Failure of Distal Femoral Locking Plate: Case Report

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Abstract: The Less Invasive Stabilization System (LISS) and titanium distal femoral locking compression plate (DF-LCP) was designed by the AO Group to combine the advantages of both interlocked intra-medullary nailing and biological plating techniques in one system. The stiffness of the construct is similar to a 95° condylar plate, dynamic condylar screw, or condylar buttress plate.

We report a case of the DF-LCP and screw breakage. Early weight bearing and lack of callus consolidation precipitated failure of the implant. Non-weight bearing and early autologous bone grafting may be indicated in open distal femoral fractures.

Keywords: Distal femoral fracture, plate failure, distal femoral locking compression plate, screw breakage.

INTRODUCTION

Requirements for intra-articular fracture fixation are to ensure anatomical reduction and stable fixation of the intra-articular fracture components, along with the fixation of the articular block to the shaft to restore the mechanical axis of the limb [1].

The Less Invasive Stabilization System(LISS) was designed by the AO Group to combine the advantages of both interlocked intra-medullary nailing and biological plating techniques in one system [1]. The advantage of a locking device for the distal femur is increased stability in torsion and axial loading. The device implements a fixed angle support for metaphyseal fractures and osteopaenic bone and anatomical preshaping of the fixator improved fit on the bone, becoming an internal fixator [1]. The angular stability between the screws and plate no longer requires compression between the plate and bone for secure anchoring [2]. Thus, blood supply to the bone under the fixator is preserved [1]. The anatomically shaped buttress plate is anchored with self-drilling, self-tapping, uni-cortical screws. The stiffness of the construct is similar to a 95° condylar plate, dynamic condylar screw, or condylar buttress plate [1]. Further development of the LISS plate resulted in the titanium distal femoral locking compression plate (DF-LCP).

Local complications include nonunion, delayed union, implant loosening, implant breakage, infection, heterotopic ossification, restricted movement, rotational and angular deformities [2]. Button *et al.* reported four cases of LISS failure, of which two were plate breakages [3]. Schandelmaier *et al.* followed 40 patients with one breakage of implant [2]. There have been no reported cases of DF-LCP failure in current literature.

We report a case of the DF-LCP and screw breakage. There have been 15 cases of DF-LCPs implanted in 18 months prior to this complication.

CASE REPORT

A 45-year-old lady presented to us after a motor-vehicle accident. She was a pillion rider on a motorcycle, which was hit by a car. She sustained a left Gustilo type IIIB open, comminuted supra-condylar femur fracture with inter-condylar extension (AO type 33 C2). There was no significant past medical history.

Wound debridement was performed within four hours. Antibiotics were administered for two weeks, during which skeletal traction was employed.

Two weeks later, she underwent open reduction, inter-condylar lag screw fixation and biological plating with the nine hole titanium DF-LCP via a lateral approach under fluoroscopic guidance. She was discharged well after four days with non-weight bearing crutch walking.

Subsequent reviews showed good wound healing with knee range of motion (ROM) from 0-110°. Three months post fixation, she was ambulating with a walking frame but there was no evidence of union. She then underwent bone grafting utilising autologous bone and bone substitutes. The intervening fibrous tissue at the fracture ends was excised.

Two months post grafting, she walked into our clinic with minimal callus posteriorly at the fracture site. A month after, she presented with pain, swelling and

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shortening following a trivial fall. This occurred about six months after the initial fracture fixation.

Figure 1: Broken implant x-ray.

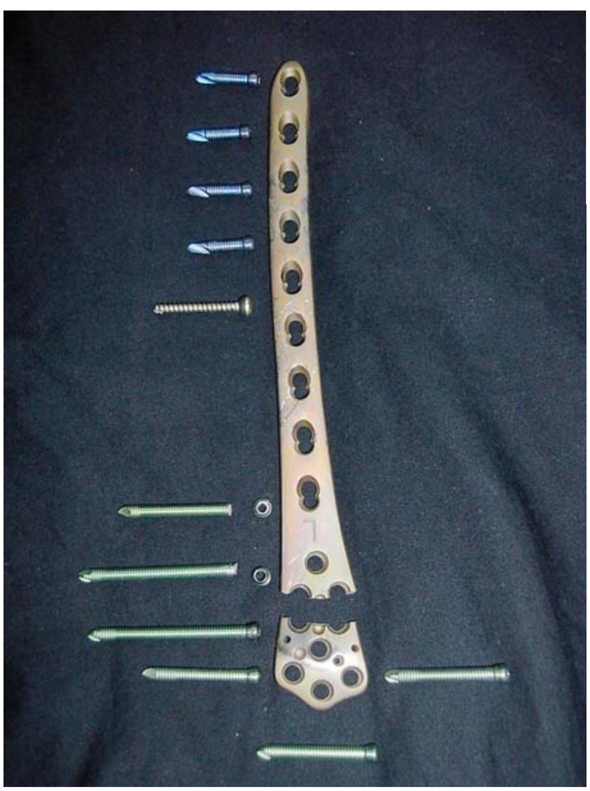

Figure 2: Broken implant.

Radiographs revealed plate and screw breakage at the distal femoral fixation part (Figures **1** and **2**). Revision of the plate fixation and bone grafting with local intra-medullary cortical struts and cancellous chips was done (Figure **3**). The previous bone substitute had not formed any callus and was removed. There was no obvious loosening of the implant but there was blackish discolouration of fibrous tissue over the screws - pathological investigation reported it as consistent with black dye deposition. The broken implants were tested by the Dr. h.c. Robert Mathys Stiftung Foundation and the failure was attributed to overload and fatigue.

Figure 3: Immediate post revision.

We discharged her with strict non-weight bearing instructions and eight months later, there was clinical and radiological union (Figure **4**). Physiotherapy consisted of quadriceps and hamstrings strengthening with ROM exercises. Non-weight bearing ambulation was taught including stair climbing. Knee ROM was 0-135°. At eight months, she was on full weight bearing with no ligamentous laxity, rotational or angular deformity. However, there was a shortening of four centimetres and Ilizarov lengthening has been offered. The shortening was performed during the revision surgery to gain apposition of the bones. However, she declined any further surgery as she was able to walk with a short limb gait.

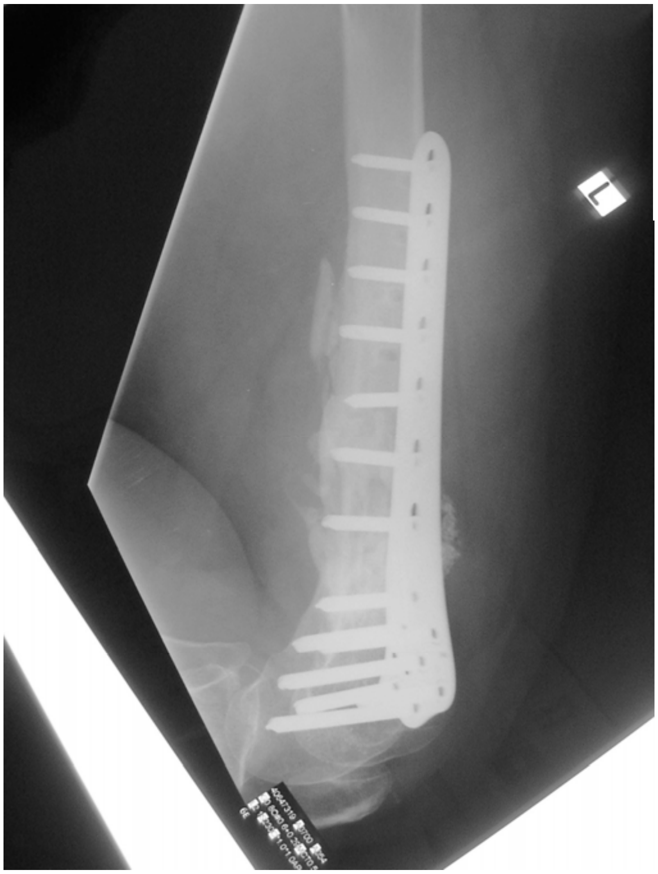

Figure 4: Eight months post-op.

DISCUSSION

The LISS-DF is made from forged Ti-6Al-7Nb alloy. Biomechanically, under the most unfavourable conditions investigated, one single screw is able to sustain a load comparable to one body weight for 2,000,000 cycles [1]. While each individual 50-millimetre uni-cortical screw has only approximately 60% of the normal pullout strength of a bi-cortical screw, the entire LISS is designed to be overall more stable than a conventional plate system. This is because essentially no screw toggling can occur. Failure is usually due to screw pullout of the bone, which happens in the proximal part of the fixation [2]. Biomaterials of the LISS-DF and the DF-LCP are similar. The difference lies in the shaft screw holes, which are circular in the LISS-DF but oval with compression and locking segments in the DF-LCP.

In our patient, a combination of factors led to the breakage. Although bone grafting was performed, the bony deficit persisted. In addition to that, she started weight bearing before fracture consolidation. Plate breakage occurs when bony defects are radiographically evident [3]. Lack of callus consolidation precipitated cyclical overloading of the implant, which eventually failed.

The fatigue resistance of titanium is inferior to stainless steel and fatigue plate fractures occur at the sides of a screw hole. The titanium screws also show typical fatigue fractures at the junction of the shaft and head. This section is subjected to a combination of loads, including torque and bending.

The use of titanium implants in conditions of some biomechanical instability may leave metal debris in the soft tissue due to the higher tendency of titanium implants to undergo wear in fretting conditions. This was evidenced by the black dye deposition. So despite the DF-LCP being rigid, it demonstrates some instability.

Due to preservation of blood supply via the periosteum, there is a reduced need for bone grafting [2]. However, we agree with Button et al about the need for earlier bone grafting [3].

This case report is to highlight that in conditions of comminution and lack of structural bony support, early bone grafting and protected non weight bearing is essential to avoid implant breakage which may occur without screw pullout. In conclusion, as far as we are aware, this is the 1st case report of DF-LCP breakage with concomitant screw breakage.

ACKNOWLEDGEMENTS

None.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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