ANALYSIS OF CAUSES AND TREATMENT MODALITY IN NON-UNION OF LONG BONES DIAPHYSEAL FRACTURES

Abstract

Objective: The purpose of this study was to analyze the causes of nonunion leading to modification in treatment modalities in long bones diaphyseal fractures.

Study Design: Descriptive Study

Place and duration of study: Combined Military Hospital Quetta, Combined Military Hospital Sialkot, Pakistan, from 5th Sep 2005 to 26th Dec 2008.

Patients and Methods: Non-healing long bones diaphyseal fractures > 6 months were included with exclusion of pathological fractures, delayed union < 6 months. Patients general profile and fracture details with non-union causes were recorded. Old failed surgery with re-do surgical intervention was analyzed. Infected cases were treated with removal of implant, thorough debridement, appropriate antibiotics followed by delayed stabilization while non-infected cases with stable fixation and bone grafting.

Results: Out of fifty six patients, tibial fractures were maximum 17 (30.4%), femur 16 (28.6%), radius ulna 15 (26.6%), and humerus 8 (14.3%). Most patients were young 37 (66.07%) and male 48 (85.7%). Road traffic accident caused 43 (76.8%) fractures. Causes of non-union were high energy trauma 37 (66%), insufficient stabilization 31 (55.4%), followed by smoking, soft tissue interposition, poor nutrition, NSAIDs, broken implants, infection, intact fellow bone, multiple segment fracture, repeated manipulation, chronic illness and neuro-vascular impairment in descending order. Plates failed more than K nails. Complications like superficial and deep infection, neuroprexia and delayed healing settled with bone healing in mean time 4.76 months.

Conclusion: Nonunion of long bones diaphyseal fractures can be prevented by avoiding causative agents, early intervention, tissue protection and stable fixation. Interlock nailing is best for femur, good for tibia, may be useful in humerus but not suitable for radius and ulna. Bone graft accelerates healing process. Early re do surgery must be considered because of manageable rate of complications.

Article

INTRODUCTION

Long bones diaphyseal fractures are common in orthopaedic trauma. They are being handled by so many people ranging from expert orthopedic surgeons to bone setters sitting in streets. Presently, success rate of surgery in diaphyseal fractures of long bones have markedly increased in expert hands with modern devices, however failed fracture union is still a major problem in patients operated by inexpert hands with use of inadequate implants. Long bones mean femur, tibia, fibula, humerus, radius and ulna. These provide firm framework to support the body for movements. A union is defined as clinically having no pain, no tenderness, no need of assistance for movement; and radiographically, as trabeculae having passed through the fracture gap or the solid cortical callus having bridged both the fragments. Nonunion is defined as a fracture that has not healed after six months of treatment or repeated surgeries are performed to achieve union. Refractory nonunion of tibia and femur are physically and mentally devastating conditions for the patients and the treatment is challenging for the orthopedic surgeons. By knowing the patho-physiology of non-union of bones we can easily assess the contributing factors. Treating the causative agents will lead to high rate of bone union. Choice of implant depends upon bone affected, site of fracture and type of fracture. However, stable fixation with bone grafting.

MATERIAL AND METHODS

This descriptive study was carried out at CMH Quetta and CMH Sialkot from 5th Sep 2005 to 26th Dec 2008. This study included patients with diaphyseal fractures of femur, tibia, fibula, humerus, radius and ulna, which had shown no clinical and radiological evidence of bone union after 6 months of fracture. The patients unwilling for surgical intervention unfit for anesthesia, patho-physiological fractures, delayed union less than 6 months duration, active infection and fracture calcification, were excluded. Record of patients was kept on pre-designed proforma. Parameters recorded were age and sex of patients, cause of injury, type of fracture, previous treatment, duration of nonunion and type of nonunion (atrophic/ hypertrophic), neuro-vascular deficit before surgery, associated ailments, type of definitive surgery. Mechanical, biological and injury related causes of non-union were analyzed. Infected nonunion were treated with removal of failed implants, thorough debridement, and antibiotic cover, followed by delayed stabilization by implants. In non-infected atrophic or hypertrophic nonunion, bone ends were curetted, stabilization with minimal bone gap at fracture site filled with iliac crest bone graft. Old treatment of fractures was compared with re-do surgeries. Follow-up for bone union and rate of complications was observed for minimum of 1 year, with standardized interval at monthly basis for 6 months and two monthly for next 6 months. Outcome was assessed with regards to superficial and deep infection, time of bone union, range of motion in adjacent joints, shortening, neurovascular injury, complications due to iliac bone grafting, implant failure and delayed/non-union. Union was judged clinically by the absence of pain and on radiograph by the evidence of bridging callus. Data was analyzed using SPSS 13. Descriptive statistics were used to describe the data.

RESULTS

Fifty six patients reported with non-united fractures of diaphysis of long bones that fulfilled the selection criteria. Maximum cases of non-union were of tibia followed by femur, radius-ulna and humerus (Table-1).

Table-1: Data analysis of cases of non-unions in long bones diaphyseal fractures

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Data Segregation</th>
<th>Tibia &amp; Fibula</th>
<th>Humerus</th>
<th>Radius &amp; Ulna</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Age (years)</td>
<td>16</td>
<td>17</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>15-50</td>
<td>5</td>
<td>14</td>
<td>15</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>&gt;50</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>-</td>
<td>13</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>14</td>
<td>15</td>
<td>5</td>
<td>14</td>
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<tr>
<td></td>
<td>Female</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Cause of fracture</td>
<td>GSW</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fall</td>
<td>5</td>
<td>-</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>RTA</td>
<td>12</td>
<td>16</td>
<td>6</td>
<td>9</td>
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<tr>
<td>Type of Fracture</td>
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<td>9</td>
<td>13</td>
<td>7</td>
<td>13</td>
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<tr>
<td></td>
<td>Compound</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Type of Nonunion</td>
<td>Atrophic</td>
<td>13</td>
<td>15</td>
<td>7</td>
<td>12</td>
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<td></td>
<td>Hypertrophic</td>
<td>5</td>
<td>-</td>
<td>5</td>
<td>3</td>
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<tr>
<td>Time of Nonunion (months)</td>
<td>Mean</td>
<td>12.968</td>
<td>10.850</td>
<td>9.75</td>
<td>8.433</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>3.87196</td>
<td>3.52121</td>
<td>3.29502</td>
<td>3.10344</td>
</tr>
</tbody>
</table>

Key: GSW: Gunshot wounds, RTA: Road traffic accident, Upper: Tibia & Fibula, Lower: Radius & Ulna

The young patients (15-50years) had maximum incidence of non-union. Road traffic accident was the leading cause of injury, followed by fall injury and gunshot wounds. Closed fractures were more than open fractures in cases of nonunion. Atrophic nonunion was more than hypertrophic nonunion. It is very difficult to blame one cause leading to non-union; rather there were multiple contributing factors. High energy trauma and insufficient stabilization were two major contributing factors in our series followed by smoking, and soft tissue interposition. (Table-2).

http://www.pafmj.org/showdetails.php?id=4918
In redo surgery, interlock nailing was the mainstay of treatment in femur, and plating in radius-ulna. Plating to nailing ratio in tibia was 10:7, and in humerus was 3:1. The femoral diaphysis near ends was treated with DHS/DCS and dynamization in one case. One of the patients having non-union in ulna was treated by tension band wiring. Bone grafting was added to surgical procedures in 83.5% cases. (Table-3).

Post-operative complications in redo surgery were manageable. All wounds healed at fracture site and graft donor site after two weeks except five patients (8.92%). Three cases developed superficial infection treated by appropriate antibiotics and drainage within three to four weeks. Two cases had deep infection, one settled down after two months and second case received antituberculous treatment after confirmation on tissue histopathology, and settled down after 5 months.

Limb shortening was observed in 4 cases (7.1%), luckily they were all in upper limbs. Two patients developed neuroprexia in radial nerve while operating on humerus, which recovered afterward. All patients regained preoperative range of movements. Two cases (3%) of femur and tibia ended up in delayed union which ultimately settled down with dynamization. Mean union time in all these fractures was 9.76± 1.654 months (range 2-10 months).

**DISCUSSION**

Nonunion is prevented if fractures unite with a minimal gap, adequate stability, and sufficient nutritional supply.2 Incidence of nonunion following post traumatic long bones diaphyseal fractures is reported to be 5-10%.3 In a study by Haque et al causes of long bone fractures were motor vehicle accidents responsible for 60%, and 20% due to fall injuries4. In our study 76.8% cases were of road traffic accident, 16.1% of fall and 7.1% of gunshot wounds. Taitsman et al concluded that open fracture was a risk factor for femoral nonunion but our study showed that only 25% cases of nonunion were of open type5. Nonunion are atrophic or hypertrophic types according to radiological findings. Atrophic nonunion caused by loss of osteogenic power, such as large fracture defect, severe vascular destruction around the fracture site, and infection, in our study 84% of nonunion was of atrophic type3. Many mechanical, biological and injury related causes have been considered responsible for non union, but insufficient stabilization, implant failure, smoking, use of NSAIDs, thin loose nails and infection were also considered important5-7.

In our study insufficient stabilization, poor nutrition, smoking, and high energy injury were main contributing factors. We excluded the infective nonunion in our study, however treated cases were included. We followed the protocol including antibiotic holiday, aggressive surgical debridement, hardware removal, local and systemic antibiotics, with delayed revision open reduction and internal fixation with use of supplemented antibiotics.8 Rate of nonunion of Kuntcher nailing is in between and rate of nonunion after all kinds of intramedullary nailing was 8.5%.6 In our study 7(12.5%) patients of nonunion were because of nail failure. Plating is generally condemned in femur and tibia3. We found failed plates in 23(41.1%) patients.

**CONCLUSION**

The other treatment modalities for non united fractures are percutaneous autologous bone marrow grafting, autologous platelet gel, stromal cell implantation and bone morphogenic protein-7.17-19 The non operative methods such as load bearing, electrical stimulation, ultrasound, or shock wave may be effective; the success rate is generally lower than operative methods.20
High energy trauma and insufficient stabilization were two major contributing factors to non-union of long bones diaphyseal fractures. Expert initial treatment can reduce rate of nonunion. Early redo surgery with stable fixation like interlock nailing in femur, tibia and plating in humerus, radius and ulna with bone grafting can lead to bone union with manageable rate of complications.

Reference