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A CONTRIBUTION TO THE TREATMENT OF PSEUDARTHROSIS OF THE FEMORAL NECK

BY

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Pseudarthrosis of the neck of the femur is a relatively frequent complication. In a rather extensive series of investigations instituted by the American Academy of Orthopaedic Surgery, *Campbell* and *Smith* found its frequency to be 10 per cent in a material consisting of early and excellently treated fractures of the femoral neck.

From the point of view of treatment, pseudarthrosis of the femoral neck may be divided into the following 3 groups:

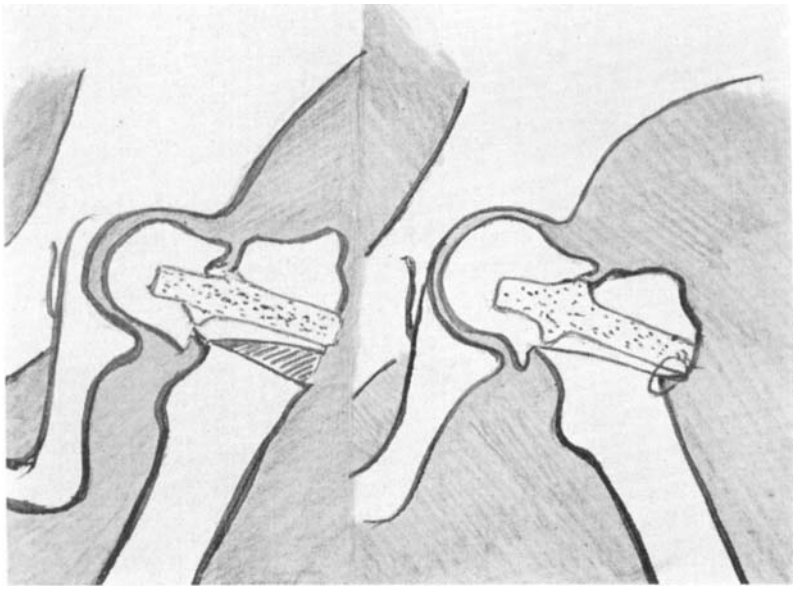
Group I. Pseudarthrosis where the vitality of the head is impaired, or where its mobility in the acetabulum is lost, as the result either of prolonged pseudarthrosis or of severe arthrosis.

Group II. Pseudarthrosis with marked upwards displacement, often accompanied by extensive resorption of the neck.

Group III. Pseudarthrosis in which both upward displacement and resorption are less marked. It is for this latter group, which is probably the most common, that the method described here is intended.

The operations which have been adopted for this group are:

1. Osteosynthesis: Nailing must be objected to, since in most of the cases it has already been employed, and, except in cases where the original nailing was unsatisfactory, it is not likely to yield any better results under the far less favourable conditions in the pseudarthrosis stage. The combination of nailing with bone-grafting, as we have seen done recently by *Von Rosen* with very good results, is a different matter.



a b

Fig. 1.

a. The canal and the side parts of the pseudarthrotic space filled up with spongiosa bone-substance.

b. Operation concluded. Distel fragment shifted somewhat medially.

2. Bone-grafting with or without osteotomy. I have used tibial grafts—(marrow, corticalis, and periosteum) driven though holes drilled in the trochanter, up through the neck into the head combined with subtrochanteric osteotomy—sometimes with and sometimes without good results. Subtrochanteric osteotomy is unsuitable for cases of pseudarthrosis in which there is considerable upwards displacement, since it leads to increased deviation at the pseudarthrosis.

3. Reich's intertrochanteric osteotomy with medial displacement of the distal fragment. The object is not only to cause pressure in the line of the axis of the bone, but also to ensure that the distal fragment is in direct contact with the fracture surface of the head.

Fig. 2 a.
Radiogram of previously nailed fracture of the femoral neck with pseudarthrosis. Kirschner wire inserted for exploration.

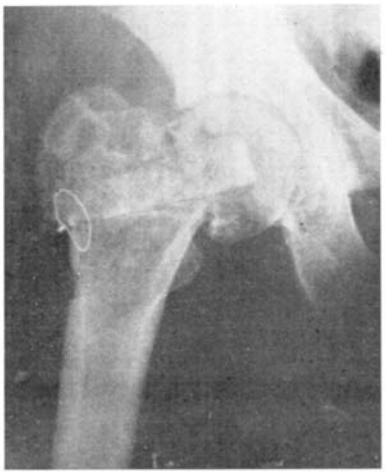


Fig. 2 b.
Same pseudarthrosis on operating-table at end of operation.

Fig. 3.
Same case 3½ months after operation. The patient had been exercising the joint freely for 3 weeks.

The percentage of successful results from this operation was about 80 per cent, but in 25 % of these the union was fibrous. *In 20 per cent of all the cases the result was not good.*

4. Bracket's operation has been used for several years at the Mayo Clinic. In this operation the ends of the fracture are exposed and trimmed, the neck is fixed into a cavity prepared in the head, and the greater trochanter is chiselled off and re-attached more distally. A vitallium screw has been used for fixing both the trochanter and the head, in recent years at the Mayo Clinic.

The results obtained from this operation at the Mayo Clinic were good in 90 per cent of the cases.

The procedure must, however, greatly endanger the blood supply of the head—and I cannot find any published investigations on the condition of the head after these operations.

Most anatomical studies have shown that in adults the head is nourished mainly by the vessels running through the visceral part of the capsule, and passing into the edge of the cartilage through numerous vasa nutritia. In about 30 per cent of the cases little or no blood supply passes through the ligamentum teres.

The method which I shall describe here consists in: 1) the removal of as much of the pseudarthrosis tissue as possible, 2) grafting of spongy bone, 3) intertrochanteric osteotomy.

The method: A Kirschner wire is inserted to determine the site and direction of the canal to the mode. A track as wide as an index finger is chiselled through the trochanter into the pseudarthrosis, and the connective tissue and fibrous cartilage is excised with a knife and gouge as far out to the sides as possible. The bony tissue is chiselled off and scraped out (with a small sharp spoon bent at an angle) an each side of the pseudarthrosis and as far out to sides as possible. It is surprising how easily the pseudarthrosis can be directly inspected, since there is little haemorrhage if one keeps to the midline. The canal is then prolonged for a suitable distance into the head spongy bone (which is obtained in abundance

from the trochanter) is packed well out to the sides of the pseudarthrosis; a graft which has been taken from the iliac crest and from which the corticalis has been removed is driven into the canal; and finally an osteotomy is made just at the lower corner of the neck (Fig. 1 a). It is usually necessary to remove a wedge of bone to make the angle of the neck sufficiently wide. The distal fragment is shifted medially so as to force the fracture surface of the head as much as possible into a horizontal plane (Fig. 1 b).

When the osteotomy has united after 8 to 10 weeks, the patient is allowed to stand up and put full weight on the limb. Weightbearing in the correct position promotes union.

The pseudarthroses were found to be up to 1 cm. thick, and consisted of tough connective tissue resembling capsule. In one case synovial membrane was also found; it was greatly thickened. In this case there was a considerable upward displacement.

The main points in this method are the extensive removal of the connective tissue of the pseudarthrosis and exposure of the spongy bone on either side, the subsequent filling of the space with spongy bone and the insertion of a graft of spongy bone through the neck into the head, and finally intertrochanteric osteotomy to secure a favourable angle of the neck.

Simple packing with chips of bone cannot give such favourable conditions for union, since there is only a small perforation into the tissue of the pseudarthrosis, corresponding to the size of the piece of bone. On the other hand the pseudarthrosis is a wide gap filled with connective tissue intertrochanteric osteotomy alone cannot be expected to bring about union in spite of the improved direction of pressure. This has been shown by follow-up examination: 20 per cent of cases with non-union, and 25 per cent of the remainer with only fibrous union.

Recently I have used this method combined with corrective osteotomy to obtain arthrodesis. After 8 weeks the patient was allowed up in plaster, and after 12 weeks radiography

showed apparent bony ankylosis. Theoretically, however, this was too early for complete consolidation, so I kept the patient in plaster for a further period. When there is severe contracture this method is easier to do than the usual intra-articular arthrodesis.[1]

So far I have only done this operation for pseudarthrosis of the femoral neck in 4 cases and the latest of these is too recent for assessment; to that this paper must be regarded as only a preliminary report. I should, however, be glad if anyone who has a large number of pseudarthrosis cases than I have had would try the method. Certainly technical improvements will be possible. For instance it could be adapted to cases where there is marked upward displacement, reduction being performed after temporary removal of the greater trochanter. This has not as yet been necessary in any of my own cases.

SUMMARY

The author distinguishes between:

1. Pseudarthroses where the nutrition of the head is impaired, or movement of the head in the acetabulum must be considered lost.
2. Pseudarthroses with marked displacement, often combined with marked resorption of the neck.
3. The most common form of pseudarthrosis, in which the displacement and the resorption of the neck are less marked.

He discusses the most common operations for the two last types. Of these, Reich's osteotomy fails in 20 % of cases; Brachet's operation has satisfactory early results in 90 %, but, as far as the author can find, no late follow-up investigations have been made with a view to the possibility of necrosis

[1] Since this paper was written, the author has done three more fusion and correcting operations, also one operation of pseudarthrosis, using the same method. The follow-up investigations have shown good results in every case, after a further six months (eighteen months for the first case).

of the head. Further, Brachet's operation must be regarded as dangerous to the nutrition of the head in view of the considerable chance of damaging the already damaged capsular vessels.

The author's method is the following: a canal the width of a finger is chiselled out from the greater trochanter through the centre of the neck into the pseudarthrosis; from here, as much connective tissue as possible is removed through the canal, and the canal is carried on into the head. The line of the pseudarthrosis is packed out to both sides with spongiosa tissue from the iliac crest, and a spongiosa bone graft is driven into the canal and up into the head. Finally an intertrochanteric osteotomy is made, the distal fragment being displaced medially against the pseudarthrosis surface of the head as in a Reich's osteotomy. The author has also used this method for arthrodeses in cases with severe faulty positions. The method is a simpler and less severe operation than an intra-articular arthrodesis which improves the position, and seems, so far, to be no less effective.

RESUME

L'auteur distingue entre

1) pseudarthroses dans lesquelles la vivification de la tête fémorale est compromise ou sa mobilité dans la capsule articulaire pratiquement supprimée,
2) pseudarthroses avec déplacement prononcé, souvent accompagné d'une forte résorption du col fémoral,
3) pseudarthroses où la résorption du col le déplacement sont moins prononcés, ces dernières étant la forme la plus communément observée.

Il mentionne les opérations les plus courantes appliquées à ces deux dernières formes. L'ostéotomie de Reich est déficiente dans 20 % des cas. L'opération de Brachet donne des résultats favorables dans 90 % des cas, mais il n'existe pas, à la connaissance de l'auteur, de comptes-rendus d'examens complémentaires par rapport notamment aux nécroses de la

tête fémorale. Etant donné qu'il est difficile, dans l'opération de Brachet, d'éviter la lésion des vaisseaux de la capsule dont l'état est déjà souvent compromis, il faut considérer que celle-ci est dangereuse en ce qui concerne la vivification de la tête fémorale.

La méthode préconisée par l'auteur consiste à évider un canal de la grosseur d'un doigt du trochanter majeur, par la partie centrale du col fémoral et jusqu'à la fente de la pseudarthrose. Le canal traverse dans la plus grande étendue possible les tissus conjonctifs. Il pénètre un peu dans la tête fémorale. Les deux extrémités de la fente de la pseudarthrose sont recouverts de tissu conjonctif spongieux. Une greffe osseuse d'os iliaque est ensuite enchevillée dans le canal et la tête fémorale. On pratique alors une ostéotomie intertrochantérale en déplaçant le fragment distal médialement vers la surface de la pseudarthrose de la tête, comme dans l'ostéotomie de Reich. L'auteur a également appliqué cette méthode dans les arthrodèses où la position vicieuse est fortement accentuée. Avec un peu de pratique, cette méthode est plus simple et moins radicale que les arthrodèses intra-articulaires de redressement et ne semble pas jusqu'ici avoir été moins efficace.

ZUSAMMENFASSUNG

Verfasser unterscheidet zwischen:

1. Pseudarthrosen, bei denen die Ernährung des Caput in Mitleidenschaft gezogen ist oder die Beweglichkeit des Caput im Acetabulum als aufgehoben angesehen werden muss.

2. Pseudarthrosen mit schwerer Aufwärtsverschiebung, oft von einer schweren Resorption des Collum begleitet.

3. Die gewöhnlichste Form von Pseudarthrosen, wo die Collumresorption und die Aufwärtsverschiebung weniger ausgesprochen sind.

Er bespricht die gewöhnlichsten Operationen bei den beiden letzten Formen.

Unter diesen versagt die Reich'sche Osteotomie in 20 % der Fälle.

Die Bracket'sche Operation gibt in 90 % der Fälle ein unmittelbar günstiges Ergebnis, es liegen aber, soweit Verfasser bekannt, für diese Operation keine späteren Nachuntersuchungen im Hinblick auf eine Caputnekrose vor. Und die Bracket'sche Operation muss wegen der grossen Gefahr einer Läsion der Kapselgefässe, die schon im voraus oft in Mitleidenschaft gezogen sind, als für die Ernährung des Caput gefährlich angesehen werden.

Die Methode des Verfassers besteht in der Ausmeisselung eines fingerdicken Kanals vom Trochanter major durch die Mittelpartie des Collum zur Pseudarthrosenspalte hinein. Deren Bindegewebe wird durch den Kanal in grösstmöglichem Umfange herausgeschnitten. Man arbeitet sich weiter ein Stück in das Caput hinein.

Die Pseudarthrosenspalte wird zu beiden Seiten mit spongiösem Knochengewebe angefüllt. Dann wird eine Cristaspange in den Kanal und in das Caput hineingestopft. Hierauf wird eine intertrochantäre Osteotomie vorgenommen, bei der das distale Fragment medialwärts gegen die Pseudarthrosenfläche des Caput verschoben wird wie bei der Reich'schen Osteotomie. Diese Methode hat Verfasser auch bei Arthrodesen angewandt, wo starke Fehlstellungen vorlagen. Die Methode ist bei entsprechender Uebung einfacher und weniger eingreifend als eine stellungsverbessernde intraartikulare Arthrodese und erscheint bisher nicht weniger effektiv.

DISCUSSION

Wiberg, Silfverskiöld, Thomasen, Bentzon, Stören.