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A Comparative Study of Management of Distal Femoral Fractures Managed by Dynamic Condylar Screw and Distal Femoral Locking Compression Plate

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Abstract

Background: *Distal femoral fractures are much less common than hip fractures and account for 7% of all femoral fractures.Distal femoral fractures are difficult to treat and ideal treatment of such fractures will include anatomical reduction, rigid fixation of articular surfaces and early mobilization of knee joint. Our study aims to compare the outcome of fifty distal femoral fractures which were treated by two different implants i.e dynamic condylar screw and distal femoral locking compression plate.* ***Materials and methods:*** *Fifty consecutive patients were included in the study with minimum followup of one year, twenty five of them were managed by surgery with dynamic condylar screw, so they were placed in group A i.e DCS group and another twenty five patients were managed by surgery with distal femoral locking compression plate hence placed in group B i.e DFLCP group. The assessment of result was done with criteria laid down by* ***Schatzker*** *and* ***Lambert*** *which was based on the union of fractures, amount of range of motion of knee joint and byassessing the complications of each implant.* ***Results:*** *In the present study, in both the DCS and DFLCP groups showed 76% of patients with good or excellent results. Based on type of fracture, for Type-A fractures, in DCS group total of 91% patients had good to excellent results, whereas in DFLCP group, total of 80% patients showed good to excellent results. For Type-B fractures, in both DCS and DFLCP group total of 80% of cases had good to excellent results. For Type-C fractures, under DCS group, 55% cases had well to excellent results and in DFLCP group 70% patients had well to excellent results.* ***Conclusion:*** *It was concluded that dynamic condylar screw and distal femoral locking plate have similar results except that distal femoral locking plate is better in comminuted distal fractures.*

Keywords: Dynamic condylar screw (DCS), Distal femoral locking compression plate (DFLCP), supracondylar and intercondylar fractures.

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INTRODUCTION:

Fractures of the distal femur whether supracondylar or intercondylar have been historically difficult to treat because of their unstable nature and degree of comminution. The proximity of these fractures to knee joint further makes full range of motion and function difficult. The incidence of malunion, nonunion, and infection is also high **(Chiron *et al*., 1974)**.

Distal femoral fractures are much less common than hip fractures and account for 7% of all femoral fractures. Anatomical reduction of the articular surface, restoration of limb alingement and early mobilization have shown to be effective ways of managing most distal femoral fractures. Despite the advances in techniques and the improvement in surgical implants, treatment of distal femoral fractures remained a challenge. Long term disability can occur in patients with extensive articular cartilage damage, marked bone comminution and severe soft tissue injury **(Schatzker*et al*., 1998)**. Osteoarthritis may occur if intra-articular step is 3 mm or more. The various methods used earlier for stabilization of distal femoral fractures were:-Closed reduction and casting, Skeletal traction alone, Angled blade plate **(Schatzker *et al*., 1979)**, Rush rods, Enders nail, GSH (Green Seligson Henry) nail and Zickle device. However all these devices were technically demanding and did not achieve rigid fixation of articular surface and good purchase of osteopenic bone.

Complications of distal femoral fractures include malunion, non union, varus angulation, limb length discrepancy, infections, and secondary osteoarthritis of patella-femoral and tibio-femoral joints. Implant failure, periprosthetic fractures and the disruption of fixation can also occur with any device used for internal fixation especially in comminuted varieties and in elderly because of osteoporosis.

The Dynamic condylar screw is an impressive mode of treatment with advantages of early and good range of motion, stable internal fixation and maintenance of anatomical reduction but the main disadvantage is that it can only be used when atleast 4 cms of area above the inter-condylar notch is uncomminuted.

The distal femoral-locking compression plate which isprecontured and provide better stability and functional outcome and allows higher elastic deformation than the other systems putting between rigid fixation and intramedullary nailing. The angular stability makes it ideal for comminuted fractures and intra articular fractures...

MATERIAL AND METHODS

Fifty adult patients, of either sex, old and fresh cases and, simple or compound fractures were taken up with distal femoral fractures (lower 9 to 15 cm of femur) for the study. Written consent was taken. On admission a general physical examination followed by local examination was done and life threatening injuries were dealt on priority.

The first aid in the form of Plaster of Paris (POP) back slab/splint, skeletal traction, analgesics, wound debridement, antiseptic dressings as required was done. Antibiotics and tetanus toxoid immunization was given, if required.

Clinical examination was followed by radiological examination and anterior-posterior (AP) and lateral views of the knee joint and distal femur were taken and classified by A O classification. Twenty five cases were managed by surgery with dynamic condylar screw, so they were placed in group A i.e DCS group and another

twenty five patients were managed by surgery with distal femoral locking compression plate hence placed in group B i.e DFLCP group. The average age at time of surgery in DCS group and DFLCP group was 43.76 yrs and 46.44years respectively. There were 19 males, 6 females in DCS group and 18 males and 7 females in DFLCP group.

OPERATIVE PROCEDURE

After epidural anesthesia, each patient was placed on traction table, lateral approachof thigh was used.

For DCS surgery, a k wire was inserted perpendicular to lateral femoral condyle, parallel to joint surface at the junction of anterior 1/3rd and posterior 2/3rd of longest AP dimension, using k wire in the joint and patellar groove as a guide. An appropriate length lag screw after proper reaming and tapping was inserted over guide wire. Once the lag screw was in place, the side plate of an appropriate length was applied with at least eight cortex achieved in the distal fragment. Additional one or two cancellous screws were put in the intercondylar region, after the anatomical reduction plate was fitted to the shaft of femur with 4.5 mm cortical screws.

In case of distal femoral locking compression plate, a lateral parapatellar approach was used in fracture patterns with significant intercondylar comminution, coronal plane fractures, or both. After proper exposure temporary fixation was done by 2mm K- wires which may also act as joysticks. Before the application of plate, the inter-fragmentary lag in the articular fragments could be achieved by 6.5 mm cannulated cancellous screws anterior and posterior to the desired position of plate. Plate is then slid and fixed to the articular block by locking screws. Then the plate was secured to the diaphyseal portion by giving stab incisions at the screw sites and fixing by locking screws.

Postoperatively the intravenous antibiotics were given for 5 days and pop back slab was applied for initial 3 to 4 days until the first dressing and was discarded and active range of motion exercises and quadriceps strengthening exercises was started.

Patients were allowed to walk with walker or a pair of crutches and bear partial weight till they achieved good quadriceps power and radiological examination revealed fracture union.

Patients were followed up subsequently with clinico-radiological examination till the fracture united. Range of motion, quadriceps power and ability to bear full weight were assessed immediate post operative, at 3 weeks, at 6 weeks, at 3months, at 6 months, at 9 months and at one year.

Clinically the following observations were made by examining the local condition of wound, the range of motion of knee joint, the joint congruency, limb length discrepancy and fracture site tenderness. Radiologically the assessment was made by seeing the articular surface of femur and the reduction of fracture, the position of the implant and the fracture callus.

Assessment of results were done with criteria laid down by **Schatzker's and Lambert (1979)** for supracondylar fractures

Excellent:	
1.	Full extension
2.	No varus, valgus or rotational deformity.
3.	No pain
4.	Perfect joint congruency
Good:	
Not more than one of the following.	
1.	Loss of length not more than 1.2 cm
2.	Less than 10^0 valgus or varus deformity
3.	Flexion loss more than 20^0
4.	Minimal pain
Fair:	
1.	Any of two criteria in good category.
Failure:	
1.	Flexion to 90^0 or less
2.	Varus or valgus deformity more than 15^0
3.	Joint incongruency
4.	Disabling pain no matter how perfect the X- ray.

RESULTS

The average age in DCS group was 43.76 years and in DFLCP group was 40.44 years. The age distribution was statistically insignificant (p value=0.45).There were 19(76%) male cases and 6(24%) female cases in DCS group and 18(72%) male cases and 7(28%) female cases in DFLCP group. The sex distribution was statistically insignificant (p=0.74, Chi Square-0.10).The mode of trauma predominantly was road accident in both groups. In DCS group, there were 21(84%) cases who had mode of trauma predominantly as road traffic accident and in the DFLCP group,19(76%) cases had mode of trauma predominantly road traffic accident. The mode of trauma in both the groups was comparable, so the difference was statistically insignificant (p=0.47, Chi Square-0.50).In DCS group right side was involved in 13(52%) cases and in DFLCP group right side was involved in 16(64%) cases. The difference was statistically insignificant (p=0.39, Chi Square-0.74). There were more closed fractures than open fractures in both the groups i.e. 72% closed and 28% open in both groups. So the difference was statistically insignificant (P=1).The type A fractures in DCS group were 44% whereas they were 40% in DFLCP group. The Type B fracture was 20% in both the groups. The Type C fracture was 36% in DCs group and 40% in DFLCP group. The difference in both groups was statistically insignificant (p=0.95, Chi Square-0.10). The average operation time was 119.6 minutes in DCS group whereas it was 129.6 minute in DFLCP group, the difference was statistically significant (P=0.03). Fracture united with average time of 14.25 weeks and 13.88 weeks in DCS and DFLCP group respectively. The difference is statistically insignificant (P=0.68).

The range of motion and knee joint in DCS group and DFLCP group was 108.4^0 and 107.6^0 respectively. There were 2 patients each in DCS and DFLCP group who had range of motion and knee joint less than 90^0 and 23 patients in both groups who had range of motion of joint more than $90^{o.}$ Thus the difference is insignificant between the two groups (P=1).The average hospital stay in case of DCS and DFLCP

group was 15.4 days and 13.08 days respectively. The difference is statistically insignificant (P=0.13).The average time from injury to surgery in DCS and DFLCP group was 81.2 days and 7.16 days respectively. The difference is statistically insignificant (P=0.53).

There were complications in both groups. The total number of complications in DCS and DFLCP group was 11 and 13 respectively. The difference is statistically insignificant (P=0.57).

According to the criteria laid by **Schatzkers and Lambert**, the Excellent/Good results in DCS group and DFLCP group were seen in 76% and 76% respectively. The overall results were the same and the difference is statistically insignificant (P=1).

DISCUSSION:

Due to increased prevalence of high energy trauma the current fracture pattern is towards complex comminuted fractures especially in young individuals. Improved healthcare results in longer life span and subsequently presents us with more osteoporotic fractures which were previously treated using conservative methods. The violent nature of injury in young individuals who sustain high velocity injuries during road-traffic accidents and osteoporotic bones in elderly patients makes conservative treatment an unsatisfactory option; in such cases internal fixation is better option.

The goal of treatment in such cases is to achieve a painless and stable joint with good range of motion. This can be achieved by open reduction and internal fixation with such devices that allow rigid fixation of articular surfaces, is easier to use, gives respect to soft tissues and allows early weight bearing.

The dynamic condylar screw is a device which makes accurate reduction and fixation easy. The purchase of lag screw in osteoporotic bone was good and it could be easily positioned over guide wire under image intensifier. Instrumentation of dynamic condylar screw was easy to master as compression screw is frequently used in treatment of hip fractures. However dynamic condylar screw is a fixed angled implant so proper insertion of lag screw at 95^0 and parallel to joint line after reduction is recommended, otherwise it can angulate the distal fragment and malunion can occur. If properly performed operative time is decreased and problems like angular deformity, instability, joint incongruity and loss of motion are also taken care of. Moreover it gives stable internal fixation so that post operative range of motion exercises can be started on 1^{st} post operative day.

The distal femoral locking compression plate is a single beam construct where strength of its fixation is equal to sum of all screw-bone interfaces rather than a single screw's axial stiffness and pull out resistance as 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 when applied via minimally invasive technique, it allows for prompt healing, lower rates of infection and reduced bone resorption as blood supply is preserved. Locking plates have biological advantages (**Sommer C**, 2003, **Wagnee M**, 2003) over standard plates. A standard plate grips the bone by friction created by the compression of plate against the bone by screws. This leads to impaired blood supply (**Perren S**, 1988) resulting in decreased cortical thickness and cancellous transformation of bone. The risk of peri implant fracture is also reduced by locking plates.

After working on distal femoral fractures, we realized that it is one of the difficult fractures to handle. Gastronemius muscle attached on the posterior femoral condyles makes the reduction more difficult, keeping the posterior fragment into flexion.

Distal femur is surrounded by muscles all around so dissection had to be careful and meticulous. Neurovascular bundle was in close proximity with the distal femur so care had to be taken. We often did tend to overlook the ligamentous injuries in view of severe bony trauma which made functional rehabilitation of patients difficult.
The results of our study are comparable with other studies. The average radiologial union time was 14.25 weeks ranging from 10-24 weeks in DCS group. **Shewring et al** 1991 showed that average union time was 11.3 weeks ranging from 6-16 wks where as **Iftikhar et al** 2007 showed average union time to be 15 wks which is comparable with the present study.

The average radiological union time was 13.88 weeks ranging from 12-30 weeks in DFLCP group**. Schandelmeir et al** in 2001 and **Mackmiller et al** in 2004 showed similar results having full radiological union was 14.3 and 13.8 weeks respectfully.

According to the criteria shown by **Schatzker's and Lambert**, the final results in our series in DCS showed that 19 (76%) patients had excellent or good results. The results of our series were comparable with the benchmark study done by Schatzker's 1974. He obtained 75.5 excellent to good results. **Slatis et al** 1971 also obtained 75% excellent to good results. **Neer et al** 1967 obtained 50% of excellent to good results. **Silski et al** 1989 and **Ostrum and Geel** 1995 showed 84.5% and 87% good to excellent results which is almost 10% more then the present study. This could be because we included more number of type C fractures in our study compared to other studies.

The results of DFLCP in present study were 76% (19) patients had excellent or good results.The results of our series were comparable with study done by **Schatzker's and Lambert** in 1979. They also obtained excellent or good results in 74% of the patients.However, in Type A fractures, the Excellent / Good results in DCS and DFLCP group were 91% and 80% respectively.. This could be due to the fact that in the DCS group, there were more number of Type A fractures i.e. 11(44%) and in DFLCP group there were 10(40%) such cases and there was one case in DFLCP group who got superficial infection and minimal pain.

In Type B fractures, the Excellent / Good results in DCS and DFLCP group were seen in 80% each suggesting both the implants are equally good in Type B fractures.

In Type C fracture the excellent / good results in DCS and DFLCP group were seen in 55.7% and 70% respectively suggesting distal femoral locking compression plate could be better for intercondylar and comminuted fractures. The result in Type A, Type B and Type C fractures could not be compared because of small sample size in each group.

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 but that was due to infection in one case of DFLCP rather than peculiarity or specificity of implant.

There was no superiority of DFLCP over DCS in old patients. This may be because of small number of old patients in our study.

CONCLUSION

Keeping in view the above observations, results and facts, it can be said that, distal femoral locking compression plate by virtue of its combi-holes in stem and locking bolts in the expanded head area fulfills these criteria and dynamic condylar screw requires a certain amount of bone stock present which limits their use in some types of fractures. Thus it was concluded that condylar screw and distal femoral locking plate have similar results except that distal femoral locking plate is better in communited distal fractures and has the same above mentioned additional advantages over dynamic condylar screw; though further studies are warranted to have better understanding.

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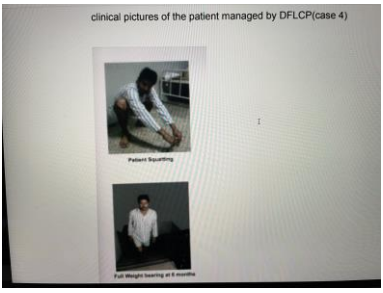
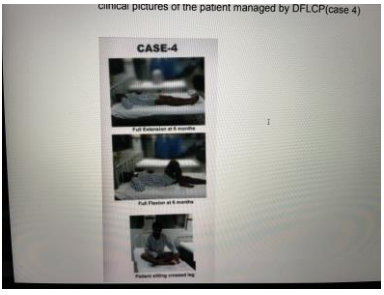
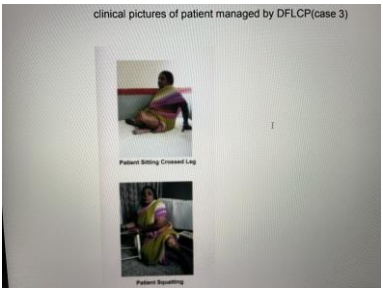
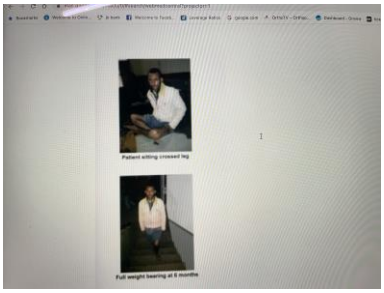
Pictures

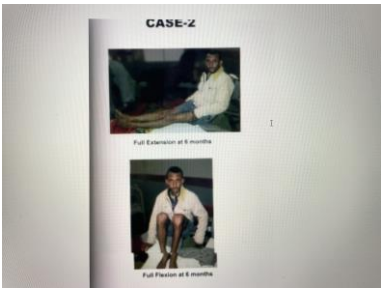

clinical pictures of the patient managed by DFLCP(case 4)
Patient Squatting
Full Weight bearing at 6 months


CASE NO. 03
PRE OP
POST OP
AT 3 MONTHS
AT 6 MONTHS


clinical pictures of the patient managed by DFLCP(case 4)
CASE-4
Full Extension at 6 months
Full Flexion at 6 months
Patient sitting crossed leg


clinical pictures of patient managed by DFLCP(case 3)
Patient Sitting Crossed Leg
Patient Squatting


Patient sitting crossed leg
Full weight bearing at 6 months


CASE-2
Full Extension at 6 months
Full Flexion at 6 months


CASE NO. 04
PRE OP
POST OP
AT 3 MONTHS
AT 6 MONTHS