

Original article

Retrospective study of two fixation methods for 4-corner fusion: Shape-memory staple vs. dorsal circular plate

L'arthrodèse des quatre os. Étude rétrospective comparant deux moyens de fixation : agrafe à mémoire de forme vs cupule vissée dorsale

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Abstract

The purpose of this study was to compare the results of two groups of patients with four-corner fusion, one group fixed with shape-memory staples and the other with locked circular plates. This retrospective study compared 52 wrists operated for scaphoid excision and four-corner fusion between 2005 and 2011. The arthrodesis was ensured by a shape-memory quadripodal staple (4Fusion[®], Memometal[™]) in 37 cases and a locking dorsal circular plate (Xpode[®], Biotech Ortho[™]) in 15 cases. In the staple group, the mean age was 58.5 years and the average follow-up was 4.3 years. In the circular plate group, the mean age was 58.6 years and the average follow-up was 3.1 years. Pain, range of motion, grip strength, functional scores (QuickDASH and PWRE), fusion of the midcarpal joint, complications (implant fracture and reoperation) and patients' satisfaction were used as outcome measures. There was no pain in 43% of patients in the staple group and 40% of patients in the circular plate group at the follow-up; range of motion and functional scores were similar in both groups. Seventy-five percent of patients in the staple group were satisfied or very satisfied versus 60% in the circular plate group. The implant broke in 24.3% of cases in the staple group and 60% in the circular plate group. Reoperation was needed in 18% of the staple cases and 14% of the plate cases. There was no difference between the implants in terms of pain, range of motion, functional scores and patient satisfactory. The implant fracture rate in the plate group was high. This study brings into question implant reliability for the four-corner fusion procedure.

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Keywords: Four-corner arthrodesis; Shape-memory staple; Screwed cup; SLAC wrist; SNAC wrist

Résumé

Cette étude avait pour but de comparer les résultats de deux séries d'arthrodèses des quatre os, l'une ostéosynthésée par agrafe quadripode à mémoire de forme et l'autre par plaque circulaire avec vissage verrouillé. Cette étude rétrospective a comparé 52 poignets opérés d'une scaphoïdectomie et arthrodèse des quatre os entre 2005 et 2011. La fixation de l'arthrodèse était assurée par une agrafe à mémoire de forme 4Fusion[®] (Stryker/Memometal[™]) dans 37 cas ou par une plaque vissée Xpode[®] (Biotech Ortho[™]) dans 15 cas. Pour le groupe agrafe, la moyenne d'âge était de 58,5 ans et le recul moyen de 4,3 ans ; pour le groupe plaque circulaire, la moyenne d'âge était de 58,6 ans et le recul de 3,1 ans. L'analyse des résultats a porté sur la douleur, les mobilités, la force de serrage (*grip*) et les scores fonctionnels QuickDASH et PWRE, la fusion des interlignes médiocarpéens, les complications (fracture de l'implant et reprise chirurgicale) et la satisfaction du patient. L'indolence était restaurée chez 43,2 % des patients du groupe agrafe et 40 % des patients du groupe plaque circulaire, les mobilités et les scores fonctionnels étaient comparables dans les deux groupes. Soixante-quinze pour cent des patients du groupe agrafe étaient satisfaits ou très satisfaits versus 60 % dans le groupe plaque circulaire. On notait un taux de rupture d'implant de 24,3 % dans le groupe agrafe et de 60 % dans le groupe plaque circulaire. Le taux de reprise était de 18 % dans le groupe agrafe et 14 % dans le groupe plaque circulaire. Il n'y avait pas de différence significative en ce qui concerne la douleur, les arcs de mobilité ou la satisfaction des patients. Le groupe plaque circulaire

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montrait un taux significatif de fracture du matériel. Cette étude soulève la problématique de la fiabilité des implants proposés dans la fixation de l'arthrodèse des quatre os.

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Mots clés : Arthrodèse des quatre os ; Agrafe à mémoire de forme ; Cupule vissée ; SLAC wrist ; SNAC wrist

1. Introduction

Scaphoid excision with the fusion of four carpal bones (hamate, lunate, triquetral and capitate) is a classical surgical option for treating arthritic wrists [1]. The goal of four-corner fusion (4CF) is to fuse these bones together while preserving some wrist mobility in the radiocarpal joint. The surgical technique has changed very little since it was first described in 1984, but the best fixation method is controversial. Fixation can be accomplished with K-wires, screws, staples, plates or cups secured with locking or non-locking screws [2–4]. There is no consensus as to which fixation method is the best.

The goal of this study was to compare the results of two 4CF cohorts, one fixed with a shape-memory quadripodal staple and the other with a locking circular plate. These cohorts were evaluated using standard primary (pain, range of motion, satisfaction and joint fusion) and secondary outcome measures (time away from work, duration of postoperative immobilization, complications and implant fracture).

2. Patients and methods

2.1. Patients

We identified 105 patients who met the following inclusion criteria: scaphoid excision and 4CF fusion performed at our facility between January 1st, 2005 and December 31st, 2012; fixation performed with a nitinol shape-memory quadripodal staple (4Fusion[®], Monometal/Stryker[™]) or a dorsal circular plate made of PEEK (polyether-ether-ketone) with titanium locking screws (Xpode[®], Biotech Ortho[™], Salon de Provence, France).

Patients were excluded for the following reasons: partial wrist fusion, other fixation method (K-wires, screws, first-generation staples) or refusal to return to the center for review (37 patients were excluded for this reason: 24 with staples, 13 with circular plates). Sixteen patients were lost to follow-up (12 with staples, 4 with plates), including two deaths unrelated to the surgery. As a consequence, 50.6% of patients with staples and 46% of patients with plates were available for this study. In all, 50 patients (52 wrists) were included in the final analysis, divided into two groups: staple group and plate group.

2.2. Surgical technique

The surgical technique used was identical in both groups, except for the fixation method. A dorsal incision was made over the 3rd and 4th extensor compartments. The posterior interosseous nerve was excised in every instance. The capsule

was opened using the technique described by Berger [5] so as to preserve the dorsal extrinsic ligament layer.

The entire scaphoid was removed and prepared so as to harvest cancellous bone graft. Any DISI deformity was reduced using a temporary radiolunate K-wire. The four bones were then locked together with temporary K-wire placed through the triquetral-lunate, triquetral-capitate and hamate-capitate joints. The dorsal side of the four bones was decorticated using an 18-mm diameter flat reamer. The cartilage surfaces between the four bones were decorticated with a bone cutter, curette or 3.5-mm diameter drill bit, depending on surgeon preference.

The bone graft taken from the scaphoid and from reaming of the dorsal side of the bones was inserted between the four bones. Fixation was accomplished with either a dorsal circular plate or shape-memory staple, depending on surgeon preference.

2.3. Group make-up

In the staple group of 37 patients, the average age was 58.51 years (41–80 years). There were 31 men and 6 women; the dominant hand was operated in 20 cases. Twenty-eight patients were employed at the time of surgery, with 23 of them performing manual labor. Thirty wrists had a SLAC deformity (all Watson stage 3 [6]) and 7 had a SNAC deformity (3 stage 2 and 4 stage 3). The average follow-up after surgery was 4.28 years (2–7.82 years).

In the plate group of 15 patients, the average age was 58.6 years (47–70 years). There were 8 men and 7 women; the dominant hand was operated in 8 cases. Thirteen patients were employed at the time of surgery, with 7 of them performing manual labor. Twelve wrists had a SLAC deformity (1 stage 2 and 11 stage 3) and 3 had a SNAC deformity (2 stage 2 and 1 stage 3). The average follow-up was 3.1 years (1.9–6.7 years).

The two groups were comparable in terms of demographics, except for the number of patients and sex ratio (Table 1).

2.4. Assessments

The 50 patients underwent clinical and radiological assessments by an independent observer.

The clinical assessment consisted of an evaluation of pain at rest using a visual analog scale (VAS). The value was expressed on a scale of 100 points (international standard). The main endpoint was the achievement of complete pain relief (EVA of 0 for pain). The patients were asked about their satisfaction on a four-point scale (not satisfied, somewhat satisfied, satisfied or very satisfied), smoking habits (smoker or non-smoker), return to work (at the pre-surgery level or not) and time away from

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