MANAGEMENT OF INFECTED NON-UNION TIBIA
BY INTERCALARY BONE TRANSPORT

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ABSTRACT
Objective: To evaluate the efficacy of Ilizarov ring fixator in treating infected non-union tibia by intercalary bone transport.
Setting: Orthopaedics Unit II at Civil Hospital, Karachi.
Patients: Sixteen patients, all males, aged 20-60 years (mean 32 years), with infected non-union tibia (Lax/Cierny Type IV Osteomyelitis); the commonest cause being open fracture and the commonest site being lower 1/3rd.
Methodology: In infected non-union of tibia with draining sinus, wound swab was sent for culture and sensitivity, and sinogram done. Debridement and sequestrectomy was done, leaving behind a gap ranging from 2-8 cms (mean 4.5 cms) and Ilizarov ring fixator, a transport assembly, applied. A navigation wire was passed through medial malleolus, irrigation system set up and the wound closed in a single layer. Proximal metaphyseal corticotomy was done. Irrigation with 2-3 litres of normal saline with appropriate antibiotic was continued for five days. On the 5th day irrigation system was removed and the transport started. Patients remained on partial weight bearing till soft tissue healing occurred. Transport took place over the navigation wire at the rate of 1mm/day till docking achieved. Full weight bearing was allowed after soft tissue healing; knee and ankle physiotherapy was started from day one. Navigation wire was removed after 2-3 weeks of docking. Follow up ranged from 12-27 months (mean 16 months).
Results: Union was achieved at the docking site in all the cases at the time of frame removal i.e. 8-13 months. The duration of union at docking site ranged from 3.5 months to 6 months (mean 4.5 months). Two patients needed bone graft at the docking site. The regenerate was broken in one case due to fall which was treated in cast. All the patients were satisfied except a 60 years old who had severe osteoarthrosis of knee. Pin tract infection occurred on & off in all the patients; appropriate antibiotic was given. The infection subsided in all the cases except two in whom debridement was followed by application of a local flap.
Conclusion: Intercalary bone transport by Ilizarov ring fixator is the treatment of choice for lax, infected non-union of tibia without leg length discrepancy.

KEY WORDS: Ilizarov Ring Fixator, Infection, Non-Union Tibia, Navigation Wire, External Fixator

INTRODUCTION

Infected non-union and gap non-union are challenges that orthopaedic surgeons have to face globally. By definition, infected non-union is a Cierny IV osteomyelitis, meaning that the fracture is unstable before and after the debridement. Many procedures have been tried to treat this particular problem including radical debridement, flaps, bone grafting, etc. None are satisfactory and the morbidity is high during treatment.

Debridement and sequestrectomy results in large gaps which are difficult to treat with conventional methods. Internal fixation with dynamic compression plate (DCP) or interlocking nail (ILN) is impossible due to the gap at the non-union site, defective quality of bone, and above all the presence of infection. In these conditions external fixator is the treatment of choice, especially the ring fixator of Ilizarov. With this apparatus intercalary bone transport is possible along with soft tissue transport, resulting in elimination of the gap and soft tissue cover without any leg length discrepancy and
stiffness.

In this technique the basic transport assembly consists of two rings in the proximal segment, two rings in the distal segment and one ring in the segment to be transported. Navigation wire is placed, in most of the cases, through the medial malleolus to navigate the transport to the docking site. Proximal metaphyseal corticotomy was done. Irrigation system of the wound with normal saline along with appropriate antibiotic has a definitive role in eradicating the infection. With this techniques resection of infected tissue and sequestrated bone and defect produced by it can be reconstructed. In this study we have attempted to treat the cases of infected non-union by intercalary bone transplant, compression and distraction technique.

**PATIENTS & METHODS**

Sixteen patients, all males aged 20-60 years (mean age 32 years), with infected non-union tibia (Lax/Cierney Type IV osteomyelitis) were treated between March 2004 to June 2006 at the Orthopaedics Unit II of Civil Hospital Karachi. The average duration of infection and non-union was two years. The commonest cause being open fracture of tibia and the commonest site the lower 1/3rd. Wound swab for culture and sensitivity was sent in all the cases and a sinogram was done. After preparation the debridement and sequestrectomy was done and the Ilizarov ring fixator, transport assembly, was applied, leaving behind a gap ranging from 2cms to 8cms (mean 4.5cms). Proximal metaphyseal corticotomy was done and a navigation wire passed through the medial malleolus (Fig.1). Irrigation system was set up and wound closed in a single layer. Irrigation with 2-3 liters of normal saline/day with appropriate antibiotics was continued for five days (Fig.2), after which the irrigation system was removed and transport started. The patient remained on partial weight bearing for about three weeks till soft tissue healing. Appropriate antibiotics were given. Transport took place over the navigation wire at the rate of 1mm/day, till docking was achieved, with full weight bearing (Figs.3 & 4). Knee and ankle physiotherapy was continued from day one. Navigation wire was removed after docking, but the patient remained on frame till the regenerate got consolidated and union occured at the docking site (Fig.5). After frame removal, above knee slab was applied for two weeks without weight bearing and then patellar weight bearing cast for two weeks. Patients were followed-up for atleast six months and advised gait training (Fig.6).

**RESULTS**

Union achieved at docking site in all the cases at the
Table I. Patients’ Data and Duration of Union

<table>
<thead>
<tr>
<th>No.</th>
<th>Age</th>
<th>Site of Non-Union Tibia</th>
<th>No. of Previous Operations</th>
<th>Duration of Union at Docking site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22</td>
<td>Junction of middle and distal 1/3</td>
<td>4</td>
<td>4.5 months</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>Mid-diaphyseal</td>
<td>1</td>
<td>6.0 months</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>Junction of middle and distal 1/3</td>
<td>3</td>
<td>3.6 months</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>Junction of middle and distal 1/3</td>
<td>1</td>
<td>4.4 months</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>Mid-diaphyseal</td>
<td>2</td>
<td>4.9 months</td>
</tr>
<tr>
<td>6</td>
<td>36</td>
<td>Junction of middle and distal 1/3</td>
<td>2</td>
<td>5.4 months</td>
</tr>
<tr>
<td>7</td>
<td>51</td>
<td>Junction of middle and distal 1/3</td>
<td>2</td>
<td>5.2 months</td>
</tr>
<tr>
<td>8</td>
<td>31</td>
<td>Junction of middle and distal 1/3</td>
<td>3</td>
<td>4.8 months</td>
</tr>
<tr>
<td>9</td>
<td>26</td>
<td>Mid-diaphyseal</td>
<td>4</td>
<td>3.5 months</td>
</tr>
<tr>
<td>10</td>
<td>23</td>
<td>Mid-diaphyseal</td>
<td>3</td>
<td>5.4 months</td>
</tr>
<tr>
<td>11</td>
<td>32</td>
<td>Junction of middle and distal 1/3</td>
<td>4</td>
<td>4.3 months</td>
</tr>
<tr>
<td>12</td>
<td>60</td>
<td>Junction of middle and distal 1/3</td>
<td>1</td>
<td>4.9 months</td>
</tr>
<tr>
<td>13</td>
<td>45</td>
<td>Mid-diaphyseal</td>
<td>3</td>
<td>5.8 months</td>
</tr>
<tr>
<td>14</td>
<td>34</td>
<td>Junction of middle and distal 1/3</td>
<td>1</td>
<td>4.9 months</td>
</tr>
<tr>
<td>15</td>
<td>20</td>
<td>Junction of middle and distal 1/3</td>
<td>3</td>
<td>4.0 months</td>
</tr>
<tr>
<td>16</td>
<td>33</td>
<td>Junction of middle and distal 1/3</td>
<td>2</td>
<td>4.7 months</td>
</tr>
</tbody>
</table>

time of frame removal i.e. 8-13 months (Fig.7). The duration of union at docking site ranged from 3.5 months to 6 months (mean 4.5 months) as shown in Table I. Bone grafting was done in two cases at the docking site because of delay in union. The regenerate was broken in one case due to fall which was treated in cast. All the patients were satisfied except a 60 years old male who developed severe osteoarthritis of the knee. Superficial Grade-I pin tract infection was noticed in all the cases on and off which was treated by local care and antibiotics. Infection subsided in all the cases except two in which debridement was done and local flap was
applied.

**DISCUSSION**

Long standing infected non-union and gap non-union is difficult to treat and is a challenging problem for the orthopaedicians. It usually leads to residual deformity, persistent infection, contracture and at worst - a useless limb.\(^2\)

Many methods have been employed to treat this situation e.g. radial debridement, local flaps, muscle flaps, bone grafting, fibriofibrular synostosis, cancellous allograft, fibrin mixed with antibiotics, antibiotic beads, micro vascular flaps and vascularized bone transplants. All have improved results but none has been able to fully solve this clinical situation.\(^9\)

The Ilizarov ring fixator gives an option of compression, distraction and bone transport, and is effective in the treatment of infected non-union of tibia where other types of treatment have failed.\(^10\) Weight bearing and the functioning of the joints while on the treatment is an advantage that cannot be matched by any other technique.

The Ilizarov apparatus is axially elastic and as the weight bearing forces are directly applied to the bone ends, maintaining the weight bearing function of the extremity actually becomes one of the prerequisites for the success of the method. The cyclic axial telescoping mobility, not rigidity, at the non-union or fracture site is an important requirement for the formation of a reparative callus. Ilizarov experimentally showed that when gradual distraction tension stress is applied to the corticotomy site, the vascularity of the entire limb is increased, which in turn enhances the ability of the bone ends to unite.\(^11\)

In a study performed by Tranquilli et al in Italy on 20 patients with non-union of tibia, the result was union in all the cases; mean time of union being 4.5 months.\(^12\) In another study Marsh et al showed union in 40 out of 46 non-union cases treated with Ilizarov method, with a high level of patient satisfaction.\(^13\) Menon and associates also concluded in their study that there is a role of Ilizarov ring fixator with nail retention in resistant long bone diaphyseal non-union and that this method could achieve high union rates where other methods failed.\(^14\)

Several modifications have undergone to increase the efficacy of treatment with Ilizarov method and patient’s acceptability, e.g. Rozbruch et al. used a computer programmable Ilizarov Spatial frame in two cases of hypertrophic non-union of tibia with deformity for which distraction was utilized, yielding noticeable results.\(^9\) The duration of frame application is a disadvantage but when all other treatment modalities have failed, this technique is probably the only alternative and the only hope for many suffering patients, though the patients’ compliance is important for a successful outcome.

**CONCLUSION**

The conclusion derived from this study is that intercalary bone transport by Ilizarov ring fixator is the treatment of choice for lax infected non-union of tibia without leg length discrepancy.

**REFERENCES**


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