Original Research Article

Comparative analysis of the functional outcome of distal femur fractures treated with Distal Femur locking Plate versus Dynamic Condylar Screw.

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Abstract

Back ground:Fractures of distal femur are more common in high velocity injuries and occur in middle aged men and old age women. Most fractures were comminuted. DISTAL LOCKING FEMUR PLATE[DLFP] appears to be technically an ideal implant for comminuted distal femoral fractures with proper physiotherapy produced excellent results. DYNAMIC CONDYLAR SCREW[DCS]appears to be relatively easy construct to fix in the distal femur fracture, however bulky implant, mandatory of 2 to 4cm Intact femoral condyle for lag screw insertion and varus collapse of medial fragment in case of comminuted fractures, made this good implant only for Muller typeA.**Objective** - To evaluate the advantages, disadvantages and possible complications associated with fixation of distal femur fracture with distal femur locking plate versus dynamic condylar screw.**Material and methods** :This is a prospective, randomised comparative study done over 24 patients in NIMS hospital, Hyderabad during study period of 1year (2018-2019) in orthopaedic department.**Results**:In Type A fractures DCS produced better functional results when compare to DLFP in our study.Infection, knee stiffness and mal alignment of fractures were the common complication we encountered in our series in both DLFP and DCS, which could be tackled by surgical expertise, meticulous soft tissue handling, judicious use of antibiotics and vigorous early knee mobilization.**Conclusion:** DISTAL LOCKING FEMUR PLATE [DLFP] produces better results and appears to be a good method of choice for management of fractures of distalfemur.

Keywords :distal femur fractures, distal locking femur plate[dlfp], dynamic condylar screw[dcs].

Introduction

The incidence of distal femur fractures is a bout3% of all femur fractures in the adult population and about 0.4% of all fractures[1]. However, its distribution is bimodal, elderly population is more prone to distal femur fractures in association with fractures of the inter trochanteric region and the neck of femur on the ipsilateral side and internal derangement of knee[2].A significant population who sustain distal femur fractures also have an associated proximal tibia fracture whose incidence is as much as 15% in closed cases and ashighas 30% in compound fracture cases. These fractures usually involve the distal 15 cm of the femoral diaphys is and metaphysic[3]. The incidence of distal femoral fractures in osteoporotic women is comparatively more than men as the age increases. These fractures present with severe comminution owing to the high velocity injury sustained and lead to a difficult restoration of alignment, angular rotation and articular congruity invariably causing impaired knee range of motion[1].Although decades ago, conservative management was an option in treating such fractures, presently surgical management clearly gives a better outcome in most cases. Closed reduction as described by Watson Jones and John Charnley led to stiffness , angular deformities or shortening and needed prolonged immobilization [4,5].This prompted most surgeon for surgical fixation of fracture which allows early mobilisation, better range of motion, better union rates and early weight bearing.

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Aims and objectives

To compare the clinical, functional and radiological outcome of distal femur fracture fixed with distal femur locking plate versus dynamic condylar screw (DCS) using hospital for special surgery criteria.

To evaluate the advantages,disadvantages and possible complications associated with fixation of distal femur fracture with distal femur locking plate versus dynamic condylar screw.

Material and methods

Study design:This is a short term, prospective, time bound, hospital based, open label randomised comparative study.

Inclusion criteria:All patients who consented to be included in the study and who are above18 years of age with closed supracondylar & distal femur fractures extending up to 15 cm from distal articular surface including Closed, Grade I and Grade II compound distal femoral fractures with displaced A.O type A1, A2, A3, C1 and C2 fractures and injuries with preoperative active mobility were included in the study.

Exclusion criteria:All patients with displaced A.O B1, B2, B3 and C3 type fractures,Grade III open fractures,Pathological fractures, fractures in children with Skeletal immaturity, undisplaced fracture patterns needing only conservative management were excluded.

Sample size: The calculated sample size is 24. Therefore, a total of 24 patients were included in this study to achieve a significant

functional difference of at least 10% between the study procedures, assuming a significance of P<0.05 and power of 80%.
Study area:NIMS hospital, Hyderabad during study period of 1year (2018-2019) in orthopaedic department.

Observations/results

The Patients included in study were evaluated pre operatively and post operatively and instructed to review as stipulated and analyzed as per the following criteria based on their all variables.

1. Age distribution:The age groups varied from 18 years to 80 years with the mean age of 37.20 years. Incidence of fracture was observed maximum between 18– 25 years of age. More clusters found in 18-25 years.
2. Sex distribution:Among the 24 cases, males were predominant with female to male ratio being 1:3.42.
3. Side of injury:Right side was common in our series,17 out of 24 cases was having right sided injury.
4. Mode of injury : Among 24 cases , 20 cases were due to road traffic accidents and 4 cases due to accidental fall.
5. Muller Subtype Of Fracture:Out of 24 cases, distal femur fracture with inter condylar extension accounted for more of number of cases followed by isolated supracondylar fractures.
6. Associated Injuries:Associated injuries mostly involves ipsilateral limb injuries since most cases are due to motor vehicle accidents where involved limb dashed against opposite force causes ipsilateral both bones, proximal femur and posterior dislocations and pelvic injuries and spinal fractures.Many polytrauma patients were associated multisystem involvement like multiple rib fractures, hemothorax and head injury in the range from diffuse axonal injury to pnemocephalus and intra cranial hemorrhage based upon amount velocity of force of injury.
7. Open Fractures:There were five open fractures, one was compound grade I and other were grade II fracture. Since compound fractures will affect functional outcome in wound healing, infection, implant failure hence Grade III compound fracture not included in this study. Grade III compound injuries indirectly indicate that high energy and always involves other organs and other bone involvement and affect the functional results.In our study, 24 cases of distal femur fracture were operated with Open Reduction and internal fixation with Dynamic Condylar screw and Distal locking femur plate. 12 patients of distal femur fractures operated with DCS and 12 patients were operated with distal locking femur plate.Patientsare followed up at an intervalof 4 weeks sequentially andwere advised forknee range of motion by the end of 6-10weeks depending on fracture pattern.The minimum follow up period in our study was 5 months and maximum follow up period was 9months.Clinically,tenderness at fracture site, knee pain, limb length discrepancy,range of movements,any varus or valgus deformity were assessed ateach followup.Theresults were analyzed with standard anteroposterior and lateral radiographs. Clinical and radiological signs of union were analyzed at each followup.The fracture was said to be radiologically united if call us was seen in at least 3 cortices in anteroposterior and lateral views. The functional outcomes were analyzed using scoring system of Hospital for special surgery.Majority of injured patients were males (70.83%).This indicates that males are more involved in outdoor activities and Highest number of patients were in their 3rd decade ,Road traffic accident was the most common mode of injury (83.3%) 1 patients had associated distal radius fracture, 6 patient had ipsilateral tibial condyle, 4 patients had ipsilateral tibial shaft fracture, 1 patient had ipsilateral ankle fracture and 4 patient had patella fracture making a total of 16 patients (66.6%) with associated fractures Most of the patients, reported within 1st week of injury to the hospital.19 out of 25 patients had closed injury. Type C2 and A1 Muller fracture was the most commonfracturetype15out of 24 patients(62.5%).The shortest followup period was 5 months and the longest follow up period was 9 months. Maximum gain in knee flexion was 120° and minimum gain about 70°. Early complications were encountered in 4 patients and these were 2 patients developed superficial wound infection,1 patient developed wound gaping and 1 patient developed mild transfusion reaction. Late complications were observed like mal-union with varus in 1patient, knee stiffness in 5 patients and screw pull out in 1 patient. The average stay in hospital was about 7 days.Postoperative immobilization with knee brace was advised for severely comminuted fractures for 3 weeks along with gentle physiotherapy. Exercises were started earlier. Patients were followed at regular intervals (i.e, once in a month for the first 3 months and once every 3 months thereafter).5 patients treated with Dynamic Condylar Screw for distal femur fractures showed excellent, 4 patient showed good and 3 had poor result. 3 patients treated with distallocking femur plate showed excellent results ,6 patient showed good results and 3 had poor result as per Hospital for special Surgery score. 2 cases in Type A Muller showed poor results, of which one case had post operative wound infection, considered as superficial wound infection and treated with parenteral antibiotics. Patients discharged after wound found to be silent and healthy. After 4th months of follow up of same patient presented with infected wound and sprouting granulation tissue from the operative scar and diagnosed as infected implant. For this case a culture sensitivity has been obtained from the wound discharge and appropriate antibiotics were initiated and patient is in regular followup.Another patient had varus deformity of the operated limb and knee stiffness. Average knee range of motions in patients treated with DLFP was 94 degrees and in DCS was 100 degrees. Average time for radiological union in DLFP was 14.16 weeks and in DCS was15.33weeks.Mean followup in DLFP was 8.25 months and in DCS was7.66 months.All the patients remained painless in the postoperative period, except for 3 cases which had wound infection. Functionally all the patients discarded walking aid by 16 weeks and one patient was using heel and solerise.

Infection: One patient with dynamic condylar screw and 2 patients with distal locking plate was showing infection in the follow up.

Funtional Evaluation –USING HOSPITAL FOR SPECIAL SURGERY SCORE:

Mean HSS score for Dynamic condylar screw was 75.08 and for Distal locking femur plate was 79.25.

Function outcome of DCS AND DLFP BY USING HSS SCORE:

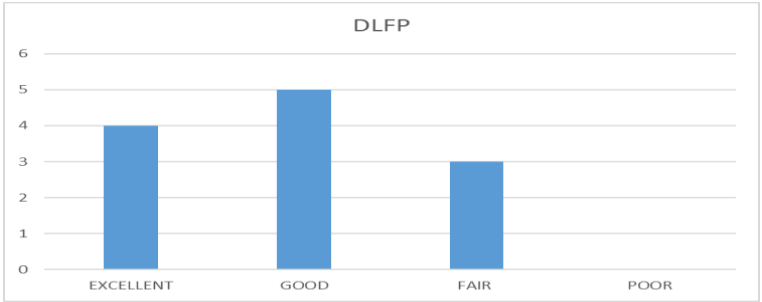

Fig 1:Function outcome of DCS AND DLFP BY USING HSS SCORE

Distribution of study population in relation to union in weeks:

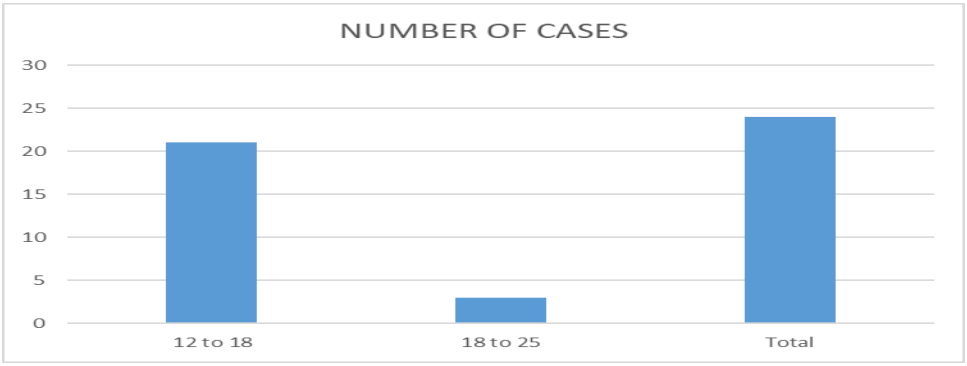

Fig 2:Distribution of study population in relation to union in weeks:

Results according to subtype of muller classification

Table 1: Results According To Subtype Of Muller Classification

MULLER'S SUBTYPE	FUNCTIONAL OUTCOME SCORE DLFP VS DCS							
	EXCELLENT		GOOD		FAIR		POOR	
	DLFP	DCS	DLFP	DCS	DLFP	DCS	DLFP	DCS
A1	1	4	1	-	-	-	-	1
A3	1	-		1	2	-	-	-
C1	1	-	2	-	-	2	-	-
C2	1	-	2	2	1	2	-	-
TOTAL	8		8		7		1	

Excellent and Good Results=16/24=66.66% Fair and Poor Results=8/24=33.33%
Excellent and Good Results in DLFP 9 out of 12=75% Fair and Poor Results in DLFP=3 out of 12=25% Excellent and Good Results in DCS=7 out of 12=58.3% Fair and Poor Results in DCS = 5 out of 12=41.6%

Table 2:Comparison of results

	Excellent and Good results	Fair and Poor results
Distal femur locking plate	9	3
Dynamic condylar screw	7	5

The difference in the functional outcome for distal femur fracture treated with distal femur locking plate versus dynamic condylar screw is insignificant. (likelihood ratio=0.756, p-value=0.66).

Table 3:Comparative results according to muller type a fractures

	Excellent and Good results	Fair and Poor results
Distal femur locking plate	3	2
Dynamic condylar screw	5	1

The difference in the functional outcome for distal femur fracture treated with distal femur locking plate versus dynamic condylar screw Muller's type A fracture classification is insignificant. (likelihood ratio=0.75, p-value =0.54).

Table 4:Comparative results according to muller type c fracture

	Excellent and Good results	Fair and Poor results
Distal femur locking plate	6	1
Dynamic condylar screw	2	4

The difference in the functional outcome for distal femur fracture treated with distal femur locking plate versus dynamic condylar screw for Muller's type C fracture classification is insignificant. (likelihood ratio=3.943, p-value=0.10)

Discussion

There have been changing philosophies to wards surgical treatment of supracondylar fractures of femur. Closed management of these fractures was the treatment of choice until 1970[5].This was due to non-availability of appropriate implants and lack of proper techniques. Apart from the usual problems of confining elderly patient to bed, conservative methods at any age may be complicated by knee stiffness, mal union and non-union[5].Early surgical stabilization can facilitate care of the soft tissue, permit early mobility and reduces the complexity of nursing care[6]. Open reduction and internal fixation has been advocated,using implants, including angled blade plate,fickle devices,Rushrods,Endernails,

Dynamic condylar screw, condylar buttress plate and interlocking nails, locking compression plate.The Distal Femur-LCP is a further development from the LISS,which was Introduced in the mid to late 1990' The main difference between the Distal Femur-LCP and the LISS is that the LISS utilizes an outrigger device for shaft holes, functioning essentially as a locking guide jig, which is attached to the distal part of the plate and guides the placement of the proximal locking screws. The shaft holes on the Distal Femur-LCP are oval allowing for the options of a compression screw or a locking screw. This leads to a more precise placement of the plate, as it is able to be compressed more closely to the bone. Distal Femur-LCP is designed to fit the anatomy of the distalfemur.This is the latest innovation in implants.Italso provides good and stable internal fixation. This can be easily used in distal femur fracture with intercondylar extension and it is user friendly [7,8]. The use of fixed angle devices such as condylar blade plate along with dynamic condylar screw (DCS) require certain amount of good bone stock should be there to insert Lag screw and also its entry makes significant amount of bone loss from lag screw entry site which itself compromise already fractured condyles hence it limits their use in some fracture type of intra articular fracture.In distal femur fracture without intercondylar extension it provides good rigid fixation. But if the fracture extends intercondylar region then the problem occurs significantly to have good rigid fixation [7,9]. Biomechanical studies revealed that gross loosening of standard condylar buttress plate and DCS occurred because of the toggle at the screw-plate interface, which leads early implant loosening results in breakage of implant and varus /valgus collapse of distal fragment [8,9].To address these issues, a first generation locking condylar plate was designed. A locking plate decreases the screw-plate toggle and motion at the bone screw interface and provides more rigid fixation. Rigid fixation is felt to be one key to the successful treatment of these fractures. The conventional plates are associated with their own demerits such as screw pull-out,implant failure and unstable fixation needing postoperative immobilization. Delay in postoperative mobilization results in stiffness of the knee which is an indicator of poor outcome. Fixation in osteoporotic and comminuted fractures which was difficult previously was addressed with the invention of locking condylar buttress plate[10]. So now with the evolution of locking compression plating for distal femoral fractures especially for the comminuted intra–articular fractures many of the older demerits could be addressed which includes the increased stability due to locking compression plating principle, multiple screw options in the distal fragment providing option for fixing the multiple fragments restoring the anatomical congruity and providing stable fixation of the distal fragment with the proximal fragment with resulting increased stability allowing for early mobilization[11]. Current fracture patterns which we encounter are complex comminuted types due to the prevalence of high speed vehicles mainly due to the high two wheeler population in countries like India. Improved healthcare results in a longer life span and subsequently presents us with more osteoporotic fractures which were previously treated using conservative methods. The LCP is a single beam construct where the strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness and pull-out resistance in unlocked plates. Its unique biomechanical function is based on splinting rather than compression resulting in flexible stabilization, avoidance of stress shielding and induction of callus formation. It can also be used as biological fixation without disturbing the fracture site.Comparable studies utilizing the Distal femur LCP demonstrate only short term results. Although the follow-up period of our series was short, studies have shown that early function is comparable to final long term outcome. The outcome seems to correlate with fracture severity, anatomic reduction, aetiology, bone quality,length of time elapsed from injury to surgery, concomitant injuries and the exact positioning and fixation of the implant.Furthermore, the initial severe concomitant cartilage damage may predispose to early osteoarthritis although there is no evidence of that yet.Of the 24 male cases 20 cases were due to RTA while travelling in a two wheeler. Of the 20 cases, 16cases (80%)involved the dominant Right side.One patient who had Type C1Muller fracture treated with DCS, immediate post op went well without any specific complaints but after 5 months follow up present with discharging wound and warmth from distal scar, it was communicated with deep structures. Pus culture sensitivity has been sent and fracture alignment maintained in acceptable position and hence planned for wound debridement after which fracture got united and Fair result was obtained.Overall there were7 fair results and 1poor result.The first one was an implant failure for type C fracture treated with DLFP. The fracture was in good alignment even after implant failure and hence conservative management with AK cast was done and resulted in a Fair result. The second one was the one with Muller's Type C2 fracture with severe comminution fixed with DLFP had decreased postoperative knee mobility and screws pull out was observed in follow up. One Patient with type A1 fracture treated with DCS was having severe osteoporosis hence early mobilization was delayed and was immobilized with AK cast result in poor outcome . When comparing infection rates among DLFP and DCS, 2 cases with DLFP and 1 case with DCS got infected but both showed similar functional results In Muller's C2 fractures due to the multiple screw options multiple fragments can be reduced with improved stability which cannot achievedbyusingtheconventional DCS which uses only one large lag screw. Also revision surgery can be done easily in LCP whereas in DCS if a revision surgery is planned the removal of the lag screw leaves a cavity in the condylar area which renders it difficult for fixation and even if fixation is done chances of failureismoredue to poor bone stock..Varus mal alignment was one of the complication which was encountered during the initial phase of the study. In the later phase of the study Varus mal alignment was low due to the technique of maintaining gap between the plate and the proximal fragment and hence the good alignment was maintained. Also using lengthier plates rather than using small plates resulted in reduced rate of this complication in the later part of the study.5 out of 6 case of Muller's type A fracture treated with DCS showed excellent and good result(83%) whereas in DLFP 3 out of 5 patients treated showed excellent and good results(60%).2 out of 6 cases of Muller's type C fracture treated with DCS showed excellent and good result(33%) whereas in DLFP 6 out of 7 patients treated showed excellent and good results(85%).Mean knee rom in patients treated with DCS was 100 degrees and for patients treated with DLFP was 94 degrees.Early kneerom started in DCS treated patients i.e.3weeks but inDLFP treated patients knee rom started at the end of 6 weeks which resulted in good knee rom outcome in DCS.The results of our study are comparable with other studies.The average radiological union time was 15.33 weeks ranging from 12-18 weeks in DCS group. Shewring et al 1991[12] showed that average union time was 11.3 weeks ranging from 6-16 weeks where as Iftikhar et al [13] showed average union time to be 15 weeks which is comparable with the present study.The average radiological union time was 14.16 weeks ranging from 12-16 weeks in DFLCP group. Schandelmeir et al in 2001and Markmiller et al in 2004 showed similar results having full radiological union was 14.3 and 13.8 weeks respectfully. So in our study we found that DFLCP has no better overall significant results. However, DFLCP had better results in Type C Fractures, though DCS was better in our study for Type A fractures[14,15]

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