The Effect of Early Active Mobilization on Union Rate after Ulnar Shortening Osteotomy

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Abstract

Background Ulnocarpal impaction occurs when there is excessive loading between the ulnar carpus and the distal ulna. Ulnar shortening osteotomies (USOs) decompress the ulnocarpal joint. Many studies have evaluated USO but none have considered the effect of early active mobilization on union rate.

Questions Does early active mobilization affect rate of union following USO? Does early active mobilization affect rate of complications following USO?

Patients and Methods We performed a retrospective review of 15 consecutive patients that underwent 16 USOs between 2011 and 2015. There were seven males and eight females. Median age at time of shortening osteotomy was 47 years (range: 11–63 years). The median time of the procedure was 62 minutes (range: 45–105 minutes) and the median change in ulnar variance was 5.5 mm (range: 0–10.5 mm). Six patients were initially immobilized in incomplete plaster casts postoperatively, while the remainder had only wool and crepe dressings. Early active mobilization commenced after the first postoperative visit at 12 days.

Results There was a 100% union rate in our series and 12 patients were pain-free at final follow-up. However, three of the patients with the longest times to union were smokers. Additionally, some patients may have achieved union between follow-up clinic visits.

Conclusion Early active mobilization after USO does not affect union rate. Prospective, randomized studies are required to investigate the effect of early active mobilization in light of factors known to increase time to union, such as smoking.

Level of Evidence This is a Level IV, case series.

Keywords

- ulnar shortening osteotomy
- nonunion
- early active mobilization

Ulnocarpal impaction occurs when there is excessive loading between the ulnar carpus and distal ulna, and can be a common cause of ulnar-sided wrist pain.¹ Positive ulnar variance increases load transmission across the ulnocarpal joint² but ulnocarpal impaction can occur with neutral or negative ulnar variance.³ An ulnar shortening osteotomy (USO) can be used to decompress the ulnocarpal joint.

Many studies have evaluated USO for ulnocarpal impaction and found improved pain scores,^{4–14} grip strength,^{7,9,10,13,14}

range of movement,^{7,8,10,13} and patient reported outcome measures.^{7,8,11,14,15}

Unfortunately, the plate fixation required for USO can cause irritation and the need or request for hardware removal is reported to be between 7¹⁰ and 79%.⁵ However, these studies include many different implant types that may affect the rate of irritation. The U.S.A. study of 93 USOs using a single plate system reported no removal of hardware, but their follow-up was for an average of just 6 months

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(range: 4–9 months) and five patients reported irritation from the metalwork.¹³

Rates of nonunion following USO are reported to be from 0^{9,13,14,16} to 18%.^{4,8,12} The median time to union was from 7¹³ to 21 weeks¹⁵ with ranges from 4 to 78 weeks.¹⁷

However, no studies have considered the effect of early active mobilization on union rate. Published postoperative protocols vary from no immobilization⁵ to prolonged periods in a forearm cast lasting up to 12 weeks.¹²

Therefore, this study asks—does early active mobilization affect rate of union following USO? And, does early active mobilization affect rate of complications following USO?

Patients and Methods

We performed a retrospective cohort study of patients who underwent USO for any indication between 2011 and 2015. We identified 16 USOs in 15 consecutive patients performed under the supervision of one consultant orthopaedic hand surgeon.

This study was conducted as a service evaluation¹⁸ with the aim of investigating if early active mobilization of this cohort of patients resulted in a higher rate of nonunion than reported in the literature for USO with traditional immobilization protocols.

There were seven males and eight females, with a median age at time of shortening osteotomy of 47 years (range: 11–63 years). Just two patients were under 18 at the time of surgery, age 11 and 16 years old. There were six right-sided procedures and 10 left-sided procedures, with half of procedures performed on the dominant side. The median duration of follow-up was 39 months (range: 25–62 months).

Clinical letters were examined for diagnosis and indication for USO, hand dominance, smoking status, time to union, clinical outcome, and any complications that occurred. Operation notes were examined for tourniquet time and immobilization instructions. Preoperative and postoperative postero–anterior (PA) radiographs were used to measure ulnar variance using the method of perpendiculars.¹⁹

All procedures were performed through the interneural approach between extensor carpi ulnaris (ECU) and flexor carpi ulnaris (FCU), with a subsequent subperiosteal approach to the distal ulna. An Acumed USO plate (Acumed Ltd, Andover, United Kingdom) was used in 14 cases, a dynamic compression plate (DCP) used in one case and a Synthes locking compression plate (LCP) Ulna Osteotomy System plate (DePuy Synthes, Leeds, United Kingdom) in another. Postoperatively, 10 patients had wool and crepe dressings only, while six patients had an incomplete plaster cast. This choice was made with the individual patients and reasons for use of a cast included temporary wound protection due to comorbidities, such as epilepsy.

Three USOs were performed for idiopathic ulnocarpal impaction while the remainder were acquired secondary to malunion from distal radius fracture (nine USOs), growth arrest from Salter–Harris II fractures of the distal radius (three USOs) and one acute longitudinal radioulnar dissociation. Three patients were smokers.

Early active mobilization commenced after the first postoperative visit at 12 days. Patients were seen at 6 weeks with radiographs to check progress to union. Further follow-up outpatient appointments were scheduled until clinical and radiographic union were achieved. These were scheduled according to the progress of individual patients, including to monitor progress with hand therapy as well as progress to bony union.

Union was analyzed both clinically (lack of pain on direct palpation on osteotomy site, no pain reported by patient) and radiographically (no lytic lines around screws, implant loosening, and inability to see the osteotomy line and presence of bridging bone).

The median time of the procedure was 62 minutes (range: 45–105 minutes). Six patients were initially immobilized in incomplete plaster casts for the first 12 days postoperatively, while the remainder had only wool and crepe dressings.

Results

There was a 100% union rate in our series, with a median time to union of 14 weeks (range: 6–40 weeks). Therefore, early active mobilization does not affect the rate of union following USO. However, three of these patients were smokers and they had the longest time to union at 28 and 40 weeks (two patients).

Our patients had a comparable rate of complications compared with other studies of USO. Ten patients had no complications from surgery. However, three patients requested removal of their plates, one developed asymptomatic lucencies around a screw that did not require treatment, one superficial wound infection was treated with antibiotics, and one patient experienced temporary neurological disturbance in the distribution of the dorsal branch of the ulna nerve.

Twelve patients were pain free at the time of final follow-up. Of the remainder, three had persistent pain and one reported irritation from the plate but did not want it removed. Range of movement was maintained postoperatively (as described in ►Table 1).

Discussion

In our study, early active mobilization after USO does not affect union rate, although smoking may increase time to union. In a U.S.A. study of 72 USO, time to union was 6 +/– 3 months in smokers compared with 3 +/– 1 month in nonsmokers.²⁰ Their study was powered to detect a difference in time to union of 3 months between smokers and nonsmokers. A large study of 325 USO from South Korea²¹ found smoking to be an independent variable to predict nonunion when comparing patients who achieved bony union to those that did not. However, other studies have not found an association with nonunion in smokers,^{4,12,15} but they were all smaller studies not designed for subgroup analysis.

Median time to union in our study was 14 weeks (range: 6–40 weeks). This is comparable to other studies where the median time to union was between 7 and 21 weeks with a range of 4 to 78 weeks.^{10,13,15,17} However, as with other

Table 1 Preoperative and postoperative range of movement

ROM	Preop data available	Preop median (IQR)	Preop data available	Postop median (IQR)
Flexion	15/16	70 (55–90)	16/16	75 (71–75)
Extension	15/16	70 (60–80)	16/16	70 (70–75)
Pronation	12/16	70 (60–90)	16/16	70 (70–80)
Supination	11/16	70 (50–85)	16/16	85 (85)
Radial deviation	12/16	30 (20–40)	5/16	20 (20)
Ulnar deviation	12/16	22 (20–40)	5/16	35 (35)

Abbreviations: IQR, interquartile range; Postop, postoperative; Preop, preoperative; ROM, range of movement.

studies our patients were only assessed for radiographic union at each clinic visit and union may have been achieved between appointments.

Additionally, in our study, only some patients were immobilized for the first 12 days to allow wound healing. The majority of studies of USO describe 4 to 6 weeks of immobilization before active range of movement and strengthening exercises are started.^{4,10,13,15,17,20,21} Therefore, arguably all patients in our study were subject to early active mobilization with a 100% union rate. In a study from Belgium,⁵ 28 USOs were allowed mobilization immediately postoperatively and had a nonunion rate of 11% (3/28).

Our union rate may be due to osteotomy technique, including irrigation of the osteotomy site during application of saw on the bone to keep the temperature down and creation of flat surfaces with good bony apposition following application of the lag screw, as well as the type of implant. Use of a single blade, as we used, has been reported to be an independent variable predicting union after USO compared with the use of a double-blade²¹ due to less heat production.

In our study, three patients (19%) requested removal of metalwork due to irritation. This is better than most studies that have rates of 30 to 79%,^{5,6,12,16,17,22} but not as good as two studies with rates of 0¹³ and 7%.¹⁰ However, these studies included a variety of USO plating systems, so new, lower profile USO plates may decrease the irritation and need for metalwork removal.

While this is a retrospective study with a small number of patients, the outcomes are better than the only other study with early active mobilization following USO,⁵ with no cases of nonunion and a low rate of complications. While our data suggest that the range of movement is preserved after USO, this study could be improved by careful measurement of function and patient-reported outcome measures (PROMs), both pre- and postoperatively to see how USO affects patients.

A systematic review of PROMs concluded that both the Disabilities of the Arm, Shoulder and Hand (DASH) and Patient-Rated Wrist Evaluation (PRWE) are reliable, valid, and responsive in a population with hand and wrist trauma.²³ The majority of the patients in our study had hand and wrist trauma and required USO secondary to malunion from previous distal radius fracture.

The PRWE has been shown to be most sensitive to detecting clinical changes after USO with a minimum

clinically important difference (MCID) of 17.²⁴ It could therefore be used to power a prospective study into the effects of early active mobilization on outcome from USO that would help control for confounding factors, such as smoking.

In conclusion, early active mobilization after USO did not affect union rate using our operative technique and had similar rates of complications and requests for removal of implants as other studies.

Ethical Approval

This study was conducted as a service evaluation.

Funding

None.

Conflict of Interest

None.

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