

**RESEARCH ARTICLE**

# Are Rush Nails Still a Good Choice for Fibula Fixation in Ankle Fractures? A Retrospective Study with Five Years Follow-Up

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**Abstract**

**Objectives:** The aim of this retrospective study is to evaluate if Rush nail fixation still has a role in distal fibular fractures surgery compared with locking plate in terms of fixation quality, complications, functional results and patient satisfaction level.

**Methods:** This study included 109 patients (average age 56.05), who had undergone operative treatment for bi- or trimalleolar fractures between 2009 and 2014. The patients were evaluated retrospectively, divided in group A (57 patients treated with Rush nail) and group B (52 patients treated with locking plate). The patients were evaluated at an average 4.9 years of follow-up (SD: 1.01) with Olerud-Molander Ankle Score (OMAS), American Orthopedic Foot and Ankle Society - Ankle-Hindfoot Scale (AOFAS) and Visual Analogue Scale (VAS) for clinical outcomes. X-rays were conducted to assess ankle osteoarthritis using the classification system by Takakura and joint space symmetry using measurements in comparison with contralateral ankles.

**Results:** The groups were homogeneous regarding age and gender. Patients treated with Rush Nail fixation (Group A) showed statistically significant worse clinical results at functional scores (78.1 Group A versus 88.7 Group B at the OMAS ( $P<0.05$ ); 83.1 Group A versus 90.1 Group B at the AOFAS ( $P<0.05$ ); higher pain levels in the VAS (3.9 Group A versus 2.4 Group B) and lower satisfaction rates (52.6% Group A versus 73.1% Group B ( $P<0.05$ )) in comparison with patients treated with locking plate fixation (Group B). However, infections rate was significantly lower in Group A (1.8%) than in Group B (9.6%) ( $P<0.05$ ). Radiographic evaluation showed more cases of post-traumatic osteoarthritis in Group A (35.1% Group A versus 15.4% Group B ( $P<0.05$ )) and worse results in regards to restoration of joint space symmetry (45.6% Group A versus 73.1% Group B ( $P<0.05$ )).

**Conclusion:** Results of current study indicates that even though plating of lateral malleolus in bimalleolar and trimalleolar fractures is superior in fracture reduction quality, early functional recovery, reduced incidence of post-traumatic osteoarthritis and greater patient satisfaction, Rush nail fixation still provides acceptable clinical results with a lower infection rate. Therefore Rush nails could be considered as a valid choice in selected patients with high risk of soft tissue complications or low functional demand.

**Level of evidence:** III

**Keywords:** Ankle, Fibular plate, Fixation devices, Fracture, Rush nail

**Introduction**

Ankle fractures are the second most common lower limb fractures after hip fractures,<sup>1</sup> the incidence is 137/100'000 per year, with a prevalence of about 10% of all fractures. Isolated malleolar fractures account

66%, bimalleolar and trimalleolar fractures occur in 34% of the patients (respectively 25% and 7 %).<sup>2-5</sup>

Ankle fractures can be classified in mono-, bi- or trimalleolar fractures depending on the number of

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fractured malleoli. The most commonly used classification is the AO classification (1970)<sup>6</sup> that is divided in three main groups (A, B, C) each one has three sub-groups<sup>1-3</sup> according to level of lateral malleolus fractures. Radiological evaluation in three views (AP, lateral and mortise) is crucial for correct classification and decision making.

The treatment of ankle fractures can be conservative in case of a stable malleolar fracture without tibio-fibular mortise dislocation. Surgical treatment is mandatory when the fracture is unstable (i.e. bi- or trimalleolar fracture, isolated lateral malleolar fracture with lesion in the deltoid ligament). According to McDade<sup>7</sup> and Yablon,<sup>8</sup> the reduction quality of the lateral compartment is more important than the medial compartment for the final position of the talus in the tibio-fibular mortise. Posterior malleolus should be fixed when dislocation is greater than 2 mm and/or more than 25% of articular surface is involved. Medial malleolus is usually treated with one or two cannulated screws and the same technique is used for the posterior malleolus. The lateral malleolus can be treated by plate or intramedullary nail. Indications for intramedullary nail fixation usually are: bad quality of soft tissues, patients unable to walk, elderly patients, and patients with polytrauma and affected by other contraindications such as diabetes. The intramedullary fixation can be achieved through specific nail systems or simply using Rush pinning. In 1936 Leslie V. Rush developed this revolutionary bone pinning which is still used nowadays and even granted him a Nobel prize nomination in 1956.<sup>9</sup> The surgical technique requires smaller incision and shorter surgical times achieving good stability even in osteoporotic bone<sup>10</sup> with the limitation of not being able to restore the perfect bone alignment in comparison with plate fixation. However, there is a paucity of literature comparing clinical and radiographic results between Rush nails and fibular plates for ankle fractures<sup>10,11</sup>

In our institute the intramedullary nail fixation with Rush pinning is a well-used alternative fixation technique for distal fibular fractures in patients with contraindications (i.e. diabetes and skin disorders) or with small dislocation. The aim of this study is to evaluate if still exist indications for using Rush nails in distal fibular fractures comparing fixation quality, complications, functional results and patient satisfaction levels with locking plate fixation in a large cohort of patients.

## Materials and Methods

We performed a retrospective study, including patients who have accessed the trauma emergency room in our unit for ankle fracture between May 2009 and May 2014. The study protocol was approved by the hospital's Ethical Review Board and it was conducted in accordance with the principles of the Declaration of Helsinki and its amendments. We fully informed all the Subjects about the characteristics of the study and they gave their consent.

Inclusion criteria were the following: according to the AO classification for ankle fractures 44 type A (A1; A2; A3), 44 type B (B1, B2; B3) and 44 type C (C1; C2; C3); age over 18. Exclusion criteria were the following: conservative treatment, need of a syndesmosis fixation, tibial plafond fracture, polytrauma patients.

Initially we considered 187 patients and we excluded 78 of them: 22 were treated conservatively, 14 were age under 18, 10 were polytraumatized, 17 needed of syndesmosis fixation and 15 got lost in the follow up. The final sample included 109 patients who were divided into two groups. In both groups the tibial malleolus was fixed by one or two cannulated screws and the mean follow-up was 4.9 years (SD: 1.01).

Group A was composed of 57 patients affected by diabetes and skin disorders treated with intramedullary Rush nail fixation device: average age 58.3; 17 men (29.8%), 40 women (70.2%); 15 patients (26.3%) had suffered a dislocation of the talus; the posterior malleolus was fixed by cannulated screw in six cases (10.5%). According to the AO classification for ankle fractures, 5.3% of type A (A2; A3), 73.7% of type B (B2; B3) and 21.0% of type C (C1; C2).

Group B was made up of 52 patients treated with titanium locking plate fixation device: average age 53.8; 14 men (26.9%), 38 women (73.1%); 24 patients (46.2%) had suffered a dislocation of the talus; the posterior malleolus was fixed by cannulated screw in three cases (5.8%). According to the AO classification for ankle fractures, 5.8% of patients of type A (A2; A3), 75.0% of type B (B2; B3) and 19.2% of type C (C1; C2).

## Clinical evaluation

Clinical evaluation was performed using the following scores: Olerud-Molander Ankle Score (OMAS).<sup>12</sup> It is a functional rating scale from 0 (totally impaired) to 100 (completely unimpaired) and is based on nine different items: pain, stiffness, swelling, stair climbing, running, jumping, squatting, supports and activities of daily living. OMAS has been frequently used to evaluate subjectively scored function after ankle fracture.

American Orthopaedic Foot and Ankle Society - Ankle-Hindfoot Scale (AOFAS).<sup>13,14</sup> It is a clinician-based score that measures outcomes for the foot and ankle. The questionnaire consists of nine items that are distributed over three categories: pain (40 points), function (50 points) and alignment (10 points). These are all scored together for a total of 100 points.

Visual Analogue Scale (VAS) for pain<sup>15</sup>: rating scale from 0 (no pain) to 10 (pain as bad as it could possibly be) satisfaction rate: satisfied or not satisfied time to recover after completing the rehabilitation protocol.

## Radiographic evaluation

The main radiographic evaluation criteria at final follow-up (4.9 years; SD: 1.01) were: talocrural angle (normal range 8°-15°),<sup>16</sup> symmetry of joint space and post-traumatic osteoarthritis (Stage two or higher according to the Ankle osteoarthritis classification system by Takakura).<sup>17, 18</sup> Radiographic examples of two cases are shown in [Figure 1] and [Figure 2].

## Postoperative protocol

There were differences in the postoperative protocol between two groups: in the Group A (intramedullary Rush nail), the involved ankle was placed in a below-the-knee cast; in the Group B (plate), the involved ankle was placed in a Walker brace and patients were encouraged to remove the cast and actively move the ankle several times during the day. This two different protocols are due to the

higher stability synthesis of the group B. Both groups were not allowed weight-bearing for the first three postoperative weeks with ankle elevation above the heart to prevent swelling. During the following two weeks, partial weight-bearing was allowed five weeks after assessing bone healing through X-Ray evaluation. In patients with posterior malleolus fracture, full weight-bearing was allowed two weeks later. All patients performed the same antithrombotic prophylaxis and rehabilitation protocol and were clinically and radiographically evaluated at five weeks, one year and at final follow-up.



Figure 1. Trimalleolar fracture treated with rush nail



Figure 2. Trimalleolar fracture treated with locking plate

### Statistical analysis

The Student t-test and chi-square test (Pearson's test)

were used to analyse the data for the patients in this series. To evaluate the primary study outcomes (patients' satisfaction, clinical scores (OMAS, AOFAS, VAS), radiographic evaluation), the power to detect a difference between plating and Rush nail for fibula fixation mean scores has been determined with a level of statistical significance set at a  $P < 0.05$  (95% interval of confidence). Statistical analysis was performed using R (GNU GPL for Microsoft Windows; version 3.1.0).

### Results

There was no significant difference between the two groups for age and gender ( $P < 0.05$ ). The mean follow-up was 4.9 years (SD: 1.01). The two groups were homogeneous with regards to the AO classification of ankle fractures ( $P < 0.05$ ). Another surgery was performed at least after one year to remove all the fixation devices in 22 patients out of 57 (38.6%) in Group A and in 25 patients out of 52 (48.1%) in Group B, due to discomfort with swelling and localized skin reaction. In Group A the local infection rate was lower (one patient out of 57 (1.8%) treated with medical therapy) than in Group B (5 patients out of 52 (9.6%) all treated with medical therapy in association with plate removal in three cases).

### Clinical evaluation

The functional average scores at final follow-up for the OMAS were 78.1 (SD: 10.3) in Group A and 88.7 (SD: 9.8) in Group B ( $P < 0.05$ ). The functional average scores for the AOFAS were 83.1 (SD: 11.2) in Group A and 90.1 (SD: 11.7) in Group B ( $P < 0.05$ ). The pain level average scores for the VAS was 3.9 (SD: 2.3) in Group A and 2.4 (SD: 1.9) in Group B ( $P < 0.05$ ). Satisfaction rate was lower in Group A in which 30 patients out of 57 were satisfied (52.6%), than in Group B in which 38 patients out of 52 were satisfied (73.1%) ( $P < 0.05$ ). Patients in Group A had an average 30.1 days (SD: 6.8) as "time to recovery" after completing the postoperative protocol; patients in Group B had faster time to recovery (15.2 days; SD: 4.1) ( $P < 0.05$ ). Data are reported in [Table 1].

Table 1. Clinical outcome scores

	Group A	Group B	p-value
OMAS (0-100)	78.1 pt (SD: 10.3)	88.7 pt (SD: 9.8)	<0.05
AOFAS (0-100)	83.1 pt (SD: 11.2)	90.1 pt (SD: 11.7)	<0.05
VAS (0-10)	3.9 pt (SD: 2.3)	2.4 pt (SD: 1.9)	<0.05
Satisfaction (Y/N)	52.6 % Yes	73.1 % Yes	<0.05
Time to recovery	30.1 days (SD: 6.8)	15.2 days (SD: 4.1)	<0.05

### Radiographic evaluation

There were no statistically significant ( $P > 0.05$ ) differences in talocrural angle reconstruction between Group A (75.4% within the normal range; mean value 9.3°;

SD: 3.2) and Group B (67.3% within the normal range; mean value 10.4°; SD: 3.7). The patients in Group A had significantly worse results in restoration of joint space symmetry (45.6% versus 73.1%) ( $P<0.05$ ). There were 20 cases out of 57 (35.1%) of post-traumatic osteoarthritis in Group A and eight cases out of 52 (15.4%) in Group B ( $P<0.05$ ). Data are reported in [Table 2].

Table 2. Radiographic outcome scores

	Group A	Group B	p-value
Talo-crural angle	9.3° (SD:3.2)	10.4° (SD: 3.7)	>0.05
Joint symmetry restoration	45.6 %	73.1 %	<0.05
Lack of malleolus rotation	50.1 %	88.5 %	<0.05
Osteoarthritis	35.1 %	15.4 %	<0.05

## Discussion

The most important finding of this study is to evaluate if there still exists a surgical space for Rush nail osteosynthesis in distal fibular fractures. Bimalleolar and trimalleolar fractures represent one third of malleolar fractures; both are considered unstable fractures and therefore they often require surgical treatment. Gold standard for the surgical treatment of medial and third malleolus fractures is the fixation with cannulated screws and that is widely accepted<sup>19, 20</sup>; instead there isn't a gold standard technique for the fixation of the lateral malleolus. Available choice techniques for fibula fixation are intramedullary nail, Rush nail or plate.

The most debatable aspect of the Rush fixation is considered the clinical outcome as this osteosynthesis is not anatomical in comparison with plate fixation. Most studies report unsatisfactory clinical results.<sup>21-23</sup> That is in line with the results of our study with a statistically significant difference with plate fixation results at clinical scores (OMAS, AOFAS, VAS) and at time to recovery. However, Rush nail fixation has significantly lower risk of local infection than locking plate, we reported an infection rate of 1.8% for pinning versus 9.6% for plating ( $P<0.05$ ). The result of the plates infections is in agreement with other authors.<sup>24</sup> Furthermore, in the Rush nail group the infection resulted more easily to treat; in fact in Group B it was necessary to remove the fixation device in three cases out of five, while in Group A local infection has been resolved with only medical therapy. While the Rush nail fixation remains controversial it must be taken into consideration the clinical conditions of patients at the moment of surgery regarding skin conditions, comorbidity and in the elderly patients. Rush fixation clearly requires smaller incision and less surgical time with consequent overall lower risk of infection rate. Furthermore in most cases it is able to achieve a

satisfactory reduction of the fracture even using Rush nails and that in our opinion does not justify the wide skin incision to apply a plate.

At the radiological examination there was no difference in the rate of bone union and in the talocrural angle reconstruction between two groups. Plate fixation resulted better than Rush nail in restoring joint space, which resulted in an early functional recovery, reduced incidence of post-traumatic osteoarthritis and greater patient satisfaction. Finally, shorter surgical time using Rush nails may be important in selected patients, in particular for the polytrauma patients and for the hemodynamically unstable patients. The main limitation is that not all the fractures allowed to choose indifferently all the three type of osteosynthesis fixation. Further similar studies with larger sample size are needed to confirm our results.

## Conclusion

Even though plating of the lateral malleolus in bimalleolar and trimalleolar fractures provides better results in fracture reduction quality, early functional recovery, reduced incidence of post-traumatic osteoarthritis and greater patient satisfaction, Rush nail seems to provide satisfactory clinical results with a lower infection rate. Therefore Rush nails still can be considered as a valid choice in selected patients with high risk of soft tissue complications or low functional demand.

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