ORIGINAL RESEARCH PAPER

Volume-8 | Issue-3 | March-2019 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

STUDY ON LIMB RECONSTRUCTION SYSTEM AND ITS OUTCOME ON TREATMENT OF NONUNION LONG BONE FRACTURE

Orthopaedics

Dr. K. Ravichandran M.S Associate professor of Orthopaedics, Govt.Sivagangai medical college, sivagangai, Tamilnadu

Dr. S. Ramanathan* M.S Associate professor of Orthopaedics, Govt.Sivagangai medical college, sivagangai, Tamilnadu *Corresponding author

ABSTRACT

The aim of the study is to analyze the outcome of treatment of infected Nonunion of long bones using limb reconstruction system and to reveal its real usefulness Nonunion is diagnosed, until clinical or radiographic evidence shows healing has ceased and that union is highly improbable. Nonunion is defined as "established when a minimum of 9 months has elapsed since injury and the fracture shows no visible progressive signs of healing for 3 months This is a prospective and retrospective study which consists of 30 cases in the age range from 20 yrs to 65 yrs Patients who were lost to follow up were not included in this study. Our institution approved our treatment protocols and all patients gave written informed consent. ASAMI' criteria were used to analyze the results in our study. In this study we conducted, we could achieve a success rate of 80%, giving good encouraging results to most of our patients. Hence we conclude that the Indian version of the Limb reconstruction system is effective and convenient method for the treatment of infected nonunion of long bones. This can also be used to correct the limb length discrepancies simultaneously, which can arise during the course of the treatment.

KEYWORDS

fracture,non-union,limb reconstruction, outcomes

1.INTRODUCTION

Nonunion is diagnosed, until clinical or radiographic evidence shows healing has ceased and that union is highly improbable. Nonunion is defined as "established when a minimum of 9 months has elapsed since injury and the fracture shows no visible progressive signs of healing for 3 months." This criterion cannot be applied to every fracture, however A fracture of the shaft of a long bone should not be considered a nonunion until at least 6 months after the injury because often union requires more time, especially after some local complication, such as an infection.Although the exact causes of delayed union and nonunion are unknown systemic and local factors are thought to contribute to their development. Systemic factors include the patient's metabolic and nutritional status, general health , and activity level. The use of tobacco has been implicated in the development of nonunions. Castillo et al.[1] found that nicotine decreased vascularization at fracture sites and increased the chances for the development of osteomyelitis. Kyro et al.[2] reported an increase in nonunions of the tibia in patients who smoked compared with nonsmokers. Hak et al.[3] reported that tobacco use had a detrimental impact on the success of exchange reamed intramedullary nailing of femoral shaft nonunions and delayed unions. It has been shown that smokers have a decreased oxygen level in the cutaneous and subcutaneous tissues, which leads to poor wound healing. Even though approximately 50% of smokers return to their habit, it is best for healing of bone and soft tissue if they can abstain while being treated for their injury. Additionally, nonsteroidal antiinflammatory drugs (NSAIDs) have been found to decrease fracture healing in multiple animal studies. Several studies have found delayed healing in human subjects who were taking NSAIDs, whereas many other studies refute the hypothesis that NSAIDs delay fracture healing. At best, the literature is still conflicting concerning the influence of NSAIDs on fracture healing. We suggest that patients with a delayed union or nonunion abstain from using NSAIDs or steroids, if possible, during their fracture treatment. Boyd, Lipinski, and Wiley found in their review that local factors play a main role in management of nonunions of long bones Heppenstall et al., in a study of 185 nonunions of the tibia, found that 92.4% had an initial delay in weight bearing of more than 6 weeks. The severity of the trauma, infected open injuries, an intact fibula, and fracture in the distal third of the tibia also were important factors in the development of nonunion in their series. Infected nonunion of long bones are not only a source of functional disability but also can lead to financial burden to the patients. Infected nonunion13, 32 has been defined as a state of failure of union with persistent infection for a period of 6 to 8 months at the fracture site. Infected nonunion can develop as a result of open fracture, after a previous open reduction and internal fixation (ORIF), or as sequelae to chronic hematogenous osteomyelitis. The incidence also seems to be increasing especially in view of increasing high velocity trauma, which is more frequently treated with internal fixation. Biomechanical stability and biological vitality of the bone, are the cornerstone of bone healing as they provide an environment in which new bone can be formed. According to AO manual 44, External fixator is considered as the standard method of fixation in infected nonunion. Internal fixation is deferred in case of infected nonunion for the fear of persistence/recurrence of infection. The limb reconstruction system is an unilateral external fixator system. With the frequent association of infection; bone defect, limb shortening, deformity and soft tissue problems with atrophic non-union makes limb reconstruction system , an attractive option for skeletal stabilization.

2.AIM OF STUDY

The aim of the study is to analyze the outcome of treatment of infected Nonunion of long bones using limb reconstruction system and to reveal its real usefulness.

3.MATERIALS AND METHODS

MATERIALS: This is a prospective and retrospective study conducted at Rajiv Gandhi Govt. General hospital ,Chennai which consists of 30 cases in the age range from 20 yrs to 65 yrs (with a mean age of 35.6 yrs.) who were treated at our institution.Patients who were lost to follow up were not included in this study. Our institution approved our treatment protocols and all patients gave written informed consent.There were 26 males and 4 females in our study with male to female ratio of 6.5:1These infected nonunion were classified by the AO Classification 15, 44. In our study, According to this classification we had Infected quiescent non- draining nonunion – 6 casesInfected active non-draining nonunion– 6 casesInfected draining nonunion –18 cases.Patients with wounds that had no discharge for 3 months were labeled as non-draining (Quiescent). Infection was evident by local symptoms and signs like increase warmth, redness, sinus, fever, etc,.13 patients had infected nonunion of femur, 17 patients had infected nonunion of tibia. Of the 13 cases of femur, 5 had infected nonunion after ORIF with nail/pate for closed fractures, 4 had infected nonunion which occurred after open fractures and subsequent native treatment, and 4 had infected nonunion following treatment of open fracture with AO externalfixator system. Among the 17 cases of tibia, 4 patients had infected nonunion after ORIF for closed fracture, 9 infected nonunion occurred after open fracture ,6 patients had infected draining nonunion. Our follow up period was with a maximum of 18 months to a minimum of 5 months (mean 8.3 months). The bone involved and the type of nonunion, along with the number of cases and age distribution are given in table 1,2,3,4.In Toto, of the 30 cases, infected nonunion resulted from previous surgeries in 9 cases. In 6 cases infected nonunion resulted from improper treatment of the open fracture by native bone setters and in 2 other cases infected nonunion resulted after cast immobilization for Grade 1 open fracture (Gustillo Anderson

classification), and 13 cases of Grade III b open fractures treated with external fixator initially. Diagnosis was established by history physical examination and investigations like erythrocyte sedimentation, total and differential white blood cell count, pus culture sensitivity and standard AP, LATERAL X-rays. History is taken from the patient including the date of injury, detail of original accident and subsequent treatment. Special attention was focused on limb length measurements, range of motion ofthe joints, neuromuscular status and distal vascularity. 9 cases of infected non-union

METHODS:

The cost of the original Limb reconstruction system is high. The price is beyond the reach of our patients. Various Indian versions of Limb reconstruction system have been introduced in the recent past, which is much cheaper than the original and is available at an affordable price for the patients. We did not come across gross deformity as most of the cases in our study have had previous surgeries and the problem was mainly infected nonunion with minimal deformity. The most common organism isolated from draining nonunion was staphylococcus, other than that pseudomonas, proteus, klebsiella were also isolated in different cases. Based on the culture report specific antibiotics were chosen and given to patients. Antibiotics have always been considered as complementary to surgery.

ANAESTHESIA:

Spinal anesthesia is preferred for lower limb surgeries.The appropriate parenteral antibiotics, which the patient has been taking preoperatively for infection, are administered before the start of the surgery and continued post operatively.Through previous scar if surgery has been done already, thorough wound debridement and excision of the infected soft tissue and necrotic bone till fresh bleeding appeared(Paprika sign.)39, was done. The sinus tract, infected soft tissue, and unhealthy granulation tissues was excised and sent for histopathological and culture study. The medullary canal was opened on either side by gentle reaming. Monolateral external fixator was applied following this. The most distal and the proximal screws were applied first and tightened after making sure that the limb is in proper alignment and rotation, remaining screws were passed subsequently. In all the cases acute docking was done at the nonunion site and compression given. The operative field was thoroughly irrigated and wound closed by staysutures. In some of the cases drain was kept, which was removed after 48 hrs.In four cases there was wound dehiscence, which healed after skin grafting after the formation of healthy granulation tissue. In 23 of our cases the shortening was ranges from 1 to 4 cms (mean 1.44 cms.) acute docking was done at the debrided site and osteotomy was performed distal to the tibial tuberosity at the proximal metaphyseal area for tibia and osteotomy for femur at the proximal third by means of separate set of instruments so as to prevent introducing infection at the osteotomy site. An open approach is made to perform corticotomy by means of multiple drill holes which is made complete by osteotome. Attention should bepaid to preserving periosteum because it has a major role in osteogenesis. Segmental resection of fibula was done in leg to allow acute docking. Distraction was started on the 7 th post operative day1, 32. For femur the fixator was always applied11, 44 to the lateral aspect, for the tibia the fixator was always applied to the medial aspect . In the hospital the distraction was done by the surgeon and afterdischarge from the hospital this was done by the patient or his relatives. To know the exact direction of rotating the key the patients asked to mark with marker over the compression and distraction set.. In all of the cases after debridement acute docking was done at the nonunion sites, as the maximum amount of bone loss we encountered was 5 cms. Distraction was carried on for a period of minimum 34 days to a maximum of 58 days (mean 46.6 days). The length of bone gained wasfrom 3 to 5 cms. (Mean 4.2 cms.). In some of the cases supplementary procedures like skin grafting, flap cover, revision of pins and bone grafting were carried out.In spite of through debridement and antibiotics, infection did not get controlled in 8 cases.POST-OPERATIVE PROTOCOL:Post operatively, the limb is kept elevated to reduce the post-operative edema. The ankle is splinted in neutral position. Drain is removed after 48 hrs. Parenteral antibiotics were continued for 2 weeks post operatively or till the subsidence of infection and then oral antibiotics were given for an additional 2 weeks. Joint motion exercises and non-weight bearing followed for 4 weeks and then partial weight bearing was advised. Distraction was carried at the rate of 0.25 mm fourtimes a day, which was started from the 7 th postoperative day1, 32. Radiograph was taken every week during the initial period of distraction and at monthly interval thereafter. On discharge, all patients were taught about pin site care, hygiene and the rhythm of distraction where lengthening procedure was carried out. The patients were followed in the out patient department, whereassessment of clinical and radiological progress was made. The rate of distraction was altered based on the radiographic appearance of the regenerate. In all cases compression at the nonunion site was maintained till union. Poor consolidation of the regenerate was treated by encouraging weight bearing and alternate compression –distraction (Accordion technique) 32. The distraction wasstopped when sufficient gain of length has been achieved. The fixator was left in position for a further period to allow consolidation of callus. In six cases, in spite of successful docking and control of infection, there were no signs of radiological union; iliac graft was applied at the docking site. Our criteria for radiological union22 are the presence of bony consolidation in three out of four cortices in AP and Lateral x-rays. When this is achieved, the patient is examined clinically and the fixator is removed. After removal of the fixator patient is advised to use functional cast brace and crutches for lower limb for a period of 6 weeks during which the patient is gradually mobilized to full weight bearing.

4.RESULTS

we had the opportunity to treat 30 cases of infected non-union with Limb reconstruction system. Of the 30 patients 19(73.3%) patients developed infected nonunion following open fracture and 11 patients (26.6%) developed infected nonunion following previous implant surgeries for closed fractures.Union time ranged from 4 to 8 months (mean 4.9 months). Sinus tract got cleared in all cases except 6 where the sinus tracts were multiple and there was no progression towards union in those cases. There was no difficulty in this series as far as transportation of bone. There was considerable delay in the consolidation phase in all cases. Out of 30 cases 12 cases had pin tract infection (40%). For wound dehiscence in the post operative period, split skin graft cover was given in 6 cases. During transportation phase in bone lengthening procedure there was pin tract infection and loosening in two cases for which pin revision was done. In all cases there were no infection at the corticotomy site. After a period of waiting for consolidation to occur, the final result of the healing of the osteotomy was adequate in all 9 cases. The cases with limb length discrepancy up to 2.5 cms in lower limb managed with modified footwear with heel and sole raise. The results were divided into bony results and functional results, according to the classification of the ASAMI 1,15 (Association for the study and application of the method of Ilizarov). ASAMI'S criteria were used to analyze the results in our study, as there were no specific criteria available in the literature for assessing the results after treatment with Limb reconstruction system fixator.

BONE RESULTS:

The bone results were determined according to ASAMI'S criteria as follows:

(1) Union
(2) Infection
(3) Deformity
(4) Leg length discrepancy.

BONE UNION RESULTS:

E-Excellent -Union + No Infection+ Deformity<7 degrees+ Shortening<2.5cms.
G-Good - Union + any TWO of the above factors.
F –Fair -Union+ any ONE of the above factors.
P-Poor -No union/Refracture/none of the above factors.
According to these criteria the bone result in our study was
Excellent - 8 cases
Good - 8cases
Fair - 6cases
Poor - 8 cases.

FUNCTIONAL RESULTS:

The functional results were based on five criteria 1,15:

(1) A noteworthy limp
(2) Stiffness of either the knee or ankle (loss of more than 15 degrees of full extension of the knee or of 15 degrees of dorsiflexion of the ankle in comparison with the normal contra lateral side)
(3) Soft tissue sympathetic dystrophy
(4) Pain that reduced activity or disturbed sleep and
(5) Inactivity (unemployment or an inability to return to daily activities because of injury.)

Functional results– limp, equinus, ankle rigidity, soft tissue deformity,

pain & inactivity
Excellent -active + no other
Good -active + 1 or 2
Fair - active + 3 or 4
Poor - inactive irrespective of whether other criteria were applicable.
According to these criteria the functional result was
Excellent - 10 cases
Good - 7 cases
Fair - 8 cases
Poor - 5 cases.
There was no neurological or vascular injury as a result of instrumentation.

5.DISCUSSION & CONCLUSION

The goal of treating infected nonunion is to control the infection, healed aligned and drainage free limb which is functionally better than amputation and artificial prosthesis fitting. Factors considered in reconstruction of long boneIncluding 1.the patient's age, 2. metabolic status,3. mobility of the foot and ankle, 4. Intact neuro-vascular structures and 5. Patient and attenders reassurance & rehabilitation. The bony debridement should be done upto punctate bleeding points observed. The non union site is resected and bony alignment achieved by compression at fracture site. The decision for reconstruction mainly depends upon

1. surgeon's ability to restore a functional limb ,
2. Duration of treatment ,
3. anticipated residual disability.

The functional result is affected by, the condition of thenerves, muscles, vessels, joints, and to a lesser extent bone. The nonunion site united in 24 out of 30 cases (80%), which is comparable to the study conducted by Eduardo Garcia et al16 in 2004 wherein the bony union result was 86.7%. Antonio Biasibetti in his study had a success rate of 93%. In long-term study of tibial fractures, Merchant and dietz 9 determined that angular deformities of 10 to 15 degrees are well tolerated. Leg length discrepancy of up to 2.5 cms does not require any treatment, 5to 6 degrees of tilt is acceptable. Likewise minimal translation in the mechanical axis is acceptable. (Range of acceptability unknown)Pin tract infection occurred in 12 out of 30 cases (40%), which is comparable to the study conducted by Gopal.S et al20 ,[4] where the reported pin tract infection was in ten out of 19 cases (53%). In another study by J.R Coll [5]the reported pin tract infection was 30%. Hence the rate of pin tract infection remained high in our study. Bone transport resulted in a better restoration of limb length discrepancy in lower limbs. Larger bone defects can be tackled with two level corticotomies. Our experience is only with single level corticotomy. Some of the patients who had shortening of more than 1 cm of lower limb did not give consent for limb lengthening procedure which was planned after evidence of union at the nonunion site. The mean limb length discrepancy noted in our study was 4 cm . In a study of 26 cases of infected nonunion conducted by Eduardo et al[6] Bone grafts can be added, after infection settles at the nonunion site. Graft can also be added to theregenerate site if progression towards consolidation is slow as quoted in the literature3. The Limb reconstruction system is a telescopic device that can be locked for rigid fixation or unlocked to permit load sharing. Even though the cost of the fixator is high, the patients because of the following reasons accept it: Light weight, patient friendly, day to-day activities can be done easily, Since the pins are unilateral it is much more comfortable for the patients, hence joint mobilization can be done with ease. Being rigid6, early weight bearing can be allowed with the device. Patient themselves can lengthen very easily. More over plastic surgery procedures like cross leg flap, Fascio-cutaneous flap and skin grafting can be done comfortably. Once the patients have been taught about how to do distraction they are advised to come for review once in 15 days to asses the length gained and also to asses the quality of the regenerate. Moreover the fixator (other than the tapered half pins) can be reused for another patient provided there is no damage to the apparatus. The disadvantages include the high cost of the system, inability to use the apparatus for correction of infected nonunion with gross deformity, in severe osteoporosis, stabilization very close to a joint, for which Ilizarov fixator could be a better option. The cost factor has been reasonably managed by the introduction of Indian version of Limb reconstruction system . Compared with the Ilizarov ring fixator11 the unilateral external fixator is simpler to apply and better tolerated by the patients. The learning curve for implementation of the unilateral fixator is less steep than that encountered with the Ilizarov fixator.[6]In this study we conducted, we could achieve a success rate of 80%, giving good encouraging results to most of our patients. Hence we conclude that the Indian version of the Limb reconstruction system is effective and convenient method for the treatment of infected nonunion of long bones. This can also be used to correct the limb length discrepancies simultaneously, which can arise during the course of the treatment. Patient with poor cooperation are not good candidates for this technique, which requires wearing the frame for a long time, with probably additional secondary surgical procedure.

6.REFERENCES :

1. Castillo cv, Choon DS, The treatment of open tibial fractures and of tibial nonunion with a novel external fixator:Injury.2002 Nov; 33(9): 829-34.
2. Kyro et al; Treatment of femoral nonunion by cyclic compression and distraction CORR No. 436,pp. 222-228, 2005.
3. Hak HJ, Mann JW.Experience with the orthofix device for limb lengthening; Orthop clin North Am. 1991 Oct; 22(4): 651-61.
4. Gopal .S, S.Majumder; The radical orthopaedic and plastic treatment of severe open fractures of the tibia: JBJS Vol 82-B, No.7 sep 2000.
5. Coll JR, Lawton JO: Clinical results and cost effectiveness of external fixation J R Coll Surg Edinb. 1995 Oct; 40(5): 344-6.
6. Eduardo Garcia-Cimbrelo et al; Circular external fixation in tibial nonunions. Clin orthop. No.419, Feb 2004