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Partial arthrodesis of the wrist

An investigation in cadavers

Partial arthrodesis of the wrist was performed on six cadavers in order to study the residual excursion of the wrist. Arthrodesis between the radius and scaphoid left 40 per cent extension/flexion and 61 per cent radial/ulnar deviation. Arthrodesis between the radius, scaphoid and lunate left 36 per cent extension/flexion and 59 per cent radial/ulnar deviation. Arthrodesis between the capitate, scaphoid and lunate left 59 per cent extension/flexion and 91 per cent radial/ulnar deviation.

Key words: arthrodesis; wrist joint.

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The loss of mobility after arthrodesis of the wrist is associated with considerable loss of function (Volz et al. 1980). Partial arthrodesis, which stiffens only that part of the wrist that causes the symptoms, offers some residual mobility. Graner et al. (1966) performed intercarpal arthrodesis in the treatment of lunatomalacia and pseudarthrosis of the scaphoid bone. Schwartz (1967) performed radiocarpal arthrodesis in the treatment of arthrosis between the radius and the scaphoid bone in long-standing pseudarthrosis of the scaphoid bone and his patients had some residual mobility in the wrist-joint.

Partial arthrodesis has since been used in other affections of the wrist such as rotatory subluxation of the scaphoid bone (Kleinman et al. 1982), lunatomalacia (Fenollosa & Valverde 1970) and pseudarthrosis of the scaphoid bone (Ricklin 1970).

The wrist excursion to be expected after partial arthrodesis is not exactly known. In order to gain some insight into this question we performed partial arthrodeses on normal cadaver wrists, and measured residual mobility.

Material and methods

A cadaver forearm was fixed in supination on a special stand (Figure 1), forearm rotation having been cancelled by fastening the radius to the ulna with two Kirschner wires. All specimens were studied in supination, and the difference between supination and pronation was disregarded.

The tendons of the extensor carpi ulnaris, the extensor carpi radialis longus, the extensor carpi radialis brevis, the flexor carpi ulnaris and the flexor carpi radialis were connected to a constant-force spring via a steel wire. By exerting traction on various tendons the hand could be placed in maximum extension and flexion and ulnar and radial deviation.

The excursions of the wrist-joint were measured with the aid of roentgenograms. For this purpose two roentgen tubes were used which were set up perpendicularly at 1 m distance from the specimen. The

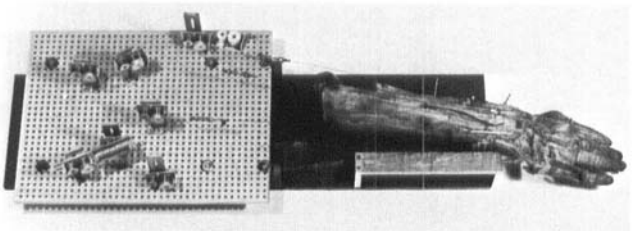

Figure 1. Stand for fixation of the forearm

Table 1. Wrist excursion in degrees, before and after arthrodesis

Type of arthrodesis	Type of movement	Specimen number					
		1	?	3	4	5	6
No arthrodesis	Radial/ulnar deviation	65	62	13	16	33	18
Radius-scaphoid	Radial/ulnar deviation	31	36	7	11	27	10
Radius-scaphoid-lunate	Radial/ulnar deviation	37	34	7	10	22	10
Scaphoid-lunate-capitate	Radial/ulnar deviation		59		16	23	18
No arthrodesis	Flexion/extension	127	146	75	112	85	80
Radius-scaphoid	Flexion/extension	31	66	22	47	35	45
Radius-scaphoid-lunate	Flexion/extension	40	67	15	47	29	34
Scaphoid-lunate-capitate	Flexion/extension		95		62	44	50

angle between the third metacarpal bone and the radius was taken to indicate wrist excursions.

Partial arthrodesis was performed by drilling Kirschner wires into the carpal bones and fastening the protruding ends together with plaster of Paris. Roentgenograms were used to assess whether mobility in the wired bones was indeed abolished.

Three types of arthrodesis were performed in this way, i.e., radius-scaphoid, radius-scaphoid-lunate and scaphoid-lunate-capitate.

The arthrodesis was performed with the wrist in a neutral position.

In six forearm specimens the maximum excursions (extension and flexion and ulnar and radial deviation) were measured before and after arthrodesis.

Results

The six specimens differed widely in pre-arthrodesis excursion (Table 1). For comparison of the results, post-arthrodesis excursions were expressed as percentages of pre-arthrodesis excursions.

Radius-scaphoid arthrodesis. This arthrodesis left 40 per cent residual flexion/extension (16 per cent flexion and 24 per cent extension) and 61 per cent radial/ulnar deviation. Only three specimens showed a sufficient degree of residual lateral mobility to differentiate reliably between ulnar and radial deviation (35 per cent and 28 per cent, respectively).

Radius-scaphoid-lunate arthrodesis. This arthrodesis caused but little additional restriction of movement and hardly changed the distribution of residual extension/flexion and of residual ulnar/radial deviation (Table 1).

Scaphoid-lunate-capitate arthrodesis. This arthrodesis was performed on four specimens and left 59 per cent residual extension/flexion (23 per cent flexion and 36 per cent extension) and 91 per cent radial/ulnar deviation.

Discussion

Pain, instability, loss of strength and limitation of movement are the clinical manifestations of a disturbed wrist-joint mechanism. Arthrodesis causes loss of function because it completely eliminates wrist-joint mobility. Partial arthrodesis replaces one disturbed situation by another, likewise disturbed situation with some residual mobility. Its beneficial effects are alleviation of pain and enhanced stability and strength. It remains to be seen whether the changes in load and transmission of forces will quickly lead to fresh complaints due to a more widespread arthrosis in the wrist joint. In this context it is interesting that Watson (1980) mentioned a patient who, 11 years after radius-scaphoid-lunate bone arthrodesis, still had satisfactory wrist-joint function without any sign of arthrosis.

In our experiments residual mobility after radius-scaphoid bone arthrodesis hardly differed from that after radius-scaphoid-lunate bone arthrodesis. This might be clinically relevant. After the former type of arthrodesis, great forces act on the lunate bone and its ligaments, especially the interosseous liga-

ment. This increased load may gradually lead to lunatomalacia or subluxation of the lunate bone. The latter type of arthrodesis avoids these possible complications without causing additional restriction of movement.

The principal conclusion from this study is that partial arthrodesis leaves adequate residual mobility with good distribution of extension/flexion and ulnar/radial deviation; whether similar residual mobility can be achieved in the treatment of patients remains to be established.

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