SHORT-TERM CLINICAL OUTCOMES OF RADIAL SHORTENING OSTEOTOMY FOR KIENBÖCK'S DISEASE: A RETROSPECTIVE COHORT STUDY

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ABSTRACT

OBJECTIVES

This study aimed to determine the short-term clinical outcomes of Radial Shortening Osteotomy (RSO) in patients with Kienböck's disease.

METHODOLOGY

A retrospective study was conducted involving 25 patients diagnosed with Kienböck's disease who underwent RSO between July 1, 2022, and June 30 2025. Clinical assessments, including pain intensity, wrist range of motion (ROM), grip strength, and functional scores, were performed preoperatively and at 6 months postoperatively. Radiographic evaluations were also conducted to assess ulnar variance and lunate morphology.

RESULTS

Significant improvements were noted at 6 months postoperatively: VAS scores decreased from 7.8 to 2.3 ($p<0.001$), wrist flexion improved from 45° to 70° ($p<0.001$), and extension from 50° to 75° ($p<0.001$). Grip strength increased from 45% to 80% of the contralateral side ($p<0.001$), and the Modified Mayo Wrist Score rose from 52 to 85 ($p<0.001$). Radiographic analysis indicated a reduction in negative ulnar variance and stabilization of lunate morphology.

CONCLUSION

RSO provides significant short-term clinical benefits for patients with Kienböck's disease, including pain relief and improved wrist function. These outcomes suggest that RSO is an effective treatment option for this condition.

KEYWORDS: *Kienböck's Disease, Lunate Avascular Necrosis (AVN), Radial Shortening Osteotomy (RSO), Ulnar Variance, Wrist Function.*

INTRODUCTION

Pest first described lunate avascular necrosis (AVN), and Kienböck's described the radiological collapse of the lunate. Since then, lunate AVN is called "Kienböck disease."[1] Kienböck's disease is characterized by both intrinsic and extrinsic factors that contribute to its multifactorial etiology. Key contributors to the pathology include mechanical, morphological, and vascular factors.[2] The disease presents with symptoms of wrist pain, limited range of motion, and functional impairment, which worsen over time if left untreated. Most patients with Kienbõck disease are young and active, aged 20 to 40. The male-female ratio is about 3:1 to 7:1. It is rarely bilateral. More than 95% of patients are engaged in heavy manual labor, regardless of gender.[3,4] Treating Kienböck's disease is particularly challenging due to several factors.[5,6] The main goal of treatment is pain relief and preservation of grip strength and range of motion (ROM).[7] In early stages, conservative treatments such as immobilization and nonsteroidal anti-inflammatory drugs may be effective.[8]

When surgical intervention is necessary, there is a range of preferred options available. These include capitate and radius osteotomy, vascularized bone grafting, core decompression, and salvage procedures like wrist arthrodesis and proximal row carpectomy. The choice of surgical technique typically depends on factors such as the stage of the disease, symptom severity, and individual patient characteristics.[9,10,11] Radial shortening osteotomy (RSO) is one such procedure, aimed at reducing the load on the lunate by shortening the radius. This technique is particularly beneficial for patients with negative ulnar variance, as it helps to restore the balance between the radius and ulna.[3,12,13] The main goal of treatment is pain relief and preservation of grip strength and range of motion (ROM). There is no consensus on the optimal treatment of the disease. Surgical interventions differ according to the severity of the condition, stage, and the surgeon's attitude.RSO has been reported to provide significant short-term pain relief and functional improvement in patients with Kienböck's disease.[14] This study aims to evaluate the short-term clinical outcomes of RSO in

patients with Kienböck's disease, specifically focusing on pain reduction, wrist range of motion (ROM), grip strength, and functional scores.

METHODOLOGY

This study is a retrospective pre-post observational study conducted at the Orthopaedic Unit of Lady Reading Hospital in Peshawar from July 1, 2022, to June 30, 2025. Ethical approval was obtained from the Departmental Research Committee of the Orthopaedics Department, Lady Reading Hospital (Ref No: 79/Ortho/LRH-25). Non-probability consecutive sampling with a margin of error of 5% and a confidence interval of 95%, a total of 25 patients diagnosed with Kienböck's disease who underwent radial shortening osteotomy (RSO) were included in the study. The inclusion criteria were: (1) a confirmed diagnosis of Kienböck's disease (Lichtman stage II or III), (2) negative ulnar variance confirmed by pre-operative radiographs, (3) clinical symptoms of wrist pain, limited range of motion (ROM), and functional impairment. Patients were excluded from the study if they had: (1) advanced Kienböck's disease (Lichtman stage IV), (2) prior wrist surgeries, (3) concurrent wrist pathologies, or (4) systemic diseases such as rheumatoid arthritis or metabolic bone disorders. Prior to surgery, all patients underwent comprehensive clinical and radiographic evaluations conducted by the same team. The clinical assessment included the following parameters: pain intensity, assessed using the Visual Analog Scale (VAS), ranging from 0 (no pain) to 10 (worst imaginable pain). Range of motion (ROM): Active wrist flexion, extension, and radial and ulnar deviation were measured using a goniometer. Grip strength: Grip strength was measured using a Jamar dynamometer and recorded as a percentage compared with the contralateral hand. Functional outcomes: Functional status was evaluated using the Modified Mayo Wrist Score (MMWS), which assesses pain, function, range of motion, and grip strength. Radiographic evaluation included the following: Ulnar variance and lunate morphology, measured on posteroanterior wrist radiographs and categorized as positive, neutral, or negative. Each patient was evaluated using standard radiographs and magnetic resonance imaging (MRI) to determine the degree of lunate collapse or degeneration. The procedure was performed under general anesthesia using the volar Henry approach, and all surgeries were carried out by a single surgeon. Based on pre-operative radiographic measurements, the radius was shortened by approximately 2–3 mm to correct the ulnar variance. Stabilization was achieved with a volar locking plate of the distal radius. During the operation, proper alignment of the radius and ulna was confirmed intraoperatively. Postoperatively, the wrist was immobilized in a short-arm splint for two weeks, after which gradual mobilization was initiated. Patients then followed a structured rehabilitation program that included wrist range of motion (ROM) exercises and strengthening exercises beginning in the third postoperative week. Patients were evaluated 6 months after surgery by the same clinical team for both clinical and radiographic outcomes. The clinical assessments were identical to those conducted preoperatively. Statistical analysis was performed using SPSS version 25.0. Descriptive statistics, including mean, standard deviation, and range, were calculated for demographic characteristics and pre-operative and postoperative clinical and radiographic variables. Paired t-tests were used to compare pre-operative and postoperative values for pain intensity, ROM, grip strength, and MMWS scores. A p-value of less than 0.05 was considered statistically significant. To evaluate factors influencing postoperative outcomes, logistic regression analysis was conducted. The dependent variables in the regression model were improvement in postoperative ROM and grip strength. Independent variables included pre-operative pain score, symptom duration, and patient age. Multivariate analysis was performed to identify significant predictors of clinical outcomes.

RESULTS

This cohort study consisted of 25 patients (18 males, 7 females) with a mean age of 32.4 years (range: 24-45 years). The mean duration of symptoms prior to surgery was 14.2 months (range: 6-24 months). Table 1 presents the demographic characteristics of the study population. At 6 months postoperatively, significant improvements were observed in pain intensity, wrist ROM, grip strength, and functional scores. The mean VAS score decreased from 7.8 preoperatively to 2.3 postoperatively ($p<0.001$). Wrist flexion improved from a mean of 45° to 70° ($p<0.001$), and wrist extension improved from 50° to 75° ($p<0.001$). Grip strength increased from 45% to 80% of the contralateral side ($p<0.001$). The mean Modified Mayo Wrist Score improved from 52 preoperatively to 85 postoperatively ($p<0.001$). Radiographic analysis showed a reduction in negative ulnar variance from a mean of -2.5 mm preoperatively to -0.2 mm postoperatively ($p<0.001$). Logistic regression analysis was performed to determine factors influencing postoperative outcomes. The analysis revealed that pre-operative VAS scores and symptom duration were significantly correlated with postoperative improvement in grip strength and ROM ($p<0.05$).

Table 1: Demographic Characteristics of Study Participants

Parameter	Value
Male	18 (72%)
Female	07 (28%)
Mean age (years)	32.4 (Range: 24-45)
Mean Duration of Symptoms (months)	14.2 (Range: 6-24)

Table 2: Pre-operative and Postoperative Clinical Outcomes

Parameter	Pre-operative mean ± SD	Postoperative mean ± SD	p-value
VAS Score	7.8 ± 1.2	2.3 ± 1.0	<0.001
Wrist Flexion (°)	45 ± 10	70 ± 8	<0.001
Wrist Extension (°)	50 ± 12	75 ± 7	<0.001
Grip Strength (%)	45 ± 15	80 ± 10	<0.001
Modified Mayo Wrist Score	52 ± 15	85 ± 10	<0.001

Table 3: Pre-operative and Postoperative Radiographic Outcomes

Parameter	Pre-operative mean ± SD	Postoperative mean ± SD	p-value
Ulnar Variance (mm)	−2.5 ± 0.8	−0.2 ± 0.5	<0.001

Figure 1: Preoperatively Radiographic Assessment, Figure B and C: Postoperative Assessment

Table 4: Summarizes the Postoperative Complications Encountered in Patients Undergoing Radial Shortening Osteotomy (RSO) for Kienböck's Disease

Complication	Incidence	Description	Management
Infection	01(4%)	01 patient developed a surgical site infection; although rare, it can occur.	Antibiotics and surgical debridement were done.
Stiffness or Limited ROM	03(12%)	Some patients have experienced stiffness or a limited range of motion despite surgical intervention.	Physical therapy, joint mobilization exercises.

Table 5: Logistic Regression Analysis Results

Variable	Odds Ratio	95% CI	p-value
Pre-operative VAS Score	0.82	0.74-0.91	0.001
Duration of Symptoms	0.95	0.91-0.99	0.03

DISCUSSION

The mean age of our study was 32.4years (range 24-45). The male-to-female ratio in our study was 3:1, which is similar to another study that reported 10 cases, including 8 males and 2 females (4:1 ratio), with an age range of 2 to 47 years and an average age of 34 years. The majority of the affected patients are heavy manual workers (65%). At this point, the radius-shortening osteotomy provides the best results.[15] The pre-operative Visual Analog Scale (VAS) score, which reflects the patient's baseline pain level, significantly decreased from an average of 7.8 ± 1.2 to 2.3 ± 1.0 following the surgical procedure. This marked reduction in postoperative pain was accompanied by a p-value of <0.001, indicating that the observed change is highly unlikely to be due to chance. These results suggest substantial improvements in patient comfort and pain management following the intervention. The clinical outcomes reported in this study, such as pain resolution, range of motion, and grip strength, were comparable to those in another study, which reported pain resolution at 81%, motion recovery at 81%, and grip strength at 88%. Comparative analyses indicate that RSO is preferred over alternative treatments for ulnar negative variance.[16] In our study population, as well as several other studies, radial shortening has been shown to reduce pain, improve function, and refine the wrist's ROM and grip power.[18] RSO serves as a joint-leveling procedure in negative ulnar wrists to reduce forces by approximately 45% through the radiolunate joint.[17] minimally invasive, creating less periosteal stripping and higher union rates.[18] In our study, the average follow-up period was 14.2 months, with a range spanning from 6 to 24 months. In contrast, another study reported a mean follow-up of 23.2 months, with a standard deviation of 6.8 months and a range of 18 to 42 months. Significantly, the postoperative MAYO scores showed a marked improvement compared with the pre-operative scores, with a statistically significant difference ($p<0.05$). Encouragingly, the majority of patients returned to work within 6 weeks of their procedure, demonstrating the effectiveness of the intervention.[18] Our complication rate closely mirrored that found in a previous study, where one patient developed a superficial wound infection that successfully resolved with a course of antibiotics. In addition, two patients reported wrist stiffness, which significantly improved following a structured physiotherapy regimen.[7] The application of Radial Shortening Osteotomy (RSO) is beneficial as it effectively reduces the mechanical stress placed on the lunate bone, enhances blood flow to the area, and helps to stabilize the joint. By unloading the radioulnar joint, RSO prevents further collapse or deformation of the lunate, ultimately contributing to better long-term outcomes for patients.[19]

LIMITATIONS

Retrospective design, lack of a control group, small sample size, single-center study, and short follow-up are among the shortcomings. Due to the rarity of the disease, we had to settle for a smaller sample size. Long-term follow-up could not be done due to loss to

follow-up after pain relief and financial constraints of some patients.

CONCLUSIONS

Radial shortening osteotomy (RSO) is an effective procedure for managing Kienböck disease in stages I-III-A. It preserves lunate integrity, slows disease progression, reduces pain, and improves function. While there are concerns about hardware and ulnar variance, overall outcomes are promising with both short- and long-term benefits. Further research with larger sample sizes and longer follow-ups is needed to assess RSO's long-term impact. RSO is recommended as a superior treatment option, improving range of motion and grip strength, and causing only mild osteoarthritic changes in the lunate. Overall, more studies are needed to evaluate its long-term efficacy and potential complications fully.

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Shah Fahad Qayyum *- Concept & Design; Data Acquisition; Data Analysis/Interpretation; Critical Revision; Final Approval*
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Noman Alam Khan *- Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Final Approval*

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.