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Effectiveness of NA External Fixator with T-clamp in treating Open proximal and Distal Fractures of Tibia

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Abstract:

Objective: To compare the outcomes of the open proximal and distal fractures of tibia treated by Nasser Awais External Fixator with T-clamp. **Methodology:** This cross sectional study was carried out in the department of orthopaedics Nishtar hospital, Multan in one year duration from July 2016 to July 2017. Study was started after ethical approval from hospital ethical board. Collected data of all patients was entered in SPSS software version 23 and analyzed. Mean and SD was calculated for quantitative data like age, frequency and percentages were calculated for qualitative data gender. Chi square was applied to see association of outcome variables with other variables and confounder. P value ≤ 0.05 was considered as significant. **Results:** Overall, there were 100% (n=180) patients; 50% (n=90) in each of the two groups. Clinical results were excellent in 88.9% (n=80) patients, good in 7.8% (n=7) patients and fair in 3.3% (n=3) patients in group A. While, in group B, the clinical results were excellent in 83.3% (n=75) patients, good in 10% (n=9) patients and fair in 6.7% (n=6) patients. No association was found between clinical results and the groups (χ^2= 1.411 DF = 2, P value=0.494). **Conclusion:** Nasser Awais External Fixator with T-Clamp is a safe and effective technique that enhances the union rate with a low complication rate with less union time in distal tibial fracture compared to proximal fracture.
Keywords: NAEF, Tibia, Open proximal, T Clamp, External Fixator.

Introduction:

External Fixator is a percutaneous technique used for immobilization of bone in open fractures. This technique have less clinical complications like blood loss and many advantages such as easy to perform, easily adjustable in treatment after extremity trauma (1). Most common orthopedic trauma presented in trauma centers is open proximal and distal tibial fractures. Among fractures of distal tibia metaphyseal fracture is common that needs plafond communication and soft tissue ligation (2).

External fixation is successful treatment of such types of fractures with minimum wound contamination (3). Naseer Awais external fixator first time introduced in 1981 by Professor Dr Syed Muhammad Awais and studies on its use were presented in national and international conferences till four years after invention (4). Another modification was made in 1998 with name of NA-5, it is actually a change of modified external fixation system consist of multiple components joint to perform more successful work.

In MEFS both compression and distraction can be applied simultaneously which makes its application easy, fast and usable in wide range of problematic fractures. Another change was made in 2004 to allow adjustment of Schanz screw insertion named as T shaped clamp (5). This modification made it easy to perform proximal fracture fragment small distal stabilization (6). NAEF is less costly and tolerable when combined with other axial fixation. In our community most of patients belong to poor socioeconomic status, so NAEF is best choice in these fractures (7). Compression and distraction ability of NAEF makes it more successful by healing of open tibial fractures. Schanz screw can be inserted through the clamp which makes its application more stable (8). In 2015 Makhdoom A et al (4) conducted a study and reported 86.6% excellent results after application of NAEF on open tibial fractures.

We designed this study to investigate the union time, complication and non union in two groups treated with NAEF with T clamp with this hypothesis that NAEF with T-clamp is equally effective in both treatment groups.

Methodology

This cross sectional study was carried out in the department of orthopaedics Nishtar hospital, Multan in one year duration from July 2016 to July 2017. Study was started after ethical approval from hospital ethical board; consent was taken from patients after complete information and ensured about confidentiality of patient demographic data. Sample size was calculated with WHO sample size calculator using following figures: CI 95%, Power of study 80% proportion of effectiveness of bakri balloon (p) 86.6% (9). Data collection was done by using non probability consecutive sampling technique. Patients with multiple fractures, hypertension diabetes like comorbidities and head injury patients were excluded. Fractures of gustilo type I, II, III A and III B were selected for study. Non probability consecutive sampling technique was used. Detailed examination of fracture site was done for tissue and nerve injury. Fractured limb also examined for joint stability above and below. Within 48 hours of admission NAF was applied, surgical toilet repeated to deal with soft tissue injury. X ray was taken after two hours of surgery and at next day, wound was examined twice in a week until fully healed. Patients mobilized without weight bearing. Antibiotics and analgesics were given as per standard protocol. Alternatively compression and distraction was applied after three weeks of external fixator application in both groups and repeated till formation of callus. Union of fracture was considered as satisfactory when there is no movement at site of fracture, absent tenderness and fracture line was absent on x ray. Cast was applied after NAEF removal below the bone. All patients were followed up upto twelve weeks.
All collected data was entered in SPSS software version 23 and analyzed. Mean and SD was calculated for quantitative data like age, Partial weight-bearing walking, full weight bearing, NAEF T-clamp time, fracture union time, frequency and percentages were calculated for qualitative data gender, mode of Injury, pain during walking and pain site osteolysis, type of Fracture and effectiveness. Chi square was applied to see association of outcome variables with other variables and confounder. P value ≤ 0.05 was considered as significant.

Results:

Overall, there were 100% (n=180) patients; 50% (n=90) in each of the two groups. The mean age, partial weight-bearing walking, full weight-bearing, fracture union time and NAEF T-clamp time in Group A was 28.65±5.26 years, 11.53±2.49 weeks, 15.10±2.64 weeks, 17.98±1.92 weeks and 20.88±2.81 weeks respectively, while the mean age, partial weight-bearing walking, full weight-bearing, fracture union time and NAEF T-clamp time in Group B was 35±6.47 years, 15.32±2.55 weeks, 17.17±2.88 weeks, 23.27±3.88 weeks

and 26.92±2.16 weeks respectively. There were 74.4% (n=67) males and 25.6% (n=23) females in group A, and 97.8% (n=88) males and 2.2% (n=2) females in group B. (Table 1).

In terms of mode of injury, there were 64.4% (n=58) cases of road traffic accident (RTA) in group A and 65.6% (n=59) in group B. There were 14.4% (n=13) cases of firearm injury in group A and 18.9% (n=17) in group B. There were 13.3% (n=12) cases related to fall from height and assault in group A and 11.1% (n=10) in group B. Moreover, there were 7.9% (n=7) cases related to blast and machine injury in group A and 4.4% (n=4) in group B. (Table 2).

Complications were pain during walking and pain site osteolysis. There were 18.9% (n=17) cases of pain during walking, Pin site osteolysis was seen in 31.1% (n=28), Pin tract infection was observed in 23.3% (n=21) cases, ankle joint stiffness was seen in 15.6% (n=14) cases and knee joint stiffness was seen in 11.1% (n=10), in group A. While, in group B, there were 36.7% (n=33) cases of pain during walking, Pin site osteolysis was seen in 33.3% (n=30), Pin tract infection was observed in 14.4 % (n=13) cases, ankle joint stiffness was seen in 10% (n=9) cases and knee joint stiffness was seen in 5.6% (n=5). (Table 2).

According to Gustilo classification, G1 noted as 15.6% (n=14), GII noted as 30% (n=27),IIIA noted as 38.9% (n=35) and IIIB noted as 15.5% (n=14) in group A. while, in group B, G1 noted as 23.3% (n=21), GII noted as 16.7% (n=15), IIIA noted as 25.6% (n=23) and IIIB noted as 34.4% (n=31).(Table 3).

Natural healing and closure of the injury was observed in 15.6% (n=28) cases, delayed primary closure was done in 40% (n=72), partial thickness skin graft was done in 27.8% (n=50), while local fasciocutaneous flap was done in 20.6% (n=37) cases to deal with the skin defect (Table 4).

Clinical results were excellent in 88.9% (n=80) patients, good in 7.8% (n=7) patients and fair in 3.3% (n=3) patients in group A. While, in group B, the clinical results were excellent in 83.3% (n=75) patients, good in 10% (n=9) patients and fair in 6.7% (n=6) patients. No association was found between clinical results and the groups (χ^2= 1.411 DF = 2, P value=0.494) (Table 5).

No association was found for clinical results with gender (p=0.411), age (p=0.459), partial weight-bearing walking (p=0.242), full weight-bearing (p=0.723), fracture union time (p=0.180), NAEF T-clamp time (p=0.084), Mode of Injury(p=0.056), Type of Fracture(p=0.351), Natural healing and closure of the injury (p=0.527), delayed primary closure (p=0.907), partial thickness skin graft (p=0.905), local fasciocutaneous flap (p=0.618), except pain during walking and pain site osteolysis (p=0.000), after the chi-square was applied. (Table 1-4).

Table-1: Demographic variables and Inferential Results

Variable	Group A (Distal) (n=90)	Group B (Proximal) (n=90)	Chi-Square P-Value
Gender	M=74.4%(n=67), F=25.6%(n=23)	M=97.8%(n=88), F=2.2%(n=2)	**0.411**
Age	28.65±5.26 years	35±6.47 years	**0.459**
Partial weight-bearing walking	11.53±2.49 weeks	15.32±2.55 weeks	**0.242**
Full weight-bearing	15.10±2.64 weeks	17.17±2.88 weeks	**0.723**
Fracture union time	17.98±1.92 weeks	23.27±3.88 weeks	**0.180**
NAEF T-clamp time	20.88±2.81 weeks	26.92±2.16 weeks	**0.084**

Table-2: Mode of injury and complications in both groups

Characteristics	Group A (Distal) (n=90)	Group B (Proximal) (n=90)	Chi-Square P-Value
Mode of Injury			
Road traffic accident (RTA)	64.4% (n=58)	65.6% (n=59)	**0.056**
Firearm injury	14.4% (n=13)	18.9% (n=17)	
fall from height and assault	13.3% (n=12)	11.1% (n=10)	
Blast and machine injury	7.9% (n=7)	4.4% (n=4)	
Pain during walking and pain site osteolysis			
Pain During Walking	18.9% (n=17)	36.7% (n=33)	**0.000**
Pin Site Osteolysis	31.1% (n=28)	33.3% (n=30)	
Pin tract infection	23.3% (n=21)	14.4 % (n=13)	
Ankle joint stiffness	15.6% (n=14)	10% (n=9)	
Knee joint stiffness	11.1% (n=10)	5.6% (n=5)	

Table. 3

Comparison of Gustilo classification in both groups

Type of Fracture	Group A (Distal) (n=90)	Group B (Proximal) (n=90)	Chi-Square P-Value
G1	15.6% (n=14)	23.3% (n=21)	**0.351**
GII	30% (n=27)	16.7% (n=15)	
IIIA	38.9% (n=35)	25.6% (n=23)	
IIIB	15.5% (n=14)	34.4% (n=31)	

Table. 4: Inferential results related to mode of treatment

Characteristics	Frequency	Percentage	Chi-Square P-Value
Natural healing and closure of the injury	28	15.6	**0.527**
delayed primary closure	72	40	**0.907**
partial thickness skin graft	50	27.8	**0.905**
local fasciocutaneous flap	37	20.6	**0.618**

Table. 5: Association between clinical results and the groups

Clinical results	Groups		Total	P-value
	Distal	Proximal		
Excellent	80	75	**155**	**0.494**
Good	7	9	**16**	
Fair	3	6	**9**	
Total	**90**	**90**	**180**	
***P-value is statistically insignificant with Pearson χ^2 = 1.411, d.f=2**				

Discussion:

In our study, patients included were between 18-60 years of age and the mean age + SD was 28.65±5.26 years and in proximal group 35±6.47 years. In a study Thakur and Patankar et al (10) reported similar results in their study like mean age was 38 years which is near to our report. Makhdoom A et al (4) also reported similar findings in their study.

In our study, There were 74.4% (n=67) males and 25.6% (n=23) females in group A, and 97.8% (n=88) males and 2.2% (n=2) females in group B. These results are comparable to the local report conducted by Makhdoom A et al (4) who found 60 (88.24%) males and 08 (11.76%) female patients in his report. It was found that males were more than female, may be due to their life style adaptations. Most of the females in our community remain confined to their homes so another factor is social set up. Females are less prone to environmental factors of open fractures. Sex incidence in our study is comparable with findings of S.K. Moda et al (11) conducted on Indian population, similar findings may be due to similar social set up.

In our study in terms of mode of injury, there were 64.4% (n=58) cases of road traffic accident (RTA) in group A and 65.6% (n=59) in group B, in comparison with, Court-Brown et al (12) had 90% and Shahid Sultan 1993 (13) had 87.6% RTA patients. Most of time ignorance of traffic rules will be the cause of RTA, causes of ignorance of traffic rules may be different like high speed, increases in number of vehicles, urgency to reach the destination, busy schedule, and poor condition of roads in our community.

The mean time of bone union was 17.98±1.92 weeks in group A and 23.27±3.88 weeks. Similar findings reported by Tornetta P et al (14) who achieved union in 16-20 weeks duration, Ayaz khan et al (15) in 20 weeks duration and Thakur AJ et al in 20 weeks duration.

Pin tract infection is the most common complication of external fixation23.3% (n=21) in distal group and 14.4 % (n=13) in proximal group. M. Ayaz Khan et al (15) found 20.5%, 11.4% and 47.4% respectively.

The non union is main complication of external fixator, many authors called external fixator a machine of nonunion. In our study we have 88.9% (n=80) excellent, 7.8% (n=7) good and 3.3% (n=3) fair results in distal group whereas in proximal group 83.3% (n=75) excellent, 10% (n=9) good and 6.7% (n=6) fair results. In previous studies Bhandari M. et al (16), M J Iqbal et al (17) and M. Ayaz Khan et al (15) reported 14.2%, 9.6% and 5% non union. Piwani M et al (18) reported 13.33%, non-union in 3.33% and delayed union in 3 (10%) cases. Shoaib M et al (19) show union in his study 83.33% patients out of 30 within 12 to 20 weeks duration.

Conclusion: Nasser Awais External Fixator with T-Clamp is a safe and effective technique that enhances the union rate with a low complication rate with less union time in distal tibial fracture compared to proximal fracture.

Authors contributions:

6. *Conceived idea, design study, proof reading*------- Dr Ayesha Tariq
7. *Data collection, Manuscript writing*---------- Dr Saba Babar
8. *Data collection, literature review*---------- Dr Muhammad Azeem Mir
9. *Data analysis, Proof Reading*---------- *Dr Aamir Furqan*

References:

1. Gupta U, Chaudhary S, Khan A, Pathania VP. Treatment of intra-articular distal radius fractures by a combined dynamic and static jess mini external fixation technique. J Evo Med Dental Sci. 2014;3(21):5886-93. DOI: 10.14260/jemds/2014/2678.
2. Wang SQ, Gao YS, Wang JQ. Surgical approach for high-energy posterior tibial plateau fractures. Indian J Orthop. 2011; 45(2): 125–131.
3. Ramos T, Ekholm C, Eriksson BI, Karlsson J, Nistor L. The Ilizarov external fixator-a useful alternative for the treatment of proximal tibial fractures A prospective observational study of 30 consecutive patients. BMC musculoskelet disord. 2013;14(1):11.
4. Makhdoom A, Maheshwari LD, Laghari MA, Tahir SM, Ali SM, Siddiqui KA. Open proximal & distal fractures of tibia treated with Naseer Awais External Fixator with T-clamp. J Pak Med Assoc. 2015;65:727-32.
5. Du H, Hu L, Li C, Wang T, Zhao L, Li Y, et al. Advancing computer-assisted orthopaedic surgery using a hexapod device for closed diaphyseal fracture reduction. Int J Med Robot. 2015;11(3):348-59. doi: 10.1002/rcs.1614.
6. Orbay JL, Gray R, Vernon LL, Sandilands SM, Martin AR, Vignolo SM. The EFCR Approach and the Radial Septum—Understanding the Anatomy and Improving Volar Exposure for Distal Radius Fractures: Imagine What You Could Do With an Extra Inch. Tech Hand Up Extrem Surg. 2016;20(4):155-60.
7. Álvarez LA, Casanova MC, García LY. Fracturas diafisiarias abiertas de tibia. Rev Cubana Ortop Traumatol 2004;18 (1):24-8.
8. Sanaullah, Kashif S, Ali B, Hakeem A, Ahmed I, Khan MA. AO external fixator in the management of open fracture of tibia. Rawal Med J. 2016;41(4):459-61.
9. Tahaoglu AE, Balsak D, Erdogdu E, Bakır MS, Aksin S, Bala M, et al. Bakri balloon placement effectively treats uterine atony and placenta previa. Biotechnol Biotechnolo Equip. 2017;31(4):795-9, DOI: 10.1080/13102818.2017.1298467.
10. Thakur AJ, Patankar J. Open tibial fractures. Treatment by uniplanar external fixation and early bone grafting. J Bone Joint Surg Br. 1991;73(3):448-51.
11. Moda S, Kalra G, Gupta R, Maggu N, Gupta R, Kalra M. The role of early flap coverage in the management of open fractures of both bones of the leg. Injury. 1994;25(2):83-5.
12. Court-Brown CM. Wheel Wright EF, Christ J, Mcqueen MM. External fixation for type 111 open tibial fracture. J Bone Joint Surg 1990;(72)5:801-4.
13. Sultan S, Shah AA. Management of open tibial fractures at Ayub teaching hospital Abbotabad. J Ayub Med Coll 2001;(13)1:22-3.
14. Tornetta P, Bergman M, Watnik N, Berkowitz G, Steuer J. Treatment of grade-IIIb open tibial fractures. A prospective randomised comparison of external fixation and non-reamed locked nailing. J Bone Joint Surg Br 1994;76(1):13-9.

15. Khan MA, Khan SW, Qadir RI. Role of external fixator in the management of type 11 & 111 open tibial fractures. J Postgraduate Med Inst 2004; (18)1: 12-17.
16. Bhandari M, Guyatt GH, Swiontkowski MF, Schemitsch EH. Treatment of open fractures of the shaft of tibia: A systematic overview and meta-analysis. J Bone Joint Surg Br 2001;83(1):62–8.
17. Iqbal MJ, Cheema GM, Akhtar S, Awais SM, Akhtar NM. Complications of the AO external fixator in open type 111 tibial fracture. Pak J Orthop 1996;12(3):120-23.
18. Piwani M, Bhutto IA, Ahmed I. Evaluation of AO external fixator in the management of open diaphysial fracture of tibia Gustilo type III A and III B. Gomal J Med Sci 2015; 13: 66-9.
19. Shoaib M, Shabir M, Sahibzada SA, Gul R. Outcome of close reduction and casting in close tibial diaphyseal fracture. Journal of Medical Sciences. 2005;13(2):154-6.