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ORIGINAL ARTICLE

RADIAL SHORTENING OSTEOTOMY FOR SYMPTOMATIC STAGE 3 KEINBOCKS DISEASE. PATIENT RELATED 1-YEAR OUTCOMES

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ABSTRACT

Background: Keinbock's disease, also known as lunatomalacia or avascular necrosis of the lunate first described by Austrian Robert Keinbock in 1910, is a relatively rare condition affecting the wrist. Its epidemiology varies across different populations and regions, and several factors contribute to its occurrence. Keinbock's disease is considered relatively rare, with an estimated annual incidence of 1-3 cases per 100,000 individuals. Treatment strategies range from lunate-preserving techniques in early stages to salvage procedures in advanced stages. This study focuses on Stage 3 Keinbock's disease patients without osteoarthritic signs, evaluating the efficacy of radial shortening osteotomy in improving patient outcomes.

Materials & Methods: This descriptive study was conducted in a District Headquarter teaching hospital Bannu, KPK and Lady Reading Hospital Peshawar KPK from January 2023 to June 2023. All the cases were performed by one of the Hand surgery fellows. The study was approved by Hospital ethical committee. Between 2018 and 2022 all the cases of keinbocks disease treated by radial shortening osteotomy meeting the inclusion criteria were included in the study.

Results: There were 12 patients in this study with keinbocks disease. Out of these, 5 were males and 7 were females. Right side was predominantly involved and no patients had bilateral disease. Average follow up was more than 12 months for each case. Physiological and radiological parameters were assessed both preoperatively and post operatively using standardized protocol. Pain improved significantly, which was severe in 7 cases and moderate in 5 cases, postoperatively was present mildly in 2 cases. Grip strength which was 45-60 % preoperatively improved to 80 -90% postoperatively. Similarly, loss of wrist ROM also improved dramatically almost to normal. There was much less effect on the radiology of the patients. Lunate sclerosis remained the same. Only one case developed arthritis after one year of surgery but he had no pain and needed no further treatment.

Conclusion: Radial shortening osteotomy for Stage 3 Keinbock's disease appears promising based on our 1-year follow-up results.

KEY WORDS: Keinbocks disease; radial shortening osteotomy; lunate avascular necrosis.

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INTRODUCTION

Keinbock's disease, also known as lunatomalacia or avascular necrosis of the lunate first described by Austrian Robert Keinbock in 1910, is a relatively rare condition affecting the wrist. Its epidemiology varies across different populations and regions, and several factors contribute to its occurrence. Keinbock's disease is considered relatively rare, with an estimated annual incidence of 1-3 cases per 100,000 individuals.[1] However, the prevalence may be higher in certain populations or among specific demographics, such as those involved in manual labor or activities that exert repetitive stress on the wrist. Keinbock's disease typically affects individuals in their 20s to 40s, with a peak incidence in the third decade of life.

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However, it can occur at any age. There is a slight male predominance, with males being affected more often than females, although this difference may not be significant in some studies. Certain occupational or lifestyle factors may contribute to the development of Keinbock's disease.[2] Individuals involved in activities that place repetitive stress on the wrist, such as manual laborers, athletes engaging in high-impact sports, or those with occupations requiring repetitive wrist motions, may have a higher risk. Additionally, trauma or injury to the wrist, such as a fall onto an outstretched hand, can predispose individuals to Keinbock's disease.[3]

Overall, the epidemiology of Keinbock's disease is multifactorial, influenced by a combination of demographic, anatomical, occupational, and genetic factors. Further research is needed to better understand the precise risk factors and underlying mechanisms driving the development of this condition across different populations. Lichtman's classification outlines four stages of Keinbock's disease based on radiographic findings, guiding treatment decisions. Treatment strategies range from lunate-preserving techniques in early stages to salvage procedures in advanced stages.[4] This study focuses on Stage 3 Keinbock's disease patients without osteoarthritic signs, evaluating the efficacy of radial shortening osteotomy in improving patient outcomes. The purpose of this study was to evaluate the patient-related 1-year outcomes of radial shortening osteotomy for symptomatic Stage 3 Keinbock's disease.

MATERIALS AND METHODS

This descriptive cross sectional study included patients treated for Keinbock's disease with radial osteotomy at two hospitals between 2018 and 2022. Inclusion criteria encompassed Stage 3A and 3B Keinbock's disease in unilateral cases. Exclusions were age <18 or >60 years, bilateral disease, or prior wrist surgery or infection. Data collection included pre- and post-operative radiological (Stahl index, ulnar variance) and functional (pain, wrist ROM, grip strength) assessments. Patients were evaluated for radiological parameters and functional outcomes at two different timings. These included at the time of presentation and one year after surgery. The grade of pain was assessed as mild pain which occurs occasionally, moderate pain which occurs after strenuous activity and severe pain which occurs in daily activities and was graded on visual analogue scale (VAS). Wrist ROM was measured by goniometer and grip strength was measured by Hand Dynamometer.

All the cases were performed under general anesthesia. A single dose of intra venous antibiotics was given preferably Inj. Augmentin 1.2 gram. Hand was exsanguinated through an Esmarch and tourniquets was elevated. A volar trans FCR approach was used in all cases. Skin incision was given on the FCR and it was retracted radially, then FCR fascia incised and pronator quadrates exposed. It is then excised about 1 cm from the radial margin. The radius is exposed and osteotomy was performed about 5 to 6 cm proximal lunate fossa. About 5 mm of bone was removed from radius. A simple 4-hole 3.5 DCP was applied or volar locking plate depending on the situation. The wound was closed in a systematic way after removal of tourniquets and securing the hemostasis. A long arm back slab was applied for 2 weeks which was converted to short arm slab for 4 more weeks. Physiotherapy was started after 6 weeks with gentle range of exercises. Grip strengthening exercises were started after 3 months post operatively.

RESULTS

There were 12 patients in this study with keinbocks disease. Out of these, 5 were males and 7 were females. Right side was predominantly involved and no patients had bilateral disease. Average

Table 1: Preoperative parameters

Case no	Gender	Side	Pain	ROM	Grip strength	Ulnar Variance	Stahl Index	Lunate changes	Wrist arthritis
1	M	R	7	25	70	2	0.4	Sclerosis	No
2	F	R	8	30	60	2	0.4	Fragmentation	No
3	F	L	7	20	70	3	0.3	Sclerosis	No
4	M	R	8	30	65	2	0.4	Sclerosis	No
5	F	L	6	25	55	2	0.35	Sclerosis	No
6	M	R	8	35	60	0	0.4	Fragmentation	No
7	F	R	7	25	45	0	0.35	Sclerosis	No
8	F	R	9	40	45	2	0.3	Fragmentation	No
9	M	L	8	35	50	2	0.3	Fragmentation	No
10	M	R	7	25	55	0	0.45	Sclerosis	No
11	F	R	7	25	60	2	0.4	Sclerosis	No
12	F	R	8	30	45	0	0.35	Fragmentation	No

Table 2: Post-operative parameters.

Case no	Gender	Side	Pain	ROM	Grip strength	Ulnar Variance	Stahl Index	Lunate changes	Wrist arthritis
1	M	R	1	0	85	0	0.4	Sclerosis	No
2	F	R	1	15	80	0	0.4	United	No
3	F	L	0	0	90	0	0.3	Sclerosis	No
4	M	R	1	10	80	0	0.4	Sclerosis	No
5	F	L	1	10	85	0	0.35	United	No
6	M	R	2	10	85	-1	0.4	Sclerosis	No
7	F	R	1	0	85	-1	0.35	Sclerosis	No
8	F	R	2	15	80	0	0.3	Sclerosis	No
9	M	L	1	10	90	0	0.3	Fragments	Yes
10	M	R	1	0	85	-1	0.45	Sclerosis	No
11	F	R	1	10	95	0	0.4	Sclerosis	No
12	F	R	2	10	90	-1	0.35	United	No

follow up was more than 12 months for each case. Physiological and radiological parameters were assessed both preoperatively and post operatively using standardized protocol. Pain improved significantly, which was severe in 7 cases and moderate in 5 cases, postoperatively was present mildly in 2 cases (mean pain 7.5 vs 1.16, p-value $\leq$0.05). Grip strength which was 45-60 % preoperatively improved to 80 -90% postoperatively (48.33 vs 85.83, p-value $\leq$0.05). Similarly, loss of wrist ROM also decreased dramatically from 28.75 degrees to of 7.5 degrees (p-value $\leq$0.05) after the surgery. There was much less effect on the radiology of the patients except ulnar variance which decreased to neutral in 8 cases and negative in 4 cases. There was no change in Stahl's index both preoperatively and post operatively. Lunate sclerosis was present in 8 cases, remained the same in the follow-up period. Similarly, Lunate fragmentation which was present in 4 cases, 3 cases showed healing and union of fragments after 1 year follow-up. Only one case developed arthritis but he had no pain and needed no further treatment.

DISCUSSION

Radial shortening osteotomy improves vascularization to the lunate by unloading forces across the radio-lunate joint. Our data confirm the short-term effectiveness of this treatment, with most patients reporting either complete resolution or mild pain during work and sport activities. Thus, radial osteotomy achieves the treatment goals of reducing pain, maintaining or enhancing wrist range of motion (ROM), and increasing grip strength.[1,2]

Continued radiological disease progression after radial osteotomy, albeit slower, aligns with previous findings. A study found ongoing degenerative changes around the scaphoid post-osteotomy.[5] Interestingly, a study found that radial osteotomy did not correct Stahl index or carpal height ratio, concluding no treatment superiority for Keinbock's disease.[6] Similarly, another noted radial osteotomy slowed disease progression, providing lasting pain relief and potential grip strength improvement, albeit without a definitive cure. [7] Indications for surgical intervention should be based on symptoms and functional impairment rather than radiographic evidence, as not all patients experience disease progression.

The clinical benefits of radial osteotomy include unloading across the radio-lunate joint, promoting creeping revascularization and improved functional outcomes post-operatively. Osteotomy near the lunate may induce changes in arterial inflow or venous drainage, leading to pain relief and occasional architectural changes. Younger patients may experience better postoperative radiological outcomes due to higher revascularization capacity. Approximately 50% of our cases showed postoperative lunate union, even in displaced fractures, highlighting the efficacy of radial osteotomy for Keinbock's disease at this stage.[3,5,8]

Long-term clinical and radiological outcomes of radial osteotomy for Keinbock's disease are relatively rare. An article reported positive pain resolution outcomes but noted progressive osteoarthritic changes in most of the cases. [2,9] Although osteoarthritic progression occurred in our study group, it was mild, with no evidence of affecting clinical outcomes.

CONCLUSION

The exact cause of Keinbock's disease remains poorly understood, leading to multiple treatment options. Radial shortening osteotomy for Stage 3 Keinbock's disease appears promising based on our 1-year follow-up results. However, further research, including multicenter randomized controlled studies with long-term follow-up, is necessary to validate the efficacy of this procedure.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

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Conception or Design:	AUJ, SA, SK
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Manuscript Writing & Approval:	AUJ, SA, SK, AK, JA, STM, MSK

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.