LIMB LENGTH DISCREPANCY IN LOWER LIMB MANAGEMENT WITH UNILATERAL EXTERNAL FIXATOR

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ABSTRACT

Objective: *To evaluate the outcome of lower limb lengthening with unilateral external fixator in limb length discrepancy.*

Material and Methods: *This descriptive study was conducted at the Department of Orthopedics Postgraduate Medical Institute, Hayatabad Medical Complex, Peshawar from 2002 to 2005, on 35 patients treated by Wagner method for their limb-length discrepancy. The limb-length discrepancy and bony alignment was measured and ascertained both clinically and radiologically. Unilateral external fixator assembly was fixed on the affected limb, percutaneous corticotomy was carried out and distraction was started one millimeter per day after one week. Distraction gap was assessed and measured with periodic radiological examination.*

Results: *Out of 35 patients, 25 were male and 10 were females. Their ages ranged from 18 years to 50 years with a mean of 29.3 years. In 17 (48.6%) patients tibial lengthening, in 14 (40%) patients femoral lengthening and 4 (11.4%) patients both tibial and femoral lengthening was done. A total of 207 complications occurred in 39 segments. Out of which 128 were minor and 79 were major complications. We were able to achieve excellent or good grade in 89% of bony results and 97% of functional results, as per criteria of the association for the study and application of the Wagner method.*

Conclusion: *The outcome of Wagner method for limb lengthening is excellent in over 80% of cases both in terms of bony and functional results.*

Key Words: *Wagner, Limb length, Discrepancy, Shortening.*

INTRODUCTION

Lower limb inequality is not simply a cosmetic concern, but also a functional concern. The short leg gait is awkward and increases the energy expenditure because of excessive vertical rise and fall of pelvis; it may also result in backache and compensatory scoliosis and decreased spinal mobility[1].

Limb lengthening is not a new concept, the first recorded leg lengthening was carried out by Codivilla in 1905. Earlier attempts at lengthening relied on acute distraction of an osteotomy but there was an extremely high complication rate and this method was abandoned in favour of gradual distraction[2].

A high incidence of serious complications continued to be associated with leg lengthening until recently, with the development of fixators coupled with a better understanding of biology, had justified the reintroduction of this technique into orthopaedics practice[3].

G.A. Ilizarov[4] and his colleagues in the Siberian city of Kurgan were carrying out research on tissue-growth during distraction. They discovered a reliable way to stimulate new bone formation within a gradual distraction using ring fixator, while the West Wagner[5] and De-Bastiani[6] introduced their unilateral fixators, both handed over a powerful tool for lengthening and bone transport to the orthopaedic surgeons.

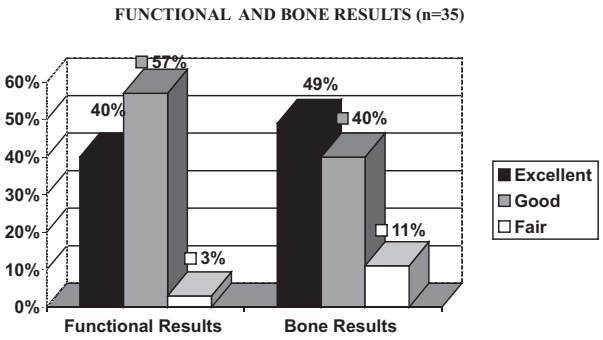

Figure 1

With modern limb lengthening procedure using Wagner and Ilizarov apparatus the rate of complications have been substantially reduced[7]. These procedures are safe and have excellent results in experienced hands[8].

Limb lengthening procedures are rarely carried out in this part of the world due to lack of sophisticated health care facilities. With improvement in life style of population and availability of better facilities, limb lengthening procedures are gaining popularity. The present study was designed to evaluate the outcome of limb lengthening procedure with unilateral external fixator. We used Wagner technique[5] in our study for correction of limb length inequality along with any associated deformity.

MATERIAL AND METHODS

This descriptive study was conducted at the Department of Orthopedics Hayatabad Medical Complex Peshawar from September 2002 to August 2005. Thirty five patients with lower-limb length discrepancy were included in the study fulfilling the following criteria.

Inclusion criteria:

a. Apparent shortening of one leg of more than 4 cm with the opposite leg not requiring a caliper.

b. Patients whose overall disability does not hindered the effectiveness and benefits of the procedure.

c. Unbalanced foot was not a contraindication for lengthening and the deformities of the foot (e.g. equinus) were corrected after bone lengthening procedure.

Exclusion criteria:

a. Muscle power of the different groups in the thigh and leg were assessed by using Medical Research Council (MRC) scale and M 3 or below were excluded

b. Deformity of the limb that could not be surgically corrected.

c. Presence of any debilitating systemic disease e.g. severe diabetes, malignancy and hormonal disorder, mental retardation, prolonged bed ridden patient and patient with short life expectancy.

d. Old age (above 60 years)

e. Short stature patients and those requiring lengthening for cosmetic purpose were not included in the study.

After fitting in the inclusion criteria of the admitted patient, a thorough history was taken, complete physical examination performed. A detail examination was done which include the measurement of both the limbs as a whole and each of femoral and tibial segments separately with measuring tape and investigations carried out. All the patients were counseled about their conditions which necessitated an urgency of the surgical procedure they had to undergo. Informed consent was taken from all patients.

Technique of Application of Unilateral Fixator (Wagner)

Under general or regional anesthesia,

SECONDARY PROCEDURES (n=35)

Secondary Procedures	Group-I (n=17)	Group-II (n=14)	Group-III (n=4)	Total
Readjustment	6	8	3	17
Repeat corticotomy	3	4	3	10
Pin removal	3	3	2	8
Lengthening of tendo-achillis	2	2	1	5
Bone grafting	10	10	4	24
Fixation with plate	6	10	2	18
Ankle Arthrodesis	2	2	--	4

Table 1

ASSOCIATION FOR THE STUDY AND APPLICATION OF THE METHODS OF ILIZAROV (ASAMI) SCORING SYSTEM

Bone results	
Excellent	Union, no infection, deformity<7°,limb length discrepancy<2.5 cm
Good	Union + any two of the following: no infection, deformity<7°,limb length discrepancy<2.5 cm
Fair	Union +only one of the following: no infection, deformity<7°,limb length discrepancy<2.5 cm
Poor	Non union / refracture / union + infection + deformity>7° + limb length discrepancy>2.5 cm
Functional results	
Excellent	Active, no limp, minimum stiffness(loss of <15°knee extension/<15° dorsiflexion of ankle),no reflex sympathetic dystrophy, insignificant pain
Good	Active with one or two of the following: Limp, stiffness, RSD, significant pain.
Fair	Active with three or all of the following: Limp, stiffness, RSD, significant pain
Poor	Inactive(unemployment or inability to return to daily activities because of injury)
Failure	amputation

Table 2

antiseptic painting and draping of the limb was done. At the site of Shanz screw fixation a short stab skin incision was made. Shanz screw was passed straight through the soft tissue to reach the bone. Then Shanz screws were inserted through the clamps using a power drill or a T – handle. The screws were placed absolutely parallel to each other in all planes to avoid stresses at the pin bone interface.

Two level fixation using two or three pin clamps was used in most of the cases that provided a good stable fixation.

TIBIAL LENGTHENING: The corticotomy was completed after applying the fixator. After the tibial corticotomy, fibular osteotomy was performed through a lateral incision in the middle third of fibula by 1 cm osteotome within proximal two pins.

FEMORAL LENGTHENING: In femoral lengthening also the technique of constructing the frame piece by piece, directly over the limb was employed rather than pre-constructing the frame. The Femoral corticotomy was performed using round bone technique. But because of brittleness of femur as compared to tibia, sometimes-manual osteoclasis was required to achieve complete corticotomy.

The completion of corticotomy was always confirmed under image intensifier. Before the patient left the operating theatre, full segment X-rays were taken including the proximal and distal joint in AP and Lat. views. This was necessary to know the proper alignment of bone and to detect any angulation at the corticotomy site, as pre-operative image intensifier does not give full picture of the bony segments.

Antibiotics were also given for first two days by parenteral route. On the first post-operative day special attention was given to physiotherapy. Patient was encouraged weight bearing on the operated limb and walking with the help of crutches or walker as much as possible. Distraction was usually started on seventh post-operative day at the rate of 0.5mm 12 hourly. Both the patient and their relatives were taught the technique.

FOLLOW-UP

The average duration of follow up was 18 months (ranges 2 to 39 months). During the "Lengthening period" the patients were advised to attend orthopedic out patient department (OPD) weekly. At each visit, the fixator was checked and tightened; the pin sites were inspected and cleaned. Joints were examined for contracture and range of movement. X-rays were taken to ascertain the continuing distraction and alignment of bony segments.

RESULTS

Out of 35 patients, 25 were male and 10 were females. Their ages ranged from 18 years to

MINOR COMPLICATIONS

Minor Complications	Group-I (n=17)	Group-II (n=14)	Group-III (n=4)	Total (n=35)	
				number	%
Pin tract infection superficial	07	01	02	10	28.6
Pin tract infection deep	07	07	03	17	48.6
Edema	08	05	03	16	45.7
Pain control problem	03	04	02	09	25.7
Transient knee stiffness	13	08	03	24	68.6
Neuro praxia	03	01	01	05	14.3
Pin loosening	06	04	04	14	40
Ugly/Hypertrophic scar	02	01	01	04	11.4
Turning of nuts in wrong direction	02	02	--	04	11.4
Tendon impalement	03	01	--	04	11.4
Depression	08	10	03	21	60

Table 3

50 years with a mean of 29.3 years.

All these patients under going limb lengthening procedure were categorized in the following three groups for the purpose of better follow up and meaningful results.

Group1: Included 17 (48.6%) patients who needed tibial lengthening only with or without deformity correction.

Group II: Included 14 (40%) patients who required only femoral lengthening with or without deformity correction.

Group III: Included 04 (11.4%) patients who required both tibial and femoral lengthening with or without deformity correction.

Majority of the patients (40%) belonged to the category in which lengthening was done along with bone transport to cover the bone loss. Next was the group in which only lengthening was done (35%). The etiology of limb length discrepancy was Post traumatic mal-union (37%), Non-union with bone loss (26%), Poliomyelitis (17%), Fire Arm Injury with bone loss (14%) and Pseudoarthrosis (6%).

A total of 86 secondary procedures were carried out apart from primary procedures. Some of these procedures were carried out in out-patients, like minor adjustments, but most of them required hospitalization. The most common secondary procedures were the re-adjustment of pin in 17 and repeat corticotomy in 10 patients. (Table 1)

The healing index calculated by dividing the total number of days the fixator was in place by total lengthening achieved ranging from 32 days to 40 days per centimeter. In case of tibial lengthening (Group I) it was 34 days per centimeter whereas in case of femoral (group II) it was 40 days per centimeter. Where both femoral and tibia lengthening were carried out it came down to 32 days per centimeter.

The results were divided into Bone-results and Functional-results according to the Association for the Study and Application of the Methods of Ilizarov (ASAMI) scoring system. (Table 2)

Bone Result

Thirty patients had developed union and consolidation of regenerate in the first instance. Accordingly bone results were excellent in 17 (49%) patients, good in 14(40%) patients and poor in 4(11%). (Figure 1)

Functional Result

All the 35 patients were able to return to work or activity they were doing prior to treatment, eleven patients (Figure 1) had stiffness of either knee or ankle and four patients had soft tissue atrophy. Five patients had persistent pain, which interfered with activity and sleep. According to ASAMI scoring system the functional results were excellent in 14(40%) patients, good in 20(57%) patients and fair in 1(3%) patient.

Complications were divided into minor which responded to non-operative treatment and did not result in any lasting sequelae and major which required an operative procedure to correct it and which resulted in prolongation of treatment or a compromised outcome or a lasting sequelae. A total of 207 complication occurred in 39 segments in which128 were minor (Table 3) and 79 were major complication (Table 4).

MAJOR COMPLICATIONS

Minor Complications	Group-I (n=17)	Group-II (n=14)	Group-III (n=4)	Total (n=35)	
				number	%
Post Fixation Fracture Through pin site post lengthening	–	04	–	04	11.4
Collapse of regenerate	–	–	02	02	5.7
Premature consolidation	07	02	04	13	37.1
Non-union delayed /consolidation	04	–	–	04	11.4
Mal-alignment	03	04	01	08	22.9
Angulations	11	03	05	19	54.3
JOINT SUBLUXATION					
Knee	01	–	01	02	5.7
Hip	–	–	01	01	2.9
JOINT DISLOCATION					
Patella femoral	02	–	–	02	5.7
superior tibia fibular	–	–	–	–	–
CONTRACTURE					
Knee	06	03	06	15	42.9
Hip	–	–	01	01	–
Equinus foot	07	–	01	08	22.9

Table 4

DISCUSSION

The average age of the patient in this study was 27 years which is a little higher than in most of the national and international studies. [9,10] The most common case of limb lengthening discrepancy was post traumatic condition either with mal-union or bone loss (37%). Firearm injury with bone loss was the cause of lower limb length discrepancy in 5 (14%) patients. Kenwright and his colleagues in 1991 reported previous fracture and epiphyseal injuries as a cause of lower limb length discrepancy majority of their patients [11]. Poliomyelitis and its sequelae are still predominant in our community. Six of our patients (17%) had post polio paralysis as a cause of the lower limb lengthening.

Almost all patients who had limb length inequality had some sort of associated deformity. This showed limb length discrepancy rarely occurs in isolation; mostly it is associated with one or other limb deformity. The most frequent deformity encountered with limb length discrepancy was the flexion contracture knee (20%) though hip contracture (10%) and equines foot (10%) were also of common occurrence. These deformities seem to develop mainly due to defective gait in the presence of long standing shortening.[12]

Average lengthening achieved in Group-I was 4.8cm, in Group-II it was 3.8cm and in Group-III it was 7cm. There were two cases in Group-III where only one segment was short (femur in both cases) but both tibia and femur were lengthened as the over all shortening was more than 5cm (5.5cm in one case and 7cm in other). This was because lengthening of more than 5cm in single segment has been reported to be associated with high rate of complications.[11]

A total of 207 complications occurred in 39 bone segments. This means that the complication rate was 5.3 per segment including both minor and major complications. The rate of complication is higher than reported in literature.[13-14]

The most common complication is 49% while it is 40.2% in Pasha et al[15] and 38% in Iqbal et al[16] study. In our study malalignment was 23% and angulation was 55% while Sangkaew[7] reported malalignment in 5.7% of patient using monlateral conventional external fixator. In our study equinus deformity of foot was found to be 23% while in Pasha et al[15] study it is 13.3% and in Iqbal et al[16] study it is 7.7%. Joint sublaxation especially at knee can be minimized by avoiding significant simultaneous femoral and tibial lengthening and by maintaining the joint in full extension.

In our study one centimeter (cm) lengthening in Group I took 34 days, in group II 40 days and in group III took 32 days while Pasha et al[15] reported 62 days per cm and Iqbal et al[16] reported 42.8 days per cm by using "Naseer and

Awais" fixator. Dendrinos et al[17] reported 46 days per cm by Using Ilizarov fixator.

A total of 86 secondary procedures were carried out on 35 patients with the frequency of about 2 procedures per patient. Some of the procedures were carried out to correct the associated deformities.

Although we encountered many complications both minor and major during our study period the end results both in terms of bony and functional results are satisfactory and are comparable to most international studies.[18-21]

CONCLUSION

Lower limb length discrepancy is a functional and cosmetic problem and needs correction with modern limb lengthening procedures. The common causes of limb length discrepancy in our community are post traumatic condition and firearm injuries resulting in bone loss. Poliomyelitis is still a common cause of limb length inequality in our country. The outcome of Wagner method for limb lengthening is excellent in over 80% of cases both in terms of bony and functional results.The key to successful outcome are proper patient selection, detailed preoperative patient evaluation, including clinical and x-ray examination and expertise of surgeon. The other important considerations are proper preoperative explanation of the procedure to the patient. Due to over zealous expectations on the part of patient sometimes results are dissatisfaction with the outcome and frequent secondary procedures are required during the process.

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