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### RESEARCH ARTICLE

## ARTHROSCOPIC LIMITED INTERCARPAL FUSION WITH BONE GRAFT IN PATIENTS WITH KIENBÖCK'S DISEASE.

Abdelkader S.M, Attia Abd, Eid Abd and Hamada I.

Orthopedic Surgery Department, Zagazig University Hospitals, Egypt.

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Arthrodesis; arthroscopy; Kienböck's disease; midcarpal fusion; wrist.

### Abstract

**Objectives:** This study aims to present our clinical results obtained in arthroscopic limited intercarpal fusion performed with use of bone graft in patients with Kienböck's disease.

**Patients and methods:** The study included 16 patients with Kienböck's disease (9 males, 7 females; mean age 28.9 years; range 14 to 51 years) who were performed arthroscopic scaphocapitate fusion with or without lunate excision between January 2016 and May 2018. Bain and Begg Arthroscopic Classification was used for the staging of Kienböck's disease. Quick Disabilities of Arm, Shoulder and Hand and Mayo Wrist scorings were used for clinical evaluation.

Our inclusion criteria were skeletally mature patients with ulnar side wrist pain and failure of trial conservative treatment.

Our exclusion criteria were skeletally immature patients, active infection of the wrist joint, pan arthritis involving all or most compartments of the wrist and rapidly progressive inflammatory arthritis at proliferative stage e.g. Rheumatoid arthritis.

**Results:** Intercarpal fusion was achieved in approximately 6.5 weeks. There was a statistically significant difference in pre- and postoperative Mayo Wrist scores and pre- and postoperative Quick Disabilities of Arm, Shoulder and Hand scores. There was no postoperative complication.

**Conclusion:** According to our study findings, arthroscopic limited intercarpal fusion with bone graft and without lunate excision may be performed in patients with Kienböck's disease. Satisfactory clinical and functional results were obtained as a result of treatment with this method in stage 3 and 4 Kienböck's disease.

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### Introduction:-

Kienböck's disease is a progressive, debilitating disease that can lead to chronic wrist pain with significant limitations of function.[1,2] The etiology is still not clear, but mechanical, traumatic, and vascular factors have been suspected.[1] Among the treatment modalities for Kienböck's disease, there are lunate core decompression with Lichtman stage 1-3B,[3] vascularized bone graft in Lichtman stage 2-3A-B,[4] partial capitate shortening in Lichtman stage 2-3A,[5] radial shortening in Lichtman stage 3B,[6] proximal row corpectomy (PRC) in Lichtman stage 3,[7] excisional arthroplasty with palmaris longus tendon in Lichtman stage 3,[8] and arthroscopic scaphocapitate fusion (SCF) in Lichtman stage 3A-B.[9] Recently, with increased use of wrist arthroscopy,

**Corresponding Author:- Abdelkader S.M.**

Address:- Orthopedic Surgery Department, Zagazig University Hospitals, Egypt.

treatment algorithm based on arthroscopy grading system was proposed by **Bain and Begg**. [10] They suggested PRC or radioscapholunate (RSL) fusion for stage 1 disease, RSL fusion for grade 2A and PRC for grade 2B, partial and total wrist fusion or hemiarthroplasty for grade 3-4 disease. Limited intercarpal fusion is an effective surgical procedure for degenerative wrist conditions as Kienböck's disease. [11] The biomechanical alterations and motion loss after limited fusion of wrist are well presented in the literature. [12-15]

### Patients And Methods:-

Arthroscopic SCF was performed in 16 patients with Kienböck's disease (9 males, 7 females; mean age 29 years, February 2016 and May 2018 at the Orthopedic Department, Zagazig University Hospitals-Egypt. The dominant side was affected in 11 patients, while the non-dominant side was affected in 5 patients. Arthrodesis decision was established for stage 3 and 4 Kienböck's disease due to arthroscopic classification described by **Bain and Begg** (Table I). [10]

**Table 1:-** Bain and Begg arthroscopic classification.

Stage	Arthroscopic findings of articular surface
0	All articular surfaces are normal
1	Proximal surface of lunate is abnormal
2A	Proximal surface of lunate and lunate fossa of radius are abnormal
2B	2B Vertical fracture of lunate
3	Lunate fossa of radius and proximal and distal surfaces of lunate are abnormal
4	Lunate fossa of radius and proximal and distal surfaces of lunate and the proximal surface of capitate are abnormal

Pre- and postoperative clinical and radiological assessments were performed for all patients. Clinical evaluation was conducted by Quick Disabilities of Arm, Shoulder and Hand (QuickDASH) and Mayo Wrist scores. [18,19] Radiological evaluations were performed pre- and postoperatively (Figure 1a, b)



**Figure 1:-** Plain x ray left wrist showing Kienbocks disease stage III b.



**Figure 2:-**Plain x ray follow up of scaphocapitate fusion in kienbocks disease show complete fusion after 6 weeks.

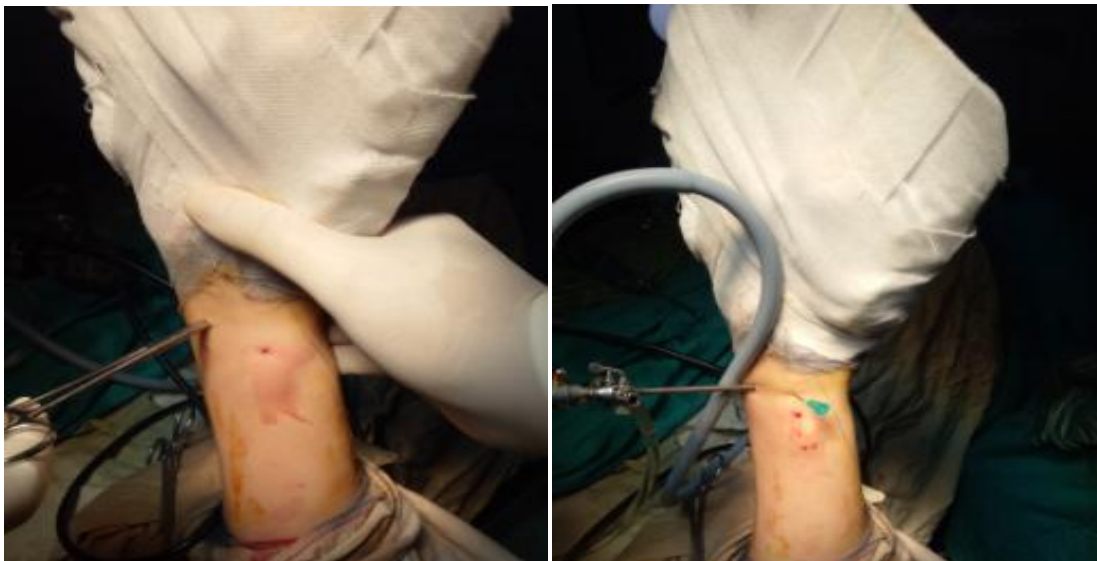
All operations were performed under general anesthesia. An arm tourniquet was applied. Vertical wrist traction was applied by finger traps to fingers via wrist traction tower (Figure 2a). We did not need any adjustment at the traction tower during the denudation of the intercarpal surfaces (Figure 2b). For distension and washout of the joint, we used continuous saline solution via infusion pump. We routinely used a 2.7mm diameter and 30 degree angulated arthroscope. Standard 3-4, 6R, midcarpal ulnar (MCU), and midcarpal radial (MCR). Portals were used for examination of bones, joints and ligaments (Figure 3,4).



**Figure (2a,b):-**traction tower.



**Figure 3:-**establishment of radiocarpal portals

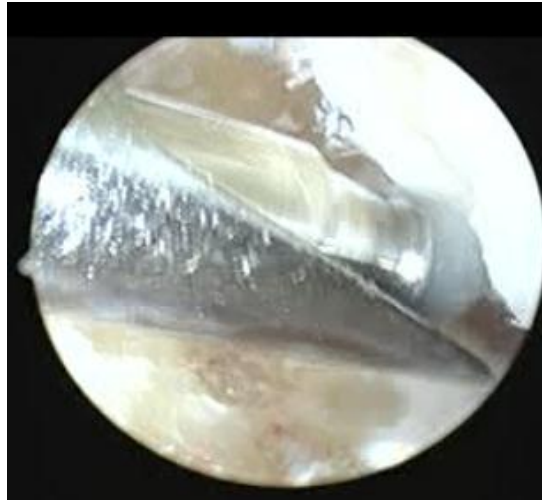


**Figure 4:-**establishment of mid carpal portals

After routine arthroscopic examination, synovial hypertrophy was debrided by shaver. Kienböck's disease stages were assessed arthroscopically. We excised the lunate by 2.7 mm arthroscopic burr and rongeur through 3-4, 4-5 portals only in one patient. Then, the denudation of scaphocapitate joint surfaces were accomplished from MCR and MCU for the preparation of arthrodesis (Figure 5). A guide wire was inserted percutaneously under image intensifier between scaphoid and capitate bone (Figure 5). Headless cannulated screw (Herbart screw) was inserted through guide wire. Bone graft was used in our patients and more than one screw was used to achieve a stiffer fixation at the scaphocapitate joint if necessary. So, we used one screw in ten patients and two screws in six patients for fusion.[20]

A short arm cast was applied to all of the patients for six weeks. At sixth week, if there was union, cast immobilization was abandoned; otherwise, the immobilization time was prolonged until achievement of the radiological finding of fusion (Figure 1b).

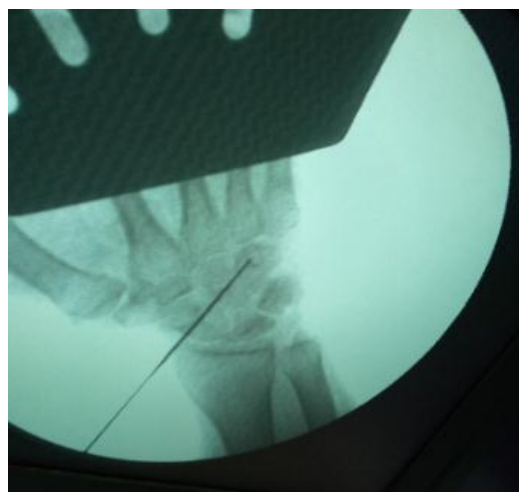




**Removal of articular cartilage of scaphoid and capitate interface with burr and preparation for fusion.**



**Insertion of Herbert guide wire between scaphoid and capitate.**



**A-P view radiographic checking of wire position**



lateral view radiographic checking of wire position

### Statistical Analysis:-

For statistical analysis, Wilcoxon signed-rank test was used to compare variables for each group before and after follow-up.

### Results:-

Demographics and the functional parameters, arthroscopic surgery time (AST) and fusion time of the patients are presented in Table II. The average AST was 120 minutes (range 90 to 150 minutes). All patients were followed-up in outpatient clinics at two weeks intervals for the first six weeks postoperatively, then weekly till union was detected on anteroposterior plain radiograph (Figure 1c). Then, they were examined monthly until sixth month. Average follow-up time was 14.4 months (range 6 to 19 months). Union was achieved in all patients in an average of 7.2 weeks (range 6 to 10 weeks). The criteria for union were bridging trabeculae crossing the fracture site on anteroposterior plain radiographs. Average QuickDASH scores improved from preoperative 69.63 (range 50 to 100) to postoperative 45.6 (range 0 to 75). Average Mayo Wrist scores were 59.5 (range 10 to 80) and 70.9 (range 55 to 80), pre and postoperatively, respectively. All patients returned to their previous occupations. There was a statistically significant difference in Mayo Wrist scores of pre postoperative third and sixth months as well as pre- and postoperative QuickDASH scores (Table III). No wound infection, nonunion or other complications were noticed. No radioscaphoid arthritis were detected during the follow up of all patients.

Patient	Age	Sex	Occupation	Trauma	Stage	AST (minutes)	Fusion time (weeks)	Preoperative DASH	Post-operative DASH	Preoperative MAYO	Postoperative MAYO
1	33	M	Manual worker	+	3	150	8 weeks	100	60	60	90
2	24	M	Technician	-	3	150	7	80	50	55	80
3	21	F	Student	-	3	140	6	75	60	70	90
4	18	M	Student	-	3	120	8	80	65	50	70
5	42	M	Manual worker	-	4	135	7	85	60	65	85
6	35	F	House wife	-	3	100	8	70	50	50	75
7	16	F	Student	-	3	120	6	60	0	60	100
8	37	M	Teacher	-	4	110	6	50	20	65	95
9	22	M	Student	-	3	100	7	75	50	40	70
10	31	F	House wife	-	3	90	8	85	60	45	80

11	27	M	Car driver	+	4	110	6	90	50	50	80
12	24	F	Nurse	-	3	90	8	65	20	70	90
13	22	M	Student	-	3	100	6	85	50	55	75
14	30	F	House wife	-	3	90	7	95	65	65	70
15	26	M	Technician	-	4	90	7	75	40	55	85
16	34	M	Car driver	-	3	90	6	65	0	65	90

### Discussion:-

The treatment for Kienböck's disease is predominantly guided by symptoms and functional deficits of the patients, likewise by the disease stage. [1] It is not well defined whether surgical treatment methods achieve better results than conservative treatment methods. A great number of the surgical managements had satisfactory clinical and functional results in the literature. [1-9] In this study, satisfactory clinical and functional results were achieved in patients with stage 3 or 4 Kienböck's disease with arthroscopic minimal invasive surgery. It has certain advantages such as shorter operation time. We used headless and full threaded compression screws for fixation. Complete fusion was achieved in all of our patients. Duration of operation was about 150 minutes at the beginning; however, after the fourth operation, it was reduced to less than 90 minutes. Fusion achieved in 7.2-weeks with bone graft could be attributed to lesser attenuation of osseous vascularization during arthroscopic minimal invasive surgery. The wrist consists of multiple bony linkages from the forearm to the metacarpus via the carpal bones, and this anatomic peculiarity offers an opportunity to allow fusion of the painful segments of the wrist while preserving motion in other unaffected segments. It also helps to halt any predictable mechanical collapse of the carpal column and maintain carpal height in carpal instability conditions due to failure of ligament constraint or loss of bony integrity such as scaphoid nonunion and Kienböck's disease. [14] Midcarpal arthrodesis with open surgical method is a well-accepted treatment option for advanced carpal collapse. **Neubrech et al.** [11] retrospectively assessed survival, analyzed complications, and reviewed the long-term follow-up after midcarpal fusion in 572 patients who had undergone 594 four-corner fusions between 1992 and 2001. Of these, 56 patients with 60 midcarpal fusions were accomplished and forty midcarpal fusions (6.7%) had to be converted into complete wrist arthrodesis. The reasons were ongoing pain in spite of a well-healed midcarpal fusion or nonunion. Sixty-three patients (11%) required revision surgery because of nonunion, hematoma, wound infection (three) or persisting pain. As a result, they suggested that the midcarpal arthrodesis is a long-lasting treatment option for advanced carpal collapse and has good long-term results. [11] However, no complications described above were seen in our patients treated by arthroscopic SCF.

The operations described in the literature are mostly open surgeries requiring much soft tissue dissection, including capsular and ligament incisions around the wrist to expose the carpal intervals. This may lead to iatrogenic stiffness of the joint on top of the mechanical constraint rendered by selected carpal fusion. Contrary to open surgery, arthroscopic intervention in partial wrist fusion has potential advantages of minimal surgical damage to the supporting ligaments and capsular structures of the wrist while allowing an unimpeded view to most articular surfaces of the joints and important soft tissue elements.

**Ho** [17] performed arthroscopic partial wrist fusion in 12 cases, including scaphotrapeziotrapezoid fusion in three cases, scaphoidectomy and 4CF in four cases, radioscapulohumeral fusion in three cases, radiolunate fusion in one case, and lunotriquetral fusion in one case. Autogenous cancellous bone graft or bone substitute was inserted and impacted to the fusion site through cannula under direct arthroscopic view. Symptom was resolved or improved, and functional motion was gained in all cases. All surgical scars were almost invisible, and aesthetic outcome was excellent. [17] **del Piñal et al.** [16] described dry arthroscopic 4CF with bone grafting and presented a technique for dry arthroscopic scaphoidectomy and 4CF, which reduces the operative time to less than two hours. In their series, despite the first operation which lasted four hours, the last two operations were completed in one hour and 45 minutes and one hour 55 minutes, respectively. No complications were noted. [16]

**Leblebicioğlu et al.** [9] presented a study on 16 patients with stage 3A or 3B Kienböck's disease. They were randomized to either open SCF and lunate revascularization (group 1) or fully arthroscopic SCF and capitate pole excision (group 2) groups. An autogenous bone graft was used for all cases from ipsilateral distal radius. The average

time toradiographically evident fusion was shorter in group 1(7.25 weeks versus 9 weeks). The mean operating time(153 versus 99 minutes), hospital stay (3.6 versus 2.3days), and return to unrestricted daily activities (15versus 5.8 weeks) were shorter in group 2. It wasconcluded that arthroscopic SCF and capitate poleexcision in stages 3A and 3B Kienböck's diseaseresulted in shorter operating time, shorter hospitalstay, earlier return to unrestricted daily activities, andequal range of motion and grip strength as comparedwith open SCF and lunate revascularization.[9] Ourmean fusion time was shorter than **Leblebicioğlu's**result (7.2 weeks and 9 weeks, respectively). The meanAST for the last two patients was 81 minutes.The limitations of our study include the smallsample size and short follow-up period.In conclusion, arthroscopic limited intercarpalfusion withiliac bone graft may be an appropriate method in patients with Kienböck's disease that needlimited intercarpal fusion. Being minimally invasive,this method has satisfactory clinical and functionalresults with high union rate and rare postoperativewound complications.

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