



Tertiary Care Orthopedic Hospital Experience to Find Effect of Dynamisation in Delayed Union Tibia Shaft Fracture

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective: Our study was designed to evaluate the effect of dynamisation in delayed union tibia shaft fractures.

Methodology: This prospective study was conducted at the Orthopedic Department, Shaheed Mohtarma Benazir Bhutto Medical College, from March 2020 to March 2021. During this timeframe total of 20 patients who underwent dynamisation for reamed intramedullary nailing were recruited. After two successive visits, those patients whose fracture failed to show progressive signs of callus

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formation underwent dynamisation. We removed the single static screw from the longer fracture segment to perform the dynamisation procedure. We inserted a poller screw slightly medial to the nail from anterior to posterior to provide additional stability to the proximal fragment. Statistical analysis was performed by using SPSS 23.0. For evaluating the success of dynamisation Chi-square test was used.

Results: The mean age of recruited patients was reported as 35.92 years ranging from 16 years to 63 years old. Out of these twenty cases, 17 were male (85%). The mean time duration of nailing was reported as 35.4 hours. Total fourteen patients were immediately treated with nailing within 20 hours of injury, while the rest six underwent delayed nailing. Total four cases of tibial fracture were turned out as failure because the patient failed to achieve union after dynamisation and underwent augmentation plating with bone grafting for the complete union.

Conclusion: Delayed dynamisation is a convenient and cost-effective technique to achieve union in femoral shaft fractures. Overall, our study reported an 80% success rate but failed to achieve early dynamisation in comminuted fractures.

Keywords: Intramedullary nailing; dynamisation; Tibial shaft.

1. INTRODUCTION

Intramedullary nailing is considered a standard treatment for healing tibial shaft fractures with a 90% to 100% union rate [1-2]. However, some fractures cause complications in terms of delayed union and nonunion [3]. A delayed union fracture occurs when the bone takes longer than expected to mend, although it is likely to recover without the need for extra surgery. After nailing, 0% - 5% risk of nonunion in tibial shaft fractures were reported [4,5]. Fracture location, instability, infection, and insufficient blood supply are one of the major risk factors in tibial nonunion [3,4]. Risk of nonunion increases in areas involving isthmus due to expanding diaphysis, which causes tension between nail and cortex [6]. Treatment of nonunion tibial fractures includes nail dynamisation, plate augmentation, and exchange nailing with aiming to obtain mechanical stability of the fracture [7]. Cases of the delayed union are widely treated with less time-consuming and cost-effective nail dynamisation procedures. Dynamisation involves the withdrawal of distal statically locked screws from the intramedullary nail, which helps in promoting bone union [8]. Dynamisation helps to enhance micromovements at the fracture gap and results in bone healing [9]. Usually, the best suitable time for dynamisation was reported as two to three months after surgery [10-12]. Unstable fractures involving proximal or distal 1/3 tibial diaphysis dynamisation did not provide suitable results of fracture compression. Moreover, complex fractures such as oblique and multifragmentary fractures lead to loss of reduction. This reduction sometimes causes proximal angulation [13]. In the past, various studies on nail dynamisation reported

contrasting results in terms of union. These results vary from 19% to 82% success rates [10-12]. A very limited amount of literature was produced in the past to evaluate the role of dynamisation in the delayed union. Our study was designed to evaluate the effect of dynamisation in delayed union tibia shaft fractures.

2. METHODOLOGY

This prospective study was conducted at the Orthopedic department, Shaheed Mohtarma Benazir Bhutto Medical College, from march 2020 to march 2021. During this timeframe total of 20 patients who underwent dynamisation for reamed intramedullary nailing were recruited. This dynamisation procedure was conducted after twelve weeks from index surgery and followed for six months. To identify the patients' demographic parameters, we reviewed the medical records of the patients from the department of medical records. We further gathered information related to fracture type, index surgery details, dynamisation time, and smoking details from medical records. All the patients with pathological fractures, fractures associated with tibial plateau, type 3 fractures were excluded from the study. We further excluded all the patients who underwent interlocking nails for the delayed union. After two successive visits, those patients whose fracture failed to show progressive signs of callus formation underwent dynamisation. We removed the single static screw from the longer fracture segment to perform the dynamisation procedure. We inserted a poller screw slightly medial to the nail from anterior to posterior to provide additional stability to the proximal fragment. To

analyse the position of the proximal screw. Picture archiving and communication system tool was used in the dynamic hole of the nail. This procedure was carried out under local anaesthesia, and patients were immediately allowed to weight-bearing.

Furthermore, patients were followed up at one, three, six months, and till union. We calculated callus and bone diameter by using pre dynamisation radiographs. These radiographs helped obtain the Fracture healing index (FHI) by taking the radiological ratio of the largest callus diameter in two planes and the adjacent normal bone diameter. Union was defined as osseous bridging of three cortices on follow-up radiographs, whereas those radiographs without progressive callus increase were defined as dynamisation failure [14]. Statistical analysis was performed by using SPSS 23.0. For evaluating the success of dynamisation Chi-square test was used.

3. RESULTS

Our study included twenty-one cases of tibial shaft fractures March 2020 to March 2021. Out of these twenty-one cases, a total of 20 cases underwent delayed nail dynamisation. The mean age of recruited patients was reported as 35.92 years ranging from 16 years to 63 years old. Out of these twenty cases, 17 were male (85%). Nine cases (45%) were open injuries while the rest were closed (55%). According to Gustilo Anderson's classification total of six cases (66.6%) were type I and open, and the rest 3 (33.3%) were type II open injuries. These open fractures were treated with nailing with primary skin closure. The mean time duration of nailing was reported as 35.4 hours. Total fourteen patients were immediately treated with nailing

within 20 hours of injury, while the rest six underwent delayed nailing. The reason for delayed nailing was observed as polytrauma (5%) in one patient. One patient (5%) reported fat embolism, and delayed representation was reported in four patients (20%). Nineteen tibial fractures were undergone fixation with standard locking nails, while in one case of proximal fracture, we used an expert nail. We used an average 9.8mm diameter nail for all patients. For stable fractures, we immediately allowed weight-bearing while the comminuted fractures were suggested to walk without weight-bearing for the initial month. After the index procedure, none of the patients underwent the ultrasound stimulation. The average time duration of dynamisation from nailing was reported as 19.11 weeks. The total dynamisation duration ranged from 12 weeks to 36 weeks. In our study, we observed that majority of the fractures are comminuted or transverse.

Total sixteen cases achieved union after dynamisation. The total mean time of union from surgery was reported as six months. Total four cases of tibial fracture were turned out as failure because the patient failed to achieve union after dynamisation and underwent augmentation plating with bone grafting for the complete union. Fourteen cases were dynamised within 20 weeks, and the rest six cases were dynamised after 20 weeks. We did not find any significant correlation between age, sex, smoking status. Unfortunately, we failed to achieve statistical significance in terms of open fractures and dynamisation time $P > 0.05$. We observed that comminuted fractures had poor outcomes in terms of delayed dynamisation. We observed 92.8% union rates among cases with > 1.18 FHI score, whereas the study of Vaughan et al. observed a 93% union ratio among cases > 1.17 .

Table 1. Demographic characteristics of recruited patients

Parameters	Frequency %	p-value
Mean Age (Years)	35.92	0.84
Sex		
Male	17 (85%)	0.66
Female	3 (15%)	
Smokers	12 (60%)	1.00
Fracture type		
Open fractures	9 (45%)	0.77
Closed fractures	11 (55%)	
Mean duration of index nailing in hours	35.4	1.00
Mean duration of dynamisation in weeks	19.11 (12-36 weeks)	0.58
Mean diameter of the nail in diameter	9.8 mm	0.77

Table 2. Gustilo Anderson's classification [14]

Gustilo Anderson's classification	Frequency %
Type I open fracture	6 (66.6%)
Type II open fracture	3 (33.3%)

Table 3. Fracture type

Anatomy	Frequency (%)
Comminuted	11 (55%)
Oblique	1 (5%)
Segmental	1 (5%)
Spiral	1 (5%)
Transverse	6 (30%)

Table 4. Union rate after dynamisation

Anatomy	Union from dynamisation		Chi-square	p-value
	No N (%)	Yes N (%)		
Comminuted	3 (27.2%)	8 (72.7%)	9.48%	0.05
Oblique		1 (100%)		
Segmental	1 (100%)			
Spiral		1 (100%)		
Transverse		6 (100%)		

4. DISCUSSION

For enhancing union in the tibial shaft, nail dynamisation is considered an effective and cheap method. It assists at fracture site by improving contact area to achieve union in a shortened period [8]. Researchers claimed nail dynamisation should be done two to three months after nailing [10,11,12]. This would help to achieve sufficient callus to prevent excess mobility at the fracture site. However, nail dynamisation also has some cons regarding limb length discrepancy in patients with comminuted and long oblique fractures. Researchers suggest that it would be suitable for transverse, wedge, and short oblique fractures [15].

Our study observed an 80% success rate after 12 weeks of surgery. These results are comparable with the previous study of Chalidis et al. [16] Kempf et al. [10] and Pihajamashi et al. [17]. Although the mean duration of dynamisation was shortened in these mentioned studies,, the results are still parallel to ours. In our study, the mean duration of dynamisation was reported as 19.11, range 12- 36 weeks, whereas the study of Wu and Shi et al. [18] reported a mean duration of 12 weeks with a max time frame of 30 weeks. The study of Wu and Chen et al. [19] obtained 50-60% successful results in less than 16 weeks, while Wu et al 20's maximum duration was 24 weeks. In a study by Wu and Shi [18], they

reported a 54% (out of twenty-two cases of tibia and femur fractures) success rate after dynamisation. Overall their mean duration from nail dynamisation was thirty weeks; still, they failed to observe statistical significance between dynamisation time and fracture union. A similar study by Wu et al. [20] also reported a 54% union ratio within 5.2 ± 2 months. On the other hand, we observed six months as a mean duration of the union from dynamisation.

Our observations revealed that comminuted fractures had poor results after dynamization compared to oblique fractures ($P = 0.05$). Overall the comminuted fractures had a 72.7% success ratio. These results are parallel to the literature in which researchers claimed that dynamisation in comminuted fractures causes loss of reduction and shortening [21]. We observed 100% union in transverse fracture. During the study, we observed that one case of segmental fracture also failed to achieve union. So, our study contributed that poor dynamisation can be observed in segmental comminuted fractures [21]. Pre dynamisation of fracture healing index was another important variable to predict successful union. Our study observed 92.8% union rates among cases with > 1.18 FHI score, whereas the study of Vaughan et al. [22] observed a 93% union ratio among cases > 1.17 . These results reflect that there should be some amount of callus present at the fracture site before

proceeding with the procedure for successful results.

A limited number of samples and single-center study are the main limitations. Multicenter studies on longer duration should be carried out.

5. CONCLUSION

As the finding of our study, we can conclude that delayed dynamisation is a convenient and cost-effective technique to achieve union in femoral shaft fractures. Overall, our study reported 80% success rate but failed to achieve early dynamisation in comminuted fractures. Patients should be aware of the nonunion so that the early representation of delayed union can be treated easily.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Before initiating the study, we obtained ethical clearance from the institution.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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