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Role of locking compression plate in management of metaphyseal fractures in osteoporotic bones: an experimental study from rural Maharashtra

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ABSTRACT

Background: Osteoporosis is multi factorial disease, which is caused by complex interaction between genetic and environmental factors that influence bone turnover, bone mass, skeletal geometry and risk factors. Distal femur fracture needs aggressive management in terms of open reduction and internal fixation with locking compression plate and early mobilization. Objectives were to study the role of locking compression plate in the management of osteoporotic metaphyseal fractures.
Methods: Present study is a prospective study comprising of 50 patients who sustained various fractures in different bones of body due to osteoporosis and were treated using locking compression plate (LCP). All patients were evaluated for effectiveness of LCP.
Results: In present series majority of patients (44%) fall in age group of 61-70 years having senile osteoporosis, followed by 12 (24%) from 51-60 years age group. Majority of the cases involved were distal femur fractures (50%). 15 i.e. 30% cases were fracture of proximal tibia and 20% were fracture of proximal humerus. 96% had osteoporosis. C1 type of fracture was commonly seen in 6 (12%) patients. The mean constant score at one month was 58 and at the end of one year it was 80. The mean oxford score at one month was 28 and at the end of one year it was 38.
Conclusions: Locking compression plate is an ideal implant for fixation in metaphyseal osteoporotic bones when used methodically.

Keywords: Locking compression plate, Metaphyseal fractures, Osteoporotic bones

INTRODUCTION

Age related bone loss and bone loss due to osteoporosis pose major problems for orthopedic surgeons, not only because of diminished bone stock in which fixation devices must find anchorage, but also because future bone formation at the site may fail to solidify the construct or because future bone resorption may cause loosening of construct and failure. Osteoporosis is multi factorial disease, which is caused by complex interaction between genetic and environmental factors that influence bone turnover, bone mass, skeletal geometry and risk factors.[1,2]

By age of 60, approximately 15% of all women have osteoporosis and this figure increases to 38% by age of

80. Osteoporosis has few physical signs and because of this, diagnosis is difficult to make clinically until patient has suffered fragility fracture.[3] According to Balu Shankaran's reports incidence of osteoporotic fractures occur a decade earlier in Indians than in Caucasians. 50% of Indians more than 50 years have osteopaenia. Five crores at risk of fractures; 50 lakhs will have fractures. Osteoporosis is preventable and treatable yet most of the cases remain undiagnosed and untreated.[4]

Osteoporosis is classified into two major groups. Primary osteoporosis includes post-menopausal osteoporosis in women (type 1), age related or senile osteoporosis; and Idiopathic osteoporosis in juvenile and young adults.[5] Secondary osteoporosis includes osteoporosis that is secondary to heritable or acquired abnormalities; this is broad based disease grouping that includes bone loss associated with Marfans syndrome, Morquio's syndrome, homocystinuria, osteogenesisimperfecta, adult hypo-phosphatasia, Werner's syndrome, lactase deficiency, male hypogonadism, gut malabsorption, renal hyper-calcuria, renal tubular acidosis (type 2), cirrhosis, immobilization, multiple myeloma, conditions associated with low serum phosphate, selective deficiency of 1,25 dihydroxy vit–D (adult onset), Anticonvulsant drug usage, female hypogonadism, cushing's syndrome, thyrotoxicosis, chronic alcoholism, diabetes, chronic heparin treatment, chronic obstructive pulmonary disease, systemic mastocytosis and multivitamin D deficiency.[6,7]

Fixation in osteoporotic bone has always caused problems for the surgeons and implant failure has been a constant worry. We routinely face situations like implant failure, screw cut out, screw backing and loosening and reduced vascularity of the bone underneath the plate. To overcome these problems and achieve stable fixation the A.O. group has come out with principles of fracture fixation and plate design called the locking compression plate.

Objective was to study the role of locking compression plate in the management of osteoporotic metaphyseal fractures.

METHODS

Present study is a prospective study comprising of 50 patients who sustained various fractures in different bones of body due to osteoporosis and were treated using LCP ideal to fractures of metaphyseal osteoporotic bone, in post graduate Institute of Swasthiyog Pratishthan, Miraj operated in between July 2005 to July 2007. Follow up ranges from 8 weeks to maximum 2 years.

Selection criteria

All patients who sustained platable distal femoral fractures, proximal tibial fractures and proximal humerus fractures and were detected osteoporotic by BMD and other investigations were included in the study.

Radiographic examination

When fracture was suspected on clinical grounds, radiograph was taken of the affected bone in at least to planes at right angles to one another. If needed various oblique views of the fracture site were taken. All the patients hip X-rays were evaluated for grading of Singh's index. Comminuted intra articular fractures of proximal humerus, proximal tibia, and distal femur were evaluated with help of CT scan.

Plate and screw fixation

Specially designed plate for the particular fractures were used. All AO approved implants were used. First of all interfragmentary compression screws were used for securing reduction of articular surface and then theshaft was reduced to the metaphysis and other simple screws were inserted and at the end all locking screws were inserted by a specially designed torque limiting screw driver. The specific drill sleeves which are fixed to plate by threads were used for locking screws to determine the direction of screws. The depth measure was used to measure the screw length and tap was used wherever necessary. Plate span ratio, number of screws and working length all were followed according to the principle. Locking screws can be unicortical or bicortical but preferably bicortical in osteoporotic bones.

Statistical analysis

Data thus collected was entered in MS excel sheet and analysed using SPSS 17 version. Qualitative data was expressed as percentages and quantitative data was expressed as mean.

RESULTS

In present series of study majority of patients (44%) fall in age group of 61-70 years having senile osteoporosis, followed by 12 (24%) from 51-60 years age group.

In present series of the study male predominance is seen (30, 60%) though osteoporosis is more common in females. Most of the female sustained osteoporotic fractures with trivial fall. But the predominance of male is due to road traffic accidents and sustaining fractures around the knee with osteoporotic bones.

In our study majority of the cases involved were distal femur fractures (50%). 15 i.e. 30% cases were fracture of proximal tibia and 20% were fracture of proximal humerus.

48 patients i.e. 96% had osteoporosis and remaining 2 i.e. 4% had osteopenia.

In our study C1 type of fracture was commonly seen in 6 (12%) patients. C2, tibia Schatzker type 6 and proximal

tibia extra articular was observed in 5 i.e.10% patients each.

Table 1: Distribution according to age and gender.

Variables	No. of cases	Percentage
Age group (in years)		
0-20	1	2.0
21-30	0	0.0
31-40	2	4.0
41-50	3	6.0
51-60	12	24.0
61-70	22	44.0
71-80	9	18.0
81-90	1	2.0
Gender		
Male	30	60.0
Female	20	40.0

Table 2: Distribution according to osteoporotic bones involved in study.

Bones involved	No. of cases	Percentage
Distal femur	25	50.0
Proximal tibia	15	30.0
Humerus (proximal)	10	20.0
Total	50	100.0

The mean constant score at one month was 58 and at the end of one year it was 80.

Table 3: Distribution according to type of fracture.

Type of fractures	No. of cases	Percentage
Femur		
A1	3	6
A2	4	8
A3	4	8
C1	6	12
C2	5	10
C3	3	6
Tibia Schatzker		
Type 4	2	4
Type 5	3	6
Type 6	5	10
Proximal tibia extra articular	5	10
Proximal humerus Neers		
2 part	2	4
3 part	4	8
4 part	3	6
Fracture dislocation	1	2
Total	50	100

The mean oxford score at one month was 28 and at the end of one year it was 38.

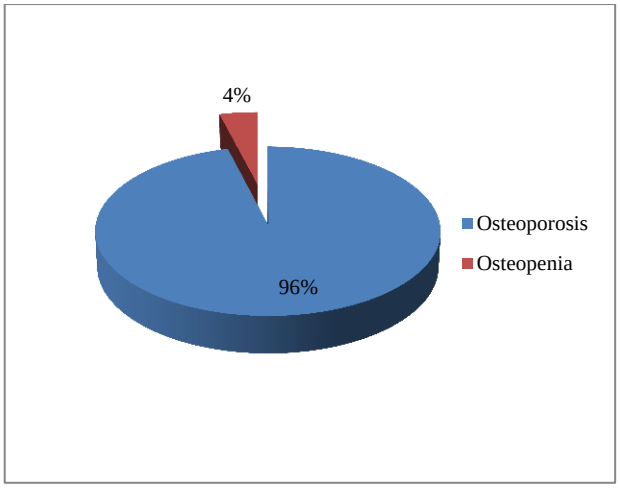

Figure 1: Distribution according to osteoporotic bones involved in study.

Table 4: Constant scoring for proximal humerus fracture.

Follow up	Mean constant score
One month	58
3 months	72
6 months	78
One year	80

Table 5: Oxford knee score for distal femur and proximal tibia fracture.

Follow up	Oxford knee score
1 month	28
3 months	33
6 months	36
One year	38

DISCUSSION

The majority of cases of fracture was seen in the age group of 61-70 (44%), followed by in the age group of 51-60 (24%), this can be explained because in this age group the prevalence of osteoporosis is more.

Sex distribution of patients

Of 50 patients 60% were male and 40% were females. Thus male predominance was observed in our series though osteoporosis is common in females is due to increasing incidence of RTA where males are the common victims.

Mode of injury

In our series of 50 patients 48% resulted from trivial trauma like fall on outstretched hand, slip of foot while walking or mere getting up from sitting posture suggesting osteoporosis is the causative factor which

predisposes to fracture from minor stress or strain on bones with which normal individuals are unaffected in day to day life. 12% fractures resulted from fall from minor height and 40% fractures resulted from RTA.

Fractures involved

In the present study 50 patients with osteoporotic fractures were studied. 25 patients were distal femoral fractures AO type A or type C. 15 patients were proximal tibia fracture Schatzker type4 type 5 or type 6 or extra articular proximal tibia fractures and 10 patients were proximal humerus fractures Neers type 2 part or 3 part or 4 part. All were treated with a LCP specific for the fracture and the region. The study group included 30 males and 20 females. The most common age group being 60-70 years, all distal femur fracture were classified as per the A.O. (Muller) classification, proximal tibia by Schatzker and proximal humerus by Neers classification.[8]

Duration of surgery

The operative time was considerably increased for the patients treated with distal femur fractures with average time being 195 minutes as compared to 90 minutes in proximal tibia fractures and 130 minutes for proximal humerus fractures. However with increasing experience the time required for performing LCP has reduced.

In our series of distal femur fracture femur type A and type C with osteoporosis, according to AO classification were treated with LCP and one experience LISS. One male patient of age 19 was osteoporotic due to juvenile rheumatoid and sustained RTA and was treated with LCP.[8] In proximal tibia Schatzker type 4, 5 and 6 and extra articular non nailable fractures were treated with LCP. The results are demonstrated in the following tables and the knee score was evaluated by Oxford knee score.[10]

Fankhauser conducted the operative procedure on 29 such fractures with open reduction and locked compression plate and found that mean constant score 74.6 as against 80 of our study.[9] He also experienced 2 screw cutouts and partial bone necrosis in 2 cases.

Schütz, Müller, Krettek et al using LCP or LISS found healing rate as 91% and knee flexion 107 degree. In our study it was 92% and knee flexion 103 degree.[11-13]

Schütz found more than 5 degree deviation in 40% patients which is more as compared to our findings i.e.12%.[11]

Cole, Kregor also studied in proximal tibia using LCP and LISS and found infection and bone grafting in 1 patient each.[14-15] They observed malalignment (>5 degrees) was seen in 13% patients. Our study findings are consistent with their findings.

CONCLUSION

Locking compression plate is an ideal implant for fixation in metaphyseal osteoporotic bones when used methodically. The principles and rules for LCP fixation should be followed strictly. The features which make LCP an ideal implant for fixation in osteoporotic bones is fixed angle device, single beam construct, preservation of blood supply, easier for MIPPO and LISS.

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