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Original article

Distal radius fracture fixation with a volar locking plate and endoscopic carpal tunnel release using a single 15 mm approach: Feasibility study

Ostéosynthèse de l'extrémité distale du radius par plaque verrouillée antérieure et neurolyse endoscopique du nerf médian au canal carpien par une voie d'abord unique de 15 mm : étude de faisabilité

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ABSTRACT

Distal radius fractures (DRF) may trigger, reveal or decompensate acute carpal tunnel syndrome (CTS) in 0.5–21% of cases. Internal fixation and median nerve release must then be carried out urgently. Less invasive approaches have been described for both the median nerve release using an endoscopic device and for the DRF fixation using a volar locking plate. We assessed the feasibility of DRF fixation and median nerve release through a single, minimally-invasive 15 mm approach on a series of 10 cases. We reviewed retrospectively 10 consecutive cases of DRF associated with symptomatic CTS in 8 women and 2 men, aged 57 years on average. CTS was diagnosed clinically. All patients were treated during outpatient surgery with a volar locking plate and endoscopic carpal tunnel release using a single 15 mm minimally-invasive approach. In one case, arthroscopic scapholunate repair was also required. Six months after the procedure, all patients were reviewed with a clinical examination and a radiological evaluation. The average values for the clinical and radiological outcomes were as follows: pain on VAS 1.5/10; QuickDASH 14.3/100; flexion 90%; extension 90.6%; pronation 95.6%; supination 87.9%; grip strength 90.1%; 2PD test 5.2 mm (4–8 mm). Five complications occurred: two cases of temporary dysesthesia in the territory of the median nerve and one case of temporary hypoesthesia of the palmar branch of the median nerve, which had all completely recovered; two cases of complex regional pain syndrome type I, which were still active at 6 months. Despite its methodological weaknesses, our study is the only one to describe the technical feasibility of a single 15 mm minimally-invasive approach for both internal fixation using a volar locking plate and endoscopic nerve release, with no serious complications. This technique should be added to the surgical toolbox of minimally-invasive procedures for the hand and wrist.

RÉSUMÉ

Les fractures de l'extrémité distale du radius (EDR) peuvent causer, révéler ou décompenser un syndrome du canal carpien (SCC) dans 0,5 à 21 % des cas. Une ostéosynthèse et une libération du nerf médian doivent être réalisées en urgence. Des abords moins invasifs ont été décrits tant pour la libération du nerf médian en utilisant un endoscope que pour l'ostéosynthèse de l'EDR en utilisant une plaque antérieure à vis verrouillées. À partir d'une série de 10 cas, nous avons évalué la faisabilité de l'ostéosynthèse de l'EDR et de la libération du nerf médian au travers un abord mini-invasif unique de

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15 mm. Nous avons revu rétrospectivement 10 cas consécutifs de fracture de l'EDR associée à un SCC symptomatique chez 8 femmes et 2 hommes, âgés en moyenne de 57 ans. Le SCC a été diagnostiqué cliniquement. Tous les patients ont été opérés en chirurgie ambulatoire pour une ostéosynthèse par plaque antérieure à vis verrouillées et une libération endoscopique du nerf médian au canal carpien, en utilisant un abord mini-invasif unique de 15 mm. Dans un cas, une réparation arthroscopique du ligament scapho-lunaire a été nécessaire. Au recul de 6 mois, tous les patients ont fait l'objet d'une évaluation clinique et radiologique. En moyenne, les résultats cliniques et radiologiques étaient les suivants : évaluation visuelle analogique de la douleur 1,5/10 ; score QuickDASH 14,3/100 ; flexion 90 % ; extension 90,6 % ; pronation 95,6 % ; supination 87,9 % ; force de préhension 90,1 % ; test de discrimination de 2 points statiques 5,2 mm (4–8 mm). Cinq complications ont été décrites : deux cas de dysesthésies transitoires dans le territoire du nerf médian et un cas d'hypoesthésie transitoire dans le territoire du rameau palmaire du nerf médian, qui ont tous trois connu une résolution complète ; deux cas de syndrome douloureux régional complexe de type I, encore évolutifs à 6 mois. Certains auteurs ont traité la question de la voie d'abord utilisée dans le cas de fracture de l'EDR associée à un SCC. Malgré ses nombreuses faiblesses méthodologiques, notre série est la seule à décrire un abord mini-invasif unique de 15 mm permettant à la fois une ostéosynthèse par plaque antérieure à vis verrouillées et une libération endoscopique du nerf médian, sans complication sérieuse. La libération endoscopique du nerf médian au canal associée à l'ostéosynthèse de l'EDR par plaque est techniquement possible au travers d'un abord mini-invasif unique. Cette technique vient enrichir l'arsenal de la chirurgie mini-invasive de la main et du poignet.

1. Introduction

Recent decades have seen the development of minimally-invasive, endoscopic and arthroscopic techniques in orthopedic surgery [1] and specifically in hand surgery.

Surgical release of the median nerve in the carpal tunnel, which was traditionally performed using a wide volar approach, is now commonly performed using a "mini-open" technique [2] or an endoscopic technique [3].

Fixation of distal radius fractures (DRF) using volar locking plates is becoming the gold-standard technique [4]. Several minimally-invasive techniques using volar locking plates have been described in recent years [5–10]. The technique used in our study, using a 15 mm approach, was previously described and validated in a cadaver study [11] and a clinical study [12]. More recently, Naito et al. reduced the size of this approach to 10 mm using a similar technique for extra-articular fractures or simple intra-articular fractures [13].

DRF may trigger, reveal or decompensate carpal tunnel syndrome (CTS) in 0.5–21% of cases [14]. Internal fixation and median nerve release must then be carried out urgently [15]. Over the past six years, we have been using a minimally invasive approach to fix almost any kind of DRF with a volar locking plate. Feeling confident after about 1000 endoscopic carpal tunnel release procedures with no serious complications, we sought to combine these two procedures when required. The aim of this study was to assess the outcomes of 10 clinical cases to validate the feasibility of DRF fixation and median nerve release using a single minimally-invasive 15 mm approach.

2. Material and methods

This was a retrospective, single-center, single-surgeon study including patients operated between January 1st, 2014 and September 1st, 2015 for a DRF with CTS. As shown in Table 1, the cohort included 8 women and 2 men, aged 57 years on average (26–81 years) with 6 patients having type A fractures, 2 with type B fractures and 2 with type C fractures according to the AO classification. All were closed fractures. CTS was diagnosed clinically in an emergency department; the clinical criteria were acroparesthesia and/or hypoesthesia following the trauma. We did not find any other acute cause explaining the nerve compression.

In two cases, the CTS existed before the trauma, but the intensity of the symptoms increased after the trauma. In one case, an additional diagnostic wrist arthroscopy was required: scapho-lunate (SL) dissociation was diagnosed and arthroscopic treatment as described by Mathoulin et al. [16] was performed.

All procedures were performed as outpatient surgery under regional anesthesia, using tourniquet. The procedure included two steps: DRF fixation followed by endoscopic carpal tunnel release. In one case, an additional wrist arthroscopy was required. DRF fixation was performed using an Initial R StepOne™ volar locking plate (NewClipTechnics, Haute-Goulaisne, France) through the minimally-invasive volar approach described by Lebailly et al. [12] (Figs. 1–2). Endoscopic carpal tunnel release was performed by cutting the flexor retinaculum as described by Agee et al. [17], using a Centerline™ Endoscopic Carpal Tunnel Release System (Arthrex, Naples, Florida). Through the same approach, the flexor carpi radialis (FCR) was retracted on the radial side and the palmaris longus (PL) was retracted on the ulnar side. The median nerve and its palmar branch were identified (Fig. 3). After detaching the synovial sheath from the deep portion of the flexor retinaculum (Fig. 4), the endoscope was introduced between the FCR and the PL, above and ulnar to the median nerve (Fig. 5). At the carpal tunnel, the tip of the endoscope was located just beneath the retinaculum (Fig. 6). As shown in Fig. 1c, both the median nerve and its palmar branch had to be on the radial side of the endoscope, so as not to cross their path while cutting the retinaculum. At the end of the procedure, the skin was closed with a running subcuticular suture. The size of the incision never exceeded 15 mm (Fig. 7).

At 6 months, all patients were reviewed in person using the following criteria: pain according to a visual analogue scale (VAS), ranging from 0 (no pain) to 10 (maximum pain); evaluation of the overall function of the upper limb using the QuickDASH score ranging from 0 (normal function) to 100 (nonfunctional upper limb); measurement of joint range of motion (flexion, extension, pronation and supination) expressed in % compared to the opposite side; measurement of grip strength using a Jamar dynamometer (Sammons Preston Rylolan™, Bolingbrook, JL, USA) expressed in % compared to the opposite side; measurement of fingertip

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