ORIGINAL ARTICLE

Outcome of Segmental Tibial Defects Treated by Distraction Osteogenesis with the help of Naseer Awais (NA) External Fixator

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Abstract:

Introduction: Bone segment transport leads to new bone formation (distraction osteogenesis). It is a type of bone healing in which regeneration process fills the bone defects. These long bone defects are produced either by bone loss during high energy trauma, sequestrectomy in chronic osteomyelitis or after excision of bone tumors. There are many external fixators which are designed to achieve the surgical objective of managing bone defects using the principles of distraction osteogenesis.

Objective: The objective of Segmental Tibial defects treated by distraction osteogenesis with the help of Naseer Awais (NA) external fixator.

Methodology: This quasi experimental study was done on forty four patients with tibial defects at department of Orthopedics surgery and Traumatology Mayo Hospital Lahore from May 2010 to June 2013. NA fixator was applied to in all cases and patients were followed up monthly basis and radiographs were assessed to see the bone healing process. Full weight bearing advised after 8-10 weeks according to the bone healing seen in x-rays. After complete healing and consolidation, fixator dynamization was performed for one month then the fixator was removed.

Results: A total of 44 subjects were included in this study with a mean age of 33 ± 4.3 year. Among them forty (90.9%) male and four (9.1%) females had segment transport with NA external fixator, and male and female ratio was 10:1. Out of forty four patients, seven were lost to follow-up. So out of this thirty seven patients, the healing time was 369 ± 56.2 days (median-333).Pin loosening was in nineteen (44.2 %), clamp loosening in ten (23.3%) and pin break in one (2.3%) cases.In four (10.5%) cases knees had to be arthrodesed due to defect in the joint, sixteen (42.1%) cases had flexion in the range of 121-130º, six (15.8%) had flexion <100.

Conclusion: NA external fixator is a useful device for segment transport and hence can be used in future for better outcome of segmental tibial defects treated by distraction osteogenesis.

Key words: *segment transport, distraction osteogenesis, arthrodesis, flexion, extension.*

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Introduction:

Treatment of large segmental bone defects has been a test for an orthopedic surgeon. In old days, amputation was the best alternative for a large number of these type of patients as prosthesis might lead to early ambulation, however the interest for limb salvage has turned out to be more common.[1] Initial injury may cause segmental bone loss, secondary to debridement or developed by post-traumatic osteomyelitis may require resection of necrotic bone segment for treatment, prompting to open fracture with soft tissue damage. Treatment of these complications if delayed may end up in amputation. Because of this reason, the treatment of segmental bone loss is a very difficult task for an orthopedic specialist.[2]

For the treatment of these patients many different procedures have been found in literature.[3] Autogenous bone graft can be utilized for defects up to 7-8 cm, likewise vascularized bone graft, transplantation of allograft and synthetic bone substitute are equally used.[4] As such, treatment choices must be found on the accessible information, contemporary fracture administration standards, and thought of patient and surgeon variables.[3]

The utilization of external fixator has been very regular. Ilizarov is the customary technique utilized for this reason in any case around the globe. Various reviews have demonstrated the use of uniplanar external fixator for bone transport using different standards. Uniplanar fixators are cost effective utilizes less energy utilization and the outcomes are by and large similar. The literature utilizing these fixators demonstrate great outcomes and are less demanding. Some of these fixators are orthofix, AO fixator, Wagner fixator etc.[5,6] We directed this study to treat Segmental tibial defects by distraction osteogenesis with the assistance of NA external fixator.

Materials and Methods

Using non-probability purposive sampling forty four patients with tibial defects were included in this study. This was a quasi-experimental study in which NA was applied to all cases and study was completed in three years at department of Orthopaedics surgery and Traumatology Mayo Hospital Lahore from May 2010 to June 2013. Patients having following pathologies were included:

1. Traumatic bone loss
2. Infected defect nonunion
3. Bone defect created after excision of tumor

Patients having large bony defects in which external fixator application was not possible, having absent distal pulses and having contractures of foot and ankle resulting to poor outcome and those who refused this surgical option were excluded from the study.

These patients were operated under Spinal or general anesthesia. Uniplanar Naseer Awais external fixator was applied, 5 mm pins were used to insert in three or four pin clamps of different shapes according to the fracture geometry and held with two rods, one smooth, the other threaded with 1mm thread pitch. First proximal then distal pin clamps were applied for alignment of tibia then two pin clamp applied to the transporting segment. Tibial osteotomy was performed according to the availability of bone mass either proximally or distally, osteotomy compressed, periosteum stitched and wound closed. The patient was discharged on the second post-op day and examined after the 10th day of surgery to start the distraction by moving nut on the threaded rod 0.5 mm twice, so 1mm daily till the two bone segments joins each other (in some cases docking was performed).

During this period pin and wound care with quadriceps exercises, knee and ankle mobilization and non-weight bearing walk with crutches or walker were advised. The patient was followed up monthly basis and radiographs were assessed to see the bone healing process. Full weight bearing advised after 8-10 weeks according to the bone healing seen in x-rays. After complete healing and consolidation, fixator dynamization was performed for one month then the fixator was removed.

Results

A total of 44 subjects were included in this study with a mean age of 33 ± 4.3 year. Among them forty (90.9%) male and four (9.1%) females had segment transport with NA external fixator, and male and female ratio was 10:1. Twenty five (56.8 %) left tibia and nineteen (43.2%) right tibia cases were operated for segment transport. In 25 (56.8%) patients with middle tibial defect, bone loss was maximum. Proximal tibial defect was found in 9(20.5%), distal tibial defect was found in 8(18.2%) and ankle foot involvement was found in 2(4.5%) patients. Out of 44 patients, 07 were lost to follow-up. So taking 37 patients, the healing time was 369 ± 56.2 days (median-333).Pin loosening was detected in 19 (44.2 %), clamp loosening in 10 (23.3%) and pin break in one (2.3%) cases. Mean hospital stay (in days) was 15 ± 4.7.In 04 (10.5%) cases segment transport resulted into kneearthrodis leading to knee stiffness. 16 (42.1%) cases had flexion in the range of 121-130º, 06 (15.8%) had flexion <100.T30 (78.9%) had extension lag within range of 0-4º and 08 (21.1%) had 5-9º extension lag.

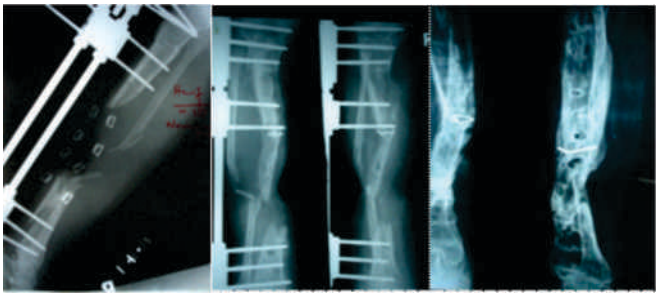

Fig 1. Segmental defect tibia after complete healing

Table 1: *Descriptive Statistics of Age (years), hospital stay (days) and healing time (day)*

	Mean	S.D
Age (years)	33	4.3
Hospital stay (days	15	4.7
Healing time	369	56.2

Discussion

Bone transport distraction osteogenesis is widely used in the reconstruction of large bone defects following trauma. However, clinical efficiency of bone transport distraction osteogenesis in

Table 2: *Frequency distribution of patient's presentation and outcome*

		F (%)			F(%)
Gender	***Male***	40(90.9%)	**Complication**	***No***	13(30.2%)
	Females	4(9.1%)		***Pin loose***	19(44.2%)
Side involved	***Left***	25(56.8%)		***Clamp loose***	10(23.3%)
	Right	19(43.2%)		***Pin break.***	1(2.3%)
	Both	0(0%)	**Knee flexion^0**	***Zero***	4(10.5%)
Anatomic location tibia	***Prox.***	9(20.5%)		***< 100***	6(15.8%)
	Mid	25(56.8%)		***100-110***	5(13.2%)
	Dist	8(18.2%)		***111-120***	3(7.9%)
	Ank. Inj.	2(4.5%)		***121-130***	16(42.1%)
Bone loss	***Loss 2-5 cm***	24(54.5%)		***131-140***	4(10.5%)
	loss 5-10 cm	12(27.3%)	**Knee extension^0**	***0-4***	30(78.9%)
	loss > 10cm	8(18.2%)		***5-9***	8(21.1%)

the reconstruction of large tibial defects remains unclear.[7] A number of options are available including Ilizarov, uniplanar orthofix, AO tubular external fixator Hoffman fixator and locally made "Naseer-Awais" (NA) uniplaner fixator as well.[6] The evidence is undoubtedly declared that knowledge and skill on the part of the surgeon and hospital resources are required to successfully face the challenge because any unfavorable outcome is often unacceptable to patients and their families.[8]

In our study, there is significant difference between male and female ratio because males are always more prone to accidents and tibia fractures in our country as males are more on the roads and it is comparable to the other studies conducted in Pakistan. Shabbir et al. (2010) treated 32 patients having segmental defects using NA external fixator. There were 29 (90.2 %) male and 3 (9.3 %) were female.[2] Awais et al. (2010) treated bone defects by NA fixator in 10 patients, 8 (80 %) were male and 2 (20 %) female9 Sahibzada etal. (2005) treated segmental bone defects by NA external fixator with male preponderance having 20 patients 14 (70%) were males and 6 (30%)were female patients. 6In studies of other parts of the world, male and female ratio is also comparable to our studies. Atesalp et al. (1998), treated bone defects in 43 patients with circular fixator, all were males. 1019 patients having bone defects treated by Kesemenli et al. (2001) with history of trauma, sixteen (84.2 %) out of them were male and three (15.7 %) were male.[11] Kokly, S. (2014) treated 12 patients (11 males, 01 female) by AO tubular fixator.[12]

Our series is comparable with Atesalp et al. (1998) in which average age was 24.7 years (range: 14-72).[10] Hosny et al. (1998) operated 11 patients withaverage age of 27 years (range 17-51).[13] Magadum et al.(2006) operated 27patients with mean age 39 years.14 Shabbir (2010) had 29 patients with average age of 29 years range from 16 to 49 years.[2] In comparison with some other series our mean age is more, like Kapukaya et al. (2000) the mean age was 17 years and 3 months (range 7-37 years).[15] Kesimenli et al. (2001) had a series of 19 patients with segmental bone defects following trauma with mean age of 19.4 years.[7] Awais et al. (2010), the average age of patients was 19.6 years with range from 10 years to 48 years.[3] Chanchit Sangkaew (2005)treated 70 patients (77 limbs) with AO fixator with an average age of 26.8 years (range, 4-54). [16]

In our series left side is involved more than right side which is comparable to different studies. Atesalp et al. (1998) treated 43 patients in which the right side was affected in 19 cases and the left in 26.[10] Right tibia was involved in 12 patients (60%) and left tibia in 8 patients (40%) in the series of Sahibzada et al. (2005).[6] In the series of Shabbir et al. (2010) right limb was involved in 14 cases while the left in 18.2 In the series of Kesimenli et al. (2001), proximal tibia was affected in 4 (33.3%), mid 3 (25%), distal 5 (41.6).[11] Magadum (2006) had involvement in proximal tibia in 5 (18.5%) middle tibia 18 (66.6%)distal tibia 4 (14.8%).[14]

The follow-up period after removal of the apparatus was for between 28 and 98 months, with a mean of 50 months. Satisfactory union was obtained in 40 cases in study by Atesalp et al., 1998. Also the length of the defect ranged from 2 to 15 cm with a mean of 9.7 cm10; whereas in another study the mean period of use of the external fixator was 12.5 (range 8-18) months. Mean union time 6.3 months, and mean duration of consolidation 10.2 months.[14] In the study of Kolky, S. (2014), mean overall treatment was 16.08 months or 1.91 month/cm.[12] and in the study of Chanchit Sangkaew average healing time was 244.7 days.[16] In a local study the average length of bone transport was 7cm; ranges from 3 to 17 cm.[2] Study by Awais et al., showed that the bony defects ranged from 4 cm to 15cm with an average of 8.7cm.[9] Hence NA external fixator had comparable results with regard to major characteristics with other techniques traditionally opted worldwide.

Conclusion

NA external fixator can reliably be used for distraction osteogenesis to treat the segmental tibial

defects in terms of healing time, complications, length of bone loss and joint congruity. We recommend it as a very useful device for distraction osteogenesis.

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