Minimally invasive hardware removal after minimally invasive distal radius plate osteosynthesis (MIPO): Feasibility study in a 388 case series

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ABSTRACT

Hypothesis: The aim of the present study was to assess the technical feasibility of minimally invasive volar plate removal following distal radius fracture.

Material and methods: Three hundred and eighty-eight plates removed from 387 patients (357 females: mean age, 50 years) were assessed retrospectively. The incision used the primary minimally invasive approach and was closed after plate removal by intradermal continuous suture, without drainage or immobilization.

Results: Mean scar size was 22.2 mm preoperatively, and the incision was 19.8 mm at start and 21.4 mm at end of procedure, these differences being non-significant. The scar was enlarged by accidental skin tear in 13 cases and intentionally by lancet in 11 cases. There were 29 screw-related complications, 1 bone crack without clinical impact, and 1 plate fracture. There were no postoperative complications.

Discussion: The present results demonstrate the feasibility of removing a volar plate on the distal radius via a 20-mm approach. These findings should be confirmed on a future study comparing minimally invasive plate ablation and conventional approaches.

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1. Introduction

Minimally invasive plate osteosynthesis (MIPO) is widely used in general traumatology, and has been applied in distal radius fracture since the 2000s [1]. There have been many descriptions of minimally invasive treatment of simple or complex epiphyseal fracture [2–12], epiphyseal-diaphyseal fracture [11,13] and osteotomy for malunion [14,15], using longitudinal or transverse approaches. To date, however, there have been no reports of the feasibility of minimally invasive techniques for hardware removal.

The present study assessed the technical feasibility of minimally invasive surgery to remove volar plates in a clinical series of 388 cases of distal radius fracture.

2. Materials and methods

Files for all patients undergoing removal of hardware for anterior internal fixation of distal radius fracture in our department between 2011 and 2014 were retrospectively analyzed. Of the 408 files, 20 were excluded as incomplete. The series comprised 387 patients (357 females), with a mean age of 50 years; 1 patient was operated on bilaterally.

All procedures were performed with pneumatic tourniquet, under locoregional anesthesia, on a day-surgery basis. The ablation incision was in the primary scar, sometimes shorter or longer depending on the intraoperative circumstances. After removal of the plate, the incision was closed by absorbable intradermal continuous suture, with tension often enabling scar length to be reduced (Fig. 1). No drainage was implemented. Patients were encouraged to mobilize the limb without force as soon as they recovered from anesthesia.

Assessment consisted in measuring (in millimeters) the preoperative scar and the incision at start and end of the ablation procedure. Intraoperative complications were recorded, notably including impossibility of ablation and iatrogenic fracture.
Postoperative complications were recorded, notably including hematoma and infection.

Statistical analysis consisted in comparing mean values for “incision length” before, at start and at end of procedure. The novel, very powerful, Bayesian method was applied, consisting in observing the distribution of coefficient T in the model and calculating the probability of observing a difference or not. This analysis renders a probability ranging between 0 and 1, which is much more precise than a binary $P < 0.05$. If the interval of coefficient T did not include 0 and the probability was greater than 0.95, the difference was considered significant.

3. Results

Indications comprised 314 cases of systematic ablation and 55 of discomfort reported by the patient, including 9 of associated carpal tunnel syndrome operated on in the same step, 4 of flexor synovitis treated by synovectomy, 13 of flexor adherence treated by tenolysis, 2 of flexor pollicis longus repair by palmaris longus graft, and 2 of sepsis.

In 379 cases, the plate was a Step One® (Newclip Technics™, Haute Goulaine, France), in 8 cases a long plate (Newclip Technics™, Haute Goulaine, France), and in 1 case an Aptus plate (Medartis™, Basel, Switzerland).

Mean scar length was 22.2 mm (range: 15–110 mm) preoperatively, 19.8 mm (range: 15–110 mm) at start of incision and 21.4 mm (range: 15–110 mm) at end of procedure. The mean difference between pre- and postoperative scar length was $-0.7785$ mm (range: $-1.7246$ to 0.1635 mm), with a 5% probability of being positive or 95% probability of being negative. Thus, considering a 2-mm difference to be clinically negligible, the difference between pre- and postoperative scar length could be said to be negligible and the lengths to be equivalent. The scar was lengthened by accidental skin tear in 13 cases and intentionally (by lancet) in 11 cases.

Ablation-related intraoperative complications comprised 29 screw problems, including 25 of stripping and 4 breakages, with the screw left in place in 20 cases despite attempted extraction (by salvage screwdriver, tungsten drill or trephine), 1 iatrogenic bone crack which required neither complementary internal fixation or immobilization, and 1 plate fracture. There were no postoperative complications.

4. Discussion

MIPO was developed to conserve bone vascularization [16], improve consolidation [17], reduce infection, facilitate fracture reduction by ligamentotaxis [1,18], and meet patients’ strong esthetic demands [19,3]. In the wrist, MIPO is intended to improve bone healing [2], as, unlike the conventional Henry approach [20,21], the pronator quadratus muscle, periosteum around the fracture and bone vascularization are conserved. In distal radius fracture, all MIPO techniques use palmar approaches [4]. We use MIPO regularly for internal fixation of distal radius fracture.

Certain authors use MIPO in osteotomy to correct distal radius malunion [14,15]. However, no series of minimally invasive volar plate ablation have previously been reported.

Removing the volar plate after internal fixation of distal radius fracture on conventional techniques is not systematic. It is generally agreed that about 10% of plates should be removed [22,23]. Indications are guided not by plate thickness, as complications rates are identical between 2.4 mm and 3.5 mm models [24], but by pain, hardware protrusion, flexor or extensor tenosynovitis with risk of tendon tear, secondary displacement, infection, stiffness, malunion, non-union, intra-articular screw protrusion, etc. [22,23,25]. There have been no precise recommendations as to the ideal interval to removal, but some authors consider ablation to be more difficult after 1 year, partly because the plate is liable to have developed bone coverage and partly because cold fusion, sometimes observed in titanium plates, may prevent screw removal [24,25]. To avoid such complications, we systematically remove volar plates in patients aged less than 65 years.

Thirty of the present series of 388 minimally invasive volar plate ablations were indicated for disabling symptomatology.

Some technical intraoperative complications related to hardware removal occurred, but without postoperative clinical impact; there were no postoperative complications.

Weak points of the present study comprised its non-comparative retrospective design, without measurement of preoperative clinical assessment variables (pain, strength, motion, DASH score) or time off work, precluding demonstration of superiority for MIPO over conventional approaches. The esthetic advantage, on the other hand, is undeniable.

In conclusion, the present results demonstrated the feasibility of removing a distal radius volar plate via a 20-mm approach.
These findings should be confirmed on a future study comparing minimally invasive plate ablation and conventional approaches.

Disclosure of interest

Philippe Liverneaux has conflicts of interest with Newclip Technologies, Argomedical.
The other authors declare that they have no competing interest.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.otsr.2016.10.015.

References