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PROXIMAL INTERPHALANGEAL JOINT ARTHRODESIS IN RHEUMATOID ARTHRITIS

A Follow-Up Study of 122 Operations

By

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In recent years there has been a steady increase in the surgical treatment and reconstruction of deformities of the hand caused by rheumatoid arthritis. Numerous articles have appeared dealing with the general rehabilitation of the "rheumatoid hand" (*Flatt* 1963, *Fowler* 1963, *Inglis* 1965, *Laine, Sairanen & Vainio* 1957, *Lipscomb* 1965, *Straub* 1959). Few, however, have gone into details or have provided adequate operative procedures. It is the purpose of this paper to provide a follow-up study on the treatment of various disabling deformities of the proximal interphalangeal (PIP) joints of the fingers exclusive of the thumb by a specific method, namely, arthrodesis utilizing Kirschner wires alone for fixation. It is further felt that it is necessary to dissect the "rheumatoid hand" into its component disabled parts to better evaluate the efficacy of surgical treatment. At the same time one would not of course lose sight of the fact that the entire spectrum of the disease must be borne in mind and that the status of all joints in the upper extremity must be evaluated. The overall goals of treatment were to provide these patients with a better functioning extremity. More specifically we hoped to give a painless and stable union in a functional position in a reasonable period of time. A number of goals for PIP arthrodesis was determined by *Moberg & Henrikson* (1960).

CLINICAL MATERIAL

This series represents all the PIP arthrodeses performed at the Rheumatism Foundation Hospital in Heinola, Finland, from 1954 to 1964. There were 65 patients representing 122 procedures. The follow-up statistics on the procedures themselves

are based on the number of arthrodeses, not the number of patients. There were 11 males and 54 females. The ages of the time of operation ranged from 17 to 61 with the average being 41. Fifteen were classified as having had the juvenile form of the disease, *i.e.* an onset before age 16. The duration of the disease ranged from 3 to 35 years with an average of 15 (Table 1). Finger involvement occurred first in the course of the disease in 53 patients (81 per cent). The index finger was operated upon 19 times, the middle finger 29 times, the ring finger 43 times and the small finger 31 times (Table 2).

Table 1. Clinical material.

Total number of patients	84
Number of follow-up patients	65 (77 %)
Total number of operations	150
Number of follow-up cases	122 (80 %)
Range of ages (aver.)	17– 61 (41) years
Males	11
Females	54
Juvenile form	15
Duration of disease (aver.)	3– 35 (15) years
Length of follow-up (aver.)	½– 11 (4.2) years

DEFORMITY

The rheumatoid process may cause varying deformities in the PIP joint. In our series 62 fingers had buttonhole deformity, 41 had intrinsic-plus (swan-neck) deformity, 17 had flail fingers and 2 had other causes. The large number of buttonhole deformities corresponds with the previously reported high incidence of this deformity in rheumatoid arthritis (*Laine et al.* 1957). It will be noted that the fourth and fifth fingers are particularly prone to develop this deformity. The reason for this is as yet unexplained (Table 2).

Table 2.

Deformity related to finger involved incidence

Finger	Deformity				
	Button-hole	Swan-neck	Flail	Other	Total
Index	4	8	6	1	19
Middle	11	13	4	1	29
Ring	25	12	6	0	43
Small	22	8	1	0	31
Total	62	41	17	2	122

FOLLOW-UP

Arthrodesis of the PIP joint was performed on 84 patients of which 65 were available for follow-up (77 per cent). This represented 122 operations followed and reported here out of 150 performed (80 per cent). All 65 were seen clinically and all had post-operative X-rays. The follow-up time averaged 4.2 years. The longest was 11 years and the shortest 6 months. An adequate length of follow-up is especially important in rheumatoid disease because of the progressive nature of the disease (Table 1).

INDICATIONS

The overall purpose of arthrodesis in these patients was to restore function. When grip and digital function are impaired by virtue of joint destruction, or irreparable damage to joint stabilizing ligaments, arthrodesis in a functional position is indicated (*Boyes* 1964). It has been stated that fusions generally within the hand are not acceptable due to the progressive nature of the disease; and that fusion previously performed to increase function may later become a liability (*Flatt* 1963). This has not been our experience in this series with the length of follow-up that we have. When a hand is rendered useless by the destruction of the PIP joint, reconstructive procedures are indicated where possible. The procedures for dealing with the PIP joint are limited. Repair of the buttonhole deformity is extremely difficult in any hand and virtually impossible in the rheumatoid hand (*Flatt* 1963). The early swan-neck deformity can be improved by the Littler procedure, but in late cases with cartilage destruction or ligamentous instability or dislocation, it is of no value (*Inglis* 1965). Capsulotomy is indicated when the integrity of the joint surface has been maintained, the surrounding structures are yielding and the collateral ligaments are the chief offenders. These criteria were not present in any of our cases. Digital arthroplasty is of questionable value generally and in the 5 cases reported by *Cregan* (1959), all had poor results. Prosthetic replacement has been adopted relatively recently and our experience with it has been limited and not very favorable. The indications for its use are limited as well.

Thus, when patients were presented with hand function seriously impaired by severe deformity, dislocation, marked ligamentous instability, and/or pain associated with joint destruction, it was felt that arthrodesis in a functional position was indicated.

TECHNIQUE

Under tourniquet control a longitudinal midline incision is made centered over the PIP joint. The central tendon is split in line with the skin incision. The attachment of the central slip at the base of the middle phalanx is removed and the collateral ligaments are divided with care being taken not to sever the lateral bands. The synovium is excised and the cartilaginous surfaces are removed with a small osteotome or rongeur in such a way as to achieve the desired degree of flexion when the surfaces are opposed. Two crossed Kirschner wires are placed across in such a way as to engage a cortex on both the proximal and distal phalanges. Care must be taken to avoid distraction. In the cases done between 1954 and 1957 only one obliquely placed wire was used. This technique has been successful in fractures (*vom Saal* 1953). This was felt to be inadequate in rheumatoid patients and since 1958 two wires have been used as normal routine. There are in addition some special problems encountered in the rheumatoid hand which are important to note. Care must be taken not to resect too much of the head of the proximal phalanx. In rheumatoid arthritis it is often partly eroded. Too great a surgical resection will reach the neck of the phalanx and bony contact with the base of the middle phalanx will be inadequate. In those cases where the head is largely destroyed in its entirety by the invading synovium, it may be necessary and desirable to place the re-shaped phalanx as an arrow into a target in an effort to achieve better bony contact.

If there is marked bone loss as in mutilans deformity, or severe swan-neck deformity, a graft is placed between the prepared phalanges and wires are then similarly placed incorporating the graft. This has been performed in only 4 cases. The tendon is sutured together and the skin is closed with wire. A pressure dressing is applied. Plaster has not been used exept in a few cases with marked instability at the time of closure. Five days post-operatively the pressure dressing is removed and motion of the metacarpo-phalangeal joints is permitted, but no gripping is allowed. Six weeks post-operatively the finger is evaluated. If it appears clinically stable, nothing further is needed and the patient is permitted free use of the hand.

TECHNIQUE OF DOUBLE ARTHRODESIS

In some cases of extreme buttonhole deformity with complete luxation of both the middle and distal phalanges the following method has been

Figure 1. In this case of extreme buttonhole deformity the middle phalanx was used like an intercalated graft. The other fixation pin has been removed.

used. A midlateral incision is used, as it may be difficult to close a dorsal incision. The middle phalanx is temporarily removed and used as an intercalated graft after appropriate shortening and remodelling. All three phalanges are fixed with two Kirschner wires in position to permit pinch with the thumb (Figure 1).

RESULTS AND DISCUSSION

One hundred twenty-two arthrodeses of the PIP joint in rheumatoid patients were followed and evaluated. The exact time of union is difficult to assess accurately, but those cases appearing to have stability at six weeks after operation were permitted free use of the hand. All but eight achieved clinical and radiographic union. Of these 8 cases of non-

union 6 had swan-neck deformities, 3 of which were totally flail. Only 2 of the 8 had buttonhole deformities.

Possible causes of non-union were as follows. Five involved technical difficulties with wire placement. One had only one wire placed initially. In 3 others of these 5 the wires migrated and had to be removed early and in one case the wires were placed parallel rather than in the crossed position. Two cases were in patients with amyloidosis and severe osteoporosis. The cause of non-union in one case was not known. Three of the eight obtained fusion at a second procedure.

Of the 15 patients with juvenile arthritis, all achieved union. This represented 35 operations. The procedures were carried out when the patients were adults.

Of the 104 cases recording opposition of the thumb, 74 could not oppose pre-operatively. Eighteen could not oppose post-operatively. Thus, 75 per cent achieve pinch with the arthrodesed finger though they could not do this pre-operatively. The chief causes of inability to pinch were deformity of the thumb, as discussed in the literature (*Clayton* 1962), and fusion of the finger in a position of too much extension.

In assessing the adequacy of the position of function it was felt that 24 cases were fused in too much extension. *Straub* (1959) has stated that the position of fusion should be that position most readily adopted by these joints when the hand is at the position of rest. The optimum position of function can only be determined by taking into consideration not only the patient's general needs, but the condition of the adjacent joints of the finger in question and the status of the thumb. Twenty of these 24 cases were fingers with swan-neck deformity. Four were flail fingers. Only four required osteotomy to allow adequate use of the hand. The others were either functionally useful as such or the difficulty could better be helped by surgery on the deformed thumb. In addition some of these patients who were unable to oppose, were able to grip and were satisfied. Grip itself was not statistically evaluated,

Table 3. Complications in 122 cases.

Non-union	8
Too extended	24
Second operation needed for position	4
Too flexed	1
Ulnar deviation at PIP (10–15°)	6
Absence of pinch post-oper. (total)	18 (of 104)
Absence of pinch due to thumb deform.	10
Infection	3

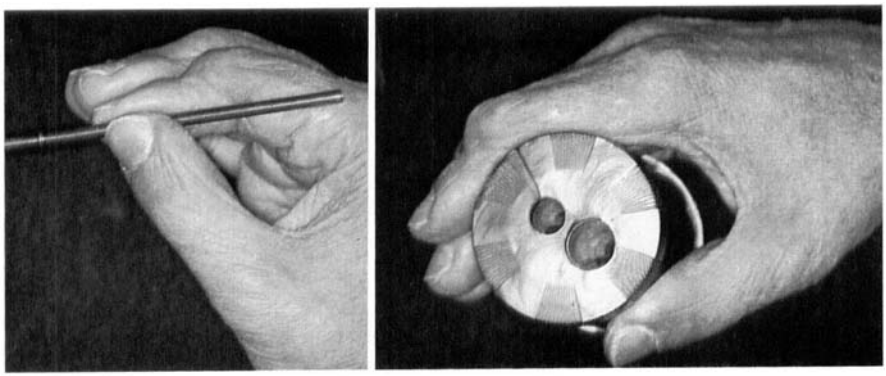

Figure 2. The same hand in Figure 1. Before the operation the patient was not able to touch the fingertips with the thumb. Good grip was obtained after fusion of all the interphalangeal joints and the metacarpophalangeal joint of the thumb.

but it was our impression that those patients with successful arthrodesis obtained improved grip unless other changes in the hand prevented it. There were no rotational malalignments but 6 fingers were fused in 10–15 degrees of ulnar deviation at the PIP joint (Table 3).

The involvement of other joints of the finger in question was not thought to be a contra-indication to PIP arthrodesis. Four cases had fusions of the distal interphalangeal joint as well as the PIP joint of the same digit with good function resulting (Figure 2).

Fourteen cases had fusions of PIP joint with arthroplasty of the metacarpophalangeal joint of the same digit though not at the same time. Their function, too, was good in allowing improved use of the hand (Figure 3). The position of fusion in these hands must be carefully considered.

By avoiding plaster immobilization the other joints of the hand are permitted free motion. This is an advantage in any hand and especially in the rheumatoid patient, where extensive immobilization may seriously reduce the range of motion in involved joints.

Infection occurred in 3 cases. All healed without further difficulty by secondary intention.

The possibility of gaining fusion in a high percentage of cases without the need of an intra-medullary bone graft as used by *Moberg & Henrikson* (1960) is also advantageous in making the procedure less complex especially in view of the structure of the bone involved. In selected cases, however, the use of cancellous graft from the crest of the ilium may be necessary to achieve better functional position espe-

Figure 3. A. Destruction of the metacarpophalangeal and proximal interphalangeal joints of the II–III fingers. B. Five years after fusion of the proximal interphalangeal joint of the index and resection-arthroplasty of the II–III metacarpophalangeal joints the patient is working as a professional typewriter.

cially in cases with hyperextension deformity accompanied by marked bone loss.

SUMMARY AND CONCLUSIONS

1. A follow-up study of 122 cases of arthrodesis of the proximal interphalangeal in rheumatoid arthritis is presented.

2. Union was achieved primarily in 93.5 per cent of cases with the use of Kirschner wire fixation alone as noted in the text.

3. Union, pinch, and adequate position for function were more difficult to obtain in fingers with swan-neck or flail deformity than in the button-hole type of deformity. Possible reasons for this are outlined.

4. Seventy-five per cent of patients who could not oppose to the thumb pre-operatively could do so after fusion.

5. Grip was generally improved with successful fusion.

6. In cases with severe osteoporosis or bone loss the use of a cancellous bone graft improves the possibility of obtaining solid fusion in the desired position.

7. Involvement of other joints of the same finger is not of itself a contra-indication to arthrodesis. The position of fusion in these cases must be carefully considered.

8. The possibility of gaining fusion in a high percentage without plaster immobilization is of particular benefit to the rheumatoid patient.

RESUME

1. Il a été présenté une enquête portant sur 122 cas d'arthrodèse de la phalange proximale dans des cas d'arthrite rheumatoïde.

2. La soudure s'est établie primairement dans 93.5 pour cent des cas à l'aide de la seule fixation par fil Kirschner, comme noté dans le texte.

3. La soudure, la faculté de pincer et la position adéquate de fonction ont été plus difficiles à obtenir pour les doigts ayant une déformité en cou de cygne ou de fléau que dans ceux du type de la déformité en boutonnière. On a cherché à en donner les raisons possibles.

4. 75 pour cent des malades qui ne pouvaient pas opposer le doig au pouce avant l'opération pouvaient le faire après.

5, La faculté de saisir était généralement améliorée après une bonne fusion.

6. Dans les cas atteints d'ostéoporose grave ou de perte osseuse, l'usage d'une greffe osseuse poreuse améliore la possibilité d'obtenir une bonne fusion dans la position souhaitét.

7. Le fait que d'autres articulations du même doigt sont impliquées n'est pas en soi une contre-indication de l'arthrodèse. Dans ces cas toutefois la position de la fusion doit être minutieusement prise en considération.

8. La possibilité d'obtenir la fusion dans un pourcentage élevé des cas sans immobilisation dans le plâtre est particulièrement à l'avantage des malades rheumatisants.

ZUSAMMENFASSUNG

1. Eine Nachuntersuchung von 122 Fällen von Arthrodese des proximalen Interphalangealgelenkes bei chronischem Gelenksrheumatismus wird vorgelegt.

2. Primäre Vereinigung wurde in 93,5 Prozent der Fälle mittels alleiniger Kirschnerdrahtfixierung, wie im Text beschrieben, erzielt.

3. Vereinigung, Griff und angemessene Funktionsstellung waren schwieriger bei Fingern mit Schwanenhals-oder Wackeldeformitet als bei der Knopflochdeformitet zu erreichen. Die möglichen Gründe dafür werden skizziert.

4. Fünfundsiebzig Prozent der Patienten, die vor der Operation nicht gegen den Daumen opponieren konnten, vermochten es nach der Versteifung.

5. Das Greifen war im allgemeinen nach erfolgreicher Versteifung verbessert.

6. In Fällen mit schwerer Osteoporose oder Knochenverlust verbessert die Verwendung eines Spongiosaspahnes die Möglichkeiten eine solide Versteifung in der gewünschten Stellung zu erhalten.

7. Das Ergriffensein von anderen Gelenken am selben Finger ist an und für sich keine Kontraindikation für eine Arthrodese. Die Stellung der Versteifung muss in diesen Fällen besonders sorgfältig erwägt werden.

8. Die Möglichkeit in einem hohen Prozentsatz eine Versteifung ohne Gipsruhigstellung zu erhalten ist besonders wertvoll für den rheumatischen Patient.

REFERENCES

Boyes, J.: Bunnell's Surgery of the Hand. Lippincott Company, Fourth Edition.

Clayton, M. (1962) Surgery of the Thumb in Rheumatoid Arthritis. J. Bone Jt. Surg. **44**-*A*, 1376.

Cregan, J. C. F. (1959) Indications for Surgical Intervention in Rheumatoid Arthritis of the Hand and Wrist. Ann. Rheum. Dis. **18**, 29.

Flatt, A. E. (1963) Care of the Rheumatoid Hand. C. V. Mosby Co., St. Louis, Mo.

Fowler, B. (1963) The Hand in Rheumatoid Arthritis. Amer. Surg. **29**, 430.

Inglis, A. (1965) Rheumatoid Arthritis of the Hand. Amer. J. Surg. **109**, 368.

Laine, V., Sairanen, E. & Vainio, K. (1957) Finger Deformities Caused by Rheumatoid Arthritis. J. Bone Jt Surg. **39**-*A*, 527.

Lipscomb, P. (1965) Surgery of the Arthritic Hand. Proc. Mayo Clin. **40**, 132.

Moberg, E. & Henrikson, B. (1959/1960) Technique for Digital Arthrodesis, a Study of 150 Cases. Acta chir. scand. **118**, 331.

vom Saal, F. H. (1953) Intramedullary Fixation in Fractures of the Hand and Fingers. J. Bone Jt Surg. **35**-*A*, 5.

Straub, L. R. (1959) The Rheumatoid Hand. Clin. orthop. **15**, 127.