Nepal Orthopedic Association Journal
https://doi.org/10.59173/noaj.20251103j

CASE SERIES

Functional and Radiological Outcomes after Radial Core Decompression in Kienböck's Disease: A Case Series of 14 Adults

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ABSTRACT

BACKGROUND

Kienböck's disease, characterized by avascular necrosis of the lunate, remains a therapeutic challenge. Radial core decompression (RCD) has emerged as a joint-preserving option to halt disease progression by improving vascularity. This study evaluates the functional and radiological outcomes of RCD in patients with Kienböck's disease.

METHODS

A retrospective analysis was conducted on patients diagnosed with Kienböck's disease who underwent radial core decompression. All patients underwent radiological evaluation using plain radiographs and/or MRI, and were categorized according to Lichtman staging. Functional outcomes were assessed using grip strength, range of motion (ROM), and patient-reported scores including the Disabilities of the Arm, Shoulder and Hand (DASH) and Visual Analog Scale (VAS). Radiological progression was assessed on follow-up imaging.

RESULTS

Fourteen patients were included, with a mean age of 28.6 years. Based on Lichtman staging, 4 patients were Stage I, 8 were Stage II, and 2 were Stage IIIA. At a mean follow-up of 18 months, patients reported significant pain relief, with a mean VAS reduction of 5.1 points. Grip strength improved by 85–95%, and ROM increased to a mean of 105°. Radiologically, 85.71% of cases showed no further lunate collapse, while 14.29% exhibited stable disease without progression. No patient demonstrated stage progression during follow-up.

CONCLUSION

RCD demonstrates promising mid-term functional and radiological outcomes in Kienböck's disease, especially in early-stage cases. It may serve as a viable alternative to more invasive procedures, though longer-term studies are warranted.

KEYWORDS

Avascular necrosis, Kienböck's disease, lunate, functional outcomes, radial core decompression, radiological outcomes

INTRODUCTION

Kienböck's disease, first described in 1910 by Robert Kienböck, is a rare but debilitating condition characterized by idiopathic avascular necrosis of the lunate.[1] The disease predominantly affects young to middle-aged adults, often leading to chronic wrist pain, stiffness, and progressive carpal collapse if left untreated.[2] Its etiology is considered multifactorial, with proposed contributors including negative ulnar variance, repetitive microtrauma, and vascular insufficiency.[3]

The management of Kienböck's disease is guided by the stage of the disease, as classified by the Lichtman system, which is based on radiological and clinical findings.[4] Treatment options range from conservative measures (e.g., immobilization) to surgical interventions such as joint-leveling procedures, vascularized bone grafting, and salvage procedures like proximal row carpectomy.[5,6] Among these, radial core decompression (RCD) has gained attention as a minimally invasive technique aimed at reducing intraosseous pressure and promoting lunate revascularization.[7]

Although RCD has shown potential, the literature remains limited, with heterogeneous outcomes and no standardized treatment protocols.[8] Previous studies report variable success rates, with some demonstrating pain relief and functional

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improvement, while others raise concerns about disease progression in advanced stages.[9,10] In this study, we aim to evaluate the functional and radiological outcomes of RCD in patients with Kienböck's disease, contributing to the existing body of evidence and helping to inform future treatment decisions.

METHODS

This retrospective study analyzed consecutive patients diagnosed with Kienböck's disease who underwent radial core decompression (RCD) between 2020 and 2024 at a single tertiary care center. Ethical approval was obtained prior to data collection.

Inclusion criteria were: (1) patients with clinically and radiologically confirmed Kienböck's disease classified as Lichtman stage I, II, or IIIA; (2) symptomatic wrists with no evidence of advanced degenerative changes or carpal collapse; and (3) availability of complete clinical and radiological follow-up for a minimum of 12 months postoperatively. Patients with Lichtman stage IIIB or IV disease, prior wrist surgeries, or incomplete follow-up data were excluded.

All patients underwent preoperative assessment, including plain radiographs and MRI, to confirm diagnosis and stage the disease according to the Lichtman classification. Ulnar variance was measured using standard posteroanterior wrist radiographs in neutral rotation. Surgical intervention involved radial core decompression performed by a single experienced surgeon under regional or general anesthesia using a standardized technique.

Postoperative follow-up included serial clinical assessments and radiographic evaluations at regular intervals. Functional outcomes were measured using grip strength (dynamometer), wrist range of motion (ROM), and patient-reported scores such as the Visual Analog Scale (VAS) for pain and the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire. Radiological outcomes were assessed with follow-up X-rays and/or MRI to monitor lunate morphology and disease progression.

Data were recorded and analyzed using descriptive statistics, with continuous variables expressed as means and categorical variables as frequencies and percentages.

Surgical Technique

All procedures were conducted under either regional or general anesthesia, with the choice individualized based on patient preference, comorbidities, and anesthesiologist recommendation. A standard dorsal longitudinal approach to the distal radius was employed in every case. Dissection was carried out carefully to expose the dorsal metaphyseal region of the distal radius-specifically targeting the area just proximal to Lister's tubercle, corresponding to the central zone of the lunate fossa when projected fluoroscopically. This site was chosen for its alignment with the axis of the lunate and to ensure optimal tunnel orientation toward the lunate body while preserving surrounding anatomical structures.

Under continuous intraoperative fluoroscopic guidance, a 3.5 mm cannulated drill was introduced perpendicularly to the dorsal cortex and advanced in a volar-distal direction, angled approximately 30–40 degrees to the long axis of the radius, to reach the subchondral region of the lunate without breaching the articular surface. Only a single decompression tunnel was created in each case. The decompression was done with the help of medium sized curette. (Figure 1)Particular care was taken throughout drilling to avoid cortical breakthrough, preserve the volar cortex, and maintain tunnel trajectory centered within the radius-lunate axis. In cases where intraoperative anatomical variation was encountered, subtle trajectory adjustments were made under fluoroscopy to ensure proper tunnel depth and direction.

This standardized decompression protocol ensured consistent technique across all patients while minimizing risks of iatrogenic injury. No intraoperative complications such as breach of the joint surface, injury to extensor tendons, or neurovascular structures were noted. Postoperative care included wrist splinting for three weeks, followed by progressive mobilization and strengthening exercises. Clinical and radiological evaluations were conducted at regular intervals to assess recovery.

RESULTS

A total of 14 patients were followed for a mean duration of 18 months (range: 12–28 months). The cohort included 12 males and 2 females, with a mean age of 28.6 years (range: 19–42 years). Based on the Lichtman classification, 4 patients were classified as Stage I, 8 as Stage II, and 2 as Stage IIIA. Negative ulnar variance was present in 10 patients, while 4 had neutral variance. All patients were symptomatic at baseline, with chronic wrist pain, reduced grip strength, and limited range of motion (ROM).

Significant improvement in clinical outcomes was observed at final follow-up. The mean Visual Analog Scale (VAS) score for pain decreased from 7.2 ± 0.8 preoperatively to 2.1 ± 1.1 postoperatively, representing a mean improvement of 5.1 points. This change was statistically significant ($p < 0.001$, paired t-test). Grip strength improved from 55–70% of the contralateral side preoperatively to 85–95% postoperatively. Similarly, wrist ROM increased from a mean of 75° (flexion-extension arc) to 105°, indicating a 40% improvement. All patients reported subjective pain relief and improved hand function during daily activities.

Radiologically, 12 out of 14 patients (85.71%) demonstrated no further lunate collapse on follow-up imaging. Notably, lunate collapse was initially present in 2 patients—both classified as Stage IIIA—who showed mild radiological progression but retained satisfactory wrist function and stability. In contrast, patients with Stage I and II disease demonstrated stable radiological findings, with no evidence of collapse or disease progression. Furthermore, 9 patients showed MRI evidence of lunate revascularization. No major surgical complications or adverse events were recorded during the study period, underscoring the safety profile of RCD in this cohort. (Figure 2).

Table 1: Demographic characteristics of patients enrolled in the study, preoperative and postoperative clinical and radiological outcomes assessment scores.

Patient ID	Age (yrs)	Lichtman Stage	VAS Preop	VAS Postop	ROM (°) Preop	ROM (°) Postop	Grip Strength Postop (% of contralateral)	Lunate Collapse at Follow-up
1	21	I	7.5	1.5	70	110	90%	No
2	25	II	6.9	2.0	75	105	85%	No
3	32	IIIA	7.8	3.5	70	90	88%	Mild progression
4	27	II	7.0	1.8	80	110	92%	No
5	30	I	6.8	2.0	75	100	87%	No
6	22	II	7.4	1.2	65	100	90%	No
7	34	II	7.6	2.5	80	105	85%	No
8	29	IIIA	8.0	4.0	70	90	88%	Mild progression
9	26	II	7.2	2.0	75	110	89%	No
10	19	I	6.7	1.5	70	100	95%	No
11	42	II	7.0	2.0	80	105	90%	No
12	35	I	6.9	1.8	75	110	91%	No
13	24	II	7.3	2.0	75	100	86%	No
14	28	II	7.1	2.2	75	105	89%	No

VAS = Visual Analog Scale; ROM = Range of Motion; RCD = Radial Core Decompression

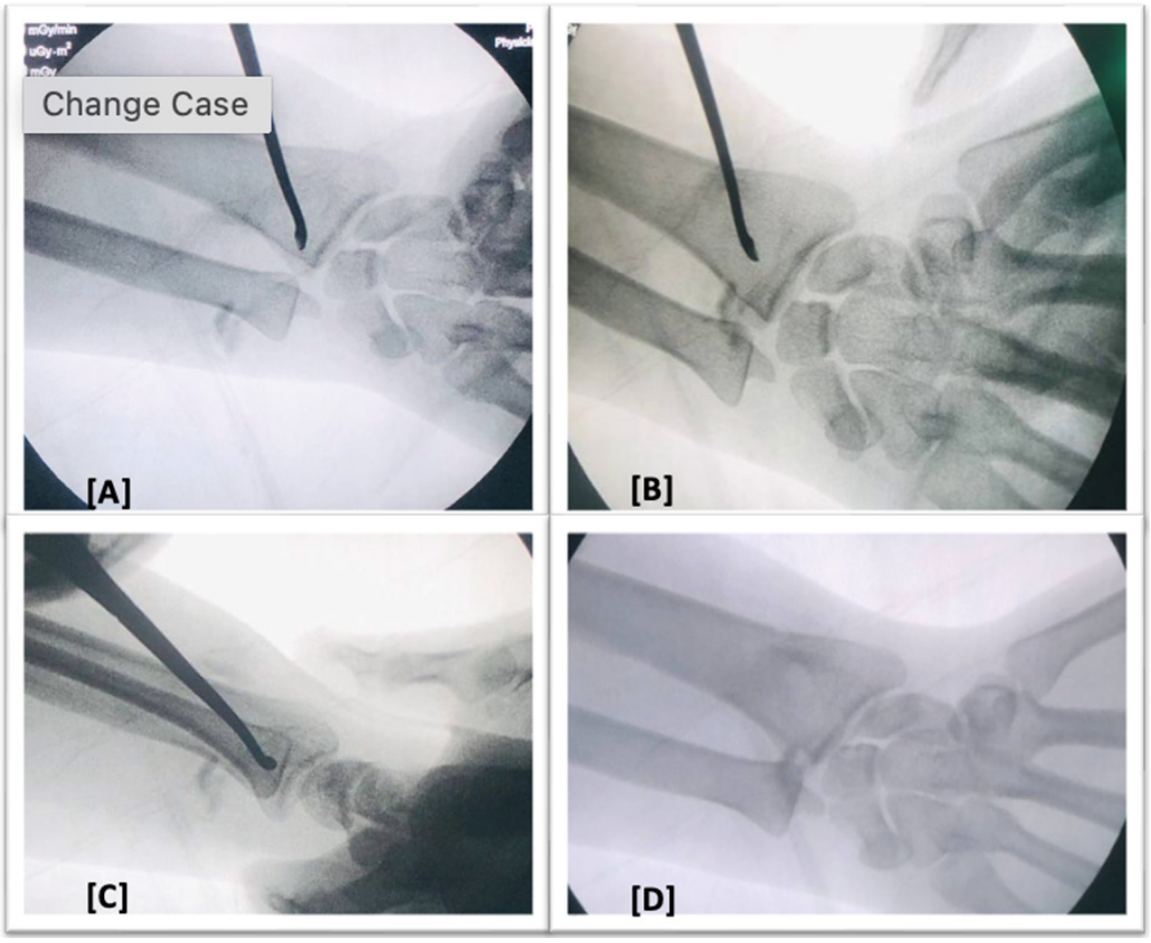

Fig. 1: Intraoperative fluoroscopic images showing the positioning of the curette to initiate core decompression of distal radius in patients with Kienbock's Disease, A: Radial corticotomy done 2 cm proximal to styloid and curettage done towards lunate fossa, B: Curette introduced to the radial canal, C: Curettage done volar lip of radius, D: After curettage

Fig. 2: Clinical (A-F) and Radiological outcome (G,H) at 2 years follow-up

DISCUSSION

Kienböck's disease is a progressive wrist disorder characterized by avascular necrosis of the lunate, leading to pain, stiffness, and functional impairment in young adults. Over the years, the management strategy for this condition has evolved from simple immobilization to a range of surgical techniques aimed at altering biomechanics or restoring lunate vascularity. Treatment selection has increasingly emphasized joint preservation, particularly in early stages of the disease. Among these, radial core decompression (RCD) has emerged as a minimally invasive, vascularity-enhancing approach, especially relevant for Lichtman stages I and II.

In our case series of 14 patients treated with RCD, we observed meaningful improvements in both clinical and radiological outcomes. Pain relief was substantial, with VAS scores decreasing from 7.2 to 2.1—a statistically significant improvement ($p < 0.001$). Functional gains were notable, with grip strength reaching 85–95% of the contralateral side and a mean increase in range of motion from 75° to 105°. Radiological stabilization was achieved in 12 out of 14 patients, and MRI showed evidence of lunate revascularization in approximately two-thirds of the cases. Importantly, disease

progression was not observed in any of the Stage I or II patients. Among the two patients with Stage IIIA disease, mild radiological progression occurred, though both retained satisfactory function, supporting cautious optimism in select cases.

Our results are consistent with prior studies demonstrating favorable mid-term outcomes with RCD. Sevimli et al. reported similar pain reductions and functional improvements, while Tatebe et al. described long-term durability in early-stage disease.[11,12] Kamrani et al. found RCD outcomes comparable to radial shortening osteotomy, albeit with reduced surgical morbidity.[13] Additionally, Sherman et al. and Imaeda et al. have offered a physiological basis for RCD, demonstrating its capacity to lower intraosseous pressure and improve perfusion.[14,15] However, not all reports are uniformly positive. For instance, recent studies highlight the unpredictability of outcomes in more advanced disease and emphasize that RCD alone may be insufficient beyond Stage II, necessitating more aggressive approaches like vascularized bone grafting or osteotomy.[16,17]

A strength of our study is its uniform surgical technique, consistent follow-up period, and use of both clinical and imaging-based assessments. The inclusion of Lichtman staging, ulnar variance measurement, and MRI follow-up allowed for comprehensive outcome assessment. However, limitations exist. The small sample size limits subgroup statistical power, particularly for Stage IIIA cases. Though functional preservation was achieved in these two patients, they did show mild radiographic progression, emphasizing the need for caution in generalizing outcomes beyond Stage II. Additionally, while imaging showed promising signs of revascularization, serial MRI protocols were not standardized, limiting precise quantification. Lastly, technical variables such as tunnel size or drill trajectory were not analyzed, though they may impact efficacy.

CONCLUSION

Radial core decompression appears to be a safe and effective treatment option for early-stage Kienböck's disease (Lichtman I–II), offering substantial pain relief, functional improvement, and radiological stability. While outcomes in carefully selected Stage IIIA cases may also be encouraging, further research with larger sample sizes and long-term follow-up is needed to better define its role in advanced disease. Given its minimally invasive nature and favorable safety profile, RCD holds promise within the joint-preserving treatment spectrum for this challenging condition.

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