death; whilst Hermann² gives 52·4 per cent. as the mortality of the operation during the first three months of life, and Gotthelf³ 50 per cent. for a similar period. The latter cannot but be considered as an extraordinarily high death-rate, and possibly antiseptic precautions were not carefully observed. Trendelenburg⁴ reports 44 cases treated in the course of three years with seven deaths; the infants were between three and six months old. Fifteen were simple cases, with one death; twenty-one were complicated, with two deaths; and eight most complex forms, with four deaths. Only one died within a fortnight of the operation; the remainder from intercurrent maladies. Still, however, he reckons the death-rate during the first year of life of children operated on as 41·6 per cent., explaining it by malnutrition and the want of intelligent artificial feeding. Fritzsche reckons the mortality during the first two weeks after operation as about 5 per cent., but even this is higher than

¹ 'Deut. Zeitsch. für Chir.,' xix, p. 15.

² Hermann, 'Beitr. z. Statistik und Behandlung der Hasenscharten,' Diss. Breslau, 1884.

³ Gotthelf (Heidelberg), 'Archiv f. klin. Chir.,' xxxii.

⁴ Op. cit., p. 39.

I should consider consistent with the results of British surgery.

My own personal experience has been much more satisfactory, and the above figures are much too high to represent my results. Out of between 300 and 400 cases treated between the fourth and eighth weeks, *i.e.* by the early operation, I have had no death as an immediate result, but several have died subsequently from intercurrent maladies or defective nutrition. I attribute this success largely to the fact that I never operate upon out-patients, but always take the precaution of carefully preparing and watching them for a few days prior to operating. In the practice of the late Sir W. Fergusson the one or two fatal cases which I recollect occurred in children who were taken home immediately after the operation.

It has been claimed for the deferred operation that convulsions are liable to ensue when an infant under six months is operated on, and also that the interdiction of nursing impairs nutrition; but this has not been my experience.

From a consideration of the foregoing facts, it would appear that from the fourth week to the third month is the most favorable period for interference, and that at which the greatest proportion of success has been obtained.

In conclusion, whilst fully admitting that it is impossible to lay down rules which will meet every case, and that each must be dealt with on its own merits, I would venture to suggest the following propositions which may be helpful as a guide to practice:

1. That, *cæteris paribus*, it is important to close the cleft in the lip as early as possible.

2. That, under ordinary circumstances, the immediate operation is dangerous to life, and should only be undertaken in desperate cases as a means of saving it,¹ *i.e.* in double

¹ Trendelenburg objects to the harelip operation being called a life-saving

cleft of the lip and palate, where suction is impossible and swallowing difficult.

3. That experience shows that the sixth week may be taken as an average at which operations can be safely performed; but that if the child be very weakly, it is better to defer such treatment for a few days, until careful spoon-feeding has improved our little patient's condition.

4. That association with cleft palate in no way invalidates the previous propositions.

In many cases of slight cleft without alveolar complication the child is able to take the breast, and as it is desirable to maintain this after the lip has healed, care must be taken that the lacteal secretion is not checked. The child is often able to suck five to seven days after operation; during that period the mother's milk must be drawn off by a breast-pump when necessary, and should be given to the child by spoon. Any mammary inflammation is thus avoided, and the child's diet is not changed. In many cases of severe deformity, where the child is unable to suck from the first, an early disappearance of the milk has of necessity entailed spoon-feeding. When such an infant is taken from home into hospital it is well to wait for a few days before operating until acclimatised to the change of surroundings and of diet. The general state of health should be as satisfactory as possible, and every effort must be made to ensure this; it is often politic to defer operation on this account for a short period. Any aphthous condition of the mouth should be treated by swabbing with a weak boracic solution (1—40) or by the application of *mel boracis*.

one, on the ground that the inability to gain sufficient nutriment depends rather on the associated cleft palate than on the cleft lip. But if the lip be united efficiently the method of feeding by bottle suggested at p. 66 enables the child to suck and swallow satisfactorily in spite of the palatal defect.

Anæsthesia is now-a-days invariably employed, chloroform being the agent used. Care must be taken by the anæsthetist to prevent any drop coming in contact with the wound, such an occurrence being liable to interfere with primary union.

With regard to the position of the patient, some difference of opinion appears to exist. The practice adopted years ago and described by the late Sir W. Fergusson in his manual¹ consisted in the surgeon and nurse sitting opposite one another, the latter holding the child with its head on the surgeon's knee. To quote his own words: "A cloth should be wrapped round the chest so as to confine the arms; a pillow-case answers the purpose well, as the legs can then be secured by slipping the patient into it. Then the child should be held by an assistant with its head resting face uppermost between the surgeon's knees; if he puts on an apron of waterproof cloth, it will answer the double purpose of keeping his trousers free of blood, and preventing the child's head falling too low; a little pressure with the thighs will enable him to keep the head more steady."

The majority of surgeons at the present time employ the recumbent posture on a table, a plan which I always follow, the surgeon standing behind the child's head, and the anæsthetist and assistant one on either side. Some prefer to stand at the side of the infant, with the assistant behind its head.

OPERATION FOR SINGLE HARELIP.

For convenience of description, the operation may be divided into three stages:

1. Detachment of the lip from the maxillæ.
2. Preparation of the edges of the cleft.
3. Union by sutures, and application of dressing.

¹ Fergusson, 'A System of Practical Surgery' (Churchill), 1865, p. 497.

STAGE I.—*Detachment of the Lip from the Maxillæ.*

The importance of thoroughly loosening the attachment of the lip to the maxillæ and alveoli cannot be too strongly insisted on; and although emphasized in monographs on the subject by several authors, yet in our ordinary surgical textbooks it is but scantily noticed or not alluded to at all. Unless this proceeding is carried out efficiently, the tension upon the stitches subsequently inserted will be so great as to hazard successful union, and will prevent the surgeon from obtaining a symmetrical adaptation of the parts. In severe cases it may be necessary to carry the knife as far as the infra-orbital foramen, and I have often had occasion to go close up to the orbital margin to gain as much freedom as was needful. The maxillary attachment of the ala nasi must also be completely divided, so that the flattened and distorted nostril may be made to correspond in shape and form to that on the opposite side. This dissection in single harelip is mainly needed to the outer side of the cleft, but rarely to such an extent as described above unless the cleft be very wide.

The knife must be kept close to the bone in order to minimise bleeding, and not unnecessarily to lacerate muscular and other structures. Sponge pressure will readily control any hæmorrhage. Afterwards the plastic exudation that results is useful in steadying the mask of the face, and the temporary division of facial muscles has a like effect.

STAGE II.—*Preparation of the Edges of the Cleft.*

Many different methods have been suggested and practised for the preparation of the margins of the cleft, some of which will be noticed in detail hereafter. It is necessary to keep clearly in view the points to be aimed at in the operation.

The mere union of the two segments of the divided lip is not sufficient; we also require to obtain symmetry of the nostrils, to avoid an unsightly flattening of the tip of the nose, to have a scar almost invisible, and no notch in the lip margin; the muco-cutaneous line or red margin, moreover, should be so united as to be continuous.

Many surgeons have endeavoured to utilise almost, if not every particle of tissue bounding the cleft, notably Malgaigne, Nélaton, Henri, and Giraldés; but the principal objections to this are that it leaves the nostril wide and depressed, and the expression anything but agreeable, whilst in some of the plans suggested the muco-cutaneous line will be irregular. From my own experience of operations I am convinced that better results may be obtained by a free removal of tissue, principally from the outer or buccal half of the cleft; and in so doing the knife should always encroach upon the affected nostril, and thus the necessary diminution in the size of its aperture can be obtained.

Bearing in mind the tendency of scar tissue to contract in all directions, it is obvious that the surgeon must so plan his incisions that the united lip shall be at first slightly longer vertically than is ultimately desired. The incisions, instead of being made parallel to the edges of the cleft, should be curved, with their concavities facing each other, so that when in apposition a vertical elongation may be obtained. To avoid the formation of a V-shaped notch, a result so liable to occur, a variety of methods of forming a *prolabium* have been suggested and practised. Most of these aim at the formation of a protrusion which, exaggerated at first, will ultimately be reduced to normal dimensions by subsequent cicatrisation. Some surgeons (*e. g.* Mirault and Giraldés) are content with using the mucous membrane of one side only, and planting it on a prepared surface on the other margin of the cleft; whilst Malgaigne,

Henri, and Stokes make use of labial tissue from both sides. My usual plan of procedure is a modification of that described by Dr. Stokes, though I have had recourse to other methods.

Great care must be taken to make the incisions clean and at right angles to the skin. By some, however, the edges are bevelled, and when for any reason such is thought desirable it is important to remember that each side will need bevelling to a proportionate extent. The use of scissors for this purpose is sometimes preferred to that of the knife, but the difficulty of cutting cleanly appears to me much greater with scissors, however sharp, than with a scalpel.

Various kinds of lip compressors have been suggested for controlling the hæmorrhage from the coronary arteries during this stage of the operation; but I agree with the majority of surgeons in considering that these are cumbersome, and quite unnecessary when one has intelligent assistants. The constant presence of such an instrument distorts the parts, and prevents the operator from seeing clearly how to plan his incisions. Nothing can be so well adapted for this purpose as the thumb and index finger.

The usual method that I am accustomed to adopt for cases of simple unilateral harelip is as follows:—Standing behind the patient's head, and my assistant holding the right side of the lip between the finger and thumb of his right hand, so that the index finger is in the mouth, and so holding the lip forward and inward at a sufficient distance from the margin to enable me to remove the requisite amount of tissue without difficulty, I enter the knife with its edge downwards either at the apex of the cleft, or in a complete case at the margin of the nostril as high as desirable, and cut in a curved direction downwards until the muco-cutaneous junction is reached. The edge of the knife is then turned so as to cut through the mucous membrane of

the lip in a direction practically at an angle of 60° to the former incision. Then grasping the left side with my own left thumb and forefinger, and thus making it tense, I make an exactly corresponding incision, dealing with the muco-

FIG. 46 A.

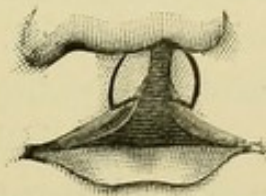


FIG. 46 B.

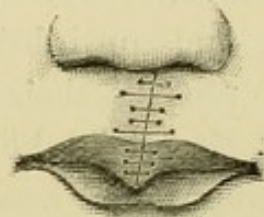


FIG. 46 A.—Author's method of preparing edges of cleft, showing semilunar incision as far as red margin of lip, and oblique upward cut on either side to form the prolabium.

FIG. 46 B.—Shows flaps in position, and the nostrils symmetrical. The wide stitch lines represent the position of the wire sutures, the narrow those of the catgut.

cutaneous margin and mucous membrane in a similar manner (Fig. 46 A). Having approximated the edges and fitted them together, we are now ready to undertake—

STAGE III.—*Union by Sutures and Application of Dressing.*

Many surgeons still retain the plan first introduced and figured by Ambrose Paré¹ of uniting the edges by means of harelip pins and figure-of-8 sutures; but this has been largely superseded by the use of silver wire and intermediate fine sutures.

Good results undoubtedly followed the old plan of treatment, and it had the advantage in pre-anæsthetic days of being more rapidly accomplished. But success could not be depended on for the following reasons: it was more difficult to

¹ 'The Works of the famous Chirurgeon, Ambrose Paré' (1579), translated in 1678 by Th. Johnson.

adjust the edges with exactness, and the muscular movements of the lip were liable to cause them to slip, and being hidden by the coils of superjacent suture the displacement was undetected until the removal of the pins. Moreover the track of the pins, especially if they were retained beyond the fourth day, was liable to become the seat of suppuration, and unsightly cicatrices resulted. In some instances the pins cut their way out of the lip, leading to still more evident cicatricial deformity, and the liability to septic infection of the wound was of course much greater. At the same time I have no desire to detract from the one great and acknowledged advantage of pin-transfixion and figure-of-8 suture, viz. the steadying and accurate approximation of the deeper parts, when efficiently inserted; but I maintain that the same advantages can be secured by the use of silver wire as detailed below.

When harelip pins are used, the method of introduction is as follows:—The first pin should be inserted close to the muco-cutaneous margin, and about one centimetre from the edge of the right side of the lip, and its point should emerge on the deep aspect of the raw surface close to the mucous membrane. It should then be passed on through the opposite side of the lip, entering at an exactly corresponding point on the raw surface, and passing out through the skin of the left side at the same distance from the edge as on the other. One or two more pins should be similarly passed at equal distances through the other portions of the cleft. Moderately thick unwaxed silk is now used as a figure-of-8 suture, whilst during this the assistant presses the cheeks, and holds the lip *in situ*. The parts should not be dragged together by this means, but merely retained in the position to which they have been easily brought by the pressure of the assistant's fingers, as a result of the previous undercutting. A separate silken thread is advisable for each pin. The pins

are now cut short by wire-nippers, and collodion painted over all.

The plan I now adopt, in common with many others, of suturing the prepared lip is as follows:—Purified silver wire of No. 27 gauge is carefully threaded on special wire needles. I introduce two or three sutures by entering the needle at rather more than half a centimetre from the margin, and bringing out the point on the raw surface close to the mucous membrane as with the pins, taking care to pass the needle in on the opposite side at an exactly corresponding point. The three situations I select for these sutures are, one at the root of the nose or upper part of the cleft; one a little above the muco-cutaneous junction; and the third, if necessary, between the other two. In very young infants and simple cases, only two wires are needed.

Having passed the wires and tested the accuracy of their position, the ends are left long and unfastened lying on the cheeks, whilst the fine catgut sutures are being adjusted. By means of small semicircular needles, about two centimetres in diameter, held in a needle-holder, these sutures are inserted, as near to the margin of the cleft as is possible, consistent with their holding. The first two should be placed one at the muco-cutaneous junction, and the other at the nostril aperture as high as is necessary in order to bring about the approximation of the ala nasi to the median line, and thus secure the diminution in the size of the opening, and a symmetrical disposition of the features.¹

As many other fine sutures as are necessary are now inserted between these two. In regard to the mucous membrane of the lip and the formation of the prolabium, care must be taken that the exact edges are stitched together, as they are

¹ In view of the dilatation of the nasal aperture, which often takes place at a later date, it is advisable to make it at first actually smaller than on the opposite side.

very liable to curl in. It will be found of great assistance if the catgut of the first suture in the mucous membrane be not cut short, but used as a holder to lift the lip during the passage of the next stitch, which will fulfil the same office for the succeeding one, and so on, until, in this way, the mucous membrane can be thoroughly everted, and fine sutures carried through the edges on the buccal aspect. The effect of this is most satisfactory in maintaining exact coaptation of this part of the lip, which is so liable to be displaced when the child is fed or cries, permitting the entrance of food or saliva which will interfere with the progress of union. The wire stitches (sutures of relaxation) are now fastened, and in doing so there is no necessity to tighten them unduly; experience alone can teach the requisite amount of tension. This completed, all traces of blood are removed from the face, and the sutured lip carefully cleansed with a purified sponge dipped in boracic acid lotion.

A collodion dressing is then applied in the following manner: a piece of antiseptic gauze folded double is cut butterfly fashion, so that one wing is fixed upon each cheek, and the uniting portion, just the width of the lip, passes over the wound. Collodion is carried close up to, but not over, the wound itself, which is merely covered by the bridge of gauze. During the adjustment of the dressing, the assistant should hold the cheeks forward, and this position must be maintained until the collodion is firm. The contractile nature of this dressing is especially useful in limiting to some extent the movements of the cheek.

In former days the use of Hainsby's truss or cheek compressor was much in vogue, with the object of relaxing, as far as possible, all tension on the flaps; but the apparatus has now been discarded by most surgeons. The pressure of the spring was occasionally so severe as to cause sloughing of the cheek (as I have seen in one or two cases many years ago); or

else there was a great liability for the pads to slip out of position during any sudden movement of the child's head, leading to injurious pressure on or near the wound itself. In fact, if the truss was acting efficiently, pain and irritation to the child resulted; if it was comfortable, it was generally useless.

One of the principal points to be attended to in the *after-treatment* is to instruct the nurse to depress the lower lip with the index finger for some hours after the child has recovered from the anæsthetic, and to repeat it occasionally until it becomes accustomed to the diminished oral aperture; otherwise the efforts to draw air through the mouth (now closed for the first time) will tend very considerably to disturb the wounded surfaces.¹

Spoon food must be so administered as to allow it to touch the upper lip as little as possible. The arms should be fixed to the side to prevent them touching the face. In young infants constant attention day and night is necessary, for they are very liable to roll the head from side to side, and so bring the sutured lip in contact with the bedclothes, which causes pain and makes the child cry, a most undesirable occurrence. The state of the bowels should be attended to, and if constipation exist, a small dose of grey powder with magnesia may be advisable. The silver wire sutures should usually be taken out on the fourth day; the catgut stitches may remain a week, or some of them until absorbed, the collodion dressing being re-applied when necessary, and maintained for a few days after the catgut has disappeared or been removed. Occasionally saliva and milk soak into and under the gauze, producing a moist condition of the skin around the freshly united wound, which may lead to eczema. The

¹ The lower lip may also be kept drawn down and everted by the use of collodion applied longitudinally between it and the chin, thus obviating in part the need of the constant application of the nurse's finger. This ingenious plan has been suggested and practised by one of the sisters in my wards at King's College Hospital.

gauze should then be left off, and the parts gently washed with warm boracic lotion and dusted over with a mixture of equal parts of powdered oxide of zinc and starch. In mild cases without alveolar complication the child may be put to the breast on the fifth or sixth day, if the condition of the wound is satisfactory. But in the severe forms, or where the union is weak and threatens to give way, most careful spoon-feeding and general watchfulness must be continued. In spite, however, of every precaution, the depression of the nostril will sometimes persist or reappear as cicatricial contraction takes place, and a slight notch in the lip cannot be always prevented.

It will be convenient to append here a description of some of the better known methods of operating on unilateral harelip, with a few words of criticism on each.

1. *Graefe's method* is applicable only to incomplete clefts in the soft tissues. He prepares the edges by an arch-like incision (Figs. 47 A and B), and brings them together with the

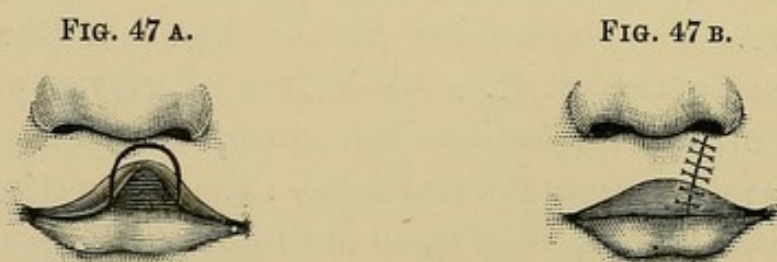


FIG. 47.—Graefe's operation. The completed lip is an impossible diagram of the result of such a section.

muco-cutaneous margin even. It will be seen that a notch must necessarily result (in spite of the successful appearance in the picture which I have borrowed) from cutting the red margin of the lip in this manner.

2. *Nélaton's method* (Figs. 48 A and B).—In this no tissue is removed, but the margin is freed by a semicircular incision

skirting the cleft and extending through the whole thickness of the lip. The centre of the fissure is then drawn down, and the opening thus created is brought together laterally so as to cause the lower portion to protrude as a prolabium. It is only suitable for very mild cases of harelip where the nostril is not involved, and has been adopted in the secondary treat-

FIG. 48 A.

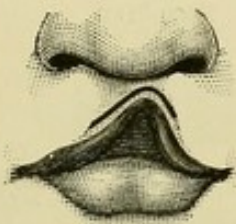


FIG. 48 B.

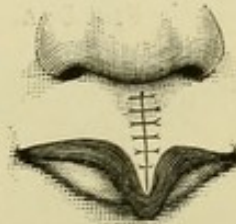


FIG. 48.—Nélaton's operation. No tissue removed, but the loosened margin pulled down and sutured.

ment of the V-shaped notches, the results of previous operations. It will be noted, however, that the prolabium in this case consists mainly of cutaneous tissue, and that there must necessarily be an unsightly break in the red margin of the lip, which makes it a most undesirable proceeding.

3. *Malgaigne's operation* (Figs. 49 A and B) was suggested for unilateral harelip where the fissure does not extend into

FIG. 49 A.

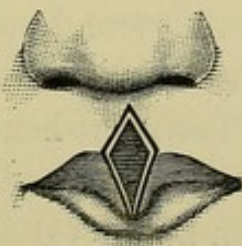


FIG. 49 B.

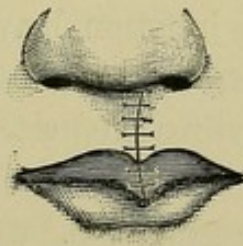


FIG. 49.—Malgaigne's operation. No tissue removed; cleft margins turned down to form a prolabium.

the nostril. No tissue is removed, but flaps are turned down from the apex of the cleft on either side, the incision stopping

at the red margin of the lip. Knife or scissors may be used. The flaps are drawn down and united to form a prolabium, whilst the raw surfaces, necessarily left above, are united from side to side. The same objection applies to this as to Nélaton's operation, viz. the break in the red margin of the lip caused by the interposition of integument.

4. *Giraldés'*¹ or the mortise operation (Figs. 50 A and B) is a

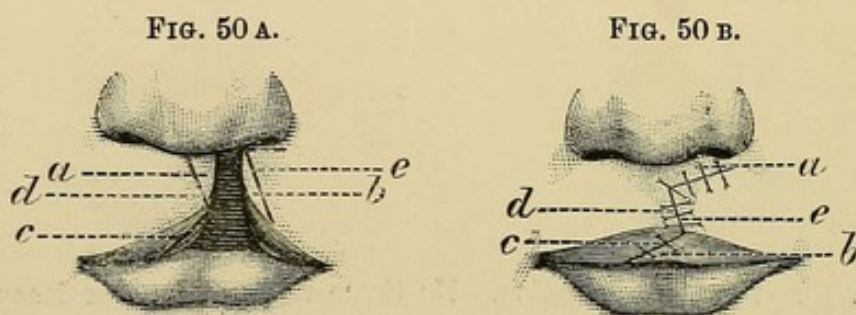


FIG. 50.—Giraldés' or the mortise operation.

somewhat complicated proceeding. Taking a left-sided unilateral cleft for illustration, a flap (*a*) is cut on the right side from below upwards, starting from the muco-cutaneous junction, and remaining attached by its base to the root of the nose. The portion of red lip margin below this is removed by an oblique incision (*c*), and so prepared for receiving a flap from the other side. On the left side of the cleft, a flap (*b*) is made by cutting from the ala nasi downwards to the muco-cutaneous junction, leaving it attached below; and in addition a transverse incision outwards is made from the same starting-point, skirting the nostril if necessary. The right-hand flap (*a*) is turned up and implanted along the opening made by the transverse incision, whilst the left-hand flap (*b*) is turned down and implanted on the oblique raw surface (*c*). It will then be easy to approximate the surfaces *d* and *e* together as indicated in the figured diagrams. I have not practised this identical operation as described above, because of the

¹ 'Dict. de Médecine,' p. 703; M. Coste, 'Lancet,' 1851, ii, 203.

objection there is to the left-hand flap, which contains skin at its upper part, being introduced into the red margin of the lip.

5. *Mirault's operation* (Figs. 51 A and B) consists in entirely

FIG. 51 A.

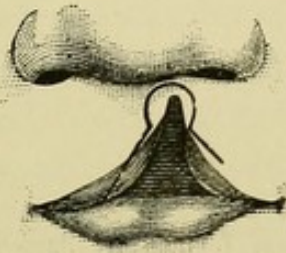


FIG. 51 B.

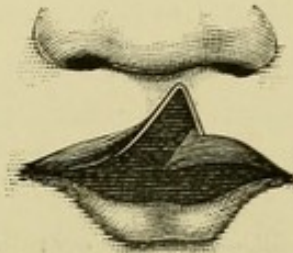


FIG. 51.—Mirault's operation. Outer side of cleft margin implanted on prepared surface of inner side.

removing the inner margin of the cleft, whilst on the outer side a flap is turned down by cutting from above downwards, commencing at or near the apex and extending to the junction of the middle and lower thirds where it remains attached. Care must be taken to make this flap sufficiently thick. It is then carried horizontally across the cleft and applied to the opposite margin, and the raw surfaces sutured together. The same objection may be raised to this as to some of the above-mentioned operations, viz. the implantation of integumental tissue in the continuity of the mucous membrane of the lip, resulting probably in an irregularity of the red margin.

6. *König's operation* is more satisfactory, and not unlike the one I usually employ (Fig. 46). It consists in paring both margins of the cleft, and in then forming two small prolabial flaps by horizontal incisions parallel to the lip margin.

7. *Stokes's operation*.—In this a prolabium is formed by tissue from both sides of the cleft by means of incisions skirting the red margin of the lip, as seen in the drawing (Fig. 52, *ab*, *a'b'*). The upper part of the cleft is not completely pared on either side, but the knife is only carried

three quarters of the way through the thickness of the lip, the mucous membrane remaining intact. These partially dissected flaps are turned back, and the edges of the skin brought into apposition, whilst the prolabial flaps are drawn downward and outward. As regards the latter part of this

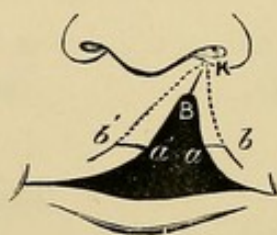


FIG. 52.—Stokes's operation. Prolabium formed by flaps $ab, a'b'$ from each side; margins of cleft partially detached, and flaps $k\ B\ ab, k\ B\ a'b'$ turned backwards to increase breadth of raw surface. (*Mason.*)

proceeding, it will be seen that my own plan is much the same, but the necessity for leaving the tissue at the back of the lip does not appear to possess any advantage commensurate with the greater difficulty that its presence entails in the accurate adaptation of the flaps.

8. *Collis's operation*¹ (Figs. 53 A and B).—This proceeding

FIG. 53 A.

FIG. 53 B.

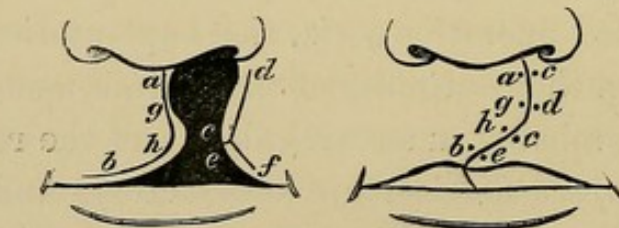


FIG. 53.—Collis's operation. No tissue removed. Inner margin is pared by incision ab , but left attached by mucous membrane, and hinged backwards. Outer margin is transfixed, and flaps cd and ef are cut; cd is turned up and attached to ag ; ef is turned down and attached to bh . (*Mason.*)

is somewhat similar to Stokes's as regards the utilisation of every portion of the soft tissues. On the inner side the knife

¹ 'Dublin Quart. Journal,' 1868, vol. xlv, p. 269.

is carried along the margin of the cleft (*ab*), but stops short at the mucous membrane, allowing this portion to be turned, as on a hinge, backwards to increase the thickness of the raw surface. On the outer side a prolabial flap (*ef*) is made from above downwards, starting at the centre of the margin, whilst the rest is turned upwards to form a flap attached above (*cd*). This latter is then drawn across and adapted to the upper part of the inner margin with its apex upwards, whilst the lower flap is drawn across and implanted on the lower portion with its apex downwards. In actual practice this is complicated and tedious, but the principal objection to it as well as to Stokes's operation lies in the fact that there is no provision for restoring the shape of a distorted nostril.

In the severer forms of harelip, where either the cleft is broad or the nostril much flattened, other modifications may be necessary; such, for instance, as that practised by Dieffenbach, the essential principle of which consists in making additional incisions horizontally below, and even skirting around the ala nasi, with the object of so loosening the tissues as to bring them more readily into apposition. I have never practised this, and cannot help thinking that the difficulty often experienced in bringing a flattened nostril into position would be rather increased than otherwise. Free undercutting of the cheek tissue will probably be found much more efficacious.

In alveolar harelip with projection of either segment of the alveolus it may be necessary to excise the projecting portion, or to reduce its bulk in order to prevent undue tension on the flaps. In many it is sufficient merely to excise the milk tooth, whilst in others a part of the bony margin may need removal with cutting pliers. Any such step, when obviously necessary, should be carried out as a preliminary operation.

OPERATIVE TREATMENT OF DOUBLE HARELIP.

This subject naturally resolves itself into the discussion of two points, viz. the method of treatment of the os incisivum, and that of the soft parts.

The treatment of the os incisivum has given rise to considerable discussion, and the practice of various surgeons differs greatly. Whilst some, especially on the Continent, have advocated its retention, others, particularly of the English school, have just as strongly urged its extirpation. One thing is plain; if the bone is to be retained steps must be taken to restore it to a normal position. It will be well to describe *seriatim* the different plans of treatment which have been suggested, and subsequently to discuss their relative value.

The oldest and simplest method consists in the complete removal of the bone, or, as it is sometimes called, the operation of Franco.¹

This should be always undertaken as a preliminary step a week or two prior to dealing with the soft parts, and is effected in the following manner:—The central portion of the upper lip, together with all the available tissue which can be turned up, is first dissected away from the bone and left attached to the columna nasi. The mucous membrane behind

¹ It may be interesting to quote Franco's own words on this subject:—"Pour l'extirpation de telle turpitude, nous y devons en premier lieu procéder de la manière que dessus (*Cure des leures fendues*, ch. 119), hormis que quand les dents et mandibules passent dehors, et que ne peuvent estre couvertes de la bouche, il n'y a point de danger de copper le superflu et ce qui ne sert à rien avec tenuailles incisives ou avec scie ou autre instrument propre à cest essai, en laissant la chair qui est dessus icelles dents s'il y en a, affin qu'elle serue en cousant les deux autres parties en icelles de chaque costé, et s'il y auoit telle distance entre lesdites leures qu'on ne peut les assembler, il faudrait user de semblables dissections en la bouche qu'au cas précédent, et procéder au reste ainsi qu'auons montré" (Franco, *Traité des hernies, &c.*, cure de dents de lieure, chap. cxxii, Lyon, 1561).

the projection is then incised transversely to allow of the introduction of a pair of cutting pliers, by which the separation of the bone from the vomer is effected. Smart bleeding from the anterior palatine vessels frequently occurs, and may require a touch of the cautery to stay it. No after-treatment is necessary, as the stump rapidly cicatrises. The child should be well fed up in view of the subsequent operation upon the soft parts.

Where the os incisivum is retained, the following methods for its treatment have been adopted :

1. Gradual and continuous backward pressure by means of a bandage (Desault). In this plan the bandage requires constant attention to keep it sufficiently tight; and it is very doubtful whether much effect can be thus produced, especially when only applied, as in Desault's cases, for from ten to eighteen days. The use of elastic tension by means of india-rubber has been also recommended (Thiersch). The effect of such treatment will be to bend the vomer in proportion to the amount of repression; but much pain must always be produced by this process, and the vitality of the central part of the upper lip may be seriously impaired.

It would appear from Desault's writings that he only advised this proceeding in cases where the projection of the bone was slight, and where there was a certain amount of mobility owing to the median septum being soft and cartilaginous, conditions which do not often obtain; and certainly statistics do not show any large number of cases treated.

Where, however, the projection is but slight, and the vomer not too strong and hypertrophied, this plan deserves a trial prior to undertaking more serious steps.

2. Forceful repression of the incisive bone by seizing the projecting tubercle at its extremity and violently forcing it back, fracturing the bony processes which support it. This proceeding, which was introduced by Gensoul of Lyons, rests

on the theoretical hope of simply fracturing its pedicle at its narrowest part without giving rise to much hæmorrhage, or to laceration of the mucous membrane. But anatomical facts are opposed to such a probability. The vomer, we know, is usually thick and hypertrophied in these cases, and the line of fracture will probably be far back, and may very possibly extend to the cribriform plate of the ethmoid and base of the skull. The mucous membrane, moreover, is liable to be severely lacerated and the hæmorrhage considerable; Sedillot¹ sums up the proceeding as "peu sûre, difficile toujours, et impossible souvent." But few cases of success are recorded, and from its uncertainty one may dismiss it as unscientific and unjustifiable.

3. Repression after excision of a wedge-shaped piece of the vomerine plate immediately behind the os incisivum (Blandin's method).² This only applies to cases of complete double cleft where the vomer is unattached to either palatal segment. Using strong scissors, M. Blandin cut out a V-shaped portion of the vomer, the anterior incision being vertical and the posterior oblique. The median tubercle could then be easily replaced. The great objection to this method, however, is the severe hæmorrhage which is liable to ensue from the divided anterior palatine arteries, and, in fact, M. Richet reported three cases in the 'Société de Chirurgie,' in 1856, in which he had performed this operation, and all with fatal results.

A much better plan is that which was suggested, in order to avoid such mishaps, by Bardeleben.³ He incises the mucous membrane along the lower border of the nasal septum behind the os incisivum, and then strips up the mucous membrane and periosteum by means of a narrow-

¹ Sedillot, 'Gaz. des Hôp.,' 1861, Nov. 7th.

² 'Journal de Malgaigne,' Jan., 1843.

³ Bardeleben, 'Lehrbuch der Chirurgie und Operationslehre,' 1872, vol. ii, p. 252.

bladed raspatory. The septum may be either divided with cutting pliers and the projection thus reduced, or being grasped by a pair of sequestrum forceps, the blades of which are protected by gutta percha, may be diminished in length by being forcibly twisted upon itself. The effect of either of these proceedings will be to cause the two portions of the vomer to overlap, a matter of little consequence, whilst the operation being subperiosteal, but slight hæmorrhage occurs. The results of this method of treatment seem to have been fairly satisfactory.

The late Mr. Butcher¹ designed certain ingenious instruments for "cutting through the projecting pieces in complicated harelip without dividing the soft parts," or interfering with the vascular supply from behind previous to bending them back.

By whatever method the median tubercle has been replaced, it is always advisable to operate at the same time on the soft parts, as the united lip is the best splint for steadying the bone in its new position and giving it as good a chance as possible for becoming fixed. To assist this fixation various plans have been adopted, but with very partial success, *e. g.* the lateral aspects of the cleft and the os incisivum have been freely pared in order to obtain firm adhesions of the raw surfaces, and even silver wires have been passed, a proceeding somewhat detrimental to the developing teeth.

Langenbeck,² after paring the edges of the prominent tubercle and of the maxilla, transfixed the parts with a harelip pin after replacement into position, and I have myself tried the same plan, but with indifferent success.

In discussing the relative merits of these two forms of treatment, extirpation or reposition, it must be remembered

¹ Butcher, 'Essays on Operative Surgery,' p. 715; 'Dublin Quarterly Journal of Medical Science,' xxix, p. 296.

² 'Archiv,' vol. ii, p. 230.

that the latter is practically impossible in adults or in patients rather older than the usual infants operated on, for the os incisivum will in such be larger and more bulky than usual, and the palatine cleft having become narrower, the space into which the bone has to be repressed is much smaller than usual. The advantages claimed for reposition are the following :

1. The profile view of the face is much improved by retaining the normal shape of the alveolar border, and the appearance, especially when the mouth is open, as in laughing or yawning, is more pleasant.

2. The normal contour and size of the upper jaw is maintained, preventing the patient from becoming so obviously "underhung" as is commonly the case after extirpation.

3. The patient retains his own teeth, and is able to use them better than any artificial appliances.

But such advantages are more theoretical than practical, as the following facts will show.

The os incisivum in its new position is admittedly never very firm, and usually has considerable mobility, and hence its use in bearing the incisors is considerably discounted. Moreover the position of these teeth is such that they are both useless and unornamental; for from the rotary movement by means of which reposition is effected, the teeth will generally erupt obliquely backwards; they are in addition often small and decayed. Although it may be desirable to maintain the normal contour of the jaw, we must assert that the presence of the incisive bone between the anterior portions of the maxillæ is by no means an unmixed good, as its wedge-like action interferes materially with the subsequent narrowing of the palatine cleft, and so renders the later operation for the cure of this defect more serious and difficult.

Again, it has been already pointed out that it is desirable to complete the operation on the lip simultaneously

with the reposition of the median projection; the effect of this more serious step is manifestly to increase the shock to the little patient, who is probably not in the most vigorous condition of health from its inability to take nutriment in the usual way, and at any rate renders the occurrence of primary union less likely. This fact may perhaps explain the much higher death-rate after operation amongst German surgeons than in this country. The prominent condition of the under lip (Fig. 75, p. 147) can be remedied later on by excising a V-shaped portion from its centre, resulting in marked improvement to the facial expression, especially in patients operated on after infancy.

To my own mind the disadvantages of the retention of the incisive bone so clearly outweigh the *prima-facie* advantages, that in my practice I have followed the usual course adopted by the majority of British surgeons in removing the bone at the earliest opportunity. By this removal the operation on the lip can be more successfully accomplished, and as regards the profile effect the later introduction of a dental plate with artificial incisors will greatly improve the appearance, and enable the patient to bite in a satisfactory manner, far more so, in fact, than with the mobile os incisivum.

After removal of the bone and union of the lip, the approximation of the maxillæ to one another has been repeatedly observed and accurately noted. Whether this is due to the insensible pressure of the united lip or to increased osseous development is a matter of but slight importance; probably both agents contribute to this desirable effect. If, however, the maxillæ are considerably drawn together, the "bite" or dental adjustment between the upper and lower jaws becomes uneven, *i. e.* the upper teeth fall within the lower so that during mastication, side-to-side movements of the mandible, as seen in horses and cows, become needful.

After the child has recovered from this preliminary opera-

tion of extirpation of the incisive bone, and the raw surface left by its removal has cicatrised, the soft parts of the lip are then dealt with. This cannot be well undertaken before the tenth to the fourteenth day. The operation, so far as the lateral segments are concerned, should be carried out according to the principles enunciated for the single harelip opera-

FIG. 54 A.

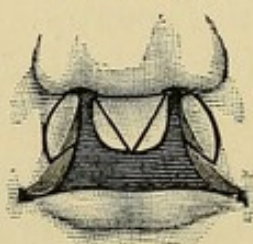


FIG. 54 B.

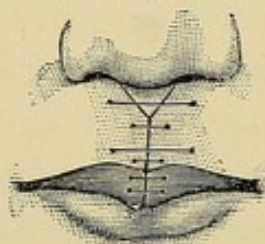


FIG. 54.—Author's incisions for double harelip. The central tubercle is pared in a V-shaped manner, and the lateral segments by curved incisions from above down to the muco-cutaneous junction, and then obliquely upwards and inwards. Only the apex of the central portion is included in the completed lip. The long cross lines represent the position of the wire stitches, and the short ones of the catgut sutures.¹

tion. A free detachment of the lip from the maxillæ by undercutting should be the first step, and this must be accomplished thoroughly in these bilateral cases. The edges will then require preparation by curved incisions made from above downwards as far as the muco-cutaneous junction, and then prolabial flaps are formed by cutting upwards and inwards at an angle of 60° to the preceding (Fig. 54 A).

The treatment of the central part of the upper lip demands special notice. In the first place it is quite evident that to attempt to draw it down to any extent between the flaps would have the effect of depressing the point of the nose and producing an unsightly lateral dilatation of the nostrils, for it must be remembered that this stunted portion of tissue represents in most cases not only the central part of the lip, but also the columna nasi. Very commonly there is but

¹ The central portion requires catgut stitches in addition to being transfixed by the upper wire.

little more tissue than will suffice to form a columna. Though thus deficient in length it is often broader than is necessary, and may subsequently require further operative treatment to reduce it to a shapely size (p. 148); otherwise it encroaches too much upon the nostrils, and is very unsightly. Consequently it is only the extremity of this philtrum which needs preparation, and this is effected by cutting it into a V-shape, the raw margins thus exposed being carefully implanted between the edges of the lateral flaps at the upper part (Fig. 54 A). Wire stitches are now passed; the upper one should traverse the apex of the V, and other fine catgut sutures should be used for accurately adjusting this central portion. The outer segments can then be brought together in the median line in the manner previously described in the operation for unilateral harelip (Fig. 54 B).

Several other operations have been suggested, and notable amongst them are those of Sédillot and Mr. Thomas Smith. The former devised a cheiloplastic method of remedying this double deformity, the incisions for which are shown in the accompanying engraving (Fig. 55). Flaps *aa* consisting of the outer margins of the clefts are turned down to form the

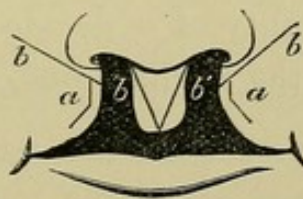


FIG. 55.—Sédillot's operation for double harelip.

aa. Prolabial flaps to form red margin of lip by union in middle line. *bb*. Incisions below alæ nasi to permit approximation of the above. *b'b'*. Incisions in sides of central tubercle. (*Mason*.)

red border of the completed lip, and united in the middle line, whilst oblique incisions are made upwards and outwards to free the outer segments. The central tubercle is pared, leaving raw surfaces (*b'b'*), to which are applied by suture

the surfaces (*bb*) made by the oblique incisions. I cannot but think that the objections stated above to a similar plan suggested for single harelip are equally valid as regards this method (p. 91), viz. that the nasal distortion is less easily remedied by this plan than by the free under-cutting of the segments which I invariably practise.

The latter operation (T. Smith's, Fig. 56) is only adapted



FIG. 56.—T. Smith's operation for double harelip. The outer segments are pared and the parings removed. Prolabial flaps are turned down from the sides of the central tubercle. Evidently it can only be of use where the soft tissues are abundant. (*Mason.*)

to those rare cases where the soft tissues of the central tubercle are abundant. He turns down marginal flaps from this central part and implants them on prepared surfaces of the outer segments. The apex of the philtrum thus forms the central part of the united lip; hence there must not only be a tendency to depression of the point of the nose, but also great probability of a decided notch subsequently manifesting itself in the median line, when cicatrisation is complete.

CHAPTER VI.

OPERATIVE TREATMENT OF CLEFT PALATE.

Period of operation.—Preparation of patient.—Anæsthesia.—Duties of the assistant.—Instruments.—Description of uranoplasty; of staphyloraphy.—After-treatment.—Complications.—Modifications of operation.

THE period of life at which an operation can be safely undertaken for Cleft Palate is a matter which demands careful consideration. Before the introduction of anæsthesia the assent of the patient was required, and therefore the operation was seldom performed before the age of puberty. With the aid of chloroform this is obviated, and we can now operate at an earlier period; undoubtedly as regards the subsequent power of articulation the earlier the operation is performed the better. On the other hand, the palatal tissue in infant life is so delicate, and the cavity of the mouth so small that a plastic operation is attended with more than usual difficulty. Further it is almost impossible to keep an infant sufficiently quiet to allow of primary union, as it is constantly interfering with the stitches by pushing the tongue against the wound, and sucking the edges apart. Statistics of results, moreover, tend to prove that such operations conducted on young infants are not only directly dangerous to life, but also indirectly, by depressing the general vitality and increasing the liability to subsequent disease. Thus Ehrmann¹ records ten cases operated on under two

¹ Ehrmann, "Des opérations plastiques sur la palais chez l'enfant," Cong. Franc. de Chir. 1888, p. 462.

years of age with two deaths, two failures, and six cures, which latter he considers due to the fact that the children were fed after the operation by œsophageal tubes passed through a protective plate of hardened rubber so as to prevent interference with the sutures. Of these six cases cured, only one was living after four years had elapsed, and in this the soft palate only had been closed. He considers that the loss of blood, and the shock of the prolonged operation or operations interfered in a serious manner with the vitality of the patients. These are, perhaps, somewhat scanty facts to argue from, but they tend to show that there is a greater risk associated with operations performed at an early period of life, although we have the authority of many well known surgeons for attempting them. Thus Billroth has operated at the age of four weeks, Roye of Lausanne at eight days ; but my own experience is certainly in favour of deferring operation until the child is at least three years old, or as soon after that period as possible if it is at all of a tractable disposition ; the moral control at this age is usually sufficient for our purpose.

As to whether the whole cleft should be dealt with at one operation or not, the practice of surgeons differs considerably ; and indeed each case needs to be decided upon its own merits. Where the cleft merely involves the soft palate, or possibly extends but for a short distance into the hard, one operation will usually suffice ; but in extreme cases of complete cleft of the hard and soft palate with wide separation of the edges, it may be advisable to deal at different times with the hard and soft, some preferring to close the hard at the first operation, and others the soft. This must depend upon the surgeon's confidence in himself and in his patient. Personally I always prefer, if practicable, to obtain union in the hard palate at the first operation ; then if after taking the necessary steps for loosening the muco-periosteal flaps the

parts appear to come easily together, the edges of the whole cleft can be pared, and the whole process completed at one sitting. I cannot too strongly insist on the paramount importance of obtaining firm union in the anterior part of the palate, for if the smallest opening be left in that situation, distinctness of speech in after-life will be seriously impaired.

PREPARATION OF PATIENT.

The state of the health and the local conditions of the mouth, nose, and pharynx must be carefully examined before the operation is decided on.

The little patient's general condition must be as satisfactory as possible, and a course of tonic preparatory treatment (including possibly a change to the seaside) is often advisable. Sources of infection from measles, &c., should be carefully avoided, and for a few days prior to the operation they should be kept under observation and at rest, to prevent any likelihood of catarrhal developments.

The local conditions, too, must be satisfactory. There should be no excessive secretion from the naso-pharyngeal mucous membrane, as such is usually associated with an œdematous infiltration of that structure, most unfavourable to the attainment of primary union; and, moreover, this excess of mucus tends to insinuate itself between the edges of the flaps. If present, it should be treated by rest in a warm mean temperature, bland diet, and the application locally of gargles of boracic acid and chlorate of potash, combined with the careful use of astringents such as tannic acid and alum; the tongue also should be clean. The state of the tonsils should be looked to, and when greatly enlarged they ought to be previously removed, for they may materially interfere with the union of the palate, either from their size,

or from the possible supervention of inflammation ; when only moderately enlarged there is, I believe, no necessity for their removal ; on the contrary they subsequently assist in closing the aperture between the nose and mouth during speech. Similarly post-nasal adenoid growths should not be interfered with, unless absolutely necessary (p. 70).

For the *immediate* preparation of the patient it is advisable that the bowels should be moved the day before operation, that no food be administered for at least six hours previously, and fluids only for some hours prior to this.

The patient should be placed on a suitable narrow table in such a position that the light falls well into the mouth. Where practicable, a graduated head piece capable of being raised and lowered, in order at one time to throw the light on the soft, and at another on the hard palate, is desirable ; but in private houses this is usually attained by a due adjustment of pillows. To prevent any sudden movement on the part of the patient the hands should be fixed to the side, and my usual method of accomplishing this is to pass a leather strap around the thighs immediately below the trochanters, and to this the wrists are attached by means of leather bracelets locking on to the circular strap by spring hooks. This plan of fixing the arms enables the patient to be turned from side to side to allow blood to pass out of the mouth when respiration becomes embarrassed by an accumulation in the pharynx. If the patient is strapped down to the table, this cannot be accomplished, and the plan just indicated will be found of great practical value. For it must not be forgotten that the anæsthesia is not always so deep as to prevent sudden reflex movements of the hands, which might jerk the operator's knife and cause serious mischief.

To obviate the dangers arising from the flow of blood into the pharynx and larynx, it has been recommended by Prof. E. Rose of Berlin to operate with the head hanging over the

end of the table, thereby causing the blood to gravitate into the nose. I have only adopted this suggestion in one or two instances, but in those in which it was tried considerable congestion of the vessels of the head was produced, and the administration of the anæsthetic interfered with. A skilled assistant should to my mind render such inversion unnecessary.

ANÆSTHESIA.¹

The importance of efficient anæsthesia during this operation is so obvious that a few suggestions as to the best means of obtaining and maintaining it will not be out of place. First, as to the choice of an anæsthetic, the conditions of the operation are such that chloroform seems the only agent which is conveniently applicable; our patients moreover are generally children, and with such at any rate it may be safely used. It has been recommended and practised by some to produce initial unconsciousness by the administration of the A. C. E. mixture, ether, or nitrous oxide gas, and then to maintain it with chloroform. This plan is quicker, and supposed to be safer, but on either plea the gain, if any, is so slight as to render the extra complication undesirable.

As to the method of administering chloroform, the old plan of soaking a piece of lint or towel with the drug and applying it closely to the air passages until anæsthesia is produced ought by no means to be followed in these days of advanced knowledge. It is well known that more than 4 per cent. of the vapour of the drug is dangerous, and hence a safer method must be employed. All plans requiring the introduction of nasal or buccal tubes are undesirable. The best method is that recommended and always followed in the

¹ Many of the points alluded to under this heading are obtained from an excellent paper furnished me by Mr. G. L. Cheatle, late Surgical Registrar to King's College Hospital, who has had considerable experience in such work.

practice of my colleague, Sir Joseph Lister. The corner of a well-starched towel fixed into a hollow oval by a safety pin, sufficiently long to extend from the glabella to the point of the chin, is kept continually moist by chloroform from a drop-bottle.

It is held close to the face without actually touching it; and when complete anæsthesia has been induced can be held out of the way of the operator, and yet sufficiently near for the patient to be still affected by the drug. Any opportunity of inserting this adaptable mask into the region of the mouth must be always taken advantage of by the anæsthetist, so that as little delay and inconvenience as possible may be experienced.

During the operation a strict watch must be maintained upon the respiratory functions, so that any laryngeal obstruction may be readily noticed and treated. The colour of the pinna of the ear, the mobility of the tongue, if unrestrained by a gag, and the condition of the conjunctival and pupillary reflexes assist in giving useful indications for an increased or decreased administration when the patient's face is obscured by hands, instruments, or congealed blood.

When the conjunctival reflex is absent, and the pupil dilated and unaffected by light, the anæsthetic should be temporarily suspended.

When the conjunctival reflex is absent, the pupil contracted, and the colour good, the patient is in the best condition of anæsthesia, and this state should be maintained, if possible, throughout.

When the conjunctival reflex is present together with dilatation of the pupil, movements of the tongue, and other "reflex" efforts, the amount of chloroform should be increased.

During the first stage of the operation, when hæmorrhage is profuse, deep anæsthesia is undesirable for fear of blood passing into the larynx. To prevent this, after the incisions

have been made, sponge pressure should be applied, and the head turned on one side. Any gurgling in the throat, or dusky colour of the face, indicating threatening laryngeal obstruction by blood-clot, needs an efficient application of a sponge on forceps behind the tongue, the effect of this being not only to remove blood, but also to stimulate closure of the glottis. The bleeding having been arrested, and the later stages of the operation reached, a deeper anæsthesia is necessary. Sudden increase or decrease of the amount of the anæsthetic will readily induce vomiting, and if much blood has been swallowed in the earlier stages, this *contretemps* may be inevitable in spite of all precautions.

DUTIES OF THE ASSISTANT.

For the efficient performance of the various steps of the operation a skilled assistant is absolutely essential. His duties will consist, first and foremost, in keeping the pharynx clear of blood; secondly, in such dextrous use of sponges as will allow the parts to be clearly seen by the operator; thirdly, in the judicious use of a tongue depressor, when necessary; and fourthly, in exercising a careful supervision over the stitches before they are finally fastened.

For the purpose of clearing the pharynx, he must be provided with a pair of long smooth-nosed forceps (Fig. 61 B), and some small loose pieces of purified sponge; or the sponges may be fastened on pieces of stick about six inches long in such a manner and so securely that the necessary manipulations shall not detach them. The former of these methods is, I think, preferable.

The great art in clearing the pharynx consists in letting the sponge slide over the dorsum of the tongue, and then by a rotary movement of the wrist the clots are entangled upon

its surface and easily removed. In this manipulation the sponge should not touch the palatal structures more than is absolutely necessary, as any friction or bruising of the edges when pared is highly injurious. Vomiting, moreover, is readily excited by too frequent sponging, especially about the uvula and soft palate.

INSTRUMENTS.

An efficient *gag* is one of the most important requisites for a rapid and successful performance of this operation. In the selection of such appliances the choice will lie between those which merely separate the jaws and those which, in addition, command the tongue. The latter are represented by such as T. Smith's (Fig. 57) or Whitehead's gags; but with

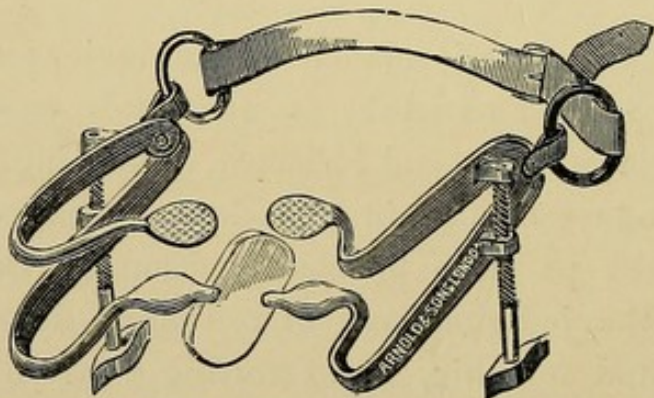


FIG. 57.—T. Smith's gag with tongue plate (*Arnold*).

either the tongue is apt to curl up at the back of the plate which is intended to repress it, and severely embarrass, if not altogether interfere with respiration, necessitating a hurried readjustment. Any gag with a tongue plate is not only more difficult to adjust, but also to remove in an emergency. I am inclined on the whole to think that it is better to leave the tongue free, the assistant depressing it, when necessary, with an ordinary spatula. The apparatus should be as simple as possible, unilateral, and easily moved from one side of

the mouth to the other, and constructed with a minimum amount of metal and projections which might obscure the field of operation, or cause delay by entanglement of the stitches. These conditions are, I believe, fulfilled as nearly as possible in my own adaptation of the late Mr. Francis Mason's gag, generally used by Sir Wm. Fergusson (Figs. 58 and 59). As will be seen from the drawing, the gag is unilateral,

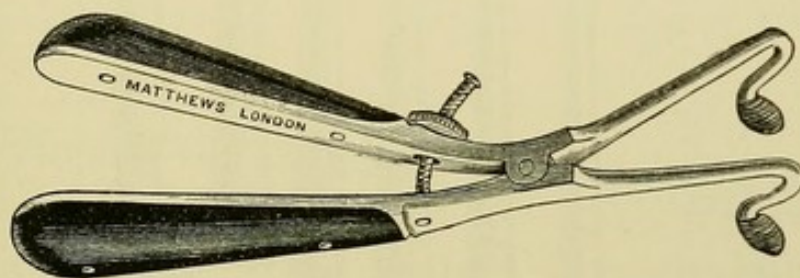


FIG. 58.—Mason's gag.

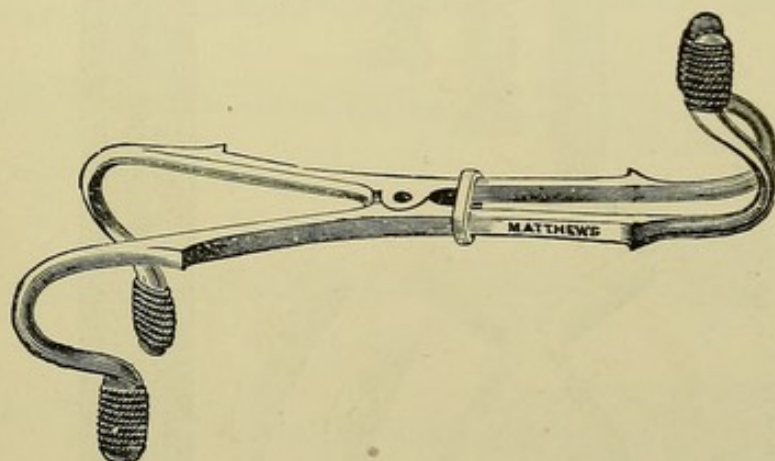


FIG. 59.—Rose's gag, double ended. Large end for adults; small end for children. Sliding ring-catch fixing instrument in position.

provided with a sliding ring-catch easily thrown in and out of position, and so made that by reversing ends it can be used either for an adult or a child. The portions inserted between the teeth are covered with rubber tubing or fine twine, thus protecting them from injury, and in some measure preventing the gag from slipping. I admit that the supervision of an assistant is needed to maintain its position, but contend that this is rather an advantage than otherwise, and

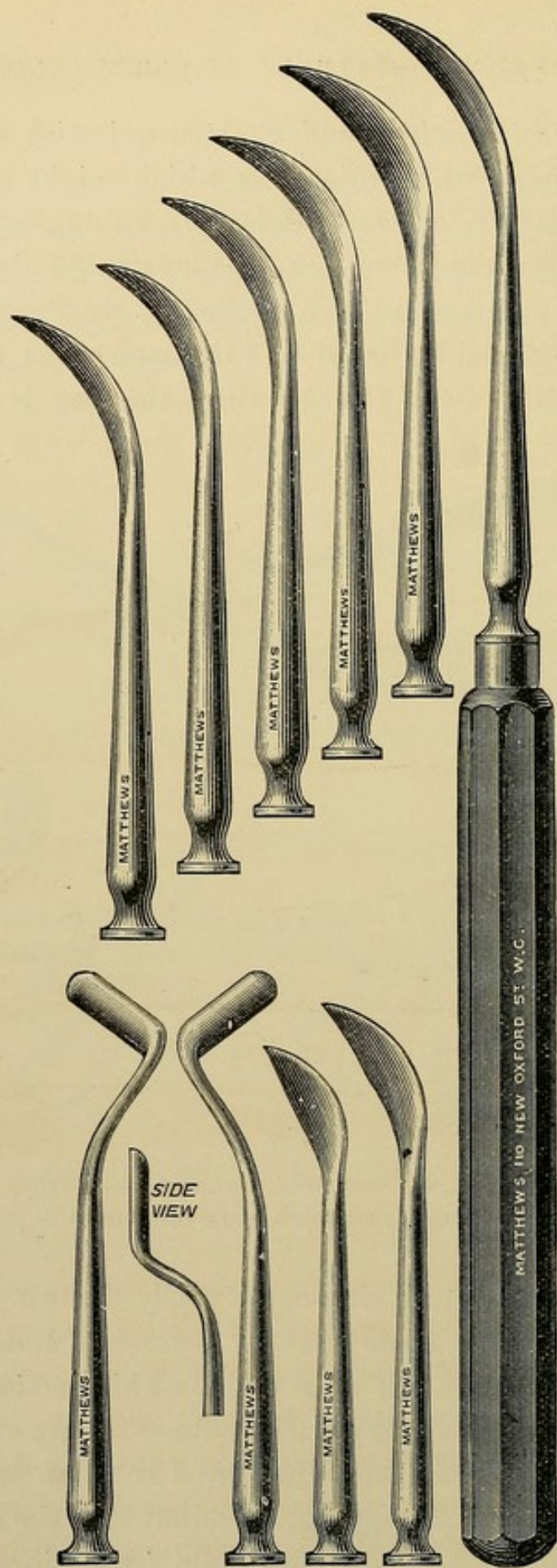


FIG. 60.—Various forms of raspatories employed in detaching the muco-periosteal flaps in uranoplasty. The three in the left-hand lower corner are used for detaching the flaps anteriorly (After *Durham*).

the breathing is less likely to be interfered with. It is inserted closed between the lateral incisors, and is gently pushed back until between the molar teeth, when it is opened to a sufficient extent, and fixed in that position by the sliding catch.

A small scalpel, raspatories of various shapes, right and left-handed (Fig. 60), long smooth-nosed, and fine hooked forceps, and a long-handled, narrow-bladed, very sharp paring-knife (Fig. 61) are necessary. For seizing the edge of the cleft in

FIG. 61 A.



FIG. 61 B.



FIG. 61 C.



FIG. 61 A, B, C.—Fine hook forceps. Long smooth-nosed forceps. Knife for paring the edges of the cleft (*Mason*).

order to remove the mucous membrane therefrom, the surgeon will find the forceps depicted in Fig. 62 extremely useful; they are an adaptation of a pair of German trachelorrhaphy forceps, and possess the following advantages: first, by their angular prehension they can seize the exact edge of the palate, and then when seized, the hold is maintained by means of a spring catch in the handle. It is obvious that a pair of straight hooked forceps (Fig. 61 A) introduced

FIG. 62.

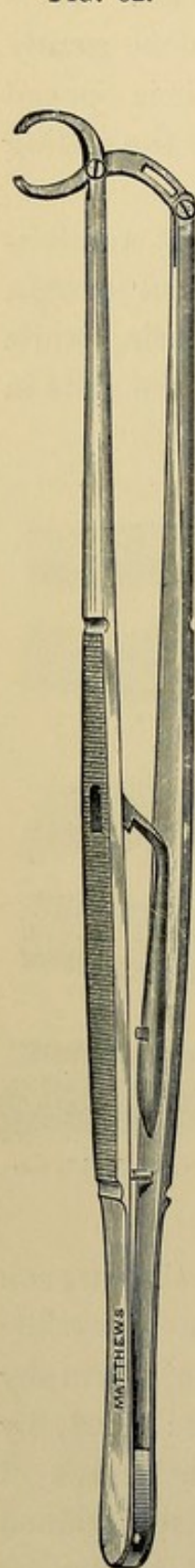
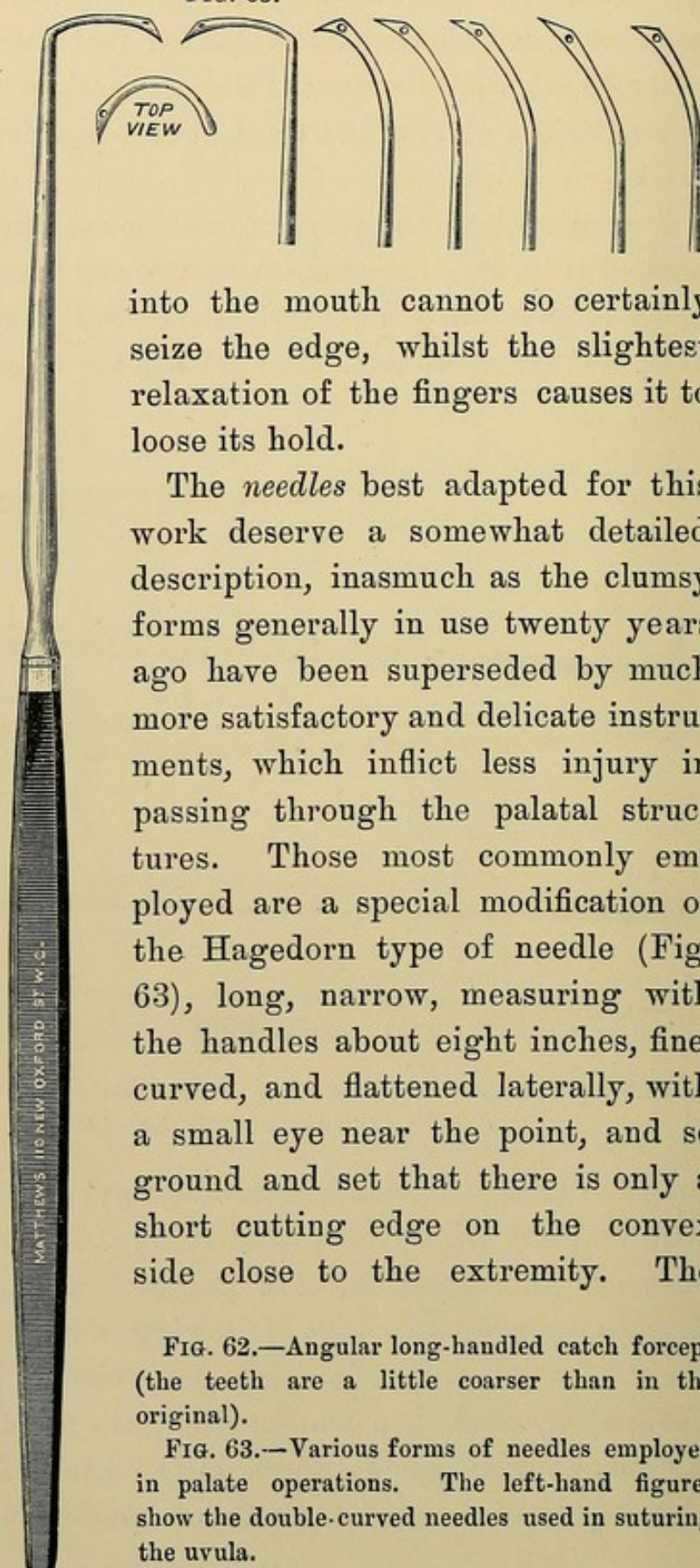


FIG. 63.



into the mouth cannot so certainly seize the edge, whilst the slightest relaxation of the fingers causes it to loose its hold.

The *needles* best adapted for this work deserve a somewhat detailed description, inasmuch as the clumsy forms generally in use twenty years ago have been superseded by much more satisfactory and delicate instruments, which inflict less injury in passing through the palatal structures. Those most commonly employed are a special modification of the Hagedorn type of needle (Fig. 63), long, narrow, measuring with the handles about eight inches, fine, curved, and flattened laterally, with a small eye near the point, and so ground and set that there is only a short cutting edge on the convex side close to the extremity. The

FIG. 62.—Angular long-handled catch forceps (the teeth are a little coarser than in the original).

FIG. 63.—Various forms of needles employed in palate operations. The left-hand figures show the double-curved needles used in suturing the uvula.

advantage of this is that when introduced quite close to the edge of the palate, its blunt concave border directed towards it has no tendency to cut its way out, whilst the convex cutting edge makes a track for the needle and suture to follow. It is manifest that the incision thus made is at right angles to the margin of the cleft, and consequently when the suture is drawn tight, the tendency is rather to close than to open the needle track. With the old needles making as they did in their passage an incision parallel with the edge of the cleft, the tightening of the suture caused the opening to gape, and this occasionally resulted in the establishment of a fistulous aperture leading to subsequent trouble. (Compare Figs. 64 and 65.) Mr. T. Smith emphasised this point as far back as 1868. (*Vide* an interesting paper of his in 'Med.-Chir. Trans.,' vol. 51.)

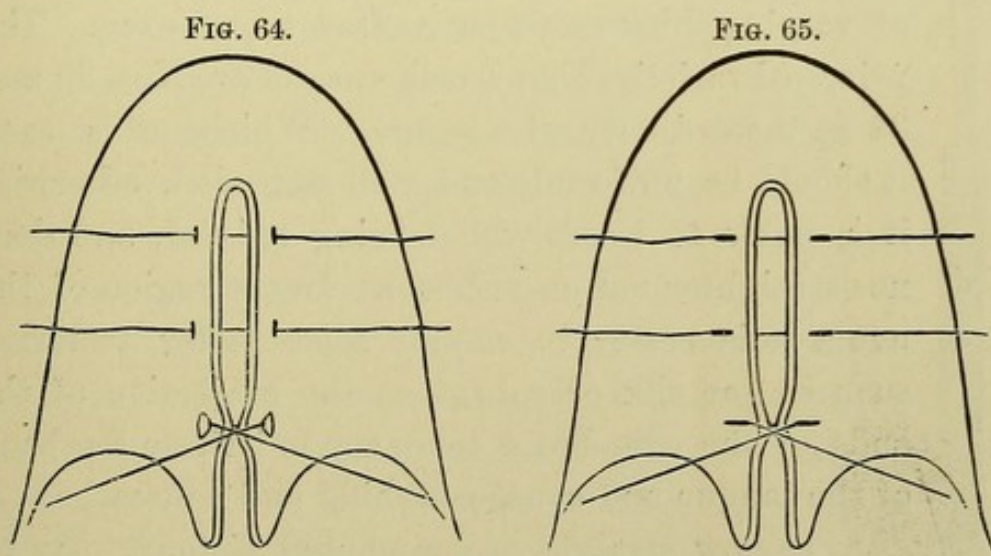


FIG. 64.—Shows effect of drawing stitches together when needles cutting parallel to the edge of the cleft have been used, resulting in an oval opening at the site of each needle puncture.

FIG. 65.—Contrasts the effect produced when needles cutting at right angles to the cleft margin are used. There is no tendency to opening up of the needle tracks, but rather to close them.

With reference to the *sutures*, many different materials have been employed, such as silk, silkworm gut, catgut, horsehair, and fine silver wire. For many reasons the silver wire is to

be preferred; it can be more easily and accurately adjusted to the required degree of tension, and has no tendency to slip; catgut and horsehair are often so springy that the knots are liable to come unfastened. Silver wire is less irritating, and therefore can be left for an almost indefinite period *in situ*; it is incapable of absorbing septic material, and is insoluble in the tissues. The method of introducing the wire stitches is described later (p. 119); the wire twister (Fig. 66) will be found useful for the purpose of regulating their tension.

The thickness of the wire used must vary directly with the delicacy or otherwise of the palatal tissues; the thinner the palate, the finer the wire, and *vice versa*. In different portions of the same palate, wires of varying thicknesses have often to be used. The principal varieties that I make use of are Nos. 30 and 32 on the ordinary wire gauge. Whichever is used, it should be uniformly and well annealed, otherwise it is liable to break whilst being twisted, and does not straighten out on removal. In the region of the uvula it is better to employ some softer material, such as fine silk or catgut, as the projection of the ends of the wire has a tendency to irritate the back of the tongue and cause coughing and nausea.

A narrow straight probe-pointed bistoury may be needed to extend the lateral incisions into the soft palate, in order to relieve lateral tension.

THE OPERATION.

It will be convenient first to describe in detail the technique of the operation in a typical case of combined cleft of the hard and soft palate, *i.e.* the



FIG. 66.
Wire
twister
(Maw).

operations of uranoplasty and staphyloraphy combined, and subsequently indicate the modifications necessary under special circumstances.

The method which is now almost universally employed is that known as Langenbeck's, effecting complete closure by dissection of muco-periosteal flaps obtained from either side of the cleft, and sutured in the middle line. Although called after the great German surgeon, and rightly so, inasmuch as he first clearly enunciated the principles underlying the operation, it is certain that similar plans had been previously employed by others. The late Mr. Avery, of Charing Cross Hospital, seems to have been the first in this country to completely close a cleft in the hard palate, and he employed and described¹ a method very similar to Langenbeck's. This was undertaken in 1848, and in 1853 Messrs. Weiss made improved and special raspatories for the operation. Langenbeck's paper, on the other hand, did not appear until 1862. Previous to this various plans of surgical treatment had been employed. Operations upon the soft palate were undertaken much earlier than upon the hard, and although priority has been claimed both for Prof. Graefe² (1816) and M. Roux³ (1819), who performed staphyloraphy independently, yet it is certain that a similar proceeding had been adopted by others in the latter half of last century. The first reference to a successful case that we possess is in 1760, when a dentist named Lemonnier⁴ united the borders of a cleft in a child. Desault and others record similar cases in the first decade of this century. As regards the hard palate, M. Krimer⁵ seems to be the first who attempted operative treatment (1824); he dissected up small muco-periosteal flaps on either side of the

¹ 'Lancet,' vol. ii, 1852.

² Graefe, 'Hufeland's Journal,' 1816.

³ Roux, 'Mémoire sur la Staphyloraphie,' Paris, 1825.

⁴ 'Mémoires sur différents objets de Médecine,' Paris, 1764.

⁵ 'Dictionnaire de Médecine et de Chirurgie Pratiques,' 1836, vol. xv, p. 19.

cleft, reversed them from without inwards, and united them in the middle line by sutures. M. Beaufils made use of a single flap twisted on itself so as to fill the aperture. Dr. Mason Warren in 1843 published a method of operating which seems in his hands to have been moderately successful, although only after repeated operations. He dissected up the mucous membrane, and freed the soft palate by dividing the posterior pillars with strong curved scissors, and then sutured in the median line. Several methods of "bony suture" have also at different times been suggested. Dieffenbach¹ led the way in 1826, and was followed by many other surgeons, Fergusson and Mason being prominent amongst them in this country. But the results were never satisfactory, and the method has now been entirely superseded by Langenbeck's operation, which is applicable in almost all cases.

It may be divided into four stages :—

Stage 1. Incision, and detachment of muco-periosteal flaps.

Stage 2. Paring the edges of the cleft.

Stage 3. Passage and tightening of sutures.

Stage 4. Relief of lateral tension.

STAGE I.—*Incision and Detachment of Muco-periosteal Flaps.*

The patient being thoroughly anæsthetised, and the mouth held open by the gag, the surgeon, standing on the right side of the patient, commences by making a lateral incision, preferably on that side of the cleft which is opposite to the gag ; it facilitates matters to shift the gag to the opposite side of the mouth when the second incision is made. These incisions should commence a little internal and opposite to the last molar tooth (Fig. 67 A), and should be carried forward parallel to the alveolar margin to a point immediately behind the

¹ 'Die Operative Chirurgie,' von Johann Friedrich Dieffenbach, Erster Band, 1845, p. 856.

lateral incisor, terminating a little anterior to the apex of the cleft, if the alveolus be intact. The knife should be held so that the incision is always perpendicular to the

FIG. 67 A.

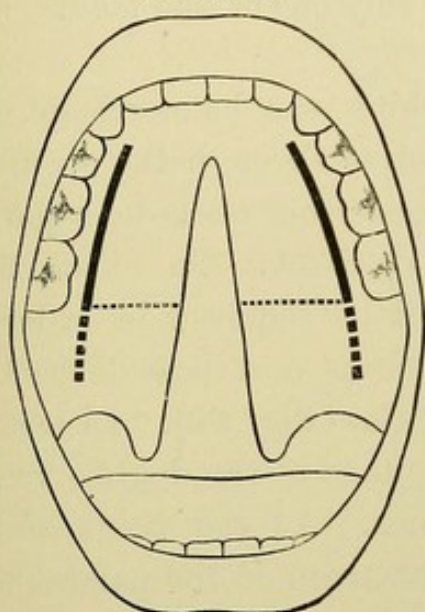


FIG. 67 B.

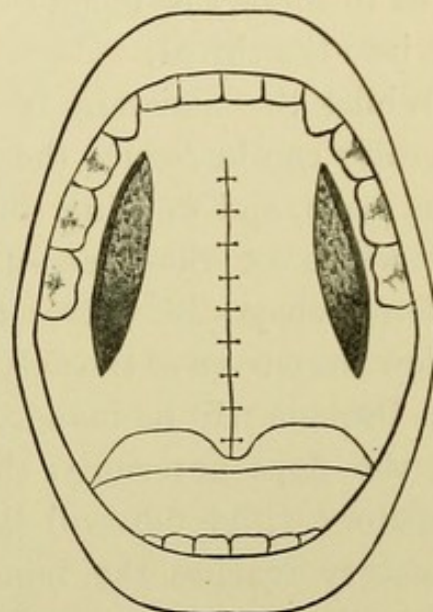


FIG. 67 A.—Diagram to indicate the extent of the incisions in Langenbeck's operation. The thick black lines show the primary incision; the thick dotted lines the extension backwards of the same to relieve any lateral tension (made after the insertion of the stitches); the thin dotted lines indicate approximately the position of the free posterior border of the bony palate.

FIG. 67 B.—Shows the position of the sutures and the condition of the parts at the close of the operation.

varying planes of the mucous membrane, in order to prevent the edge from being bevelled, which may seriously impair its nutrition. All the structures should be cleanly divided down to the bone.

Hæmorrhage, even to a considerable amount, naturally follows, and this should be checked by pressure with purified sponges; it will be much more serious should the palatine arteries be included in the line of incision. The distribution of the anterior and posterior palatine arteries is so variable, and their pulsation so rarely to be felt beforehand, that it is not always possible to avoid wounding one or

other of them. Should this occur, it is important that the vessel be *completely* divided, as a buttonhole in it will cause severe and protracted hæmorrhage. During the bleeding the patient's head should be turned on one side and lowered, so as to allow the blood to run freely out of the mouth and not into the throat.

Whilst the assistant is staunching the hæmorrhage, the operator can introduce the raspatories through the openings thus made, and working them *from without inwards*, separate the whole of the muco-periosteal tissue. To effect this, different shapes of instruments will be required in order to follow the curves of the palatal segments, and those devised by Mr. Durham will be found most useful (Fig. 60). In loosening the flaps anteriorly, the advantage of the double-curved raspatory (Fig. 68) will be obvious. As the point of the raspatory reaches the inner free margin of the palatal segment, the separation of the muco-periosteal flap should be completed by the protrusion of the instrument into the cleft at the junction of the buccal and nasal mucous membranes. This is more readily accomplished if the edges have been previously pared; but it is better to postpone this step until the flaps have been detached, as the raw edges are less liable to be bruised by the sponging, and with the flaps loosened the margin can be pared with greater accuracy. In cases where the vomer is attached to one free edge of the palate (Fig. 11) the junction of the nasal and buccal mucous membrane should be incised to prevent its being lacerated by the raspatory.

The attachment of the soft structures to the hamular process and back of the hard palate must be freely and fully divided. This is a most important and delicate part of the operation, and as the structures are here extremely thin, great care must be exercised. Should this separation be incomplete, the lateral incision cannot be carried down into the soft palate, and the flaps will not come into proper apposition. It

may be attained by the use of a sharp cutting raspatory kept close to the bone, and as regards the hamular process, by a narrow probe-pointed bistoury, or a pair of curved scissors.

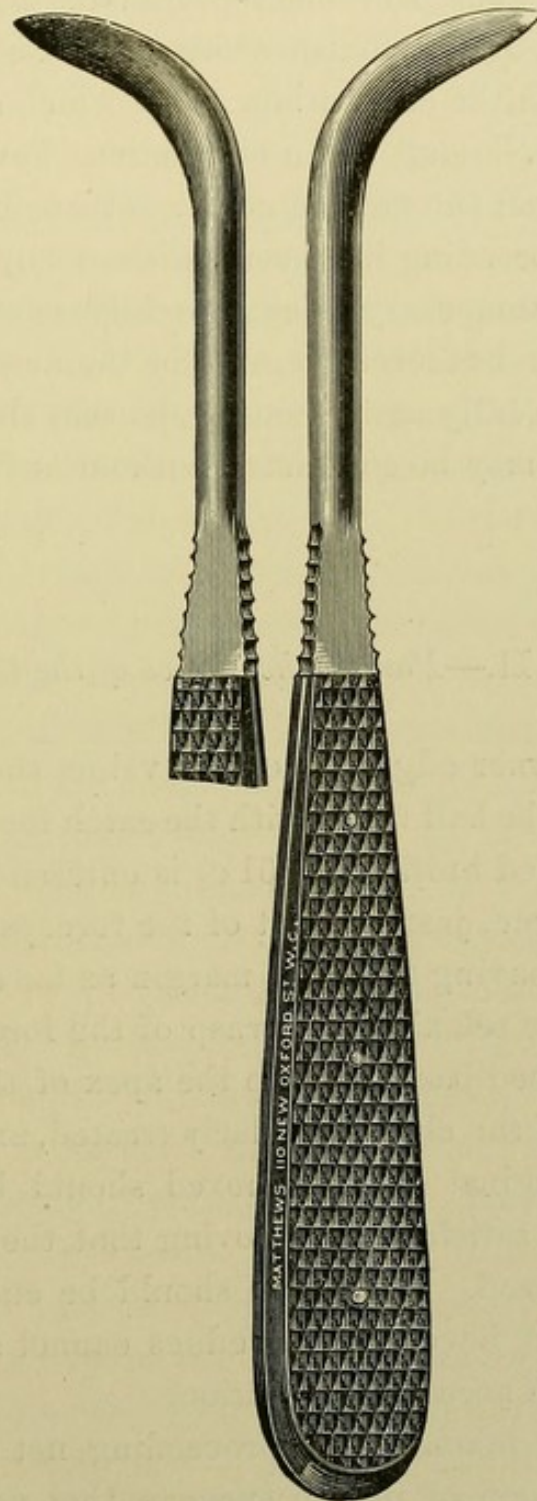


FIG. 68.—Double-curved raspatories for detaching the anterior portion of the muco-periosteal flaps in uranoplasty.

The introduction of the left forefinger into the incision is of great assistance in effecting this with precision and thoroughness.

After detachment the muco-periosteal flaps will often appear blanched or of a bluish-white colour as a result of the interference with the circulation, a fact which has been commented on by M. Trélat. The circulation, however, is soon re-established, and the normal colour returns in a few hours.

When this proceeding has been satisfactorily accomplished on both sides, a temporary delay generally occurs for the assistant to arrest the hæmorrhage, and for the anæsthetist to get the patient more fully under control, so that the second most important stage may be conducted without any struggling.

STAGE II.—*Paring the Edges of the Cleft.*

The extreme inner edge of the cleft velum should be seized near the base of the half uvula with the catch forceps (Fig. 62). The narrow-bladed knife (Fig. 61 c) is entered with the back towards the tongue, just in front of the forceps, and made to cut the merest shaving from the margin as far as the apex of the cleft. Before relaxing the grasp of the forceps, the same process is continued backwards to the apex of the half uvula. The other side of the cleft is similarly treated, and, if possible, the strip of marginal tissue removed should be continuous throughout, thus satisfactorily proving that the whole of the cleft has been pared. This strip should be cut square with the palate, for if bevelled, the edges cannot afterwards be brought into such accurate apposition.

Care should be taken in this proceeding not to contravene the important canon of plastic surgery, that no unnecessary amount of tissue should be removed; for it is most impor-

tant to remember that in these cases, there is no excess of material, and that a too free removal of marginal tissue will lead to increased tension in the united palate, and subsequently to a less satisfactory functional result from defective closure of the posterior nares.

STAGE III.—*Passage and Tightening of Sutures.*

The quickest method and the one calculated to disturb the parts the least is a modification of that introduced and practised by the late Sir William Fergusson, the so-called "loop-method." It consists in the passage of a loop of fine silk through both sides of the cleft, to act as a carrier for the silver wire which is to be the permanent suture. One of the needles already described, previously threaded with a piece of fine silk about sixteen inches in length, so that its ends are equal, is passed from the buccal aspect through the loose flap close to the margin of the cleft (*i. e.* about 2 or 3 mm. from it), and as near as possible to its anterior extremity. To accomplish this it is unnecessary to hold the flap with forceps, as its margin may be seriously damaged. The needle track should be perpendicular to the palate surface, and therefore parallel to the pared margin of the cleft. The silk is then seized close to the eye of the needle with the smooth-nosed forceps introduced within the cleft, the needle withdrawn, and the loop pulled forwards sufficiently to be laid temporarily on the side of the cheek. The same process is repeated at an exactly corresponding point on the opposite side, so that now there are two loops emerging from behind forwards through the cleft. By loosely threading the right loop through the left and gently withdrawing the latter, the former is carried through the flap on the left side (Fig. 69); in this way we have a double thread, with its loop

on the left side and its free ends on the right, passing through the flaps on either side. This process is repeated at intervals of about 5 to 6 mm. throughout the length of the cleft from

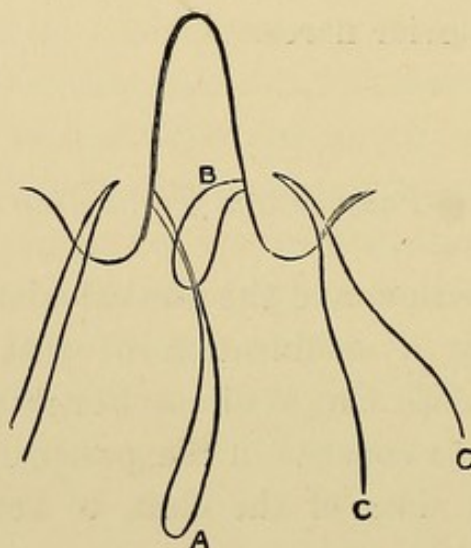


FIG. 69.—Loop method of passing sutures in palate operations. (*Mason.*)

before backwards, until the uvula is reached, the anæsthetist and assistant guarding the loops and ends of the silk by placing their hands on them at the sides of the face. This is especially needed if much sponging is called for, or if vomiting occur. The uvula need not be dealt with until the silver sutures have been tightened.

The silver wire must next be substituted for these loops, and this is effected by taking a six-inch length of the former and doubling half an inch of one end into a hook over the loop; gentle traction on the free ends of the silk will easily draw the wire through into its place. A small piece of sponge lightly dabbed on the edges of the cleft at the point of suture removes any adherent blood-clot or mucus. The ends of the wire are crossed and the wire-twister (Fig. 66) applied, and in this way the suture is tightened until the margins of the cleft lie accurately in apposition, without undue mutual pressure or folding in of the edges; expe-

rience and practice can alone decide the requisite amount of tension. When this has been accomplished, the twisted ends are cut off with scissors, leaving a sufficient length visible to allow of easy removal when necessary. It is better to deal in this way with each wire separately, in order to prevent entanglement or confusion.

To stitch the uvula, a double-curved semicircular needle (Fig. 63) may be advantageously employed, and passed through both sides before withdrawing it; as previously stated, no substitution of wire is advisable (p. 114), but the silk is drawn tight by means of a slip-knot made fast in the usual way (Fig. 70). Two of these silk sutures may often with advantage be inserted in the uvula, but this should be accomplished with the greatest possible delicacy of manipulation, as any rough handling with the forceps may result in bruising, oedema, and subsequent non-union. The sutures, moreover, must be so placed that the circulation in the uvula is not interfered with when they are drawn tight, or strangulation and sloughing may follow.

Although the above detailed process appears very elaborate, it certainly seems to me the best. Other methods are used by many, and amongst these perhaps the most frequently employed is the "direct" method of Mr. T. Smith. In this the needle (Fig. 71) is double-curved and hollow, and the wire which is wound on a drum in the handle of the instrument can be projected at will from the aperture at the point by a movement of the thumb. Different shapes are used for different parts of the palate. The needle is passed from below upwards through one side of the cleft, and without withdrawing it through the other from above downwards; the wire is now protruded from the point of the needle, grasped by forceps, paid out from the drum, and the needle withdrawn as it entered. Mr. Smith's usual practice is to stitch from the uvula upwards, tying each stitch as it is inserted,

and making use of the ends of one stitch to steady the palate whilst introducing the next. The advantage claimed for this method, viz. the saving of time, is more than counter-

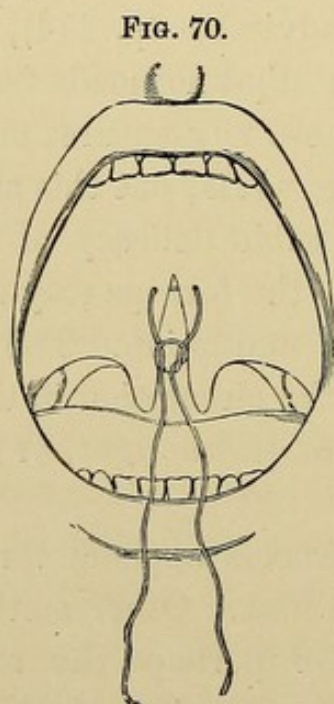


FIG. 70.

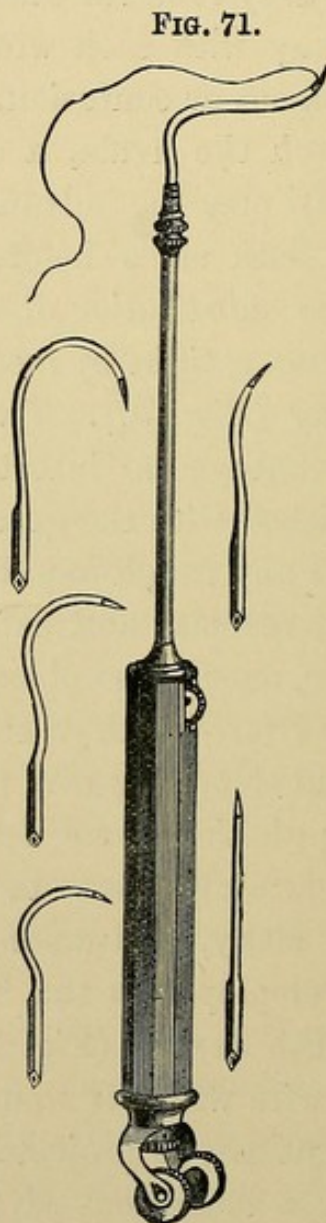


FIG. 71.

FIG. 70.—Method of tying slip-knot for uvula stitch; formerly used in each suture. (*Fergusson*.)

FIG. 71.—T. Smith's palate needle (*Arnold*).

balanced in my opinion by the following drawbacks; first, the strain exercised upon one of the palatal flaps in order to pass the needle through the other; second, the occasional and not infrequent hindrances to the smooth working of the

wire by its kinking; and, thirdly, the difficulty often experienced in seizing the end of the wire.

STAGE IV.—*Relief of Lateral Tension.*

The palate having been thus satisfactorily sutured, the relief of lateral tension and the division of the levator palati have now to be undertaken; for however well the parts may appear to lie, it is never safe to omit this. A narrow-bladed probe-pointed bistoury is introduced through the lateral aperture on either side, and carried directly backwards through the soft palate. It is useful to introduce the left index finger into the lateral opening to ascertain if any fibres of the muscle still remain undivided. This plan was first introduced and practised by Mr. Pollock in mild cases of cleft palate, where the fissure extended through the velum only.

It may not be out of place to notice the method adopted by Sir W. Fergusson for dividing the levator. A triangular-bladed knife set at right angles to a long stem was introduced behind the velum, and the two edges of the angular point made to cut their way between the pterygoid plates down to the bone, so as to divide the muscle close to its origin. From a theoretical point of view this appears all that can be desired; but practically the results following this procedure were not always satisfactory, inasmuch as the tension upon the stitches often appeared to be but little relieved, and one could never tell with certainty whether the muscles were effectually divided or not; in addition to which, unless the surgeon were very skilled in the use of the instrument and the anatomy of the region in which he was cutting, serious mischief might and did sometimes ensue. A knife such as the one to be employed, cutting at right angles to the handle, can never be used with absolute precision,

particularly when the part to be dealt with is out of sight. The ease and certainty with which the structures can be divided by the former method of prolonging the lateral incision backwards have rendered this plan of Fergusson's obsolete, although in his hands it was often very successful.

Should the hæmorrhage from these final incisions made in the soft palate be excessive, steps should be taken to ascertain whether the trunk or any large branch of the posterior palatine artery has been partially divided, as if so the bleeding is liable to recur at intervals, and may become serious. Under such circumstances, complete division of the vessel has almost always the immediate effect of staying the hæmorrhage. Sponge pressure and syringing with iced boracic lotion may be useful adjuncts in arresting the general oozing; but long continuance of the latter is detrimental to the vitality of the flaps and may endanger primary union. For a similar reason, plugging the lateral apertures, or recourse to powerful styptics, such as perchloride of iron, should if possible be scrupulously avoided.

All lateral tension being now relieved, and no serious hæmorrhage continuing, the sutured palate should present a solid, if somewhat blanched appearance in the middle line; the gag can be removed and the operation is complete.

Thus far we have been describing the operative treatment in the severer forms of cleft, in which both hard and soft palate are involved. When, however, the velum alone is cleft, merely the operation of *staphyloraphy* is required. In such cases the lateral incisions need not be of such an extensive character, and are usually made after the edges have been pared, and the stitches passed. It was for this type of case that Mr. Pollock introduced his method of dividing the levator palati by entering the knife through the mucous membrane of the velum a little in front and to the inner side of the hamular process, which can be felt in the mouth just

behind the last molar tooth. The knife is pushed through the substance of the palate, and then by raising the handle and depressing the blade the muscle can be fully divided without making too extensive an incision in front. I should strongly recommend, however, a sufficient incision being made to admit the tip of the index finger, in order to ascertain with certainty that no tense fibres of the muscle remain undivided.

When the uvula alone is cleft no lateral incisions are necessary.

When the cleft extends for a short distance into the hard palate, lateral incisions must be made in the first stage of the operation, extending to a point a little anterior to the apex of the cleft, for the purpose of introducing raspatories to loosen the soft tissues around this point.

In some cases, after the soft palate has been brought together, a certain amount of tension is observed to be exercised upon the flaps by the traction of the muscles in the pillars of the fauces. If this be so, they should be divided by snipping them across with a pair of blunt-pointed scissors curved on the flat. By this means lateral tension is diminished, and the velum can be subsequently more easily approximated to the posterior pharyngeal wall.

MANAGEMENT OF THE PATIENT AFTER OPERATION.

The patient should be placed in bed with the head low and no pillow, so that any oozing or accumulation of mucus, whether from the upper or lower surface, may gravitate into the pharynx; otherwise it may insinuate itself between, and tend to separate the lips of the wound.

A certain amount of shock is frequently observed during this period, and the circulation in the extremities should be promoted by warmth. A shivering fit, scarcely amounting to a rigor, is often observed, but is of no prognostic import-

ance. During reaction, the blood which has been swallowed during the operation is usually vomited; when this occurs early the danger to the palate is not very great; but any vomiting at a later period has a serious disturbing effect, and the greatest care must be exercised in the supervision of the diet and general hygienic surroundings in order to prevent such accidents.

Diet.—It is best to give no nourishment for the first three or four hours, and but very sparingly for the first twenty-four. Iced milk and water, or milk and soda-water, given in small spoonfuls, should be the first food supplied; but after twenty-four hours, when the tendency to vomiting has disappeared, the food should be slightly warm. Milk and water given by spoon or from a feeder at frequent intervals will form the staple article of diet; but if the patient be rather older, strong broths and clear soup may be added. By the fifth day they may often safely take soaked bread, custard pudding or some soft farinaceous food; but no hard substance, liable to damage the newly-formed adhesions, should be allowed for fully a fortnight.

If the patient be sufficiently intelligent, it is advisable that the *mouth* should be gently *washed out*, especially after food, with a tepid weak boracic solution. This is best effected by using it as an ordinary gargle; syringing the mouth I consider to be unadvisable, because the jet if forcible will tend to find its way between the margins of the wound, and hinder union. Some surgeons recommend that prior to fastening the stitches during the operation, the edges of the wound should be touched with a solution of chloride of zinc in order to assist in keeping them aseptic; this is really unnecessary if careful washing of the mouth after the operation be enjoined.

Of course *absolute quiet* is essential, and all attempts at talking must be strictly forbidden. The child should be

closely watched, and any attempt to meddle with the palate should be prevented by tying down the hands, which may be done as a matter of precaution throughout the whole duration of the case with young children, and as a routine during sleep with all patients. If the child is noticed to suck at the palate, or curl the tongue up against it, an effort should be made to divert its attention.

The palate should not be examined too often. The blanched appearance observed at the close of the operation generally disappears during the first few hours, and a moderately injected condition of the mucous membrane with slight swelling of the palatal tissues is a sign that all is doing well. The lateral incisions usually fill with granulations rapidly, and these subsequently cicatrise; the rate of their healing depends on the width of the aperture and on the vitality of the patient.

It is impossible to lay down any hard and fast rule as to the period when the stitches should be removed. In the majority of cases where the course has been satisfactory the stitches in the velum may be safely removed on the sixth or seventh day; those in the hard palate, if causing no irritation, had better remain a little longer. If there is any doubt as to the firmness of the union, the sutures should not be touched till later, as they seldom of themselves give rise to any trouble. It occasionally happens that a child refuses to open its mouth, and renders removal of the stitches without the chance of damaging the palate impossible; an anæsthetic must then be administered.

AFTER-COMPLICATIONS.

In spite of every precaution taken both at the time of the operation and subsequently, it occasionally happens that the process of repair does not proceed satisfactorily.

This is mainly due either to a low state of vitality on the part of the patient, or to the development of some febrile or catarrhal condition, or to a septic contamination of the wound. Cases have occurred in which diphtheria, measles, or scarlet fever have shown themselves a few days after the operation, and, under such circumstances, there is a great probability of complete failure of union, the stitches ulcerating through, and even a portion of the soft palate being destroyed by a necrotic process. Such a result, however, does not necessarily ensue, for in one of my cases good union was obtained throughout the greater part of the palate in spite of an attack of measles.

In the majority of instances where defective union occurs there has been some neglect in the observance of the precautions upon which stress has been laid above. The most common errors are as follow :

a. Inefficient relief of lateral tension. Of late years I have become more than ever convinced of the paramount importance of the use of free incisions, and also that the vascular supply of the palate is amply sufficient to allow of these being made without any danger of sloughing, or of hindering primary union. That sloughing has occurred in the practice of others is undoubted; but this is more likely to have been due to a septic contamination and bruising of the tissues than to the extent of the incisions. I would again refer my readers to what has been already written (p. 118) as to the separation of the palatal tissues from the hamular process, and the complete detachment of the muco-periosteal flaps from the point of junction of the hard palate with the soft, where the tissue is thinner than elsewhere.

b. Defective paring of the edges of the cleft. This probably occurs from want of skill on the part of the surgeon, who fails to remove in one strip the mucous membrane from the margins.

c. Bruising of the edges from careless sponging, or rough manipulation with clumsy instruments. This is particularly liable to occur if the edges are pared prior to the detachment of the muco-periosteal flaps, in accordance with the mistaken directions given in many text-books.

d. Inaccurate coaptation of the edges of the wound, caused either by the stitches not being inserted at exactly opposite points on either side of the cleft, or by bringing the edges together too loosely, or so tightly that they are curled in.

e. Incomplete division of the levator palati will possibly explain some cases of non-union of the soft palate.

f. Want of careful supervision after the operation, and unsuitable food.

g. The occasional occurrence of uncontrollable vomiting or excessive hæmorrhage.

The most frequent situation of defective union is at the point of junction of the hard and soft palate; the tissue here is extremely thin, and laceration is liable to occur during the detaching process.

The apex of the cleft is another likely spot where union may fail; here from rigidity of the tissues accurate apposition is rendered difficult and sometimes impossible, particularly when the deformity is associated with alveolar cleft.

When apertures have resulted from any of the above detailed causes, it is useless to attempt to close them immediately, and moreover subsequent cicatrisation may much diminish their size or even close them entirely. M. Trelat¹ has seen one 9 mm. in diameter thus disappear, and my experience fully confirms such an observation. When, however, the contraction has come to a standstill, the margins may be pared, the lateral apertures reopened, the tissues loosened again from the bone, and the opening closed by as many sutures as may be

¹ Trelat, "Technique des opérations plastiques sur le Palais," *Revue de Chirurg.*, 1886, p. 89.

necessary. Small fistulæ are often cured by the application of lunar caustic or fuming nitric acid.

Occasionally some trouble is experienced in the closure of the lateral apertures, one or both of them remaining patent and threatening to become fistulous. As a rule no anxiety need be entertained on this score. The only case in which I have had trouble was in a severe complete cleft in a young woman of twenty-seven; one of the openings was only closed twelve months after operation by applying nitric acid.

The occurrence of *secondary hæmorrhage* may be of so severe a character as to give rise to great anxiety, and it, as well as the treatment adopted for its arrest, may seriously interfere with the process of repair. Both intermediary and secondary hæmorrhage are met with; the former generally ceases after the application of cold, and seldom requires more active treatment. If, however, it arises from a large vessel such as the posterior palatine, which may have been incompletely divided, the re-introduction of the bistoury to complete the division and allow the artery to retract and subsequent sponge pressure will be necessary. In cases of true secondary hæmorrhage the palate wounds have probably progressed satisfactorily up to the fifth or seventh day, when suddenly there is an alarming gush of blood from one of the lateral apertures, and the patient becomes blanched and faint. The lateral apertures should be at once carefully syringed out, and the source of the bleeding discovered, if possible; the patient should lie with the mouth open and the head supported on a pillow. The use of styptics, such as perchloride of iron, should be studiously avoided, and, if absolutely necessary, I infinitely prefer to use the galvanic or Paquelin's cautery. Some (*e. g.* Howard Marsh) have recommended and practised searching for the posterior palatine canal with a probe, and plugging it with a piece of wood, but of this I have had no experience. Although the bleeding may cease for a time it is liable to

recur; under such circumstances it is best to enlarge the lateral apertures in order to expose the source of the hæmorrhage, which can then be dealt with as needful. Plugging of the lateral wounds should be reserved as a *dernier ressort* for fear of pressing injuriously upon the new vessels in the recent median cicatrix. These plugs, whether of lint, gauze, or sponge, soon become septic and sources of danger, and cannot therefore be long retained, whilst removal is liable to be attended with fresh bleeding.

MODIFICATIONS OF THE OPERATION.

The operation of *osteoplasty* demands a brief notice under this heading. It was first practised by Dieffenbach in 1826, and subsequently revived in 1874 by the late Sir William Fergusson, whom I had the privilege of assisting in some eighty cases.

The principle of the operation consisted in carrying each lateral incision through the bony palate by means of a chisel, and prising the detached portions towards the middle line. Prior to this, however, the edges of the cleft were pared, and sutures were passed through holes previously drilled in the bony margins. The intention was to secure the union of flaps containing bone in the median line. Unfortunately, the results were anything but satisfactory, for in many instances the detached portions became necrosed and set up active inflammation and suppuration, leading to non-union. The bone, moreover, did not always cleave in the desired direction, and although the late Mr. Mason endeavoured to obviate this by punching holes, as a preliminary step, along the line the chisel was subsequently to take, on the postage-stamp principle, the results were not improved. One great objection to this lies in the difference of level which often exists between the two sides of the palate,

especially when the vomer is attached to one margin. It is then excessively difficult to get the detached segments accurately together, whereas in Langenbeck's operation the muco-periosteal flaps drop readily into position. Consequently, this method of osteoplasty has long since fallen into disuse.

In cases where the vomer is attached to either side of the cleft with a wide gap and scanty tissues, Mr. T. Smith has suggested the utilisation of the mucous membrane covering the vomer as a means of bridging the cleft. He incises it in a direction parallel to the edge, and at such a distance above the palate margin as is thought advisable; detaches it from above downwards by a hooked vaspatory, and stitches it to the pared margin of the opposite side. Owing to the extreme delicacy of the membrane in this situation and the tendency it has to curl up, the success of this manoeuvre is not always to be assured.

Mr. Davies-Colley has recently published¹ an account of an operation for which, indeed, he does not claim superiority over the usual method of closing ordinary clefts in the hard and soft palate, but which, he urges, should be adopted in the following contingencies—(1) for infants, (2) when the ordinary operation has failed, and (3) when the cleft in the hard palate is very wide. It consists in dissecting up a triangular muco-periosteal flap from one side of the cleft and entirely detaching it anteriorly, its base being at the junction of the hard and soft palate. On the other side a raw surface is prepared for its reception by reflecting a longitudinal flap of muco-periosteum in such a way that it can be turned as on a hinge into the cleft, and maintained in position there. The loose flap is then planted on it, and fixed by sutures. A bridge is thus formed across the hard palate consisting of a double muco-periosteal flap. The advantages claimed for this operation are less hæmorrhage, double thickness of flap, no loss of tissue, absence of tension,

¹ 'Brit. Med. Journ.,' 1890, ii, 950.

and that upward pressure of the tongue is more likely to do good than harm, whereas in Langenbeck's the reverse is the case. There are obvious disadvantages, in particular that the hard palate is alone united, and that a foramen at the front part of the cleft usually remains; and although in Mr. Colley's hands it may be occasionally successful, it scarcely appears to be one adapted for general use. As to its applicability in the case of infants, it is probably a procedure not devoid of risk, inasmuch as no operation can be safely undertaken in the majority of cases before the age of three years. The reader is referred to p. 101 for my reasons for this. When an operation has failed, it is surely more advisable to attempt closure of the whole cleft by repeating Langenbeck's method rather than by a proceeding admittedly incomplete at first and requiring further treatment. When the cleft is wide anteriorly, it must be conceded that ordinary uranoplasty is often not sufficient to effect at one operation complete closure, and an anterior opening is not unlikely to persist, a condition, however, which Mr. Colley's operation in no way prevents. My own practice, under such circumstances, is to obtain union as far forward as possible at the first operation, and to deal subsequently with the fistula by a modification of the same proceeding.

When a triangular opening has been left in front, owing to absence or previous removal of the *os incisivum* with the maxillæ more or less widely separated by a gap which extends anteriorly to the mucous membrane of the lip, it is often impossible to bring the edges of the cleft together however freely the raspatory is used, and many plans have been devised to meet this very definite difficulty.

Some surgeons have detached one muco-periosteal flap anteriorly, and so been able to bring it across the cleft and stitch it to the opposite side. But the interference with the vascular supply to the apex of the flap, and the rapid shrinkage which is apt to take place, frequently make matters

worse than before. My experience of this plan has not been satisfactory.

Another method that I have recently employed with partial success consisted in reflecting a flap of mucous membrane from the back of the upper lip, and turning it down into the gap, fixing it laterally to the refreshed margins by fine wire sutures. Even if complete union does not take place, the portion thus reflected forms a *point d'appui* for later plastic interference.

It has also occurred to me to try the effect of cutting through the alveolar process immediately external to the canine tooth; that is, instead of detaching the palatal flap anteriorly to continue the lateral incision forward through the bony alveolus and after partially detaching this to prise it towards the median line. This proceeding is practically a modification of Fergusson's osteoplasty, but differs from it inasmuch as there is little fear of necrosis on account of the spongy and vascular state of the alveolus. In the performance of it, after the palatal flaps have been detached by the raspatory, I incise the gum vertically along the line indicated, that is, continuing the lateral incision forward external to the canine tooth; a notch is then made with a small saw, and a chisel inserted cuts through and sufficiently detaches the portion of the alveolar process contiguous to the palate. The edges are now carefully freshened, and, if necessary, on the bevel, so as to allow for the slight rotation which occurs in drawing them together. Sutures are passed through the soft tissues deep enough to gain a firm hold of the flaps, so that when twisted they do not cut their way out in spite of the traction which is exercised. Care must be taken to pass the stitches in such a manner as to prevent undue rotation of the detached portions, otherwise the raw edges will not come into proper contact. Having at present given this plan but a limited trial, I do not wish to speak too confidently in its

favour. Should such operative proceedings fail, an obturator should be fitted to the aperture.

Many other methods have been from time to time suggested as accessories to the ordinary operations of uranoplasty and staphyloraphy, and some of these need a cursory notice. Passavant stitched the halves of the velum to the posterior pharyngeal wall by an operation, known as "staphylo-pharyngoraphy." Schönbein and Trendelenburg suggested "staphyloplasty" as an improvement, *i. e.* taking a flap of mucous membrane from the posterior pharyngeal wall and stitching this to the hinder wall of the velum. Both these operations aimed at totally shutting off the nose from the mouth; but in practice this was found to be not only uncomfortable, but also injurious. Smell and hearing were both interfered with, and breathing could only be carried on through the mouth; actual inflammatory troubles followed, which necessitated the communication being reopened.

Von Mosetig Moorhof attempted to improve upon these operations by allowing a fistula to remain at the position of the anterior palatine canal, which could be filled with an obturator by day to prevent the objectional nasal twang, and at night could be left open for breathing purposes.

Still more heroic are the operations which have been undertaken for the closure of palatal clefts by tissue taken from the face. Only three such cases, are, I believe, on record and of these two were for acquired deformities, and but one was for a congenital deficiency.

Blasius operated in a case where both the nose and the palate had been destroyed, by dissecting up a flap from the forehead attached to a long pedicle. This he easily twisted down into the mouth owing to the absence of the nose, and stitched into the gap. Success, however, did not follow from the drying effect of the double current of air. The same method was tried on the cadaver by Nussbaum, who

demonstrated the possibility of drawing the flap through a slit in the nostril into the mouth and fixing it there ; but he never had the opportunity of operating upon the living subject.

Professor Thiersch in 1868 successfully closed a hole in the hard palate, the result of a gunshot injury. He chiselled away the alveolar process, and turned in through this a flap consisting of the whole thickness of the cheek, its base being close to the nose.

Rotter records a third instance.¹ It was in a case of very wide right-sided harelip with cleft palate, in which Langenbeck's operation had been successfully performed in so far as union in the middle line was concerned but the left palatine process was so nearly vertical that a lateral cleft half an inch in breadth resulted. This was repaired by a modification of Blasius' operation. A long cutaneo-periosteal flap was taken from the forehead ; the raw under-surface was grafted and allowed to heal entirely before being placed *in situ*. To accomplish this it was merely necessary to draw it through the still unclosed harelip to pare the edges of the flap and of the cleft, and to fix with sutures the former within the latter. When united firmly, the pedicle was divided, and the harelip closed. A good result followed, and was maintained two years later.

Such procedures can only be necessary in exceptional cases. Permanent scarring of the face is always to be regretted, and Langenbeck's method or some slight modification of it, carefully and skillfully carried out, should meet nearly all contingencies. There is an instance recorded by Wolff² where the whole of the right-sided flap in a case of uranoplasty became gangrenous, leaving a wide opening which, however, was successfully closed subsequently by a repetition of the same process.

¹ Rotter, 'Munch. Med. Wochensch.,' 1889, xxxvi, p. 535.

² Wolff, 'Berl. Klin. Wochensch.,' 1889, p. 577.

CHAPTER VII.

ON OBTURATORS AND ARTIFICIAL VELA.

BEFORE the year 1830, when operative treatment for the closure of cleft palate first attracted attention, and began to be recognised as a legitimate surgical procedure, the only means of alleviating the troublesome symptoms resulting therefrom was by the use of artificial mechanical appliances; and in spite of the increased safety and certainty, the outcome of increased knowledge, with which such operations are now performed, the use of these has not been entirely superseded, and in America they are still much in vogue. These appliances are called obturators or artificial vela according to their position and function in the mouth.

“An *obturator* is a stopper, plug, or cover, stationary, and fitting to an opening, with a well-defined border or outline, and closing the passage.

“An *artificial velum* is an elastic moveable valve, under the control of surrounding or adjacent muscles, closing or opening the posterior nares at will, and applicable to cases of congenital cleft, occasionally when the soft palate has been destroyed by ulceration, but never merely to perforations of the hard, or soft palate.”¹ Such are the Utopian definitions given by American dentists.

It may be interesting to pass in review some of the ingenious appliances which have been from time to time suggested, and to indicate some of the various steps in the progress of their production.

¹ ‘Amer. Syst. of Dentistry,’ vol. ii, p. 1056.

It is evident that the ancient Greeks were acquainted with some means of closing or remedying acquired or congenital defects of the palate; but nothing is known definitely of the method adopted. In the year 1565 Petronius, in his work '*De Margo Gallico*,' proposed to close the opening by wax, cotton, or with a gold plate adapted to the curve of the palate; but in all probability this was no new suggestion. Ambrose Paré, in his book on Surgery, published in Paris in 1579, translated into English in 1649, suggests that the cavity should be covered over by a gold or silver plate, "made like unto a dish in figure, and on the upper side which shall be towards the brain, a little sponge must be fastened, which when it is moistened with the moisture distilling from the brain will become swollen and puffed, so that it will fill the concavity of the palate, that the artificial palate cannot fall down, but stand fast and firm, as if it stood of itself." A modification of this was suggested shortly after by Isaac Guillemeau, who, to increase the accurate adaptation of the obturator, proposed a "packing" of sponge or lint around the edges of the apparatus. At the beginning of the eighteenth century, Garangeot, in his '*Treatise on Instruments*,' proposed to fix the sponge, which was placed above the obturator in the nose, by passing through it a screw stem, arising from the upper surface of the plate, and screwing a nut down upon it; evidently trouble had arisen in some cases from the nasal sponge becoming liberated, and retained in the nose.

In this country, Wiseman, Sergeant-Surgeon to King Charles II, suggested the accurate filling of the cleft with a paste composed of myrrh, sandarac, and a number of other ingredients; but as to the means by which this was to be maintained in position we are left in ignorance.

The discontinuance of the nasal sponge seems to have first occurred to Astruc, who, in his '*Treatise on Syphilis*' (1754),

replaces it by a silver button attached to the upper surface of the obturator in order to avoid the unpleasantness arising from the absorption of mucus. This was soon followed by another suggestion emanating from M. Pierre Fouchard (1786), who describes a silver obturator with an arrangement of metallic wings, worked into position after introduction through the opening by means of a hollow stem and nut, which, when screwed down, kept the wings covered with soft sponge across the aperture. The introduction of "elastic gum" as a suitable substance to be used in the restoration of the velum and uvula was the next step in advance; this was utilised in 1820 by M. De la Barre, who devised some very clever, but extremely complicated pieces of mechanism. Thus far it appears that no particular precautions had been taken to secure the accurate fitting of the apparatus; but in 1828 Snell drew attention to the necessity of obtaining an accurate model of the mouth, and his results, in consequence, were much more satisfactory. Since that period various instruments have been devised and used with more or less success; but in this work it is unnecessary to do more than mention the names of Stearns, Kingsley, Sercombe, Ramsay, Oakley Coles, and Wolff as being authorities on the subject, and to indicate some of the plans adopted.

The obturators employed in recent days have been much simplified, and practically have been reduced to a simple plate fixed in the roof of the mouth by an arrangement similar to that employed for ordinary dental plates, *i. e.* attached to one or more of the teeth. This is a great improvement on the old form of "plug" obturator, which by its constant pressure had the effect of increasing the size of the opening.

Artificial vela are always somewhat complicated, and that success will attend their use cannot be assured. They consist of a vulcanite or gold palate plate fastened to some of the teeth, and of a moveable flap attached to it by a hinge and

spring of suitable strength (Figs. 72 and 73), or simply of a rubber flap sewn to the posterior margin of the plate (Fig. 74). These vela either rest above the palatal segments, or their sides can be grooved to allow the palatal segments to fit into them. It is very difficult to obtain an artificial

FIG. 72.

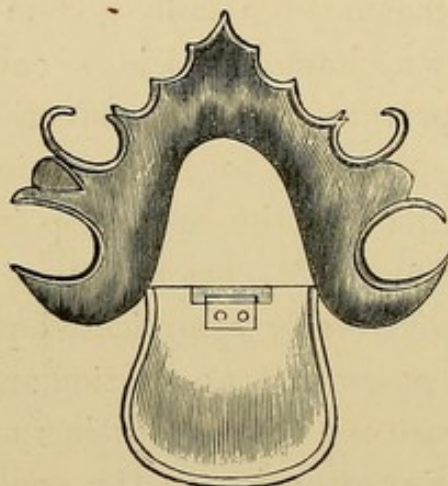
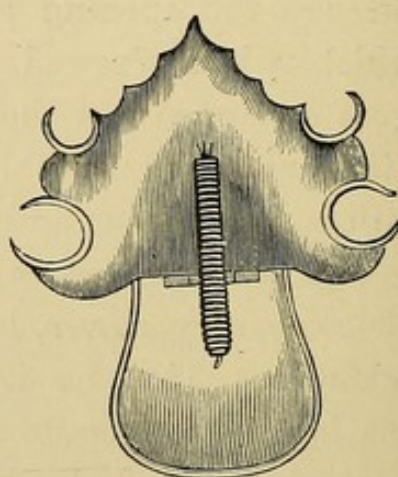


FIG. 73.



FIGS. 72 AND 73.—Figures of artificial velum as seen from below and above, consisting of a metal palate plate with a velum hinged to it, and supported above by a spring of suitable strength. (Coles.)

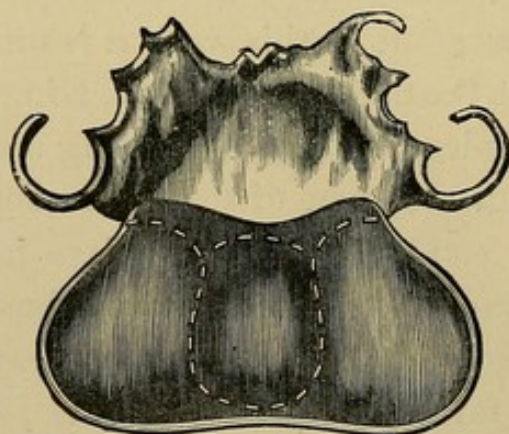


FIG. 74.—Another form of artificial velum. (Coles.)

velum sufficiently strong to retain its position, and yet light enough to allow of its being easily moved by the displaced and probably weakened muscles.

In 1864 Dr. N. W. Kingsley, of America, suggested for this purpose the use of soft india rubber of such delicacy as

to resemble the normal velum as nearly as possible. The rubber was arranged in two layers, one of which rested above and behind the cleft, and the other overlapped for about half an inch all the margins of the cleft seen from the front. This amount of overlapping was found sufficient to prevent the apparatus from becoming displaced during muscular contraction, and at the same time by its means allowed the palate muscles to effect closure of the posterior nares.

Mr. Baker, in the 'Boston Medical and Surgical Journal,'¹ describes a velum consisting of rubber distended with water, which was fixed with a hinge to the back of the palatal plate, and under the control of the muscles by being inserted above them on either side. A stop prevents it falling too low, and the posterior extremity is almost semi-circular to allow of perfect apposition with the pharyngeal wall, which is drawn forward by the superior constrictor. He claims to have met with much success.

Wolff and Schiltsky have devised a similar apparatus, but use air instead of water for distending the hollow rubber velum.

The main arguments that have been adduced in favour of the use of artificial substitutes for the palate rest upon the fact that until recently the results of operative interference in severe cases of fissured palate were often very unsatisfactory; in most, if not all, an aperture was left anteriorly, which caused the speech of the patient to remain indistinct. But with the greater success which has followed increased experience and practice, this cause can be eliminated; and, moreover, secondary operations for the attainment of this object can always be undertaken with every prospect of success. Another objection raised to operation is that no immediate improvement takes place in the power of clear articulation;

¹ Baker, 'Boston Med. and Surg. Journ.,' 1889, p. 212.

and although this is perfectly true, the patient is in the same condition in this respect as when first provided with an obturator, and will require the same educational process for the improvement of speech. Again, the mental effect on patients operated on is much more satisfactory than that following the application of artificial assistance; whilst the presence of a foreign body in the mouth is a source of continual danger and irritation; for there is always the possibility of the obturator slipping out of position and becoming impacted in the pharynx or œsophagus. Irritation of the sides of the cleft not uncommonly results from their use, and may end in ulceration and even necrosis. When obturators and vela are removed from the mouth, a spongy granulating surface is often seen, bleeding on the slightest touch, and giving rise to a peculiar foetor of the breath. Under these circumstances a temporary discontinuance of the apparatus becomes necessary, a most undesirable and unpleasant contingency.

Again these appliances cannot be fitted to a patient much before the age of fifteen, and the habit of defective articulation has been fully formed by that time. They also need constant renewal, and are thus a source of continual expense, putting them beyond the reach of hospital patients.

In spite, therefore, of the optimistic arguments so boldly maintained by our American dental confrères, and of the successes they claim to have attained by the use of these artificial means, I am driven to the conclusion that in the majority of cases of cleft palate operative interference, followed by a suitable educational course, will give results incomparably superior to these, and unattended by the above-mentioned disadvantages.

But whilst strongly maintaining the superiority of the treatment by operative rather than by mechanical means, I will readily grant the greater applicability of the latter in

certain conditions ; viz. in acquired defects of the palate, the results of syphilis, traumatism, or surgical operations involving extensive loss of tissue—as, for instance, after excision of the superior maxilla : obturators are almost invariably the only means by which these apertures can be closed. In cases of congenital cleft where the os incisivum has needed removal, leaving a broad anterior opening the closure of which by operation is often impossible (p. 135), the application of an obturator is similarly advisable ; and one suggests this method of treatment the more readily from the ease with which it can be effected, inasmuch as it merely necessitates an extension backwards of the plate which carries the artificial incisors. The communication between nose and mouth is thus effectually closed, and the functional success of previous plastic work and subsequent educational efforts ensured.

In cases of hopeless deformity, where the palatal tissue is so attenuated that operative interference is impracticable, the recourse to artificial assistance is inevitable ; but such cases are fortunately rare.

CHAPTER VIII.

RESULTS OF TREATMENT—AFTER-TREATMENT.

THE typical result which we desire to gain after an operation for harelip is a symmetrical appearance of lip and nose, and a normal contour and projection of the parts as seen from the front and in profile. The cicatrix should be practically invisible, and the red margin of the lip continuous throughout. Unfortunately, however, in many cases these results are not easily attainable. The tip of the nose tends to become drawn down and depressed, especially when in double harelip the philtrum is poorly developed, or when a mistaken attempt is made to incorporate it between the segments of the lip. This stunted but thickened columna encroaches on and obstructs the anterior nares, whilst in unilateral cases the aperture on the affected side is apt to become dilated and distended from the absence in some instances of the osseous floor, but also from subsequent cicatricial contraction of the previously divided bands between the cheek and maxilla. The behaviour of young cicatricial tissue, moreover, is not always the same. In some young and feeble children it remains vascular for a long time, and at first tends to stretch and become more evident;¹ subsequently contracting, it may leave an indurated cord-like ridge. In addition to this, a longitudinal contraction takes place in direct proportion to the thickness of the

¹ This is more likely to happen if the stitches are removed too soon from loss of their support.

cicatrix, reducing the length of the scar and the depth of the lip, thus bringing about the **V**-shaped notch in the lip margin, and assisting in the dilatation of the nostril.

In double harelip, where the os incisivum has been removed, it has already been mentioned that the upper lip sinks back, the lower lip projects forwards, and the profile resulting therefrom becomes very unsightly (Fig. 75).



FIG. 75.—Profile of a case of double harelip after operation with removal of the os incisivum, showing the falling in of the upper lip and the prominent projection of the lower. (*Coles.*)

Many of these defects may be remedied by subsequent treatment. I am frequently in the habit of advising and practising secondary operations for the improvement of the facial expression in young children and adults presenting the unsatisfactory cicatrices detailed above. The operation comprises not only the removal of scar tissue, but also the obliteration of the **V**-shaped notch, elevation of the depressed nose, and the diminution in size, if necessary, of the nasal aperture. For a simple **V**-notch without other complications, I have sometimes made use of Nélaton's operation (Fig. 48) with most satisfactory results.

The narrowing or partial obliteration of the nostrils in double harelip from the large size of the columna has sometimes to be remedied subsequently. One plan which I have practised several times for reducing the breadth of the columna is by excising a central lenticular-shaped portion, extending nearly the whole length through its entire thickness, and closing the gap with sutures. But a simpler method consists in paring the edges of the columna on either side to the required dimensions, and allowing the raw surfaces thus formed to cicatrise. The redundant tissue should be removed on the inner or nasal aspect, so that when cicatrisation takes place the skin is drawn round into the nares, and the resulting scar is unobtrusive.

The falling in of the upper lip after the operation for double harelip, when the os incisivum has been removed, can best be remedied by the adjustment of a plate carrying the required artificial incisors, and furnished with a central cheek-plate to restore the natural profile. Where the lower lip projects unduly in spite of the above-mentioned artificial adjustment, it may be requisite to reduce its size by the removal of a **V**-shaped portion from its centre. This is so easily accomplished as to need no detailed description; suffice it to say that the greatest care is needed in the accurate application of the sutures.

I cannot conclude this portion of my subject without mentioning the manual and mechanical aids which may be beneficially employed for the improvement of the mobility and appearance of the face and nose after such operations. The under-cutting of the integuments of the lip and cheek, and the subsequent cicatrisation involved, necessarily lead to a certain amount of rigidity of the parts. This can be remedied in a great measure by persistent gentle manipulation of the lip and cheek, care being taken always to press the parts towards the median line. This should be carried out by the mother or nurse daily after due instruction. A slight de-

pression or collapse of the nostril on one side can be improved by the use of an apparatus supplied by Messrs. Hawksley, consisting of a head-band across the forehead, to which are attached vertical stems ending in smooth bulbs, which, by rack and pinion movement, can be so adjusted as to press the nostril into the desired position. The apparatus can be worn at night and for a certain time during the day.

The conditions which are essential to a complete success after plastic operations for cleft palate are as follows: complete closure of the cleft with no fistulous communication in any part of the line of union, and a velum capable, when necessary, of being approximated to the posterior pharyngeal wall so as to shut off the nasal cavity during speech and deglutition. That this is not invariably attained is an undoubted fact, and in spite of the merest shaving being removed when paring the edges of the cleft, the velum when united is frequently so scanty as to be unable to fulfil this condition. To remedy this, it was proposed some years ago by the late Mr. Mason to loosen the soft palate by lateral incisions, passing downwards and backwards through the free border, thus relaxing the tension, and allowing it to be drawn upwards, when requisite, into relation with the pharyngeal wall. I have adopted this plan in several cases, but with only transient success, inasmuch as the subsequent cicatrization of the incisions neutralises the temporary benefit derived. The division of the pillars of the fauces, however, is occasionally needful and more satisfactory. This has been already alluded to (p. 127), and may either be performed at the time of the first operation, or subsequently if found to be necessary.

Even in cases where the tissue is abundant, and the united velum loose and moveable, the immediate effect on the speech is not always satisfactory. The other advantages of the operation (*e. g.* exclusion of nasal mucus from the mouth, prevention

of regurgitation of fluids through the nose, improvement in taste and smell, and the psychical effects) are immediately apparent; but speech is a more complicated proceeding, and the first result of the operation is often to dislocate the mechanism which the patient had formerly made use of in its production, and hence, as has been often noticed, speech and voice may be temporarily deteriorated, even after a successful operation. This is a disappointment both to the patient and friends unless they have been previously warned. A subsequent thorough educational course at the hands of a professional voice-trainer, if possible, is therefore most important.

In some instances tension of the velum is no doubt the cause of the persistent nasal twang, but in many others habit is the principal factor, and this can alone be got rid of by a suitable education. The reluctance to breathe through the mouth, and the unwillingness to open it sufficiently during articulation, are conditions very liable to persist after operation. Such patients also speak too rapidly and run the words into one another, the velum evidently not being under control. The most difficult letters to pronounce are *t*, *b*, *d*, *k*, *g*, *s*, *z*, and *l*. The best means of dealing with the defective breathing is to make the patient undergo a course of "respiratory gymnastics." Thus he should be made to practise deep abdominal breathing with the mouth wide open; he should stand in front of a looking-glass, and breathe with his mouth open and his tongue voluntarily depressed. He should next repeatedly exercise the movements of his tongue and lower jaw; this is often productive of great improvement in the facial expression. These exercises should be followed up by others directed to the improvement of speech. The distinct production of the various vowels and consonants and of all the sound combinations must be a matter of daily practice. He should be made to speak and read aloud according to the recognised laws of elocution, and by so

doing obtain proper modulation of the voice and fluency of speech. Compression of the nasal apertures during these exercises is also advantageous.

The physical condition of the hard palate after the operation of uranoplasty is a subject of considerable interest. Langenbeck¹ claimed that a new formation of bone really occurred about three or four weeks after the operation, and attained in time considerable solidity. From experiments, however, by M. Marmy on the palates of dogs, doubt was thrown on the correctness of this assertion; and M. Ollier, so well known as an authority on subperiosteal work, declares that "if there may be doubt as to the ossification, all must admit that it forms a very resisting surface, which has the strength and takes the place of bone." Opportunities for post-mortem investigation do not seem to have been taken advantage of for deciding this question; but clinical experience seems to indicate that no new bone is actually formed, the central portion of the palate consisting merely of dense fibro-cicatricial tissue covered with mucous membrane. In operating after a lapse of several years for the closure of oval apertures in the hard palate in patients in whom a previous operation had been but partially successful, I have never found osseous tissue, either when paring the margins or when detaching the flaps through lateral incisions.

The shape and size of the alveolar arch are sometimes considerably affected as an after result of uranoplasty. It would appear that in the young the contraction of the cicatrix between the palatal segments and of the new tissue in the lateral openings exercises a narrowing influence on the transverse diameter. The alveolar borders approach one another, and this approximation is most marked at the level of the first or second bicuspid, and indeed is so great occasionally as to produce an obvious incurvation of the alveolar ridge. M. Ehrmann

¹ 'Archiv für klin. Chir.,' vol. v, 1, p. 3.

of Paris, has investigated many instances of this change, and from his work¹ the figures mentioned below are obtained.

In one case a child was operated on for total cleft at three and a half years. Six months later the following measurements were taken :

Transverse interval between canines	.	.	.	13 mms.
"	"	1st molars	.	18 "
"	"	2nd "	.	26 "

At twenty-three years of age the following were the measurements :

Transverse interval between canines	.	.	.	7 mms.
"	"	1st premolars	.	13 "
"	"	2nd "	.	19 "
"	"	1st molars	.	23 "
"	"	2nd "	.	32 "

The alveoli here formed a reversed V, and when the patient spoke, the tongue was more or less protruded. In another case, operated on at five years of age for the palate defect, a double harelip having been treated at an earlier date, the measurements were—

		At 5 years.	At 6 years.	At 11 years.
Intervals between canines	...	23 mms.	19 mms.	12 mms.
"	1st premolars...	27 "	24 "	14 "
"	2nd "	32 "	27 "	19 "
"	1st molars	—	—	23 "

This result is more frequently seen in the severer forms of cleft palate associated with double harelip, especially where the os incisivum has been removed. Extreme youth increases the tendency to the production of these deformities, which may become troublesome, not only by interfering with the size of the buccal cavity, and so causing protrusion of the tongue during speech, but also by interfering with the "bite," necessitating lateral movement of the jaw during mastication.

¹ Ehrmann, "Des opérations plastiques sur le palais chez l'enfant; leurs résultats éloignés," 'Cong. franç. de Chir.,' 1888, p. 462.

In one of Ehrmann's cases an actual increase of the interdental diameters was found; this was one in which Fergusson's osteoplasty had been performed with complete success; possibly the formation of new bone from the callus produced led to this, or it may have been merely an evidence of normal growth. The measurements were as follows:

				At 3 years.	At 11 years.
Intervals between canines ...	...	...	...	24 mms.	26 mms.
„ 1st premolars ...	...	...	...	26 „	29 „
„ 2nd premolars ...	...	...	...	29 „	32 „
„ 1st molars ...	...	...	...	—	34 „

CHAPTER IX.

SYPHILITIC AFFECTIONS OF THE PALATE.

THIS small work will not be complete without some allusion to the destructive effects of syphilis upon the hard and soft structures of the palate, resulting either in loss of substance of the velum, or in the production of apertures which of necessity impair its functions in the same way as do congenital deformities. They occur at different stages of the disease, but mainly in cases which have been neglected, and of which the treatment has been unsatisfactory.

In the *secondary* period the most common manifestation of this disease in the palate is, in its mildest form, simply a moderate injection of the mucous membrane, similar to the roseola seen on the skin. It is situated mainly on the velum and anterior pillars of the fauces, and under efficient treatment soon disappears. Severer manifestations are, however, met with, from the mucous plaque, with its resulting "snail-track" ulcer, to the most serious forms of destructive change. Such severe forms occur usually towards the close of the secondary period, and in persons of vitiated constitution. The process starts in the neighbourhood of the uvula, and involves the velum and pillars of the fauces; the mucous membrane and submucous tissue become hyperæmic and infiltrated with the products of inflammation, and the hyperplasia may be such as even to suggest the presence of epithelioma. Ulceration soon follows, and if the disease be extensive the patient's condition may become serious from the difficulties experienced

in deglutition and respiration. The loss of substance may extend to a variable depth, and subsequent cicatrisation tends more often to produce pharyngeal stenosis than to leave permanent apertures in the velum; as a result, speech becomes indistinct, and the act of swallowing is much interfered with. In many of these cases the primary sore has been intentionally or accidentally overlooked, or no treatment adopted.

In the *tertiary* stage the disease usually commences as a gummatous infiltration of the periosteum of the hard palate, resulting in an inflammatory swelling which softens and breaks down, the mucous membrane over it giving way; portions of the bony palate are thrown off at a later date with the discharge, in the form usually of "crumbly" spongy sequestra of variable size. This process often extends beyond the palate to the bones of the nose, to the walls of the antrum, and to the alveolar border of the superior maxilla. After cicatrisation has taken place, apertures of varying extent are left bounded by dense fibro-cicatricial tissue, which in some measure tends by its contraction to diminish the size of the opening. Clear articulation is impossible under these circumstances.

Similar conditions occur in *inherited* syphilis, leading to destruction of the bony palate, but in these cases the disease usually extends downwards from the nose.

The *treatment* of these affections need not here be discussed in detail so far as regards the general means to be adopted. What we are chiefly concerned with is the question as to the possibility of surgical interference with a view to closing the apertures, so as to improve the speech and increase the patient's comfort by preventing the regurgitation of fluids from mouth to nose, and the descent of nasal mucus on to the tongue. The result, however, of the experience of all surgeons tends to prove that in the majority of cases any operative interference is worse than useless, and is likely to increase existing mischief.

The chief reasons for the want of success are (1) that so much loss of substance has already occurred; (2) that the tissue dealt with is cicatricial, and consequently of low vitality; and (3) that the constitutional condition of such patients is extremely unfavorable for plastic work. Although I have myself repeatedly attempted the closure of apertures in the hard palate, I cannot recall a single case in which complete success was attained when the operation was performed on middle-aged individuals. On the other hand, small holes in the soft palate can in many instances be successfully dealt with, and I should not hesitate to attempt the closure of a small opening in the hard, provided that there was a reasonable prospect of gaining sufficient tissue to be brought together without tension after paring the edges, and that no external manifestation of local or general disease was present. When any such operation is decided on, the only hope of success consists in an absolute freedom from all tension, gained by extensive lateral incisions.

The application of lunar caustic or nitric acid for the purpose of closing small foramina is of doubtful utility on account of the feebleness of the tissues dealt with.

In most instances, therefore, we are compelled to have recourse to the use of obturators, and these are now made to accurately fit the opening without undue pressure on the sides. Two discs of india-rubber united by a central stem generally answer the purpose satisfactorily, and a plate may be worn fixed to one or more of the teeth. In hospital patients a piece of sheet india-rubber, which they fit for themselves, and maintain *in situ* by suction, is a cheap and efficacious contrivance.

ADDENDUM.

RECTAL ANÆSTHESIA.

THE plan of inducing anæsthesia *per rectum*, which has recently been brought before the profession in this country by Dr. Dudley Buxton, was originally suggested by Pirogoff in 1847, ether being the agent employed; but the introduction of chloroform in 1848 led to the disuse of ether in any way for many years. More recently Pirogoff's suggestion has been resuscitated, and made use of by Bull, Weir, and others in America, Ollivier and Molière in France, by Iversen and Wancher in Copenhagen, and by Dudley Buxton in this country. The last-named anæsthetist recommends an apparatus (supplied by Mayer and Meltzer) consisting of a receiver for the ether, which is placed in water at about 120° F. The vapour thus given off is conducted by a $\frac{3}{4}$ -inch rubber tube, about four feet long, through a specially constructed interceptor to prevent any liquid ether bubbling into the rectum, and enters it by an anal tube. A special device maintains sufficient pressure upon the perineal pad to prevent the escape of flatus or ether from the bowel. Anæsthesia may be induced from the first in this manner; or, as a preliminary step, chloroform or ether may be given by inhalation in the usual way, and the rectal administration subsequently relied on. The disadvantage of this combined method is the difficulty of judging when the absorption by the rectum is sufficient to be trusted alone; otherwise the patient may regain partial consciousness, and struggle. When the rectal plan only is

used, the patient is often twenty or thirty minutes becoming unconscious, although ether may be smelt in the breath within five of its commencement. There is no excitement or struggling, and fewer after-effects. Care must be taken to regulate the amount of ether used, or abdominal distension and rectal catarrh may result; particularly is this the case if the operation be protracted. The method may prove of value, when properly employed, in operations involving the tongue, lips, pharynx, larynx, palate, jaws, &c. There are, however, obvious dangers in connection with its use, and unfortunately these fears have been realised in America by the combustion of the vapour leading to rupture of the bowel and other disastrous consequences.

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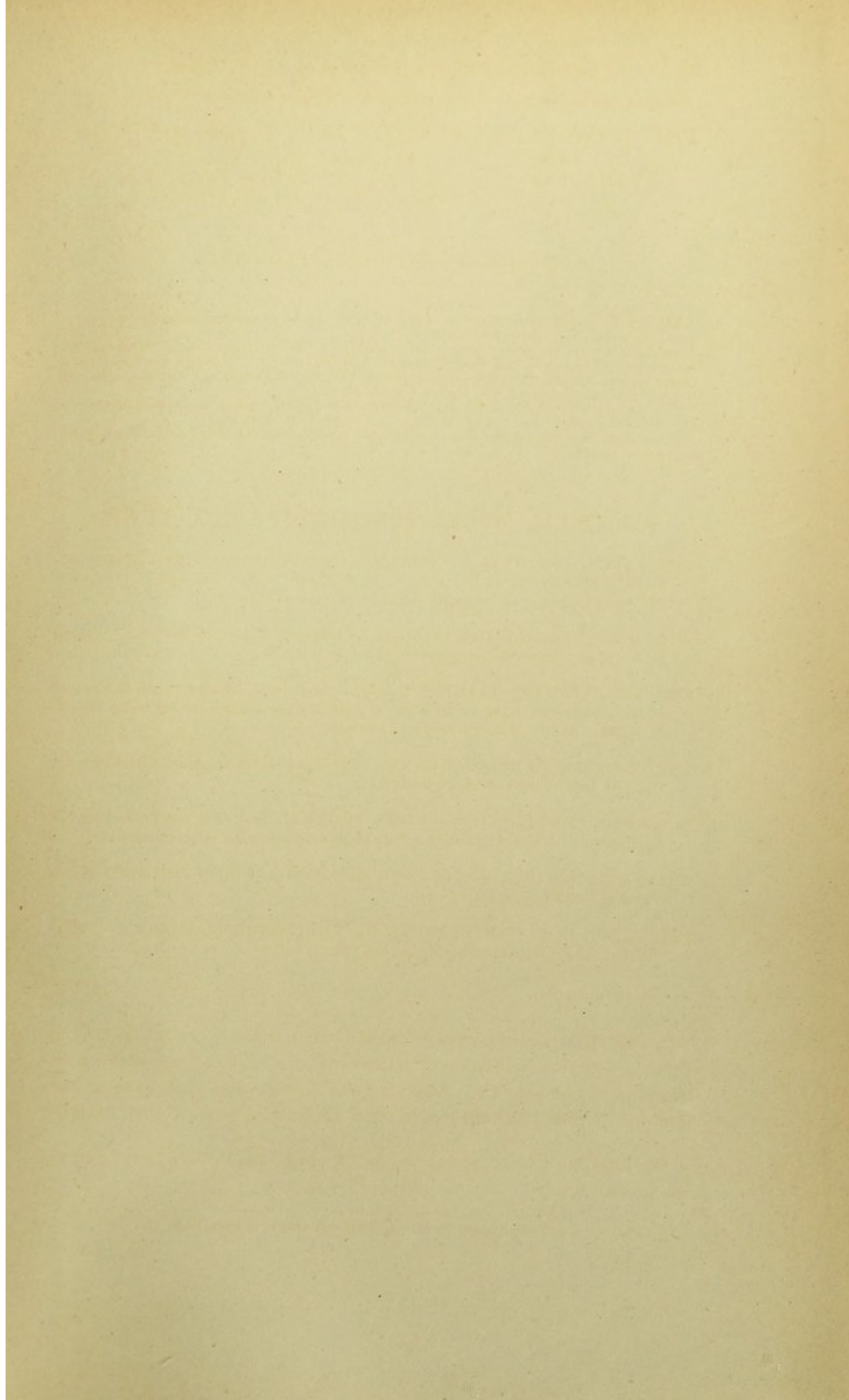
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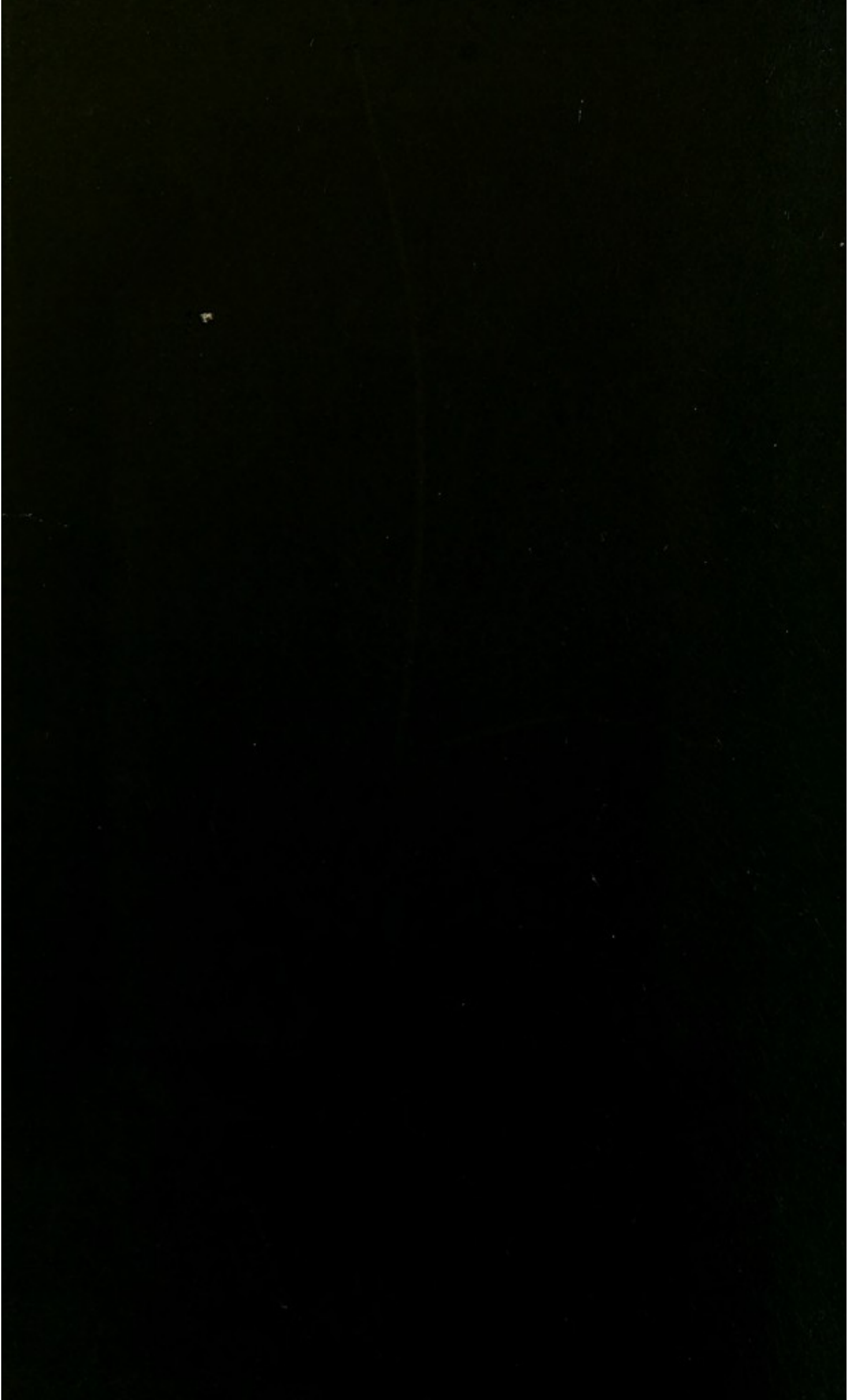
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