Minimal-invasive treatment of distal femoral fractures with the LISS (Less Invasive Stabilization System)

A prospective study of 30 fractures with a follow up of 20 months

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Background **There is no consensus on the best treatment of distal femoral fractures.**

Patients and methods **In a prospective study, we treated 29 patients with 30 distal femoral fractures with the Less Invasive Stabilization System (LISS) from 1997 to 2000. Almost 1/2 of them had open fractures, 1/3 extraarticular type A and 2/3 articular fractures type C (AO classification) and these had been caused by high-energy trauma with concomitant severe injuries or osteoporosis.**

Results **The follow-up examinations after mean 20 (13–42) months consisted of radiographs, and determination of the Lysholm Knee Score and Knee Society Score (KSS). The outcome correlated with the severity of the fracture, anatomic reduction, exact positioning and fixation of the LISS and concomitant injuries.**

Interpretation **We found the LISS for treatment of distal femoral fractures of all types to be a safe procedure with good results after careful planning and experience with this surgical technique. There is usually no need for primary cancellous bone grafting.**

Distal fractures of the shaft of the femur, whether they are caused by high velocity trauma or osteoporosis, are treated in many ways. At present, there are improved versions of the dynamic condylar screw (DCS), the condylar plate (CP), the Burri supporting plate and/or screw osteosynthesis alone (Mueller et al. 1992). The Less Invasive Stabilization System (LISS), the retrograde femoral nail (Siliski et al. 1989, Leung et al. 1991, David et al. 1997) and the external fixator permit fixation with less exposure (Marsh et al. 1997).

The LISS, developed by the AO/ASIF, is a plate formed to approximate the anatomy of the lateral femur that can be inserted through a small lateral incision from distal to proximal between the lateral vastus muscle and the periosteum. This is supposed to bridge the supra/diacondylar fracture zone as an internal fixator, and does not require extensive dissection of the bone fragments. The length and position of fixed-angle screws are precisely determined before surgery and depending on the bone quality, should also hold well enough even with monocortical anchoring (Frigg et al. 2001, Kregor et al. 2001, Marti et al. 2001).

Fractures type AO-33A1-C3 are an indication for this new implant (Mueller et al. 1990).

We prospectively studied this procedure in 29 patients.

Patients and methods

In the period 1997–2000, we stabilized 30 fractures of the distal femur in 29 patients (16 women) with LISS. Their average age was 57 (18–92) years, 65 years in women and 48 years in men. 17 fractures were caused by a traffic accident; in 9 patients, a motor-cycle was involved and in 7, an automobile. 1 had bilateral supracondylar fractures caused by high energy trauma after a crash with a lorry. 12 patients (8 women) were injured in a fall from standing height.

10 fractures were AO type A and 19 fractures type C. 16 fractures were of the intraarticular complex type C3.3 (n = 10) and C3.2 (n = 6). None was a type B fracture. 14 of the fractures were open, 3 grade I, 9 grade II, and 2 grade III, according to the AO classification (Mueller et al. 1990).

15 patients sustained multiple injuries in traffic accidents. 5 were ipsilateral and 4 contralateral leg fractures, 3 contralateral fractures of the femur, 2 tibial plateau fractures and 3 malleolar fractures. 11 patients had a concomitant head injury.

8 patients were transferred to our university medical center after receiving primary care in other hospitals.

Treatment

The average time from the accident to the operation was 4 (0–17) days. 16 fractures were stabilized within one day, 7 within the first week. The remaining 6 patients had been injured in high-energy accidents and, because of severe concomitant injuries, their fractures were first treated with an external fixator and definitively stabilized with LISS more than a week after the accident.

Before surgery, the lengths of the LISS (5-, 9-, 13-hole plate) and the condyle screws were determined from a radiograph with a template and a calibration plate. Standard length (26, 40, 55 mm) mono- or bicortical fixed angle screws were used in the shaft area.

The approach was lateral or parapatellar or, when the joint was involved, as for an anterolateral parapatellar arthrotomy, so that joint fragments could be reduced and fixed with screws first.

The patient was placed with the knee supported, the supracondylar fracture was reduced manually and temporarily fixed with Kirschner wires and, in 2 cases, a temporary external fixator.

The plate was inserted along the femoral shaft, under control with an image intensifier, from distally to proximally with the aid of an insertion handle that also served as a target device for the percutaneous application of the proximal shaft screws. The plate was temporarily secured with Kirschner wires. Then the self-drilling/self-tapping screws were applied to the condyle and finally to the shaft with the target device.

Continuous passive motion (CPM) and physiotherapy with passive motion were started soon after surgery. Weight-bearing was decided individually.

The average length of hospitalization was 22 (5–61) days, and mainly depended on the presence of concomitant injuries.

Follow-up

During a mean period of 20 (13–42) months complications, clinical and radiographic findings were followed prospectively. 23 patients underwent a standardized follow-up examination, consisting of radiographic and clinical findings assessed with the Knee Society Score (KSS) (Insall et al. 1989) and Lysholm Score (Krämer and Maichl 1993). 2 patients were lost to follow-up, they died after 8 and 11 months from unrelated causes (pneumonia, heart failure); in 4 cases the data were obtained from the history and radiographic findings.

Results

Callus formation was seen after a mean of 5 (4–11) weeks and bony consolidation after 12 (8–23) weeks. The time until the fracture could bear full weight ranged from 6–18 weeks, depending not only on the healing of the fracture, but also on concomitant injuries and the patient's age.

The mean KSS score was 131 (79–200) and the mean Lysholm score 71 (43–100). 6 patients had no pain, 10 occasional slight pain, 9 reported occasional moderate pain and 2 patients had constant moderate pain.

The mean range of movement was 113° (90°–140°) in type A fractures and 101° (60°–130°) in type C. The loss of extension was 4° (0°–10°) in type A fractures and 9° (0°–15°) in type C.

Instability was reported by 6 patients and, with the exception of 2 patients with concomitant injuries of the anterior cruciate ligament, this was clinically classified as lateral instability during varus stress with a maximum at 30° of flexion.

3 patients had to be reoperated on because the plate had become loose. In the first operation, monocortical short 26 mm screws were used in the proximal shaft; these were replaced by bicortical screws. 2 5-hole plates and 1 9-hole plate were replaced by longer plates.

In 1 patient, healing was delayed and the screws became loose; healing was obtained after the screws

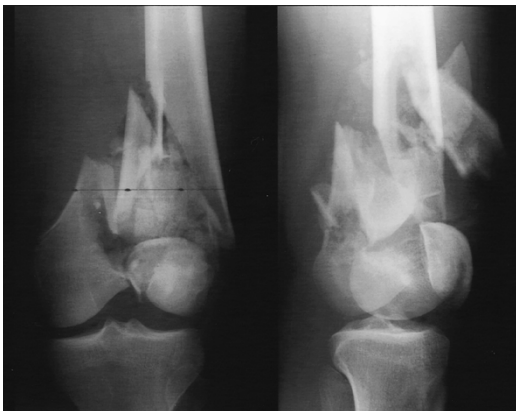

Figure 1. C3.3 supradiacondylar femoral fracture.

Figure 2. Loosening of the 13-hole LISS proximaley in the shaft after monocortical anchoring.

were changed and the spongious bone grafted. In 2 more patients, the monocortical screws in the shaft loosened early (once after another fall) and were replaced by bicortical fixed angle and 4.5 mm cortical screws (Figures 1, 2, 3).

At the time of the follow-up, 7 implants had been removed, mainly because of pain over the iliotibial tract. In each of these cases, the implant had not been made to fit the 10° angle of the lateral surface of the distal femur. In 2 patients, the knee was mobilized when the metal was removed.

Figure 3. Refixation of the LISS with bicortical fixed angle and 4.5 mm cortical screws.

Discussion

Several papers have dealt with the correct choice of implant, technical difficulties and LISS-specific complications (Marti et al. 2001, Schandelmaier et al. 2001, Schuetz et al. 2001). In our group of patients, we relied on closed reduction, using manual methods that require protection from radiation and involve reduction with the aid of the implant itself and the insertion handle. With comminuted fractures, the danger of rotation, varus and valgus malpositionings and shortening can not be avoided even if the shape of the implant largely fits the distal lateral femur.

With intraarticular fractures that require precise open repositioning and fixation, care must be taken to place the separate screws so that they do not collide with the fixed-angle screws of the LISS in the condyle. It is important not to let the plate tilt away from the condyle, which is at about a 10°

Figure 4. C3.3 supradiacondylar femoral fracture.

Figure 5. Stabilization with a 9-hole LISS after fixation of condylar fragments with screws.

angle to the sagittal plane. Otherwise the patient may have pain over the iliotibial tract. This was the main reason why implants had to be removed from our patients.

Figure 6. 9 months postoperatively and complete bony consolidation.

The anchoring of the LISS in the condyle is very reliable. Even with osteoporotic bone, the distal end of the plate never loosened. When the plate loosened or became displaced, it was because the lever-arm of the leg or the bone quality had been misjudged, or the plate and screws were not in the correct position, tangential to the shaft. With osteoporotic bone or comminuted fractures, we recommend a medium or long LISS and perhaps bicortical anchoring of the shaft screws.

Our findings indicate that primary cancellous bone grafting as proposed by some authors (Giles et al. 1982, Mize et al. 1982), is not necessary with LISS (Figures 4, 5, 6). This accords with other reports (Schuetz et al. 2001).

The results in terms of the clinical KSS and Lysholm scores as well as the radiographs show that the outcome depends primarily on the etiology of the fracture, the severity of the injury, concomitant trauma, bone quality and the time elapsed from injury to surgery.

Intraarticular type C fractures tend to have poorer results as regards pain and function more because of the nature of the injury than to the implant, which limits movement and causes loss of strength more than instability.

Despite the large number of open and comminuted fractures, such serious complications as deep infections, vascular lesions, deep venous thromboses or pseudoarthroses were not a problem. This was due to therapy that included debridement and antibiotic prophylaxis and above all, emphasis on minimally invasive osteosynthesis without excessive denudation of bone fragments and careful handling of soft tissue (Farouk et al. 1998, 1999, Henry 2000).

If the plate needs to be removed later, minimally invasive extraction will usually be impossible, especially when there is bony overgrowth proximally. Nonetheless, we had no complications after removal of the plate.

No competing interests declared.

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