

Man-Kwan Wong · Frankie Leung · Shew Ping Chow

Treatment of distal femoral fractures in the elderly using a less-invasive plating technique

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Abstract We treated 16 patients having fractures of the distal femur with the less-invasive stabilization system (LISS). Patients' mean age was 75 (62–101) years. Fifteen patients had low-energy trauma. Eight fractures were type A (AO classification), three were type B and five were type C. In two cases, loosening of the proximal fixation was seen and surgical revision performed. Union time averaged 30 (16–68) weeks. There was no non-union. Average Oxford knee score was 46 (22–60). No loosening of the distal fixation was found. LISS appears to be an effective device in treating osteoporotic distal femoral fractures.

Résumé Nous avons traité 16 malades présentant une fracture fémorale distale avec le Système de Stabilisation peu Invasif (LISS). L'âge moyen des malades était de 75 ans (62–101). Quinze malades avaient eu un traumatisme à basse énergie. Huit fractures étaient de type A (classification AO), trois étaient de type B, et cinq étaient de type C. Dans deux cas un démontage de la fixation proximale est survenu, avec nécessité de reprise chirurgicale. Le délai moyen de consolidation était de 30 semaines (16–68). Il n'y avait aucune non-consolidation. Le score moyen de genou Oxford était 46 (22–60). Il n'y a eut aucun démontage de la fixation distale. Le système LISS paraît être une méthode efficace pour traiter les fractures fémorales distales ostéoporotiques.

M.-K. Wong · F. Leung · S. P. Chow
Department of Orthopaedics and Traumatology,
Queen Mary Hospital,
The University of Hong Kong,
Hong Kong SAR

M.-K. Wong (✉)
Department of Orthopaedics and Traumatology,
Pamela Youde Nethersole Eastern Hospital,
3 Lok Man Road,
Chai Wan, Hong Kong SAR
e-mail: wongmankwan@hotmail.com
Tel.: +852-2-5956493
Fax: +852-2-5956414

Introduction

Among the various osteoporotic fractures those around distal femur are rather challenging to orthopaedic surgeons. Different treatment methods [3] have been used but malunion and nonunion are not uncommon [2, 5, 10]. Worse still, complications such as joint stiffness, muscle wasting and deep vein thrombosis [7] are often seen. The idea of indirect reduction and splintage has prompted the use of a plate in a similar manner as a nail. This led to the development of minimally invasive plate osteosynthesis (MIPO) and a less-invasive stabilization system (LISS) [2, 5, 10].

The objective of this study was to evaluate the clinical outcome and complications of LISS in managing distal femoral fractures in a geriatric population.

Material and methods

This was a prospective study performed in one center. All patients older than 60 years admitted for distal femoral fractures were included. Patients with compound fractures or who were medically unfit to undergo surgery were excluded. Altogether, 16 patients with 16 fractures were recruited from February 2001 to February 2003. There was one man and 15 women; eight fractures were on the right side and the remaining eight on the left. The mean age was 75 years with a range from 62 to 101 years.

The majority of patients had low-energy trauma with 15 patients having falls on level ground. One patient was knocked down by a vehicle in a road traffic accident and 13 patients had isolated injuries while three had multiple fractures. According to the AO classification, eight patients had type A, three type B and five type C fractures.

All patients were treated surgically within one week of the injury. The fracture was reduced accurately with manual traction or traction table under image intensifier. A small incision over the distal lateral thigh was used and LISS was introduced submuscularly and temporarily held with K wires. Distal fixation was performed with the aim-

ing device. Stab incisions over the thigh were made for subsequent screw insertion. Postoperatively, patients underwent knee exercises. Protected weight bearing walking was usually necessary for 8–12 weeks.

Patients were followed-up in our outpatient clinic for three, six, and nine months, and one and two years postoperatively. The severity of pain, range of movement of the knee joint, Oxford knee score, radiological evidence of union, and presence of complications were recorded. The average follow-up period was 23 (14–34) months.

Results

Concerning the severity of pain, nine patients had no pain, three had pain when weight bearing, two had pain at rest, and two had pain requiring regular oral analgesic. Concerning the range of motion, six patients had full, nine had slightly limited and one had severely limited range-of-knee motion. Concerning the function of lower limbs, the Oxford knee score was used. Scores ranged from 22 to 60 with an average of 46. The full score was 60 (Table 1).

Union was defined radiographically as presence of bony trabeculae across the fracture site. All fractures united with an average union time of 30 (16–68) weeks. No bone graft was used.

There was no infection. However, there were two cases with failure of fixation, which occurred early in our series. Both were loosening of the proximal fixation of LISS. In both cases, the relatively short five-hole plates were used instead of the standard nine-hole plates because the fractures involved the relatively distal part of the femur. Revision operations were performed with revision of the proximal femur using bicortical screws. The distal fixation was found to be secure in both cases. Both fractures finally united (Figs. 1, 2, 3, 4).



Fig. 1 A 79-year-old woman with a C1 fracture of the distal femur

Discussion

Open reduction and internal fixation with various conventional implants have improved the functional outcome of distal femoral fractures compared with nonoperative measures. But it also creates complications, especially infection, delayed union and non-union. Osteoporotic bone complicates the problem further because poor bone quality makes screw purchase and fixation less secure. With the newer designs, LISS may be the solution to osteoporotic distal femoral fractures.

The MIPO supports the concept of indirect reduction and biological internal fixation. The fracture is reduced accurately. The plate is inserted submuscularly but above the periosteum. Fixation is some distance away from the fracture site. This reduces the dissection of soft tissue around the fracture site and enhances fracture healing [2, 5, 10].

Table 1 Function of the lower limbs using the Oxford knee score

Gender	Age (years)	Side	Fracture type (AO)	Follow up period (months)	Severity of pain ^a	Knee range of motion ^b	Oxford knee score	Radiographic union time (weeks)	Complication
M	62	L	B3	34	2	2	43	22	
F	79	L	B3	32	1	1	60	22	
F	68	R	A3	30	1	1	60	16	
F	72	L	C3	30	1	1	40	32	
F	66	R	A1	26	4	3	22	52	Loosening
F	81	L	A2	24	1	2	40	30	
F	80	L	C3	22	4	2	29	68	Loosening
F	80	R	B3	21	2	2	41	28	
F	76	R	C1	22	1	2	44	24	
F	63	R	A1	21	1	1	60	18	
F	85	L	C3	19	1	1	52	20	
F	74	L	C2	19	2	2	50	30	
F	83	R	A2	19	1	1	50	30	
F	101	L	A3	19	1	2	50	28	
F	68	R	A1	15	3	2	40	32	
F	74	R	A3	14	3	2	53	30	

^a1 = No pain, 2 = pain when weight bearing, 3 = pain without weight bearing, 4 = pain to the extent that regular oral analgesic needed

^b1 = Full range, 2 = slightly limited range, 3 = severely limited range and 4 = totally stiff knee



Fig. 2 Early postoperative X-ray showing good reduction and satisfactory alignment

LISS can be regarded as an internally placed “external fixator.” The screw head is threaded and locks itself to the plate. Therefore, after tightening the screws, the plate is held in position and there is no compression force exerted by the plate to the bone whereas in the traditional plate and screw system, the plate is pushed by the screw head towards the bone. Since there is no compression to the periosteum, disturbance to the vascular supply is minimized. Furthermore, LISS uses the concept of angular stability that is different biomechanically from the conventional plate and screw system. In the conventional system, the stability of a plated long bone depends on



Fig. 4 At 8 months postoperatively and after revision, there is fracture union

friction between the plate and bone whereas for LISS, the distal fixation screws are inserted and locked at different angles to one another. Each screw acts as a fixed-angle device in the bone. This design is more stable as a whole because the screw toggling is eliminated. The design of the distal fixation screw also intentionally reduces the depth of screw thread. A shallower thread screw is less likely to cut into the osteoporotic bone than the traditional cancellous screw. It also allows a thicker screw core diameter, so it can withstand more loads. All these designs aid in the fixation in osteoporotic bone in the elderly [4].

A biomechanical study conducted by Marti in Switzerland used cadaver femoral bone to compare the biomechanical properties of LISS with two conventional plate systems: condylar buttress plate and dynamic condylar screw [6]. It showed that the monocortical screw fixation system with angular stability had an enhanced ability to withstand high loads compared with the two other systems. Some other earlier clinical studies showed a satisfactory outcome with union rate more than 90% [1, 4, 8, 9]. However, LISS is a relatively new implant and there is still limited literature support to determine its superiority over conventional implants.

In our study, the overall result was satisfactory. All fractures united and the outcome measures were good. However, we do not recommend the use of the short five-hole plate, as there were two complications involving the loss of proximal fixation of LISS. The osteoporotic bone made the purchase and fixation of the uni-cortical screws rather insufficient to secure stable fixation. The use of the shorter five-hole plate also reduced the working length of the implant and aggravated the problem. We recommend that in osteoporotic bone, it would be better to use a longer plate at the beginning so that it provides a longer working length



Fig. 3 X-ray at 1 month postoperatively, progressive loosening is seen

and, as a result, a more stable construct. Alternatively one could have bi-cortical screw purchase instead of the uni-cortical ones so as to achieve the same goal of more stable fixation. In our cases, revision operation was performed using longer screws to obtain purchases in both cortices and both fractures united after the revision.

Despite the two cases of failure of proximal screw fixation, there was no loosening of distal femoral fixation in our study. The same observation was also reported by Fankhauser et al. [1].

Our study was limited by its small sample size but brings the important message that fixation in osteoporotic bone in a geriatric population does present great difficulty. Randomized controlled study is necessary to address the issue as to whether LISS is superior to traditional implants. Following our study, we feel that LISS is an effective way to treat distal femoral fractures in the elderly. Special precautions should be taken if the bone is osteoporotic and secure fixation is questionable. A longer plate or bicortical screw fixation is recommended.

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