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ORIGINAL ARTICLE

Study to Evaluate the Treatment Options and Clinical Outcomes of Nonunion of Long Bones

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ABSTRACT

Introduction and Objective: Nonunion is a significant fracture condition. Non-union management has proven a continual challenge. The care is complicated by the accompanying bone defect, shortening, deformity, and infection. This study aimed to evaluate the treatment options and clinical outcomes of non-union in long bones.

Material and Methodology: A prospective study was conducted on 31 patients with non-union of long bones admitted to an orthopedic ward in Bilawal Medical college Jamshoro.at BMCH Kotri0 Pakistan between July 2019 to July 2021. Nonunion of the tibia was reported in most patients, followed by non-union of the femur. A thorough medical history was taken, and a clinical and radiological evaluation. The diagnosis was confirmed, and a treatment plan was devised and implemented.

Results: Out of 31 treated patients, 22 were males. Mean age was observed. 40.19 ± 6.43. In this study, 58.08 % (n=18) of the patients had closed fractures, 61.30 % (n=19) were of the movable type of non-union. This study's most prevalent treatment technique was a fixation with nail plus cortico-cancellous bone grafting, used in 51.61% (n=16) patients, followed by fixation with plate plus bone grafting in 29.03% (n=09). Clinically Excellent results were observed in 28.57 % of the cases. Good results were reported in 32.14% of patients, satisfactory in 35.71% cases, and poor results in 3.57%.

Conclusion: Corticocancellous bone grafting with fixation is the most common method for treating Non-Unions. Most cases are managed and treated with an excellent or good outcome.

Keywords: Nonunion, Fracture, Bone grafting

INTRODUCTION

Nonunion is difficult to define precisely. According to the US FDA classification, a non-union is defined as a fracture that remains ununited 9 months after injury or one that has failed to progress toward union over the prior three months. Nonunion is a significant fracture condition. Non-union management has proven a continual challenge. The care is complex by the accompanying bone defect, shortening, deformity, and infection[1] Major injuries are no longer associated with twentieth-century battlefields. The fast advancement of modes of transportation, industrialization, and machine farming in the twenty-first century has resulted in a multifold increase in accidents.

High-energy trauma that causes the significant bone and soft tissue damage, along with advances in trauma care, has increased the number of severely injured patients who survive[2] This is thought to be linked to a higher rate of delayed and non-union of long-bone fractures[3] The FDA panel defines non-union as occurring after a minimum of 9 months has passed since the accident, and the fracture has shown no apparent indications of healing for three months. The criterion, however, cannot be applied to all fractures. Rather than being constrained by a time-frame-based definition of non-union, today's surgeons have realised that earlier and more aggressive treatment is required. 3 to 5 months following fracture surgery, surgical intervention is usually recommended if serial radiography shows no evidence of healing[4,5]

Nonunion can be diagnosed by abnormal mobility, the absence of transmitted movements, continuous disability at the fracture site with the loss of function of the part, specific radiological findings of various types of non-union, and histological changes at the fracture site suggesting fibrous tissue[6]

Intervening extensive gap (gap non-union), loss of blood supply, ischemia/damage to surrounding muscle, abnormal biomechanics, infection, extensive comminution, improperly applied fixation devices, individual bone susceptibility, insufficient immobilisation, iatrogenic factors, interposition of soft tissue, immunological factors, instability, and metabolic disturbances are the most common causes of non-union. Cigarette smoking has been shown to increase the likelihood of delayed healing or non-union in patients[7,8] Non-union occurs in 5 to 10% of all long bone fractures[9,10] Tibia is the most common location of non-union in long bone fractures, followed by the femur, humerus, and forearm, respectively[11,12]

In general, the complexity of non-union treatment increases as the number of non-union components (infection, deformity, shortening, bone defect) grows[13] Nonunion can be treated in a variety of ways, each with its own set of risks and benefits[14,15] The method selected should generally leave as many options open as feasible. Non-union operations are time-consuming and should only be recommended after non-union has been shown clinically and radiologically, and when union is unachievable without a change in treatment. Hypertrophic non-union can generally be treated with stable fracture repair, whereas atrophic non-union necessitates bone grafting and refreshing[16] Autologous bone grafting electrical stimulation, open reduction and fixation, percutaneous bone marrow injection, and external ring fixation are some of the therapy options for non-union[17] This study aims to observe the treatment modalities of long bone non-union and clinical outcomes.

MATERIALS AND PROCEDURES

The current study is a prospective study of 59 individuals with non-union of long bones, admitted orthopedic ward in Bilawal Medical college Jamshoro.at BMCH Kotri Pakistan between July 2020 to July 2021. All patients were included in this study if long bone fractures showed no obvious indications of healing after three months. Patients with pathological fractures, primary or secondary tumours, and congenital pseudoarthrosis were excluded from the study.

All of the patients were clinically assessed, focusing on local skin conditions and neurovascular involvement. Anterior, rear, and lateral views of standard X-rays were taken and examined. Patients were thoroughly investigated for operational and anaesthetic purposes. Pre-operatively patient and relatives were counselled on the treatment strategy, potential complications, prognosis, and outcome. The patient's consent for surgery and the research study was obtained. Patients were thoroughly assessed, and a treatment strategy was planned. Team of Orthopaedic surgeons along with technicians performed the surgical procedure.

All of the surgeries were performed in a sterile operating room with strict aseptic techniques. Depending on the procedure, either spinal anesthetic or regional block anesthesia was used. Patients were placed on an operating table and had their joints painted and draped for free movement. The fracture non-union site was accessed using normal incision and surgical procedures. The soft tissue at the ends of the bones was removed, and the callus was refreshed to create a bleeding zone. The medullary canal was opened, and the reduction was achieved. The implants were fixed and evaluated for stability using normal surgical techniques. Slices of cortico cancellous bone graft from the iliac crest were obtained and implanted at the non-union location. The dressing was done after the incisions were closed in layers. During the course of the current study total 31 patients of non- union of long bones were treated.

Post-operative treatment included using posterior slabs as necessary, intravenous antibiotics forc five days, and injectable analgesics for the first three days. On the second day, static quadriceps workouts for neighboring joints were begun. On the fifth postoperative day, check dressings were applied, and infections were ruled out. After the fifth day of surgery, oral antibiotics were given until the wound healed. On the 10th to 12th post-operative day, sutures were removed, and casts were applied as needed.

Patients were dismissed with instructions to return in 6 weeks for a follow-up appointment. At the last follow-up, the final evaluation was completed. Clinical union, deformity, shortening, mobility of adjacent joints, and consequences were all mentioned. The results were divided into four categories: excellent, satisfactory, good, and poor.

RESULTS

In total, 37 cases of non-union were reported to the orthopedics department, six of which were lost in follow-up after initial diagnosis. The remaining 31 cases were given appropriate operational therapy and were followed up regularly. Males were 70.96 (n=22) of the total. The patients ranged in age from 15 to 70 years old. The majority of patients were between 21 and 40 years (n=14, 45.16%). The Mean age of the patients was 40.19 ± 6.43.

Table 1: Demographic Characteristics of Patients

Variable	Frequency (n=31)	Percent
Gender		
Male	22	70.96%
Female	9	29.03%
Age Group (in years)		
<20	2	6.45%
20 to 40	14	45.16%
40 to 60	9	29.03%
>60	6	19.35%

The most prevalent cause of the trauma was due to vehicle accidents, which occurred in 54.83% (n=17) of the patients, followed by a fall from height in 25.08% (n=08) of the patients. In this study, 58.08 % (n=18) of the patients had closed fractures, whereas the remaining had open fractures. We observed that 61.30 % (n=19) were of the movable type of non-union, while the rest were of the stiff type. (Table 2)

Table 2: Mode of Trauma, Clinical Type and Nature of Injury

Mode of trauma		
Vehicular Accident	17	54.83%
Fall From Height	08	25.08%
Assault or Direct Trauma	06	19.35% Clinical Types
Mobile Non-Union	19	61.29%
Stiff Non-Union	18	38.70 Nature of Injury
Closed Fracture	13	58.06%
Open Tracture		41.93%

This study's most prevalent treatment technique was a fixation with nail plus cortico-cancellous bone grafting, used in 51.61% (n=16) patients, followed by fixation with plate plus bone grafting in 29.03% (n=09). Other treatment techniques employed in this study included ring fixator application, simple external fixator patients, bone grafting alone, and tibialisation of the fibula. (Table 3).In this study, we observed that iatrogenic non-union was the most common cause of non-union, accounting for 35.48 % (n=11) of the cases, followed by soft tissue interposition and unstable fracture. (Table 3)

In 28 out of 31 patients, the union was accomplished. Because one patient had less than a three- month follow-up, one patient was still in a state of non-union, and one patient had an above-knee amputation. Thus they were eliminated from the study. The majority of patients, 71.43 (n=20) demonstrated fracture union in 3 to 6 months. However, 7.14 % (n=2) of cases took longer than 14 months to heal. In this study, complications have been recorded that included surface infection in 2 patients, deep infection in 1, neighboring joint stiffness in 5, and limb shortening of more than 1 inch in 4 patients. Other problems such as non-union, amputation, and a nail in the joint were reported in 1 of the cases. Clinically Exccelent results were observed in 28.57 % (n=8) of the cases.Good results were reported in 32.14% (n=9) patients, satisfactory in 35.71% (n=10) cases , and poor results in 3.57% (n=1) . (Table 4).

DISCUSSION

In the current study, the most common treatment option for managing non-union is Corticocancellous bone grafting with fixation either with nail or plating. Moreover, more than 60% of the patients reported good or excellent outcomes.In our study, a higher number of males were present. Moreover, the mean age of the patient was around 40 years. In another study performed in Pakistan, we observed similar findings[18]

Another study also reported that Non-union fractures are more prevalent in males[10] In our investigation, most of the patients experienced fractures due to a motor vehicle or road traffic accident, indicating an elevated accident rate. Similar findings were observed in a study performed in Pakistan[19] The same pattern is reported by Indian research, where motor vehicle accident was the most common cause of fracture and the second most common cause was fall from height, reported in 60% and 20% of the cases, respectively[20]

We found that more than 60% of the patients reported excellent or good clinical outcomes in the current study. Different studies reported more or less similar findings. Haque reported excellent outcomes in 80% of the cases[20] One more study reported that the clinical outcomes were excellent in 55% of patients, good in 30%, fair in 5%, and poor in 10% of the case[21] Another study's results are also in agreement with the results of the current study[22] We found that more than 70% of the patient's reunion occurred within six months in the current study. Reunion depends upon multiple factors. Similarly, non-union is also associated with smoking, infection, amount of damage to soft tissues and articular cartilage, the accuracy of reduction, the stability of the joint, the stability of fixation, and the overall alignment of the limb. [23] Similar findings are also mentioned in the literature[23,24]

Complications like infection, stiffness of the adjacent joint, shortening of the limb, etc., have been observed in our study. Previous studies have also reported complications after treating or managing non-union fractures[1,25,26] In our analysis, most patients had an iatrogenic etiology of non-union. Soft tissue interposition was identified in 11 cases. Unstable fractures, gap non-union, and wide displacement without treatment were also reported in our study. These findings are consistent with the finding of a previous study[22]

Fast and modern living are epidemiological factors in the host. High-velocity accidents with severe bone and soft tissue damage are epidemiological elements of the agent, while epidemiological variables of the environment include increased surgical management with soft tissue neglect. All of these elements appear to play a role in the development of non-union. Nonunion is more common in young males, with the tibia and

femur being the most usually involved bones. Iatrogenic and soft tissue interposition are the two most common causal factors. The most prevalent treatment method was an open reduction, and internal fixation with freshening of bone ends with autologous bone grafting. Proper initial therapy, such as implant selection, increased use of closed fixation, and consideration of soft tissues during surgery to avoid ischemia, may help to reduce the rising incidence of non-union. In our study, the small sample is a limitation. Furthermore, instead of a single-center study, most realistic results will be obtained if it is performed in multi centers.

CONCLUSION

Corticocancellous bone grafting with fixation is the most common method for treating Non-Unions. Most cases are managed and treated with an excellent or good outcome.

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