ORIGINAL ARTICLE

# Mid-term clinical outcome of radial shortening for kienbock disease

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**Background:** To evaluate the intermediate-term outcomes of radius shortening as a treatment for Kienbock's disease. **Materials and Methods:** In a historical cohort, 16 skeletally mature patients (9 men and 7 women) with Kienbock disease, who were treated with radial shortening osteotomy between 2002 and 2012, were reviewed in our study. The mean age of our patients was 30 (range 18-43) years old. According to Litchman staging, there were 7 wrists at stage II and 9 wrists at stage III (6 at stage IIIA and 3 at stage IIIB). The data of grip strength, pain (visual analog scale (VAS) score), wrist range of motion (ROM), ulnar variance (according to Palmer method), and the Lichtman stage were gathered before and after surgery. We evaluated overall wrist function using the Mayo Wrist score and disabilities of the arm shoulder and hand (DASH) score before surgery and at the last follow-up. **Results:** The average of follow-up was 7 years (range from 5 to 9 years). Preoperative ulnar variance was –1.3 mm (range from 2.5 to 1) preoperatively. The mean postoperative ulnar variance was 1 mm positive (range from 0.5 to 1.5). The VAS pain score, the mean arc of wrist flexion and extension, and grip strength improved significantly preoperatively compared to after recovery from surgery. The Lichtman stage was unchanged in nine patients, one grade worse in six patients, and one grade better in one patient. The mean DASH and Mayo scores improved significantly postoperatively compare with preoperation. Comparing preoperative positive, neuter, and negative ulnar variance, there was no significant difference in terms of VAS, DASH, and Mayo scores as well as ROM and grip strength. **Conclusion:** Our study shows that radius shortening surgery improves pain and disability regardless of ulnar variance.

**Key words:** Kienbock's disease, mid-term, radial shortening

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## INTRODUCTION

Kienböck disease is idiopathic osteonecrosis of the lunate. There is no consensus on treatment.[1] Hulten *et al*. in 1928[2] documented that there was a correlation between Kienböck disease and negative ulnar variance. This led to a theory that the lunate is experiencing too much force from the radius especially when there is a concomitant ulnar minus status. Treatment options based on this theory include radial close or open wedge osteotomy[3,4] and shortening[5-11], or ulnar lengthening.[12] However, some methods directly address the revascularization[13-17] Worldwide, radial shortening seems to be the most common procedure.[8-12]

In the current study, we hypothesized that there is no association between reducing ulnar variance and reducing symptoms.

## MATERIALS AND METHODS

In a historical cohort, all 16 skeletally mature patients with Kienbock disease, who were treated with radial shortening osteotomy at Gaem Hospital, Mashhad, Iran between 2002 and 2012, were invited to participate in our study. The patients' data were extracted from surgeons' database. Lunate osteonecrosis was confirmed with both plane radiographies and magnetic resonance imaging. Skeletal maturity was defined in plane radiographies if all physes were closed. This retrospective review of these 16 patients was approved by the Ethical Research Committee of the Mashhad University of Medical sciences (MUMS ref. no. 87711).

### Population

The mean age of our 16 patients was 30 years (range, 18-43 years). There were 9 men and 7 women and three out of 16 were left-handed. Two patients were cigarette smokers at the time of operation. Only three patients were heavy laborers. According to the Lichtman classification[18] there were 7 wrists at stage II and 9 wrists at stage III (6 at stage IIIA and 3 at stage IIIB). None of the patients had been treated by either casting or surgery prior to radius shortening osteotomy.

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### Surgical technique

All the patients underwent radial shortening regardless of ulnar variance, because our goal primarily was lunate salvage. In our department, radial shortening is the most common surgical procedure for lunate osteonecrosis which was done before with most certain outcome. We explained for patients that further impingement if happened, could be resolved surgically. Radial shortening was achieved by making two parallel transverse saw cuts to remove 2 mm segment of bone using free hand technique, 6-7 cm proximal to the radiocarpal joint. Fixation was achieved with a 3.5 mm five-or six-hole stainless steel dynamic compression plate (Synthes com, Zuchwil, Switzerland).[11]

### Measurement tools

Grip strength was measured as the maximum measurement out of three attempts for both sides using a dynamometer (Jaymar Engineering, Los Angeles, CA, USA) set at the third station with the elbow at ninety degrees of flexion and the forearm and wrist in neutral. Dominant side grip was multiplied by a factor of 0.85 to compensate for the usually weaker nondominant side.[19] Pain was recorded using a visual analog scale (VAS). We categorized the pain during daily activities as severe, moderate, mild, and no pain before and after surgery, based on a four options question. We used the technique described by Palmer *et al*.[20] to measure ulnar variance on radiographs taken at the time of diagnosis and when union achieved after surgery.

We evaluated overall wrist function using the Mayo Wrist score. We measured upper-extremity specific disability using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire.[6]

### Statistical analysis

We calculated the mean and standard deviation of continuous variables and frequencies of categorical variables. We used the Kruskal-Wallis test for checking normality in continuous variables. We used the paired *t*-test for comparing continuous variables pre and postoperation. Kruskal-Wallis test was used to analyze the different scores means (Mayo, DASH, grip strength, range of motion [ROM]) in different stages of the disease and different ulnar variance groups. In analyzing the scores, a $P < 0.05$ was considered significant.

## RESULTS

The average of follow-up was 7 years (range from 5 to 9 years). Preoperative ulnar variance was negative for eight patients, positive for 3, and neutral in the other 5. The mean pre and postoperative ulnar variance were –1.3 mm (range from 2.5 to 1) and 1 mm positive (range from 0.5 to 1.5), respectively. The average of preoperative distal radius inclination angle was measured 18.4 ± 4.1. Comparing pre and postoperative, the Lichtman stage was unchanged in nine patients, one grade worse in six patients, and one grade better in one patient [Figure 1].

The VAS pain score, mean arc of wrist flexion and extension, and grip strength improved after surgery. More data are shown in Table 1.

The mean DASH and Mayo scores improved significantly [Table 1].

Comparing preoperative positive, neuter, and negative ulnar variance, there was no significant difference in terms of VAS, DASH, and Mayo scores as well as ROM and grip strength. Different stages of the disease (II, IIIA, and IIIB) showed the same results.

## DISCUSSION

Radial shortening can be opted after lunate osteonecrosis regardless of ulnar variance.[18,21-27] Surgeons are usually worried of using radial shortening for patients with ulnar positive or neutral variance for fear of creating ulnocarpal impingement. Nevertheless, we documented decreased

**Table 1: Pre and postoperation clinical outcome in patients suffering from Kienboch disease**

| Outcome | Preoperative | | Postoperative | | *P* |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| ROM (degree) | 67 | 8.1 | 74 | 9.5 | 0.04 |
| Grip power* | 62 | 14 | 81 | 10 | 0.01 |
| DASH score | 38 | 7.9 | 13 | 4.0 | 0.001 |
| Mayo Wrist score | 29 | 11 | 77 | 8.5 | 0.003 |

*Compare to the unaffected side. Dominant side grip was multiplied by a factor of 0.85 to compensate for the usually weaker nondominant side. SD = Standard deviation; ROM = Range of motion; DASH = Disabilities of the arm shoulder and hand

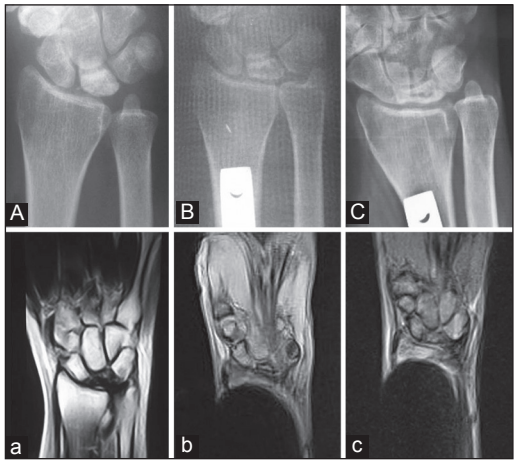


**Figure 1:** A 31-year-old woman with Kienböck disease. (A and a) Radiograph and associated magnetic resonance image at the time of diagnosis. (B and b) 12 weeks after radial shortening. (C and c) 5 years after operation. Although lunate has been revascularized, lunate collapsed. However, clinical symptoms were minimal

pain (VAS score) and disability (DASH score) in our patients. This is in spite of the fact that objective impairment (ROM) did not improve, and radiographic Lichtman stage often deteriorated.

The limitations of the study are that this is a relatively small case series as is typical for uncommon diseases. We did not compare radial shortening method with other operative or nonoperative methods. The advantages of our study are preoperative pain and disability measurements and mid-term follow-up.

Similar to our study, Salmon *et al*. compared two methods of casting and radial shortening with Lichtman stage III Kienböck disease and found patients treated by radial shortening had less pain and better grip strength than those managed nonoperatively.[9] Our patients had comparable ROM and grip strength to patients in other studies of disease-modifying treatment. The results of radial shortening osteotomy were not affected by preoperative ulnar variance. Previous studies suggested this modality only if ulnar variance is negative. But our results showed that radial shortening can be opted for Kienbock disease regardless of being concerned about ulnar variance. It seems that lunate decompression inside the carpal joint is important rather than matching the ulnar and radius heights. The results of other studies are summarized in Table 2. We could not find any similar study comparing the outcomes based on the ulnar variance.

The observation that only subjective (pain and disability) and partly subjective (grip strength) outcomes improved, while objective outcomes (motion and radiographic stage) either did not change or got worse raises several questions about the treatment of Keinbock disease.

First, there is no evidence that any of our operative treatments is better than the natural history of the disease. At the time of diagnosis, we do not know if the pathophysiological process is old and complete, active but resolving, or active and progressive. There is currently no way to know this based on symptoms, examination, imaging, or diagnostic surgery. It is only an assumption. Surgeons can only make a difference for actively progressive disease. All other surgeries intended to modify the course of the disease can be considered unnecessary if the disease progress has already spontaneously arrested.

Second, there is no evidence that any operative treatment can modify the course of actively progressive disease. To prove, this would require a sizable prospective randomized trial of surgery versus sham surgery or nonoperative treatment-which is very difficult to achieve with such an uncommon disease.

Finally, there is no evidence that any operative treatment can improve symptoms better than placebo. In other words, it may be active care and intervention that are meaningful to patients and allow them to feel better and more capable, even if the surgery has no actual effect on pathophysiology or nociception. Other possibilities for improvement after surgery are regression to the mean and the self-limiting course of disease and symptoms. Only sham surgery controlled trials could demonstrate that surgery is responsible for pain relief in patients with Keinbock disease.

Our study shows that radius shortening surgery improves pain and disability, even when creating an ulnar positive wrist in some patients. Since we could not demonstrate any modification in the course of the disease and many patients worsened in spite of our intervention, we cannot be sure that the risk of creating a symptomatic ulnar positive wrist is justified. Nevertheless, we did not note any major adverse events and this operative intervention seems to compare favorably to other interventions. Finally, to suggest the best surgical method in patients not suffering from negative

**Table 2: Comparison of previous studies using radial shortening with our results**

| Study | Cases | Fallow | Age | Pressure | Lichtman classification | ROM % | Grip % | DASH score | Mayo score | VAS score |
|---|---|---|---|---|---|---|---|---|---|---|
| Weiss *et al*. | 29 | 5 | | Radial shortening | I, II, IIIA, IIIB | 78 | 86 | 11 | – | – |
| De Smet *et al*. (1995)[28] | 17 | 4.5 | 37 | Radial shortening | II, III, IV | 70 | 72 | – | – | – |
| Salmon *et al*. | 15 | 4 | 29 | Radial shortening | II, IIIA, IIIB | 73 | 75 | – | – | 0.5 |
| Maged *et al*. (2002)[29] | 15 | 6 | 30 | Radial shortening | II, IIIA, IIIB | 55 | 85 | – | – | – |
| Zafra *et al*. | 5 | 2 | 20 | Vascularized BG + radial osteotomy | IIIA, IIIB | 70 | 88 | – | – | – |
| Iwasaki *et al*. | 9 | 2.5 | 32 | Radial shortening | IIIB, IV | 80 | 85 | – | – | – |
| De Smet *et al*. | 51 | 6 | 35 | Proximal carpectomy | IV | 70 | 70 | 18 | – | – |
| Tambe *et al*. | 6 | 5 | 40 | Radiolunate fusion (chamay) | IV | | 55 | 41 | – | 6 |
| Kremer *et al*. (2008)[30] | 45 | 3 | 48 | Proximal carpectomy | III, IV | 70 | 51 | 26 | 55 | – |
| Bartak *et al*. (2009)[31] | 18 | 8 | 30 | Pisiform transposition | III, IV | 70 | 57 | 21 | – | 3 |
| Watanabe *et al*. (2009) | 19 | 21 | 39 | Radial shortening | II, IIIA, IIIB | 81 | 88 | 8 | 83 | – |
| Current study | 16 | 7 | 30 | Radial shortening | II, III | 74 | 81 | 13 | 77 | 3 |

DASH = Disabilities of the arm shoulder and hand; VAS = Visual analogue scale; ROM = Range of motion; BG = Bone graft

ulnar variance, we suggest long-term studies comparing radial shortening with radial close wedge osteotomy.

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## AUTHOR'S CONTRIBUTION

MHE, AM, EV and ARK contributed in the conception of the work, conducting the study, revising the draft, approval of the final version of the manuscript, and agreed for all aspects of the work.

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