ORIGINAL ARTICLE

Management of Segmental Tibial Defect with Intercalary Bone Transport by Ilizarov Method

ZULFIQAR A. SOOMRO[1], ZAMIR A. SOOMRO[2], SAEED A. SAMO[3]

ABSTRACT

Objective: To assess the outcome of the management of segmental tibial defect with intercalary bone transport by Ilizarov method.

Patients and methods: This prospective study was conducted at department of Orthopaedic Ghulam Muhammad Mahar Medical College (GMMMC) Sukkur from July 2008 to June 2011. Twenty cases with segmental tibial defect with or without any associated deformity selected from Outpatient Department GMMMC, Sukkur. .All types of segmental bone defects involving the tibial diaphysis, met the criterion of inclusion in the study.

Results: Twenty patients were included in this study. Out of twenty, 18 were males and 2 were females. The average follow up period was 18 months. No patients have lost follow up. No mortality was observed in current study. The overall success rate was 95%

Conclusion: The intercalary bone transport by Ilizarov ring fixator in the skeletal segmental defect of tibia is successful method and can be recommended confidently and most importantly, patient is quite able to walk next day, attend school, and take part in many normal activities while the apparatus is in place.

Key Words: Intercalary bone transport, Tibia, Ilizarov method

INTRODUCTION

The tibia is one of the most difficult bone to manage and the most frequently injured and encountered with segmental defect[1]. When discussing lower extremity trauma, the proto type injury is the severe open tibial fracture[2]. In addition, the tibia has a large subcutaneous surface and it is one of the bones in which open fractures commonly occur the tibial shaft, particularly in its lower half, does not have abundant blood supply, so delayed union and non-union are not uncommon[3]. Even the best treatment of cases, with non-union and mal-union is often complicated infection, particularly after fractures of tibia[4]. A defect in osseous tissue may be the result of loss, secondary to original trauma, as in grade III open fractures or debridement of devitalized or infected bone. Skeletal defects of any size can now be over come without bone grafting. This is recently accomplished by elongating one or both fragment on either side of defect[5]. The technique of distraction osteogenesis used by Putti and Anderson, improved the results and further differentiated towards corticotomy and fragment transport by Ilizarov method, is a further possibility of treating long segmental bone defects[6] The Ilizarov concepts seems to have important advantages over other methods. Thus good bone consolidation is usually obtained without the need of bone grafting or internal fixation[7]. The demonstration that bone and soft tissue could reproducibly be formed by gradual distraction-histogenesis provided an important new tool for the orthopaedists in the management of a variety of congenital and acquired bony problems.[8] With this method, missing osseous tissue of any length, can be reconstructed without the need of bone grafting[9]. The newly formed bone rapidly ossifies and becomes corticalized. Soft tissue defects that accompany missing bone will close during the process of bone transport. His technique, enables correction of angular, rotational and translational osseous deformities as well as restoration of limb length discrepancy and eliminate segmental osseous defect[10,11]. The bone is fixed with small caliber transosseous wires, which are affixed to the ring and tensioned to increase their rigidity. The osteotomy (corticotomy) is performed through a small incision in the periosteum. The periosteum is elevated approximately 1 cm. A 0.5cm (1/4 of inch) osteotome is introduced through this opening, and as much cortex as possible is osteotomized (corticotomized). The remaining cortex is broken by rotation of the proximal and distal segments of the bone in opposite directions. This is followed by gradually distraction of the provisional callus at a rate of not more than I mm daily (0.25mm/6 hourly) to avoid the necessity for internal fixation or bone grafting[12]. The system's many parts allow application to almost any limb segment, limb size or limb deformity.

Department of Orthopaedics, [1]GMMMC Sukkur, [2]CMC Larkana, [3]PMC, Nawabshah

Correspondence to Dr. Zulfiqar A. Soomro, e-mail: zulifqar@hotmail.com

MATERIALS AND METHODS

The study has been conducted from July 2008 to June 2011. Total number of 20 cases who reported to OPD of Orthopedics Department GMMMC Sukkur with segmental tibial defect with or without any associated deformity. The age ranged from 5 to 35 years and either sex was included. The patients with segmental tibial defect who attended orthopedic were difficulty or inability to bring the remarkable functional results by other existing conventional methods. Out of 20 patients, 8 received injuries in road traffic accidents, 4 patients received fire arm injuries, one patient sustained trauma due to fall of a piece of rock on his leg, where as remaining 7 patients had congenital pseudoarthrosis of tibia. Nineteen patients out of 20 had under gone surgery for at least one or more times previously. Five patients (25%) also had associated deformities that are, 2 had knee contracture 20 degree and 5 degree respectively, 2 had disuse atrophy of muscles and one had congenital varus deformity of foot. Five patients (25%) had also shortening of limb ranged from 1.5-3.5 cm (average 2.4 cm). Corticotomy was performed in proximal metaphysis region in all of these patients. The average initial operating time was 2.8 hours (range 1.8–4.2). After corticotomy latency period of 5 days (range 4–6 days) was observed before distraction to allow early good quality callus formation. There after distraction commenced at a rate of 0.25 mm every 6 hourly/day.

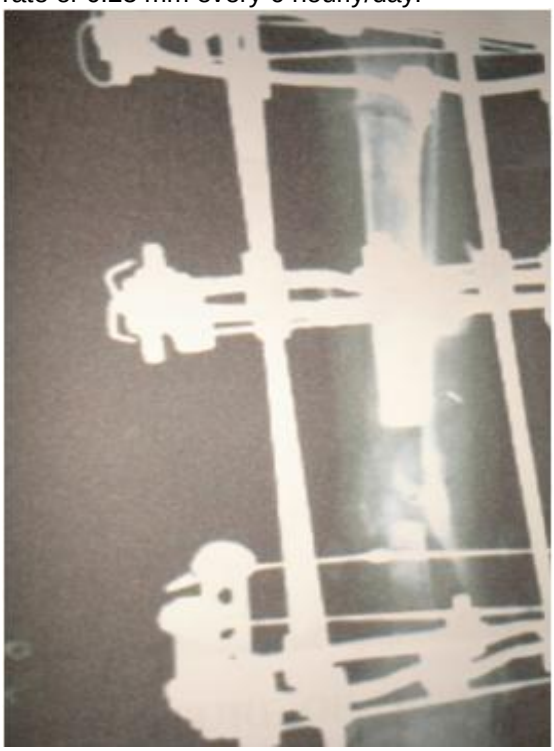

Fig.1: Corticotomy with bone transport

RESULTS

Twenty patients were included in this study. Out of twenty, 18 were males and 2 were females (Table 1). The age ranged from 5 to 35 years with average of 15.8 years (Table 2). The average follow-up period was 18 months. No patients have lost follow-up. No mortality was observed in the current study. The overall success rate was 95%. All types of segmental bone defects involving the tibial diaphysis, met the criterion of inclusion in the study. Of these, 2 at the time of cases, Seven (35%) had acquired segmental defect due to excision of pseudoarthrosis site. Four (20%) developed segmental defect secondary to surgical debridement as in open fractures of tibia, while 9 (45%) had initial bone loss at the time of original injuries. Twelve (60%) patients underwent fixation with ilizarov apparatus for their segmental bone loss with in 12 months of initial injury. While, time of initial injury was counted in the cases of pseudoarthrosis from the day, when problem was just noticed by the parents. In one patient premature fusion of corticotomy site observed and re–corticotomy was performed shortly after 15 days.Time from initial injury to application of ilizorv apparatus in 12 patients was less than 1 year ranging from 3-34 weeks (22-234 days). In two patients, it was less than 2 years ranged from 66-103 weeks (465 to 424 days) while in other 6 patients application of apparatus was performed between 2-5 years i.e. 158-260 weeks,(1106 days to 1825 days) In 18 patients, frames were assembled during surgery, while in two patients pre –assembled frame was used for the sake of experience. Mean length of skeletal segmental defect was observed 3.6 cm ranging from 1.5 cm to 8.5 cm. in five patients length of defects ranged from 1.5 -2.5 c. 12 had bone loss ranging from 3-5 cm while remaining 3 had segmental defect of 6-8.5 cm. Out of 20 patients, 5 had additional limb length inequality which ranged from 1.5 cm to 3.5 cm (average 2.4 cm). Ten patients had involvement of left leg while 10 had right sided involvement with ratio of 1:1. From application of apparatus the mean duration of post operative hospital stay remained about 3 weeks (23 days ranged from 1-12 weeks (7-84 days).One patient developed osteoporosis of his affected bone due to disuse of the limb. The mean time of distraction of bone considered as, time from start of turning nuts till successful completion of filling the defect and docking of transported segment. It was 7 weeks (49 days) ran segment after from 3-13 weeks (20-90 days). While in 5 patients, who had limb shortening we continued distraction even after docking of transported segment after necessary alteration in their frames till elimination of limb length discrepancy. High tibial (metaphyseal) corticotomy

was performed in all cases where as fibular osteotomy was performed in 5 patients who were also planned for lengthening of their limbs to complete their treatment in single application of frame. We purposely did distraction 0.5 cm more than the actual length of defects in all except one of early cases to compensate future collapse of regenerate. Collapse of regenerate was observed in one patient so limb length inequality of about 0.5 cm was remained and result was noted as unsatisfactory in that patient (Table 3).

Table 1: Frequency and percentage of genders and ages of the patients (n = 20)

Variable	No.	%
Gender		
Male	18	90.0
Female	2	10.0
Age (years)		
5 – 15	10	50.0
16 – 25	6	30.0
26 – 35	4	20.0

Table 2: Frequency and percentage of etiology (n = 20)

Etiology	No.	%
Road traffic accident	8	40.0
CPT	6	30.0
Fire arm injury	4	20.0
Fall of rock piece	2	10.0

DISCUSSION

In the orthopedic surgery while treating segmental bone loss is considered to be the most challenging problem[13]. The prolonged nature of the treatment results in disruption of all aspect of the patient's life for a prolonged period. All methods of treatment in skeletal bone defects, including use of auto and allograft, techniques of burri-papineau or micro vascular bone transfers takes a long time and often fail to unite to the recipient osseous tissue at one or both ends. Use of plaster cast is also a different problem, immobilizing two or more joints for about 6-12 months results in stiffness of these joints. For the elimination of skeletal segmental defects including limb length discrepancy various techniques have been developed[14-16]. However, many practical considerations still restrict this mode of treatment in long segmental defect. Among all limitations, the notorious one, the ability to replace absent bone with cancellous graft is limited by the amount of available autogenous donor material in the body. Ilizarov first introduced distraction osteogenesis as a biologic technique for creating new bone in potentially unlimited quantities from existing local, host bone[17]. An important modification of this technique, called bone transportation has revolutionized the management of treating intercalary defects successfully[18]. During current study of 20 patients it was observed that all of them belong to one province Sindh. Out of 20 patients, initial cause for segmental defect was road traffic accident (RTA) in 8 patients, congenital pseudoarthrosis 7 patients, fire arm injury 4 patients, while one patient had trauma due to fall of rock. Out of 20 patients, 9 had bone loss at the time of injury, 7 patients acquired bone loss due to excision of pseudoarthrosis site while remaining four patients developed bone loss during surgical debridement of open fracture of tibia. During current study pin tract infection was more common in patients who had additional limb length discrepancy, probably because there were chances of stretching of skin.[19] Amongst other complications, equines foot was observed only in those cases where limb length discrepancy was corrected.[20-23] In four patients deviation of transported fragment was observed probably due to pulling of muscles and incorrect moving of nuts[24]. Surgical intervention was required in these patients to treat the deviating segment by intramedully nailing in 2 patients and replacement of olive wires in 2 patients. One developed premature fusion of corticotomy, due to turning of nuts by patient himself in reverse direction. Recorticotomy was performed after 2 weeks on completion of the procedure. Collapse of regenerate occurred in one patient where limb was lengthened up to 8.5 cm and additional 0.5 cm distraction was not performed so limb length inequality of about 0.5 cm resulted. Patient was satisfied with his gait and did not desire for other procedure. Delayed union was observed in two patients and probable cause was relative early removal of the fixator and incomplete co-operation of patient to full weight bearing in the fixtor. In one patient with limb length in equality superior tibiofibular joint was dislocated during lengthening where this joint was not stabilized in the proximal ring during surgery. Olive wire was placed to overcome this complication. Among the surgical interventions required in post operative period were readjustment and removal of wires as a minor procedures. Major surgical interventions required were re-corticotomy in one patient, bone grafting in 2 patients, intramedullary nailing in two patients, placement of olive wires in three patients. Average duration of post-operative stay was 23 days (range 6-79 days), only 3 patients had longer stay i.e. above two months. The fixator was removed with an average of 113 days (range 68- 184 days). 10 patients had more than hundred days, fixator time because consolidation was not evident radiologically. Thus, the Ilizarov technique is not only a reasonable method of limb salvage but is very cost effective one. The Ilizarov method of bone transport and limb lengthening has given the orthopedic surgeons a powerful tool to overcome these complex problems. Like treatment of pseudoarthrosis and long segmental defect of tibia that previously were either impossible or so difficult and unsuccessful that

surgeon and family were even willing to accept amputation as an alternative and effective treatment. However, Ilizarov circular fixator offers a unique advantage in its ability of simultaneous filling the segmental skeletal defects, correcting the limb shortening and soft tissue contractures in a very precise, controlled manner.[25] Thus the intercalary bone transport by Ilizarov ring fixator in the skeletal Segmental defects of tibia is successful method and can be recommended confidently. The rate of complications and length of treatment are acceptable. Most importantly, patient is quite able to walk next day, attend school, and take part in many normal activities while the apparatus is in place.

CONCLUSION

The Ilizarov method of bone transport and limb lengthening has given the orthopaedic surgeons a powerful tool to overcome these complex problems, like treatment of pseudoathrosis and long segmental defect of tibia that previously were either impossible or so difficult and unsuccessful that the surgeon and family were even willing to accept amputation as an alternative and effective treatment. However, Ilizarov circular fixator offers a unique advantage in its ability of simultaneous filling the segmental skeletal defects, correcting the limb shortening and soft tissue contractures in a very precise controlled manner. Thus the intercalary bone transport by Ilizarov ring fixator in the skeletal segmental defects of tibia is successful method and can be recommended confidently. The rate of complications and length of treatment are acceptable. Most importantly, patient is quite able to walk next day, attend school, and take part in many normal activities while the apparatus is in place.

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