

WRIST ARTHRODESIS WITH MINIMAL FIXATION PRESERVING THE CARPOMETACARPAL JOINTS

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ABSTRACT

Objective: Wrist arthrodesis is a surgical procedure that should always be considered in cases of pathological conditions in which anatomical and functional structures are altered. In general, the results are very satisfactory, particularly for pain relief, and in the majority of cases, there is considerable functional improvement. Various techniques have been described, with different methods of internal fixation, most of which include the carpometacarpal joints in the fusion. The objective of this study was to evaluate the results from wrist arthrodesis using a technique that is simpler, more biological, less expensive, and does not involve the carpometacarpal joints. *Methods:* Fifteen patients with wrist arthrodesis were evaluated (six with sequelae from trauma, four with rheumatoid arthritis, three with Kienbock grade IV, one with Preiser and one with panarthrosis). The technique consisted of using an iliac bone plate and internal fixation with Kirschner wires,

avoiding the carpometacarpal joints. *Results:* The evaluation was based on consolidation time (93% in seven weeks); movements of the fingers and pronosupination; pinch and grasp strength; functional evaluation through the DASH, pain and patient satisfaction questionnaires. In general, the results were similar to those of other, more aggressive techniques, and the non-inclusion of the carpometacarpal joints did not affect the final result. *Conclusion:* Wrist arthrodesis with fixation using Kirschner wires and an iliac bone plate, preserving the carpometacarpal joints, gives good or excellent results that are not inferior to those of other techniques that have been described. However, it presents major advantages over other methods: it is less aggressive and cheaper, and does not have the inconvenience and complications associated with the use of plates and screws.

Keywords – Wrist; Arthrodesis; Bone graft; Carpometacarpal joint; Internal fixators

INTRODUCTION

Arthrodesis is generally regarded as a surgical procedure providing salvation. When pain, deformity and instability compromise hand function, wrist stabilization by means of fusion is a procedure of recognized validity⁽¹⁻³⁾. Several techniques for radiocarpal arthrodesis have been described, such as simple decortication with removal of cartilage and fixation with Kirschner wires⁽⁴⁾, use of a Rush rod from the third metacarpal to the metaphysis of the radius^(5,6), slippage or rotation of a bone plate from the distal extremity of the radius, fixed distally in the carpal bones^(4,5,7), fixation with a metal plate from the third metacarpal to the radius^(8,9) and grafting and fixation with a bone plate modeled from the iliac crest⁽¹⁰⁾.

Most of the techniques recommend inclusion of the carpometacarpal joints of the index and/or middle finger, in the fusion. The aim of this study was to present the technique and the results from wrist arthrodesis without including the carpometacarpal joints and without using metal plates.

This study received approval from the institution's Ethics Board.

METHODS

The medical files of 15 patients who underwent wrist arthrodesis (15 wrists) between September 1996 and November 2006 were reviewed. For all of these patients, the procedure was indicated because of pain and

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deformity, together with major dysfunction of the hand, caused by sequelae from trauma such as fractures (five cases) and chronic ligament injury (one case); Kienbock's disease with panarthrosis (three cases), rheumatoid and psoriatic arthritis (four cases), sequelae from Preiser's disease (one case) and panarthrosis of indeterminate cause (one case).

Eight of the patients were men and seven were women. Their ages ranged from 18 to 62 years, with a mean of 44.5 years. The dominant side was affected in 80% of the patients. The mean length of follow-up was 66.2 months, ranging from 15 to 136 months.

Surgical technique

The access route was by means of an S-shaped dorsal incision centered on Lister's tubercle and going around 3 cm proximally and distally from it (Figure 1A). The sensitive branches of the radial and ulnar nerves and the veins that run longitudinally were carefully preserved. The tendon of the long extensor of the thumb was brought out from behind Lister's tubercle and separated radially, along with the tendons of the radial extensors of the carpus. The fourth extensor compartment was separated ulnarly, thus exposing the joint capsule. This was opened by means of an H-shaped incision in which the horizontal central bar was located at the radiocarpal joint (Figure 1B). The two longitudinal branches of around 2 cm in width were incised as far as the bone and, using an osteotome, two osteocapsular flaps were raised: one proximally and the other distally (Figure 1C). The distal flap included the dorsal cortex of the lunate, scaphoid and capitate bones, with preservation of the carpometacarpal joints, while the proximal flap included around 2 cm of the dorsum of the distal extremity of the radius. After flexing the wrist, decortication was performed, removing all of the radiocarpal cartilage and the scaphoid-lunate-capitate. From the lateral wall of the iliac, a bone plate of around 3.5 x 2.0 cm was removed. The lateral wall of this bone had a curvature of approximately 15° and the bone plate, after adaptation to the bed that had been prepared on the dorsum of the wrist, would give the desired position for the arthrodesis (15° to 20° of extension) (Figures 2A and B). The open surfaces of the radiocarpal and intercarpal joints were filled with spongy bone from the iliac crest. The bone plate was fixed to the bed using two 1.0 mm Kirschner wires and the wrist was fixed using two crossed wires of 1.5 mm in diameter, in the desired

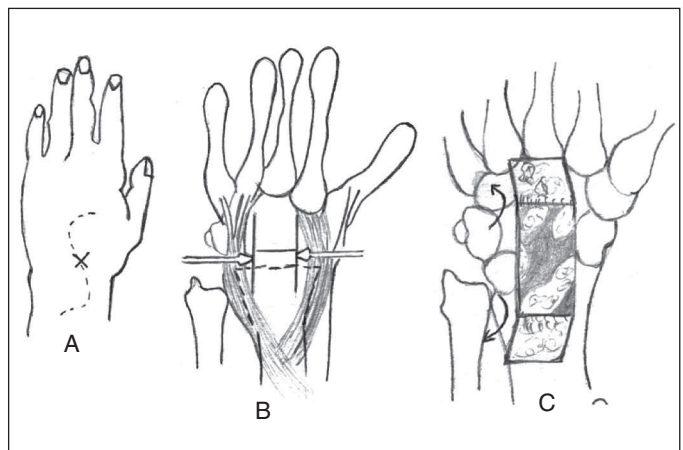


Figure 1 – **A)** Access route for wrist arthrodesis: S-shaped incision centered on Lister's tubercle. **B)** Finger extensor tendons of the fourth compartment were separated ulnarly and the radial extensors and long extensor of the thumb, radially. The capsule was opened in an H shape, with the central bar over the radiocarpal joint. **C)** Raised osteocapsular flaps. After flexing the wrist, decortication was performed on the radiocarpal joint surfaces and scaphoid-lunate-capitate bones, while preserving the carpometacarpal joints

position. The wires were cut such that around 5 to 6 mm remained outside of the skin. The osteocapsular flaps were sutured on the bone plate, thus obtaining a regular bed for slippage of the extensor tendons. The retinaculum and skin were sutured in the usual manner. In no case was the distal extremity of the ulna removed.

The arm was set in plaster from the axilla to the palm, with clefts to avoid excessive edema in the fingers after the operation. After four weeks, the long plaster cast was replaced by a short cast, control radiographs were produced and the Kirschner wires were removed. The short plaster cast was removed three weeks later and control radiographs were produced. If there was still no evidence of consolidation, the wrist was again set in a plaster splint, for a further three weeks.

The analysis on the results was based on reviewing the medical records and making objective and subjective evaluations. The objective evaluation was performed by means of conventional radiographs in two views, of flexion-extension and pronation-supination movements of the fingers and of pinch and grip strength. The subjective analysis was done by means of the DASH questionnaire (Disability of the Arm, Shoulder and Hand)⁽¹¹⁾, pain evaluation on a visual analog scale and a patient satisfaction questionnaire.

Out of the 15 patients, 10 agreed to participate in this study. Of these, seven came to the hospital in person and

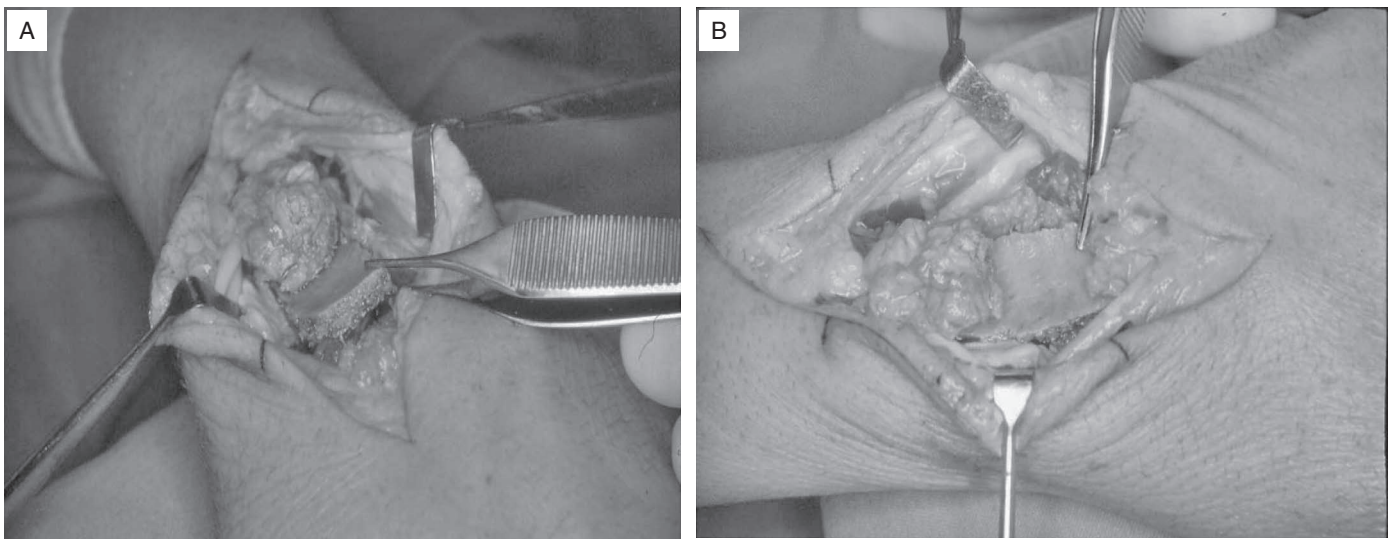


Figure 2 – A) With the wrist flexed, the bone plate from the iliac was fitted under the proximal osteocapsular flap (radius) and distal osteocapsular flap (lunate, scaphoid and capitate). **B)** By extending the wrist to 15° to 20°, the bone plate was adapted to the bed that had been prepared. The flaps were sutured over the bone plate and the wrist was fixed using two crossed Kirschner wires. The bone plate was fixed with two thinner, divergent wires

three were evaluated from responses to questionnaires via e-mail and/or telephone because they were unable to come to the hospital.

The statistical analysis was performed using the Epi-Info software, through which means and standard deviations were calculated.

RESULTS

Out of the 15 patients whose medical files were analyzed, consolidation was achieved in 14 wrists (93.3%) over a mean period of seven weeks (Figure 3). The single patient for whom consolidation was not achieved underwent reoperation, and the radiocarpal pseudarthrosis consolidated after bone grafting. The results regarding forearm and finger movements were very satisfactory, attaining a mean of 64° for pronation and 56° for supination. For all the patients, finger flexion-extension was normal.

The mean grip strength measured using a Jamar dynamometer was 25.616 kgf, ranging from 18.66 to 32.33 (standard deviation, SD = 5.393), or 96.3% of the strength of the non-operated side. The mean pinch strength of the finger pads, measured using a pinch meter, was 14.281 kgf, ranging from 12.66 to 15.00 kgf (SD = 0.757), or 94.6% of the opposite side. It was noteworthy that the pinch strength on the operated side was greater on average than on the non-operated side (operated side: 15.189 kgf; SD = 0.857; and non-operated side: 14.234 kgf; SD = 1.642).



Figure 3 – Lateral-view radiograph of a wrist that underwent arthrodesis with minimal fixation. Note the dorsal bone plate and the free carpometacarpal joints. The Kirschner wires that had been holding the bone plate and radiocarpal joint have been removed

In the subjective evaluation, we used the DASH questionnaire. This test evaluates symptoms and function, i.e. the patient's capacity to perform certain activities, through 30 questions that ask about writing ability, turning a key, using cutlery, feelings of weakness, etc. Responses need to be given for at least 27 of these

items. Each question has five responses, with values between 1 and 5, according to the difficulty of the task: none, a little, moderate, severe or incapacity. The result is subjected to a mathematical formula to transform it into multiples of 100⁽¹¹⁾. The higher the score is, the worse the incapacity is, and vice versa. The mean score in the DASH questionnaire was 27.004 (SD = 15.717), with a range from 0 to 45 (out of 100).

In the pain evaluation using the visual analog scale, all of the patients indicated the left end of the scale, i.e. absence of pain.

With regard to satisfaction with the surgical result, all of the patients declared that they were satisfied. Out of the ten patients who were evaluated, eight returned to their previous activities and two (who were public employees) were granted retirement through the social security system even though their results from the DASH questionnaire had been good and they had declared that they were satisfied with the surgery.

DISCUSSION

Arthrodesis of the wrist is a procedure providing salvation but which gives rise to limitations among patients. Nonetheless, it has an important role as a means of pain relief and, when correctly indicated and accomplished, it may result in good function and improved quality of life⁽¹²⁻¹⁴⁾.

The technique that we used has undoubted advantages over the technique using metal plates for fixing the arthrodesis that was described by the AO group⁽¹⁵⁾. We showed that minimal fixation using Kirschner wires was effective, with consolidation in more than 93% of the cases, i.e. similar to the results from other techniques that have been described^(6,16). Fixation using metal plates, particularly in rheumatoid patients with severe osteoporosis, may be problematic because of the risk that screws may become loose. Moreover, such surgery is more aggressive and requires greater displacement of soft tissue. In lean patients, the prominence of the plate under the skin, especially when fixed to the metacarpals, may be disturbing for patients. According to Urbaniak⁽⁹⁾, the disadvantage of using metal plates is that more extensive exposure is required and that plates often have to be removed after achieving consolidation, because of their subcutaneous prominence or because of attrition of the extensor tendons. In 73 cases of arthrodesis in which metal plates (AO)

were used, Zachary and Stern⁽¹⁷⁾ found 82 complications in 50 wrists, of which 40 were over the short term (relating to the surgical wound, lack of complete extension of the fingers, transitory neurological deficit, infection and pain in the distal radioulnar joint) and 42 were over the long term. Among the latter, the plate was removed in 14 cases. These complications included: painful prominence of the plate, loosening of the screws, fracturing of the third metacarpal and radius and metacarpal-phalangeal rigidity.

We believe that in cases in which the carpometacarpal joints remain unaffected, these do not need to be included in the wrist arthrodesis. We observed that in some cases, there was an increase in the range of motion of these joints after the fusion. This finding had already been noted by Urbaniak⁽⁹⁾. Abbott *et al*⁽¹⁸⁾ had already demonstrated the importance of carpometacarpal movements during gripping actions.

Nagy and Buchler⁽¹⁹⁾ conducted a comparative study between 47 wrist arthrodesis procedures that included the carpometacarpal joint in the fusion and 34 in which this joint was not included. In all the cases, a metal plate was fixed to the third metacarpal (in the cases without carpometacarpal fusion, the plate only formed a bridge over this joint). In the first group of 47 cases, 20 evolved with pseudarthrosis and 11 of these were painful, requiring additional surgery. In the second group of 34 cases, only one evolved with pain.

In none of our patients was it necessary to remove the distal extremity of the ulna. This did not affect the functional result with regard to pronation and supination movements. Although the patients presented some degree of deficit, there was no impairment of their activities of daily living. These findings were similar to those reported by Barbieri *et al*⁽¹⁴⁾.

The grip strength of the operated hand among our cases was 96% of the grip strength of the non-operated hand, and this ratio was greater than the findings of other authors^(14,20,21). The fingertip pinch strength (pad to pad) was on average similar to what has been found using other techniques. However, the pinch strength on the operated side was, surprisingly, greater than on the non-operated side.

The result from the DASH questionnaire, which is one of the hand function assessment methods most used today, presented a mean score of 27 (where 0 = no incapacity and 100 = total incapacity). This was similar

to the results of Adey *et al*⁽²¹⁾, slightly better than those of Wieloch *et al*⁽²²⁾ (35.5) and much better than those of De Smet and Truyen⁽²³⁾ (44). The latter authors used two different techniques and did not differentiate the results according to the procedure used. Our results were also superior to those of Sauerbier *et al*⁽²⁴⁾, who obtained a mean of 51 points among their arthrodesis patients who presented radiocarpal arthrosis or Kienbock's disease.

With regard to pain, our result coincided with the findings of Barbieri *et al*⁽¹⁴⁾, i.e. pain was only manifested with activities that required pronosupination more vigorously. All the patients evaluated said that they were satisfied with the results from the surgery and that they would undergo this treatment again.

CONCLUSION

Wrist arthrodesis with minimal fixation, i.e. with Kirschner wires, is less aggressive, inexpensive and technically simple. Removal of the wires does not require major procedures, the biological material is autogenic and the complication rate is very low. From our experience, there is no need to include the carpometacarpal joints in the arthrodesis and the patients generally feel satisfied with the results from this surgery.

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