

From the Orthopaedic Hospital of the Invalid Foundation, Helsinki.  
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## ARTHRODESIS OF THE CARPAL JOINT

*By*

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Arthrodesis of the wrist joint is generally considered to be indicated when prolonged pain in the wrist, severe deformity in the carpal region, or flaccid or spastic paresis causes material difficulty in the use of the hand.

Methods of wrist arthrodesis can be divided into type groups in a variety of ways. There are many methods and in most of them a bone graft taken from the tibia (*Brittain 1952*), rib (*Colonna 1944*), ilium (*Butler 1948*), distal end of ulna (*Smith-Petersen 1940*) or distal end of radius (*Gill 1947, Herbert & Paillot 1950*) is used as a support for the arthrodesis. Arthrodesis can also be performed without a bone graft by destroying the intercarpal joint surfaces (*Liebolt 1938, Abbot et al. 1942*) or by inserting the sharpened distal end of the radius into a depression cut in the wrist (*Brockman-Nissen 1951*).

### MATERIAL AND METHODS

At the Orthopaedic Hospital of the Invalid Foundation in Helsinki arthrodesis of the wrist joint was performed in 42 cases during the period 1945-1963. Seven patients were women and 35 men. Table 1 shows the distribution of the material by age groups. The youngest patient was 14 years of age and the oldest 65.

Table 1.

	Men	Women
Below 15 years	1	-
15-19 years	9	1
20-29 "	9	5
30-39 "	7	-
40-49 "	8	1
Over 50 years	1	-
Total	35	7

The majority of operations were performed by Brittain's method. In some cases the method was modified by fixing the bone graft with screws at one or both ends. Table 2 shows the distribution of the material according to the indication of the operation. Five patients were operated on by methods other than that of Brittain.

Table 2.

Diagnosis	Arthrodesis		Other methods
	No. of cases	Brittain	
Poliomyelitis	13	11	2
Paresis pl. brach.	1	1	—
Hemiplegia spastica	10	10	—
Arthrogryposis multiplex	1	1	—
Tuberculosis carpi	4	3	1
Malacia ossis lunati	3	3	—
Pseudarthrosis ossis navic.	3	2	1
Arthrosis carpi	7	6	1
Total	42	37	5

The unit was generally immobilized in plaster for 16 weeks. The plaster reached from the upper part of the brachium to the distal ends of metacarpals, with the wrist in slight dorsal flexion. One patient was operated according to Brockman-Nissen, one according to Butler, and one according to Liebolt. In two cases partial resection of the wrist was performed.

In cases where Brittain's method was used, a fracture of the graft was observed later in four patients and pseudoarthrosis in three. In five of these a re-operation was performed with a good result. In two patients there also occurred a fracture of the tibia from which the graft had been taken.

#### RESULTS OF THE FOLLOW-UP EXAMINATION

It was possible to re-examine 39 patients. These follow-up examinations were performed in 1963 and 1964. The average interval was between the follow-up examination and operation, thus some 9 years (8.8). The shortest interval was 1 year and the longest 17 years.

Follow-up examination showed that the operation had led to bony union in 37 cases. In three of these, however, there were signs of a healed fracture in the distal end of the graft, although the patients were unaware of a possible fracture. In one patient pseudoarthrosis had occurred at the distal end of the graft, but since he was treated in hospital for tuberculosis of the spine at the time, treatment of the wrist was not considered indicated. A reoperation was performed on

one patient with a fracture of the graft, and the treatment is not yet finished.

Table 3 shows the results of follow-up examination judged on the basis of objective findings. The result was considered objectively good if arthrodesis had led to bony union with the wrist in slight dorsal flexion or intermediate position. Slight ulnar deviation was not considered to impair the result, but when the ulnar deviation was more than 20 degrees the result was considered fair or poor. If the operation led to bony union with the wrist in volar flexion the result was also considered fair or poor.

Table 3.

Diagnosis	No. of cases	Objective results		
		Good	Fair	Poor
Poliomyelitis	11	8	3	—
Par. pl. brach.	1	1	—	—
Hemipl. spast.	10	5	5	—
Arthrogryposis	1	1	—	—
Tub. carpi	4	3	—	1
Malacia lunati	3	1	1	1
Pseudoarthr. nav.	3	3	—	—
Arthr. carpi	6	4	2	—
<b>Total</b>	<b>39</b>	<b>26</b>	<b>11</b>	<b>2</b>

Table 4.

Diagnosis	No. of cases	Good	Fair	Poor
Poliomyelitis	11	10	1	—
Par. pl. br.	1	1	—	—
Hemipl. spast.	10	7	3	—
Arthrogryposis	1	1	—	—
Tub. carpi	4	3	—	1
Malacia lunati	3	1	1	1
Pseudoarth. navic.	3	3	—	—
Arthrosis carpi	6	5	1	—
<b>Total</b>	<b>39</b>	<b>31</b>	<b>6</b>	<b>2</b>

Table 4 shows the results of follow-up examination as based on the patient's subjective estimate. The result was considered subjectively good if in the patient's opinion the wrist was painless under strain, if it was strong and stable and if the patient was otherwise satisfied with

the result achieved. If pain was felt only under strain the result was considered fair. Two cases in which the operation had led to fibrous union were considered both objectively and subjectively poor.

Table 5 shows the period of unfitness for work before and after operation. The longest period during which a patient was unable to use his wrist was 18 years. Of those patients who were not at work before operation part were still at school or engaged in later studies and thus without profession or earnings. Their period of unfitness for work after operation was considered to be ended when they were able to use their hands at a trade school. Three patients were prevented by other disability from starting work after operation.

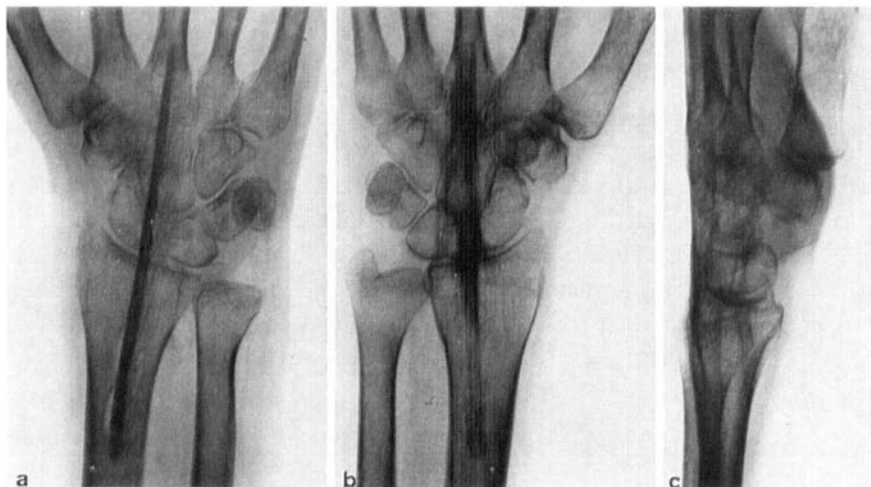
Table 5.

Period of unfitness before operation	No. of cases	Period of unfitness after operation			
		Below 6 m.	6-12 m.	Over 1 yr.	Not at work
Below 1 year	15	12	3	—	—
1- 2 years	5	2	2	—	1
2- 5 "	14	7	4	2	1
5-10 "	1	—	1	—	—
Over 10 years	4	1	1	—	2
Total	39	22	11	2	4

Table 6.

Earlier type of work	No. of cases	Type of work after operation		
		Heavy	Light	Not at work
Heavy	12	10	1	1 (fr. graft)
Light	7	—	7	—
Not at work	20	1	16	3 (1 polio 1 epilept. 1 tb.spond.)
Total	39	11	24	4

Table 6 shows the type of work done by the patients before and after operation. Most patients returned to the same work or to a similar type of work. Of the patients who had been doing heavy work only one did not return to work. This was because of a fracture of the graft, for



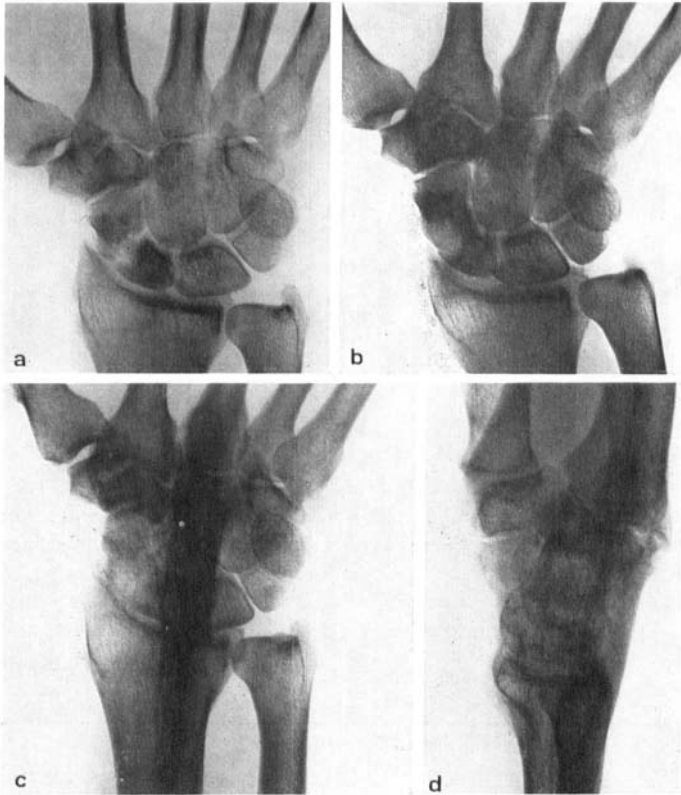
*Figure 1. Left wrist of a 25 year old female patient, who had paresis of both upper and lower extremities after polio. a is one month after Brittain's arthrodesis, b and c six and a half years later. The wrist is stable in 5° dorsiflexion, fingerfunction is fairly good, active pro-supination 120°. The patient is able to perform light hand-work. The result was regarded as good.*

which he was treated after the follow-up examination. The treatment of this patient is not finished. Three others who did not return to work were rendered unfit by other disability. Of these, however, one polio patient is doing handwork at home, so that there has been benefit from the operation.

Figures 1–3 show the results obtained by wrist arthrodesis in three cases where arthrodesis was performed on different indications.

#### DISCUSSION

At the follow-up examination it was surprising to note to how slight a degree a stiffened wrist hampers a patient's working ability in various trades. In manual work certain twisting movements may cause slight difficulty, but some patients were able to perform exacting manual work as automobile and lift fitters or machine fitters and repairers. Chopping movements caused pain in some cases, but working ability was not prevented. When the finger function is good and forearm pronation and supination are unrestricted the patient can often compensate for a stiffened wrist by movements of the elbow and shoulder joints. Some patients were able to write freely with a stiffened wrist. One patient, however, had learnt to write with the other hand.



*Figure 2. A 37-year old lift technician who in the winter war incurred a fracture of the carpal scaphoid. One year immobilisation in plaster gave no result. a: condition before a bone transplantation operation which led to bony union, but the wrist was still painful, b: two years after the above-mentioned operation, c and d: 8 years after Brittain arthrodesis. The patient obviously had a fracture of the graft at its distal end, but he has not been aware of that. The wrist is now completely painless.*

For purposes of comparison Table 7 shows the primary results of the chief studies in this field published up to the end of 1963. It will be seen that arthrodesis of the wrist was performed by various methods. It is an obvious drawback of the Brittain method that the bone graft may break either in the middle or at the distal point of attachment. Brittain himself recommended the reinforcement of the graft at the centre by two smaller grafts (1952). *Hazewinkel* (1962) recommended fixation of the graft by screws at the distal end, but his own study showed that the graft broke in 6 cases out of 26. The distal end of the graft also projects injuriously below the skin.

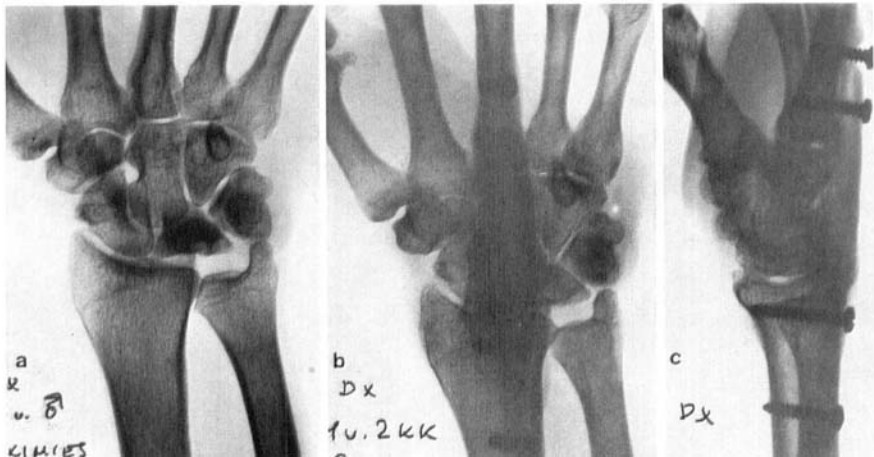


Figure 3. A 23 year old plumber who has had malacia ossis lunati for two years. Immobilisation in plaster for varying periods gave no help. He was not at work during these two years. a: before Brittain arthrodesis, c and d: one year and two months after arthrodesis. The wrist is stable in 20° dorsiflexion, active pro-supination 110°, finger function good. The patient complains of pains after continuous pro-supination movement in his work as an automobile technician.

Table 7.

Author	Year of publication	Method	No. of cases	Good Fair	Complications
Liebolt	1938	Liebolt	40	27	11 pseud. 2 amput.
Abbot et al.	1942	Abbot	48	47	1 pseudoarthr.
Ross	1950	Brittain	21	15	5 fr graft 1 fr III mc
		Abbot	16	15	1 pseudoarthr.
Brittain	1952	Brittain	25	22	2 fr graft 1 pseudoarthr.
Evans	1955	Brockman	19	17	2 pseudoarthr.
Merle d'Aubigné	1956	Smith-Petersen	51	44	5 pseudoarthr. 2 fr graft
MacKenzie	1960	Seddon	34	33	1 pseudoarthr. 3 p. oper. swell
Hazewinkel	1962	Brittain	26	19	6 fr graft 1 pseudoarthr.
Danielsson-	1963	Brittain	16	12	3 fr graft
Unander-Scharin		(3 Abbot)			1 pseudoarthr.

Results shown in the above material, as in earlier studies, may be summarized as indicating that arthrodesis of the wrist joint is a suitable treatment when prolonged pain in the wrist, deformity or spastic or flaccid paralysis hinders the effective use of the hand. The operative methods used led in most cases to consolidation, and most patients were satisfied with the result achieved. In some cases in which the result was considered objectively fair because of a slight volar flexion remaining in the wrist, the patient himself considered the result good.

#### SUMMARY

The present writer carried out a follow-up examination of 42 patients on which operations aiming at arthrodesis of the wrist had been performed. Thirty nine of them appeared for examination themselves. The operation had led to consolidation in 37 cases. There was a fractured graft in one case and a pseudarthrosis in one. Judged on the basis of objective findings the results were good in 26 cases, fair in 11 and poor in 2. Judged on the basis of the subjective feelings of the patients the results were considered good in 31 cases, fair in 6 and poor in 2. Arthrodesis is considered desirable when pain in the wrist or a paralytic condition makes working difficult, and when the use of the hand cannot be improved by other methods. In most occupations bony ankylosis of the radiocarpal joint causes little or no difficulty.

#### RESUME

L'auteur a effectué un examen complémentaire de 42 malades chez lesquels avait été pratiquée une opération tendant à établir l'arthrodèse du poignet. 39 se présentèrent d'eux-mêmes à l'examen. L'opération avait abouti à la consolidation dans 37 cas. Il y avait une greffe fracturée dans un cas et une pseudarthrose dans un autre. Sur la base des trouvailles objectives, les résultats ont été jugés bons dans 26 cas, assez bons dans 11 et piètres dans 2 cas. Sur la base des sensations subjectives des malades, les résultats ont pu être considérés comme bons dans 31 cas, relativement bons dans 6 et piètres dans 2. L'arthrodèse est considérée comme souhaitable lorsqu'une douleur dans le poignet ou un état de paralysie rendent le travail difficile et quand l'usage de la main ne s'améliore pas par d'autres méthodes. Dans la plupart des occupations, une ankylose osseuse de l'articulation radio-carpienne ne cause pas ou peu de difficultés.

## ZUSAMMENFASSUNG

Der Verfasser nahm eine Nachuntersuchung von 42 Patienten vor, an denen eine Operation zum Zweck einer Arthrodesis des Handgelenkes ausgeführt worden war. Neununddreissig der Patienten erschienen selbst zur Untersuchung. Die Operation hatte in 37 Fällen zur Konsolidierung geführt. In einem Fall kam es zum Bruch des Transplantates und in einem anderen zur Pseudarthrose. Auf Grundlage objectiver Befunde beurteilte man das Ergebnis in 26 Fällen als gut, als mittelmässig in 11 und als schlecht in 2 Fällen. Auf Grundlage der subjectiven Meinung der Patienten waren die Ergebnisse in 31 Fällen gut, in 6 Fällen mittelmässig und in 2 Fällen schlecht. Man ist der Auffassung, dass die Arthrodesis wünschenswert ist, wenn Schmerzen im Handgelenk oder ein Lähmungszustand die Arbeit schwierig macht und wenn der Gebrauch der Hand nicht mittels anderer Methoden verbessert werden kann. Für die meisten Beschäftigungen bedeutet die Ankylose des Handgelenkes nur geringe oder keinerlei Schwierigkeit.

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