

Original article

## Retrograde percutaneous screw fixation for scaphoid type II non-union in Schernberg zones 2 to 4: A series of 38 cases

*Vissage percutané des pseudarthroses de type II en zone 2 à 4 de Schernberg, à propos de 38 cas*

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### Abstract

Regardless of the treatment used, 25 to 45% of scaphoid fractures do not heal. Open surgery compromises vascularization and destabilizes ligament attachments. The aim of this retrospective study was to assess the value of retrograde percutaneous screw fixation of Alnot stage IIA and IIB scaphoid non-union in Schernberg zones 2 to 4. This series included 38 patients with a mean age of 31 years. Based on the Alnot classification, there were 16 stage IIA non-unions (12 in zone 3 and 4 in zone 2 according to the Schernberg classification) and 22 stage IIB non-unions (9 in zone 3 and 13 in zone 2). The time elapsed between the initial trauma and the surgical treatment was 10 months on average. Percutaneous retrograde fixation was performed with a cannulated 2.7 mm compression screw. At 25 months follow-up, 31 of the non-union cases had healed (81.6%), of which 14 were stage IIA (87.5%) and 17 were stage IIB (77.3%), after an average 6.3 months. Average pain was 1.6. The average Quick DASH was 17.3/100. Compared to the opposite side, the average range of motion was 84.8% in flexion, 84.7% in extension, 98.9% in pronation, 96.5% in supination, 96.8% in ulnar deviation and 86.4% in radial deviation. The grip strength was 80.4% of the contralateral side. Seven patients did not heal after screw fixation; four of them healed after additional electromagnetic stimulation and three after addition of a vascularized bone graft. Based on this study's results, stage IIA non-unions can heal with simple retrograde percutaneous screw fixation. The same procedure could be enough for stage IIB non-union cases, however we recommend adding a cancellous bone graft by arthroscopy. Open surgery procedures are preferred when percutaneous procedures have failed.

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**Keywords:** Scaphoid; Non-union; Compression screw

### Résumé

Les fractures du scaphoïde ne consolident pas dans 25 à 45 % des cas, tous traitements confondus. La chirurgie à ciel ouvert compromet la vascularisation et déstabilise les attaches ligamentaires. Le but de cette étude rétrospective était d'évaluer l'intérêt du vissage percutané rétrograde dans les pseudarthroses du scaphoïde de type IIA et IIB d'Alnot en zones 2 à 4 de Schernberg. La série comprenait 38 patients d'âge moyen 31 ans. Selon Alnot, il existait 16 pseudarthroses de stade IIA (12 zones 3 et 4 zones 2 selon Schernberg) et 22 pseudarthroses de stade IIB (9 zones 3 et 13 zones 2). Le délai moyen entre le traumatisme initial et le traitement chirurgical était de 10 mois. Le vissage percutané rétrograde était réalisé avec une vis canulée à compression de 2,7 mm. Au recul moyen 25 mois, 31 pseudarthroses avaient consolidé (81,6 %), dont 14 stade IIA (87,5 %) et 17 stade IIB (77,3 %) en 6,3 mois de moyenne. La douleur moyenne était de 1,6, le quick DASH moyen 17,3/100. Par comparaison avec le côté opposé, la flexion moyenne du poignet valait 84,8 %, l'extension 84,7 %, la pronation 98,9 %, la supination 96,5 %, l'inclinaison ulnaire 96,8 %, l'inclinaison radiale 86,4 % et la force 80,4 %. Sept patients n'avaient pas consolidé après vissage, dont 4 avaient finalement consolidé après

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stimulation électromagnétique et 3 après transfert osseux vascularisé. D'après nos résultats, les pseudarthroses de stade IIA peuvent consolider par vissage rétrograde percutané simple. Les stades IIB peuvent aussi consolider, mais nous recommandons d'y associer un greffon osseux spongieux sous arthroscopie. Les techniques à ciel ouvert ne sont pour nous indiquées qu'en cas d'échec des techniques percutanées.

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*Mots clés* : Scaphoïde ; Pseudarthrose ; Vis à compression

## 1. Introduction

Scaphoid fractures are the most common in carpus traumatology [1]. Regardless of the type of treatment, 25 to 45% progress towards non-union [2,3]. Poor scaphoid vascularization and high mechanical forces explain these poor results [4]. In practice, the prognosis for these non-unions depends on several parameters: fracture line location, radio-scaphoid and/or mid-carpal osteoarthritis, scaphoid proximal pole necrosis, carpal DISI [5]. Classifications for scaphoid non-union have been proposed by Alnot [6] in France, Gelbermann [7] in the USA, Inoue in Japan [8]. Based on these classifications, the results seem better when the non-union is moderately resorptive, no DISI is present and the fracture line is distally located.

Many surgical techniques have been described to treat scaphoid non-union. These all incorporate the principles of necrotic bone tissue debridement, reduction of the displaced non-union and fixation. Open approaches – whether dorsal or volar – compromise the already precarious scaphoid vascularization and destabilize ligament attachments. Minimally invasive or percutaneous techniques attempt to preserve carpus stability and scaphoid vascularization. They can be suitable for Schernberg zone 1 non-unions [9] or in zones 5 to 6 where non-unions are rare.

The aim of this retrospective study was to assess the feasibility of percutaneous volar screw fixation for Alnot stage IIA and IIB scaphoid non-unions [6] in Schernberg zones 2 to 4 [9] after a follow-up of two years.

## 2. Material and methods

Non-unions in Schernberg zones 1, 5 or 6, and cases with associated perilunate dislocation, SNAC wrists and proximal pole necrosis were excluded. Patients with a history of any type of wrist surgery were also excluded. This retrospective series included 44 patients operated on between October 2005 and October 2011. Among them, two patients were lost to follow-up and four were excluded because of a lack of clinical data. The final study population consisted of 38 patients including 36 men and 2 women (Table 1). The mean age was 31 years old (17–67). Seventeen patients were manual workers. The dominant side was involved in 16 patients. According to Alnot's classification [6], there were 16 stages IIA non-unions (bone cysts with no intracarpal deviation) and 22 stage IIB non-unions (bone cysts with intracarpal DISI deviation but no osteoarthritic changes). Among the 16 stage IIA non-unions, 12 were in Schernberg zone 3 and 4 were in zone 2. Among the 22 stage

IIB non-unions, 9 were in Schernberg zone 3 and 13 in zone 2. The mean time elapsed between the initial trauma (or the beginning of symptoms when it could be traced) and the surgical treatment of the non-union was 10 months.

Percutaneous fixation was performed under regional anesthesia with an anesthetic block at the arm and a pneumatic tourniquet. The wrist was held in extension and ulnar deviation with a radiolucent malleable lead hand (Chirobloc<sup>®</sup> AREX<sup>™</sup>, Palaiseau, France). Using fluoroscopy, a 0.8-mm diameter pin was inserted with a surgical motor into the scaphoid tubercle along the major axis of the scaphoid from proximal to distal. Initially, the pin was not pushed beyond the non-union line. The surgeon made sure the pin was in the middle of the scaphoid using four intra-operative views (AP, lateral and two oblique).

The pin was then pushed beyond the non-union line up to the second cortex. The screw length was measured. The pin was then pushed beyond the second cortex to avoid having to remove it with the drill. The first pin was meant to guide the screw. The second pin was inserted parallel to the first to avoid any rotation of the bony fragments during drilling and fixation. A 2.7 mm diameter dual-compression cannulated screw (Biotech International<sup>™</sup>, Salon de Provence, France or Newclip<sup>™</sup>, la Fourrassière, France) was inserted by hand under fluoroscopic control. The second pin was moved back and forth to abrade the non-union site and then removed. Final fluoroscopic control assessed the proper compression of both bone fragments. The wrist was immobilized with a volar splint in slight extension for 6 weeks. All smoking patients were advised to limit their tobacco consumption.

In cases with stage IIB non-union and a DISI deformity, a temporary radiolunate K-wire was placed in the flexed wrist to maintain the scaphoid reduction before screw fixation.

Patients were followed up at 6 weeks, 3 months, 6 months, one year and then every 6 months until subsequent healing. The final evaluation consisted of measuring clinical and radiological variables at the last follow-up. Among the clinical variables, pain was evaluated with a visual analog scale (VAS) from 0 (no pain) to 10 (maximum imaginable pain). Grip strength was measured with a Jamar<sup>®</sup> dynamometer (Sammons Preston Ryolan<sup>™</sup>, Bolingbrook, IL, USA) in two positions. Results were expressed as a percentage of the contralateral side. Overall hand function was assessed with a Quick DASH upper limb functional score ranging from 0 (normal use of the upper limb) to 100 (upper limb not used). Wrist range of motion was measured in flexion, extension, pronation, supination, radial inclination and ulnar inclination with a goniometer and compared to the other side. Results were expressed as a percentage of the contralateral side. For the

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