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MYOPLASTY ON THE GLUTEUS MAXIMUS IN PARESIS
OF THE ABDUCTORS OF THE HIP-JOINT

Whereas paresis of certain groups of muscles of the lower extremities — e. g. the hamstring muscles and the adductors of the hip-joint — impairs the function of the leg during gait very little, the failing of other groups — e. g. the quadriceps and the abductors of the hip-joint — is especially fatal. This is well-known and is a presupposition for the applicability of muscle transplantations as a treatment of localized pareses. By means of this treatment the invaliding sequels of paralysis of the quadriceps and of several other pareses of the lower extremities may be reduced, but so far attempts at providing an active compensation for the abductors of the hip-joint (especially the gluteus medius) have not yielded any satisfactory results. The anatomicotopographical conditions only afford few possibilities of transplanting other muscles to this region, and the muscles which may come into consideration — and which have been tried — do not possess the special physiologic properties of the abductors: a comparatively short contraction with great power.

Of the methods hitherto prepared with a view to activation of the abduction of the hip-joint by means of muscle transplantation the so-called Legg's operation — transplantation of the tensor fasciæ latæ for insertion on the trochanter major — is the simplest and, I suppose, also the one which in suitable cases is most likely to yield a certain (though by far sufficient) compensation. Of other methods those stated by Lange are well-known. Lange has accomplished three different methods of transplantation for replacement of the gluteal muscles:

In order to replace the glutei medius and minimus *Lange*

has accomplished two methods of transplantation. In the first *Lange* forms from the middle of the base of the contralateral m. latissimus dorsi a broad muscle flap, which he provides with a long silk tendon, the latter being passed subcutaneously across the columna and the crista ilii on the paralytic side and fastened to the trochanter major. The objections to which this operation is open are obvious. The muscle substance detachable from the latissimus dorsi in this way is so thin and relatively narrow that the power which, at best, can be transferred to the hip only becomes minimal in proportion to the loss which has to be compensated. The technical difficulties with which an alloplasty of this kind is fraught — one has to insert paper parchment between the silk tendon and the proc. spinosi as well as the crista ilii in order to prevent adhesion there — make this interference less than attractive.

On his second attempt to find a material of muscles to replace the abductors *Lange* goes more diastally on the femur and, detaching the origin of the vastus lateralis from the femur, he forms a flap of this muscle. The muscle flap is provided with a silk tendon consisting of several threads which are passed across the trochanter major and fastened radiately to the crista ilii. It is no easy matter to foretell the effect of this operation. Normally one has to reckon with every muscle fibre of the vastus lateralis being placed in such a manner that it connects an origin from the femur or from fascial elements with the extensor apparatus of the knee-joint. If the origin be detached and, by means of the silk threads, inserted into the crista ilii the part in question of the vastus lateralis will be transformed into a strange *muscle acting on two joints* with extensor action on the knee-joint and with a possibility of causing movements of the hip. It seems very doubtful, however, whether the effect on the hip-joint will become an abduction, which will be understood when considering the rather close correspondence between the course of the upper parts of the gluteus maximus, which act on the tractus ilio-tibialis and have *no* abducting effect (vide below), and the transplantation material made from the vastus lateralis by *Lange*.

The third method aims at a replacement of the gluteus maximus and is thus, strictly speaking, beyond the scope of the of the subject discussed here, but it will, however, be mentioned. He uses the sacro-spinalis muscle, which is detached at its sacral origin and is provided with a silk tendon that is passed to the trochanter major. The anatomical and physiologic properties of this muscle substance approach the properties of the muscle which it has to replace, but the power that it is capable of producing is smaller than the one which has to be replaced. The nuisance incidental to alloplasty — silk tendon and insertion of paper parchment — is still present.

At the German Orthopedic Congress at Munich in 1929 *Lange* demonstrated a number of patients treated according to these methods of transplantation. In these cases the operations had been successful in so far as the muscle flaps transplanted showed contractility, but the effect was of no objectively demonstrable importance to the function of the leg during gait. *Lange* openly admitted this; the limping of the patients was not less marked than before the operation. *Lange* stated, however, that the patients in question felt a subjective improvement of the condition, a sensation of greater stability of the hip being felt during gait. This may perhaps be called rather a poor result of so relatively comprehensive surgical interventions. It would, however, be unjust if other orthopedists did not give *Lange* the credit which he deserves for his endeavours to remedy so serious an invalidism as the one represented by abductor paresis. As long as better methods cannot be pointed out *Lange's* operations are not only justified but also highly laudable experiments, which should be watched with the greatest interest.

We are continually confronted with patients to whom the marked limping engendered by abductor paresis means a serious invalidism marking them for the whole of their lifetime, and we cannot omit looking out for a means to help these patients. In this connection I shall not mention what may be achieved by means of splints or operations on the bones, but I shall confine myself to the methods of transplantation.

Deliberating the existing possibilities of activating the abduction I thought of the gluteus maximus as a possible material compensating for the abduction. I cannot say for certain whether this has been suggested or perhaps even carried out previously. It is difficult to get a comprehensive view of the monographs on these subjects, because the matter have been treated under highly varying titles. In the text-books that I have perused nothing is stated about such a transplantation.

When the gluteus maximus is mentioned as the muscle which has to replace the abductors, the question will undoubtedly be put at once how often one may expect to find a wholly or comparatively unimpaired gluteus maximus together with paralytic or markedly paretic abductors in our patients suffering from poliomyelitis. I have tried to form an opinion of this in going through the poliomyelitis case-books of the clinic and counting the cases in which a wholly or comparatively unimpaired gluteus maximus is recorded together with paralytic or markedly paretic abductors. This combination was found in 36 of 235 patients with poliomyelitis treated in clinic, — and in this case-book material *all* the patients suffering from poliomyelitis are included, and not only such as displayed pareses of the lower extremities. Therefore, in a large number of cases with poliomyelitis, one has to reckon with the presuppositions for performing an operation — aiming at the activation of the abduction in the hip by means of the gluteus maximus — being present rather often.

Before describing the method of my operation I must speak a little about the normal function of the gluteus maximus. This muscle is the extensor of the hip-joint, a powerful outward rotator, and moreover it has an adducting effect which by no means is slight; but no part of it, not even the uppermost part, has any abducting effect whatever (when the hip is extended). In one of the anatomical text-books which I have perused in this connection (*Quain*) it is stated that »the upper part will assist in producing abduction«, but other authors (e. g. *Cunningham*, *Spalteholz*, *Ivar Bromann*) do not ascribe any abducting effect to the gluteus maximus, and on examination of

a patient with paralysed abductors but a completely unimpaired gluteus maximus one may easily be convinced that there is no faculty whatever for active abduction. Considering the course of the muscle fibres in relation to the centre of rotation of the hip-joint it seems probable at first glance that the uppermost

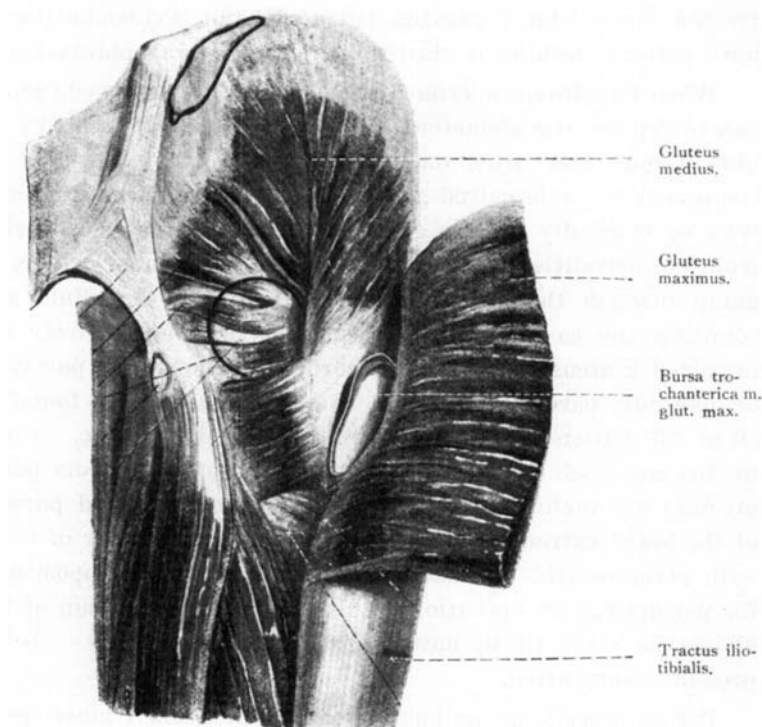


Fig. 1.

After Spalteholz. Caput femoris and the origin of gluteus maximus from os ilii marked by the author.

parts of the gluteus maximus might have an abducting effect; when this part of the muscle is incapable of producing an abduction in the hip it must be explained by the fact that it is not inserted into the femur but passes to the tractus ilio-tibialis, which is separated from the trochanter major by means of the large bursa trochanterica (see fig. 1).

On preparing the scheme of operation which I have used I examined these things on a dead body and was thus enabled to ascertain that pure abduction and adduction in the hip-joint affect the tension of the uppermost parts of the gluteus maximus very little (whereas this part of the muscle is tightened rather much on inward rotation and is relaxed on outward rotation).

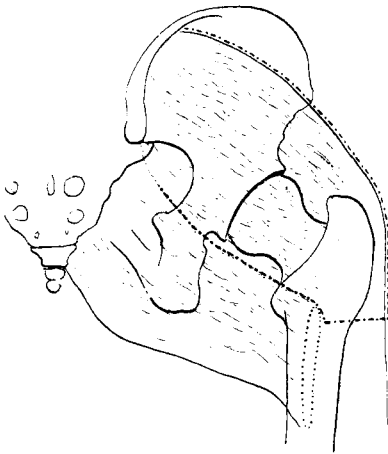


Fig. 2.

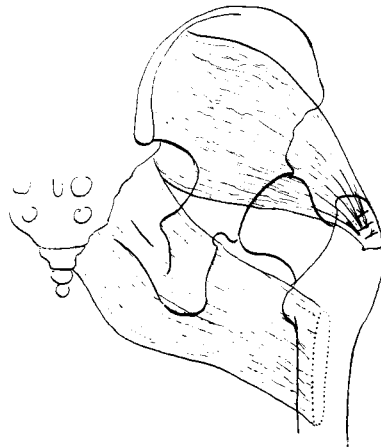


Fig. 3.

On the anatomical preparation I then tried to cut apart the upper half of the muscle together with a short flap of the tractus ilio-tibialis, and I sutured the muscle flap thus formed direct to the periosteum of the uppermost part of the trochanter major. After this transplantation it appeared that the part in question of the muscle was markedly tightened on adduction and relaxed on abduction and thus would be able to act as an abductor of the hip-joint.

I have then carried out the operation in the following manner: a curved incision, slightly convex ventrally and upwards, is made from the posterior part of the crista ilii across the trochanter major where it ends (see fig. 4). The flap consisting of the skin and the adipose tissue is turned medially and downwards. 3—4 cm to the distal of the prominence of the trochanter major a transverse section is made through the tractus

ilio-tibialis and starting from this point the upper edge of the gluteus maximus is isolated. When the muscle-fascia flap thus formed is turned posteriorly the very large bursa trochanterica is exhibited; this bursa is carefully *extirpated* — just as it would be done in an operation for hygroma. Now the trochanter is seen, only covered by the periosteum and the insertion of the gluteus medius. Near the middle of the gluteus maximus a section, parallel to its fibres, is made through the muscle, a large flap being formed by the upper half of the muscle which is connected with the parts of the tractus ilio-tibialis and the fascia lata that have been cut apart. These fibrous elements are folded together, an »insertion-tendon«, 2—3 cm broad, being formed which is sutured to the outer aspect of the trochanter major close to its upper prominence. (See the diagrams, figs. 2 and 3.) I use strong fish-gut sutures and a solid needle (*Mayo's* »Round Point«), which makes it possible to pass the sutures well through the periosteum. Skin sutures. Plaster-of-Paris bandage with the hip rather strongly abducted. Technically the operation must be termed a very simple one, everything is performed in superficial layers and there are no large vessels or nerves to which one has to pay attention. Some hæmorrhage may occur from the section into the gluteus maximus, but it is easily checked.

As yet I have only had the opportunity to perform the operation in two cases:

Marcella R., born on March 5, 1910. — Poliomyelitis in September 1910. The right lower extremity remained almost completely paralytic, and on the first admission to the clinic, in October 1912, there were contractures of the flexors of the hip, of the hamstring muscles, and of the triceps. The contracture of the hip was removed then by means of tenotomy on subspinal muscles, the biceps and the semitendinosus were transplanted to the paralytic quadriceps, the contracture of the hamstring muscles thus being removed too, and by means of various transplantations of the, to some extent very paretic, muscles of the crus and slight lengthening of the triceps a more satisfactory position of the foot and a more favourable distribution of the

muscles here were attained (Prof. *Slomann*). The patient now got a rather good function of the leg; the muscles transplanted to the quadriceps showed a rather good function when *Slomann* saw the patient for the last time at an after-examination in March 1916, but on this occasion it was noted that the gluteus medius and the gluteus minimus were completely paralytic, whereas the gluteus maximus was powerful. At this juncture *Slomann* advised arthrodesis of the ankle-joint, which, however, was never performed.

The patient came under my treatment in February 1929. The power of the muscles transplanted to the quadriceps was now minimal, and as a slight flexion contracture of the knee had occurred simultaneously the former muscles were insufficient. Each time she weighted her leg she had to make a powerful flexion of the hip (jerking the truncus forward) in order to stabilize the leg for the weight by means of the gluteus maximus. The right crus displayed a very marked torsion deformity, the foot pointing laterally at a right angle to the sagittal plane with the patella in the vertical plane.

The flexion of the knee and the torsion of the crus were corrected by means of a high, oblique cuneiform osteotomy on the tibia. The patient was now free from the forcible jerking of the truncus during gait when the right leg was weighted, and the rotation deformity of the crus was completely corrected. The gait was, however, still limping owing to the paresis of the abductors of the hip-joint.

The above operation on the gluteus maximus was then worked out with a view to this patient. In this case it had to be expected that the result of the operation — the power of abduction of the transplantation material derived from the gluteus maximus — would be reduced by a co-existing and rather markedly paralytic coxa valga et coxa antetorta; for the increased angle of the collum reduces the abduction impetus of the part of the gluteus maximus that has been transplanted. In order to remedy this an attempt at drawing the origin of the muscle forward was made — in addition to the above transplantation of the insertion of the gluteus maximus —, a number

of strong fishgut sutures being sewn between the upper anterior edge of the muscle and the crista illii. Such a displacement of a muscle by means of sutures running across its fibres is, however, never advisable — the effect of the sutures will only be of a short duration — but out of regard to innervation and nutrition I dared not loosen and transplant the origin too.

As will be seen the girl (demonstration) has attained so powerful and active an abduction that, lying on her side, she is able to keep her leg in abduction, but partly owing to the other, rather extensive, muscular defects of the extremity, partly owing to the paralytic coxa valga, causing the traction of the transplantation material to be deficient, the operation did not cause the disappearance of claudication, although the latter has been distinctly reduced.

The result that I obtained in this case showed, however, that it is possible to bring about an active abduction of the hip by means of the transplantation performed with a part of the gluteus maximus. Therefore I have performed operations recently on this 6 year old boy (demonstration), in whom the conditions for obtaining a favourable result were better.

Henning B., born on Nov. 22, 1923. — In good health until he got poliomyelitis on Nov. 25, 1928. Immediately after the acute stage both lower extremities were completely paralytic, later on the condition improved considerably. About 6 months after the occurrence of the disease the patient had seen another doctor and got a splint for the right crus, but he used it for a few months only; later on no treatment until admission to the clinic on March 18, 1930.

The upper extremities and the truncus are not involved. On the left lower extremity the tibialis anticus muscle is paralytic and there is a slight contracture of the triceps, the foot can, however, be dorsiflexed to 90°; otherwise this extremity is normal. Of the hip muscles of the right lower extremity the ilio-psoas muscle is powerful, the tensor fasciæ latæ is paralytic, (the sartorius rather powerful), the gluteus medius is completely paralytic and the gluteus minimus is almost completely paralytic, the patient being unable to abduct the leg when lying on his side.

The gluteus maximus is powerful, practically speaking normal. The adductors are powerful. The hamstring muscles and the extensors of the knee are not involved. On the crus the tibialis anticus and posticus and the peronei are paralytic, the extensor digitorum and the extensor hallucis are rather powerful and so are the deep flexor muscles, the triceps is rather weak, slightly contracted. No deformity of the foot.

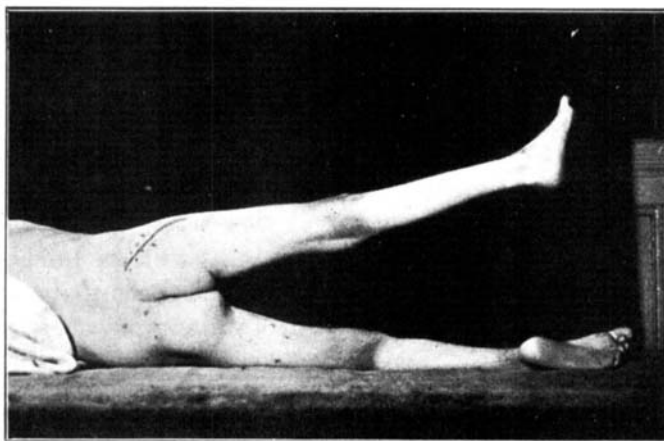


Fig. 4.

There is marked limping of the right leg during gait, *Trendelenburg's* sign markedly positive. X-rays do not reveal coxa valga or any other paralytic deformity of the collum femoris. The case was, therefore, considered a suitable one for the above operation on the (right) gluteus maximus and the operation was performed on March 22, 1930 in conformity with the scheme stated above. In this case the iliac origin of the muscle covered a comparatively great part of the crista, the abducting effect of the transplantation material thus being exceedingly good. The mobilizing after-treatment was commenced 20 days afterwards, and the ability to active abduction advanced rapidly.

(On demonstration at the meeting it was shown that the patient had no positive *Trendelenburg's* sign now and was able to

walk with a minimum of limping. The weak muscles of the crus mark his tread to a slight degree; arthrodesis of the ankle-joint may perhaps be indicated later on.)

Fig. 3 shows the power of the transplantation material derived from the gluteus maximus to elevate the leg when the patient is lying on his side. He is also able to abduct to a considerably greater extent, but it is just the muscular power during the very first part of the abduction from the medium position of the hip which is of the utmost importance during gait and to which one should pay special attention.

The operation described here must be considered so rational, undangerous, and, from a technical view-point, so easy to perform that it ought to be performed in cases with an unimpaired gluteus maximus and paralytic, or only insufficient, abductors. The gluteus maximus possesses anatomical and physiologic properties rendering it extremely well suited to replace the abductors; its power of extension is not impaired through this intervention, the muscle only being altered from a purely adducting extensor to an extensor capable of abducting and adducting. In cases where an unimpaired tensor fasciæ latae muscle can be made use of (and can be spared in flexion of the hip) it would be rational to combine the operation described here with a transplantation of the tensor fasciæ to the trochanter major (Legg's operation).

DISKUSSION:

Langenskiöld, Helsingfors,

has had functionally good results from the Schanz operation in cases of glutæus medius insufficiency.