Arch Orthop Trauma Surg (2014) 134:881–885
DOI 10.1007/s00402-014-1976-x

HANDSURGERY

Ulnocarpal impaction syndrome: treatment with a transverse ulnar shortening osteotomy from an ulnodorsal approach

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Received: 21 December 2013 / Published online: 23 March 2014

Abstract
Introduction Ulnocarpal impaction syndrome is a common cause of chronic ulnar-sided wrist pain. The distal ulnar shortening osteotomy addresses the often present positive ulnar variance and therefore relieves the excessive load on the ulnocarpal joint. In the present study, the results of a technique that uses an ulnodorsal approach with a compression device and a transverse osteotomy are presented and compared to other techniques.
Materials and methods This retrospective study includes 92 wrists with an ulnocarpal impaction syndrome, which were treated with an ulnar shortening osteotomy. The mean duration of postoperative follow-up was 50 months.
Results The mean ulnar variance was 2.17 ± 1.56 mm preoperatively and after the ulnar shortening osteotomy −1.36 ± 1.67 mm ($p < 0.05$). Radiological consolidation of the osteotomy could be shown in 91 wrists 6 months postoperatively. Patients rated the preoperative pain level at a VAS 7.9 ± 1.7 which decreased to a of VAS 2.4 ± 2.5 ($p < 0.05$). 19 patients complained of mechanical irritation. There was no neurological irritation.
Conclusion It could be shown that the distal ulnar shortening osteotomy by a transverse osteotomy using a compression device and an ulnodorsal approach has a low complication rate. It is comparable to the oblique osteotomy in effectiveness and safety.

Keywords Ulnocarpal impaction syndrome · Distal ulnar shortening osteotomy · Chronic ulnar-sided wrist pain

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Introduction

Ulnocarpal impaction syndrome is a common cause of chronic ulnar-sided wrist pain. It has been defined by Friedman and Palmer [1] as an impaction of the distal ulnar head against the triangular fibrocartilage complex (TFCC) and the ulnar-sided carpus. This results in a degeneration of the TFCC, chondromalacia of the lunate and ulnar head as well as lesions of the lunotriquetral ligament.

The ulnocarpal impaction syndrome is often associated with a positive ulnar variance [2]. It can be idiopathic or posttraumatic, with malunion of a fracture of the distal radius or premature closure of the radial epiphysis [3]. The syndrome is differentiated according to a static or dynamic increase in ulnar variance [4]. With positive ulnar variance, the normal load on the ulnar carpus of approximately 18 % increases up to 65 % [1].

The ulnocarpal impaction syndrome is important in the differential diagnosis of chronic ulnar-sided wrist pain. Other etiologies must be considered, such as pisotriquetral osteoarthritis, traumatic lesions of the TFCC or enthesopathies of the extensor carpi ulnaris, etc. [5]. The ulnocarpal impaction syndrome is additionally to the clinical symptoms diagnosed by X-ray, MRI or wrist arthroscopy [2].

One way to address the ulnocarpal impaction syndrome is the wafer resection procedure. This is an arthroscopic procedure where the positive ulnar variance is eliminated from the wrist joint through a lesion of the TFCC [6]. It can be combined with arthroscopic debridement of the TFCC. Some authors recommend this procedure as part of the initial wrist arthroscopy because of incomplete pain relief in 25 % of patients after debridement of the TFCC alone [7, 8]. The wafer resection procedure can serve to prevent possible complications of ulnar shortening osteotomy, such as nonunion or lesions of the ramus dorsalis nervus ulnaris. Limitations of the wafer procedure are the amount of ulna that can be removed and the need for a lesion in the TFCC [9].

The gold standard treatment, distal ulnar shortening osteotomy addresses the positive ulnar variance and therefore relieves the excessive load on the ulnocarpal joint [10]. There are numerous reports about the technique, different implants and results [11, 12]. The history of ulna shortening osteotomies starts with a publication by Milch in 1941 [13], who used wire sutures for the fixation. The plate fixation was first written up by Cantero in 1974 [14]. He used a transverse osteotomy of the ulna. Rayhack et al. [15] reported an oblique osteotomy—in their results, it showed a faster healing time because of increased surface areas. They used a specially designed device for the osteotomy. The most commonly used fixation is the AO dynamic compression plate [16]. All of these studies show promising results with a low complication rate of nonunions, neural lesions, etc. One of the advantages of this extra-articular technique is that it preserves the mechanical integrity of the distal radioulnar joint.

The purpose of this study is to present the results of our technique that uses an ulnodorsal approach with a compression device and a transverse osteotomy, based on one of the largest case series of which we are aware. The advantage of this method is that it uses neither a special implant nor a special approach.

Patients and methods

This study involves 82 patients with an ulnocarpal impaction syndrome, who were treated with an ulnar shortening osteotomy. Ten patients had bilateral surgery, so that a total of 92 wrists were treated.

All patients had been diagnosed with idiopathic ulnocarpal impaction syndrome. The symptoms included tenderness at the ulnocarpal part of the wrist, a painful ulnar stress test and in 86 wrists a positive ulnar variance visible on X-ray. The six patients with neutral, resp. negative, ulnar variance suffered from dynamic ulnar impaction. Other potential causes, such as pisotriquetral arthritis or ECU tendinitis had been ruled out. We excluded posttraumatic causes as well as ulna plus variances resulting from premature closure of the distal radial epiphysis. All of the patients had previously been treated with physiotherapy and nonsteroidal anti-inflammatory drugs. All of the patients were treated either at the Immanuel-Hospital or the Trauma Hospital Berlin using the same technique described below.

The median age of the patients at the time of ulnar shortening osteotomy was 42 years (range 17–71 years). There were 62 female and 20 male patients. In 56 cases, the right hand was involved and in 36 the left. Ten women were affected in both hands and underwent consecutive surgical treatments. The mean duration of postoperative follow-up was 50 months (range 20–96 months).

The indication for ulnar shortening osteotomy was therapy-refractory ulnar-sided wrist pain related to an ulnocarpal impaction syndrome. The pre- and postoperative ulnar variance was measured by two independent observers according to the method described by Kristensen, using radiological imaging during neutral forearm rotation, p.a. and lateral views of the wrist, and pronated-grip X-ray, which is taken with the patient making a fist of maximum intensity while the forearm is in pronation, because of the dynamic ulnar impaction (see Figs. 1, 2) [17]. Preoperatively, patients were asked to rate their wrist pain using the visual analog scale score (VAS-score). Other diagnostic tests that have been performed preoperatively, such as MRI or wrist arthroscopy, were documented (see Fig. 3). Preoperatively, 36 patients had an MRI to confirm the diagnosis of an ulnocarpal impaction syndrome. On 52 of the 92 wrists an arthroscopy had been performed prior to the ulnar shortening osteotomy. During the initial arthroscopy they underwent a revision of the TFCC and the indication for osteotomy was met if the ulnar-sided pain persisted.

Ulnar shortening osteotomy was first described as an operative intervention in a publication by Milch in 1941 [13], and has been modified since that time. Before every ulnar shortening osteotomy, a planning of the needed amount of resection was made. In brief, the incision for the ulnar shortening osteotomy is placed on the distal ulnar-sided forearm. A conventional 7-hole AO/ASIF 3.5 mm LC-DC plate (Synthes GmbH, Zuchwil, Switzerland) was contoured and three distal holes were predrilled. The edges and rotation of the osteotomy were marked and the osteotomy performed so as to achieve a neutral or slightly negative ulnar variance. The osteotomy itself was done in a transverse cut without the use of a cutting device. Subsequently, the plate was loaded at high tension using the compression device (see Fig. 4). The osteotomy is placed in a protective forearm splint for 6 weeks.

At the time of follow-up, the patients were questioned about disorders of sensation, local irritation caused by the plate as well as their ulnar-sided wrist pain level. Those

Fig. 1 Preoperative postero-anterior view of a wrist with positive ulnar variance and a consecutive ulnocarpal impaction syndrome

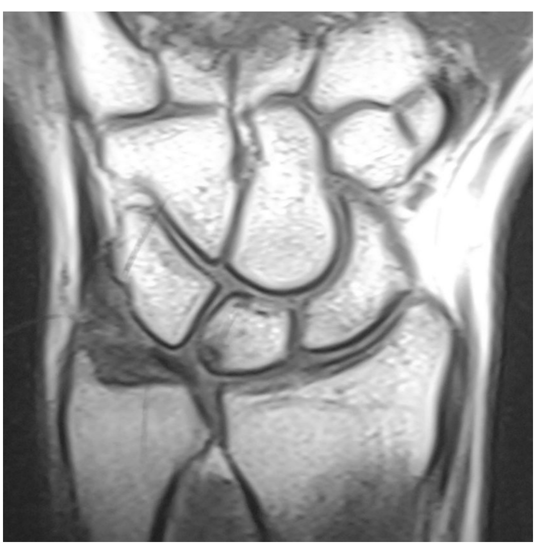

Fig. 2 Coronal MRI view of an ulnocarpal impaction syndrome

Fig. 3 Postoperative postero-anterior view of an ulnar shortening osteotomy

findings were documented using the VAS-score. The consolidation of the osteotomy was confirmed by X-ray. The stability of the DRUJ was tested clinically (piano key sign).

SPSS statistical software (version 11.5) was used to analyze the data. Differences between pre- and postoperative findings were analyzed by the Mann–Whitney *U* test for the pain level and Student's *t* test for paired samples for the ulnar variance.

Results

Before surgery, the mean ulnar variance was 2.17 ± 1.56 mm (range −2.3 to 7.3 mm). Three patients had a neutral and three patients a negative ulnar variance preoperatively, all of which suffered from a dynamic ulnar impaction syndrome. These six patients had an arthroscopy, which showed degenerative lesions of the TFCC. Ulnar shortening osteotomy resulted in a mean ulnar variance of −1.36 ± 1.67 mm (range −5.5 to 3.6 mm). Only six patients manifested a positive ulnar variance after surgery.

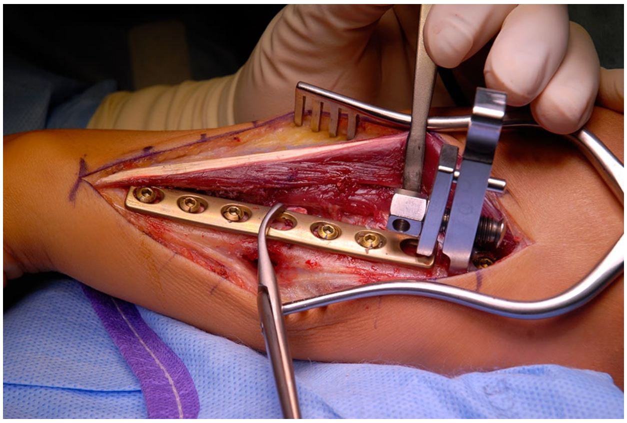

Fig. 4 Intraoperative view of an ulnar shortening osteotomy with an ulnodorsal approach and a compression device

The mean resection was 3.54 ± 1.17 mm. The difference between the preoperative and postoperative ulnar variance was statistically significant ($p < 0.05$). No postoperative instabilities of the distal ulnar joint have shown up.

Radiological consolidation of the osteotomy could be shown in 91 wrists 6 months postoperatively. One patient experienced a radiologically diagnosed nonunion, and required a secondary osteosynthesis using an autologous spongiosa graft. Two patients experienced a secondary ulnar fracture at the osteotomy site; one fracture was related to trauma (8 months postoperatively) and the other occurred after early excision of the plate 10 months after the osteotomy due to mechanical irritation.

Patients rated their preoperative pain level at a mean of VAS 7.9 ± 1.7 (range 7–9). Postoperatively, the pain level decreased to a mean of VAS 2.4 ± 2.5 (range 0–4). The reduction was statistically significant ($p < 0.05$). 19 patients complained of mechanical irritation from the plate. As a consequence they had the plate removed at a minimum of 1 year after the osteotomy with radiological confirmation of union. There were no postoperative neurological disorders.

Discussion

In this large case series, we were able to demonstrate that the ulnar shortening osteotomy performed with a compression device using an ulnodorsal approach is a reliable technique for treating the idiopathic ulnocarpal impaction syndrome. There is an ongoing debate regarding the best approach and the kinds of complications caused by an open osteotomy.

In 1990, Boulas and Milek [18] used the same ulnodorsal approach for the osteotomy on ten consecutive patients. They reported no neurological complications but six instances of irritation from the hardware. This is the most problematic issue with an ulnodorsal approach, and has been reported by many other authors [19, 20]. The average rate of complaints of hardware irritation is about 50 %. We saw only 19 of 81 patients (23 %) who complained of hardware irritation. We try to place the plate in as ulnar a position as possible to avoid this irritation. There are also studies using an ulnopalmar approach. Trankle et al. [21] justify this approach because it provides good tissue-coverage and protection of the interosseous membrane by the possibility of an exact ulnopalmar placement of the plate. The integrity of the interosseous membrane, especially of the distal part and the distal oblique bundle, is of importance in the stabilizing effect of the DRUJ in the ulnar shortening osteotomy [22]. Kitzinger et al. [23] reported hardware irritation in 6 of 23 patients. This is comparable to our rate of hardware irritation. If the surgeon keeps in mind to place the plate as ulnar as possible, the rate of irritation should be comparable.

Another possible complication of the ulnodorsal approach is injury to the ramus dorsalis nervus ulnaris. The average rate of this complication reported in the literature is 7–9 % [20, 24]. We are always careful to visualize the nerve intraoperatively and have seen no nerve irritations.

The main complication of ulnar shortening osteotomy is a high rate of nonunion, from 10 to 21 % [20, 21, 24]. The studies differ in the orientation of the osteotomy—oblique or transverse. The oblique osteotomy increases the surface area up to 40 % and therefore increases the surface [15]. Kitzinger et al. [23] report on a 45° oblique osteotomy in 27 patients without a compression device. They experienced no cases of nonunion, but they presume that the procedure is performed by an experienced surgeon. Ashan et al. [25] experienced in their retrospective chart review a rate of 7 % nonunions, despite the use of a compression device. Chen et al. [16] report on transverse osteotomy in 18 patients without any cases of nonunion. In 2012, Schmidle et al. [26] introduced a new locking plate construct for an ulnar shortening osteotomy. In 15 patients they experienced one nonunion. In the study presented here, there was a low rate of 1 nonunion in a total of 92 transverse osteotomies. We therefore see no need for a cutting guide for the transverse osteotomy because it is easier to monitor the correct angle than in an oblique osteotomy.

A new approach is a technique described by Slade and Gillon, which uses an arthrotomy of the DRUJ to perform the ulna shortening in metaphyseal bone. This technique has been biomechanically investigated and shows promising results in decreasing the load across the ulnocarpal joint [27]. Further clinical studies will be necessary to thoroughly evaluate this unique technique. Yin et al. [28]

modified the above-mentioned technique using an arthroscopic approach. It therefore reduces the surgical injury to the capsule. No results have been published yet.

In a large series of ulnar shortening osteotomies, we were able to demonstrate that a transverse osteotomy using a compression device and an ulnodorsal approach is a simple technique with a low complication rate. In our opinion, it is comparable to oblique osteotomy in effectiveness and safety (1 nonunion in 92 wrists) but it has the advantage of requiring less experience on the part of the surgeon because the osteotomy is easier to align. Furthermore, no additional devices or special and therefore often expensive implants other than the compression device are needed.

Conflict of interest All named authors hereby declare that they have no conflicts of interest to disclose.

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