

CONTRIBUTION TO THE TREATMENT OF PSEUDARTHROSES OF THE FOREARM

By

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Pseudarthrosis of the forearm forms a group, in the treatment of which the experience of the individual surgeon has been restricted. In order to obtain an idea of the frequency and importance of this group I want to refer the reader to the analysis by *Levander* from 1943, where the author examines the question basing himself on the material of a series of Swedish hospitals between 1930–1940, in all, 289 cases of pseudarthrosis, of which 60 cases concerned *pseudarthroses of the forearm*.

Treatment by osteosynthesis: a considerable percentage of permanent non-union is registered, but the author makes no analysis of pseudarthroses of the forearm.

Drilling of the fragments was performed in 18 cases (forearm), healing occurred in 8 cases after 22 operations. In the other cases it was necessary to perform another operation, in 10 cases after an average period of 4 months without consolidation. In 3 cases pseudarthrosis remained after 5, 12 and 15 months.

Splitting of the fragments was applied in 5 cases, 4 of them healed, 1 case had pseudarthrose 4 years later.

Transplantation of bone, solid, cortical bone.

a. Dead bone was used in 4 cases. Healing occurred in no case.

b. Living bone was used in 28 cases, in 14 of them the radius as well as the ulna was broken. Healing occurred in 19 cases. But in 5 cases the pseudarthrosis was still present after a period varying between 4 months and 8 years. In 7 cases another operation was necessary. The author found that 10 of the 28 patients had a permanent invalidity, whereas the other 9 of the 19 healed cases had very little to complain of. In 3 cases the definite result is unknown.

Transplantation of living bone, small pieces, was performed in 10 cases.—7 cases healed, 3 cases had a permanent pseudarthrosis.

The survey of Levander is of interest in several respects. We learn that in a series of 289 cases of pseudarthrosis 60 are concerned with the forearm, that is, about 20 % of the whole lot. The importance of



Fig. 1. Case 1.

a. After economic excision of the pseudarthrosis of the radius (plate) and a permanent defect left in the ulna at the level of the pseudarthrosis. The operation was performed 2 years after the fracture of both bones. The radiogram of the pseudarthroses, performed on admission, has been lost.

pseudarthrosis of the forearm is enhanced by the proximity of the hand and fingers and its consequential damage to the working capacity of the patient. Levander has given only a summary report of the function of the hand and the fingers after the operations on the 60 patients—many of whom have been submitted to more than one operation.

At the meeting of the Scandinavian surgical society in 1953 *Rehnberg* (Helsingfors) reported on a material of pseudarthrosis, treated during and after the Finnish war. Out of 273 cases of pseudarthrosis 146 occurred in the forearm. Out of 70 cases operated on for pseudarthrosis of the radius 11 failed to heal. Out of 59 pseudarthroses of the ulna 53 were treated with grafting, 4 with marrow nailing. Of the whole number (59) 22 cases did not heal.

Out of 17 cases of pseudarthrosis of both bones of the forearm, the final result was non-union of the radius in 2 cases and of the ulna in 6 cases.

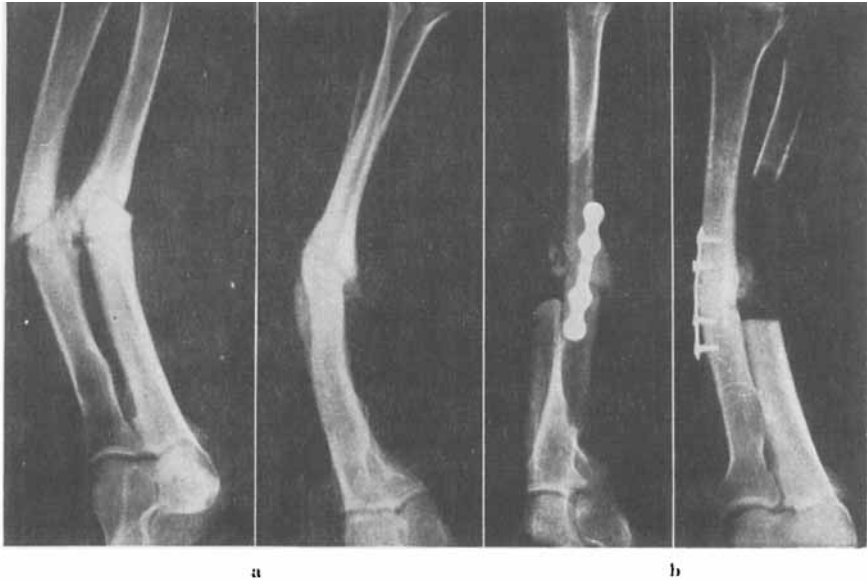


Fig. 2. Case 2.

- a. On admission, February, 1938, 2 years after the fracture and after 7 operations for non-union in different hospitals.
- b. 9 months after economic excision of pseudarthrosis of the radius (plate) and a generous excision of the pseudarthrosis of the ulna.

Rehnberg gives no account of the functional results of the hand and fingers after these operations.

The surveys of Levander and of Rehnberg give a rather serious aspect to the results and the difficulties we are still meeting in the treatment of pseudarthrosis of the forearm. We have all met them,—whether one of the bones, or still more, if both are involved. The reasons are obvious. When the pseudarthrosis has been excised, it is difficult to give the shafts their correct relative lengths and to obtain the minute reduction, respecting the curve of the radius, which is strictly essential to pronation and supination. In addition there is the problem of bone healing—which I shall not consider at all here.

I think we may now be safe in considering it an established fact that the lower half of the ulna is of only insignificant importance in the stability and function of the forearm and hand; the radius is the more important of the two bones distally, the ulna proximally. In the treatment of pseudarthroses in the middle and lower half of the forearm it is therefore reasonable to overcome the difficulties by simplifying the problem. We can sacrifice part of the ulna by an extraperiosteal excision, leaving a permanent defect in the bone, and then turn all our

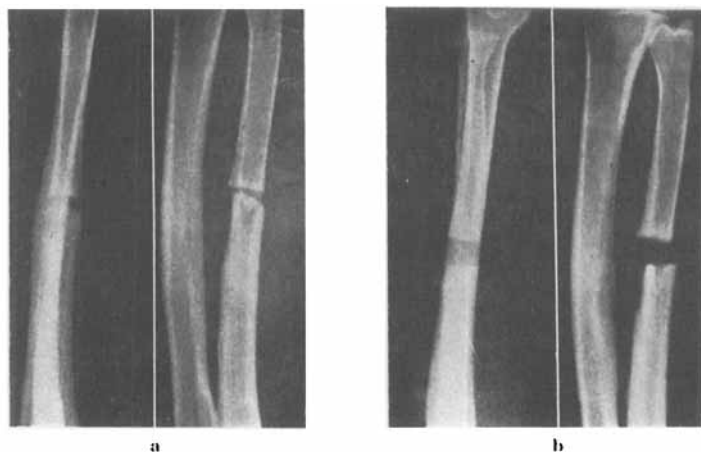


Fig. 3. Case 3.

- a. Pseudarthrosis of the ulna on admission, 8 months after the fracture.
- b. After excision of the pseudarthrosis of the ulna.

attention to the resection of the radial pseudarthrosis and to a minute reduction and rigid fixation of the fragments of the radius; in this we are not now hampered by any consideration of the ulna.

In a preliminary paper read to the meeting of the Scandinavian surgical association in 1949 I proposed to treat the pseudarthroses of the middle and lower half—in which the great majority of pseudarthroses of the forearm are found—by excision of the pseudarthrosis of the ulna, leaving here a permanent defect, and then by the best methods to attend to the pseudarthrosis of the radius and effect its consolidation in a correct position.

I will now give an account of 5 cases treated in this way. One of them had a pseudarthrosis of the radius, one of the ulna and 3 had pseudarthrosis of both bones.

Case 1. 37 year-old man.

In August, 1935: fracture of the radius and ulna, 7 cm. above the wrist. He was treated in another hospital in plaster of Paris for 3 months, then operated on for non-union. Plaster was applied for 5 months. He was admitted to our surgical department 2 years after injury with non-union of both shafts. On 27/9-37 the pseudarthroses of the ulna and radius were resected and osteosynthesis of the radius was performed (plate and osteoplastic transplantation); a permanent defect was left in the ulna. Union of the radius was obtained after 3 months, and I was told in writing in May, 1938, that he was then able to work; there was slight restriction of pronation.

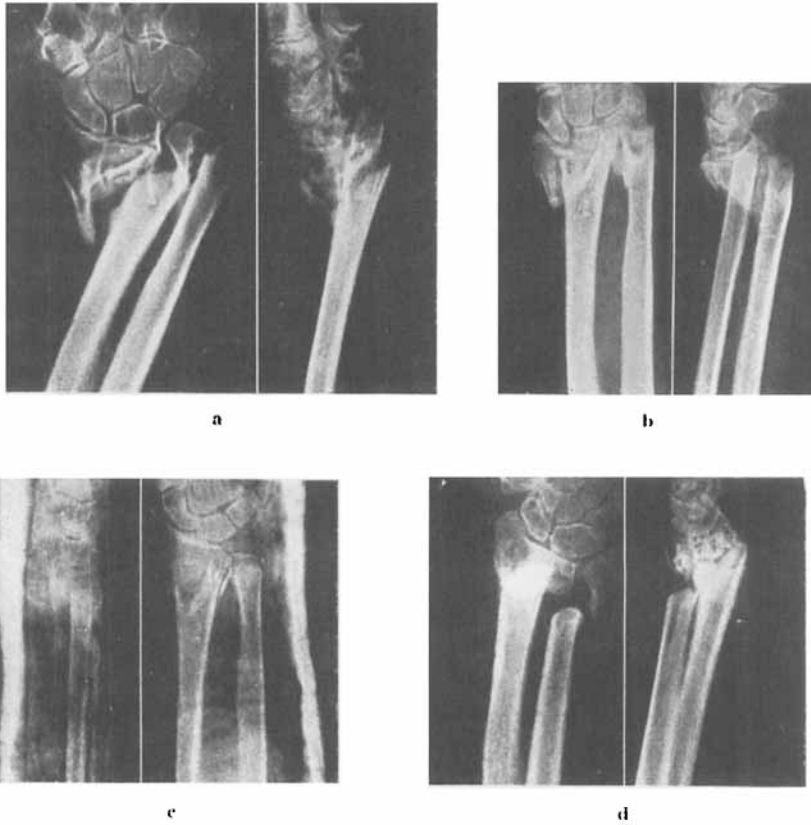


Fig. 4. Case 4.

- a. On admission the day of the accident.
- b. After first reposition, not successful.
- c. After second reposition.
- d. 8 months after the accident and 5 months after excision of pseudarthrosis of the radius and excision of the ulna.

Case 2. 24 year-old man.

February, 1936: fracture of the radius and the ulna in the middle, left forearm. He was operated on at once in another hospital (internal fixation by plates). In the following two years he had 7 operations for non-union in different hospitals. February, 1938: he was admitted to our surgical department with pseudarthroses of both radius and ulna in an angular position. The very sclerotic pseudarthroses were excised and a 4–5 cm. gap was left in the ulna. In the radius the excision was conservative, and the fragments were plated. Union of the radius followed promptly. Half a year later he was able to work as a carpenter. The hand was in 20° supination, and could be fully supinated.



Fig. 5. Case 5.

- a. On admission, 3 months after the accident, non-union of both bones.
- b. Pseudarthrosis of the radius economically excised, solid after plating and osteoplastic transplantation; pseudarthrosis of the ulna excised extra-periosteally. Radiogram taken in April, 1954, that is, 7 months after the operation.

Case 3. 39 year-old man.

July, 1946: Fracture of the ulna in the middle $\frac{1}{3}$. He was treated immediately at another hospital by wiring. $3\frac{1}{2}$ months later: non-union, the wire was removed, and the fragments were perforated. The patient was referred to our surgical department 8 months after the accident. He had non-union, pain and was unable to work (fisherman). On 15/2, 1947: the pseudarthrosis of the ulna was excised. (About $1\frac{1}{4}$ cm.) The pain was gone and writing in June, 1947, he says that he is able to work as a farmer and that in the winter he had done his job on the fishing grounds at Lofoten, in the far north of Norway.

Case 4. 60 year-old woman.

September, 1951: comminute open fracture of the radius and the ulna above the wrist. She was treated in our surgical department. Infection was moderate. $4\frac{1}{2}$ months later there was pseudarthrosis of the radius, in a vicious position. On January 22nd, 1952: Excision of the pseudarthrosis of the radius and excision of 3 cm. of the ulna above the capitulum. Reposition of the radius, which was impossible before resection of the ulna, was performed successfully after this resection. Treatment finished on May 29th, 1952. The radius was solid.

I personally reexamined her on the 20th of May, 1955. She has free movements in the elbow and shoulder. Hand and fingers had a normal position. No pain. Movements of the wrist dorsally: 30° (40°): flexion 40° (50°).

Pro- and supination of the hand and forearm was free. Movements of the fingers were free. The patient can do all the work of a farmer's wife.

Case 5. 44 year-old man.

June, 1953: fracture of the radius and the ulna 7 cm. above the wrist. In another hospital reposition was performed and a little plate put on the radius (2 screws). He came to our hospital 3 months later with non-union and some angulation. On October 1st: extraperiosteal excision of a piece of the ulna at the level of the pseudarthrosis. Economic excision of the pseudarthrosis of the radius followed with reposition, plate, 4 screws. 4 months later: the bone-callus was scarce and position good.

5/1, 1954: Removal of plate, subperiosteal application of a lamella of cortical bone in the fracture of the radius.

4 months later: consolidation. His local doctor wrote to me, 30/7, 1954: He moves his wrist 60° dorsally and 45° in the volar direction. Rotation of the hand is normal.—The patient wrote to me, 30/9 1954, that for 3 months he had been working as an electric engineer as previously and that he considered himself as fully able as before the fracture.

SUMMARY

A report is given of 5 cases of pseudarthrosis or non-union of fractures in the lower half of the forearm, 3 of both bones and 1 of each bone.

Consolidation of the pseudarthrosis of the radius in a satisfactory position has been obtained by economic resection of the pseudarthrosis of the radius and a generous extraperiosteal excision of the pseudarthrosis of the ulna, leaving here a permanent defect. The defect in the ulna facilitates a precise reduction and rigid fixation of the fragments of the radius in which we are not now hampered by any consideration of the ulna.

The follow-up shows all the patients very well satisfied; the position and the stability of the hand is normal and the patients have a satisfactory working capacity.

The extraperiosteal excision of the ulna above the pronator quadratus muscle is the best means to restore or improve the pro-supination of the hand if this important function has been lost, consequently to the fracture.

RESUME

Il est rendu compte de 5 cas de pseudarthrose ou de non-consolidation de fractures dans la partie inférieure de l'avant-bras, 3 des deux os et 1 dans chacun de ceux-ci.

La consolidation de la pseudarthrose du radius dans une position satisfaisante a été obtenue par résection prudente de la pseudarthrose du radius et une large excision extrapériostale de la pseudarthrose du cubitus, laissant ici une défectuosité permanente. La défectuosité du cubitus facilite une réduction précise et la fixation rigide des fragments du radius, étant donné que l'on n'a plus à se préoccuper du cubitus.

A la suite d'un réexamen, on a pu constater que l'état de tous les malades était satisfaisant; la position et la stabilité de la main sont normales et les malades ont une capacité de travail satisfaisante.

L'excision extrapériostale du cubitus au-dessus du muscle pronateur carré est le meilleur moyen de redresser ou d'améliorer la pro-supination de la main si cette importante fonction a été perdue à la suite d'une fracture.

ZUSAMMENFASSUNG

Es wird über 5 Fälle von Pseudarthrose oder Nichtheilung von Brüchen in der distalen Hälfte des Unterarms, drei davon an beiden Knochen und je ein Fall an einem von ihnen, berichtet. Knöcherne Vereinigung der Pseudarthrose des Radius in zufriedenstellender Stellung wurde erreicht durch sparsame Resektion der Pseudarthrose des Radius und ausgiebige extraperiostale Exzision der Pseudarthrose der Ulna, an der ein dauernder Defekt belassen wurde. Der Defekt in der Ulna erleichtert eine genaue Reposition und exakte Fixation der Radiusfragmente, da man nun nicht mehr durch die Rücksichtnahme auf die Stellung der Ulnafragmente behindert ist.

Die Nachuntersuchung zeigte, dass alle Patienten sehr zufrieden sind, da die Stellung und Leistungsfähigkeit der Hand normal sind.

Die extraperiostale Excision der Ulna oberhalb des m. pronator quadratus ist das beste Vorgehen um den nach Brüchen entstandenen Verlust der Pro- und Supination der Hand wiederherzustellen.

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