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SEGMENTAL INTERLOCKING BOLT- A NEW IMPLANT SYSTEM FOR FRACTURE NECK OF FEMUR

Orthopaedic

KEYWORDS: FRACTURE NECK OF FEMUR, DYNAMIC COMPRESSION, SELF TAPPING BOLT, ROTATIONAL STABILITY.

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ABSTRACT

An implant system for fixation of fracture neck of femur is disclosed. This device is a Self tapping bolt(Fig.1) which accommodates a cannulated hip screw(Fig.3) and a lock washer(Fig.2). Compression stability can be given at the fracture site by compression top screw(Fig.4) and rotational stability can be given by a 6.5mm cancellous screw(Fig.6). The lateral cortex of proximal femur can be strengthened by lateral trochanteric plate(Fig.5). The dynamic compression while weight bearing or in collapse at fracture site can be converted to static compression by locking of serrations on the head of compression top screw to lock washer hole. By using this device, adequate compression stability and rotational stability can be given at the fracture site with promotion of early weight bearing and better chances of fracture healing.

INTRODUCTION

Today, fracture neck of femur is treated by fixation with cannulated cancellous screws or by dynamic hip screw & barrel plate and screws. Cannulated hip screws, even though give good fixation of fracture neck of femur, the patient will not be able to bear weight till the fracture unites completely because of the instability of fixation and smaller implant size. The union time may prolong more than 3-4 months and till that time, patient will be on non weight bearing mobilization. Moreover the compression stability and rotational stability obtained at the fracture site may be less for the union of the fracture and the chances of nonunion are more. Later the screws may be pulled out once the patient starts walking. This can irritate the soft tissues at the trochanteric region causing bursa formation and increase the morbidity of the patient. Another method of fixation is dynamic hip screw & barrel plate and screws. This needs an extensive surgical approach to the hip region meaning larger incision, more time for surgery, and increased post operative morbidity and mortality.

These problems are overcome by the present invention which provides a biomechanically stable compression device for fracture neck of femur with minimal surgical approach and early weight bearing mobilization. This new device can be used for both intracapsular and extra capsular fractures of neck of femur. This invention comprises of a self tapping bolt which can accommodate an 8mm partially threaded hip screw and a lock washer which can be locked in the bolt and can accommodate a 6.5mm partially threaded cancellous screw. The bolt can be introduced and fixed to the trochanteric region of the femur after drilling with appropriate reamer. The 8mm hip screw can be introduced into the head of femur with the threaded part proximal to the fracture line and can be fitted in the bolt and lock washer with a compression top screw with which adequate compression can be given at the fracture site. The 6.5mm partially threaded cancellous screw can be introduced through the lock washer into the head of femur superior to the hip screw to prevent the rotation at fracture site as derotation screw.

In one form of invention, where the patient is young and/or the fracture is intracapsular, the lock washer is enough to hold the self tapping bolt on the lateral cortex of proximal femur. In another form of invention, where the patient is elderly and osteoporotic and/or the fracture is extra capsular, a lateral trochanteric plate can be added to strengthen the lateral cortex of proximal femur.

All the components of this system can be made of stainless steel 316L /titanium.

MATERIALS AND METHODS

COMPONENTS

1)SELF TAPPING BOLT

(Fig 1)

2) LOCK WASHER

(Fig 2)

3) CANNULATED HIP SCREW

(Fig 3)

4) COMPRESSION TOP SCREW

(Fig 4)

5) LATERAL TROCHANTERIC PLATE

(Fig 5)

6) CANCELLOUS LAG SCREW

(Fig 6)

Detailed description of technique of application of invention A 3mm guide wire is passed into the center of head of femur perpendicular to the fracture line at or just below the level of greater trochanter of proximal femur. Another guide wire is passed 10mm superior to the first guide wire into the head of femur as a stay wire to prevent rotation of head of femur while drilling and reaming. Over the first guide wire, drilling with 8mm drill bit and reaming with double reamer can be done. The cannulated hip screw (Fig.3) is introduced into the head of femur over the first guide wire with the threads proximal to the fracture line. The self tapping bolt (Fig.1) is introduced over the first guide wire on the hip screw with the threads of bolt distal to the fracture line. Both guide wires are removed. The lock washer (Fig.2) is introduced and locked on the bolt. The compression top screw (Fig.4) is introduced through the 8mm hole of lock washer and the self tapping bolt into the hip screw and adequate compression can be given at the fracture site. A 6.5mm cancellous partially threaded screw (Fig.6) can be introduced through the proximal hole of the lock washer into the head of femur superior to the hip screw as a derotation screw.

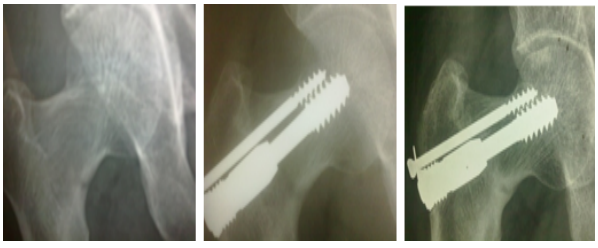
In elderly osteoporotic patients and/or extra capsular fractures of neck of femur, a lateral trochanteric plate (Fig.5) can be added to strengthen the lateral cortex of proximal femur. The lateral trochanteric plate can be fixed to the proximal femur with one or two 5mm locking screws. The remaining steps are the same as described above.

METHODS

Biomechanical studies were conducted in the Dept.of Mechanical Engineering of Regional Engineering College '

CLINICAL STUDY

Type of study	_	Short term prospective
Period of study	_	10 months (Aug.2011 to May 2012)
No. of patients	_	10
F: M ratio	_	6 : 4
Age	_	45yrs to 75yrs
Inclusion criteria	_	Garden type 1, 2 & 3
Exclusion criteria	_	Garden type 4
Time of surgery	_	First 24 – 48 hrs
Length of surgical incision	_	2 to 4 cm
Amount of blood loss	_	30 to 50 ml
Time of C-Arm exposure	_	8 to 10 seconds
Duration of surgery	_	20 to 30 minutes
Protected wt.bearing	_	4 to 10 days post op
Follow up	_	every 6 weeks
Fracture union	_	4 united well 6 progressive unions.



Pre op **immediate post op** **6months post op**

DISCUSSION

Cannulated hip screw and self tapping bolt are introduced perpendicular to the fracture line. So the lag screw principle can be properly applied. There is no constrain of fixed angle. So adequate compression can be given at fracture site with good chances of fracture healing.

Dynamic compression may be obtained at the fracture site by allowing sliding out of hip screw through the bolt while weight bearing or in minimal collapse at the fracture site. This dynamic compression may be converted to static compression by locking of serrations on the head of compression top screw into the lock washer hole. So there will not be any constrain of pulling out of implants and loss of fixation while weight bearing or due to collapse as compared to cannulated screw fixation. So early weight bearing can be promoted which may enhance fracture healing.
Early results of clinical trials are promising which include

- Smaller surgical incision (3 cm)
- Lesser time for surgery (30 minutes)
- Adequate compression at fracture at fracture site
- Rotational stability at fracture site
- Early post operative weight bearing
- Minimal per and post operative morbidity
- More chances of fracture healing
- Shallow learning curve for surgeon

CONCLUSION

Segmental Interlocking Bolt System is a simple patient-friendly and surgeon-friendly implant system which helps patients with fracture neck of femur to recover to normal life in a faster and easier way.

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