



## Is radiolunate fusion a viable option in advanced Kienböck disease ?

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The management of Kienböck's disease in the advanced stages (Lichtman stages 3B and 4) remains controversial. The aim of this study was to report the results of radiolunate fusion (Chamay) in patients with advanced Kienböck with localised radiolunate chondral changes.

There were six patients. The average age was 40 years and the mean follow-up was 67 months. The average postoperative visual analogue pain score was 6, which was not a significant improvement on the preoperative score. The average postoperative carpal height achieved using the Modified Bauman's Index was 1.32, significantly less than normal. The average postoperative DASH score was 41.02, not significantly better than the preoperative score. The average grip strength and satisfaction rating were 0.55 and 3.83 respectively. Three of the six patients who had radiolunate fusions were clinically defined as failures and underwent total wrist fusion.

Based on these findings, although radiolunate fusion appears as an attractive proposition in patients with localised chondral changes, we do not recommend its routine use in advanced Kienböck's disease.

**Keywords :** Kienböck's disease ; advanced stages ; radiolunate fusion (Chamay) ; outcome.

### INTRODUCTION

Kienböck's disease is a rare, painful disorder of the wrist of unknown aetiology, characterised by avascular necrosis of the carpal lunate and progressive carpal collapse with ultimately secondary

osteoarthritis. According to the Lichtman and Degnan classification (5) which has been used as a guide in treating patients, stage 3B is characterised by progressive carpal collapse, altered carpal kinematics, fragmentation of the lunate, and stage 4 has additional secondary osteoarthritis.

More recently with common use of arthroscopy some stage 3B cases have been noted to have chondral ulcerations in the radiolunate and capitulate articulations not seen on plain radiographs (12) and should be actually classified as early stage 4. Watanabe *et al* (12) also found that these chondral changes seem to be localised at least initially before becoming global. The pattern of involvement appears initially to involve the radiolunate joint, then the capitulate joint and finally the wrist joint globally.

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There is very little literature highlighting this aspect of spread of Kienböck's disease. Watanabe *et al* (12) and Nakamura *et al* (6) suggest that these wrists should also be treated as stage 4 wrists rather than 3B. In such wrists, attempting to reconstruct the lunate and preserve carpal joint anatomy has a high chance of failure because of the existent arthritic changes and loss of lunate anatomy. They suggested that the treatment options in this stage could include radiolunate (Chamay) (1) fusions, proximal row carpal excision and wrist fusion. The option of performing an isolated radiolunate fusion to treat wrists with isolated chondral changes is very attractive as it would ameliorate the pain, maintain strength and preserve motion. Moreover using the lunate as the key stone of the carpus, the fusion allows correction of malalignment and instability.

The aim of our study was to report the results of a small series of radiolunate fusions (Chamay) in cases of Kienböck disease with localised arthritic changes.

#### PATIENTS AND METHODS

This was a retrospective study undertaken at Wrightington Hospital, Lancashire, United Kingdom. At Wrightington Hospital we maintain a register of all the patients diagnosed with Kienböck's disease and seen by consultants in the North West of England (The Northwest Kienböck register). Currently there are 223 patients on this register. From this data base, patients with stages 3B and 4 Kienböck's disease who had been found to have localised chondral changes and were therefore treated with radiolunate fusion were included. The assessment of chondral changes had been done by radiographs and preoperative wrist arthroscopy. These patients were stage 3B or 4 on radiography, however on arthroscopy of the wrist they were found to have isolated chondral changes in the radiolunate joint only. The radioscaphoid and the midcarpal joints were pristine and unaffected. These changes were confirmed at surgery.

For the radiolunate fusion the wrist was exposed by a dorsal approach centered over Lister's tubercle. Capsular flaps were created through the fourth extensor compartment and the carpus was exposed. The lunate was identified and the changes in the radiolunate fossa and other areas of the wrist joint were confirmed. The

articular surface of the proximal aspect of the lunate was excised along with some necrotic bone leaving behind a shell of cartilage on the midcarpal side with a variable amount of vascularised bone so as to attempt to maintain the outside dimensions of the lunate. Similarly the articular surface on the lunate fossa of the radius was prepared. A block of cortico-cancellous bone was harvested from the distal radius after flattening Lister's tubercle going through the third extensor compartment. A graft of the size of 1.5 by 1.5 centimeters was harvested and then fashioned to be inserted into the radiolunate interval. The bone graft and radius were fixed with two K-wires inserted parallel longitudinally from the radial side of the radius toward the lunate fossa. Traversing the midcarpal joint was avoided. Any gaps present were packed with cancellous chips harvested at the same time.

After surgery, the wrist was immobilised in a cast for 6 to 8 weeks. At that time the K-wires were removed and a further splintage was maintained for 6 weeks. This was followed by a course of supervised physiotherapy.

Patient outcome was assessed by a visual analogue score before surgery and at a later stage of follow-up. In addition, range of motion (goniometre) and grip strength (Jamar dynamometer) were assessed. These were compared to the contralateral side. In addition to patient's satisfaction the pre and post op DASH scores were recorded. Finally, radiographs were taken to assess fusion and any progression of the disease process. In addition any postoperative complications or further surgery, were noted.

#### RESULTS

Eight patients who had a radiolunate fusion for similar indications were present in the database. Six of these could be evaluated completely. There were five male and one female. Two patients who were classified as being stage 3B on radiographs were actually found to have chondral changes in the radiolunate fossa on direct vision at surgery. The other four were classified as stage 4 as there was radiological evidence of early radiolunate arthritis confirmed on arthroscopy. The average age of the patients was 33 years (range : 24 to 43). Two patients had heavy manual jobs and the rest had office based jobs. The mean follow-up was 67 months (range : 24 to 108).



**Fig. 1.** — Patient with radiologic stage 3B disease who was found to have chondral changes and ulceration on direct visualisation. Radiolunate fusion done.



**Fig. 2.** — Patient with a successful radiolunate fusion. However midcarpal arthritic changes are appearing, causing persistent pain.

Failure of treatment was defined as persistent postoperative pain on activity greater than five on the visual analogue score or symptomatic radiologic non union. Non union was assessed by radiography. If there was a doubt CT scan was used to assess union.

Three patients were defined as failures, two due to nonunion and one due to progression of arthritis to other areas of the wrist despite union having been achieved, resulting in persistent pain. These three patients have been revised to total wrist fusion. There were no complications of note from this procedure, although one patient did have a superficial infection at the pin site, which resolved on removal.

Clinical results are summarised in table I. Although the numbers are too small to undertake any statistical analysis, the difference in the scores between the first three patients, those who were classified as failures and the last three, who generally had a good result, is quite marked. Though the patients who achieved union had a significant improvement in the pain scores, complete pain relief was not achieved in any patient. Similarly there was reconstitution of the carpal height to a small extent in those patients who achieved union. However it was significantly less than the normal accepted Modified Bauman's Index of  $1.57 \pm 0.05$  (9). The DASH scores and grip strengths

achieved are all summarised. The DASH scores improved markedly after surgery in patients who achieved union.

## DISCUSSION

The term advanced Kienböck's disease has been coined in many articles, and wrists with stages 2, 3A, 3B and stage 4 have all been included. There are however significant differences between all these stages and hence considering them together and comparing the results is inappropriate.

Watanabe *et al* (12) found that in 61% of patients with stage 3B disease in their series, ulceration of the lunate fossa was observed with no evidence of these changes on radiographs. Changes were also noted in the lunocapitate articulation in a smaller number. They suggested that these patients should be treated differently from the other stage 3B patients. We also made similar findings in a number of cases and agree that these particular stage 3B wrists should be grouped along with early stage 4 and as a consequence be treated similarly. In such cases the lunate and the carpal articulations cannot be preserved.

Various methods of treatment have been suggested to treat wrists with Kienböck's disease stage 3B and stage 4. They include lunate replacement (9,11), lunate excision (4), proximal row carpectomy (6,8),

Table I. — Summary of patients' results

	VAS	DASH SCORE	CARPAL HT INDEX	SATISFACTION RATING	GRIP STRENGTH	OUTCOME
	PreOp PostOp	PreOp PostOp	PreOp PostOp			
Patient 1	10 10	68.1 62.1	1.33 1.29	3	0.39	NONUNION
Patient 2	9 8	70.32 60.23	1.29 1.24	3	0.33	NONUNION
Patient 3	6 6	61.45 43.33	1.28 1.36	4	0.49	FAILURE
Average	8.3 8	66.62 55.22	1.30 1.29	3.33	0.40	
Patient 4	5 3	67.33 24.17	1.31 1.37	4	0.66	GOOD
Patient 5	10 5	59.24 25.83	1.27 1.38	5	0.82	GOOD
Patient 6	7 4	75.34 30.83	1.30 1.33	4	0.62	GOOD
Average	7.33 4	67.30 26.94	1.29 1.36	4.33	0.70	
OVERALL AVERAGE	7.83 6	66.96 41.08	1.29 1.32	3.83	0.55	

limited carpal fusion with lunate excision and tendon ball arthroplasty (6,8) the modified Graner procedure (10) and wrist fusion (7). There are very few studies which look at truly advanced Kienböck's disease (only stages 3B and 4). Most of these studies also do not assess their patients aggressively using arthroscopy or MR arthrograms.

Limited carpal fusion (STT or SC) with lunate excision with a tendon ball replacement has been used in advanced Kienböck (6,8). However, whilst all the studies recommended the use of this procedure, they unfortunately included a mixture of stages 3A, stage 3B and stage 4 cases. There is no mention if the good results were noted in the earlier stages. Takase and Imakiire (10) used the modified Graner's procedure (lunate excision, capitate osteotomy, STT arthrodesis) and reported two failures in 15 patients with stage 3B and 4 disease.

Proximal row carpectomy has been described as a primary procedure in treating advanced Kienböck's disease (6,8). The results of the proce-

dures were inferior in both studies to those of limited carpal fusions. Nakamura *et al* (6) as well as Watanabe *et al* (12) also pointed out that if the radiolunate fossa is compromised, performing a proximal row carpectomy is disadvantageous as the main axial load of the capitate would pass through the compromised lunate fossa of the radius. So in summary PRC could be performed in some stages 3B but might result in persistent pain if arthritic changes are pre-existent. We have no experience using this procedure as a primary treatment for advanced Kienböck's disease.

Lunate replacement arthroplasty either with a silicone or titanium implant or a tendon ball (5,9, 11) has also been tried. Swanson *et al* (9) reported good results in a series of patients with stage 3 and 4 disease with titanium arthroplasty with only 3 failures. Viljakka *et al* (11) using silicone arthroplasty in a mixture of cases from stage 1 to 4 reported good results in 24 and fair results in 28 patients out of 55. They did however report a steady progression of arthritis.

Radiolunate fusion was originally used by Chamay (1) to treat patients with rheumatoid arthritis. It was used in patients with radiocarpal instability with dorsal subluxation of the ulnar head or with ulnar drift of fingers. Thirteen out of 21 wrists were pain free and they recommended the use of this procedure.

Since then radiolunate arthrodesis has been used for a variety of indications including traumatic ulnar translation, dynamic midcarpal instability and static VISI (volar intercalated sement instability) (3). Halikis *et al* (3) reported their experience in 14 wrists and had 2 nonunions but the results were satisfactory in the others. They therefore remind the reader that the radiolunate arthrodesis does work and should hence not be forgotten in other cases either.

As a result of their findings Watanabe *et al* (12) recommended the use of radiolunate fusion in the presence of isolated chondral changes in the lunate fossa. At this time we were only able to find one article, that of Nakamura *et al* (6), who report the results of these fusions in Kienböck's disease. Nakamura *et al* (6) compared the results of proximal row carpectomy versus limited carpal fusion in advanced Kienböck's disease. They used a mixture of limited carpal fusions, scaphotrapezotrapezoid arthrodesis in five, scaphocapitate arthrodesis in four, radiolunate arthrodesis in three and lunocapitate in one. There were two nonunions one in the group with radiolunate fusions and the other in the patients with STT fusion and they felt that radiolunate arthrodesis might be difficult to achieve due to the small bone mass of the lunate. Despite having very small numbers they conclude that STT fusion should be recommended in selected patients with advanced Kienböck disease.

In our study union was achieved in four out of six patients but three patients were defined as being failures (two nonunions and one severe persistent pain). The pain was due to late progression of arthritis to unfused areas. The difference in scores between the patients who were classed as failures and those who were not is quite marked though the numbers are too small to test the difference for significance. However in the patients who united some pain was still present. Complete pain relief was not

achieved. Similarly even in the patients who united there was a reduction in carpal height as compared to normal values.

In conclusion all patients with stage 3B Kienböck's disease need to be rigorously evaluated preoperatively by further investigation, either MRI scan or wrist arthroscopy, as they could have subtle early arthritic changes making the lunate unsuitable for reconstructive procedures. Essentially these patients need to be treated as patients with early stage 4 disease. Undoubtedly radiolunate fusion appears as an attractive option, and it certainly offers the advantages of being less invasive and has the potential for being motion preserving. In our series however, given the 50% failure rate due to both nonunion and progression of the arthritis as well as not very significant improvement in the other cases, we do not currently recommend this operation to our patients. This arthrodesis definitely has a role in other indications. Even in Kienböck's disease, in selected cases with use of better fusion methods and vascularised grafting methods, the results might be much better making it a viable option then.

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