One-way compression along the femoral shaft with the Medoff sliding plate

The first European experience of 104 intertrochanteric fractures with a 1-year follow-up

Karl Lunsjö[1], Leif Ceder[1], Leif Stigsson[2] and Anders Hauggaard[2]

This is an assessment of a new device for treatment of intertrochanteric and subtrochanteric fractures. The Medoff sliding plate (MSP) allows compression in 3 different modes: along the femoral shaft, along the femoral neck or a combination of both. In this prospective series of 104 consecutive intertrochanteric fractures, dynamic compression was allowed only along the femoral shaft. Simple undislocated intertrochanteric 2-part fractures were excluded. The patients were followed clinically and radiographically for 1 year. 21 patients died within 1 year after the operation. 7 technical failures including 2 non-unions occurred. All were lag screw penetrations, 4 of which were considered to be due to unforced errors by the surgeons.

The technical failure rate in this preliminary evaluation of the MSP is similar to that of the dynamic hip screw. Randomized trials comparing the MSP with other hip screw systems should follow to ascertain possible advantages of the MSP, with its various sliding modes in different types of fractures of the proximal femur.

Departments of [1]Orthopedics and [2]Radiology, Helsingborg Hospital, S-251 87 Helsingborg, Sweden
Tel +46 42-102410. Fax -102450
Submitted 94-11-19. Accepted 95-05-03

The dynamic hip screw (DHS) is currently the implant most widely used for trochanteric hip fractures. The technical failure rate is between 2 and 20 percent (Möller et al. 1984, Bannister et al. 1988, Mainds and Newman 1989, Simpson et al. 1989, Larsson et al. 1990, Nungu et al. 1991, Thomas 1991, Leung et al. 1992).

A new concept in screw-plate systems with sliding and compression along the femoral shaft instead of along the neck of the femur was recently introduced by Medoff (Medoff and Maes 1991). The device was originally called the axial compression screw. In the report on this device in 25 patients with unstable intertrochanteric and high subtrochanteric fractures, no technical failures were observed when only one-way compression along the femoral shaft was used (Medoff and Maes 1991). The aim of our study was to make a preliminary evaluation of the MSP used in this fashion.

Patients and methods

The MSP is a modification of the standard DHS with the side-plate replaced by 2 sliding components that can slide up to 2.5 cm because of fracture compression. The side-plate is curved and allows bone screws to be placed in a biplanar way. The lag screw may be prevented from sliding laterally in the barrel of the plate by a locking set screw and a distal compression screw allows intraoperative longitudinal compression along the femoral shaft (Figure 1).

Operative technique

The operative technique is similar to that of the standard compression screw systems, but one should mention some distinguishing features. In all trochan-

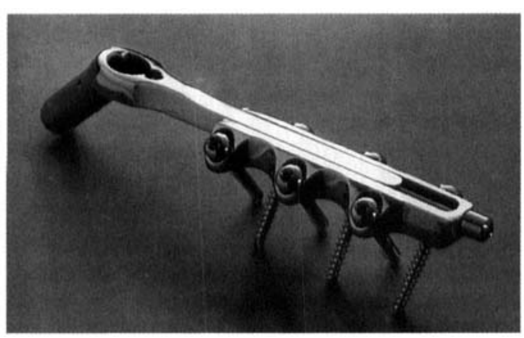


Figure 1 A. The Medoff sliding plate without the locking set screw. Notice the biplanar placement of the bone screws.

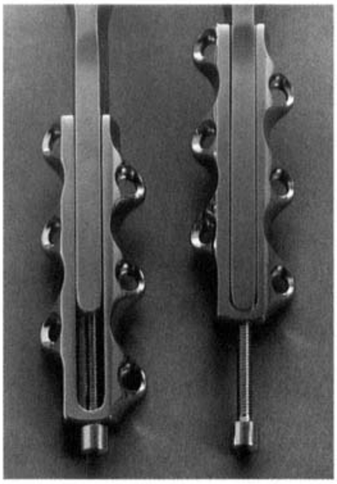
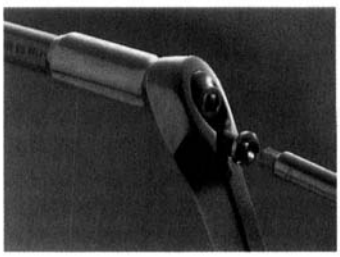


Figure 1 B. The distal part of the plate demonstrating its sliding capacity of 2.5 cm.



C. The locking set screw impedes sliding of the lag screw, thus preventing medialization of the femoral shaft.

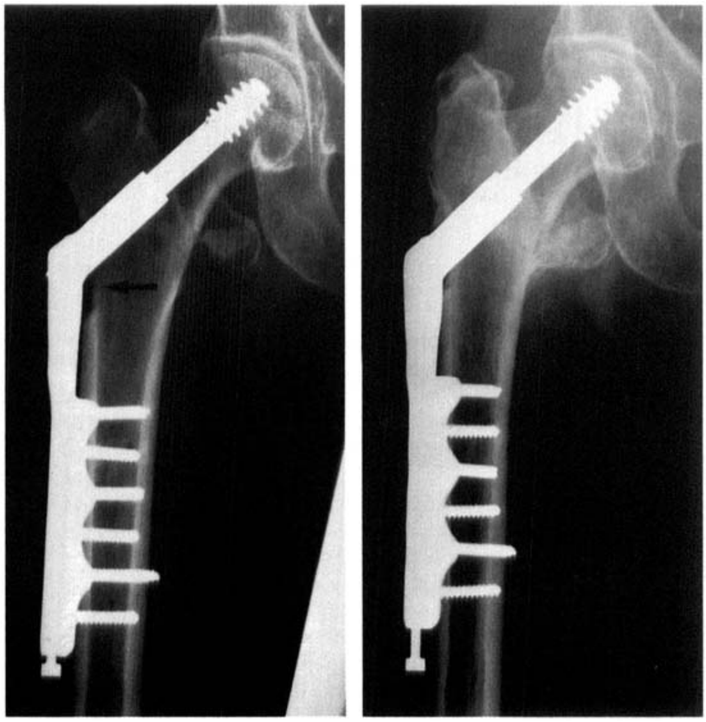


Figure 2. Examinations at day 1 (left) and at 1 year (right) postoperatively. The entry hole was enlarged distally to allow unimpeded compression (left). Notice how the enlarged hole has diminished due to the compression (right).

teric fractures, the aim of the reduction is to achieve cortical alignment on both the AP and the lateral views. If anatomical reduction is not achieved, a valgus position is preferable to a varus (Parker 1993). It is imperative to avoid overtraction of the fracture during the operation. If not corrected, this procedure may immediately postoperatively consume all the dynamic capacity of the sliding plate. It may turn the device into a rigid system which substantially increases the risk of lag screw penetration when the locking set screw is used.

The MSP at present exists only in a 135° angle version and therefore the guide pin must be inserted accordingly. If the fracture is located proximal to the lag screw entry site on the lateral femoral cortex, fracture compression along the femoral shaft will be impeded. To prevent this obstruction, the entry hole should be enlarged up to 2.5 cm distally with a rongeur to allow compression (Figure 2). However, if the fracture is located distal to the entry site of the lag screw, unimpeded axial compression occurs and no enlargement of the entry hole is needed.

Clinical study

During 1992, we operated on 103 patients with 104 consecutive intertrochanteric fractures. Patients with pathological fractures and patients with prior surgery of the proximal femur were excluded. Also excluded were those with undislocated 2-part intertrochanteric fractures, as these fractures usually heal uneventfully, regardless of the method of fixation (Jensen et al. 1980a). The mean age of the patients was 81 (47–103) years. The female:male ratio was 2.8:1. 60 patients were admitted to the hospital from their own homes. 52 patients walked without any kind of support prior to the fracture. 10 patients had concomitant fractures which delayed their mobilization. The operations were done by 19 surgeons with various amounts of experience.

On admission, tibial pin traction was applied. Dextran 70 (500 mL Macrodex) was given intravenously before operation and repeated during the operation. Low-molecular heparin (Klexane 40 mg) was given subcutaneously daily until the patient was mobilized. Prophylactic antibiotics (Zinacef 750 mg) were administered intravenously during the operation and repeated twice at 8-hour intervals postoperatively.

The following parameters were registered: blood loss as estimated by the anesthesia nurse, operating time skin-to-skin, the length of the skin incision and the hospital stay.

Immediate full weight bearing as tolerated was allowed in 102 of the 104 cases. In the remaining 2 cases, full weight bearing was delayed for 6 weeks because the surgeon was of the opinion that the fracture had an unusually unstable configuration.

Deep wound infection (defined as a positive culture beneath the fasciae), superficial wound infection (defined as a positive culture above the fasciae), pulmonary embolus (diagnosed by pulmonary scintigraphy) and deep venous thrombosis (diagnosed by phlebography) were recorded.

At 4 and 12 months postoperatively, residence, walking ability and pain on weight bearing were recorded.

Radiographic examinations were performed on admission, on days 1 and 7 and at 4 and 12 months postoperatively. The fractures were classified according to the Jensen and Michaelsen modification of the Evans system (Jensen and Michaelsen 1975) (Figure 3). Technical failures were defined as lag screw penetration, breakage or loosening of the plate or nonunion of the fracture. Migration of the lag screw within the femoral head or varus angulation of the fracture, without lag screw penetration, was not regarded as a technical failure. The degree of the postoperative dynamic compression was followed as well as the healing process.

2 patients were unable to attend the clinical and radiographic follow-up at 4 months as well as a further 13 patients at 1 year, postoperatively. However, all 15 patients were followed up by telephone interview.

Results

The standard operative routine was not followed in 10 patients: in 7 of these, the surgeon forgot to place the locking set screw, but no technical failure occurred; in 2 patients, the surgeon used a cerclage wire for stabilization of the fracture and one of these patients had a lag screw penetration; in another patient, an extra bone screw was used for the same reason, but no technical failure took place.

The mean intraoperative blood loss was 0.4 (0.03–1.7) L. The mean operating time was 69 (30–150) min and the mean length of the skin incision was 19 (13–24) cm. The mean hospital stay was 19 (2–95) days.

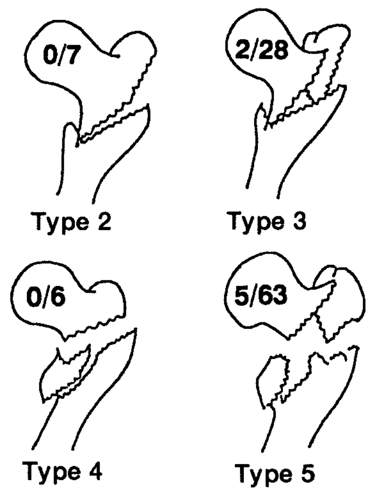


Figure 3. The intertrochanteric fractures were classified according to Jensen and Michaelsen. The number above the line represents technical failures and the number below the line the total number of fractures of each type.

No deep wound infection but 10 superficial wound infections, 2 pulmonary emboli and 1 deep venous thrombosis occurred.

1 year after the injury, 21 patients had died. Of the 39 survivors who walked without any kind of support prior to the fracture, 19 still did so. 35 of the 42 survivors coming from their own homes had returned home. At the 1-year follow-up, only 51 of the patients were able to tell us about their pain on walking. Of these, 1 had severe and 4 had slight pain.

The postoperative dynamic compression along the femoral shaft took place up to 4 months after the operation. However, it was most pronounced during the first postoperative week.

Follow-up radiographs showed 7 technical failures (Figure 3), all lag screw penetrations, 2 of which were only by 1 mm. 4 of these complications were considered to be unforced errors by the surgeons. 2 of the 7 lag screw penetrations, both in the type 5 fracture group, turned into non-unions. All other fractures healed. 4 patients required further surgery. No complication that was not already known at the 4-month control was detected at the 1-year follow-up.

Discussion

The 1-year mortality rate in our series was about the same as in most other studies (Zain Elabdien et al. 1984, Sernbo et al. 1988) in spite of a 5-year higher mean age than in the series by Larsson et al. (1990).

The high age of our patients was probably reflected by the fact that only half of the patients had been independent walkers before the fracture. Half of these patients had regained the same walking capacity at the 1-year follow-up. In the retrospective series by Larsson et al. (1990), which also included undislocated 2-part intertrochanteric fractures, two thirds of the patients recovered their prefracture walking capacity. The rate of returning home for the patients was almost the same in the present study as in that by Larsson et al. (1990).

The mean time of the operation and the mean intraoperative blood loss in our series were similar to those reported for DHS patients (Sernbo et al. 1988, Larsson et al. 1990, Nungu et al. 1991, Leung et al. 1992). However, the scar length was 3 cm longer with the MSP than with the 4-hole DHS (Leung et al. 1992).

The technical failure rate in our series was similar to the average complication rate reported in several studies with the DHS, some of which also included the undislocated intertrochanteric 2-part fractures (Jensen et al. 1980b, Möller et al. 1984, Sernbo et al. 1988, Mainds and Newman 1989, Davis et al. 1990, Larsson et al. 1990, Nungu et al. 1991, Thomas 1991, Leung et al. 1992). Several of these studies were retrospective, with special exclusion criteria, and therefore the true failure rate was probably higher.

It is noteworthy that in all but one of our failure cases the sliding capacity of the plate was used to its limit, i.e., the plate acted eventually as a rigid nail-plate. Failure of partial release of the traction to the leg prior to fixing the plate to the femur was probably the cause. Such unforced errors by the 19 surgeons and a learning period with a new method could explain at least 4 of the complications.

One advantage of the MSP is that it acts in a more load-sharing mode as compared to the more load-bearing mode of the standard compression screw-plate, which reduces the risk of plate breakage. In addition, the biplanar placement of the cortical bone screws may give the MSP a better grip on an osteoporotic femoral shaft than the uniplanar screws of the standard plate, thus reducing the risk of plate loosening.

In conclusion, Medoff's principle of using the locking set screw in intertrochanteric fractures is debatable. A combined two-way compression along the neck and the shaft of the femur may be the best and safest treatment of these complex fractures.

Randomized studies are needed to establish the role of the MSP with or without the locking set screw in different types of fractures of the proximal femur.

Acknowledgement

This study was supported by grants from Thelma Zoega's Foundation, Helsingborg, Sweden.

References

Bannister G C, Gibson A G, Ackroyd C E, Newman J H. The fixation and prognosis of trochanteric fractures. A randomized prospective controlled trial. Clin Orthop 1988; 254: 242-6.

Davis T R, Sher J L, Horsman A, Simpson M, Porter B B, Checketts R G. Intertrochanteric femoral fractures. Mechanical failure after internal fixation. J Bone Joint Surg (Br) 1990; 72: 26-31.

Jensen J S, Michaelsen M. Trochanteric femoral fractures treated with McLaughlin osteosynthesis. Acta Orthop Scand 1975; 46: 795-803.

Jensen J S, Töndevold E, Sonne-Holm S. Stable trochanteric fractures. A comparative analysis of four methods of internal fixation. Acta Orthop Scand 1980a; 51: 811-6.

Jensen J S, Sonne-Holm S, Töndevold E. Unstable trochanteric fractures. A comparative analysis of four methods of internal fixation. Acta Orthop Scand 1980b; 51: 949-62.

Larsson S, Friberg S, Hansson L-I. Trochanteric fractures of the femur. Analysis of mobility, complications and mortality in 607 cases operated by the sliding screw technique. Clin Orthop 1990; 260: 232-41.

Leung K S, So W S, Shen W Y, Hui P W. Gamma nails and dynamic hip screws for peritrochanteric fractures. A randomised prospective study in elderly patients. J Bone Joint Surg (Br) 1992; 74 (3): 345-51.

Mainds C C, Newman R J. Implant failures in patients with proximal fractures of the femur treated with a sliding screw device. Injury 1989; 20: 98-100.

Medoff R J, Maes K. A new device for the fixation of unstable pertrochanteric fractures of the hip. J Bone Joint Surg (Am) 1991; 73 (8): 1192-9.

Möller B N, Lucht U, Grymer F, Bartholdy N J. Instability of trochanteric hip fractures following internal fixation. A radiographic comparison of the Richards' sliding screw-plate and the McLaughlin nail-plate. Acta Orthop Scand 1984; 55: 517-20.

Nungu S, Olerud C, Rehnberg L. Treatment of intertrochanteric fractures: comparison of Ender nails and sliding screw plates. J Orthop Trauma 1991; 5 (4): 452-7.

Parker M J. Valgus reduction of trochanteric fractures. Injury 1993; 24 (5): 313-6.

Sernbo I, Johnell O, Gentz C, Nilsson J. Unstable intertrochanteric fractures of the hip. Treatment with Ender pins compared with a compression hip-screw. J Bone Joint Surg (Am) 1988; 70: 1297-303.

Simpson A H, Varty K, Dodd C A. Sliding hip screws: modes of failure. Injury 1989; 20 (4): 227-31.

Thomas A P. Dynamic hip screws that fail. Injury 1991; 22 (1): 45-6.

Zain Elabdien B S, Olerud S, Karlström G. Ender nailing and pertrochanteric fractures: results at follow-up evaluation at one year. Clin Orthop 1984; 191: 53-63.