Clinical Results of A Novel Arthroscopic Microfracture Technique For Chondral Lesions of The Lunate

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Research article

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Abstract

Purpose

Chondral lesions of the lunate are one of the causes of ulnar-sided pain, but there has been little interest to date in treating them. In this paper, we describe a modification of the subchondral drilling technique in which an 18-gauge (G) needle was used as a sleeve to guide a K-wire to the lunate chondral defect.

Methods

Eleven patients (nine women, two men) who had undergone a simultaneous arthroscopic wafer procedure and lunate microfracture between 2014 and 2017 were retrospectively reviewed. After completion of the arthroscopic wafer procedure, an 18G needle was placed into the joint via the 6R portal and the needle tip was inserted into the subchondral bone. A 0.8-mm K-wire was then advanced through the needle and the lunate was drilled to a 2–3-mm depth. It is possible to safely drill remaining areas by only changing the direction of the needle.

Results

Eight patients met inclusion criteria. There was no significant difference between the preoperative and postoperative wrist range of motion ($p>0.05$). Grip strength was significantly improved postoperatively ($p<0.05$). According to the Mayo wrist scoring system, six and one patients had excellent and good results, respectively.

Conclusion

Arthroscopic lunate microfracture is an effective treatment for chondral defects of the lunate in the setting of ulnar impaction syndrome, and using a needle as a sleeve can ease manipulation and increase accuracy.

Level of Evidence: IV

Introduction

Ulnar impaction syndrome is defined as impaction of the ulnar head against the triangular fibrocartilage complex and ulnar carpus, which results in degenerative wear of the triangular fibrocartilage complex (TFCC), and carpal and ulnar chondral damage [3]. This entity typically occurs in ulnar-positive variance wrists, but may also be seen in patients with ulnar-neutral variance [10]. Werner found that shortening of the ulna by 2.5 mm decreased the axial load borne by the ulna to 4.3% and removal of the articular disc portion of the TFCC decreased the load on the intact ulna from 18.4–6.2% [11].

Wrist arthroscopy is indicated in patients with a neutral to positive ulnar variance and persistent ulnar-sided wrist pain despite conservative treatment. It has been used as an essential diagnostic and therapeutic tool by hand surgeons for ulnar impaction syndrome. Although arthroscopic treatment is usually focused on unloading the ulnocarpal joint by ulnar shortening (the wafer procedure) and TFCC debridement, there has been less interest in treating chondral lesions of the carpal bones, which are also a cause of ulnar-sided pain [9]. Palmer found that the impaction often leads to carpal chondral damage, which is also a hallmark of type IIB to type IIE TFCC lesions [6].

Arthroscopic microfracture of the knee, hip, and ankle has been well defined and considered as the first-line option for treating isolated chondral lesions. However, only one study has described arthroscopic microfracture for an isolated chondral lesion of the lunate in the setting of ulnar impaction syndrome [4]. Because of the narrow joint space of the wrist, it is difficult to direct a microfracture awl into the chondral defect. We have been using a simple technique to overcome this problem. In this study, we describe a novel arthroscopic subchondral drilling technique in which an 18-gauge (G) needle was used as a sleeve to guide a K-wire to the lunate chondral defect and assessed clinical outcomes. We hypothesized that subchondral drilling would provide significant improvement in preoperative and postoperative Mayo wrist scores, range of motion, and grip strength.

Patients And Methods

Institutional review board approval was granted for the study. We retrospectively reviewed the records of all patients treated with the wafer procedure and lunate microfracture technique between 2014 and 2017. Inclusion criteria included patients older than 18 years of age who had arthroscopically confirmed Outerbridge type IV full-thickness isolated cartilage lesions on the lunate and had a minimum 2 years of follow-up. Exclusion criteria included patients younger than 18 years of age, those with ulnacarpal and distal radioulnar joint (DRUJ) osteoarthritis (Palmar type IIE), and patients who had undergone previous wrist surgery for ulnar impaction syndrome.

All patients were assessed preoperatively and postoperatively for wrist range of motion, grip strength, and Mayo wrist score. The Jamar hand dynamometer (Jamar Hydraulic Hand Dynamometer, Sammons Preston, Bolingbrook, Illinois, USA) was used to measure the grip strength. Wrist range of motion was measured with a goniometer. Standard wrist radiographs were obtained with the shoulder abducted 90°, the elbow flexed, and the wrist in a neutral position to measure the ulnar variance. Magnetic resonance imaging (MRI) was performed in all patients to assess TFCC tears and focal cartilage defects.

The data were analyzed using SPSS 22 software (Armonk, NY, USA) and studied with 95% reliability. A test of equivalence compared with the contralateral wrist was performed with two one-sided t-tests for wrist range of motion. Preoperative and postoperative grip strength were compared using a paired sample t-test.

Surgical Technique

The wrist arthroscopy was carried out in the standard fashion (Video). Under regional anesthesia, a tourniquet was applied, and traction of the wrist joint was performed using a Chinese finger trap.

Standard 3–4, 6R, midcarpal radial (MCR), and midcarpal ulnar (MCU) portals were used for imaging and instrumentation (Fig. 1). The radiocarpal and midcarpal joints were evaluated by using a 2.7-mm, 30° arthroscope. If a full-thickness chondral lesion with exposed subchondral bone was identified over the lunate surface, the chondral flaps were trimmed back with a shaver to create a stable rim. After completion of the wafer procedure, an 18G needle was placed into the joint via the 6R portal, and the needle tip was inserted into the subchondral bone (Fig. 2). A 0.8-mm Kirschner wire was then advanced through the needle, and the lunate was drilled to a depth of 2–3 mm. Subsequently, an 18G needle could easily be manipulated to remaining areas like a sleeve. Generally, three to four microfracture sites were created based on the surface area of the cartilage defect. The patient was placed in a short-arm cast for 6 weeks to allow for maturation of the fibrocartilage. After 6 weeks, the cast was removed, and the patient was allowed to perform range of motion exercises.

Results

A total of 11 patients underwent lunate microfracture for ulnar-sided wrist pain by the senior author. Among the 11 patients, 8 patients (7 female, 1 male) met inclusion criteria. The mean age of the patients was 41 years (range, 27–62 years) and mean follow-up was 30 months (range, 8–60 months) after surgery. According to the Palmer classification, four patients were type 2B, two patients were type 2C, and one patient was type 2D. All seven patients demonstrated ulnar-positive variance on preoperative X-rays (mean, + 1.3 mm; range, + 0.8 to + 3 mm). The mean ulnar variance achieved after surgery was − 2.0 mm (range, − 3.0 to 0 mm). The mean preoperative and postoperative wrist range of motion difference with the non-affected side was 2.6° (range, 0–10°) and 2.0° (range, 0–5°), respectively. There was no significant difference between the preoperative and postoperative wrist range of motion ($p > 0.05$). The mean preoperative grip strength was 37.4 kg/m^2 (range, 24–54 kg/m^2) and the mean postoperative grip strength was 49.1 kg/m^2 (range: 33–67 kg/m^2). The grip strength was significantly improved postoperatively ($p < 0.05$). The mean preoperative Mayo wrist score was 68 (range, 50–70), and the mean postoperative Mayo wrist score was 88 (range, 80–95). Six patients had excellent results and two patients had good results. The mean preoperative visual analog scale (VAS) score was 6.2 (SD, 1.99) and the mean postoperative VAS was 4.4 (SD, 2.6). There were no intraoperative or postoperative complications, and none of the patients required further intervention.

Discussion

Several potential pain generators have been associated with ulnar impaction syndrome. Currently, wrist arthroscopy for ulnar impaction syndrome only addresses TFCC debridement and/or the wafer procedure [10]. Although Palmer et al. described carpal chondral damage in type II lesions, there has been less interest in treating these lesions. In the literature, to our knowledge there is only one study focusing on surgical management of chondral defects within the lunate [6]. In their case series, Kaufman et al. described arthroscopic lunate microfracture technique for Outerbridge type IV chondral lesions and reported good outcomes [4].

Microfracture technique is an effective treatment for full-thickness chondral defects. The controlled microfracture allows access to bone marrow, which includes mesenchymal and pluripotent stem cells [9]. These cells migrate to the chondral lesion and promote regeneration by forming fibrocartilage that fills the original cartilage defect. While fibrocartilage is less stiff and less resilient than hyaline cartilage, it may provide durable cartilage [4]. It has been reported that the durability of fibrocartilage in weight-bearing joints is worse than the upper extremity joints, as they are more exposed to compressive forces [2]. In addition, non-weight-bearing joints have improved outcomes with fibrocartilage tissue [1]. We believe that the reason for the improvement of symptoms and the absence of progression to ulnacarpal arthritis in our patients may be the successful filling of the defect by fibrocartilage tissue. However, because TFCC debridement and ulnar shortening were also performed in the same procedure, it is difficult to make a definitive conclusion as to which one of these is most effective at improving symptoms.

Significant unloading of the ulnar aspect of the wrist can be achieved after excision of the central portion of the TFCC and resection of the radial two-thirds of the ulnar head [12]. Werner found that excision of 3 mm of subchondral bone decreased the force transmitted across the ulnar head by 50% [11]. Arthroscopic ulnar shortening has the advantage of being less invasive, and is not associated with complications like nonunion [8]. In addition, lunate surface and lunotriquetral (LT) stability can be evaluated arthroscopically. However, if more than 4 mm is required for ulnar shortening, open ulnar shortening osteotomy is recommended [5].

In this study, we propose a technique that simplifies arthroscopic microfracture. Because a specifically designed awl is not available for the wrist, using a needle as a sleeve enables multiple perforations to be made as close together as possible while maintaining the integrity of the subchondral bone. Unlike the knee or ankle, it is challenging to manipulate the microfracture awl on the lesion during wrist arthroscopy because of the narrow radiocarpal joint space. Using a simple needle to locate the correct entry point to the scaphoid during percutaneous scaphoid fracture fixation has been widely used by hand surgeons. In the same manner, using a needle to localize an accurate entry point for lunate microfracture would make the surgery easier. The major advantage of using a needle over the standard microfracture technique is a greater ability to target defects because of the small joint space of the wrist. Furthermore, in the absence of special tools, an 18G needle can be safely used to perform microfracture.

There are several limitations to our study. Because there was no control group, the clinical improvement may be attributed to the wafer procedure and TFCC debridement. A prospective randomized controlled study would help us to understand whether the clinical improvement was a result of chondral healing or the wafer procedure and TFCC debridement. Using a K-wire for microfracture can be considered another disadvantage because it may cause excessive heat and subsequent progenitor cell death. Finally, we did not confirm chondral regeneration with a control MRI or a second-look arthroscopy.

Conclusion

lunate microfracture may be performed with a concomitant wafer procedure and TFCC debridement. It is a safe and straightforward procedure that may improve symptoms and increase grip strength. The major advantage of using an 18G needle as a sleeve over microfracture with an awl is a greater ability to target defects due to the small joint space of the wrist. Ulnar shortening osteotomy may be performed as a salvage procedure in cases of failure.

Abbreviations

DRUJ
distal radioulnar joint
LT
lunotriquetral
MCR
midcarpal radial
MCU
midcarpal ulnar
MRI
Magnetic resonance imaging
SD
Standart deviation
TFCC
triangular fibrocartilage complex
VAS
visual analog scale

Declarations

Ethics approval and consent to participate: Institutional review board approval was granted for the study.

Consent for publication: The authors give the permission the publisher consent for publication.

Availability of data and materials: The datasets analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no conflict of interest

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Authors' contributions: Bulent Ozcelik designed the study, performed surgeries. Tugrul Yildirm analysed the data and wrote the manuscript.

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Figures

Figure 1

A. An 18G needle is placed into the joint via the 6R portal. B. A 0.8-mm Kirschner wire is advanced through the 18G needle.

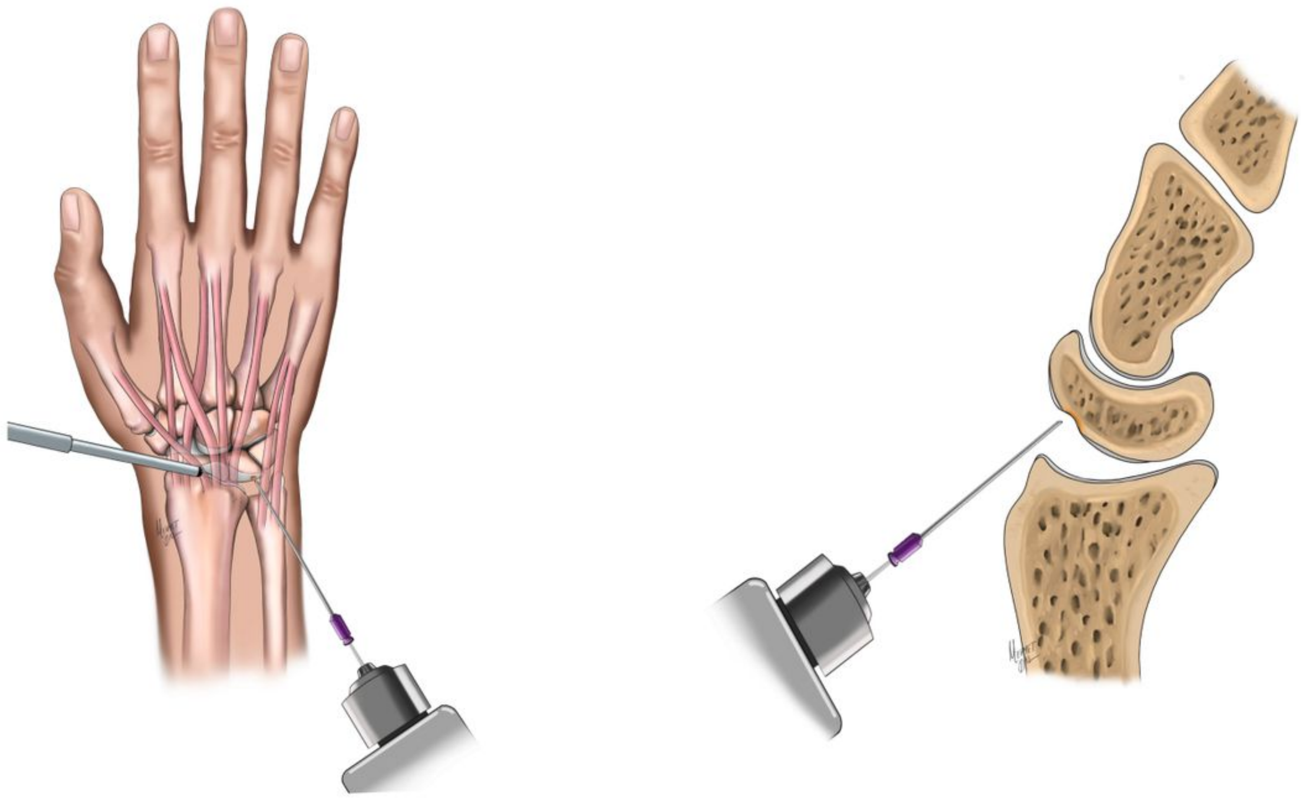

Figure 2

Schematic view of the surgical technique. An 18G needle tip is inserted on subchondral bone. A 0.8-mm Kirschner wire was then advanced through the needle, and the lunate was drilled to a depth of 2–3 mm. The needle could easily be manipulated to remaining areas like a sleeve.

Supplementary Files

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- Video.mp4