**On the use of the sutures in the bones of animals / [Benjamin Gibson].**

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IN THE

## Bones of Animals.

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ON THE

# USE OF THE SUTURES

IN THE

# SKULLS OF ANIMALS.

THE full use of the singular junction of the bones of the skull which is called Suture, has, from the earliest periods of anatomy and surgery, attracted the attention and eluded the researches of the physiologist. To this remarkable feature in osteogeny, in a great measure peculiar to a certain period of life, many uses have been attributed. Some of these are totally erroneous; such as that for allowing the transpiration of moisture, to keep the brain cool and fit for thinking; for giving a more strict adhesion of the *dura mater* to the inner surface of the skull; for admitting a more free communication by blood-vessels between the external and internal parts of the head; or for affording interstices, that the

bones may be pushed asunder by the growth of the brain, lest that organ should be cramped in its growth, in consequence of the comparatively slow growth of the bones of the skull.

Other uses attributed to the Sutures are merely slight advantages derived from their structure, which are enjoyed in early infancy, or till adult life, but gradually cease after that period. Thus at the time of birth the loose union of the bones of the skull accommodates the shape of the head to the figure of the different parts of the cavity through which it passes. At adult age, when the sutures are fully formed, they may occasionally check the progress (if I may be allowed the expression) of a fracture nearly spent ;—or vibrations, communicated to the bones of the skull, will be propagated with less force to the brain, in consequence of the bones being separated at the sutures. It is, however, abundantly evident, that these are not the main purposes for which the sutures are formed ; otherwise they would not begin to be obliterated at a period of life when they would perform these offices more usefully than ever. Consistent with this remark we shall find, that the true purpose for which they are formed, and the particular process with

which they are connected, is fully completed before their obliteration takes place.

When we take a view of the mode of junction between many bones, and parts of bones in the human body, which do not admit of motion, we find that with little exception they all agree in this particular; that sooner or later the cartilage or periosteum, which once was interposed is obliterated, and these different portions, or entire bones, coalesce.

The separate portions, which originally compose the vertebræ, are early in thus uniting: after these the sides of the lower jaw; at a later period the epiphysis of a cylindrical bone is united to its body: and still later the bones of the skull usually coalesce, and the sutures are obliterated. Other bones, as those of the face, which have no motion and sustain little weight, are irregular in this respect; sometimes uniting, but generally remaining distinct, to the end of a long life.

The original formation of the osseous system in several distinct pieces, respects principally its speedy ossification at an early period of life, and its future convenient extension, till it has arrived at its full growth; and we may consider it as a general principle, that where two parts of *one* bone are separated from each other by an intervening cartilage, or *two* distinct

bones merely by periosteum, at that part osseous materials are added to increase their length or extend their superficies. This we shall find takes place, whether the junction be effected by comparatively smooth surfaces, as between the body of a bone and its epiphysis; or between the bones of the skull by jagged sutures. Hence it appears that the bones of the body generally are increased in length or extent, not by a uniform extension of the whole substance, but by an addition of bony matter in some particular part.

Thus the body of a cylindrical bone is lengthened by addition to each end. This we might conclude would be the case from considering the part, in which its ossification commences: as this commences in a middle point and proceeds to each extremity, it is natural to suppose that its growth still goes on in the same direction, or continues at the extremities. That this is the case we know, not by reasoning alone, but by a direct experiment. Mr. Hunter sunk two small pieces of lead in the middle of the tibia, or shin bone of a pig, and measured accurately the distance between them: on examining the animal some time afterwards, it appeared, that though the bone had increased considerably in length, the

pieces of lead still remained at the same distance from each other that they were before. From this experiment we learn, that a cylindrical bone is not extended in its middle, but is lengthened by addition to its extremities, where the body of the bone is joined to its epiphysis; the chief intention of the epiphysis being to allow the intervention of a vascular organ, which may conveniently deposit bony materials, without interfering with the joint itself.

As cylindrical bones are lengthed at their extreme parts, we are led by analogy to conclude, that the same general plan is pursued in the extension of the flat bones of the body: and although we have no direct experiment by which this has been proved, there are circumstances which leave little doubt but they are extended by addition to their edges. Thus to take the parietal bone as an example; as ossification begins in a central point and extends towards the circumference, it is probable that to the completion of the process, it continues to go on in the same direction; and the same circumstance taking place in every bone of the cranium, it is probable, that even after the whole of the brain is incased in bone, the addition is still made at the edge of each, and that the general enlargement originates where

they are all mutually joined by the sutures. Of this process I had a very striking illustration some years ago. In a young subject, from what cause I know not, the deposition of osseous matter had been suddenly increased a short time before death. It was in different stages of progress, but had taken place in all the bones of the body which I preserved; in some partially, in others generally. In all, the new osseous matter was elevated above the level of the bone, upon which it was placed. In some parts of the parietal bones it was only in its commencement, and put on the appearance of a net-work, similar to that which may be observed in the same bones at an early period of their formation. In other parts the meshes of the net-work were more or less filled up; in others again completely, so as to put on the uniform appearance of solid bone. The same reticulated appearance was evident on the edges of all the bones of the skull, where they form the sutures, and at the extremities of the cylindrical bones, between the body and epiphysis. The same appearance of increased deposition was seen on the surface of the cylindrical bones, with this difference, that the meshes were not circular, but oblong squares; so as to put on more of the striated appearance. In some parts, the newly secreted

bone was easily separable from the general mass, and formed a thin layer externally, affording one of the best proofs I have met with, of the increase of cylindrical bones in thickness by deposition externally, whilst a corresponding internal absorption goes on. From the striking similarity of appearance on the surfaces and edges of the bones, we may safely conclude, that the same process of deposition was going on in both, and may thence infer, that the bones of the skull are increased in extent by the deposition of osseous matter at their edges, or where they are joined to each other by suture. This fact points out to us, in a great measure, the real use of this peculiar mode of junction.

In order that the bones of the skull may be increased in extent, it is necessary that they should be retained at a certain distance from each other; that the periosteum with its vessels may pass down between them, free from compression and secrete the osseous matter. At the same time, the thin bones composing the upper part of the skull, resting as an arch upon its basis, must be united together so firmly, as not to be separated by common degrees of violence. For this purpose, projecting points from the external surface of each bone, are reciprocally received into corresponding nitches;

which only penetrate through one half of the thinckness of the skull, and form an irregular kind of dovetailing.

Two advantages arise from this structure being superficial and confined to the external table of the skull. The projecting points from each side, resting upon the solid surface of the internal table of the opposite bone, can resist more effectually any violence, which might tend to force the bones inwards; and the internal part of the skull presents, by this means, a smooth surface to the coverings of the brain; for internally no appearance of a jagged suture is seen.

From this view of the subject we see, that the sutures of the human skull, by their peculiar formation, at once unite the bones together, and so far separate them, as to allow the interposition of a vascular organ by which their superficies is gradually increased to its greatest extent.* This explanation of the use

* Since this paper was written in the year 1800, I have found, that a similar opinion was published by Professor Soemmerring in 1794, in his valuable work, "de corporis humani fabrica." To him, therefore, any credit which may belong to the primary suggestion of this use of the sutures is due. As his opinion, however, has been little noticed by anatomists generally, and is placed in a clearer point of view by the facts which suggested this further explantion

of sutures comprehends and accounts for those concomitant circumstances, which were considered by older anatomists as their real use; and as far as I can see, is not contradicted by any fact connected with them.

of it to me, it has not been thought improper to give this essay a place in these Memoirs. But whilst the reader will see, by the following quotation, the near resemblance between the opinion of Professor Soemmerring and that which I have brought forward, I hope the character of plagiarist or compiler will not be attributed to me.

" Usus horum sic sese habentium terminorum ossa cranii inter bene liquet.

" Incrementum ambitus calvariæ levant, ni enim inter " ossa capitis mox post partum suturæ interponerentur, " hæc crescere non possent, nisi aliâ ratione natura rem " instituerat. Tali igitur modo incrementum calvariæ " cum incremento reliquorum ossium convenit; initio enim " suturis, vel potius lineis cartilaginosis ossa iis locis con- " glutinantur, verum tamen non nisi in embrionibus ad " fonticulos, ut aiunt, hæc linea notabili latitudine, " observatur. Ossibus enim capitis hic locorum cerebro " crescente, placide quasi diductis, cartilago augetur, latior " evasura, nisi pristina pars simul in os mutaretur, inde " ossa calvariæ, eodem modo, quo ossa longa diductis " epiphysibus, vel quod unum idemque est, marginibus " crescere, liquet, etsi in ossibus, longis sutura epiphyses " inter et diaphysin non crispetur.

" Quo junior igitur infans, eo minus crispa et implexa " sutura, vel ut rectius loquar, linea cartilaginosa angusta, " ossa jungens, observatur. Quum vero aucta ætate ossa, " crescente cerebro, diducuntur, eorumque crassitudo, " adposita cum internæ, tum externæ potissimum tabulæ,

If it be asked, for instance, why at the sutures there is a stronger adhesion of the *dura mater* internally and *periosteum* externally than in other parts of the skull? the answer is, that these membranes with their vessels are continued into the sutures, to form conjointly the secretory organ, by which the bones are extended.

If it be asked, why there is a greater vascularity or an appearance of blood-vessels passing through the sutures? it is perfectly consistent with this opinion to answer, that the increase of blood goes to this secretory organ, for the purpose of the extension of the bones.

The explanation here offered, accounts also for the general obliteration of the sutures after a certain period of life; for the bones having then arrived at their full size, the organ for the secretion of osseous matter is no longer needed; it shrinks and is absorbed, and the bones gradually coalesce; by which a further ad-

" (internæ enim incrementum citius absolutum videtur) " massa ossea, augetur, non potest non esse, quin hæc " crispa suturæ forma, quum quidem nasci cœpit, externâ " in superficie tamdiu, augeatur, donec tandem ipsa ea " quam maxime impediat, quo minus cerebrum calvariam " ulterius diducere possit, quod pubertatis tempore accidit. " Rarissime hæc ossificatio ad ætatem virilem usque de- " tinetur."— Soemmerring de corporis Humani Fabrica, page 212.

vantage is derived, that of an accession of strength to the cranium at large.

If any additional argument be necessary in support of this opinion, I may also notice the striking analogy, which subsists between the separation of one bone of the skull from another by a suture; and that separation which exists between the body of a cylindrical bone and its epiphysis. They each remain only for a certain length of time; each allows the interposition of a secretory organ; and both begin to be obliterated, when the bones with which they are connected have completed their growth, and their continuance is no longer necessary.