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Original article

Comparison of screw versus locked plate fixation for Scarf osteotomy treatment of hallux valgus

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ABSTRACT

Introduction: The Scarf osteotomy is a commonly used surgical procedure for treating hallux valgus in Europe. Screw fixation is standard practice, although some surgeons now go without internal fixation. Plate fixation is still being studied. The aim of this study was to compare the radiological outcomes of these fixation methods, which has not been performed up to now. Hypothesis: Relative to screw fixation, plate fixation of a Scarf osteotomy of the first metatarsal (M1) prevents secondary impaction, without increasing the complication rate or recurrence rate.

Materials and methods: A retrospective study was performed of two internal fixation methods for Scarf osteotomy (screw vs. plate), by analyzing the secondary impaction of the first metatarsal, recurrence of the hallux valgus (angle M1P1 > 20) on X-rays, incidence of complications and potential discomfort related to the hardware. The osteotomy procedure was the same in both groups: 50 patients were included consecutively in each fixation group between February 2014 and November 2015.

Results: The mean follow-up was 13.0 ± 2.7 months in the screw group and 12.3 ± 1.1 months in the plate group. There were no severe complications, although four cases of delayed wound healing occurred (3 in plate group, 1 in screw group). In the screw group, there was one case of secondary impaction, two cases of recurrence (4%) and one case of discomfort. In the plate group, there were no cases of impaction, three recurrences (6%) and five cases of discomfort, leading to plate removal in three of these cases.

Discussion: There was no significant difference between groups in the M1 secondary impaction rate or recurrence rate: screw fixation did not lead to a higher recurrence rate. Systematic fixation with a locked plate for Scarf osteotomy had no advantages over screw fixation in our study.

Level of evidence: II, Comparative study with continuous cohorts.

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1. Introduction

In France and throughout Europe, the Scarf osteotomy is frequently used during hallux valgus surgery [1,2]. Several fixation methods have been described for this first metatarsal (M1) osteotomy [3,4]. Two-screw fixation and then single-screw fixation with a proximal bone wedge is standard practice [5,6], although some surgeons no longer use any internal fixation [7,8]. Osteotomy procedures with a sizable rotational component have a higher risk of secondary displacement according to surgeons who advocate “no fixation” procedures. We suggest fixation with a locking plate in cases where screw fixation or transosseous fixation are not secure and have a high risk of secondary impaction or fixation failure

(osteoporosis, revision, large translation needed). This type of fixation is currently being used during Chevron-type M1 osteotomy procedures.

To date, no study has determined the secondary impaction rate and M1 shortening rate after Scarf osteotomy performed with cephalic oblique screw fixation. Excessive M1 shortening increases the secondary risk of transfer metatarsalgia [9] to the lateral rays. Also, no study has determined whether the recurrence rate is affected by the fixation method. The risk factors identified for recurrence are the severity of the preoperative M1P1 angle and of the intraoperative sesamoid centering [10–12].

The aim of this study was to compare two fixation methods for Scarf osteotomy: single cephalic oblique screw fixation and locking plate fixation. We hypothesized that plate fixation of Scarf osteotomy prevents secondary impaction without increasing the number of complications and/or recurrences.

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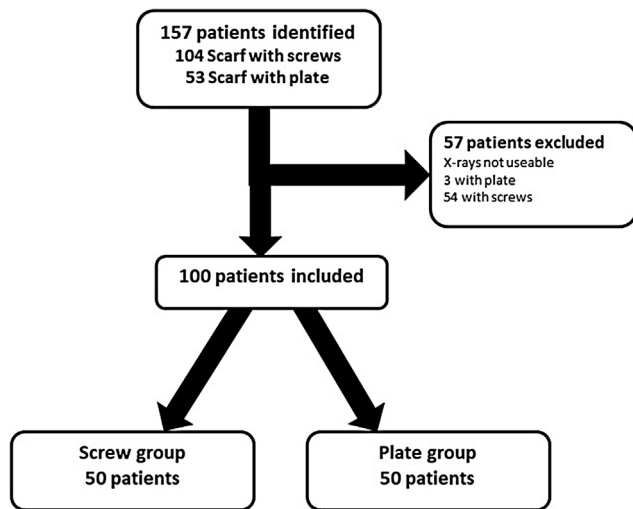


Fig. 1. Study flow chart.

2. Material and Methods

This was a single-center, retrospective comparative study of two continuous series of 50 patients operated between February 2014 and October 2015 by a senior surgeon specialized in foot surgery (JLB).

2.1. Patients

The inclusion criteria were an osteotomy performed to correct hallux valgus, pre-, intra- and postoperative X-rays showing the entire length of M1 and M2, and minimum follow-up of 1 year (Fig. 1).

The exclusion criteria were lack of pre-, intra- and postoperative X-rays showing the entire length of M1 and M2, or less than 1 year of follow-up.

Over the study period, 157 patients were operated on; 54 patients who underwent screw fixation and 3 who underwent plate fixation were excluded as the X-rays did not show the entire length of M1 and M2.

Between November 2014 and June 2015, a continuous series of 50 Scarf osteotomy cases were treated with the Scarf Extreme® plate (Biotech Ortho, Salon de Provence, France) (Fig. 2). Before (February to November 2014) and after this period (June to October 2015), 50 continuous Scarf osteotomy cases were treated with a 2.5 mm Pyxis® screw (Biotech Ortho, Salon de Provence, France) and had a full radiological assessment. The patients in the screw fixation group were included retrospectively to ensure 50 patients were included with a similar follow-up to the plate group (Table 1).

The comparability of the two groups was confirmed before the analysis (Table 1). There were no significant preoperative and immediate postoperative differences in terms of age, sex, associated procedures, pre- and postoperative M1M2 and M1P1 angles. The distal metaphyseal articular angle (DMAA) was higher in the plate group (8.9° versus 8.3°, $p=0.04$). The mean follow-up was 13.0 ± 2.7 months (10–24) in the screw group and 12.3 ± 1.1 months (12–18) in the plate group.

2.2. Surgical technique

Internal fixation of M1 Scarf osteotomy using a single distal cephalic oblique screw is standard practice in our department. The surgery was performed as either an inpatient or outpatient

procedure, with a tourniquet used at the ankle. The osteotomy performed was identical in the two groups—only the fixation method differed. A Hologic Fluoroscanner® Mini C-arm system was used in all the procedures. Several studies have shown that the radiation induced by the Hologic Fluoroscanner® Mini C-arm system is minimal [13–15] when used in accordance with good practice guidelines. The radiation data (dose, duration of exposure) were recorded in the patient records.

Of the 100 patients reviewed, 39 had only the first ray procedure. The other 61 patients had additional surgical procedures performed on the lateral rays during the same operative session, in identical proportion between groups (Table 1):

- screw fixation group: 12 procedures on lateral rays (M2, M3, M4 osteotomy), 13 procedures on lateral rays and claw toe deformity, 6 procedures on M5 ± claw toe deformity;
- plate fixation group: 12 procedures on lateral rays (M2, M3, M4 osteotomy), 9 procedures on lateral rays and claw toe deformity, 8 procedures on M5 ± claw toe deformity, 1 procedure for claw toe deformity.

The postoperative course was standardized. Immediate weight bearing was allowed with the patient using a rigid post-operative shoe with a rockered sole for 1 month. Active rehabilitation of the intrinsic muscles was given to patients starting on day 4 and the intensity increased at week 4 postoperative. The patients were reviewed at 3–4 weeks, 3–4 months and 1 year, at which point they underwent clinical and radiological assessments.

2.3. Analysis methods

The outcomes consisted of a pre-, intra- and postoperative radiographic analysis with 1-year follow-up and a clinical analysis to detect complications and discomfort related to the hardware. X-rays were taken during office visits as in current practice. The current practice was not altered for this study.

AP X-rays were taken showing the M1 and M2 base to allow measurements of the entire length of these two metatarsals (Fig. 3). M1M2 angle and M1M2 ratio were measured. (Fig. 4). The M1/M2 ratio was calculated by dividing the length of M1 (mm) by the length of M2 (mm). This ratio was used to get around magnification issues on plain X-rays. The M1–M2 index, which used to determine shortening, was defined as the difference in length in millimeters between the apex of the M1 and M2 heads relative to a horizontal line passing through the center of the lateral sesamoid and perpendicular to the foot axis (center of midfoot/M2 head). This index could be either negative (index minus: M1 shorter than M2) or positive (index plus: M1 longer than M2). Secondary impaction was defined as a reduction in the M1/M2 ratio during the follow-up period, and an increase in the index minus between M1 and M2.

The primary endpoint was the incidence of secondary impaction determined 1 year after the surgery. The secondary endpoint was the M1P1 angle (Fig. 4b) and M1 measured on 1-year postoperative X-rays to look for a recurrence of the deformity, which was defined as $M1P1 > 20$. It was labeled as moderate when $20 < M1P1 < 40$ and severe when $M1P1 > 40$ [15,16].

The complications were recorded (septic or wound-related, significant residual pain, non-union of the osteotomy, etc.), as was the presence of discomfort due to the fixation hardware. Hardware-related discomfort appeared as thickening on the medial side of the joint, swelling and contact-induced rubbing; these were subjective findings.

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