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Efficiency of locking-plate fixation in isolated talonavicular fusion

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ABSTRACT

Introduction: Talonavicular (TN) fusion is an effective means of treating hindfoot deformity and pain. At the cost of a certain limited morbidity, it allows lasting stabilization of all of the torque joints. Non-union rates, however, are high, due to insufficient mechanical stability of the fixation. The present study assessed radiological and clinical results in TN fusion fixed by two retrograde compression screws and a dorsal locking plate.
Material and method: A retrospective single-surgeon study recruited 26 TN fusions performed in 25 patients (13 male, 12 female; mean age, 54.6 ± 15.4 years) between March 1st, 2010 and February 28th, 2014. Mean follow-up was 14.9 ± 8.7 months. Bone fusion and anatomic results were assessed on dorsoplantar, lateral and Méary weight-bearing radiographs.
Results: Radiologic fusion was achieved in all cases, at a mean 2.7 ± 0.7 months. Mean TN coverage angle was 21.7 ± 10.5° preoperatively and 3.8 ± 1.8° at follow-up. Mean AOFAS score improved significantly, from 37.2 ± 11.8 (range, 20–53) preoperatively to 79.4 ± 11.4 (range, 45–98) at follow-up.
Conclusion: TN fusion fixed by two retrograde compression screws and a dorsal locking plate provided a high rate of consolidation without loss of angular correction and with satisfactory clinical results.
Level of evidence: IV.
Type of study: Retrospective.

1. Introduction

Talonavicular (TN) fusion was first described in 1884 by A. Ogston [1]. It is indicated in degenerative, inflammatory and traumatic TN joint lesions and hindfoot deformity [2–7]. At the cost of a certain limited morbidity, it lastingly stabilizes all the torque joints [8–15], and is thus a useful alternative to more invasive procedures such as Chopart arthrodesis or complete torque joint fusion [16].

However, TN fusion is associated with non-union rates of up to 35% [8,17–20]. Two etiologies have been suggested for this: poor vascularization of the navicular bone and talus [21]; and insufficient mechanical stability of fixation of this key hindfoot ball-and-socket joint during consolidation, which tends to be long [19,20,22,23]. In support of these hypotheses, two series of TN fusion for in-situ TN rheumatoid arthritis reported non-union rates of less than 5% with compression screw fixation and associated autologous graft [24,25].

In other indications, screwed locking plates have shown greater resistance to torsion stress and better fixation, enhancing assembly stability and improving consolidation rates [12,26,27]. Since 2010 we have therefore used them to neutralize stress in TN fusion with compression screw fixation. The hypothesis that this means of fixation improves consolidation rates in TN fusion was tested by retrospective assessment of patients managed using this technique.

2. Material and method

2.1. Inclusion criteria

Continuous retrospective follow-up was performed in all cases of TN fusion with compression screw fixation associated to a rigid plate with uniaxial locking screws in neutral mode (Darco®, Wright Medical Technology, Memphis, TN, USA), treated by a single surgeon (J.B.) using a standardized technique in the University Hospital of Tours, France, between March 1st, 2010 and February 28th, 2014.

Exclusion criteria comprised: TN fusion using a different technique, follow-up less than 6 months or incomplete radiological and clinical records.

The population initially consisted of 35 cases in 33 patients. Nine cases were excluded: 3 due to incomplete records, 3 in which

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Fig. 1. Weight-bearing radiographic assessment at 12 weeks, showing consolidation of talonavicular fusion with fixation by two retrogrades compression screws and a plate with uniaxial locking screws in neutral mode.

no locking plate was used, and 3 performed with plate and staple fixation.

2.2. Surgical technique

Surgery was performed under nerve blocks associated to general anesthesia according to patient tolerance. Antibioprophylaxis was initiated following the institution's protocol after validation of the checklist. The patient was positioned supine, with a cushion under the ipsilateral buttock so as to position the hindfoot vertically.

The first step consisted in assessing tendon and muscle retraction. Equinus was addressed with a percutaneous Achilles tendon triple hemisection lengthening procedure such that 10 to 15° of ankle dorsiflexion was reached. Attention was then directed toward release of the peroneus brevis tendon. A longitudinal incision was made over the tendon approximately 3 cm above the ankle joint along the posterior aspect of the fibula. The tendon was delivered out of the incision and two hemisections 2 cm apart were performed allowing the tendon to shear longitudinally and to lengthen. If correction of the hindfoot valgus was insufficient after peroneus brevis lengthening, peroneus longus lengthening was then performed using the same technique.

The stabilization step was initiated once the foot was plantigrade and hindfoot deformity could be reduced by external maneuver. The TN joint was approached dorsomedially, so as to spare the deltoid ligament and allow the same approach to be used again if subsequent ankle joint surgery was required. The medial branch of the superficial peroneal nerve was dissected and mobilized. The extensor retinaculum was cut between the anterior tibial tendon and extensor hallucis longus muscle. Dorsal capsulotomy was performed after identification of the talar neck, and extended within the deformity and sometimes into the plantar region, to facilitate correction of the deformity. The talar head was then dislocated dorsally. Joint freshening was performed using a slow rotating burr (5,000 rpm) so as not to jeopardize consolidation by overheating [28], and sought to respect the concave-convex shapes of the joint surfaces, in order to optimize bone contact and minimize shortening of the medial column of the foot. Freshening was completed by multiple K-wire perforations, exposing the subchondral bone [29]. The deformity was corrected manually, and the TN joint line was temporarily fixed with a Kirschner wire to assess correction under simulated weight-bearing, completed in some cases by fluoroscopy. An autologous corticocancellous anterosuperior iliac graft was associated in case of segmental bone defect involving more than one-third of the joint surface.

Final fixation used two 3.5 mm retrograde compression screws. The first screw was positioned in the convexity of the deformity, often percutaneously, ascending from the navicular tuberosity to the talar neck. A second screw was positioned laterally through the approach or percutaneously. Stress was neutralized by a dorsal plate with uniaxial locking screws (Darco Modular Rearfoot System UPS 3.5 mm, Wright Medical Technology, Memphis, TN, USA), taking care not to impinge with the anterior aspect of the tibial pilon, in maximum ankle dorsiflexion (Fig. 1). Fluoroscopic control was available to check any screw penetration into the subtalar joint.

The final step was washing of the surgery site. Closure was performed in 3 layers with a suction drain in contact with the neck of the talus. The deep capsule and fatty tissues covered the dorsal plate, then the retinaculum and finally the subcutaneous and cutaneous layer were sutured.

Postoperative care included at least 6 weeks of non-weight-bearing splint immobilization. Walking was then progressively resumed, in ordinary shoe-wear with or without orthopedic insoles.

2.3. Methodology

The main outcome measures were radiographic bone fusion and correction of the deformity. The secondary outcome was clinical results.

Radiographic measurements were obtained from standard weight-bearing AP and lateral radiographs of the foot as well as hindfoot standing Méary alignment radiographs performed preoperatively and at follow-up [30]. Bone fusion and correction of preoperative joint deformity were assessed.

Bone fusion was assessed according to Rush et al. [31]. Nonunion was diagnosed on lytic radiolucency increasing the joint space, absence of bone bridge, or fixation material breakage. Failure was defined by painful incomplete radiographic healing 6 months postoperatively. Radiographic measurements [32] were made by an independent observer with a digital goniometer (OrthoView®, Jacksonville, FL, USA), integrated in the institution's digital archiving system (Horizon Medical Imaging, McKesson®, San Francisco, CA, USA). Méary-Toméno angle was measured on lateral weight-bearing view (Fig. 2). Plantar convexity was measured positively and dorsal convexity negatively. Talar coverage or Giannestras angle was measured on dorsoplantar view (Fig. 3). Medial uncoverage was measured positively and lateral uncoverage negatively. Talar valgus was measured on Méary alignment view. Valgus above seven degrees was measured positively and valgus under seven degrees or varus negatively.