Some anatomical considerations of joint fixation / William Mackenzie.

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SOME ANATOMICAL CONSIDERATIONS OF JOINT FIXATION.

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The Significance of Fixation and Cure.

The uses of joints in the animal economy are varied and associated mainly with the improvement of the active and passive mobility, and hence of the utility of the otherwise rigid limb, with the lessening of the risk of fractures, and the dissipation of jars. Correlative and commensurate with the increased mobility of a joint, we find a multiplication and specialisation of the muscles which act across it. Of the major joint functions—active and passive mobility and anti-concussion—active or muscular mobility is by far the most important. Hence we can say that morphologically and physiologically a joint is dominated by the muscles which act across it. When, therefore, we come to deal with the question of immobilisation of a limb, or part of a limb, for the purpose of conferring "perfect" rest upon a damaged or diseased joint, the endeavour must be to effectively and accurately counteract the active and passive forces which tend to alter that disposition of the component parts which has been selected by the surgeon as the most appropriate for securing ankylosis on the one hand, or improved or normal range of movements on the other. When we speak of perfect rest of a joint we refer of course to that position in which passive contact of damaged areas is reduced to a minimum by the proper disposition of the parts, and friction contact eliminated by fixation. Counter-action of the passive forces—largely gravitational—can be

easily and effectively accomplished by the veriest tyro. But when, however, we come to consider the counteraction of the active forces operating against the maintenance of the position of "perfect" rest, our attention must be paid to the origins and insertions of the muscles which act across the joint.

The results aimed at in the treatment of diseased joints may be practically divided into two groups:

(1) Those in which recovery takes place with a complete or partial restoration of the articular function.

(2) Those in which subsequent mobility being hopeless we endeavour to concentrate our attention on such fixation of the component elements of the joint as will be most utilitarian when ankylosis occurs.

As regards the first group, the affected joint is recovering when the range of motion of its component elements tends not to be diminished, but increased towards the normal—the progress of the cure being from the zero position of rest, along the lines of normal directions of motion, up to the limiting points of normal degree of motion along those lines, the attainment of which represents the perfection of cure.

Where our ideal is adequate fixation, no subsequent alteration of the relation of the components forming a utilitarian ankylosis should eventuate.

Comparison of the Upper and Lower Extremities.

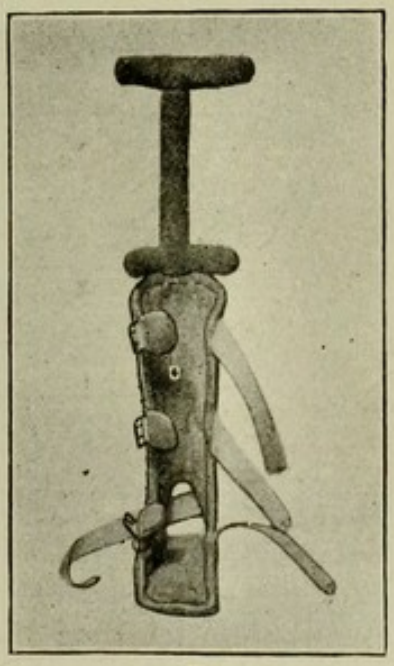
Regarded from the evolutionary standpoint, there is relatively a much higher organisation and specialisation of the upper limb, with an enormously greater co-relation with intellectuality and natural and acquired skill; and thus, we may state, that it is more important to prevent ankylosis in the upper than in the lower extremity. The main function of the latter is for the support of the body in the erect position—the Gluteus Maximus (Ectogluteus), insignificant in the quadruped where the gluteus medius (mesogluteus) dominates, is the principal muscle of the buttock—the fibula is disappearing, with the Tibia as the naturally selected bone in the leg since pronation and supination are no longer requisite;

and the big toe, in marked contrast to Koala, when it is found further back, and acts as a thumb, is placed forward, and is apparently the naturally selected one. Furthermore, in spite of ankylosis of the three joints, a case may walk comparatively well. The upper limb of man, with its finer intrinsic and extrinsic adjustments, is, as before mentioned, to be regarded as co-related to intellectuality, and is in marked contrast to Macropus, in which, in sptie of a dependent fore-limb, we have degenerate tough fibrous muscle tissue, and the absence of a pollex. In man, so even is the adjustment, that the loss of function of an Adductor Pollicis, Pronator Teres, or Supinator Brevis, may be sufficient to ruin the utility of the upper limb, a condition that would never obtain in the case of the lower. In the latter limb, since it is necessary to protect the joints from the shocks of locomotion and weight-bearing recumbency should be insisted upon at all times in diseased or damaged conditions.

Lower Extremity.

Ankle Joint.—Here the position for rest and recovery, orankylosis, should be with the foot at a right angle to the leg; overaction of the Flexors, Peronei or Tibials being associated with deformity. Owing

A



B

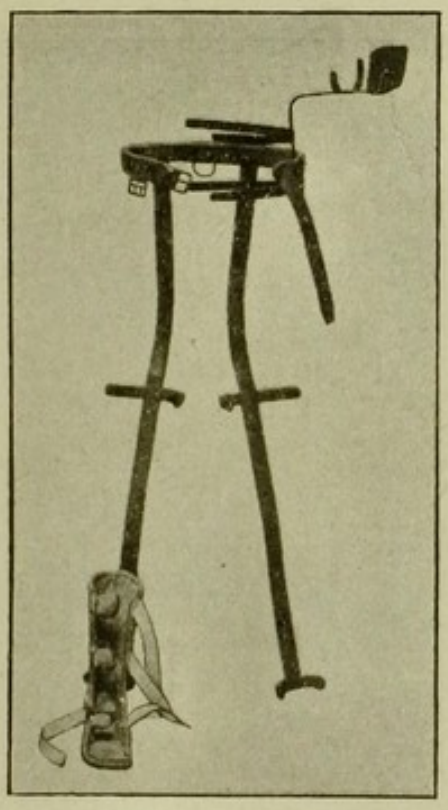
to the position of origin of the muscles forming the tendo achillis, there can be no rest of ankle unless the knee be rested also. So-called immobility is

usually secured by means of plaster of Paris applied round the joint, or the use of a Thomas crab splint, which not only does not rest the knee joint but is ineffectual to prevent inversion, or eversion, or flexion of the toes. These difficulties are overcome by means of the accompanying extended Arc splint (A and B), and should the ankle require dressing such alteration may be made in the leg piece as will permit of this without interfering with the immobility of the joint. The foot porton is made of tin, in two pieces soldered together at the heel, one for the foot and one for the heel and leg, extending to the junction of the middle and upper third of the latter. The extension to the upper third of the thigh is made by means of a stem of malleable iron ⅝ x ⅛. To avoid any tendency to in-knee, a stem of light malleable iron or aluminium may be applied with the convexity out from the leg to the thigh wings (C), towards which the convexity of the knee is pulled either by means of a bandage or strap, and thus the joint is fixed as well.

Knee Joint.—The ideal position for rest or ankylosis is almost complete extension. Adequate rest can only be secured by such a position as secures immobility of the ankle and hip also, owing to the origin and insertion of the muscles about the knee. This may be obtained by means of the preceding extended arc splint if the stem be prolonged to a thoracic wing as for a single Thomas hip splint. If

sinuses be present the wings may be altered to admit of dressing with immobility. Under this treatment no contraction can occur, and the condition can be under daily observation. The Thomas caliper knee splint is the ideal splint when the patient commences to ambulate, but since it has no control over the hip nor ankle it cannot be regarded in the bed pattern as an ideal splint for rest. Plaster of Paris extending from the mid-thigh to the mid-leg is for many reasons eminently worthless.

Hip Joint.—Almost ideal fixation at the hip is secured by means of the double Thomas splint, which, since it fixes the spine pelvis, hip and knee joints, rests the articulation—relieving pain, lessening spasm, preventing deformity, and, as Bennie, of Melbourne, in his work has pointed out, may be used to overcome not only flexion but adduction or abduction, if present. Of all the many numer-



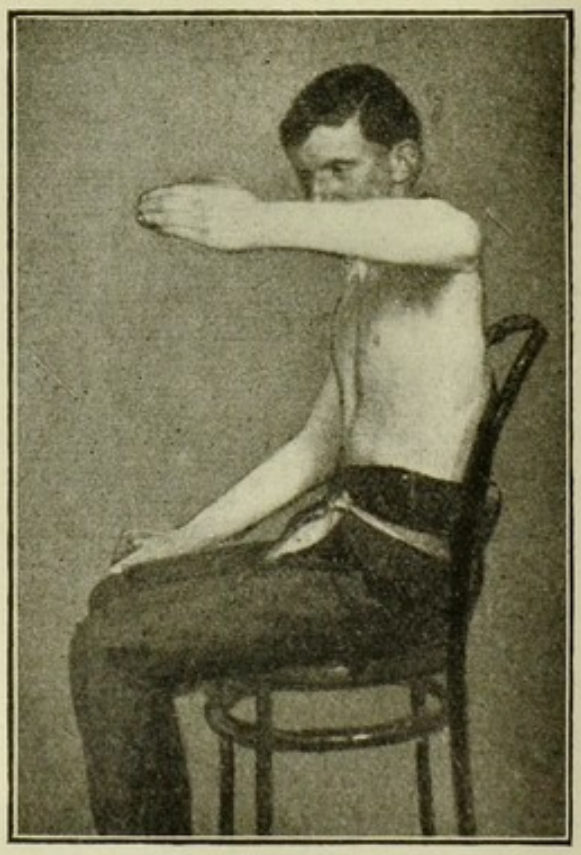
How Immobilization of Left Hip, Right Knee and Left Elbow may be effected.

ous devices introduced, no other appliance conforms to the anatomical consideration essential to hip joint fixation. Two points insisted on by the late Mr. Thomas, but frequently lost sight of, thus

bringing the treatment into contempt, are, firstly, that the essential principle of construction is that the splint be made of soft iron of a thickness that cannot be bent by the patient, but that can be readily bent and fitted by the surgeon's wrenches, and that the essential principle of treatment is that the brace be so applied that it absolutely prevents antero-posterior motion at the joint.

Upper Extremity.

Wrist Joint.—At this joint rest is usually secured by means of a flat wooden splint—Lister's splint, in which the wrist is extended and fingers flexed over a cork piece—or extension of the fingers and wrist by means of the Thomas hand splint—the limb being either supported in a sling or left dependent. Since, however, none of these control the elbow, and since the flexors and extensors of the fingers and wrist arise from the humerus, they cannot be regarded as securing anatomical rest of the joint.

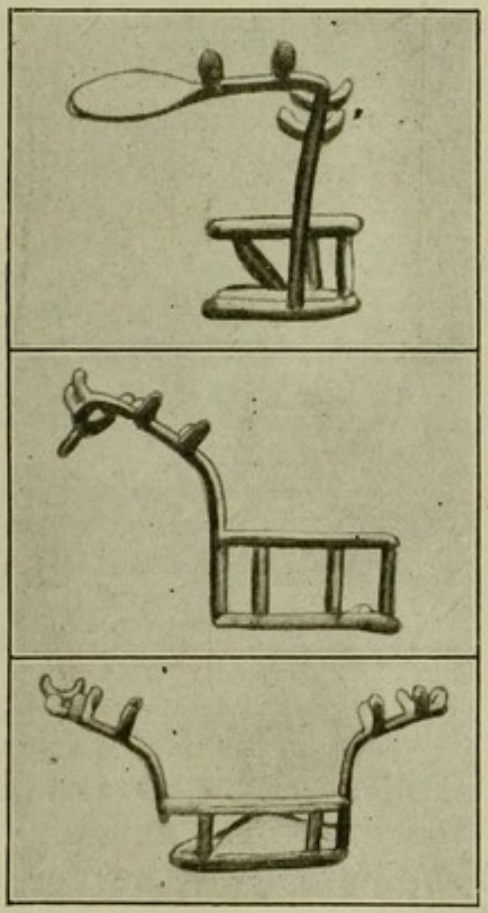


Position of Support of Upper Extremity.

For ankylosis, fixation in the extended position admits of a strong grip; fixation in the flexed position of a weak grip. Furthermore, a wrist fixed in the

position of over-pronation is worthless since flexion of the elbow would bring the back of the hand to the mouth; and similarly with fixation in the over-supinated position in which objects may be brought to the mouth, but the power of grasping is lost.

Elbow.—Here the usual treatment is a rectangular splint, or plaster, with the risk of ankylosis in a useless position, to say nothing of the interference with mobility if sinuses be present; or the position of acute flexion by means of a halter and collar, the range of flexion being increased with recovery. By these methods neither the shoulder joint through which the biceps courses nor the wrist joint are rested, nor in the latter appliance is the joint itself protected from local irritation. The ideal Fixation would be rest in a splint in a position of flexion at 45 deg., which secures rest also for the shoulder and wrist, the angle of flexion, as recommended by

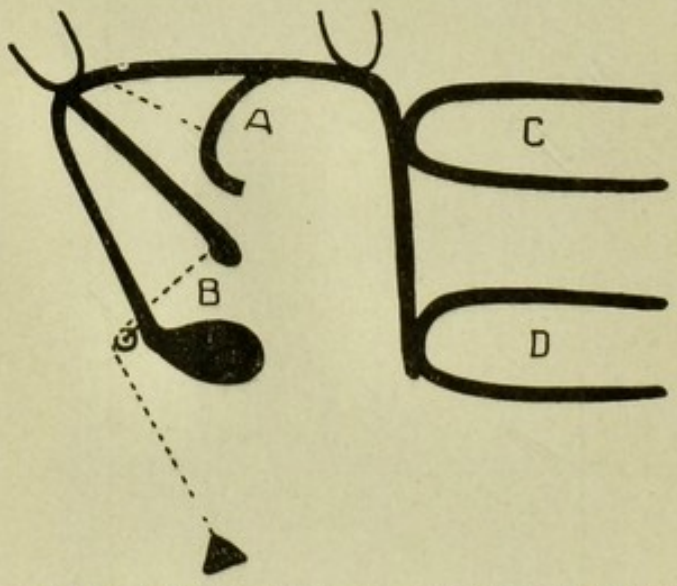


Thomas, being increased with recovery, or if ankylosis be intended in a position of flexion most suitable for the patient's trade or occupation.

Shoulder.—This joint is rarely the seat of tubercle, Bennie having only treated two cases in 25 years at the Children's Hospital. When ankylosis is in-

tended, fixation in the dependent position of the humerus, with slight abduction, is best, and the hope is of securing the use of accessory shoulder muscles. Even where recovery is hoped for a sling for the forearm is regarded as sufficient and the shoulder fixed by means of adhesive plaster—a position obviously in which deltoid and biceps are stretched.

In the upper extremity so fine and co-related is the muscular adjustment that adequate fixation of one joint is best secured by fixation of all three—a point which seems to be never insisted upon. This may be simply secured by means of a splint introduced by the writer some years ago, and here shown. By its means the humerus may be abducted and shoulder supported, thus relaxing the biceps, deltoid and scapular muscles—the abduction being lessened as recovery takes place. By its means also the elbow joint may be placed in any angle of flexion necessary, which can be altered with recovery or remain fixed at any angle for adequate ankylosis, and, by means of the hand piece, the wrist and fingers may be extended and placed midway between



The Upper Limb Splint used to overcome Contractions at Shoulder and Elbow.

pronation and supination. In spite of the presence of sinuses, which require dressing, the limb is always at rest whilst this is being done, and, furthermore, the position of the wings may be altered for the individual case without interfering with its effectiveness.

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