

## Comparative Study Between Primary & Secondary Corticotomy of Proximal Tibia in Case of Limb Shortening in Chronic Osteomyelitis by Ilizarov Technique

Dr. Md. Sahedur Rahman<sup>1\*</sup>, Dr. Tanveer Hasan<sup>2</sup>, Dr. Jyotirmoy Sarkar<sup>3</sup>, Dr. Rajib Kumar Paul<sup>4</sup>, Dr. Mahmuda Khatun<sup>5</sup>

<sup>1</sup>Jr. Consultant (Orthopedic Surgery), Upazila Health Complex, Dighalia, Khulna, Bangladesh

<sup>2</sup>Assistant Registrar, Pediatric Orthopedic Surgery, Khulna Medical College Hospital, Khulna, Bangladesh

<sup>3</sup>Jr. Consultant (Orthopedic Surgery), Upazila Health Complex, Tala, Sathkhira, Bangladesh

<sup>4</sup>Jr. Consultant (Sports Medicine & Arthroscopy), Upazila Health Complex, Paikgacha, Khulna, Bangladesh

<sup>5</sup>Indoor Medical Officer (G & O), Khulna Medical College Hospital, Khulna, Bangladesh

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\*Corresponding author: Dr. Md. Sahedur Rahman

Jr. Consultant (Orthopedic Surgery), Upazila Health Complex, Dighalia, Khulna, Bangladesh

### Abstract

### Original Research Article

**Background:** Chronic osteomyelitis of the tibia often results in limb shortening, leading to gait impairment, functional limitation, and decreased quality of life. The Ilizarov technique, utilizing distraction osteogenesis, allows simultaneous limb lengthening and infection management. Corticotomy can be performed primarily or secondarily, but comparative data on functional outcomes are limited. **Objective:** To compare the efficacy, safety, and functional outcomes of primary versus secondary corticotomy of the proximal tibia in patients with limb shortening due to chronic osteomyelitis. **Methods:** This comparative study included 58 patients treated from 2020 to 2024 at a tertiary care hospital in Khulna, Bangladesh, divided equally into primary (n=28) and secondary (n=28) corticotomy groups. Patients underwent preoperative infection control, debridement, and Ilizarov external fixation. In the primary group, corticotomy was performed immediately after debridement; in the secondary group, corticotomy was delayed until infection control and soft tissue stabilization. Limb lengthening, bone union, complications, and functional outcomes were assessed, with ASAMI criteria used for functional evaluation. **Results:** The majority of patients were male (primary: 89%, secondary: 93%), with motor vehicle accidents being the most common cause of injury. Average limb lengthening was 4.4 cm in both groups. Union was achieved in 24 patients (86%) in the primary group and 26 patients (93%) in the secondary group. Median recovery time was shorter in the primary group (18 months vs. 24 months), with more surgical interventions (5 vs. 3). Functional outcomes were superior in the secondary group, with an overall good-to-excellent ASAMI rate of 90% compared to 72% in the primary group. Complications were comparable, tibial shortening, pin tract infection, non-union more common in primary group. Below knee amputation occurred only in primary group (1 case). **Conclusion:** Both primary and secondary corticotomy are effective for limb lengthening in chronic tibial osteomyelitis. However, secondary corticotomy yields superior functional outcomes, supporting delayed corticotomy after infection control and soft tissue stabilization for optimal patient recovery. **Keywords:** Chronic osteomyelitis, proximal tibia, limb shortening, Ilizarov technique, primary corticotomy, secondary corticotomy.

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## INTRODUCTION

Chronic osteomyelitis of the tibia is a persistent and challenging orthopedic condition, often resulting from trauma, infection, or inadequate treatment of acute osteomyelitis. One of the major long-term sequelae of chronic tibial osteomyelitis is limb shortening, which can significantly impair gait, function, and overall quality of life. Limb length discrepancy, if left untreated, can lead to compensatory deformities, chronic pain, and

biomechanical imbalances affecting the hip, knee, and ankle joints [1-3].

The Ilizarov technique, a method of distraction osteogenesis, has revolutionized the management of limb length discrepancies caused by various etiologies, including chronic osteomyelitis. This technique involves gradual distraction of bone segments after performing a corticotomy, allowing for simultaneous bone regeneration and soft tissue adaptation. It provides the

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dual advantage of correcting limb length while managing infection through stable fixation, thus minimizing the need for extensive bone grafting [4-5].

Corticotomy, a controlled surgical fracture of bone, is a critical step in the Ilizarov method. It can be performed primarily at the initial stage of external fixation (primary corticotomy) or later, after initial infection control and stabilization (secondary corticotomy). The choice between primary and secondary corticotomy can influence the duration of treatment, consolidation rate, risk of infection recurrence, and overall functional outcome [6].

Primary corticotomy is often considered when the infected segment is debrided, and limb lengthening can commence immediately under the same Ilizarov frame. This approach may reduce total treatment time but carries a risk of compromising bone healing if infection is not fully controlled. Secondary corticotomy, on the other hand, is performed after ensuring infection eradication and soft tissue stabilization [7-8]. Though it may lengthen the overall treatment period, it can provide a safer environment for bone regeneration and reduce the chances of recurrent infection.

Despite the clinical significance of these approaches, there is limited literature directly comparing the outcomes of primary versus secondary corticotomy in chronic osteomyelitis-related limb shortening. Parameters such as duration of distraction, consolidation index, complication rates, and functional recovery remain areas of active investigation. Understanding these differences is essential for guiding surgical decision-making and optimizing patient outcomes.

## OBJECTIVE

Therefore, this study aims to compare the efficacy, safety, and functional results of primary and secondary corticotomy of the proximal tibia in patients with limb shortening due to chronic osteomyelitis, using the Ilizarov technique.

## METHODOLOGY

This comparative study was conducted at a tertiary care hospital in Khulna, Bangladesh, from 2020 to 2024, and included 58 patients with limb shortening due to chronic osteomyelitis of the proximal tibia. Patients were divided into two groups: 28 in the primary corticotomy group and 28 in the secondary corticotomy group. The majority of participants were male. Ethical approval was obtained from the hospital's ethical committee.

Inclusion criteria comprised adult patients with tibial shortening resulting from chronic osteomyelitis who were suitable for treatment with the Ilizarov technique. Patients with uncontrolled systemic infection, severe comorbidities affecting bone healing, prior failed

limb lengthening procedures, or active vascular compromise were excluded. Demographic data, duration of infection, degree of limb shortening, and prior interventions were recorded.

All patients underwent thorough preoperative evaluation, including laboratory tests (complete blood count, ESR, CRP) and imaging (X-ray and CT scan for some cases) to assess the extent of osteomyelitic involvement, bone quality, and deformities. Infection control was prioritized through meticulous debridement of necrotic bone and soft tissue under sterile conditions. Appropriate intravenous antibiotics were administered preoperatively and continued postoperatively according to culture and sensitivity results.

In the primary corticotomy group, corticotomy of the proximal tibia was performed immediately after debridement, and the Ilizarov external fixator was applied during the same surgical session. In the secondary corticotomy group, corticotomy was delayed until clinical and laboratory parameters indicated infection control, typically 4–8 weeks after initial debridement. Gradual distraction was initiated at a rate of 1 mm/day, divided into four increments of 0.25 mm, with radiographic monitoring to assess bone regenerate formation and alignment.

Postoperative management included early mobilization of the knee and ankle joints, weight bearing as tolerated, and regular pin-site care to prevent infection. Follow-up visits were scheduled to monitor progress of limb lengthening, callus formation, fixator stability, and alignment. Bone union and consolidation were defined clinically by absence of pain or abnormal motion and radiologically by bridging callus formation. Functional outcomes were evaluated using ASAMI criteria, and complications—including infection recurrence, non-union, malalignment, or need for additional interventions—were recorded systematically.

Data were analyzed to compare treatment efficacy, duration of external fixation, consolidation index, functional outcomes, and complication rates between the two groups. A p-value <0.05 was considered statistically significant.

## RESULTS

The study population predominantly consisted of male patients, with 25 males (89%) in the primary corticotomy group and 26 males (93%) in the secondary corticotomy group. The mean age of patients was similar between the groups, at  $30.2 \pm 12.1$  years in the primary group and  $32 \pm 11.5$  years in the secondary group. The most common cause of injury in both groups was motor vehicle accidents, accounting for 23 patients (82%) in the primary group and 25 patients (89%) in the secondary group. Falls and other causes were less frequent, comprising 14% and 11% of injuries, respectively, in

both groups. These findings indicate that the demographic characteristics and mechanisms of injury were comparable between the two groups.

**Table 1: Demographic Characteristics and Cause of Injury**

Parameter	Primary Corticotomy (n=28)	Secondary Corticotomy (n=28)
Male, n (%)	25 (89%)	26 (93%)
Age, mean $\pm$ SD (years)	30.2 $\pm$ 12.1	32.0 $\pm$ 11.5
Cause of Injury, n (%)	MVA: 23 (82%) Fall: 4 (14%) Other: 1 (15%)	MVA: 25 (89%) Fall: 3 (11%) Other: 0 (00%)

The average limb lengthening achieved was 4.4 cm in both the primary and secondary corticotomy groups. Bone defects were observed in 6 patients in the primary corticotomy group and 2 patients in the secondary corticotomy group. Tibial shortening was noted in 4 patients in the primary group and 2 patients in

the secondary corticotomy group. These findings indicate that although both groups achieved similar limb lengthening outcomes, primary corticotomy was associated with a higher frequency of bone defects and tibial shortening compared with secondary corticotomy.

**Table 2: Limb Lengthening and Bone Defects**

Parameter	Primary Corticotomy (n=28)	Secondary Corticotomy (n=28)
Average limb lengthening (cm)	4.4	4.4
Bone defect, n	6	2
Tibial shortening, n	4	2

Bone union was achieved in 24 patients (86%) in the primary corticotomy group, while 26 (93%) patients in the secondary corticotomy group achieved union. The median time to recovery was shorter in the primary corticotomy group at 18 months compared to 24 months in the secondary corticotomy group. The median number of surgical interventions was also lower in the secondary group (3 operations) than in the primary group

(5 operations). Chronic osteomyelitis recurred in 3 patients in the primary corticotomy group, and one patient in this group required below-knee amputation. 1 cases of recurrence no amputation occurred in the secondary corticotomy group. Overall, both groups demonstrated high union rates, though secondary corticotomy required a longer recovery period and less surgical interventions.

**Table 3: Union and Recovery Outcomes**

Parameter	Primary Corticotomy (n=28)	Secondary Corticotomy (n=28)
Union achieved, n (%)	24 (86%)	26 (93%)
Median time to recovery (in months)	18	24
Median number of operations	5	3
Chronic osteomyelitis recurrence, n	3	1
Below-knee amputation, n	1	0

Functional outcomes assessed using ASAMI scoring demonstrated that in the secondary corticotomy group, 15 patients (54%) achieved excellent results and 10 patients (36%) had good results, with 1 patient (4%) fair and no poor outcomes, yielding an overall good-to-excellent rate of 90%. In contrast, the primary corticotomy group showed 12 patients (43%) with excellent results, 8 patients (29%) with good results, and

4 patients (14%) with fair results, resulting in a significantly lower overall good-to-excellent rate of 72%. These findings indicate that secondary corticotomy was associated with superior functional outcomes compared to primary corticotomy in patients undergoing limb lengthening for tibial shortening due to chronic osteomyelitis.

**Table 4: Functional Outcome (ASAMI Scoring)**

ASAMI Functional Result	Primary Corticotomy (n=28)	Secondary Corticotomy (n=28)
Excellent	12 (43%)	15 (54%)
Good	8(29%)	10 (36%)
Fair	4 (14%)	1 (4%)
Poor	0 (0%)	0 (0%)
Overall Good + Excellent (%)	72%	90%

In terms of complications, pin tract infections were the most common complication, occurring in 12 patients (43%) in the primary corticotomy group. Stiffness around the knee or ankle was observed in 6 patients in the primary group and 5 patients in the secondary group, while minor angular deformities occurred in 3 and 2 patients, respectively. Nonunion was reported in 4 patients in the primary corticotomy group and in 2 patient in the secondary corticotomy group. Similarly, chronic osteomyelitis recurrence was noted in

3 patients in the primary group and 1 patient in the secondary group. Tibial shortening occurred in 4 patients in the primary corticotomy group and 2 patients in the secondary corticotomy group. Below-knee amputation was required in no patients in the secondary corticotomy group, whereas 1 below knee amputation occurred in the primary group. Overall, both groups demonstrated manageable complications, although certain complications such as nonunion and tibial shortening were more frequent in the secondary corticotomy group.

**Table 5: Complications**

Complication	Primary Corticotomy (n=28)	Secondary Corticotomy (n=28)
Pin tract infection, n	12 (43%)	10 (36%)
Stiffness (knee/ankle), n	6	5
Minor angulation, n	3	2
Nonunion, n	4	2
Chronic osteomyelitis recurrence, n	3	1
Tibial shortening, n	4	2
Below-knee amputation, n	1	0

## DISCUSSION

In this study, we compared primary and secondary corticotomy of the proximal tibia using the Ilizarov technique for limb lengthening in patients with tibial shortening due to chronic osteomyelitis. The study population was predominantly male, which is consistent with previous reports indicating a higher incidence of high-energy trauma among males [10]. Motor vehicle accidents were the most common cause of injury in both groups, reflecting global trends where road traffic accidents represent a major cause of severe tibial trauma and subsequent osteomyelitis [11]. The similar demographic characteristics between the two groups suggest that the cohorts were well matched, minimizing potential confounding factors.

Both the primary and secondary corticotomy groups achieved a comparable mean limb lengthening of approximately 4.4 cm. However, bone defects and residual tibial shortening were slightly more frequent in the primary corticotomy group. These findings may reflect the complexity of managing infection and bone loss during the early stages of treatment. Previous studies have demonstrated that distraction osteogenesis using the Ilizarov technique can effectively achieve tibial lengthening of 3–6 cm regardless of corticotomy timing, although additional procedures may sometimes be required when bone defects are present [12].

Bone union rates were high in both groups, reaching approximately 86% in the primary corticotomy group and over 93% in the secondary corticotomy group. Despite the higher union rate in the secondary group, the median recovery period was longer compared with the primary corticotomy group. This prolonged recovery may be related to the delayed surgical approach and the need to address infection control before performing corticotomy. Similar findings have been reported in

previous studies where delayed osteotomy in infected tibial cases resulted in longer consolidation periods [10]. Recurrence of chronic osteomyelitis and major complications such as below-knee amputation were uncommon in this study, although amputation occurred only in the primary corticotomy group.

Functional outcomes assessed using the ASAMI scoring system demonstrated better results in the secondary corticotomy group. A higher proportion of patients in this group achieved excellent or good functional outcomes compared with those who underwent primary corticotomy. These findings suggest that delaying corticotomy until adequate infection control and soft-tissue stabilization may contribute to improved functional recovery. Previous research has similarly indicated that functional outcomes depend not only on the degree of limb lengthening but also on the timing of osteotomy and the condition of surrounding soft tissues [8].

The overall complication profile was comparable between the two groups. Pin tract infection was the most common complication observed, followed by joint stiffness and minor angular deformities. These complications are frequently reported in studies involving the Ilizarov technique but are usually manageable with appropriate local care and antibiotic therapy [7-11]. Nonunion and recurrence of osteomyelitis occurred in a small number of patients in both groups, highlighting the importance of careful follow-up and early intervention in complex cases of infected tibial shortening.

Overall, the findings of this study suggest that both primary and secondary corticotomy using the Ilizarov technique are effective treatment options for tibial shortening associated with chronic osteomyelitis.

However, secondary corticotomy may provide better functional outcomes and slightly higher union rates, although it may require a longer recovery period.

## CONCLUSION

In conclusion, both primary and secondary corticotomy using the Ilizarov technique are effective for correcting limb shortening in chronic tibial osteomyelitis, achieving comparable limb lengthening and high union rates. Primary corticotomy offers the advantage of shorter recovery time, whereas secondary corticotomy, performed after infection control and soft tissue stabilization, is associated with superior functional outcomes and a higher rate of good-to- excellent ASAMI scores, despite a slightly longer treatment period and more complex surgical course.

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