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Locking versus non-locking one-third tubular plates for treating osteoporotic distal fibula fractures: a comparative study

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KEYWORDS

ankle fracture
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locking Plates

ABSTRACT

Introduction: Ankle fractures represent the third most common fracture in elderly patients, after hip and wrist fractures. Distal fibula fractures in this population are closely related to osteoporosis, which renders commonly used methods of internal fixation technically demanding and prone to failure. Currently there is a tendency to fix osteoporotic metaphyseal and epiphyseal fractures with locking plates. However, published accounts about the use of this technology in osteoporotic distal fibula fractures are scarce. In this study we compare the results of two groups of patients who underwent surgery for these types of fracture, one group received locking and the other non-locking screws, both using one-third tubular plates.

Methods: Sixty-two patients, aged over 64 years, underwent surgery for osteoporotic distal fibula fractures between 2011 and 2014. Forty-five of them were stabilized with a non-locking plate and the remaining 17 with a locking plate fixation. Follow-up was performed at 4, 8, 12, 26, and 52 weeks. Results were assessed according to the AOFAS Ankle-Hindfoot Score and radiological criteria for consolidation.

Results: Average time to union and AOFAS scores at 6 and 12 months were similar in both groups, including for the individual categories: function, pain, mobility, and alignment. Only time until partial weight bearing was significantly lower in the locking plate group (4.69 ± 2.63 *vs* 7.77 ± 4.30, $p = 0.03$). The most common complications were wound dehiscence and superficial infection (two cases of both).

Conclusions: Both locking and conventional non-locking plates achieved similar treatment outcomes in this group of osteoporotic patients aged over 64. However, locking plates may offer more benefits in cases that have to take into account immobilization time and concomitant soft-tissue damage.

Introduction

Ankle fractures represent the third most common fracture in elderly patients, following hip and wrist fractures, with an incidence of 184 cases per 100,000 people/year [1]. As life expectancy continues to rise, these injuries are expected to experience a 25% increase by 2050, so they will become increasingly common in most orthopedic departments' daily practice [1–3].

The correct treatment of ankle fractures must take into account a decisive factor regarding osteosynthesis: the presence of osteoporosis [4–7], which renders commonly used internal fixation methods technically more demanding and prone to failure [8]. Osteoporosis is one of the potential surgical complications that led to the development of locking plate technology [9]. The technology involves a fracture fixation system that employs a plate and screws threaded to the actual plate. Together, once locked, they form a fixed angle system [9,10]. From a biomechanical perspective, the principal advantages of locking plate technology are: greater angular and axial stability, less reliance on bone mineral density to stabilize the fracture, enables the possibility of minimally invasive surgery (so it is ideally suited to fractures with concomitant soft-tissue damage) and less soft-tissue irritation due to the plates' low profile [9]. These advantages convert this technology into the ideal type of implant in cases of severe instability, comminution, poor bone quality, or where bicortical fixation is impossible [10].

A number of factors are believed to contribute to the poor outcomes observed for internal fixation in the elderly. The soft tissue is usually in

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poor condition and this is worsened dramatically given the additional damage caused by the fracture. The state of the soft tissue is a key factor when deciding on a standard surgical treatment, that is, an open reduction and internal fixation (ORIF), as surgical wound complications are common in these patients [11–17]. Comorbidities, such as diabetes, peripheral vascular disease, and possibly the prolonged use of corticosteroids, increase the risk of deep infection, non-union, mal-union, and delayed wound healing [15–19]. Due to the large percentage of complications, according to recent literature the tendency is to treat all osteoporotic ankle fractures conservatively [13–18]. While there are a number of biomechanical studies on the use of locking plates in distal fibula fractures [20–29], there are few clinical trials in this respect [30–35]. Moreover, only a few papers dealing with osteoporotic distal fibula fractures have been published and, to the best of our knowledge, none have compared results for locking and non-locking screws used with the same type of plate implant.

The aim of this study was to compare the results for locking versus unlocking screws implanted on the same type of plate system in osteoporotic patients aged over 64 with a distal fibula fracture, in terms of: (1) global functionality according to the AOFAS Ankle-Hindfoot Score [36], (2) radiological time to achieve bone union, and (3) complications and need for secondary surgery.

Methods

Study design

This research was a retrospective, cohort, single-surgical team, single-center study. The local Ethics Committee approved the study and patients granted their prerequisite informed consent before participating (the study was conducted within the principles set out in the Declaration of Helsinki). Sixty-two patients who underwent surgery for osteoporotic distal fibula fractures between January 2012 and December 2014 were included. Based on the different implants used, patients were divided into two groups: Group A ($n = 45$): titanium, non-locking, one-third, conventional low profile tubular plate, and Group B ($n = 17$): titanium, locking, one-third, tubular plate with locking screws (Figure 1). There were 45 women and 17 men distributed randomly among the two groups. Forty patients had fractured their right ankles and 22 their left. Fifty-two fractures were classified as Danis-Weber Type B and 10 as Danis-Weber Type C fractures. Sixty cases were closed fractures while the remaining two were grade I open fractures. Mean ages were 72 years (range 67–77) in Group A and 73 (range 67–78) in Group B. Twenty-six patients had previously been diagnosed with osteoporosis by dual-energy X-ray absorptiometry (DEXA) and 36 were diagnosed with osteoporosis based on a pre-operative lateral X-ray study of the spine as described by Guglielmi *et al.* [37].

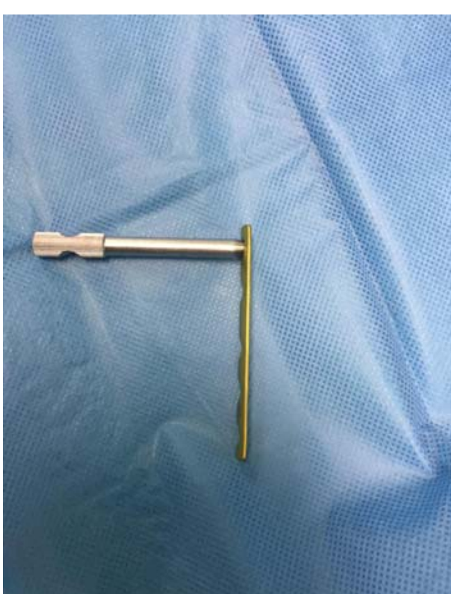

Fig. 1. One-third tubular locking titanium plate (Synthes®).

Table 1
Patient demographics and characteristics.

	Group B Locking ($n = 17$)	Group A Non-locking ($n = 45$)	*P*
Age (years)	73 ± 5.1	72 ± 5.4	0.69
Sex (F:M)	17/3	28/14	**0.01**
Side (right/left)	14/3	26/19	0.30
Time from injury to surgery (days)	7.47 ± 5.24	4.62 ± 3.57	0.18
History of diabetes mellitus (yes/no)	8/9	22/23	0.99
Smoking habit (yes/no)	1/16	1/44	0.47
Classification Danis-Weber – *n* (%)			
44B	15 (88.2)	37 (82.2)	0.71
44C	2 (11.8)	8 (17.8)	

Bold values mean that they are statistically significant (p value <0.05).

Eligibility criteria

The eligibility criteria were: (1) isolated distal fibula fracture, classed as a Weber B or C fracture with at least 2 mm displacement after a low-energy trauma; (2) minimum follow-up of one year; (3) patient ambulatory prior to injury (with or without the use of walking aids); (4) patient able to adhere to post-operative instructions; (5) ability to give informed consent; (6) age 65 or over; and (7) meets DEXA or radiological criteria for osteoporosis diagnosis. Exclusion criteria included: (1) open fractures, apart from grade I; (2) bilateral ankle fractures; (3) previous fracture of the involved limb; (4) peripheral arterial disease and/or leg ulceration prior to injury; (5) patient unfit for anesthesia; and (6) cognitive impairment.

There were no significant differences between demographic and patient characteristics in terms of age, sex, smoking habit, diabetes, and fracture mechanism and type according to the Danis-Weber classification [38], nor were there any between surgical characteristics (surgical delay and duration, tourniquet time, and length of the plates). These data are summarized in Table 1.

Operative management

Informed consent for surgery was obtained from all patients. The same surgeon carried out all the operations (MHP). Surgery was performed with intradural anesthesia, antibiotic prophylaxis (pre-operative, intravenous administration of cefazolin 2 g), using suitable measures to prevent lower limb ischemia and following AO principles. Four patients in Group B were operated on through a minimally invasive technique, without using a tourniquet, due to the soft-tissue damage around the ankle. No intraoperative complications were recorded.

Postoperative care and follow-up

Postoperatively, all patients were discharged with a short, lower leg and non-weight-bearing splint and the aid of two crutches. They took low molecular weight heparin (LMWH) for four weeks. At three weeks post-surgery, the sutures were removed and the patients were referred to physiotherapy. Partial weight bearing was allowed between 3 and 8 weeks after surgery, as long as there were no signs of pain during the physical examination. The criteria for bony union were defined as the presence of a bridging bone in 3 out of 4 cortices on two orthogonal X-ray images and full weight bearing without pain. According to Morshed [39], the average time to bone union can be set at 6 months,