FIXATION OF SUPRACONDYLAR FEMORAL FRACTURES: A BIOMECHANICAL ANALYSIS COMPARING 95º BLADE PLATES AND DYNAMIC CONDYLAR SCREWS (DCS)

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ABSTRACT

Objective: To determine, by means of comparative biomechanical tests, whether greater compressive load resistance and flexion is presented by 95º angled blade plates or by dynamic condylar screws (DCS), and to correlate the failure type presented during the tests with each type of plate. Methods: Sixty-five porcine femurs were subjected to 1 cm medial wedge osteotomy, in the metaphysis, to simulate an unstable supracondylar femoral fracture. Osteosynthesis was performed on these pieces: 35 were fixed using 95º lateral blade plates and 30 with DCS plates. Another variable studied was the failure type presented in each group, in an attempt to correlate this with the type of plate. Results: There were no statistically significant differences in biomechanical resistance between the two types of plates, or between the failure type and the plate type used for the osteosynthesis. Conclusion: The two types of plate behaved in a similar fashion. However, the angled blade plate proved to be superior to the DCS in the flexion test. No statistical difference in failure type or type of plate used was observed.

Keywords - *Femoral fractures; Fracture fixation, internal; Biomechanics*

INTRODUCTION

Fractures of the supracondylar region of the femur are complex lesions that are usually difficult to treat. They correspond to approximately 7% of all fracture of the femur and to 31% of them, if fractures of the proximal femur are excluded[(1)]. The most frequent cause among the elderly population is falls from standing height with the knee flexed, while among young patients, it is high-energy trauma (traffic accidents and falls from a height), which generally lead to varus, valgus or rotational forces with axial loading. Ligament injuries may be associated with around 20% of these cases[(1)], along with fractures of the acetabulum, the femoral neck or diaphysis and the tibial plateau.

One peculiar characteristic of such fractures is the deformation caused by the different muscle groups that act on the knee (quadriceps, ischiotibial, gastrocnemius and adductor muscles). This leads to deviation of the fragments, particularly in situations of hyperextension due to the action of the gastrocnemius, with the need for open reduction and internal fixation.

Controversy still exists concerning which method is best for supracondylar fractures of the femur. Several implantation methods are used for fixation of this type of fracture, but without any consensus regarding the method that would be most stable biomechanically. In addition to retrograde intramedullary fixation, plates with blades angled at 95º and dynamic condylar screws (DCS) have been highlighted.

Blade plates provide excellent fixation and are considered to be the method presenting greatest resistance to angulation and torsion forces, despite the greater technical difficulty[(2-3)]. On the other hand, because DCS are thicker than blade plates, they theoretically cause

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greater bone destruction(2). Studies comparing DCS with retrograde and anterograde intramedullary rods have shown conflicting results(4-7).

The aim of this study was to compare the biomechanical rigidity of internal fixation performed using 95º blade plates and DCS, in a simulation of unstable extra-articular supracondylar fractures in porcine femurs, and to correlate the types of plate with the type of failure, i.e. whether this was in the bone (fracture) or in the material used (loosening on breakage of the implant). These implants were chosen because they were the types most commonly used for treating the type of fracture that we study in our setting.

METHODS

Sixty-five femurs from pigs of the Landraz breed, of mean age 90 days, were selected for the experiment. The bones were stored at a temperature of -18ºC and then were placed at room temperature 12 hours before the fixation procedure.

Sixty-five plates were used for fixation of the femurs. Al of them had five orifices: 35 with a blade angled at 95º, of 55 millimeters (mm) in length, and 30 with DCS of 55 mm in length. The fixation at the most distal hole in both plates was performed using a spongy bone screw and three cortical bone screws were used in the proximal holes, while the hole corresponding to the region of the osteotomy was left without fixation. The osteotomy was performed around 4 cm from the joint surface. For osteosynthesis, the principles and techniques of the AO/ASIF group were used(8), using plates and screws produced by the company I.O.L. Implantes Ltda.

After fixation of the femurs, wedge osteotomy was performed, with medial subtraction of 1 cm of material in the distal metaphysis region of the femur, using a oscillatory nitrogen saw, with the aim of creating an unstable supracondylar fracture (without medial support) (Figure 1).

The bones were again stored at a temperature of approximately -18ºC after fixation. Twenty hours before starting the experiment, they were transferred to a refrigerator at a temperature of around 4ºC, and then, one hour before the tests, they were left at room temperature.

To carry out the biomechanical test, the installations of the mechanical test laboratory of the Nuclear Technology Development Center of the National Nuclear

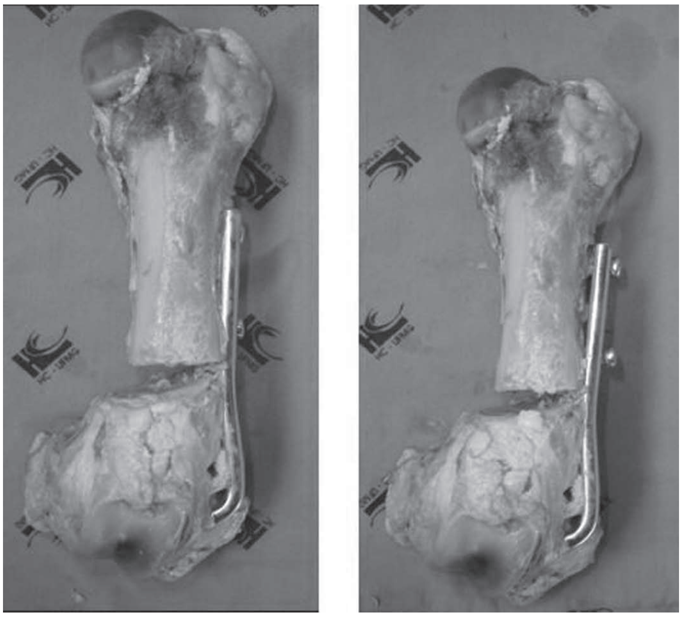

Figure 1 – Fixed specimen subjected to wedge osteotomy with medial subtraction, before and after the flexion test

Energy Commission (CDTN/CNEN) were used. The specimens were subjected to axial compression loads and flexion loads in the *Instron TTDML®* universal test machine (Canton, MA, USA), with a maximum capacity of 10 tons (Figure 2).

Metal supports were constructed to ensure a perfect fit for the specimens in the test machine while applying the loads, with the aim of avoiding any type of movement that could falsify the point of mechanical failure. In the compression test, no contact between the supports and the synthesis material was allowed, in order to avoid inappropriate transmission of the loads that were applied to the combined plate and bone. In the flexion test, it was sought to apply the load to the middle third of the diaphysis, on the cortex diametrically opposite the synthesis material (Figure 3).

The specimens were randomized into four groups according to the type of fixation and the type of test used. Thus, 20 specimens with fixation using blade plates and 15 using DCS were subjected to flexion loads, while 15 with fixation using blade plates and 15 using DCS were subjected to axial compression loads.

After correctly positioning the specimens, they were subjected to loads that were progressively increased at a rate of one centimeter per minute (cm/min). The loads, which were measured in kilogram-force (kgf), were plotted on analogue graphs as far as the point of mechanical failure. This was defined as a change in the