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ORIGINAL ARTICLE

Yield of Tibial Lengthening Surgery using NA External Fixator

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ABSTRACT

Aim: To determine the yield of tibial lengthening procedure using NA external fixator in our patients at GMC, Gujranwala, and KEMU, Lahore, Pakistan. In addition, this study will also find significant factors associated with success of the NA fixator-assisted lengthening surgery.

Methods: This cross-sectional analysis include patients having short tibia who underwent tibial lengthening procedure using NA external fixator. These patients were categorized int two groups: successful lengthening and unsuccessful lengthening procedure groups. Statistical analysis was done using SPSS version 25. Independent sample T test, Chi-square test, and binary logistic regression analysis were applied. The p-values were taken statistically significant if < 0.05. Independent sample T test and Chi-square test for independence were used for quantitative and qualitative variables respectively to determine their significant association with the success of the tibial lengthening procedure. The p-values were taken statistically significant if <0.05.

Results: Amongst 100 patients, healing occurred, and lengthening achieved in 94% and healing did not occur in 6%. The duration of hospitalization was statistically significantly less among the patients in which lengthening procedure was successful as compared to the patients in which lengthening procedure was not successful (4.83±3.44 days vs 11.00±5.59 days, p<0.01). All 6 patients in which lengthening procedure was not successful got no plaster on fixator removal (p<0.01). The skin reactions to the pins was significantly less among the group of the patients in which lengthening procedure was successful as compared to the group of the patients in which lengthening procedure was unsuccessful (p=0.027). Tibial lengthening procedure was significantly unsuccessful among the patients who received bone grafting during lengthening procedure (p<0.01).

Conclusion: The yield of tibial lengthening procedure using NA external fixator was excellent in our studied population. Duration of hospitalization as well as the reaction to pins was significantly higher among the patients in which lengthening procedure was unsuccessful. Similarly, the unsuccessful tibial lengthening procedure was significantly common for the patients who received bone grafting during lengthening procedure.

Keywords: Short Tibia, Tibial lengthening surgery, NA external fixator, Yield, SPSS

INTRODUCTION

Short leg syndrome (SLS)[1] commonly present to our Orthopaedic out-patient departments. It is also known as Leg Length Discrepancy[2]. It usually occurs secondary to a leg injury,[3] deep bone involving infection of leg[4] or a difference in growth rates between the legs[5]; however poliomyeltitis and trauma are the commonest etiologies. Short-leg syndrome may increase the risk of lower back pain,[6] stress fractures[7] and running injuries. For significant leg-length inequalities, surgical techniques are used to lengthen the shorter limb or shorten or slow down the growth of the longer leg, so that eventually the legs match in length. The lengthening process usually takes 2-3 months. But consolidation takes months. Overall, limb lengthening surgeries have a high success rate[8]. External fixation[9] is a surgical modality which is used to steady injured or broken bones. Fixators are frequently used for tibial lengthening procedure[10]. In an external fixator, clamps and metal pins are installed through muscles and skin into the bones. Then, a bar is fixed to pins and clamps out of the skin. Naseer Awais (NA) external fixator[11] was invented by Professor Muhammad Awais in 1980 and is common in practice in our hospitals.

The aim of lengthening procedures in such patients is to improve the functional mobility of the patient and prevent long term complications like degenerative joint disease. The objective of our study is to determine the yield of tibial lengthening procedure using NA external fixator in our patients at GMC, Gujranwala, Pakistan. In addition, this study will also find significant factors associated with success of the NA fixator-assisted lengthening surgery.

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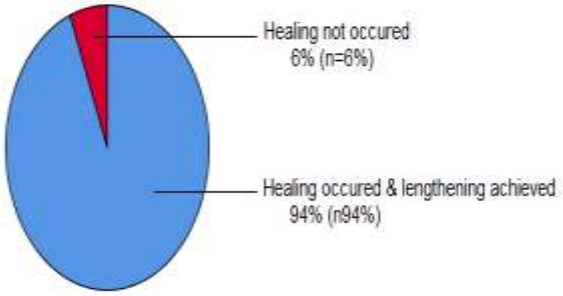
MATERIAL AND METHODS

This cross-sectional analysis was done from June 2001 to May 2021 at the Department of Orthopaedics, GMC Teaching Hospital, Gujranwala, and KEMU, Lahore, Pakistan. The data was collected by purposive sampling. After approval of IRB, an informed consent was received. The patients having short tibia of all age groups, belonging to both genders, who underwent tibial lengthening procedure using NA external fixator were included. After aseptic measures, NA external fixator was applied with or without fluoroscopy control, then osteotomy / corticotomy was performed through proximal metaphyseal/ middle diaphyseal region and compression was given at osteotomy site. Lengthening was started at day 10, 1mm daily incremental till the required length was achieved. Fixator was not removed till consolidation achieved. In those cases, in which the lengthened bone was weak, the plaster was applied. The plaster was removed after one month. These patients were categorized int two groups, one in which healing occurred and lengthening achieved were labelled as successful procedure group and second in which healing not occurred were labelled as unsuccessful procedure group. Statistical analysis was performed using the Statistical Package for Social Science (SPSS), version 25. Age of the patients, number of pins inserted during procedure, duration of hospitalization, duration of external fixation, and time of healing were the quantitative variable, while gender, cause of shortening of leg, side of affected limb, site of tibial osteotomy, apply of plaster, complications of external fixator, skin reaction to pins, bone grafting during procedure, and post-healing discomfort were the qualitative variables. Independent sample T test[12] and Chi-square test for independence[13] were used for quantitative and qualitative variables respectively to determine their significant association with the success of the tibial lengthening procedure. The p-values were taken statistically significant if < 0.05.

RESULTS

Amongst 100 patients who underwent tibial lengthening procedure using NA external fixator, healing occurred in 94(94%) while healing not occurred in 6(6%) patients (Picture 1). The mean age of the patients in which lengthening procedure was successful was 18.13±8.52 years while the mean age of the patients in which lengthening procedure was not successful was 17.67±4.93 years. The duration of hospitalization was statistically significantly less among the patients in which lengthening procedure was successful as compared to the patients in which lengthening procedure was not successful (4.83±3.44 days vs 11.00±5.59 days, p<0.01) (Table 1). The patients in which lengthening procedure was successful, 60(63.8) patients got plaster applied when their NA fixator was removed. All 6 patients in which lengthening procedure was not successful got no plaster on fixator removal (p<0.01). 48.9% patients in which lengthening procedure was successful (46 out of 94), the skin reaction to the pins occurred, while 100% patients in which lengthening procedure was unsuccessful (all 6), the skin reaction to the pins occurred. The skin reactions to the pins was significantly less among the group of the patients in which lengthening procedure was successful as compared to the group of the patients in which lengthening procedure was unsuccessful (p=0.027). Among 94(94%) patients in which tibial lengthening procedure was successful, 4(4.25%) received bone grafting while among 6(6%) patients in which tibial lengthening procedure was unsuccessful, 4(66.67%) received bone grafting. Tibial lengthening procedure was significantly unsuccessful among the patients who received bone grafting during lengthening procedure (p<0.01). There was no statistically significant correlation of the success or unsuccessful of the tibial lengthening procedure with the age of the patients (p=0.896), gender of the patients (p=0.410), number of pins inserted during procedure (p=0.578), duration of external fixation (p=0.737), time of healing (0.068), cause of shortening of leg (p=0.455), side of affected limb (p=0.184), site of tibial osteotomy (p=0.154), complications of external fixator (p=0.670), and post-healing discomfort (p=0.607) (Table 2).



Picture 1: Yield of Tibial lengthening procedure using NA external fixator (n=100)

Table 1: Associations of efficacy of tibial lengthening procedure using NA external fixator with quantitative variables (n = 100) *

Quantitative variables	Tibial lengthening procedure		Mean difference	p-value
	Successful (mean + SD)	**Not successful** (mean + SD)		
Age (years)	18.13 ± 8.52	17.67 ± 4.93	0.46	0.896
No. of pins inserted during procedure	6.68 ± 1.38	7.00 ± 0.89	0.32	0.578
Duration of hospitalization (days)	4.83 ± 3.44	11.00 ± 5.59	6.17	<0.01
Duration of external fixation (days)	267.83 ± 127.97	250.00 ± 77.97	17.83	0.737
Time of healing (days)	322.87 ± 151.32	208.00 ± 41.61	114.87	0.068

*Independent sample T-test was used

Table 2: Associations of efficacy of tibial lengthening procedure using NA external fixator with qualitative variables (n = 100) *

Predictors / Factors	Tibial lengthening procedure		Total	p-value
	Successful	Not successful		
Gender:				
Male	52 (96.3%)	2 (3.7%)	54 (54.0%)	0.410
Female	42 (91.3%)	4 (8.7%)	46 (46.0%)	
Cause of shortening of leg:				
Polio	82 (93.2%)	6 (6.82%)	88 (88.0%)	0.455
Orthopaedic Trauma	12 (100%)	0 (0%)	12 (12.0%)	
Side of affected limb:				
Right	62 (96.9%)	2 (3.1%)	64 (64.0%)	0.184
Left	32 (88.9%)	4 (11.1%)	36 (36.0%)	
Site of Tibial Osteotomy:				
Proximal metaphysis	72 (97.3%)	2 (2.7%)	74 (74.0%)	0.154
Middle Tibia	22 (84.6%)	4 (15.4%)	26 (26.0%)	
Plaster applied on fixator removal:				
Yes	60 (100%)	0 (0%)	60 (60.0%)	<0.01
No	34 (85%)	6 (15%)	40 (40.0%)	
Complications of external fixator:				
Yes	32 (94.1%)	2 (5.9%)	34 (34.0%)	0.670
No	62 (93.9%)	4 (6.1%)	66 (66.0%)	
Skin reaction to pins:				
Yes	46 (88.5%)	6 (11.5%)	52 (52.0%)	0.027
No	48 (100%)	0 (0%)	48 (48.0%)	
Bone grafting during lengthening procedure:				
Yes	4 (50.0%)	4 (50.0%)	8 (8.0%)	<0.01
No	90 (97.8%)	2 (2.2%)	92 (92.0%)	
Post-healing pain /discomfort:				
hurts	65 (94.2%)	4 (5.8%)	69 (69.0%)	0.607
No hurt	29 (93.5%)	2 (6.5%)	31 (31.0%)	

*Chi-square test for independence was used

DISCUSSION

All ongoing modalities of leg lengthening depend on distraction osteogenesis[14-16]. However, coinciding plans and strategies for mechanical bone guidance such as traditional Ilizarov constructs, Taylor Spatial Frames (TSFs), various modes for external fixation and intramedullary motor-driven nails or mechanical give scope for individual plea given by preferences and the skills of the surgeon, the affordability, the desires and necessities of patient, and the medical issue defined as a composite of bony deformity and the state of the soft tissue, joint and muscle adjoining the segment to be repaired. In our studied Pakistani population, the lengthening was achieved after proper healing in 94% patients; while in 6% patients, healing did not occur till the end of a desired period. In a similar study[17] by Luong Nguyen Van and Doan Le Van recently in 2021 at Orthopaedics Institute, Military Central Hospital, Hanoi, Vietnamy, the yield of the tibial lengthening surgery was superb and marvellous. Among 81.7% patients, excellent lengthenig was achieved; while 18.3% patients also acheived lengthening of good category. All the patients reported boost in the quality of life. Internationally, extensive research work has bben done on the topic of the outcome of the tibial lengthening; however local research is scarce. In 2001, V Shevtsov, D Popkov, A Popkov and J Prévot et al[18] studied 38 patients who underwent tibial lengthening, the mean tibial lengthening achieved was 42 mm (7.2 to 18.8%). In another study[19] of 63 patients who underwent fixator-assisted leg lengthening the mean age was 24.8 years. The mean lengthening achieved in all patients was 7.2 cm (range: 5–11 cm), with a mean duration of treatment of 9 months and 15 days (range: 7–18 months). However, in our study, we compared the duration of hospitalization instead of the duration of treatment which was significantly lower among patients whose lengthening procedure was successful ($p<0.01$). In the lengthening of a tibia, the most common reported surgical complications by Ibrahima[20] and colleagues were refractures and recurrence of infection. In another study[21] of 88 cases who underwent limb lengthening using external fixation, the pin-tract infection (PTI) rate was 96.6%. However, we studied the skin reaction to the pins of NA external fixator and the outcome was good where only 52% patients suffered the reaction. The skin reaction to the pins occured in all those patients in which the lengthening procedure proved unsuccessful later on. While only, 48.9% patients showed skin reaction to the pins in the group of the patient in which the tibial lengthening procedure proved successful finally. The difference was statistically significant ($p=0.027$) which indicates that skin reaction to the pins might have been contributed in the failure of the lengthening procedure .

Further studies with large sample size may be required to elboate the statement in detaile.

CONCLUSION

The yield of tibial lengthening procedure using NA external fixator was excellent in our studied population. Duration of hospitalization as well as the reaction to pins was significantly higher among the patients in which lengthening procedure was unsuccessful. The unsuccessful of tibial lengthening procedure was significantly common for the patients who received bone grafting during lengthening procedure. The age and gender of the patients, number of pins inserted during procedure, duration of external fixation, time of healing, cause of shortening of leg, side of affected limb, site of tibial osteotomy, complications of external fixator, and post-healing discomfort had no significant association with the success or unsuccessful of the tibial lengthening procedure.

Conflict of interest: Nil

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