Less Invasive Stabilization System for distal femoral fracture an early experience in Bir hospital

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ABSTRACT

INTRODUCTION: Less Invasive Stabilization System (LISS) is an internal fixator that was inserted percutaneous by means of minimally invasive surgical approach so that biological environment of the fracture was preserving as far as possible. The purpose of this presentation is to use of this system in patient of AO 33 distal femoral fracture and evaluate the functional and radiological outcome of these patients.

METHODS: A series of 25 patients of mean age of 52.68, with 13 AO33A and 12 AO33C patients had applied LISS implants for distal femoral fracture and were followed up 36 weeks period. Assessment included radiological evaluation of implant placement, healing, mal-alignment, pain at knee and implant site as well as knee ROM, total function outcome and complications after the operation.

RESULTS: The mean duration of healing of the fracture was 15.7 and there was no non-union in this series. All the fractures were healed within the 22 weeks of period. All the implants were correctly places in femur and there were no varus and valgus angulations. After the healing of the fracture 80% had full range of motion and 20% had slight restriction of motion of the knee; 12% patient had mild hardware pain, one had peronial paresis and 2 patients had superficial infection. Knee functional outcome in standard Oxford knee score is 92% excellent and 8% good.

CONCLUSION: The LISS showed good results in treatment of distal femoral fractures with no or minimal complication and proven to be a good alternative modalities of treatment of complicated distal femoral fracture in addition to conventional systems of treatment.

KEY WORDS: Distal femoral fracture, biological fixation, minimal invasive plate Osteosynthesis and Less Invasive Stabilization system (LISS)

INTRODUCTION

Distal femoral fracture is a difficult fracture to be treated because it is quite difficult to maintain longitudinal and varus/valgus angulations. Usually distal femoral fracture is a high velocity injury and comminution of the fracture is common and usually extend intra-articular surface. Besides the velocity of injury, thin cortices, osteoporosis and wide intra-medullar canal have made stable fixation difficult to achieve and maintain with traditional operative method. Problems including infection, non-union, mal-union, need for bone grafting and stiffness of the knee joint due to delayed mobility were common. In the traditional operative method relatively high complication rate were found and that adversely affect the clinical and functional result. In the traditional method of treating unstable distal femoral fracture, there were problem with healing and failure of fracture fixation result in varus collapse. A unique problem of this fracture is loss of fixation of distal femoral fragment, especially in osteoporotic bone when using the condylar buttress plate.

In the 1980s, advance of the fracture care were applied to reduce these complications and improve the clinical results by indirect reduction and maintenance of fracture biology popularized by Mast et al and others. He emphasizes the biological fixation of the fracture so that least derangement of the vascularity

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of the fracture leading to improve the healing biology. Similarly implant design were improved like fixed angle plate such as 95° angle blade plate and dynamic condylar screw. These devices provided the stability of plate fixation and reduced the relative shortening of the medial side that may result in varus deformity. Preservation of the osseous and soft tissues vascularity around the fracture site by indirect method of reduction of fracture and minimal periosteal stripping of the bone dramatically increase the rate of union without bone grafting and significant reduction of the complication.3, 4

Recently, locking plate system have been introduced where screw are inserted that attached to the plate forming a multiple fixed angled construct. Less invasive stabilization system or LISS (Synthes) function as an “internal fixator” where the implant lies in between the muscles and periosteum without compressing it thus maintenance of the vascularity of the fractured bone 5,8,11. Fracture stabilization with Less Invasive Stabilization System (LISS) follows the Minimal Invasive plate Osteosynthesis (MIPO) concept6, 12. This indirect approach of reduction and introduction of implant with minimal disturbances of the biological environment of the fracture is called the “biological internal fixation”. This implant consists of pre-contoured plate that can be inserted percutaneously by means of aiming devices after indirect close reduction of the fracture. Plate is fixed to the bone by locking head screws inserted through aiming devices percutaneously. The biomechanical evaluation of this system showed that it offered greater angular stability than the condylar buttress plate or the dynamic condylar screw7, 10. This system works as multiple angled blade plate. To date, no study has been made specifically to evaluate the result of high energy mechanically unstable fracture of the distal femur treated with LISS in Nepalese context. The purpose of this study is to evaluate the clinical and radiological results of patients of fracture distal femur treated with Indian modified (Green) LISS. Because of the unavailability and cost wise the author has to choose the Indian modified LISS.

METHODS

This is a prospective study started from July 2006 to June 2008. This study had been conducted in department of Orthopedic and traumatology Bir Hospital. In this 2 years period there are 25 distal femoral fractures treated with less invasive stabilization system in unit II. Distal femoral fractures attended in the unit were classified according to AO/OTA classification system and selected the unstable distal femoral fracture (33A2, A3, C1, C2 and C3). These unstable fractures were treated with Less Invasive Stabilization System (LISS). All the fracture treated by single consultant orthopedic surgeon in Bir hospital. In this study patient age below 20, type B fracture, lateral open type III fracture and stable undisplaced fractures were not included.

Patent attended in hospital were recorded their identification, age, sex, causes of injury, co-morbid status, other injury, side of injury and type of injury in their history sheet. Every patient was put on upper tibial skeletal traction until the operation was performed so that the fracture was maintained in reduced position. CBC, hemogram, Blood grouping, Blood sugar/urea, viral marker (like HIV HbsAg HBC), CXR, X-ray of whole length of femur and ECG after the age of 35 years had been routinely done pre-operatively. Written consent was taken from the patient and family. Fracture and operation time interval, operative time and blood loss were recorded during operation.
Operative method of this series of 26 patients was as mentioned below. All the patients were done under the spinal anesthesia. Patient’s position was supine on a radio-lucent table with small bolster underneath the knee joint so that the knee was flexed to 60°. Pre-operative preparation with Betadine scrub and pre-operative antibiotic with Cefazolin 1000mg IV was routinely done. High tourniquet was applied in most of the cases. Part prepared and draped so as to mobilization of the leg and extend the expose as per required.

About 6-7cm incision was made along the lateral aspect of distal femur from the Girdeys tubercle and iliotibial band fibers were incised in the line of skin. Displaced intra-articular fracture were reduced under vision and fixed with K-wire and if required, inter-fragmentary screws were applied anterior to the expected site of plate application. Metaphysio-diaphysial fractures were reduced manually with flexed knee about 60° so as to prevent the extension of distal part of fracture site due to the action gastrocnemous. Reduction was assessed visually and reassessed by Image Intensifier. Then LISS plate was slipped underneath the muscles (eg. Vastus lateralis) and above the periosteum of the bone. The plate was designed to fit the anatomy of the distal femur and was applied such that the plate was nestled up next to the metaphysial flare and lateral condyle of distal femur by sliding it proximally and distally. The plate was centered on both proximally and distally. Large bone clamp was used to hold the bone to the plate. Varus-valgus, flexion-extension and rotational deformity was checked under image and under-vision. Condylar part of the plate was temporarily fixed with K wire and 5mm self tapping locking screw was applied through the jig proximal to fracture centrifugally and then lastly the condylar screws were applied. All the screws here in this system were inserted in bi-cortical fashion. Once the adequate fixation was achieved, the system was removed and fixation was checked clinically and under image. Then the wound thoroughly irrigated and closed in layer.

Post operatively knee motion was started as early as the patient feel less pain and graduated increase of motion was done. Both passive and active knee motion was started and progressive weight bearing was encouraged once there was radiographic evidence of callus formation. Patient was regularly followed up in 2, 6, 12, 18 and 24 weeks interval. Clinical like knee pain, infection knee range of motion and any complications and radiological union were performed until was healed. Data were recorded in standard Oxford knee score system.

RESULTS

25 patients were under gone LISS for the distal femur fracture. Patients were followed from 12 weeks to 36 weeks with average 26 weeks of post operative period. The mean age was 52. 68 with SE ±2.21 and age range 34-68 years of age. Sex is 12:13 female and male ratio. There were 12 cases fall from height above the 10 feet, 10 cases due to RTA mainly from motor bike and bus accident, and 3 cases fall from cliff. According AO/OTA fracture classification there were 3 A2, 10 A3 and 4 C1, 4 C2, 4 C3. Out of the 25 patients one had type I, 2 patients had type II open fracture and 3 patients had chronic airway obstruction disease. 88% of the patient had undergone operation within two weeks period from the date of injury and remaining 12% (eg. 3 patients) had undergone within 3 weeks period. Post operative hospital stay was in an average 9 days and range from 5 – 15 days. As far as the post operative complication is concerned one patient had peronial neuropraxia and 2 patients had superficial infection. Neuropraxia had recovered after 3 months period and superficial infection healed with simple dressing.

All patients had excellent fixation at immediate post operative period and 28% had radiological union within 12 weeks period, 76% had radiological union within 18 weeks period 100% within 24 weeks. Mean period of radiological union is 15.72 ±3.39 weeks.
Radiological union in Weeks

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<td>21</td>
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<td>Total</td>
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Statistics

Radiographic union

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<tr>
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Mean: 15.72
Std. Deviation: 3.398
Range: 10

None of the patient had non-union or any mal-alignment.

Hardware pain

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<th>Valid Percent</th>
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<td>68.0</td>
<td>68.0</td>
</tr>
<tr>
<td>Mild pain</td>
<td>5</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td>Moderate pain</td>
<td>3</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>100.0</td>
<td>100.0</td>
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In this study 68% had no knee pain, 20% had mild pain and remaining 12% had moderate knee pain was felt. None of the patient had to take the analgesic for pain or had to remove the hardware.

Knee Range of Motion

<table>
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<th>Full range of motion</th>
<th>Frequency</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Full range of motion</td>
<td>20</td>
<td>80.0</td>
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<tr>
<td>Mild restriction of ROM</td>
<td>5</td>
<td>20.0</td>
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<tr>
<td>Total</td>
<td>25</td>
<td>100.0</td>
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Similarly 80% had full range of motion whereas remaining 20% had mild restriction of motion which does not hamper the daily life activities. According to Oxford knee score 8% had good result and 92% had excellent result. None of the patient had absconded and died within this period of follow up which may be because of relatively younger age group of patient.

**DISCUSSION**

Minimal invasive technique has been popularized due to advent of the concept of biological fixation of the fracture management. Minimal soft tissue injury during operation, near anatomical alignment and stable fixation promote early fracture healing and provides good functional outcome. These principles are applied to distal femoral fracture and other complex fractures of lower extremities injury from hip to the pilon fracture of the tibia\(^1\), \(^7\). Fixed angled blade plate had shown benefit in the treatment of complex distal femoral fracture\(^14\), \(^8\). Recently, LISS was developed with rationale of combining the biological advantage of minimal invasive technique with mechanical advantage of multiple fixed angled devices. LISS provides the desired stability, which relies on locking screw-plate interference rather than the plate-bone friction. Biomechanical studies showed that irreversible deformation is less with the LISS than the DCS or condylar buttress plate\(^5\), \(^7\).

Zlowodzki et al in 2004, Laboratory study of comparison of Angled blade plate; retrograde intramedullary Nailing and less invasive stabilization system (LISS) showed that LISS has significantly less plastic deformation on cyclical axial loading than the Intramedullary nail and angled blade plate\(^15\).

In a multi-centric prospective study of 116 patients of LISS, Schutz et al reported 9% non-union and 23% revision rate due to delay union and failure of fixation\(^16\). There was no non-union and failure of the implant in this series. There was radiographic callus formation with no pain and union was achieved 100% within 24 weeks period. The mean age of radiological and clinical union is 15.72±3.39 SD in this series. In this study one patient had delayed union (>22 week) because of open facture. In the study of Wight Mark and Cory, the mean healing is 13 weeks range from 7-16 weeks period\(^8\).

In the study of J Ru, Y Hu and F. Lu (2007) total follow up range from 12-26 months period the time for bone union was 11-36 weeks with an average of 16.1 weeks\(^17\).

Cemil Kayall, Haluk Agus and Ali Turgut (2007) reported successful result of LISS of 26 patients in his comparative study of multiply injury and isolated femoral fractures\(^18\). In their study there were no significant differences among the two groups in his follow up period of 25.8 months period. In this study there are 36 weeks total period of follow up and found no non-union and all cases were of isolated fracture of femoral fracture. No bone grafting has been done.
Button Govin, Wolinsky Philip and Hak David (2004) reported 4 cases of LISS failure in the distal femur\(^1\). They mentioned 2 cases had plate broke up and remaining two cases were due to lost purchase. The causes may be delayed union and early weight bearing. In this series none of the implant failures were reported within 36 weeks period followed up.

In terms of infection rate, Syed et al reported 4% deep and 8% superficial infection\(^2\); Kregor et al also reported 3% of the infection rate and Schutz et al. carried out the debridement procedure in 7% of the patients. In this study only 2(10%) superficial infection was observed, which were resolved with simple dressing and antibiotic within 2 weeks of period. Cemil Kayall, Haluk Agus and Ali Turgut in 2007 reported that there were 2 deep infection and 1(11%) had superficial infection in polytraumatised patients. There were only one patient had superficial infection among the 3 open fractures in J Ru, et al study.

In this study causes of injury 12 (48%) cases were fall from height, 10 (40%) cases were due to road traffic accident and 3 (12%) cases were due to fall from cliff; but in other studies majority were due to road traffic accident followed by fall from height and slipped injury.

One patient had peronial palsy which recovered after 12 weeks of post operative period. This peronial palsy may be due to traction of the peronial nerve. None of the report mentioned about the peronial nerve paresis yet.

In this study 3(12%) patient complaints of moderate pain at the implant site but that did not hamper their daily life activities nor need to remove the implants. Similar result of hardware pain was mentioned in 4 out of 26 patients in Weight, Mark and Cory (2004) study where 3 out of 4 patients had removal of implant. None of the patient had knee joints pain.

Post operative radiograph had shown LISS implant were positioned correctly in all most cases and correct sagittal alignment were observed in all cases. No varus or valgus angulation was noticed. This may be due to visualization of fracture site and maintained in position and centering the plate proximally by center hole under image intensifier\(^3\).

In this study 80% had full range of motion and 20% had mild restriction (10\(^\circ\)-20\(^\circ\)) range of motion of the knee joint. Hip joint had full range of motion. This restriction of motion did not hamper the daily living of the patient.

At the end, functional outcome of the knee joints were assessed by standard Oxford knee score system. With this system none of the patient had score less than 40 and found 92% had excellent and 8% had good result. Oxford score is a self based outcome scores. It is a 12 items questionnaire for the patient. In this scoring system score more than 40 indicates the satisfactory joint function which may not require any treatment.

**CONCLUSION:**

Less Invasive Stabilization System is a suitable method of treatment in isolated complex fracture of the distal femur. This system can also be used successfully in multiply injury patient. Since this system is hybrid system of biological, minimal invasive system and locking screw system good healing of bone and less complication rate were observed so far in the management of distal femoral fracture.

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