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Use of poller screw in proximal and distal metaphyseal fractures of tibia treated with intra-medullary inter-locking nail: A prospective study of 25 patients

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Abstract
Introduction: Treatment of tibia metaphyseal fractures is still difficult. Interlocking tibial fractures is preferred because it allows for some load sharing, preserves extraosseous blood flow, avoids major soft tissue dissection, and is well-known by most surgeons. Nailing of metaphyseal fractures with a short proximal or distal fragment is linked to increased malalignment, especially in the coronal plane, non-union, and the necessity for subsequent treatments to accomplish union. Blocking screws (poller screws), temporary unicortical plating, alternative nail designs with variable proximal bends (proximal third fractures), and fibular plating have all been proposed to better nailing metaphyseal fractures (distal third fractures)."The study's goal was to see if poller screws might be used as a supplement to stability in tibia metaphyseal fractures treated with a statically locked intramedullary nail.
Materials and Methods: It was a prospective trial in which 25 patients with extraarticular Tibia metaphyseal fractures presented between July 2020 and December 2021 were treated with an Intra-Medullary Inter-Locking nail augmented with Poller screws and observed for six months.
Results: The average age was 45.92 years, with a male majority. "The most prevalent type of injury was on the right side, and the majority of these injuries were caused by car accidents." The average time it took for a fracture to heal was 11.45 weeks. Sanders' average score was 36.76, with 9 patients receiving excellent outcomes, 11 receiving good results, and 5 receiving fair results.
Conclusion: We conclude that Poller screws, when supplemented the intramedullary interlocked nail of metaphyseal fractures of tibia, 1. Were effective in achieving the fracture alignment, acting as a reduction tool. 2. Improved the stability of the bone – implant construct, by functionally reducing the medullary width. 3. Maintained the fracture alignment till union, preventing loss of initial reduction.

Keywords: Metaphyseal tibial fractures, intramedullary interlocked nail, poller screw, Sander's score

Introduction

Treatment of tibia metaphyseal fractures is still difficult. Correction and maintenance of sagittal and coronal alignment, establishment of length and rotation, and early functional range of motion of the knee and ankle are all aims of surgical care. Medullary implants, half pin, thin wire, or hybrid external fixation, plate fixation, or a combination of procedures are all alternatives for treatment [1]. Interlocking tibial fracture nailing is preferred because it allows for some load sharing, preserves extraosseous blood flow, avoids substantial soft tissue dissection, and is familiar to most surgeons. Nailing of metaphyseal fractures with a short proximal or distal fragment is linked to increased malalignment, especially in the coronal plane, nonunion, and the requirement for subsequent treatments to accomplish union [2]. Displaced muscle forces and residual instability have both been blamed for the problem [3]. The nail may translate laterally along coronally positioned locking screws due to a mismatch between the diameters of the nail and the medullary canal, with no nail-cortex contact, and greater stress is imposed on the locking holes to maintain fracture alignment after surgery.
Blocking screws (poller screws), temporary unicortical plating, alternative nail designs with variable proximal bends (proximal third fractures), and fibular plating (distal third fractures) have all been recommended to enhance nailing metaphyseal fractures [4]. By generating a "artificial cortex," the poller screw works as a blocking screw, reducing the width of the

metaphysis and physically obstructing the nail [5]. This increases the mechanical rigidity of the implant-bone combination and, as a result, reduces nail translation and deformity. A poller is a short metal pole used to control or guide traffic on a ship or on a road [6]. The purpose of this study was to assess the use of Poller screws as a supplement to intramedullary nails of small diameter in the treatment of fractures of the distal part of the tibia.

Material and Methods

Between July 2020 and December 2021, a prospective study of 25 patients (15 males and 10 females) was done. Twenty-five skeletally mature individuals with extraarticular proximal and distal tibial fractures were operated on and their functional and radiological results were assessed. Prior to the surgery, institutional ethical clearance was acquired, and all patients were informed of the procedure and given signed agreement. Our inclusion criteria were as follows: a) Skeletally mature patients of both sexes, b) Displaced extra-articular metaphyseal fracture, c) complex fracture (Gustilo-Anderson Grade 1 and 2), and d) Patients who gave written consent for surgery and were willing to follow up. A) Skeletally immature individuals with severe osteoporosis, b) Comminuted fractures, c) Metaphyseal fracture with intra-articular extension, and d) surgically unsuitable patients were all excluded from the study. e) Patients who refuse to follow up. All of the patients were operated on within a week of the accident. The goal of surgical management is to restore function while maintaining axial alignment, correct length, and early mobilization. A mid patellar tendon splitting incision was done on a normal operating table in a supine posture with the knee held in a semi-flexed position. Under fluoroscopic supervision, a precise entry point was made and a guidewire was placed. A flexible reamer with the shortest diameter was used to reamer the medullary canal (8 mm). The deformity was now examined using a fluoroscope after removing the reamer and guide wire. Poller screws were put in the proximal fragment of the tibia on the side where the deformity is concave to prevent valgus or in the mediolateral direction to prevent procurvatum, and were confirmed under image intensifier in both antero-posterior (AP) and lateral (Lat) views. To avoid difficulties, the blocking screw should be inserted at least 1 cm from the fracture. A guidewire has been reintroduced more medially to the poller screw, and reaming has been done with flexible reamers of increasingly increasing diameters. After that, the intramedullary interlocking nail is placed and secured with proximal and distal locking screws. No immobilisation was given to any of the patients. Intraoperative data such as surgical time, reduction difficulties, and residual abnormalities were gathered, and postoperative knee bending and quadriceps strengthening activities began on the first day. On post-op day 7, partial weight-bearing with the aid of a walker was begun and continued for 6-8 weeks (depending on fracture pattern). After 6-8 weeks, full weight-bearing was permitted. Patients were examined radiologically and functionally utilizing Knee range of motion and Sander's Functional Score at regular intervals of 6 weeks, 12 weeks, 3 months, 6 months, and 9 months.

Statistical analysis

The statistical analysis was carried out using the SPSS statistics package software. The statistical review was carried out by a clinical epidemiologist. Due to the short sample size, the analysis was performed non-parametrically. The demographic and baseline information was presented, and then the results were compared. Statistical significance was defined as a P-value of less than 0.05.

Results

The average age of the 25 patients was 45.92 years, with a male majority (fig1). The most prevalent type of injury was on the right side, and the majority of these injuries were caused by car accidents. From the time of admission through surgery, it took anywhere from one to seven days (3.5 days on an average). The average surgical time was 118.01 minutes, and the average blood loss during surgery was 407ml. The infra-patellar nail was used to treat all of the patients. The average time to gain weight after surgery was 7 weeks, with the range being 6 to 8 weeks. The average time it took for a fracture to heal was 11.45 weeks (range: 9 weeks to 13 weeks). Sanders' most recent follow-up score was 36.76, with excellent outcomes in 9 patients, good results in 11 patients, and fair results in 5 others (fig 2).

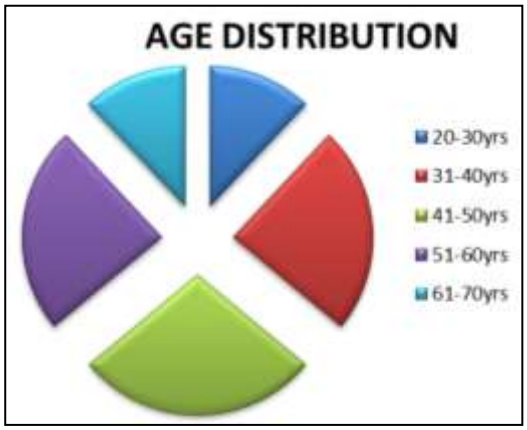

Fig 1: Age distribution

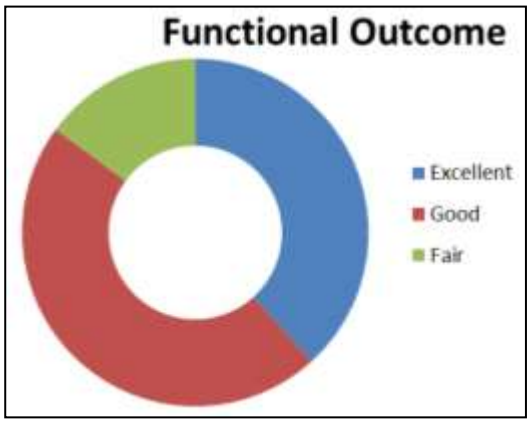

Fig 2: Functional outcome

Minor problems, such as superficial infections in five patients, were treated with antibiotics and resolved. There were no major complications including non-union, mal-union, implant failure, implant infection, compartment syndrome, or neurovascular damage. (Table 1) Any of our patients who were pleased with the surgery's outcome received follow-up.

Table 1: Patient Demographics and data

Sl. No	Age/ Sex	Side of injury	Mode of Injury	Blood Loss (ml)	Duration of Surgery (Mins)	Sanders Score		
						Pre-op	Post-op (3months)	Post -op (6months)
1	23/M	L	RTA	300	85	10	27	37
2	30/M	R	SAF	350	88	12	30	38
3	34/F	L	RTA	410	90	11	25	36
4	45/F	R	SAF	350	100	11	26	35
5	50/M	L	RTA	405	120	13	26	36
6	53/M	R	RTA	380	130	11	27	37
7	45/M	R	RTA	490	95	10	29	38
8	47/F	L	SAF	450	90	12	25	35
9	35/F	L	RTA	385	150	10	27	39
10	37/M	R	RTA	540	105	11	26	35
11	56/M	L	SAF	390	126	11	26	36
12	64/M	R	RTA	450	137	13	27	38
13	44/F	R	SAF	460	165	12	26	35
14	59/M	R	RTA	440	157	11	27	38
15	63/M	L	SAF	420	120	10	28	37
16	39/M	R	RTA	390	109	10	26	36
17	47/M	L	SAF	290	96	11	26	37
18	59/M	R	RTA	360	103	11	27	38
19	62/F	R	RTA	355	110	11	26	39
20	35/F	L	SAF	385	140	12	27	38
21	29/F	R	RTA	395	135	13	26	37
22	35/M	L	SAF	430	125	10	27	36
23	46/M	R	RTA	460	119	12	26	35
24	52/F	R	RTA	470	126	11	26	36
25	59/F	L	SAF	420	130	10	27	37

F – Female , M – Male, L – Left, R – Right, RTA – Road Traffic Accident, SAF – Slip and Fall

Discussion

The use of a trans-medullary poller screw in conjunction with an intramedullary nail enhances reduction and stabilisation of proximal one-third tibia fractures at or near the metaphysis where coronal and sagittal plane displacement is common [7, 8]." A large medullary canal and tugging of the proximal fragment by the patellar tendon while locking the nail in the extension position of the knee limit the reduction in proximal one third tibia fracture. If the fracture is at or just above the Herzog bend of the nail, reduction is extremely difficult." The blocking screw helps direct the nail to the distal portion of the fracture while also enhancing the fixation construct [9]. The poller screw provides a three-point intramedullary construct that is required for stability by providing a contact point for the proximal fragment and the nail on its side [10]. In our investigation, poller screws were put 1 cm above the fracture in the proximal section to rectify the coronal plane deformity. The nail passes medial to the blocking screws because it is a little lateral to the proximal tibia central axis. The blocking screw is placed at a site in the proximal fragment that is in the posterior half for the sagittal plane deformity [11]. The nail is moved from medial to lateral, which helps it stay close to the anterior cortex as it moves along the medullary canal. In our study, 19 patients had valgus 5°, 5 patients had varus 5°, one patient had varus 12°, and one patient had procurvatum; no patient had recurvatum, which is comparable to Ricci *et al.* study on 12 patients in which only one had a postoperative valgus misalignment of 6° that later progressed to 10° at final follow-up; however, blocking screws were not used in this case.

Non-union did not emerge in any of the cases in our investigation, and the findings are more or less consistent with those of Ricci *et al.* [8] as well as Nork *et al.* [12]. In our research, three cases of superficial infection were discovered, which were treated with dressings and antibiotics based on culture and sensitivity. In the early postoperative period, two patients complained of anterior knee pain, which was cured after the rehabilitation programme. Because poller screws are rigid, require no removal, and are cost-effective, they are preferable to other fixation additions such as K-wire, Steinmann pin, Schanz pin, and unicortical plate [13, 14, 15].

Conclusion

In tibial fractures, the benefits of intramedullary nailing over alternative forms of fixation, such as external fixators or plating, cannot be overstated. However, issues with expanding the indications to metaphyseal fractures must be investigated and handled. It was discovered in our study that the use of poller screws in metaphyseal fractures of the tibia, when combined with an intramedullary interlocked nail, was effective in achieving fracture alignment, acting as a reduction tool, improved the stability of the bone–implant construct by functionally reducing the medullary width, and also maintained fracture alignment until union, preventing loss of initial reduction. When compared to other techniques described for preventing metaphyseal malalignment during nailing, poller screws improved the stability of the metaphyseal fractures after nailing and promoted union. Poller screws are technically simple, reproducible, do not require any special instrumentation, and do not require any special design modifications in the nail. Excessive soft tissue dissection or extra hardware such as unicortical or fibular plating are not required. When poller screws are used, there is no significant increase in radiation exposure.

Conflict of Interest

Not available

Financial Support

Not available

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