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Wrist fusion versus limited carpal fusion in advanced Kienbock's disease

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Abstract We treated 18 patients with advanced Kienbock's disease surgically. Six had total wrist fusions and 12 had limited carpal fusions. The average age was 39.6 yrs and the average follow up was 61.8 months and 66.8 months respectively. The visual analogue pain scores, the patient satisfaction scores and the SF 12 were better in the total wrist fusion group. The DASH (Disabilities of the Arm, Shoulder and Hand) scores, the range of movement and the grip strengths were better in the limited carpal fusions group but this was not statistically significant. Four patients with limited carpal fusions had a non-union that required revising. We believe that total wrist fusion should be offered earlier to patients with advanced stages of the disease, as there are less surgical failures, more satisfied patients, better post operative pain scores and consistent long-term results with less potential for further deterioration with time as compared to other treatment methods.

Résumé Nous avons traité chirurgicalement 18 malades avec une maladie de Kienbock avancée. Six malades ont eu une arthrodèse radio-carpienne complète et 12 une arthrodèse carpienne limitée. L'âge moyen était de 39,6 ans et la moyenne de suivi était de 61,8 mois et 66,8 mois respectivement. La score analogique visuel de la douleur, la score de satisfaction des malades et le score SF 12 sont meilleurs dans le groupe fusion complète. Le score DASH

(Invalidités Bras, Épaule et Main), l'amplitude de mouvement et la force de préhension étaient meilleurs dans le groupe des fusions carpiennes limitées mais ce n'était pas statistiquement significatif. Quatre malades avec une fusion carpienne limitée avaient une pseudarthrose qui a exigé une révision. Nous croyons que la fusion complète du poignet devrait être offerte plus précocement aux malades aux étapes avancées de la maladie, car il y aurait moins d'échec chirurgicaux, plus de patients satisfaits, de meilleurs résultats sur la douleur, et des résultats plus solides à long terme avec moins de risque de détérioration secondaire, comparée aux autres méthodes du traitement.

Introduction

Kienbock's disease is a rare, painful disorder of the wrist of unknown aetiology, characterised by avascular necrosis of the carpal lunate. The advanced stages 3B and 4 [7] are characterized by progressive carpal collapse, altered carpal kinematics, fragmentation of the lunate and secondary osteoarthritis. At this stage the lunate is not reconstructable and surgery should be aimed at salvage only. Various treatment options have been tried which include, lunate replacement [7, 13, 15], lunate excision [5], proximal row carpectomy [1, 8, 11], limited carpal fusions [6, 8, 11, 14] and wrist fusion. There is no strong evidence to support one procedure over another.

Materials and methods

This was a retrospective study undertaken at Wrightington Hospital, Lancashire, UK. In our institute a tertiary referral centre all cases of Kienbock's disease treated here are recorded in a register called the Northwest Kienbock's register. Presently the register has 223 Kienbock's patients on it. From these we picked out patients with advanced Kienbock's disease (radiological stage 3B and 4) who either had a total wrist fusion or a Limited carpal fusion. Out of 23 patients included we were able to review 18 pa-

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tients. Of the five lost to follow up two had a total wrist fusion and three had some form of limited carpal fusion.

In the limited fusion group the wrist was exposed by a dorsal approach with a distally based flap exposing the carpus. The carpal bones to be fused were identified, the cartilage was denuded and the joints were packed with iliac crest graft and then fixed either by K-wires or screws. After surgery, the wrist was immobilized using a POP cast for 6–8 weeks. After this time if K wires had been inserted they were removed. Dependent on radiological appearances the wrist was then maintained in a removable splint for a further variable period, with subsequent therapy.

In the wrist fusion group, the wrist was exposed dorsally with a distally based flap and the carpus was exposed. The carpal surfaces were denuded of all remaining cartilage, packed with iliac crest graft and then fixed with a standard low profile contoured wrist fusion plate. Post operatively the wrists were placed in a POP cast for 8 weeks and then dependent on X-ray images were maintained for a variable period in a removable moulded synthetic splint with subsequent therapy.

Patient outcome was assessed in a research clinic using serial plain X-rays, DASH (Disabilities of the Arm, Shoulder and Hand) score, SF12 score and the visual analogue scale for pain. Patient's satisfaction was graded using a scale of 1–5. Grip strength and the range of motion were also evaluated and any post-operative complications were recorded.

Results

A total of 18 patients were included in the study, six with wrist and 12 with limited carpal fusions. In the limited carpal fusion group six patients had radio-lunate (Chamay) fusions, three had scapho-trapezoid-trapezium (STT) fusions, two scaphocapitate and one capitolunate. Two patients had undergone lunate excisions previous to the limited fusions.

The demographic data is recorded in Table 1. As can be seen there is little difference between the groups although there were proportionally more males in the total wrist fusion group. The average age of the wrist fusion group was 47 (range 31–60) years and the average age of the group with limited carpal fusion was 36 (range 26–57) years.

There were no significant post-operative complications. Failures were defined as non-unions or presence of persistent post operative pain greater than five on a visual an-

Table 2 Clinical results

	Wrist Fusion	Limited Carpal Fusion
Pre-op mean VAS score (range)	8 (5–10)	8.1 (6–10)
Post-op mean VAS score (range)	3.3 (0–7)	7.2 (4–10)
Post-op satisfaction rating (range)	4.4 (4–5)	3 (2–5)
Post-op Grip Strength		
Jamar	0.43 (0.23–1.17)	0.54 (0.11–0.83)
Myometer	0.42 (0.29–0.88)	0.54 (0.15–0.82)
Post-op average ROM		
PF-DF	0	32–41.8
RD-UD	0	12.5–21.6
Post-op mean SF12 (range)		
MCS	37 (27–48)	51 (30–63)
PCS	30 (27–48)	43 (35–57)

alogue scale. There were three non-unions in the limited carpal fusion group (two in the group with radiolunate fusions and one who had a STT fusion). Two have had a wrist fusion and one is awaiting surgery. Two patients had persistent pain postoperatively because of arthritic changes in other areas of the wrist joint. All patients diagnosed as failures had posterior interosseous neurectomy before being advised wrist fusion. The failures in this group were all diagnosed at an average of 26 months. In the wrist fusion group, one patient reported activity related pain for which he also had a posterior interosseous neurectomy.

A summary of the clinical results and the post-operative findings can be seen in Table 2. There is no significant difference between the pre-operative pain scores for the two groups, but a statistically significant difference is apparent between the post-operative pain scores, with the wrist fusion having better pain scores ($p=0.005$). The SF12 scores, the grip strengths and the DASH scores though slightly better in the limited fusion group are not statistically significant. Finally, and as one would expect, the partial wrist fusion group retained some movement whilst the total wrist fusion group had none.

Of the nine patients who had radiological stage 3B disease at surgery three were found to have chondral changes isolated to the radiolunate joint only and it was decided to proceed with a radiolunate fusion instead of another type of limited carpal fusion. Similarly in the group of patients who had total wrist fusion two patients classified to have stage 3B disease radiological; were found on direct vision to have chondral changes present in both the radiolunate and the midcarpal joints and so it was decided to do a total wrist fusion.

Discussion

The term 'advanced Kienbock's Disease' [1, 8, 11, 14] has been used in many articles but there is no clear definition or

Table 1 Demographic data

	Wrist fusion	Limited carpal fusion
Male/Female	5/1	6/6
Manual labourer	3	5
Office worker	3	7
Mean follow up (range)	61.8 mths (3–9 yrs)	66.8 mths (2–9 yrs)
Average number of surgical procedures	2 (1–4)	1.7 (1–3)

agreement on which stages can actually be classified under this group. Studies include stages 2, 3A, 3B and stage 4 [1, 5, 7, 8, 11, 12, 14]. Combining these different stages where wrist biomechanics are completely different and comparing results is not correct. For this series we have included all patients with stage 3B and 4. In these stages the lunate is fragmented, in addition presence of chondral changes makes lunate reconstruction difficult and salvage procedures are preferred. Various treatment options have been tried which include, lunate replacement [13, 15], lunate excision [5], proximal row carpectomy [1, 8] limited carpal fusions [12, 14, 16] and wrist fusion [9]. There is no strong evidence to support the use of one procedure over the other.

Nakamura et al. [8] and Rhee et al. [11] compared limited carpal fusions with proximal row carpectomy. Rhee et al. [11] concluded that the overall results of proximal row carpectomy are better than any carpal arthrodesis (STT fusion with lunate excision) though the ideal treatment of advanced Kienbock's depends on the patient's age, sex, job and the stage of disease. Nakamura et al. [8] had a mixture of limited carpal fusions in their series. They concluded that STT fusion with or without lunate excision and replacement is recommended in selected patients with advanced disease who have a fragmented lunate. They also point out that in advanced Kienbock's disease the radiolunate fossa is diseased. In proximal row carpectomy the axial load passes through the artificially created radio-capitate joint which sits in the lunate fossa. The proximal row carpectomy would be disadvantageous as the lunate fossa is diseased and hence the results of the procedure might be poor. Similar observations have been made by Watnabe et al. [17]. They also conclude that radiolunate arthrodesis is rarely used in advanced disease. Both the studies however include patients with stage 3A disease.

Takase et al. [14] in a series of 15 patients concluded that lunate excision, capitate osteotomy and intercarpal arthrodesis is a reliable treatment for advanced Kienbock's disease as it produces favourable results.

Other series using limited carpal fusions for various different indications have reported a complication rate of 52% and a failure rate of 15% [6]. A non-union rate of 12% has been noted by Pisano, Piemer and Wheeler et al. [10]. In another series [18] the authors had a 30% complication rate when they used limited carpal fusion in SLAC (scapholunate advanced collapse) wrists. They suggest that the patient should be made aware of the possibility of later conversion to a wrist fusion.

In addition to the risks of failure with STT and scaphocapitate fusions there is the potential for development of degenerative changes in the radioscaphoid and midcarpal joints due to increased shear forces across the joints and potential for deterioration of results with time, as suggested by biomechanical studies [2, 4]. Progressive carpal collapse will happen despite fusion [1].

Begley et al. [1] in a series of 16 patients concluded that proximal row carpectomy is a useful procedure to use in advanced Kienbock's disease. They had no patients with stage 4 disease and included patients with stage 3A and 3B.

Swanson et al. [13] recommended the use of titanium replacement arthroplasty in advanced Kienbock's disease especially with localised arthritic changes in the lunate fossa. However in conflict to this Lichtman et al. [7] using silicone arthroplasty concluded that the percentage of satisfactory results was higher when performed in the earlier stages of the disease when there are no arthritic changes and when the lunate is intact. They also suggest that proximal row carpectomy or wrist arthrodesis should be considered in the more advanced stages.

There are no studies that compare the use of wrist fusion to limited carpal fusion in advanced Kienbock's disease, despite it being used as a salvage procedure when the limited fusions fail. In one series where wrist fusions were used for a variety of causes [9] pain relief was reported in 27/28 patients, in whom pain had been an indication for the fusion. They reviewed 32 wrists and 25 patients were satisfied with the surgery. They reported no failures of fixation. There were five patients with Kienbock's disease but further details are not available.

Watnabe et al. [17] in a series reported that in almost 61% patients with stage 3B Kienbock's disease isolated radiolunate chondral changes are seen on direct arthroscopic assessment although no evidence of osteoarthritic changes were seen on radiograms. Similarly occult changes were seen on the capitulate articulation as well. They therefore advocate more thorough assessment of patients with advanced (stage 3B and stage 4) Kienbock's disease using arthroscopy and MRI scanning. They also conclude that proximal row carpectomy is not a suitable procedure as done by Nakamura et al. [8] and recommend that either an excision of lunate, intercarpal arthrodesis or a radiolunate fusion should be used to treat these advanced stages. Our findings were similar and we fully agree that more extensive evaluation with wrist arthroscopy and MRI is indicated in these patients. However the high failure rate in patients who had a radiolunate fusion suggests that this is not an ideal treatment option and we do not recommend its use even though, in the presence of isolated articular changes it would seem ideal.

Our study is retrospective, the numbers are small and it is non-randomised but we have a long follow-up period and it certainly should help the clinician define the indications for various salvage procedures in advanced Kienbock's disease. Patients with wrist fusions had a significant improvement in pain. There were no failures of surgery and a very high patient satisfaction rate. The limited carpal fusion group had a better average grip strength, post operative DASH score and average SF12 score but the difference was not statistically significant. There was a cumulative failure rate of 33%.

In conclusion there is no single procedure that could be used to treat patient with advanced Kienbock's disease and there is a role for all the different salvage procedures discussed. The best procedure will depend on patient age, patient expectations, occupation of patient and findings seen after extensive arthroscopic evaluation. However in selected cases with advanced Kienbock's disease, wrist fusion

should be offered earlier as the treatment option of choice as it has the benefit of avoiding multiple operations and their associated problems, consistent results, with high patient satisfaction are assured with less chances of long-term failure once solid fusion mass is achieved.

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