

Supracondylar Femoral Fractures: Evaluation of Complications Between two Methods of Fixation (DCS Plate vs Retrograde Endomedullary Nail)

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Abstract

Introduction: Supracondylar femoral fractures (SCFF) are associated with high energy mechanisms in young patients and low energy in older adults. Surgical treatment is controversial since current clinical evidence does not recommend one surgical technique over another. The objective was to compare rates of implant failure (IF), local and systemic complications in extra-articular SCFF managed with dynamic condylar screw plate (DCS) versus retrograde nailing (RN).

Materials and Methods: Retrospective cohort. Surgical files were reviewed and included patients with SCFF, treated with DCS or RN between 2011-2015 in a center by the same surgical team. Demographic data, mechanism of injury and radiographic consolidation were assessed. The IF was defined as non-radiological consolidation after 9 months, the need for revision surgery or deep infection. The rate of implant failure and local and systemic complications were compared.

Results: 32 patients met the selection criteria. In the DCS group (14 patients), 64.2% of the fractures were caused by civilian gunshot injuries, the implant failure rate was 28.5% and 7.1% presented thromboembolic events. Of the RN group (18 patients), 72.2% of the fractures were caused by civilian gunshot injuries. The implant failure rate was 0% and 5.5% presented thromboembolic events. The implant failure rate with DCS was significantly higher, without differences in the rate of other complications.

Conclusions: The RN had a significantly lower failure rate than DCS in the treatment of SCFF fractures, with a similar rate of local and systemic complications.

Keywords: Extraarticular; Distal Femur Fracture; Implant Failure; Dynamic Condylar Screw; Retrograde Nailing; Gunshot Injuries

Introduction

Supracondylar femoral fractures (SCFF) constitute 1% of adult fractures and up to 6% of all femoral fractures; they are associated

with high-energy mechanisms in young patients and low-energy in older adults [1-3]. The conservative management of these fractures increases the risk of institutionalization and loss of self-sufficiency

[4] and mortality is similar to that of the hip fracture; a surgical delay greater than four days increases the 6 and 12 months mortality, reaching up to 30% according to some series [5].

These lesions require surgery in their great majority ^{6,7}, representing a therapeutic challenge for the need of a correct reduction and stability to avoid the high rate of complications described [1,8]. Scientific evidence in the management of these fractures is scarce and of low quality [9,10] due to a stratification deficit in the type of patient and the type of fracture involved. Regarding the osteosynthesis technique, retrograde nailing (RN) has been shown in some studies to be comparable with plates [11,12], and others have shown they would be biomechanically superior to DCS and locking plates [13]. Clinical studies comparing DCS with RN show that functional outcomes, quality of life (functional and mental) indices, as well as non and mal-union rates would be similar between the two techniques [9,12,14], however there is no high-quality clinical evidence to support one technique over the other [8-10]. The objective of this study was to compare the failure rate, local and systemic complications of the use of DCS vs RN in patients with SCFF. Our hypothesis is that the use of DCS for the treatment of SCFF is associated with a higher failure rate, local and systemic complications vs RN.

Material and Method

Retrospective cohort study of all patients diagnosed with SCFF (AO-OTA 33-A) operated between the years 2011-2015, in the same center and by the same medical team. Inclusion and exclusion criteria were applied (Table 1), within the latter category we considered patients with immature skeleton, immunosuppressed, previous bone deformity, articular fractures, pathological bone fractures, floating knee, bilateral fractures and periprosthetic fractures. Two patients presented vascular lesions that required surgical repair and one patient presented a lesion of the posterolateral corner of the knee, so they were excluded from the cohort.

The surgical stabilization was performed with DCS® (DePuy Synthes) in group 1 and with non-reamed RN (DFN® - DePuy Synthes) in group 2.

The DCS is a two-part device with a stable bond, which is used to attach the distal femoral condylar mass to the diaphysis by means of a distal screw and a support plate that attaches the proximal fragment.

Inclusion criteria	Exclusion criteria
Patients > 15 yo	Immature skeleton
Extraarticular fractures	Articular fractures
Osteoporotic bone	Pathologic fracture
Gunshot wound fractures	Neurovascular lesions
High and low energy trauma	Previous bone deformity
Alcohol and poly-drug use	Floating knee
Pre and postop images	Immunodepression
Follow-up > 12 months	Bilateral fractures
Smoking	Periprosthetic fractures

Table 1: Inclusion and exclusion criteria.

The guide for DCS is placed 2 cm proximal to the distal end of the femur. In the lateral view, the distal femur is divided into thirds and the DCS entry site is at the junction of the anterior and middle thirds. Once the screw is inserted, the plate cylinder is passed over the screw rod allowing the plate to be anchored.

Group 2 was fixed by RN. For the insertion of this implant, a 2 cm longitudinal incision is made distal to the lower pole of the patella, on the middle line of the patellar tendon, then the medullary canal is opened, the nail is inserted and blocked distal and proximal with locking screws.

Regarding the choice of implant, the first years of practice (2006 to 2011) the tendency was to use DCS® and due to the high failure rate it was decided to use a different implant for the same type of fractures. Clinical records and images were reviewed to obtain demographic data, mechanism of injury, clinical follow-up, and to record immediate and late postoperative complications. The primary result was the rate of implant failure, defined as the need for reintervention due to lack of radiological consolidation in 9 months, osteosynthesis failure or deep infection. The secondary results were local complications (wound infections and dehiscence) and systemic complications (fat embolism and thromboembolic disease (TE)).

The demographic and mechanism of injury differences between the groups were studied and a comparison of the primary and secondary results was made. The statistical analysis was performed using STATA v 12.0 and the T test was used for the continuous variables. The study was approved by the institutional ethics committee.

Results

Fifty-six patients with SCFF (AO 33-A) were operated between 2011 and 2015, of which 32 patients met the selection criteria (Figure 1). In Group 1 (DCS): 14 patients (44%) and in Group 2 (RN): 18 patients (56%).

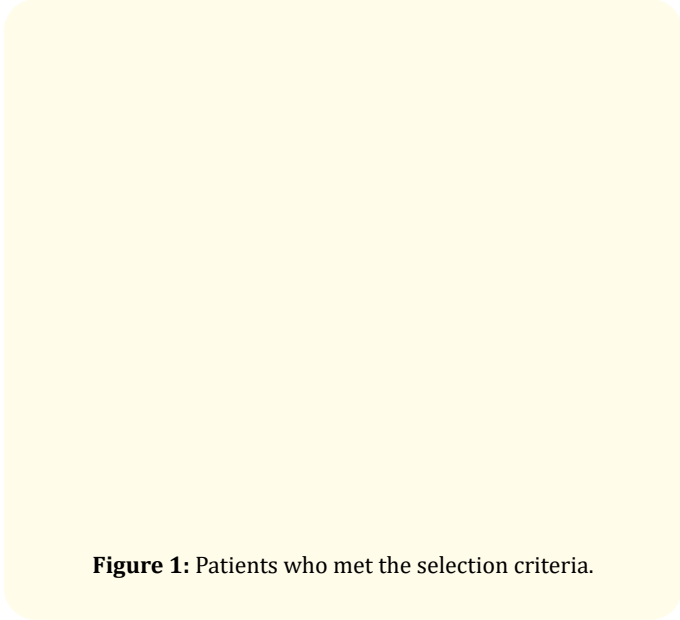


Figure 1: Patients who met the selection criteria.

Both groups were comparable in age, gender and comorbidities, however in group 1 (DCS) there was a nonstatistically significant trend of higher drug use (p = 0.06). The demographic characteristics are detailed in table 2.

	GROUP 1: DCS	GROUP 2: RN	P VALUE
n	14	18	
Age (mean)	42.1 (17-72)	38.4 (16-79)	0.2688
Women n (%)	4 (28.5)	5 (27.7)	0.99
≥ 60 yo n (%)	2 (14.2)	2 (11.1)	0.63
DM (%)	2 (14.2)	1 (5.5)	0.54
Drug user (%)	8 (57.1)	4 (22.2)	0.06

Table 2: Demographics.

DM: Diabetes Mellitus, p value < 0.05.

Gunshot fractures were the most frequent injury mechanism in group 1 (DCS) and group 2 (CEMR), with 64.2% and 72.2%, respec-

tively. There were no statistically significant differences between mechanisms of injury between the two groups (Table 3).

	Group 1: DCS	Group 2: RN	p value
n	14	18	
Gunshot fracture n (%)	9 (64.2)	13 (72.2)	P = 0.45
MVA n (%)	1 (7.1)	2 (11.1)	
Hit-and-run n (%)	1 (7.1)	2 (11.1)	
Simple fall n (%)	2 (14.2)	2 (11.1)	
Other n (%)	1 (7.1)	0	

Table 3: Mechanism of injury in groups.

MVA: Motor Vehicle Accident. p value < 0.05.

In group 1 (DCS) the rate of radiographic consolidation was significantly lower (71.4%) and the rate of implant failure significantly higher (28, 5%) (P = 0.0097) than in group 2 (CEMR), with 100% and 0%, respectively. All patients with implant failure required a revision surgery. There were no significant differences in the number of thromboembolic events (7.1% DCS vs 5.5% RN) and there were no local complications, such as infections, or fat embolism in any of the groups. The results are detailed in table 4.

	Group 1: DCS	Group 2: RN	p value
n	14	18	
Consolidation X-ray (n/%)	10 (71.4)	18 (100)	
Implant failure (n/%)	4 (28.5)	0	p = 0.0097
Mean Age	52.2	54	
Drug user	3		
Gunshot fracture	3		
Diabetes	1		
Infection (n/%)	0	0	
PE (n/%)	1 (7.1)	1 (5.5)	
DVT (n/%)	0	0	
Fat embolism (n/%)	0	0	

Table 4: Results.

PE: Pulmonary embolism, DVT: deep venous thromboembolism.

Discussion

The main outcome of this study was the significantly higher failure rate of osteosynthesis in the group of patients treated with DCS compared to RN. After one year of follow-up there were no cases of implant failure with the use of RN, and the percentage of thromboembolic events was comparable to fractures operated with DCS. When analyzing the causes of implant failure in the 4 patients (28.5%) who failed in group 1 (DCS), there were 2 cases of plate fracture, 1 case of plate bending and in the remaining case a failure of the shaft screws (Figure 2). Three of these 4 patients had a comminuted gunshot fracture and all had a history of poly-drug use. The remaining case corresponded to a woman older than 60 years, with a low energy trauma and history of diabetes mellitus.

Figure 2: Implant failure.

Among the possible causes that would explain a higher rate of failure in group 1 (DCS), is the biomechanical advantage granted by RN over DCS and locking plates as demonstrated by Heiney, *et al.* [13] in a study with synthetic bones of femur. In this study, all three methods of osteosynthesis were subjected to axial compression, and RN were significantly more rigid and with less micro-movement in the fracture site in models with supracondylar fractures (33-A) compared to LCP plates (locking compression plate) and DCS. Although the optimal balance between rigidity and micro-movement is not exactly known, it is known that excess

micro-movement can lead to non-union, mal-union or implant failure [15]. In our study, three of the 4 patients who failed in group 1 (DCS) were patients at higher risk, with drug abuse and fractures caused by gunshots. It is possible that in this context the patients did not follow the non-weight bearing instructions and being a less rigid implant and less resistant to the axial load they presented early implant failure.

Unlike our study, others show more comparable results. Christodoulou, *et al.* [9] compared the use of DCS with RN in 72 patients with closed and open SCFF (33-A and 33-C), with a mean age of 72 years. Although patients with RN had shorter surgical times and bleeding volume, this did not affect functional outcomes and union rates that were similar between both methods. A prospective randomized study of 68 closed SCFF (AO 33-A and 33-C) compared DCS with the retrograde suprapatellar nail. Patients were followed for 24-36 months, and although there were significant differences in surgical time and bleeding volume, no differences were found in time to consolidation, functional outcomes, and postoperative complications. Both previous studies have different demographic characteristics than ours. In the first [9], the population studied is of advanced age with mechanisms of fracture of low energy, without consumption of drugs and without gunshot wounds. In the second [14], the age group was similar, however, all cases corresponded to closed fractures with longer operating times in the RN. In our study most of the fractures corresponded to open fractures by firearms, which leads to greater initial damage of soft tissues. The DCS requires an open approach with periosteal stripping of the fracture site. This added to the biomechanical disadvantage in a population at risk, could explain the higher failure rate of this type of implant in our study.

In a recent systematic review of the Cochrane Journal [16], reference is made to 7 comparative studies. Three studies with 159 patients compared RN vs DCS or plate with fixed angle blade. None of these studies reported functional results. There were no differences in complications or quality of life between both implants. It is mentioned that the evidence is of low quality, mainly because the reviewed studies compare the implants in the distal femur without making differences in the features of fractures or the injury mechanism. Moreover, the rate of complications from TE and fat embolism are not mentioned in the studies reviewed. The review concludes that there is currently insufficient evidence to recommend

one fixation method over another and suggests that future studies should consider the stratification of fractures.

When analyzing thromboembolic complications between both groups, there were no significant differences, as well as no infectious complications in the patients in our study. Our series is similar to a study of 15 patients with a mean age of 27.8 years (18-52) with SCFF (AO 33-A) by firearms, in which all patients were treated with RN within 7 days. Patients were followed for one year, and no cases of superficial infection, osteomyelitis, or septic knee arthritis were reported [17].

Among the strengths of the study we can mention that we only included SCFF type 33-A in a retrospective, comparative cohort with identification of accident mechanism and risk factors. There are few studies in the literature comparing DCS with RN in which the majority of cases are by firearms. Although the number of subjects in our series was low, the populations were comparable to each other. This study was conducted in a highly complex facility whose operation depends on public health resources, with a limited budget, in which a method of osteosynthesis with a lower rate of failure and complications would not only impact the patient's well-being but would improve the cost-effectiveness of the surgical management of SCFF.

Study weaknesses: As a population with greater social vulnerability, with poly-drug use, the loss of postoperative follow-up was significant (29%). The low number of cases in this study does not allow for a power analysis, so the significant differences found between the two implants in this study should be taken with caution. Despite this, the difference in implant failure was clearly lower in patients with RN than in those with DCS, so it is recommended to use this type of implant as the first line in 33-A fractures according to the AO classification.

Conclusion

In this study, RN has a significantly lower failure rate than DCS in the treatment of SCFF, with a similar rate of thromboembolic and local complications.

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Conflict of Interest

The authors declare no conflict of interests, nothing to disclose.

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Ethical Approval

The study was approved by the institutional ethics committee.

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