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**Dr. Nikhil Singh**
Post-Graduate, Department of Orthopaedics, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India

**Dr. Rahul Bindal**
Post-Graduate, Department of Orthopaedics, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India

**Dr. Pritish Gautam**
Post Graduate, Department of Orthopaedics, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India

**Dr. Puneet Gupta**
Professor and Head of Department (HOD), Department of Orthopaedics, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India

**Dr. Amandeep Kajla**
Post Graduate, Department of Orthopaedics, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India

**Corresponding Author:**
**Dr. Nikhil Singh**
Post-Graduate, Department of Orthopaedics, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India

# A prospective observational study examining the radiological and functional results of locking compression plate treatment for femur diaphyseal fractures in children

**Dr. Nikhil Singh, Dr. Rahul Bindal, Dr. Pritish Gautam, Dr. Puneet Gupta and Dr. Amandeep Kajla**

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**Abstract**
**Aim:** The aim of the present study was to evaluate the functional and radiological outcomes of paediatric femur diaphyseal fracture treated with locking compression plate.
**Material and Methods:** Seventy patients who underwent submuscular plating for humeral, femoral, or tibial shaft fractures over the course of three years had their clinical, radiological, and functional outcomes assessed. A single surgical team from the Department of Orthopaedics, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun performed all of the procedures.
**Results:** Of the people who participated in the study, 49 were men and 21 were women. The majority of the participants were men. From the youngest patient to the oldest, the range of ages was six to fourteen years. With a standard deviation of 2.08, the average age was 11.49 years. There were 40 fractures on the right side (57.14%) more than 30 fractures on the left (42.86%). Regarding the types of fractures, there were 25 fractures (35.71%), 18 fractures (25.72%), 21 fractures (30%), 6 fractures (8.57%) that were spiral. Falling while performing sports was reported in 15.71% of injuries, while falls from heights accounted for 8.57%. Road traffic accidents accounted for 60% of all injuries. After looking at the functional results, 64 (91.42%) were great, 5 (7.14%) were good, and 1 (1.42%) were bad.
**Conclusion:** Submuscular plating is a dependable treatment option for diaphyseal long bone fractures when it is well-planned and carried out. Early mobilisation is possible with a good radiological and functional outcome with this minimally invasive method, and problems are minor.

**Keywords:** Fracture, shaft, plate, plating, submuscular

## Introduction
Fractures of the distal femur make up 4-6% of all femoral fractures and supposedly make up less than 1% of all fractures [1-3]. There are two main groups of people who are more likely to sustain supracondylar femoral fractures: younger patients who have been in high-energy accidents (such as those involving motor vehicles, motorcycles, or sports injuries), and elderly patients who have had low-energy fall fractures and are more likely to be osteoporotic. As a third prevalent group, Jahangir also noted an upsurge in periprosthetic femur fractures in patients who had undergone complete knee or hip arthroplasty in the past [4]. Improving results requires knowledge of distal femoral fracture features, therapeutic principles and difficulties [5].
Conservative therapy using a U-shaped cast, velpau sling, thoracobrachial cast, or brachial orthosis can treat most of these fractures [6-8]. The risk of nonunion, delayed union, malunion, and limited motion in the elbows and shoulders increases in such a situation. Both open and closed reduction and internal fixation with plating or nailing are part of the surgical treatment options [7, 9]. Femur shaft fractures in children are managed with external fixators for open fractures [10, 11]. Surgical treatment options include open reduction plate fixation with locking compression plate, dynamic compression plates and bridge plating, stainless steel nailing, locked intramedullary nailing, and closed reduction/open reduction with intramedullary titanium elastic nailing system (TENS) [12,13].

Paediatric long bone fracture repair typically involves transcutaneous electrical nerve stimulation (TENS) and plating. In children aged five to eleven, transcutaneous electrical nerve stimulation (TENS) is advised. Reduced intraoperative blood loss, shorter operation time, reduced pain, and shorter hospital stay are some of the benefits of transcutaneous electrical nerve stimulation (TENS) compared to plating [13, 14]. TENS is reasonably successful in treating certain types of juvenile femur diaphyseal fractures [15].

Conservative therapy using a U-shaped cast, velpau sling, thoracobrachial cast, or brachial orthosis can treat most of these fractures [16, 19] The risk of nonunion, delayed union, malunion, and limited motion in the elbows and shoulders increases in such a situation [17, 20] Closed reduction and internal fixation with nailing or open reduction and internal fixation with plating are the surgical therapy options [21, 22]. A longer surgical length, larger incision, more dissection of soft tissues, blood loss, and periosteal stripping are all necessary for open reduction and internal fixation to accomplish anatomical reduction; nevertheless, these risks come with a higher risk of nonunion, infection, and wound healing complications [23].

The purpose of this study was to evaluate the functional and radiological outcomes of paediatric femur diaphy seal fracture treated with locking compression plate.

## Materials and Methods

Seventy patients who underwent submuscular plating for humeral, femoral, or tibial shaft fractures over the course of three years had their clinical, radiological, and functional outcomes assessed. A single surgical team from the Department of Orthopaedics, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun performed all of the procedures. Prior approval from the relevant institutional ethics committee was obtained for the scientific investigation.

### Inclusion criteria

1. Fracture shaft of humerus, shaft of femur, shaft of tibia;
2. Fractures without any neurological deficit;
3. Patients with minimum 2 year follow up.

### Exclusion criteria

1. Compound fractures
2. Fractures with non-union or delayed union
3. Pathological fractures; Neurovascular insufficiency.

### Operative technique for humerus

Under general anaesthesia, the patient was placed in a supine posture and told to assume a beach chair position with their arm abducted around 400 to 600 degrees. The reduction of the indirect fracture was accomplished by hand. By maintaining the plate on the skin anteriorly, we were able to calculate the proximal and distal screw location, as well as the size of the skin incision, using the C arm length of the plate. Approximately 5 cm proximal to the flexion crease, an incision of 4-5 cm was made distally along the lateral edge of the biceps.

The brachailis was then exposed by creating a gap between the biceps tendon and the brachioradialis muscle. The anterior surface of the humerus was revealed after making an interval in the fibres of brachialis by blunt dissection. After that, an incision about four to five centimetres in the front was made, and a space was created between the medial border of the deltoid and the lateal border of the proximal biceps. The plate was used to create an epiperiosteal tunnel that connected the two incisions. A 4.5 mm narrow DCP or LCDCP, which was predermined, was pushed into the tunnel from the distal to the proximal incision. The plate's contour was superfluous because the implant served to maintain periosteal blood supply with minimum cortical contact and indirect relative stability [24]. To restore length, traction was given under C arm control, and any rotational or angular distortion was addressed manually. We accepted the best possible decrease in cases where it was challenging. Two screws were inserted into the plate's most proximal and distal holes on each side once the positioning and reduction were confirmed to be satisfactory. The plate was then left centrally on the anterior surface. The aide steadied the screw while C examined it under his arm multiple times to ensure proper reduction. Multiple layers of sterile dressing were put to the wound. We tracked the amount of time it took to close the wound after the incision was made. A sling and cuff were used to immobilise the arm. An appropriate course of antibiotics was administered following surgery. On the second day after the operation, we began active exercises for the elbow and shoulder, as long as we kept the pain levels up. Our patients were released from the hospital on the fifth day following their operation. After radiological bony union had taken place, patients were followed up with every six months. Radiological evaluation was conducted using the conventional lateral and anteroposterior views. All patients were checked for symptoms of infection, nonunion, malunion, and union at each follow-up appointment, in addition to radiographs and functional assessments.

### Surgical procedure for the femur

While adhering to all aseptic protocols, the patient was positioned supine on the operating table and scrubbed, painted, and draped. The level of the vastus ridge on the greater trochanter was the traditional location for a proximal incision, which was four to six centimetres long and determined by the fracture site. The plane between the muscle mass and the periosteum over the lateral cortex of the femur was developed distally using a long Cobb's elevator after the necessary dissection. LC-DCP plates, which are narrow and dynamic compression plates, were used. From the proximal to the distal end, the plate was moved in this plane while remaining epiperiosteal. The plate was temporarily fastened in place using intraoperative imaging and a 1.5 mm K-wire threaded through the plate hole on one end. Under fluoroscopy, the location of the opposite end of the plate was identified, and an incision was created at that level. When the break was at the farthest part of the bone, the first incision was made at the farthest point, and the plate was slid from farthest to nearest the bone using the same epiperiosteal technique. Through manipulation and longitudinal traction, the fracture was minimised. When needed, folded sterile sheets were utilised as an auxiliary for reduction. The reduction position of the plate was modified to provide good contact with the bone, and a second K-wire was inserted through a hole at the opposite end of the plate for provisional attachment if the reduction was deemed satisfactory. Three cortical screws were put into each piece after further evaluation and any required adjustments. In some instances, the presence of soft tissues rendered closed reduction challenging, necessitating the creation of an incision at the site of the fracture. This allowed for the use

of a bone hook or finger manipulation to accomplish reduction. During the time following surgery, splints were not utilised. Patients were encouraged to walk or use other forms of mobility aid within one to three days following surgery, according to their comfort level, and were advised to avoid full weight bearing for six weeks.

**Surgical procedure for the tibia**

The patient was placed in a supine position while the surgeon, using spinal or general anaesthesia, performed the procedure. A same group of surgeons performed all of the operations. Reduced indirectly through manual means. By positioning the plate on the anterolateral aspect of the proximal tibia, we were able to calculate the skin incision, proximal and distal screw placement, and C arm length. For the exposure, anterolateral approach was utilised. A straight incision is made four to five centimetres laterally to the patella and continues all the way to the tuberosity of the tibia. A large tunnel is created in the submuscular plane, the proximal attachment of the Tibialis anterior muscle is freed, and the deep fascia anterior to the IT band is revealed. LCDCP/DCP slide measuring 4.5 mm from the proximal to distal fragments. Loss alleviated by use of controlled traction guided by the C-arm, The procedure involved creating an epiperiosteal tunnel that connected the two incisions, sliding a precontured plate into the tunnel, positioning three screws, one at the proximal end and three at the distal end, closing the wound in layers, and applying a sterile dressing. Starting on the first post-operative day or as the patient felt comfortable, bedside knee, hip, and ankle immobilisation was gradually increased over the following six weeks, with full weight bearing allowed after twelve weeks. The patient was discharged on the fifth post-operative day.

## Results

**Table 1:** Demographic data

| Gender | N% | P Value |
|---|---|---|
| Male | 49 (70) | 0.743 |
| Female | 21 (30) | |
| Mean (SD) age in years | 11.49 (2.08) | 0.068 |
| **Side affected** | | |
| Right | 40 (57.14) | 0.872 |
| Left | 30 (42.86) | |

Among the study group, 49 were males, and 21 were females. There was a male preponderance. The youngest age among patients was six years old and the oldest age was 14 years old. The average age was 11.49 (2.08) years. Right side fractures 40 (57.14%) were more compared to left side fractures 30 (42.86%).

**Table 2:** Type of fracture and Mode of injury

| Type of fracture | N% | P Value |
|---|---|---|
| Comminuted | 18 (25.72) | 0.848 |
| Oblique | 21 (30) | |
| Spiral | 6 (8.57) | |
| Transverse | 25 (35.71) | |
| **Mode of injury** | | |
| RTA | 42 (60) | 0.642 |
| Self-fall | 11 (15.71) | |
| Fall from height | 6 (8.57) | |
| Sports injury | 11 (15.71) | |
| Assault | 0 | |

For types of fractures, 25 (35.71%) fractures were transverse, 18 (25.72%) fractures were comminuted, 21 (30%) fractures were oblique, and 6 (8.57%) fractures were spiral. Considering the mode of injury, road traffic accident accounted for 60%, other injuries like fall during playing sports were seen in 15.71%, fall from height accounted for 8.57%.

**Table 3:** Fracture union and complications

| Fracture union in weeks | N% | P Value |
|---|---|---|
| Less than 12 weeks | 49 (70) | 0.007 |
| 12 - 17 weeks | 14 (20) | |
| More than 18 weeks | 7 (10) | |
| **Complications** | | |
| No complications | 54 (77.14) | 0.210 |
| Thigh pain | 7 (10) | |
| Superficial Infection | 3 (4.28) | |
| Delayed union | 4 (5.71) | |
| Knee stiffness | 2 (2.85) | |

In our study, the average union time in group one was 10.5 weeks. Early complications in the form of superficial infection were in 3 patients. Late complications in the form of thigh pain in 7 patients. Cases of knee stiffness were in 2 patients and delayed union were in 4 patients.

**Table 4:** Functional outcomes

| Functional outcomes | N% |
|---|---|
| Excellent | 64 (91.42) |
| Satisfactory | 5 (7.14) |
| Poor | 1 (1.42) |
| Total | 70 (100) |

The functional outcomes were evaluated and 64 (91.42%) were excellent, 5 (7.14%) were satisfactory and 1 (1.42%) were poor.

## Discussion

Fractures of the distal femur make up 4-6% of all femoral fractures and supposedly make up less than 1% of all fractures [25, 27]. There are two main groups of people who are more likely to sustain supracondylar femoral fractures: younger patients who have been in high-energy accidents (such as those involving motor vehicles, motorcycles, or sports injuries), and elderly patients who have had low-energy fall fractures and are more likely to be osteoporotic. As a third prevalent group, Jahangir also noted an upsurge in periprosthetic femur fractures in patients who had undergone complete knee or hip arthroplasty in the past [28]. Improving results requires knowledge of distal femoral fracture features, therapeutic principles and difficulties There are two main groups of people who are more likely to sustain supracondylar femoral fractures: younger patients who have been in high-energy accidents (such as those involving [29].

Of the people who participated in the study, 49 were men and 21 were women. The majority of the participants were men. From the youngest patient to the oldest, the range of ages was six to fourteen years. With a standard deviation of 2.08, the average age was 11.49 years. There were 40 fractures on the right side (57.14%) more than 30 fractures on the left (42.86%). Falling while performing sports was reported in 15.71% of injuries, while falls from heights accounted for 8.57%. Road traffic accidents accounted for

60% of all injuries. Fixations for fractures that permit micro movements at the fracture site when subjected to physiological stress are known as flexible fixations. These fixations facilitate early union through the production of calluses. Bridge callus healing outperforms primary bone healing in terms of speed, effectiveness, and strength [30]. Without callus development, initial bone healing is weak and prone to refracture following implant removal (an issue with the open approach) [31]. Because the fracture site is not opened, it prevents the devascularization of bone fragments, protects blood supply, and avoids periosteal stripping and soft tissue damage. Additionally, by sealing off the fracture site, it maintains the fracture haematoma environment [32, 35]. Complications like infection and non-union can be avoided with this procedure because of its small incision, short length, and lack of blood loss, as well as its avoidance of soft tissue dissection and periosteal stripping [33, 34]. Regarding the types of fractures, there were 25 fractures (35.71%), 18 fractures (25.72%), 21 fractures (30%), 6 fractures (8.57%) that were spiral. The first group in our study had an average union duration of 10.5 weeks. Two individuals experienced early problems in the form of superficial infections. Thigh discomfort was reported by six patients as a late consequence. Three patients experienced delayed union and one patient experienced knee stiffness. The learning curve is longer for this one. The process requires the assistance of knowledgeable helpers. There is always the chance of axial or rotational misalignment in close reduction procedures. The humerus can tolerate a little amount of residual misalignment. Pathological fractures do not permit submuscular plating. Patients requiring bone grafting or freshening of bone ends, such as those with nonunion or delayed union, are also not candidates. In a study conducted by Hedequist DJ and Sink E et al [36]. It was observed that out of 39 patients, 8 (or 21% of the total) needed unanticipated surgical procedures. Additionally, out of 15 patients in the unstable fracture group, 10 (or 66% of the total) experienced fracture shortening or angulation. Age, weight, and fracture site had little effect on submuscular bridge plating outcomes. No matter how narrow a child's medullary canals are, which can be an issue for intramedullary nail fixation, the procedure can still be done. Due to the reduced bone nail contact, stability may be inadequate with intramedullary nails. Consistently, sub-muscular plating offers sufficient stability. After looking at the functional results, 64 (91.42%) were great, 5 (7.14%) were good, and 1 (1.42%) were bad.

## Conclusion

Submuscular plating is a dependable treatment option for diaphyseal long bone fractures when it is well-planned and carried out. Early mobilisation is possible with a good radiological and functional outcome with this minimally invasive method, and problems are minor.

## References


1. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury. 2006 Aug 1;37(8):691-7.
2. Martinet O, Cordey J, Harder Y, Maier A, Bühler M, Barraud GE. The epidemiology of fractures of the distal femur. Injury. 2000 Sep 1;31:62-94.
3. Wähnert D, Hoffmeier K, Fröber R, Hofmann GO, Mückley T. Distal femur fractures of the elderly-different treatment options in a biomechanical comparison. Injury. 2011 Jul 1;42(7):655-9.
4. Jahangir AA, Cross WW, Schmidt AH. Current management of distal femoral fractures. Current Orthopaedic Practice. 2010;21:193–197.
5. Marsh JL, Slongo TF, Agel J, Broderick JS, Creevey W, DeCoster TA, et al. Fracture and dislocation classification compendium-2007: Orthopaedic Trauma Association classification, database and outcomes committee. Journal of orthopaedic trauma. 2007 Nov 1;21(10):S1-6.
6. Sarmiento A. Functional bracing of fractures of the shaft of the humerus. Orthopedic Trauma Directions. 2008 Jan;6(01):33-7.
7. Taha MM. The outcome of conservative treatment of closed fracture shaft humerus in adult patients. Am Med J. 2011;2(1):32-9.
8. Superti MJ, Martynetz F, Falavinha RS, Fávaro RC, Villas Boas LF, Mussi Filho S, et al. Evaluation of patients undergoing fixation of diaphyseal humeral fractures using the minimally invasive bridge-plate technique. Revista Brasileira de Ortopedia. 2012;47:310-7.
9. Walker M, Palumbo B, Badman B, Brooks J, Van Gelderen J, Mighell M. Humeral shaft fractures: a review. Journal of shoulder and elbow surgery. 2011 Jul 1;20(5):833-44.
10. Strohm PC, Reising K, Hammer T, Sudkamp NP, Jaeger M, Schmal H. Humerus shaft fractures-where are we today. Acta Chir Orthop Traumatol Cech. 2011 Jan 1;78(3):185-9.
11. Bhandari M, Devereaux PJ, D Mckee M, H Schemitsch E. Compression plating versus intramedullary nailing of humeral shaft fractures-a meta-analysis. Acta orthopaedica. 2006 Jan 1;77(2):279-84.
12. Hunter JB. Femoral shaft fractures in children. Injury. 2005 Feb 1;36:A86-93.
13. Allen JD, Murr K, Albitar F, Jacobs C, Moghadamian ES, Muchow R. Titanium elastic nailing has superior value to plate fixation of midshaft femur fractures in children 5 to 11 years. Journal of Pediatric Orthopaedics. 2018 Mar 1;38(3):e111-7.
14. Beaty JH. Operative Treatment of Femoral Shaft Fractures in children and Adolescents. Clin Orthop Relat Res. 2005;434:114-22.
15. Rajak MK, Thakur R, Choudhary A, Bhaduri I, Kumar S. Titanium elastic nailing in femoral diaphyseal fractures in children of 6-14 years age. Acta Orthop Belg. 2016 Dec 1;82(4):883.
16. Sarmiento A. Functional bracing of fractures of the shaft of the humerus. Orthopedic Trauma Directions. 2008 Jan;6(01):33-7.
17. Taha MM. The outcome of conservative treatment of closed fracture shaft humerus in adult patients. Am Med J. 2011;2(1):32-9.
18. Superti MJ, Martynetz F, Falavinha RS, Fávaro RC, Villas Boas LF, Mussi Filho S, et al. Evaluation of patients undergoing fixation of diaphyseal humeral fractures using the minimally invasive bridge-plate technique. Revista Brasileira de Ortopedia. 2012;47:310-7.
19. Walker M, Palumbo B, Badman B, Brooks J, Van Gelderen J, Mighell M. Humeral shaft fractures: a

review. Journal of shoulder and elbow surgery. 2011 Jul 1;20(5):833-44.
20. Strohm PC, Reising K, Hammer T, Sudkamp NP, Jaeger M, Schmal H. Humerus shaft fractures-where are we today. Acta Chir Orthop Traumatol Cech. 2011 Jan 1;78(3):185-9.
21. Bhandari M, Devereaux PJ, D Mckee M, H Schemitsch E. Compression plating versus intramedullary nailing of humeral shaft fractures-a meta-analysis. Acta orthopaedica. 2006 Jan 1;77(2):279-84.
22. Anglen JO, Choi L. Treatment Options in Pediatric Femoral Shaft Fractures. J Orthop Trauma. 2005;19(10):724-33.
23. Mahabier KC, Vogels LM, Punt BJ, Roukema GR, Patka P, Van Lieshout EM. Humeral shaft fractures: retrospective results of non-operative and operative treatment of 186 patients. Injury. 2013 Apr 1;44(4):427-30.
24. Imarisio D, Trecci A, Sabatini L, Scagnelli R. Treatment for proximal humeral fractures with percutaneous plating: our first results. Musculoskeletal surgery. 2013 Jun;97:85-91.
25. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury. 2006 Aug 1;37(8):691-7.
26. Martinet O, Cordey J, Harder Y, Maier A, Bühler M, Barraud GE. The epidemiology of fractures of the distal femur. Injury. 2000 Sep 1;31:62-94.
27. Wähnert D, Hoffmeier K, Fröber R, Hofmann GO, Mückley T. Distal femur fractures of the elderly-different treatment options in a biomechanical comparison. Injury. 2011 Jul 1;42(7):655-9.
28. Jahangir AA, Cross WW, Schmidt AH. Current management of distal femoral fractures. Current Orthopaedic Practice. 2010;21:193-197.
29. Marsh JL, Slongo TF, Agel J, Broderick JS, Creevey W, DeCoster TA, et al. Fracture and dislocation classification compendium-2007: Orthopaedic Trauma Association classification, database and outcomes committee. Journal of orthopaedic trauma. 2007 Nov 1;21(10):S1-6.
30. Shetty MS, Kumar MA. Minimally invasive plate osteosynthesis for humerus diaphyseal fractures. Indian J Orthop; c2011, 45(6).
31. Breedervad RS, Patka P, Maurik JCV. Refracture of the femoral shaft. Neth J Surg. 1985;37:114.
32. Lau TW, Leung F, Chan CF, Chow SP. Wound complication of minimally invasive plate osteosynthesis in distal tibia fractures. Int. Orthop. 2008;32(5):697-703.
33. Gupta RK, Rohilla RK, Sangwan K, Singh V, Walia S. Locking plate fixation in distal metaphyseal tibial fractures: series of 79 patients. Int Orthop. 2010;34:1285-90.
34. Ronga M, Longo UG, Maffulli N. Minimally Invasive Locked Plating of Distal Tibia Fractures is Safe and Effective. Clin Orthop Relat Res. 2010;468(4):975-82.
35. Farouk O, Krettek C, Miclau T, Schandelmaier P, Guy P, Tscherne H. Minimally Invasive Plate Osteosynthesis: Does Percutaneous Plating Disrupt Femoral Blood Supply Less Than the Traditional Technique? J Orthop Trauma. 1999;13(6):401-6.
36. Hedequist DJ, Sink E. Technical aspects of bridge plating for pediatric femur fractures. Journal of orthopaedic trauma. 2005 Apr 1;19(4):276-9.

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