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Rush Nail in the Management of Distal One-third Fibular Fracture in Both Bone Fractured Legs: A Clinical Study

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What to Learn from this Article?

Rush nail is a good option for management of distal third fibular fracture in both bone fracture leg

Abstract

Background: Aim of this study is to evaluate the results of percutaneous rush pin fixation in distal third fibula in both bone fractured legs.

Materials and Methods: Forty patients were treated from emergency and outpatient department, having closed fracture of the distal third fibula in both bone fractured legs.

Results: Out of 40 patients, 35 patients underwent union in 3-4 months. Touch-down weight bearing was started on 2nd post-operative day. Complications were found in five patients who had delayed union in three and soft-tissue infection at the nail entry point in two patients.

Conclusions: Fixation using rush nail in distal third fibular fracture is a safe and effective method of surgery that could be performed in patients with compromised soft-tissue condition and showed sufficient stability after fixation.

Key words: Fibular fracture, percutaneous, rush pin, both bone fractures.

Introduction

Fractures of distal tibia are almost always accompanied with a fibular fracture; the fixation of which is always a matter of debate [1]. Plate fixation is the most frequent technique used for stabilization of fibula, but percutaneous techniques (pins, screw fixation) have also been proposed [2]. Plate fixation of these fractures is challenging owing to wound infection, mechanical failures, and symptoms related to metalwork which are more frequent in the elderly and patients of diabetes and neuropathy. Considering these complications, rush nail seems to be a better alternative as it offers a stable fixation with minimal surgical exposure and less prominent metalwork.

Materials and Methods

Forty patients were selected who had closed fractures of both bone legs with fibula fracture at distal one-third. A written informed consent was obtained from all the patients; they were explained about treatment plan, cost of operation, and hospital stay after surgery, and complications of anesthesia. They were followed up after surgery and were clinically and radiologically assessed for fracture healing, joint movements, and implant failure. In majority of the patients, close rush nailing of fibula was performed within 24-48 h after the injury. Fracture of the leg was evaluated using plain radiographs in anteroposterior (A-P) and lateral. The fractures were classified using the AO/OTA classification systems.


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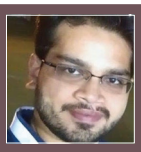
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Inclusion criteria

Age 18-60 years, all both bone leg fractures with distal one-third fibula.

Exclusion criteria

Age <18, compound grade 111b fibula fracture, and pathological fracture.

Surgical technique

The patient was placed in the supine position with a bump underneath the ipsilateral hip to prevent the usual external rotation of the limb and to give access to the lateral side of the ankle. The entire limb was prepared and draped. The starting point for the rush nail was the distal tip of the fibula. A small (approximately 2 cm) longitudinal incision was made approximately 2-3 cm distal to the tip of the fibula; it should be distal enough to allow the drill bit to drill in line with the fibular shaft. A sharp elevator cleared the soft tissue at the tip of the fibula to create a "landing zone" for the drill bit. With the help of an image intensifier, a 3.5 mm bit was used to drill an opening hole in the distal fibula. It is essential to drill in line with the diaphysis of the fibula on both A-P and lateral images to facilitate passage of the rush nail. After the opening hole was made, a long 2.5 mm drill bit was used to "ream" the distal fibula to approximately 5-6 cm. A soft-tissue sleeve for the 2.5 mm drill bit was inserted into the previously drilled starting hole. A 2.4 mm rush nail was locked securely onto the T-handle chuck. Tip of the nail was bend 10 degree approximately that helped in reduction and the passing of nail. The nail was then placed into the starting hole distally and advanced proximally with controlled mallet strikes on the chuck. Rush nail can be controlled with a T-handle chuck, "choking up" on the nail, and resetting the chuck farther back as the nail is advanced into the fibula.

There should be minimal resistance with nail insertion, and the T-handle should be rotated in 45± motions while the mallet is used. At the fracture site, the nail was advanced across the fracture and into the proximal fragment medullary canal. A closed reduction technique, such as axial traction or blunt manipulation of the fracture fragments, can be used to pass the rush nail. The nail was advanced 5-10 cm into the fibular medullary canal in the proximal fragment. The distal end of the bend nail was then impacted into the lateral malleolus. The wound was then irrigated and closed with nylon sutures. For tibia, conventional intramedullary interlocking nailing was done. Rehabilitation such as touch-down weight bearing was started on 2nd post-operative day and sutures were removed on 14th post-operative day. These patients were assessed clinically and radiologically for union timing at 6 months following surgery.

Results

Five patients out of 40 complained post-operative ankle pain, which was spontaneously resolved in 2 weeks. There were 3 delayed unions which were treated by platelet-rich plasma and bone marrow injection. In our study, two patients had soft-tissue infection at the point of entry of nail that was managed by antibiotics. No rotational instability was seen in any patients post-operatively. Patients were followed up at 1, 2, 3, and 6 months till 1 year, respectively. No cases of degenerative arthritis were noted in patients. The patients were evaluated by American foot and ankle score in which 35 patients had score above 90 and 5 were above 80 (Table 1).

Discussion

Distal tibial fractures occur in about 38% of all tibial fractures, and in about 78% of these fractures, there is a concomitant distal fibula fracture [3]. There are different modalities of fixation of fibular fracture, namely, plate osteosynthesis [2], cannulated cancellous screw, and Rush nail [1]. However, there is no clear-cut consensus in literature on the fixation of fibular fracture in combined distal tibia and fibula both bone legs and there exists a debate among surgeons as to whether or not fibular fixation is required as an adjuvant to IM nailing of tibia [3].

Plate osteosynthesis for fractures of the distal tibia is often associated with delayed healing, infection, and hardware problems [4, 5]. In our study, 3 cases of delayed healing, 1 case of infection, and 1 case of hardware problem were seen. In cases of fibular fixation in fracture of both bone lower legs, there is less varus or valgus angulation, less rotational deformity, and faster union time [6]. In our study, foot and ankle score for 35 patient was above 90, remaining 5 also had good AOFAS score above 80. For distal tibia fractures that also have a fibula fracture, plating of the fibula fracture before nailing of the tibia can help provide alignment and length [3]. This is particularly useful for simple fibular fracture patterns and very distal tibial fracture patterns. When nailing for a combined distal tibia and fibula fracture, the distal end of nail must anchor in the physeal scar adjacent to the subchondral bone to reduce toggling of narrower nail inside a wider metaphyseal medullary canal which will prevent the nail to deviate mediolaterally and prevent malunion.

Care should be taken to reduce the fibula as malreduction of the fibula will prevent accurate reduction of the tibia. After the fibula is plated, care should be taken to make sure the tibia is not malaligned in varus as the fibular plating will keep the tibia out to length laterally but will typically not prevent varus collapse. A study by Asloum *et al.* concluded that dilemma of the fibular fixation: Fibula fixation is controversial. If the fibular fixation is fixed with plating, it prevents collapse of the comminuted metaphyseal area or gap, resulting in nonunion or malunion with deformity of tibia. If the fibular fracture is not fixed, the ankle mortise may not be congruous because if not fixed, lateral malleolus may get displaced. If the fibula is fixed, bone grafting is mandatory if there is comminuted or gap/bone loss [2].

Lambert demonstrated that the fibula has weight-bearing function, carrying 1/6 of the load applied to the knee joint [7]. Prior studies have suggested fibular fixation may influence outcomes of distal tibial fractures favorably, but significant complications have also been reported with this adjunctive stabilization. High-energy fractures of the distal tibia are associated with a high incidence of soft-tissue trauma compromising the soft-tissue envelope. Hence, ORIF of the fibula has also shown an increased rate of wound

Table 1: Evaluation of patients by American foot and ankle score

Patient No.	Age	Sex	Post-operative complication	Time for union (week)	Additional procedure done to achieve union	AOFAS pre-operative	AOFAS post-operative
1	41	F	Nil	17	No	11	94
2	18	M	Nil	20	No	9	97
3	24	M	Nil	18	No	7	93
4	33	F	Nil	20	No	9	92
5	27	F	Nil	24	No	11	94
6	56	M	Nil	21	No	14	91
7	43	M	Nil	20	No	18	94
8	37	F	Nil	19	No	9	97
9	31	M	Nil	18	No	11	94
10	35	M	Nil	20	No	14	95
11	29	F	Nil	22	No	11	93
12	43	M	Nil	20	No	19	97
13	49	F	Nil	19	No	23	95
14	34	M	Nil	20	No	14	93
15	38	F	Nil	18	No	19	93
16	31	M	Nil	19	No	11	94
17	23	M	Nil	20	No	14	97
18	28	F	Delayed union	34	Bone marrow injection	9	85
19	25	M	Nil	18	No	7	93
20	55	M	Nil	16	No	11	91
21	59	F	Nil	18	No	19	95
22	34	M	Nil	20	No	7	97
23	57	F	Nil	19	No	14	95
24	51	M	Entry point infection	22	No	7	83
25	34	M	Nil	20	No	11	97
26	25	M	Nil	20	No	15	95
27	28	F	Nil	21	No	11	94
28	19	M	Nil	22	No	19	95
29	34	M	Entry point infection	20	No	14	87
30	26	M	Nil	19	No	11	95
31	55	F	Nil	18	No	18	91
32	34	M	Nil	16	No	20	97
33	28	F	Nil	23	No	15	94
34	39	M	Nil	20	No	20	93
35	20	M	Nil	18	No	11	95
36	54	F	Delayed union	32	Bone marrow injection	4	85
37	30	M	Nil	22	No	11	95
38	53	M	Nil	18	No	19	95
39	49	F	Nil	20	No	14	93
40	51	M	Delayed union	34	Bone marrow injection	17	80

complications[7]. In addition, the incidence of fibular nonunions was 9% with fibular fixation possibly from further devascularization on open surgical approach in contrast to zero without fibular fixation [8].

There are very few studies on intramedullary fibular nailing. The main criticism of this system is that it is not rigid enough. However, the notion of an interlocking nailing system cannot be compared to simple percutaneous nailing systems. The series evaluating the latter report the benefits of the percutaneous approach, but functional results vary [9]. The idea of nailing was first introduced in 1999-2000 with the ANK® nail. Kara *et al*. and Kabukcuoglu *et al*. used this nailing system for lateral malleolar fractures associated with syndesmotic injury, and they reported good results and no complications [2].

The fibula nail provides a relatively easy technique for treating displaced fracture both bone legs involving distal one-third fibula fractures. We found a high success rate with its use as depicted by foot and ankle score in our study. AOFAS was more than 90 in 35 patient and more than 80 in remaining 5 patient which is good standard. This technique affords the opportunity to provide

Figure 1: X-ray anteroposterior and lateral views of both bone legs showing (a) injury X-ray showing distal third fibula in both bone fractured legs, (b) follow-up X-ray at 6 *mont*hs showing union of fracture.

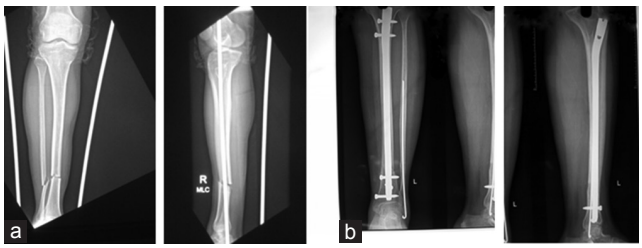

Figure 2: X-ray anteroposterior and lateral views of both bone legs showing (a) injury X-ray showing distal third fibula in both bone fractured legs, (b) follow-up X-ray at 6 *mont*hs showing union of fracture.

fixation through a minimal approach with a limited incision, which decreases the chances of wound infection [1]. Further, the intramedullary fixation eliminates the need for hardware removal from the lateral malleolus due to prominent metalwork as compared with conventional technique of plating.

In a study by Singh *et al.*, 25 patients underwent intramedullary interlocking nailing for fractures of the distal third of the tibia and rush nail for fractures of the distal third of the fibula [1]. The mean time to union was 16 weeks. Sixteen patients underwent dynamization at 12 weeks leading to the union of fracture. Two patients had angular malalignment within acceptable limits, but none had rotational malalignment. No patient had shortening, hardware breakdown, or deep-seated infection; only 1 patient had superficial infection of the lateral malleolar incision, but it was managed well with oral antibiotics and dressing [1]. In our case, 40 patients went for rush nail fibula. All 40 patient fracture united with no rotational malalignment seen. Thirty-five patients had excellent AOFAS score of more than 90. Five patients had AOFAS good score more than 80, out of which 3 had delayed union and 2 patient had nail insertion infection. However, in none patients, there was nonunion. Alignment was acceptable in all. Distal fractures are prone to malalignment because the metaphysis is much wider than the diameter of the nail, and care must be taken to avoid malunion as this may lead to a worse functional outcome [3]. The keys to avoiding malalignment distally are ensuring the guide wire is placed centrally on both the AP and lateral images (the center-center position) and keeping the fracture well aligned during reaming and nail insertion.

In a study by Khuntia *et al.*, the role of fibular fixation in the treatment of distal third tibial fractures was evaluated [10]. Forty patients with concomitant fractures of tibia and ipsilateral fibula at distal third level were included in this study during a 48-month period. Patients were randomized into two groups: Patients with fibular fixation (Group I) and without fibular fixation (Group II). The patients were followed up for at least 1 year follow-up post-operatively. Johner and Wruh's criteria were used for evaluation of functional outcome. Excellent and good results were seen in the majority of the patients (85%) in Group I as compared to Group II (65%). Infection was seen in one patient in Group I and two in Group II with Gustilo-Anderson II injuries. Majority of patients of both groups union occurred at 16-17 weeks of post-operative with average time of union came out to be 16.6 weeks in non-fixing group and 17.85 weeks in fixing group. Most patients about 60% of non-fixing group showed some variety of deformity of valgus/varus and anteversion/recurvation in post-union X-ray, and some were in unacceptable range. About 20% patients of fixation group showed deformity but in acceptable range. We observed unacceptable shortening in 3 patients of non-fibula fixation group and acceptable shortening in 5 patients of fibula fixation group. There were 2 patients having non-union one in each group. Four patients were infected with two from each group including both superficial and deep infection. Knee movement was full in 90% of cases. In three patients, there was restriction of 10°-15° of flexion with no extension lag. Ankle movement was full in 80% cases. In 3 out of 8 patients, ankle movement was restricted by 25% in dorsiflexion. Johner and Wruh's criteria were used for evaluation of functional outcome. Excellent and good results were seen in majority of the patients (85%) in fixation group as compared to non-fixation group about 65% and very less number in fair and poor result in fixation group as compared to non-fixation group [10].

Potential advantages of fibular fixation include mechanical stability, assisting in reduction, and restoring the length and alignment of the tibia. While such a construct cannot control rotation, it can preserve length as well as prevent varus and valgus displacement. In our study, all the fibular fractures were fixed with rush rods and did not see any rotational instability. Thus, we conclude that in extra-articular fractures of distal tibia with concurrent distal fibular fractures, it is advisable to fix the fibular fractures with an intramedullary rush nail rather than a plate for the reasons cited above along with intramedullary interlocking nail for tibia.

Usage of rush nails for fixation lower fibula fractures is having added advantage of small skin incision hence less chances of local infection, dynamization was more effectively achieved, less chances of rotational instability in the presence of distal locking of tibia, and more important in present era is reduction of cost of surgery over all [1].

Clinical Message

The fibula nail is probably the ideal choice for fixing distal one-third fibula fracture in both bone legs, especially with overlying skin conditions or other immunocompromised states such as diabetes in which there are higher infection rates with traditional plating techniques. We found a low complication rate and little difficulty with its use intraoperatively. Intramedullary nailing is a percutaneous minimally invasive technique that provides stable fixation and reduces the risk of wound complications. The main limitation is in the treatment of comminuted fractures.

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