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# Global Journal

## of Medical Research: H

# Orthopedic & Musculoskeletal System



Broken Distal Locking Bolt

Proximal Humerus Interlocking Plate

Highlights

Results of Surgical Management

Salvage versus Amputation (A Case Report)

Discovering Thoughts, Inventing Future

VOLUME 20 ISSUE 3 VERSION 1.0

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# Orthopedic and Musculoskeletal System

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# Contents of the Issue


i. Copyright Notice
ii. Editorial Board Members
iii. Chief Author and Dean
iv. Contents of the Issue

1. Prospective Study of Radiological and Functional Outcome of Closed Subtrochanteric Fracture Fixation with Proximal Humerus Interlocking Plate in Adolescent Patients. *1-5*
2. Removal of Broken Intramedullary Femoral Nail with Broken Distal Locking Bolt– A Case Report. *7-10*
3. Results of Surgical Management of Highly Unstable Complex Distal Femur Fractures with Distal Femoral Locking Compression Plate Fixation: A Prospective Study of 58 Cases. *11-16*
4. Management of Grade 3C Compound Injury of Right Lower Limb with Floating Knee - Salvage Versus Amputation (A Case Report). *17-37*

v. Fellows
vi. Auxiliary Memberships
vii. Preferred Author Guidelines
viii. Index

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# Prospective Study of Radiological and Functional Outcome of Closed Subtrochanteric Fracture Fixation with Proximal Humerus Interlocking Plate in Adolescent Patients

By Amit Bansal

*Abstract-* *Background:* Subtrochanteric fractures constitute 1% in children. Subtrochanteric fractures in pediatric age defined as 10% length of total femur below the lesser trochanter. Mostly these fractures are unstable types. There are various treatment options available for the management of this fracture, depending on the age group of the patient. But there is no well-defined management for adolescent subtrochanteric fractures.

*Methods:* This study includes five patients present to orthopedic emergency with closed subtrochanteric fracture without distal neurological deficit. Patients were managed operatively after informed consent with proximal humerus locking plate under regional anesthesia. Postoperatively patients were kept non weight bearing with in-bed exercises. Follow-up was done at 2, 6, 12, 24, and 36 weeks. Patients were evaluated as functional and radiologically.

*Keywords:* *subtrochanteric fracture, proximal humerus locking plate, adolescent patients.*

*GJMR-H Classification:* *NLMC Code: WE 168*

PROSPECTIVESTUDYOFRADIOLOGICALANDFUNCTIONALOUTCOMEOFCLOSEDSUBTROCHANTERICFRACTUREFIXATIONWITHPROXIMALHUMERUSINTERLOCKINGPLATEINADOLESCENTPATIENTS

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*Results:* There were five patients included in this study. There was no gender difference in the incidence of fracture. The average time of union was 11.4 wks in the adolescent age group. There was no other early and late complication. Ambulation was done with protected weight-bearing with some support at an average of 10 wks. Follow-up was done until nine months. The final average harris hip score was 91.

*Conclusion:* Proximal humerus locking plate found to be an excellent choice of implant for any pattern of subtrochanteric fracture. The plate surface found to be well contoured according to the proximal femur lateral surface.

*Keywords: subtrochanteric fracture, proximal humerus locking plate, adolescent patients.*

## I. Introduction

Pediatric subtrochanteric fracture defined as 10% percent the length of the whole femur below the lesser trochanter.[1] Subtrochanteric fractures constitute 1% in children.[1,2] Adolescent subtrochanteric fractures are unusual and have received less attention in literature.[1-3] There are various deforming forces around this fracture like proximal fracture tends to flex, abduct, and external rotate and distal fragment adducts.[1] Due to various deforming forces around this fracture, this fracture requires special attention. There are number of management available for this fracture in each age group. Infants are with Pavlik harness, children (6month – 5 years) with a hip spica cast.[1]The dilemma starts after the age of 10 years.[1] There is no definite consensus available for this age group. Management of this fracture in the adolescent age group is deficient. Traction alone found unsatisfactory and incapable of providing reduction and stability. According to literature fixation with elastic nailing is inadequate and had various complication like malunion and shortening.[1,4,5]

## II. Aims and Objectives

To study the functional and radiological outcomes of open reduction and internal fixation of closed subtrochanteric fracture with a proximal humerus locking plate.

## III. Materials and Methods

*a) Study Area*

The study was done from November/2016 to June/2018 at Safdarjung Hospital New Delhi.

*b) Study Population*

In our series age of patient was 10 to 20 years with the diagnosis of closed subtrochanteric fracture attending the Department of Orthopaedics, Safdarjung Hospital New Delhi managed surgically.

*c) Sample Size and Sample Technique*

Five adolescent patients attended the hospitals from November/2016 to June/2018 presented in emergency with the closed subtrochanteric fracture.

*d) Data Collection Technique and Tools*

Five adolescent patients operated with open reduction and internal fixation with a proximal humerus locking plate, followed by physiotherapy and range of movement exercises. Follow-up was done at 2wks, 6wks, 12wks, 24wks, and 36 wks. All patients gave their informed consent.

*Inclusion Criteria*

1. Age 10 – 20 yrs,
2. Closed fracture
3. Fracture without a distal neurovascular deficit.

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*Exclusion Criteria*

1. Patient with other life-threatening comorbidities
2. Previous hip surgery
3. Pathological fracture
4. Previous hip pathology.

*Preoperative:* Each patient had given the informed consent. We had sent blood investigation for preanesthetic clearence. Temporary Bohlerbraun splint with skin traction applied to relieve some pain and improve some fracture deformity.

*Perioperative:* Implant choice –Under general anesthesia, open reduction and internal fixation performed with proximal humerus interlocking osteosynthesis plate through lateral approach to the thigh. Proximal humerus locking plate found to have a low profile and narrow which is a right amount of thickness for adolescent patients.

*Procedure:* 1. Under general anesthesia, patient positioned in a lateral decubitus position. The patient's affected limb painted and draped.

Dead lateral incision over thigh given. Good hemostasis achieved. Lift Vastus lateral is from linea aspra instead of splitting it. Partial proximal origin of vastus lateral is removed to make space for the plate. Open reduction was done with temporary k wire fixation. Proximal locking screws were kept short of femoral head physis to avoid its injury.

Fracture was fixed with Proximal humerus interlocking plate. A thorough wash was given. An incision was closed in layers with sunction drain insitu.

*Postoperative:* First dressing was done after 48 hrs of surgery. Immediate postoperative x rays were taken. Static quadriceps exercise, knee range of motion exercises, and ankle range of motion exercises were started after 24 hrs from time of surgery. Patients were discharged on the fourth postoperative day.

*Follow up:* Patients were advised for strict non-weight bearing and in bed ambulation exercises. Patients were followed at 2wks, 6 wks, 12 wks, and 24 wks as outpatients.

*2 wks* - Sutures were removed at 2 wk follow up x-rays. In bed ambulatory exercises were continued.

*6 wks*– Follow up x rays were done to assess radiologically. Harris hip scoring was done. As the patient was adolescent, walker assisted walking was started late.

*12 wks*– follow up x rays and Harris hip scoring was done. Non-weight bearing walking with walker support was started.

*24 wks*– As patients were adolescent, Partial weight bearing was started after achieving radiological and functional improvement at 24 wks.

*36 wks* – Radiological and functional evaluation.

*e) Expected Outcome and Complication*

1. Union
2. Nonunion
3. Infection
4. Implant failure

*f) Data Analysis*

Qualitative variables/Categorical variables were presented in number and percentage (%), and Quantitative variables/continuous variables were presented as mean ± SD (whenever required). P-value ≤ 0.05 was taken as a level of statistical significance. The data was analyzed by SPSS (statistical package for social sciences) Statistical software version 17.0.

## IV. Results

There were five patients (Male – 3, female – 2). There was no gender difference in the incidence of this fracture. Pediatric age group was found to have a high potential for the union. Long spiral fracture found to be the most common pattern of fracture in our study. There was no failure in our study. The patient's visual analog scale for pain improved in two weeks from an average of 8 to 3. The radiological first sign of union on x-ray was visible at an average of 4 weeks of fixation. Average Harris hip score was 34 (2wks), 68 (4wks), 87 (6wks), >90 (after 2 months). Patients were mobilized with protected weight bearing with some support at 21/2 months. Weight-bearing was gradually increased according to the comfort of the patient. The patients were started long walking at the end of 5 months. The patient started using public transport at the end of 8 months.



*Fig. 1:* Preoperative X-ray of the patient



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*Fig. 2:* Postoperative X-ray of the same patient



*Fig. 3:* Final follow up x-ray of the same patient



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*Fig. 4:* Function picture of the patient of the same patient

*Table 1:* Clinical profile of the patient

| Serial No. | Age/sex | Complication | Time of union | Final herris hip score | Nature of fracture | End point | Follow up |
|---|---|---|---|---|---|---|---|
| 1 | 11 | - | 12 weeks | 92 | Long spiral | Union | 36wks |
| 2 | 13 | - | 11 weeks | 91 | Comminuted | Union | 36wks |
| 3 | 11 | - | 10 weeks | 87 | Short oblique | Union | 36wks |
| 4 | 14 | - | 14 wks | 95 | Long spiral | union | 36wks |
| 5 | 12 | - | 10 wks | 89 | Long spiral | union | 36wks |

## V. Discussion

Pediatric subtrochanteric fracture is a rare and unstable type of fracture.[4,5] Closed displaced subtrochanteric fracture require operative intervention.

Sanders and Egol [6] presented two cases in which adult, pre-contoured, lower extremity periarticular locking plates were utilized for fixation of subtrochanteric femur fractures in pediatric patients. They proposed that a proximal tibial locking plate in an adolescent and distal tibial locking plate in a young child correspond well to the proximal femur and are thus a viable option in their management.

Cortes et al[7] managed atrophic non-union of subtrochanteric femur fractures in an 11-year-old boy using an adult proximal humerus locking plate and packing the non-union site with the demineralized bone matrix. They chose PHLP as they found it to be adequately matched to the surface anatomy of the proximal femur. Six months after the surgery for non-union, radiographs showed complete union with the maintenance of fracture alignment and morphology of proximal femoral epiphysis. The child was completely asymptomatic with a symmetric range of motion of his hips and knees.

In our study, the proximal humeral locking plate found to be the implant of choice for fixation of any pattern of subtrochanteric fracture. Plate's pre-contouring found to be well-fitting to the proximal femur lateral surface.

## VI. Limitations

There were various limitations to our study. The small numbers of cases due to low incidence, affordability of the patient's attendant, and different patterns of fractures were the limitation. The strength was a single institute and a single operating team. Though we recommend study with larger number of follow-up period with a longer period of follow up.

## VII. Conclusion

Open reduction and internal fixation with proximal humerus locking plate found to be an excellent implant for fixation of subtrochanteric fracture in adolescent age group. Proximal humerus locking plate found to have an optimum amount of profile thickness



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for the adolescent proximal femur. This plate found to be well-fitting to the proximal femur. Proximal humerus locking plate found to be good for any pattern of subtrochanteric fractures. The direction of locking screw in this plate found to have good purchase in the calcar of neck of femur, which absolute stability for fracture union. Another conclusion drawn to our attention was that lateral decubitus position found to be ideal for adequate reduction of proximal fragment deformities as compared to the supine position. It also provided better visibility. Lateral decubitus posture on the operating table assists in the reduction of the fracture via better visibility and gravity assistance. Direction and length of the locking screws didn't damage the proximal femur physis. Most proximal screws were kept short of physis to avoid damage to proximal femur physis.

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# Removal of Broken Intramedullary Femoral Nail with Broken Distal Locking Bolt- A Case Report

By Prof. Sanjeev Sharma, Dr. Suman Sharma, Dr. Manorma Singh & Dr. Rahul Sharma

*Abstract-* Non-union after closed femoral interlock nailing is an uncommon complication and occurs when a patient starts early weight-bearing, due to faulty surgical technique or after re-trauma. Removal of broken with broken locking bolt is a difficult and challenging procedure. The present case report deals with a case of the broken intramedullary nail with a broken distal locking bolt. A 30 years male patient was inserted interlocking nail for fracture shaft femur five years back. He presented with pain with instability and inability in weight-bearing after re-trauma. An X-ray revealed a broken nail with a broken distal locking bolt. The far fragment of the broken bolt was engaging bone and nail both and was the main obstacle. His nail with the broken bolt removed and re-nailing did in a single sitting. Steinmann pin (St.pin) was inserted through the distal piece of the nail to push the trapped small screw piece.

*Keywords:* *broken nail, broken locking bolt, implant removal.*

*GJMR-H Classification:* *NLMC Code: WE 185*

REMOVALOFBROKENINTRAMEDULLARYFEMORALNAILWITHBROKENDISTALLOCKINGBOLTACASEREPORT

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# Removal of Broken Intramedullary Femoral Nail with Broken Distal Locking Bolt– A Case Report

Prof. Sanjeev Sharma [α], Dr. Suman Sharma [σ], Dr. Manorma Singh [ρ] & Dr. Rahul Sharma [ω]

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*Keywords: broken nail, broken locking bolt, implant removal.*

## I. Introduction

Interlock nailing is a widespread procedure for femoral shaft fractures. Occasionally due to early weight-bearing or re-trauma nail is broken and locking bolt may also give way. Removal of such a broken nail and bolt becomes a challenging procedure. Various methods to remove the nails and bolts have been reported in the literature. In the present case, open method was adopted to remove a broken nail with broken distal locking bolt, followed by re-nailing. The far broken fragment of distal locking bolt was pushed back into the bone by inserting Steinmann Pin in the slot of distal nail fragment.

## II. Case Report

A 30 years old male patient was inserted interlocking nail for fracture shaft femur five years back. After five years, he sustained another road traffic accident and presented with deformity, pain around left thigh and inability to put the weight. On examination, pain, tenderness, and movement at old fracture site were present. X-rays revealed hypertrophic non-union with complete breakage of the nail just below the fracture site and broken distal locking bolt. The far broken fragment of the locking bolt was probably engaging both nail and bone (Figure (Fig.) 1, 2). The intramedullary rod was of 360mm x 9mm size (Fig. 6).



*Fig. 1:* X-Ray Anterior Posterior view – broken nail and bolt.



*Fig. 2:* X-Ray Lateral view Broken nail and bolt.

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## III. Operative Technique

Removal of broken implant and exchange nailing was the planning. Removal of the proximal fragment was not difficult, as it was protruding through the entry point at the greater trochanter. But approach and taking away of distal nail fragment was a problem due to broken locking bolt and its far piece engaging both nail and bone. Furthermore, the distal nail fragment was broken slightly below the bone margin (Fig. 3, 5A) and was difficult to grasp with a plier. It was impossible to remove the distal fragment of the broken nail without dislodging the bolt. So, it was decided to adopt the open method under spinal anesthesia and C-arm control. In the supine position and pillow beneath the left gluteal region, the proximal fragment was removed with the help of standard nail extractor set after removing the proximal locking bolt (Fig. 5B-C). For removal of the distal fragment, fracture site was opened through lateral approach, and dissected out fibrous tissue of pseudo-arthrosis. Loose distal locking bolt fragment was removed by applying skin incision directly on the protruding head of the bolt (Fig. 5D-E). The proximal end of the broken distal nail fragment was approximately 4 mm below the bone margin and approached by trimming the bone sufficient to explore the nail fragment and to make the hold of plier on it. But pulling off the piece was not successful as the small broken locking bolt fragment was gripped. To push this small broken fragment of the bolt, a Steinmann Pin (St. Pin) was inserted in the slot of nail fragment from proximal to the distal direction (Fig. 5F). This pin insertion in the nail slot pushed the bolt fragment back to the bone and freed the nail fragment. After taking out the St. Pin, the piece could be simply taken out (Fig. 5G). Standard nailing technique was adopted to exchange nail (Fig. 4, 5H-I). A small piece of the broken bolt was still in situ as such. It did not produce any hindrance for the insertion of the exchange nail as it was in the bone substance and was not protruding in the medullary canal (Fig.4).



*Fig. 3:* Before Surgery



*Fig. 4:* After Surgery

## IV. Discussion

The whole procedure was lengthy and technically demanding but was safe at the same time. Removal of the broken nail with indwelling broke locking bolt either proximal or distal is a not easy procedure & a potential challenge in orthopedic surgery. Removal of nail piece with the use hooks, olive wires, St. Pins, or other special instruments are not available usually every time in the general orthopedic setup. Even sometimes surgeon opens the non-union part and changes the surgical approach to remove the nail fragment with damaging the surrounding tissue. So many complications do arise during and after surgery like lengthy surgery and exposure to the image intensifier, test the surgeon's patience, and increase the risk of postoperative complications, respectively. Levy et al mentioned the use of complete nail of smaller diameter to impact in a distal broken femoral nail to achieve antegrade extraction and local impaction [1]. Middleton et al. has been recommended to filling multiple wires in the slot of the intramedullary rod to remove distal broken fragments in anterograde fashion [2]. Marwan and Ibrahim described a technique of using metallic wire passed through a middle piece of the nail up to its distal hole and make an incision at the level of the distal outlet to fasten this wire [3]. The technique of creating a hole just distal to the proximal locking bolt of distal fragment for the removal of the distal nail fragment has been used successfully by Kretteck et al. [4]. They then placed a Hohmann-type lever into this opening to push the piece in the direction of the fracture focus. In the case of subtrochanteric fracture, distal fragment removed by retrograde impulsion and fractured proximal femoral nail by medial arthrotomy, as mentioned by Milia et al., the patients were follow upto a year of this kind of surgery but they had no knee pain and any other problems [5].

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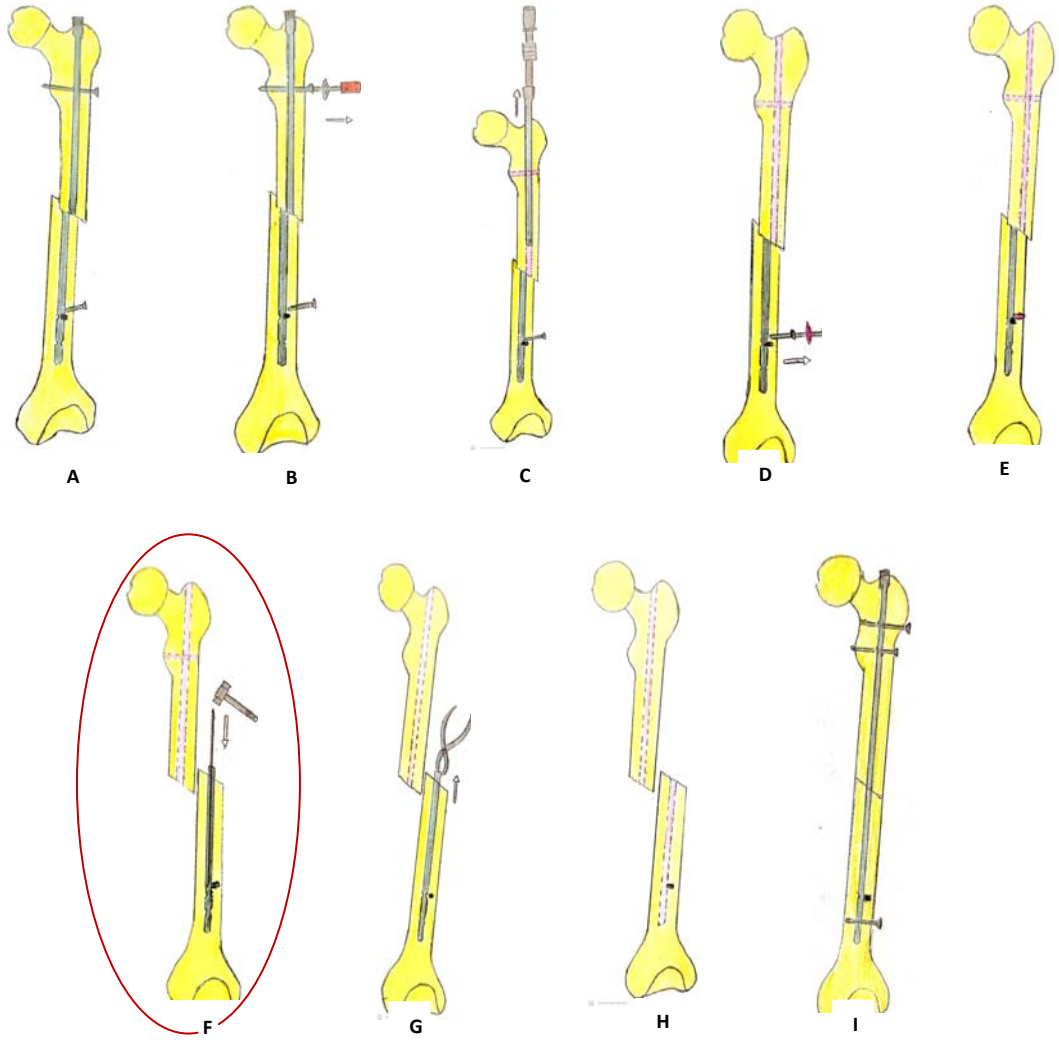



*Fig. 5:* Pictorial presentation of whole operative procedure with different stage



*Fig. 6:* Removed broken Implant

## V. Conclusion

In case of the broken bolt with one fragment of it holding the nail fragment with the bone, the present method of pushing it back by insertion of St. Pin is a valuable technique and successful. Hence, a method to be used for removal of broken nail and bolt varies from case to case, the experience of the surgeon, and armamentarium available. Before embarking on the removal procedure, one should go through published various case reports and case series and should ensure the availability of required instruments.

*Conflict of interest*

The authors declare that they have no conflict of interest.

*Ethical approval*

This case report does not contain any studies with human participants or animal performed by any of the authors.

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*Declaration of patient consent*

The authors certify that they have obtained consent of the patient and his attendants for the clinical history and images to be reported in the journal while maintaining confidentiality.

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# Results of Surgical Management of Highly Unstable Complex Distal Femur Fractures with Distal Femoral Locking Compression Plate Fixation: A Prospective Study of 58 Cases

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*Abstract-* *Background:* The optimal treatment of complex distal femur fractures always remains challenging and controversial. The purpose of this prospective study was to evaluate the efficacy of distal femoral locking compression plate (DF-LCP) in terms of functional outcome, and union rate for highly unstable or complex distal femurfractures and to determine the influencing factors of an unfavorable outcome.

*Methods:* After obtaining approval from the institutional ethics committee, 58 patients with complex distal femur were managed by open reduction and internal fixation with DF-LCP through lateral approach and as per standard protocol. The follow-up results were analyzed clinically and radiologically, using the "Schatzker and Lambert criteria" at once in a month for the first three months, once in three months upto one year and once in six months after that up to two years.

*Keywords:* *DF-LCP, lateral approach, schatzker and lambert criteria, secondary arthritis.*

*GJMR-H Classification:* *NLMC Code: WE 175*

RESULTSOFSURGICALMANAGEMENTOFHIGHLYUNSTABLECOMPLEXDISTALFEMURFRACTURESWITHDISTALFEMORALLOCKINGCOMPRESSIONPLATEFIXATIONAPROSPECTIVESTUDYOF58CASES

*Strictly as per the compliance and regulations of:*

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# Results of Surgical Management of Highly Unstable Complex Distal Femur Fractures with Distal Femoral Locking Compression Plate Fixation: A Prospective Study of 58 Cases

Dr. Rajesh Kumar Sharma [α] & Dr. Rajesh Goel [σ]

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*Results:* In the present study, the average duration of the radiological union was 16 (range 12-24) weeks. The average range of motion of the knee joint was 105.5 degrees. Out of 58 patients, clinical results were excellent in 48.3%, good in 19%, fair in 22.4%, and failure in 10.3% patients as per Schatzker and Lambert criteria. Knee stiffness (9 cases), secondary arthritis (5 cases), and non-union (4 cases) were the main complications observed in this study during two years of follow-ups.

*Conclusion:* The precontoured DF-LCP offers favorable clinical and radiological outcomes in the treatment of complex or highly unstable distal femur fractures with acceptable complication rates. It reduces impairment of periosteal blood supply due to limited plate-bone contact, provides angular stability, and rigid fixation of fragments regardless of bone quality, promotes early mobilization and rehabilitation even in osteoporotic, and severely comminuted fractures.

*Keywords: DF-LCP, lateral approach, schatzker and lambert criteria, secondary arthritis.*

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## I. Introduction

Distal femur fractures are although uncommon, but usually challenging injuries for the treating Orthopedic surgeons. The overall incidence rate of these fractures is < 1%, and 4 - 6% of all femoral fractures [1, 2]. These fractures have a bimodal age group distribution. High energy injuries like road traffic accidents, sport's injuries, and falls from height are the prominent causes in younger patients, in contrast to elderly patients, where these fractures usually occur with low energy injuries like falls during walking and other household injuries [3, 4]. Distal femur fractures usually associated with compound injuries, severe comminution, and bone loss. On the other hand, proximity to the knee joint and unstable nature of the fracture makes it more prone to adverse functional outcomes. Inadequate management of such fractures have high incidences of infection, non-union, and mal-union [5].

The management plan of these fractures depends on patient age, fracture grading, soft tissue injuries, and other associated injuries [6]. For treating Orthopedic surgeon, the ideal surgical goals are anatomical reduction of the fracture fragments, restoration of limb length, alignment and rotation, and rigid fixation that allows early mobilization and rehabilitation for the patient.

Before the 1970s, most of the distal femur fractures were treated conservatively with traction, casting, or combination of both. Due to prolonged bed rest, complications such as persistent angular deformity, bedsores, and loss of knee range of motion encountered in most of the patients [7, 8]. After the arrival of AO group, and upto the late 90s, many internal fixation devices used for the treatment of distal femoral fractures such as the dynamic condylar screw (DCS), or angled blade plate (ABP), condylar buttress plates, retrograde supracondylar inter-locking nails [9-11]. Although early mobilization was an advantage, rigid fixation in osteoporotic fractures and in severe metaphyseal comminutions were the main challenges. Other disadvantages were periosteal stripping and



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stress on implant lead to unfavorable outcomes, e.g. non-unions, and implant failures.

The distal femoral locking compression plate (DF-LCP) manufactured to overcome all these disadvantages. For highly comminuted and osteoporotic distal femur fractures, open reduction, and internal fixation (ORIF) with DF-LCP is gaining popularity nowadays. DF-LCP allows both locking and compression screw fixation of the femur shaft. The pull-out strength of locking screws is significantly higher than that of typical screws, and it's arduous for one screw to pull out or fail unless all adjoining screws do the same. The favorable benefits of DF-LCP include stable angular fixation of fragments regardless of bone quality, reduced impairment of periosteal blood supply of the bone due to limited plate-bone contact, rigid fixation, early and active mobilization even in osteoporotic, and highly comminuted distal femur fractures [12-14].

The purpose of the present study was to evaluate the functional outcome, fracture union rate, and complications in highly unstable and osteoporotic fractures of distal femur treated with open reduction and internal fixation with distal femoral locking compression plates (DF-LCP) using Schatzker and Lambert criteria [13].

## II. Methods

This study conducted during the years 2015 to 2018 in the Department of Orthopedics, Govt. Medical College, Kota (Rajasthan). Before the initiation of this study, approval of the institutional ethical committee was received. We designed a prospective study with a sample size of 58 patients with distal femur fractures, who met with inclusion criteria.

*Inclusion Criteria:* Skeletally matured patients with complex distal femur fractures (spiral, oblique, transverse, and butterfly fragment with intra-articular extension, and open fractures grade I & II as per Gustilo-Anderson classification [15], osteoporotic fractures and had preparedness to take part in the study, were included.

*Exclusion Criteria:* Polytrauma patients, pathological fractures, periprosthetic fractures, existing deformity of the same limb, any active infection, open fractures grade III & IV (as per Gustilo-Anderson classification [15], and fractures with neurovascular injuries excluded from the study.

All the mandatory preoperative routine investigations (blood and urine) done. To understand the morphology of fracture, an adequate radiological assessment, and 3-dimensional CT scan (especially in intra-articular femoral condyle fractures) carried out before the surgery. Lower tibial skeletal traction with proper weight was applied, in the situation of delayed surgery. We obtained the written informed consent from each patient before the procedures.

*a) Surgical Technique*

All surgeries performed by the same surgeons under spinal or combined spinal-epidural anesthesia. On the operating table, the patient placed in the supine position. Intravenous antibiotic (1 gm of Cephalosporin) injected 30 min before the surgery. We placed a pillow under the ipsilateral hip, and another one under the knee to obtain the flexed position of the knee. Depending on the length of the femur and proximal extension of fracture, a pneumatic tourniquet applied at the upper thigh in some patients. Routine preparations done such as scrubbing and draping of the injured limb.

The lateral standard approach used in all the patients. An incision parallel to the shaft of the femur, extending across the midpoint of the lateral femoral condyle, anterior to the lateral collateral ligament, across the knee, and gently curved anteriorly along the lateral border of the patella and up to the tibial tuberosity. The Vastus lateralis was elevated from the lateral inter muscular septum, and retracted anteriorly and medially, exposing the distal femur. The medial femoral condyle or coronal plane anatomy managed by adequate exposure of articular surface, and extension of the incision as per necessity.

The condyles were reduced and stabilized temporarily by k wires and fixed with 6.5 mm cannulated cancellous screws. The supracondylar part reduced, and the distal femoral locking compression plate placed. After putting a suction drain, the wound closure done in the standard manner.

*b) Post-operative follow-up*

Post-operatively intravenous antibiotics were given for five days, followed by oral antibiotics. Wound dressing checked on the second post-operative day. Routine post-operative X-rays done before discharge. From 3rd day, continuous passive knee mobilization exercises twice daily were given to all the patients. Our purpose was to obtain at least 90 degrees of the knee flexion at the time of discharge. For the initial six post-operative weeks, all the patients directed to perform quadriceps, hamstring, and knee bending exercises properly. After six weeks, once the satisfactory clinical union ensured on examination, partial weight-bearing with leg knee brace support allowed. In our study, the clinical unionconsidered satisfactory, if the fracture site was pain-free, and two plane stability was present clinically at the fracture site. After 12 weeks, once enough radiological signs of fracture union detected in plane X-rays, full weight-bearing was allowed. It considered satisfactory radiological union, if plain radiographs showed at least three cortices of the bone or bone trabeculae crossing the fracture site. Although, the above mentioned protocol was delayed in case of delayed union.

Follow-ups were done regularly, once in a month for the first three months, once in three months

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upto one year and once in six months after that up to two years. At each follow-up, check X rays taken, and all the information regarding postoperative complications, union time of fracture, partial weight-bearing time, full weight-bearing time of fracture recorded. Final assessment of all the patients was done at two years. For grading of the results, Schatzker and Lambert criteria [13] followed in this study.

*c) Statistical analysis*

The SPSS software version 16.0 and MS Excel 2013 used for statistical analysis. In the present study, qualitative variables demonstrated in proportion, and quantitative variables presented by the mean, and standard deviation.

## III. Results

In this study, fifty-eight eligible patients operated during the study period from the years 2015 to 2018. Out of 58 patients, 40 were male, and 18 were female, with a mean age of 42.27 years (range 19-72). The mode of injury in 37 patients, was motor vehicle collision, in 19 patients, was fall from a height, and rest two patients presented with gunshot injury [Table 1]. These fractures were closed in 49 cases and compound in 9 cases (7 were Gustilo & Anderson grade I, 2 were grade II).

The mean delay in operation was 7 (range 1-15) days. The mean duration of surgery was 80 (range 60-110) minutes. The average perioperative blood loss was 250 (range 150-400) ml. The mean days of hospital stay were 12 (range 10- 15) days. The various functional and radiological outcomes of our study, e.g. average time to weight-bearing, fracture union, ROM, and study results, are presented here in tabulated form [Table 2-4] and figures [Figure 1-4].

*Table 1:* Showing demographic variables of the study

| Demographic variables | | Features |
|---|---|---|
| Study design | | Prospective study |
| Study period | | 2015- 2018 |
| Total number of the patients | | 58 |
| Male: Female | | 40:18 |
| Mean age (range) in years | | 42.27 (19-72) |
| Mode of injury | Motor vehicle collision | 37 |
| | Fall from height | 19 |
| | Gunshot injury | 2 |

*Table 2:* Showing various outcomes of the study

| Functional Outcome | Average duration (range) in weeks |
|---|---|
| Partial weight bearing | 10 (6- 14) |
| Full weight bearing | 16 (12-24) |
| Clinical union at fracture site | 10 (6-14) |
| Radiological union of fracture | 16 (12-24) |

*Table 3:* Showing knee range of motion in operated patients.

| Post-op knee ROM* (in degree) | Functional Outcome | Number of patients (n=58) |
|---|---|---|
| 110 and more | Good to excellent | 28 (48.3%) |
| 91-109 | Satisfactory | 13 (22.4%) |
| <90 | Unsatisfactory | 17 (29.3%) |

**ROM: Range of Motion*

*Table 4:* Showing the functional outcome of the study.

| Results (according to Schatzker & Lambert criteria [13]) | Number of patients (n=58) | Percentage of patients |
|---|---|---|
| Excellent | 28 | (48.3%) |
| Good | 11 | (19%) |
| Fair | 13 | (22.4%) |
| Failure | 6 | (10.3%) |



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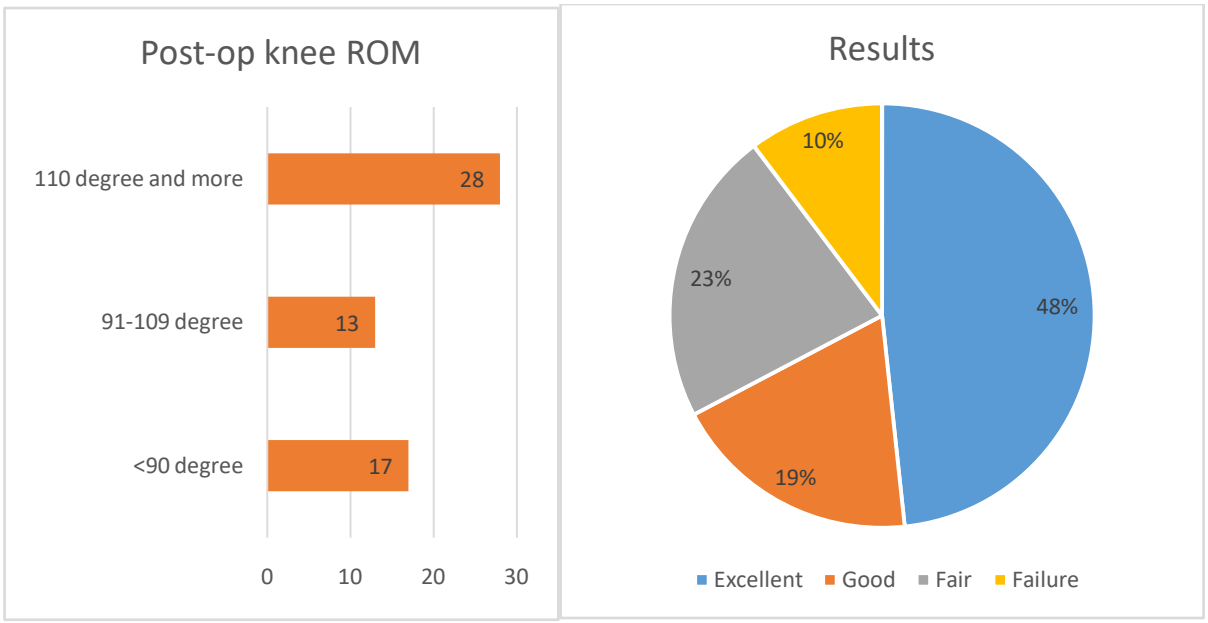
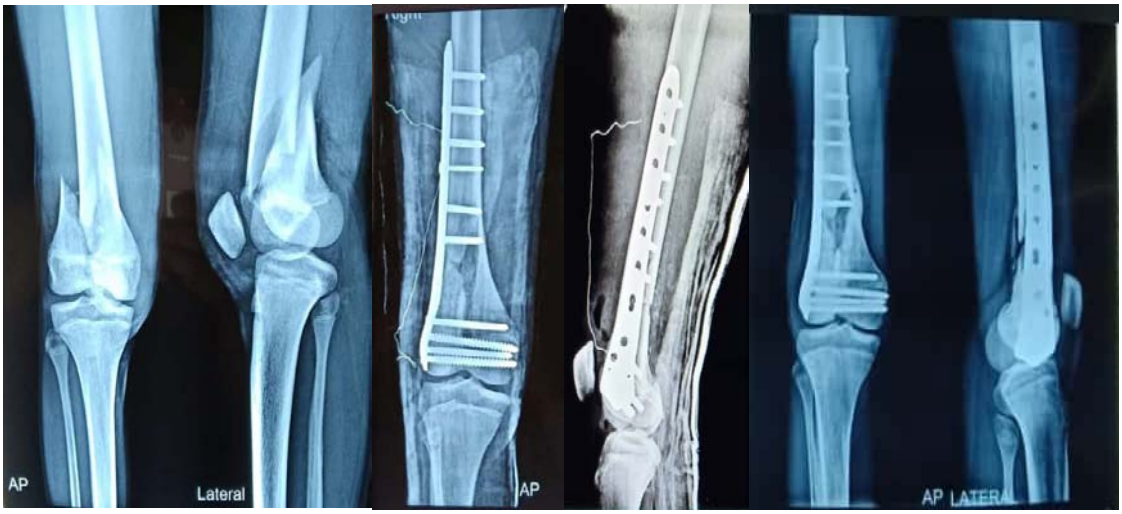



*Figure 1:* Showing knee 'Range of Motion' in post-operative patients and results of the study according to Schatzker & Lambert's criteria




[Figure 2] [Figure 3] [Figure 4]

*Figures 2-4:* Evaluation of radiological (AP & Lateral views) outcome of an unstable complex distal femur fracture, treated with DF-LCP fixation (pre-op, post-op, and at three months follow-up)

*a) Complications of the study*

We encountered some complications at the follow-ups of the patients. The most common complication was knee stiffness, observed in 9 (15.5%) patients [Table 5].

*Table 5:* Showing the complications of the study

| Complications | Number of patients & Percentage (n=58) |
|---|---|
| Superficial surgical site infection | 3 (5.2%) |
| Deep infection | 2 (3.4%) |
| Delayed union | 2 (3.4%) |
| Knee stiffness | 9 (15.5%) |
| Limb lengths discrepancy or shortening < 2 cm | 3 (5.2%) |
| Implant failure | 3 (5.2%) |
| Non-union | 4 (6.9%) |
| Secondary arthritis | 5 (8.6%) |



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## IV. Discussion

Surgical treatment methods for distal femur fractures are still controversial, and dependent on fracture type, and the surgeon's choice. Distal femoral locking compression plates (DF-LCP) have become the most commonly used procedure for internal fixation of distal 1/3rd femur fractures with or without intercondylar extension [16-18]. In DF-LCP, the sum of all screw-bone interfaces gives the strength of fixation and makes it a 'single beam construct'. This plate has higher biological advantages than a standard plate [19]. It doesn't hamper the blood supply to the bone and maintains the cortical thickness of the bone, unlike standard plate.

In our study, the average age of patients, was 42.27 (range 19-72) years. This finding is almost comparable with the study of Siliski *et al.* [20] in which they reported the mean age of their study population as 42.2 years. Males were affected more commonly than females. The in present study, out of 58 patients, 40 patients (69%) were male and 18 patients were female. It explained in such a way that working male adults were more involved in outdoor activities in a country like India and got such fractures more commonly. Similarly, 63% were male patients in the study of Yeap *et al.* [21].

In the present study, clinical union assessed at ten weeks (mean), while radiological union was observed at 16 weeks in most of the patients. Although, the delayed union was also observed in two cases (3.4%), in which union occurred at the end of 24 weeks of follow-up. Our study results are comparable with the results of previous studies of Rajaiah *et al*. [22], and Kim *et al.* [23]. They described average radiological union time as 14 - 25 weeks, and 13-20 weeks respectively.

In our study, out of 58 patients, the range of motion (ROM) of the knee joint at final follow-up (2 years) was 110 degrees and more in 28 (48.3%) patients with good to excellent functional outcome. In 13 (22.4%) patients, we succeed in achieving 91-109 degrees ROM with satisfactory functional outcome. Although, we failed to obtain a satisfactory ROM in 17 (29.3%) patient up-to their final follow-up. Some of these patients underwent knee mobilization. They refused for any additional surgery to increase ROM and continued with non-operative care. The average range of motion of the knee joint was 105.5 degrees in our study. The average range of motion of the knee joint was 110 degrees in the study of Markmiller *et al.* [24].

In this study, the results expressed according to the Schatzker & Lambert's criteria [13]. In this study, out of total 58 cases, results were as excellent in 28 (48.3%) cases, good in 11 (19%) cases, fair in 13 (22.4%) cases, and failure in 6 (10.3%) cases. Paknikar KP *et al*. [25] reported their study result as excellent in 32% patients, good in 28%, fair in 34%, and poor in 6% patients. Padha K *et al.* [26], described their study results as excellent in 44%, good in 32%, fair in 16%, and failure in 8% patients.

In the present study, out of 58 cases, three (5.2%) patients had superficial surgical site infections. These cases successfully treated with proper dressings and oral antibiotics. Although, there was no long term adverse effect on fracture healing or rehabilitation of these patients due to this superficial infection. We observed two cases (3.4%) withdeep surgical site infections. Both cases successfully managed with debridement, adequate lavage, and intravenous antibiotics. Kregor *et al.* [27] reported in their studythat deep infection manifested in 3% of their patients.

Knee stiffness observed in 9 (15.5%) patients. It was the most common complication of our study. We encountered 3 (5.2%) cases with mild limb length discrepancy or limb shortening $< 2$ cm. This mild shortening was well compensated by equinus position at ankle joint, and was acceptable to the patients. We observed a total 3 (5.2%) patients with implant failure within the first 12 weeks of primary surgery. Out of 58 patients, we noticed 4 (6.9%) patients with non-union at fracture site at their one-year follow-ups. All these cases underwent revision surgery. The procedure carried out was- implant removal and re-fixation with longer DF-LCP with autologous bone grafting from the ipsilateral iliac crest, and satisfactory functional outcomes achieved after the revision surgery. Out of 58 patients, we noted secondary arthritis in 5 (8.6%) patients, for which some of these patients have to go replacement arthroplasty at a later stage. All these complications were comparable with the complications mentioned in the previous studies [28, 29, 30].

*a) Limitations of the study*

One of the main limitation of our study was the small sample size. The small sample size influences the evaluation of outcomes, as it can overrate the results. Furthermore, the study includes the single method of fracture fixation with distal femoral locking compression plate (DF-LCP) only. At the same time, other various fixation methods could have also been used for comparison and to conclude more significant results.

## V. Conclusion

Distal femoral locking compression plate (DF-LCP) is an extra-medullary load-bearing device, which is an ideal implant to prevent metaphyseal collapse, mal-rotation and to maintain limb length especially in osteoporotic and severely comminuted distal femur fractures with intra-articular extension. DF-LCP has combi holes in the stem and locking bolts in the expanded head area. With the proper patient selection, it holds the metaphyseal bone firmly in highly unstable distal femur fractures, and simultaneously, it provides stable fixation in the distal femoral shaft to promote callus formation and allows early mobilization and early weight-bearing with acceptable complication rates.



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# Management of Grade 3C Compound Injury of Right Lower Limb with Floating Knee - Salvage Versus Amputation (A Case Report)

By Sharandeep Singh Saluja, Sundar Suriyakumar, Muthumanickam Ramanujam, B. Sundararaja, Sudharsan Reddy & Dr. N. Jambu

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*Keywords:* *amputation versus salvage, gustilo and anderson's classification, MESS, open fractures.*

*GJMR-H Classification:* *NLMC Code: WE 168*



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# Management of Grade 3C Compound Injury of Right Lower Limb with Floating Knee - Salvage Versus Amputation (A Case Report)

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*Abstract- Introduction:* Severe open injuries of limbs, especially of the femur and tibia when associated with vascular injuries, present major challenges in management. The decision to amputate or salvage can often be a difficult one even for experienced surgeons. Mangled lower extremity results due to high energy trauma especially due to motor vehicle accidents and is defined as injury to three of the four systems in the extremity i.e soft tissues, bone, vascular and nerve. Open fractures are classified by Gustilo and Anderson's classification in which type 3b is a injury where soft tissue loss and primary closure of the wound is not possible and type 3c is any open fracture with vascular compromise.

*Case report:* We report a case of 27 Years old gentleman who sustained an open 3c Gustilo-Anderson fracture with right floating knee that was initially treated with debridement and external fixator and advised amputation above knee in outside hospital and referred to our hospital for further management.Despite a borderline Mangled Extremity Severity Score (MESS) (Table- 2), due to the overall health status of the patient and local clinical status with preserved plantar sensitivity, reconstruction was attempted. After 8 months of treatment, all wounds healed completely with no pain, and satisfactory motor and sensory function was achieved (fig.18). On examination, anterior tibial artery pulsation was feeble and posterior tibial artery pulsation was absent, subsequently CT right lower limb arteriogram was done after obtaining vascular surgeon opinion. Which reveals posterior tibial vessel under spasm and anterior tibial vessel sluggish blood flow. He underwent right leg and knee wound debridement and reconstruction with ilizarov fixation and soft tissue repair. Subsequently after 7 days he underwent right leg ilizarov realignment and wound debridement with medial gastronemius flap + split thickness skin grafting +vacuum assisted closure (VAC) application (fig.17). Postoperatively, he was given rehabilitative care and physiotherapy in the form of non weight bearing mobilisation with walker support. The patient was followed up for the period of two years and he is doing symptomatically better.Based on current literature guidelines and evidence-based medicine, management for borderline cases is proposed to aid clinical decision making in these situations.

*Conclusion:* With great effort and good team work (like vascular and orthopaedic surgeons) badly comminuted compound injuries (Type III C injury) can be managed well with Ilizarov fixation.

Even though the decision of amputation versus Salvage was based on more scientific / scoring system, patient's option should be taken, especially in borderline cases considering the present medico legal scenario.

*Keywords: amputation versus salvage, gustilo and anderson's classification, MESS, open fractures.*

## I. Introduction

Mangled limb is defined as one that involves a combination of injuries affecting at least 3 out of the four components of the extremity: vascular, nervous, soft tissues and underlying bone. Basically, it is related to type IIIB and IIIC injuries within the Gustilo and Anderson´s classification. However, every work commonly uses criteria that do not always fit within this definition. It is a situation that can lead to amputation in 9% of the cases in the first 24 hours and in 21% during the hospitalization [1].

The term "floating knee" was first described by Blake and McBride in 1975 [2]. It is an ipsilateral fracture of the femur and tibia that includes diaphyseal, metaphyseal, and intraarticular regions of the bone. Floating knee injuries occur as a result of a very high-velocity trauma. Road traffic accidents are the most common cause of this type of complex injuries [3]. The incidence of road traffic accidents are on the rise and are often associated with complex life-threatening conditions and extensive soft tissue damage. Management of these injuries varies according to the type and extent of bony and soft tissue involvement. Bertrand and Andrés-Cano state "although the exact incidence is unknown, this condition is generally rare," the incidence is on the rise currently due to the increased trend in high-velocity traumas. Frequently, multiple produced fractures in the same extremity, will add new dimensions to their management. These fractures range can change from simple diaphyseal to complex articular types.

The degree of severity of open fractures is often classified in accordance with the system of Gustilo and Anderson [5, 6]. This takes into account the wound size,

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fracture pattern and degree of soft-tissue contamination. Type III of this classification corresponds to fractures due to high-energy trauma, with extensive injury to soft tissues, and is divided into three subtypes: types IIIA, IIIB and IIIC, according to the severity of the injury [4, 5, 6].

The extensive damage seen in types IIIB and IIIC may be a veritable challenge, even for surgeons with greater experience. It may require a clinical decision between attempts to salvage the limb and amputation. Clinical advances within orthopaedic, plastic and vascular surgery have provided the means for reconstructing injuries to limbs that, around 20 years ago, would have resulted primarily in amputation. However, some studies have reported that limb salvage is not always the best solution and that early amputation with prosthetic treatment should be recommended in some cases [7, 8].

Some classification scores are used to complement the detailed clinical assessment on the affected limb and aid in making clinical decisions [9, 10]. Helfet et al. [8] established the use of the Mangled Extremity Severity Score (MESS), which grades injuries based on the clinical findings and takes into consideration the characteristics of the injury, the duration of ischemia, the shock and the patient's age. Scores greater than or equal to seven have predictive value for limb amputation [7].

Although much has been now been reported regarding exposed fractures, there is a gap in the literature in relation to studies presenting a high level of evidence that have compared outcomes between limb salvage and amputation. This gap exists because of ethical concerns regarding randomization of patients between these two procedures [11, 12]. Thus, many of the recommendations that are incorporated into the treatment routines for patients with exposed fractures of the tibia and fibula are based on specialists' opinions. Thus, further scientific studies are needed in order to provide scientific backing for surgeons' and patients' choices before the operation.

In the past several decades, limbs with Gustilo type grade IIIC injuries (open fractures of the lower limb associated with vascular injury) have been difficult to salvage and have been treated by primary amputation. With the advancement of surgical technique, especially the use of microsurgery, the salvage rate for grade IIIC lower limb fractures is rising, and the rates of attempted limb salvage are also increasing [13]. Many patients have undergone successful limb salvage [14].These fractures can be managed by reconstruction or amputation. The decision regarding which option to choose can be difficult for both physicians and patients. Complicating this decision is the young age of many of the patients.

In the past, when there were few reliable options for lower limb reconstruction, amputation was the preferred choice because salvage attempts generally used skin grafting, which was inadequate to cover exposed bone [15]. This resulted in high rates of osteomyelitis and secondary amputation [15]. The advancement of microsurgical techniques allowed cooperative efforts between orthopedic and plastic surgeons to reconstruct severe open fractures and achieve predictable limb salvage [16]. Most recently, wound care technology has further increased surgeons' ability to treat open tibial fractures [15].

Reconstruction is performed at a much higher rate than primary amputation, despite the lack of evidence indicating better outcomes associated with reconstruction [15]. It is understandable that both physicians and patients will want to salvage an injured limb. Suffering a serious injury, like an open tibial facture, will have grave physical, emotional and financial consequences, regardless of the treatment method used. The choice of treatment ideally should be based on careful consideration of the available data, however, the overwhelming desire to save the leg, coupled with having the technology to achieve this aim, can cloud the decision-making process for both patients and surgeons.Decision analysis is a powerful tool that can provide evidence when a randomized controlled trial is not practical or ethically feasible. Assigning utilities to these outcomes allows for the comparison and careful examination of complex situations that, otherwise, would be difficult to research.

## II. Case Report

27 Year old gentleman who sustained an open grade 3c Gustilo-Anderson fracture with right floating knee that was initially treated with debridement and external fixator and advised amputation above knee in outside hospital and presented to us within 12 hours of initial injury. On head to toe examination, no other musculoskeletal and organ injuries were present. On initial presentation, he was hypotensive (blood pressure-90/70 mm of hg) and was started on appropriate measures by emergency room team. No known medical co-morbidities were present. He was non smoker, non alcoholic and no drug addiction. On local examination of right lowerlimb:

a. Right lower limb knee spanning external fixator present.
b. Lacerated wound of size 20x10 cm extending from distal third of thigh to middle third of leg anteriorly. Wound contamination present (fig.1).
c. Both femoral condyle fractured fragments and proximal tibial fractured fragments exposed (fig.1).
d. Patella and lateral tibal condyle absent (fig.1).
e. Tendons and muscles were exposed (fig.1).
f. Dorsalis pedis artery pulsation- feeble.
g. Posterior tibial artery pulsation- absent.
h. Sensations over right lower limb were intact.



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i. Active dorsiflexion and plantar flexion present.

*Examination of neurovascular functions-*

*Vascular–*

Anterior tibial artery pulsation feeble.

Posterior tibial artery pulsation were not felt.

*Local orthopedics severity were assessed using-*

1. Gustilo-Anderson's classification. (fig.4)
2. Modified Fraser's classification (fig.19)

Vascular surgeon opinion was sought and advised to do right lower limb CT angiogram. CT study report shows- Posterior tibial vessel under spasm and Anterior tibial sluggish blood flow. Vascular surgeon adviced conservative treatment. According to modified fraser classification it was classified under type IIC. The mangled extremity severity score (MESS) (Table-2) was used to assist in the decision of injuries that also had a vascular component and the total score was found to be 7 (≥ 7 should be consider for amputation). In view of partial vascular injury (Anterior tibial artery pulsation feeble and Posterior tibial artery pulsation were not felt), Ganga Hospital Open Injury Severity Score (GHOISS) was also used which was found to be in borderline range of 16 score (Table-1). Scoring systems provided limited diagnostic benefit. Thus, we had an extensive discussion with the patient and his relatives, in order to point out that any attempt at limb salvage might result to major complications and probably a delayed amputation. In addition, even with salvage severe disability was expected. After discussing and taking consent from patient and his relative he was taken up for combined procedure under orthopaedic and plastic surgery team after obtaining anaesthetic fitness. He underwent right leg and knee wound debridement and reconstruction with ilizarov fixator and soft tissue repair. Intraoperatively, Patella and lateral tibal condyle was found to be absent (fig.1, 5, 6). Patella tendon was sutured to quadriceps tendon. Postoperatively, he was shifted to intensive care unit in view of raised serum myoglobin and CPK levels for which cardiology opinion were sought. After 1 week, patient underwent right leg ilizarov realignment and wound debridement with medial gastronemius flap + split skin grafting + vacuum assisted closure (fig.17). Introperative period was uneventful. Intraoperatively gram, fungal and acid fast bacilli stain and culture was sent and found to be negative for organism growth. Postoperatively regular wound inspection and dressing done which was found to be satisfactory clean (fig.17, 18). Blood culture and urine culture shows no growth. He was afebrile (initially he was hypotension which was controlled during the course of treatment) and was hemodynamically stable. Gustillo and Anderson´s classification (fig.4) was used in order to highlight the contamination and the soft tissue injuries as a risk factor in the fracture evolution. It was classified as grade 3c (as vascular injury was present). He was started on rehabilitative care. Range of motion of knee was found to be 0 to 40 degree of flexion with some instability (fig. 18). Strict non weight bearing walking with walker support was encouraged. Quadriceps and hamstring muscle strengthening exercise was started. The treatment was deemed successful and the patient was discharged. Regular x-ray radiography was taken to assess fracture union (fig.2, 3, 7, 8-16). Fracture union for distal femur was seen at 8 months and for tibia it was 12 months. He was followed up for the period of two years and he is doing symptomatically better.

## III. Discussion

Floating Knee Injury (FKI) are uncommon injuries and its true incidence remains unknown. Patients with FKI are usually victims of high speed trauma, mostly motor vehicle accident which involves fracture of femur and tibia. Fracture of two very strong bone of human body required immense force.

It is not just an extremity injury, several organ injuries and multiple fractures are often associated, which can be life threatening. Careful evaluation of patient was carried out to identify other associated injuries and treatment priority should be given to life threatening injury over extremity injury.

The role of early total care (ETC) and orthopedic damage control (DCO) in polytrauma has always been a controversial issue. In stable patients, ETC is more appropriate and in unstable patients DCO is required. However, considerable doubt remains in borderline patients. Some author advised ETC in all patients except in more critical patients and some advised DCO and delayed skeleton stabilization [17].The literature has also reports utility of serum lactate to assess timing of treatment and mortality, but its role is still controversial to predict survival after major injury [18]. In our case report, we did not measure serum lactate level.

The incidence of amputation was reported to 27% in FKI which had massive soft tissue crushing, severe infection and neurovascular injuries [19].

Blake and McBride [20] defined the floating knee injury as the ipsilateral fractures of the femur and the tibia. Fraser et al. in year 1978 classified floating knee in more detail [21]. This classification was again modified by Letts and Vincent [22] in 1986 which included soft tissue injury associated with these injuries.

Decisions making in clinical situation of Mangled Extremity in complex as number of factors are involved [25]. These factors are:

*a) Wound Related*

1) Fracture grade and type. 2) Compartment syndrome. 3) Possibility of immediate fixation. 4) Duration and severity of ischaemia. 5) Loss of soft tissues of the foot.



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*b) Patient related*

1) Associated systemic injuries. 2) Shock. 3) Coaugulopathy. 4) Need for vasoconstrictiction. 5) ARDS. 6) Age. 7) Co-morbid conditions. 8) Hospital resources. 9) Transport time. 10) Mass/millitary casualty. 11) Patient Co-operation.

*c) Scoring systems*

*d) Expected outcome*

Mandatory weight bearing• Protective sensations• Presence of durable skin and soft tissues.•

*e) Experience of Surgeon Availability of vascular and plastic surgeons.*

All above factors have to be considered individually and collectively to decide on amputation Vs salvage.

Patients who initially confront a threatening injury often focus on the loss of the extremity rather than on the consequences of the limb salvage. Patients undergoing this procedure, will require more complex operations, longer hospitalization, and will suffer more complications than primary amputees. Tornetta and Olson reported on patients who have undergone multiple operations over a period of several years to "heroically" save a leg only to render the patient depressed, divorced, unemployed, and significantly disabled [23]. Unfortunately, "salvage" of a mangled extremity is no guarantee of functionality or employability. It is crucial for the patient and his family to realize that both salvage and early amputation by no means can reassure the patient that will return to a previous normal, pain free extremity [24]. In our case report, patient is doing well after limb salvage surgery. Functional improvement has been seen during the follow up periods (fig.18).

Significant indicators of poor outcome results of floating knee injuries are intra-articular involvement of the fractures, severity of skeletal injury, and severity of soft tissue injuries. In most of the patients, sepsis and other infection complications may be so severe and persistent that ultimately secondary amputation is required. Bondurant et al. [26] compared primary versus delayed amputations in 43 cases, including 14 primary and 29 delayed ones. Important findings included 6 deaths from sepsis in delayed amputation group compared with none in the early amputation group. In our case report, no clinical and laboratory evidence of sepsis were noted.

Although cost should not be a major deciding factor for limb salvage, many patients may be devastated by the cost, not only of medical bills but also of time off work [26]. Fainhurst [27] retrospectively compared the functional outcome of patients who sustained traumatic below knee amputations with that in patients who underwent limb salvage of Gustilo type III open tibial fractures. All patients in the early amputation group returned to work within 6 months of injury, while those who underwent late amputation and salvage returned to work an average of 36 and 18 months after injury, respectively. The authors recommend an early amputation when confronted with borderline salvageable tibial injury. In our case report, patient returned to his work after 12 months following injury.

Fagelman et al.[28] evaluated the correlation between fractures of Gustilo and Anderson types IIIB and IIIC and the MESS index for exposed fractures of the lower limbs and found results that significantly predicted treatment, for 93%. On the other hand, Sheean et al. [29] did not find any significant difference in MESS values between amputees and patients whose limbs were salvaged. Both of these authors highlighted the importance of the presence of vascular lesions as a factor predictive of amputation. Slauterbeck et al. [30] reported that early use of a scoring system such as MESS would possibly reduce the morbidity associated with prolonged hospital stay and with the various surgical procedures performed in these cases.

The most widely described scoring systems are: the Mangled Extremity Syndrome Index (MESI) [31], the Predictive Salvage index (PSI) [32], the Mangled Extremity Severity Score (MESS) [9], and the Nerve Injury, Ischemia, Soft-Tissue Injury, Skeletal Injury, Shock, and Age of Patient (NISSSA) Score [11]. Each scoring system has a "cutoff point". If the total score exceeds the critical "cutoff point" primary or early amputation should be considered. However, these scoring systems have been criticized as being too complex and subjective with large variations in interobserver classification of mangled extremity, and as expected none of them is accurate in all cases [33]. Even among experienced surgeons there is disagreement regarding the criteria of these scoring systems, which cannot be used with confidence in clinical practice, because their use has not led to specific outcomes.

In our case report, inspite of MESS score (Table-2) of 7 which is suggestive of amputation, we have chosen the option of salvaging the limb after considering the patient factor. With MESS score of 7 or greater, amputation is the eventual result. No scoring system, however, can replace experience and good clinical judgment. It needs to be remembered that advances made in limb salvage surgery has been matched by advances in amputation surgery and prosthesis design. More often, however, the choice between limb salvage and amputation must be made on the basis of expectations and desires of individual patient and the family.

Although scoring systems may be helpful, the patient's status cannot simply be summarized by a score number. A closer look reveals that many questions remain unanswered. These systems fail to consider factors related to the patient's quality of life,



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pain, occupation, age, wishes, social support system, family status, and financial resources. The training and experience of the surgical team may also influence the decision to amputate or reconstruct. Although these considerations are more subjective, undoubtedly they are very important. The true measure of successful limb salvage lies in the overall function and satisfaction of the patient. In our case report, the main reason for limb salvage, despite the indication for amputation according to MESS and borderline ganga scoring system (score of 16) (Table-1), it was patient and physician's choice in relation to his occupation, condition and psychology.

The final decision regarding the treatment for patients with a diagnosis of an exposed fracture of the tibia needs to take into account future functionality, availability of recovery, the patient's profile and the surgeon's expertise. The criteria for indicators such as the MESS score and the fracture classification need to be carefully analyzed so that the limb salvage can be done in an effective manner and so that amputation is done in precisely selected cases.

There are many studies in literature suggesting internal fixation of both the fractures of floating knee should be done as early as possible [35]. Ratliff found that internal fixation of both fractures was less likely to cause the development of knee stiffness and lessen the duration of hospital stay [36]. Ostrum treated patients with retrograde femoral nailing and antegrade tibia nailing through 4 cm medial parapatellar incision [37]. The average time to union of femoral fracture was 14.7 weeks and for tibial fracture was 23 weeks. Theodoratos *et al*. [21] recommended intramedullary nailing as the best choice of treatment, except for grades IIIB and IIIC open fractures. In our case report, patient was treated with initially by application of external fixator followed by ilizarov fixator application. Time to union of femoral fracture was 8 months and for tibia fracture was 12 months.

In literature we found that outcome of FKI were often variable, some author reported 0 excellent result and other author reported excellent result up to 53%. These variable results might be due to associated neurovascular injury, open fracture and variable fracture pattern with FKI [34]

Severe trauma to the lower extremity with vascular compromise often leaves the surgeon with a very difficult clinical decision; whether to salvage or amputate [39, 41, 46]. With today's therapeutic and technological advances, the trauma surgeon has the ability to salvage viability in most, if not all, severe lower-extremity injuries. Obviously, there have been some remarkable successes and, unfortunately, some horrendous failures. Patients have suffered protracted hospital courses, multiple surgeries, multiple subsequent hospitalizations, complications (especially infections and nonunions), and the inevitable delayed amputation of a viable but nonfunctional extremity [39, 43, 46]. The major decision in open fractures of the lower extremities with vascular compromise is not whether one can but whether one should attempt salvage. This decision is often clearly mandated by the nature and extent of the lower-extremity injury and the patient as a whole. Lower-extremity replantation, except maybe in children, is clearly unwarranted. Lang et al. have shown that division of the posterior tibial nerve as part of the lower-extremity injury in adults is an absolute indication for amputation [42]. Recent literature supports the overall poor prognosis for successful salvage for Type IIIC tibial injuries (open tibial fractures with vascular insufficiency) [6, 38, 42]. The occurrence of a crush injury and/or warm ischemia longer than six hours makes limb salvage futile. The traumatized patient with vascularly compromised open fractures in the lower extremity requires prioritization of life-saving procedures and is often best served by amputation. However, there are a large number of patients with lower-extremity injuries with vascular compromise who do not fit the above criteria for primary amputation. Recent literature has stressed the need for establishing objective criteria to assist the surgeon in the urgent decision for salvage versus primary amputation [39, 41, 46].

Even though the predicted value for amputation of a MESS score higher than or equal to 7 appears to be very high, with larger numbers there inevitably will be a limb with a score of higher than or equal to 7 that will be salvaged, or a limb with a score of lower than or equal to 6 that will require delayed amputation.

## IV. Conclusion

As a majority of cases represent a "gray zone" of unpredictable prognosis, and borderline cases are a dilemma, the decision to amputate or not amputate should not always be made during the initial evaluation. Although scoring systems and "cutoff points" are useful, the final decision for limb salvage should be based on team experience, technical skills, multidisciplinary consultation, tertiary-care facility, and the profile of the patient. Scoring systems should be used only as guides to supplement the surgeon's clinical judgment and experience. Excellent clinical and functional outcomes can be achieved with individualized planning of treatment which is dependent on the patient's general condition, type of fracture, and severity of soft tissue injury by an experienced multidisciplinary team instead of a fixed definite management for all patients.

With great effort and good team work (like vascular and orthopaedic surgeons) badly comminuted compound injuries (Type III C injury) can be managed well with Ilizarov fixation. Even though the decision of amputation versus Salvage was based on more scientific / scoring system, patient's option should be taken, especially in borderline cases considering the present medico legal scenario.



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*Clinical massage:* The treatment of mangled extremity treatment should be based on evidence based literature along with a clinical evaluation of every individual patient. Scores are helpful, but should not be taken as the sole indication for amputation.

*Consent:* The patient has given his informed consent for the case report to be published.

*Competing interests:* The authors declare that the interpretation of data or presentation of information is not influenced by any personal of financial relationship with other people or organizations.

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*Figures*

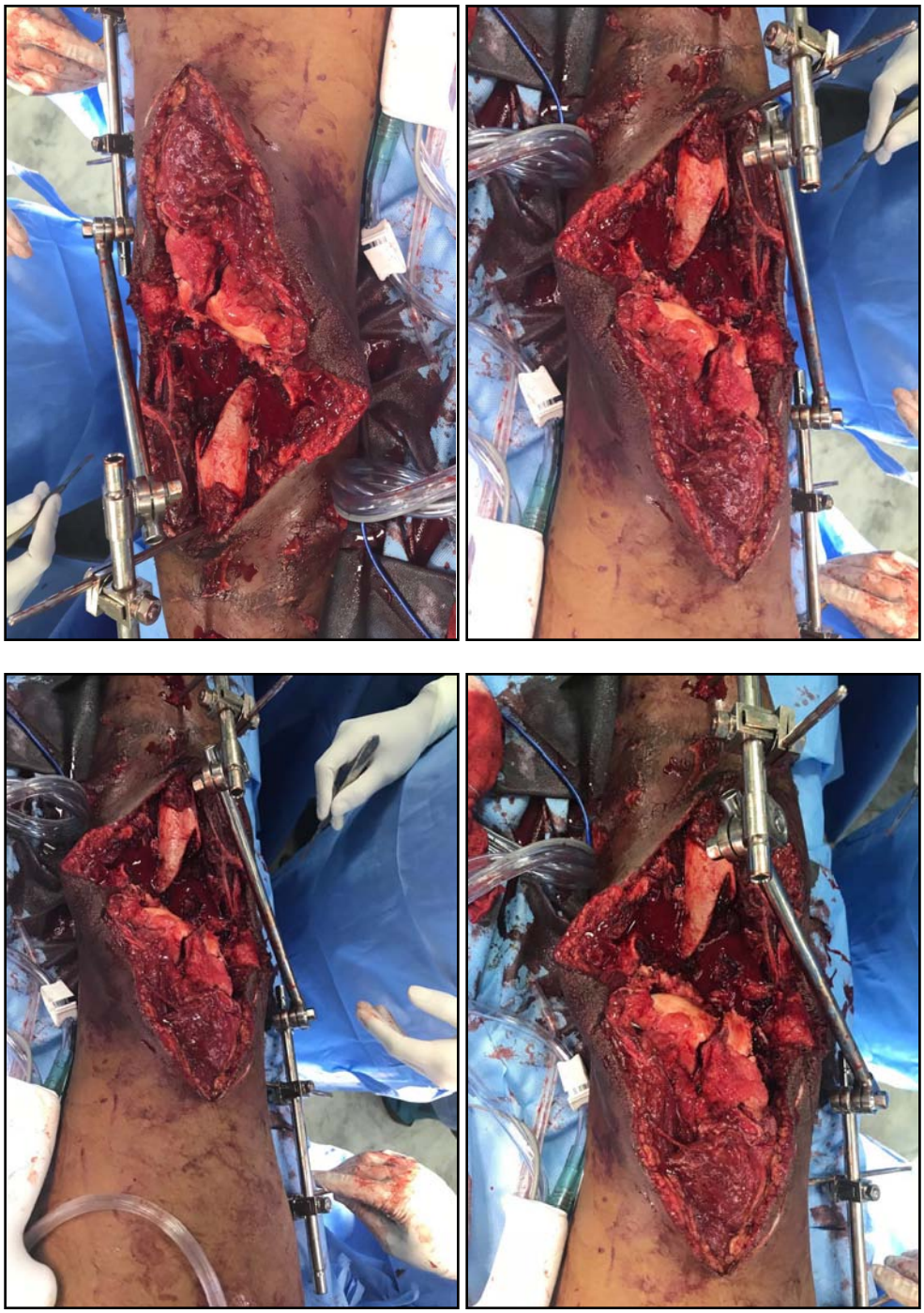


*Fig. 1:* Pre-operative clinical images of right knee with distal thigh and proximal leg anterior aspect.



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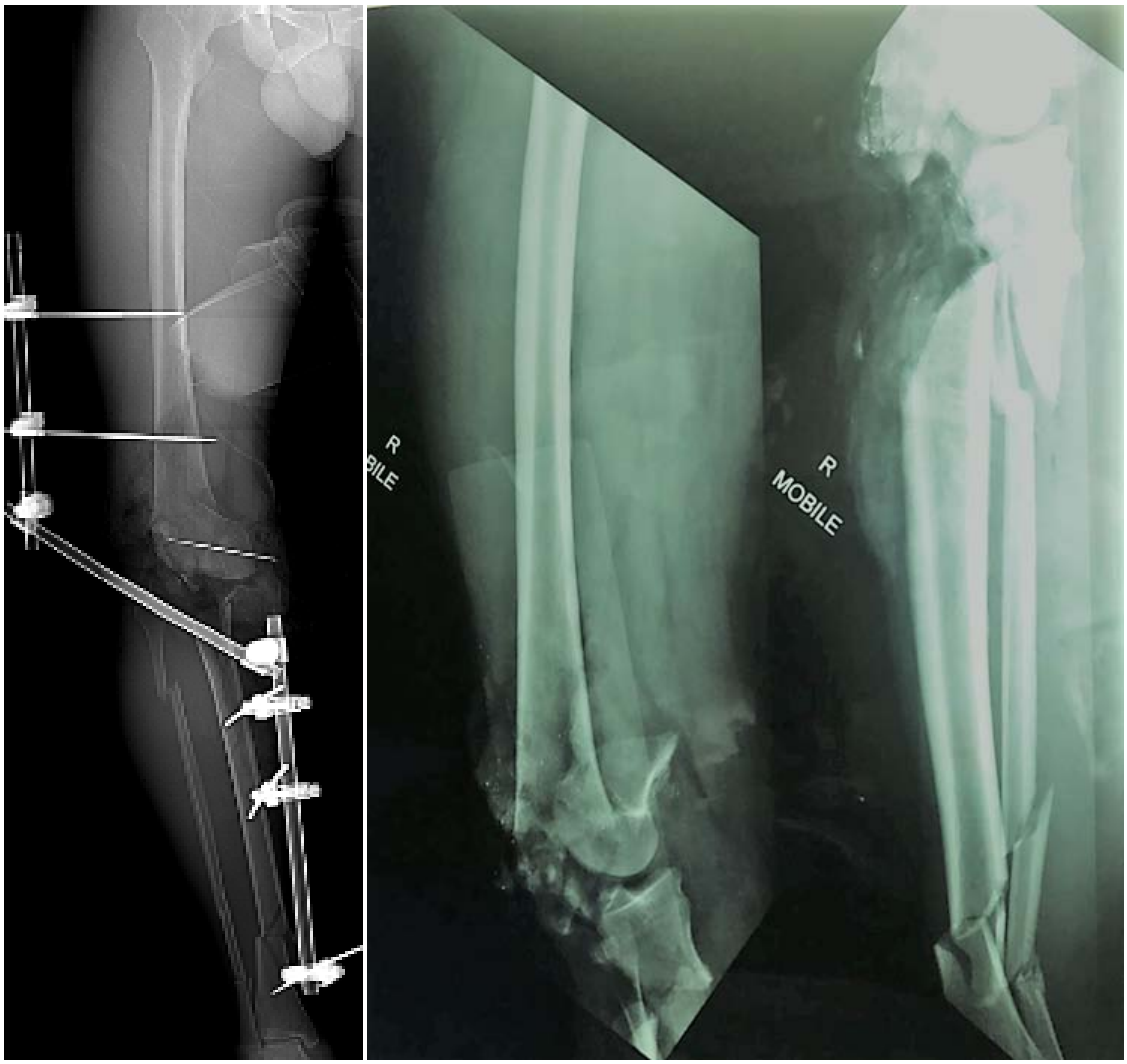



*Fig. 2:* Showing x-ray radiography Antero-posterior view of right lower limb, lateral view of right knee with distal femur and lateral view of right leg.



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*Fig. 3:* Showing x-ray lateral view right distal leg with ankle.

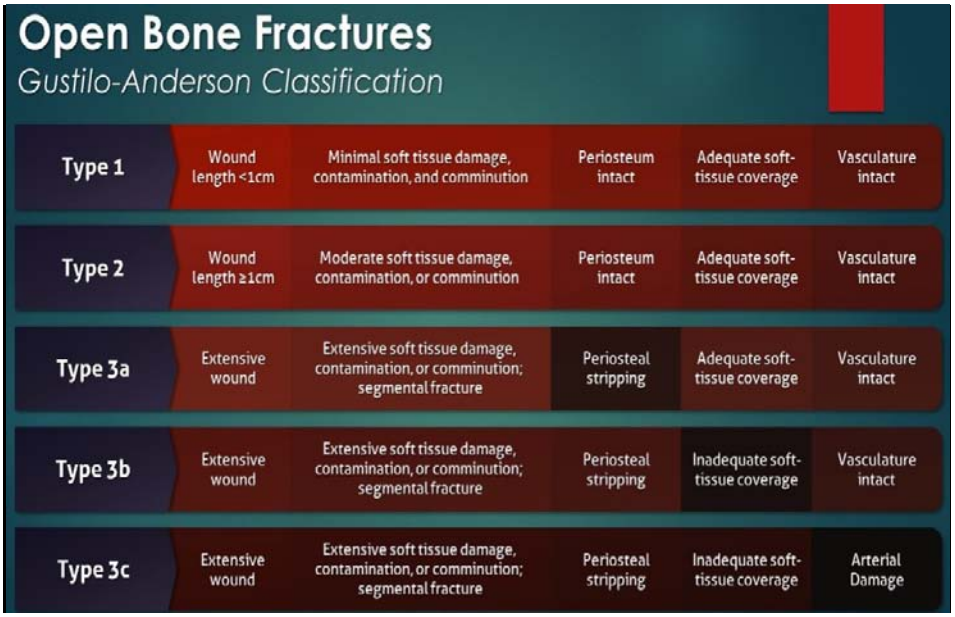



*Fig. 4:* Showing Gustilo-Anderson classification.



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*Table 1:* Showing Ganga hospital open injury severity score which is 16 in our patient

| PARAMETER | FINDING | POINTS |
|---|---|---|
| INJURY TO SKIN AND FASCIA | NONE | 0 |
| | WOUND WITHOUT SKIN LOSS NOT OVER FRACTURE | 1 |
| | WOUND WITHOUT SKIN LOSS OVER THE FRACTURE | 2 |
| | WOUND WITH SKIN LOSS NOT OVER THE FRACTURE | 3 |
| | WOUND WITH SKIN LOSS OVER THE FRACTURE | **4** |
| | CIRCUMFERENTIAL WOUND WITH SKIN LOSS | 5 |
| INJURY TO BONE AND JOINTS | NONE | 0 |
| | TRANSVERSE, OBLIQUE OR SMALL BUTTERFLY FRAGMENT (< 50% OF CIRCUMFERENCE) | 1 |
| | LARGE BUTTERFLY FRAGMENT (>= 50% OF CIRCUMFERENCE) | 2 |
| | COMMINUTION OR SEGMENTAL FRACTURE WITHOUT BONE LOSS | 3 |
| | FRACTURE WITH BONE LOSS < 4 CM | **4** |
| | FRACTURE WITH BONE LOSS >= 4 CCM | 5 |
| INJURY TO MUSCULOTENDINOUS AND NERVE UNITS | NONE | **0** |
| | PARTIAL INJURY TO UNITE | 1 |
| | COMPLETE BUT REPAIRABLE | **2** |
| | COMPLETE AND UNREPAIRABLE | 3 |
| | LOSS OF ONE COMPARTMENT | 4 |
| | LOSS OF TWO OR MORE COMPARTMENTS | 5 |

| Comorbid Conditions | | |
|---|---|---|
| 1. | > 12 hours interval between injury and debridement | **+2** |
| 2. | age > 65 years | 0 |
| 3. | contamination of the wound with sewage, organic material, farmyard, etc | **+2** |
| 4. | systolic blood pressure < 90 mm Hg at presentation (hypotension) | **+2** |
| 5. | compartment syndrome or another major injury to the same limb | 0 |
| 6. | increased risk anesthesia due to drug-dependent diabetes mellitus or cardiorespiratory diseases | 0 |
| 7. | polytrauma involving chest and abdomen with ISS > 25 and/or fat embolism | 0 |

Our score in this patient is 16.If the score is 17 it is for amputation.



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*Table 2:* Showing MESS scoring system which is 7 in our patient (score of 7 and more then that is indication for amputation).

**MANGLED EXTREMITY SEVERITY SCORE (MESS SCORE)** SRI RAMACHANDRA UNIVERSITY Chennai

| LIMB ISCHEMIA FOR > 6 HOURS | NO | YES | | |
|---|---|---|---|---|
| LIMB ISCHEMIA | REDUCED PULSE BUT NORMAL PERFUSION+1 | PULSELESS, PARESTHESIAS, SLOW CAPILLARY REFILL **+2** | COOL, PARALYSIS, NUMB/INSENSATE +3 | |
| PATIENT AGE | < 30 **0** | 30-50 +1 | ≥ 50 +2 | |
| SHOCK | SBP > 90 MMHG CONSISTENTLY 0 | HYPOTENSION **+1** | TRANSIENT PERSISTENT HYPOTENSION +2 | |
| INJURY MECHANISM | LOW ENERGY (STAB, GUNSHOT, SIMPLE FRACTURE) +1 | MEDIUM ENERGY (DISLOCATION, OPEN/MULTIPLE FRACTURES) +2 | HIGH ENERGY (HIGH SPEED MVA OR RIFLE SHOT) +3 | VERY HIGH ENERGY (HIGH SPEED TRAUMA WITH GROSS CONTAMINATION) **+4** |

**CRITICAL ACTIONS:**
Patients with a MESS ≥ 7 are likely to require amputation secondary to their limb trauma.
Our Score in this Patient is 7.

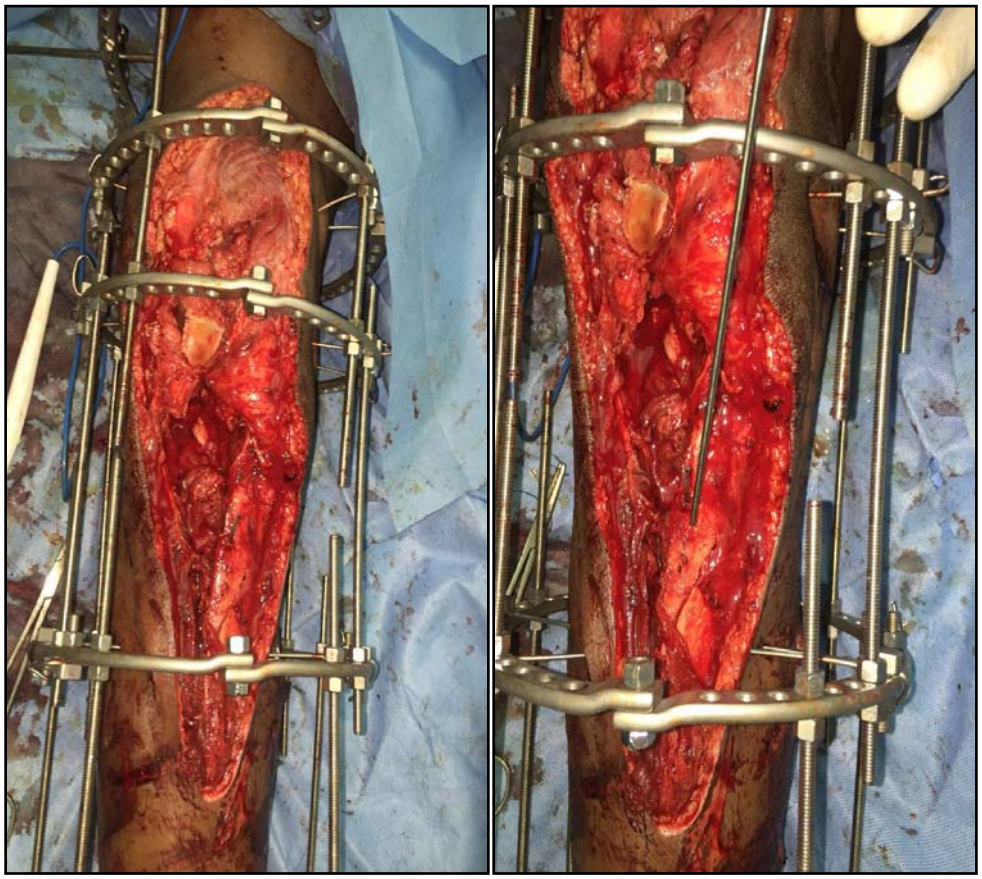


*Fig. 5:* Showing intra-operative images following ilizarov fixator application.



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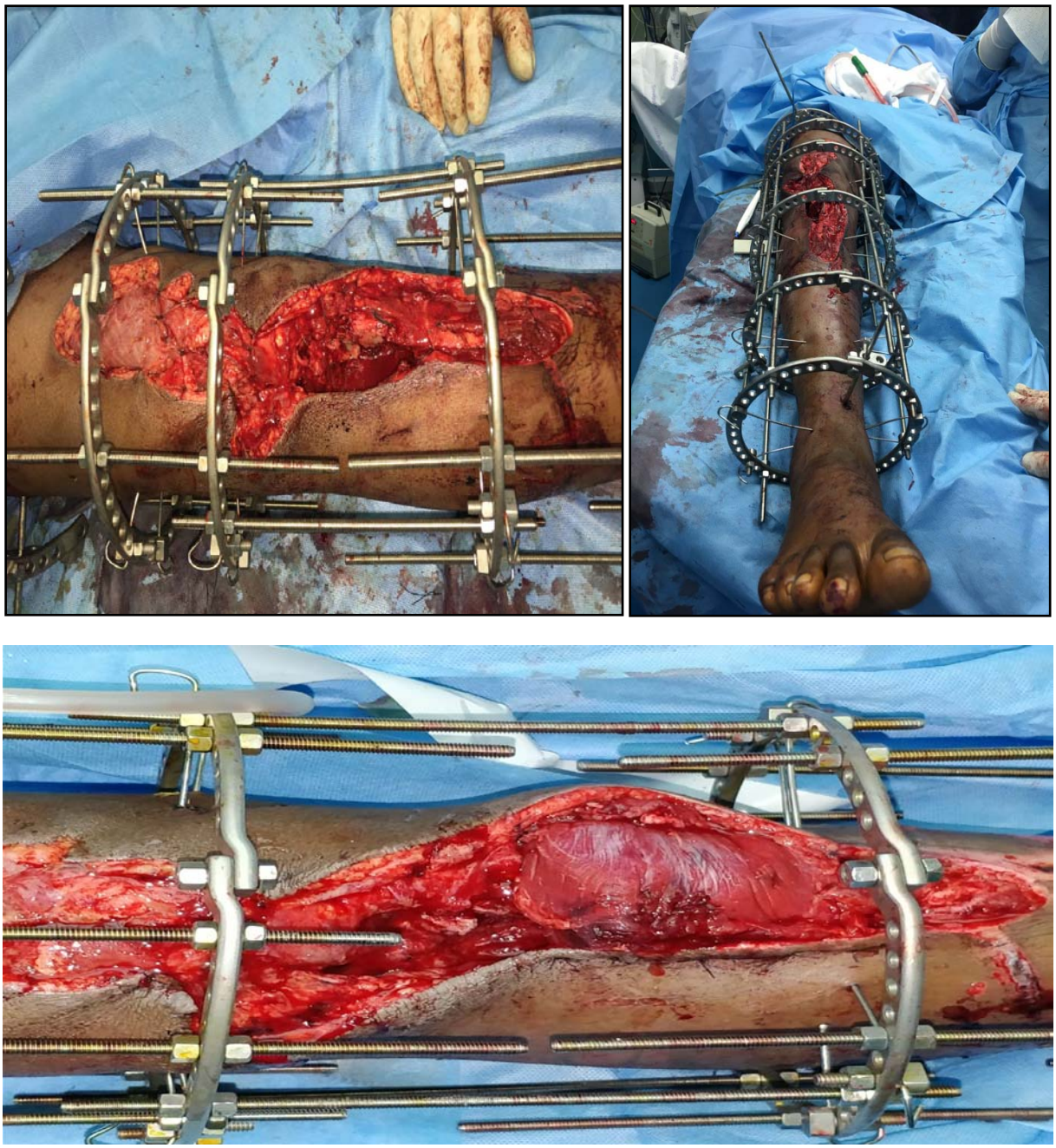


*Fig. 6:* Showing intra-operative images following ilizarov fixator application.



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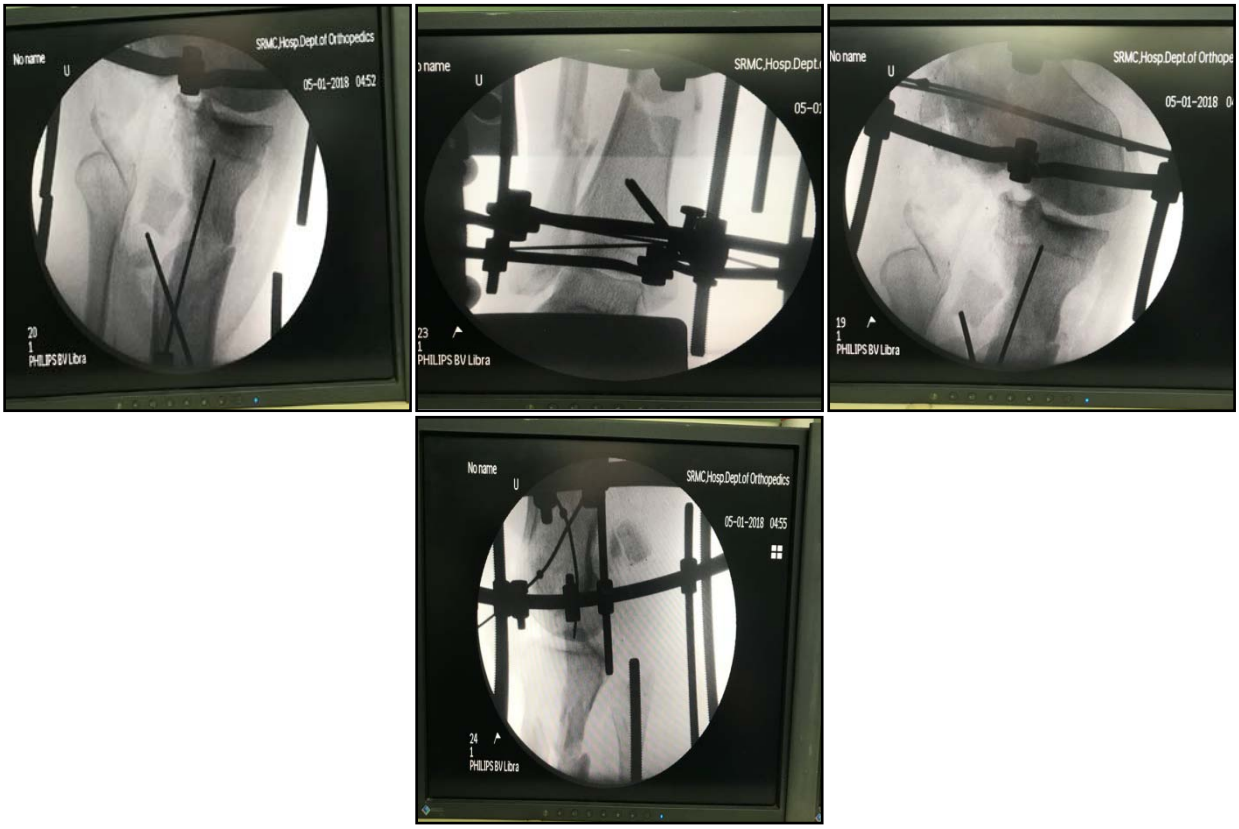



*Fig. 7:* Showing Intra-operative C-arm images following ilizarov fixator application.

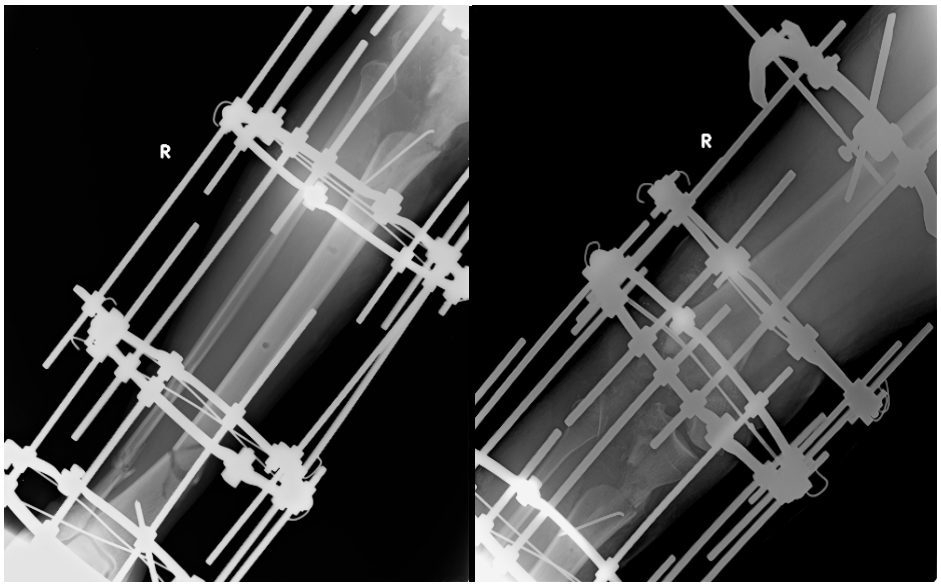



*Fig. 8:* Showing immediate post-operative x-ray right leg and knee AP view following ilizarov fixator.



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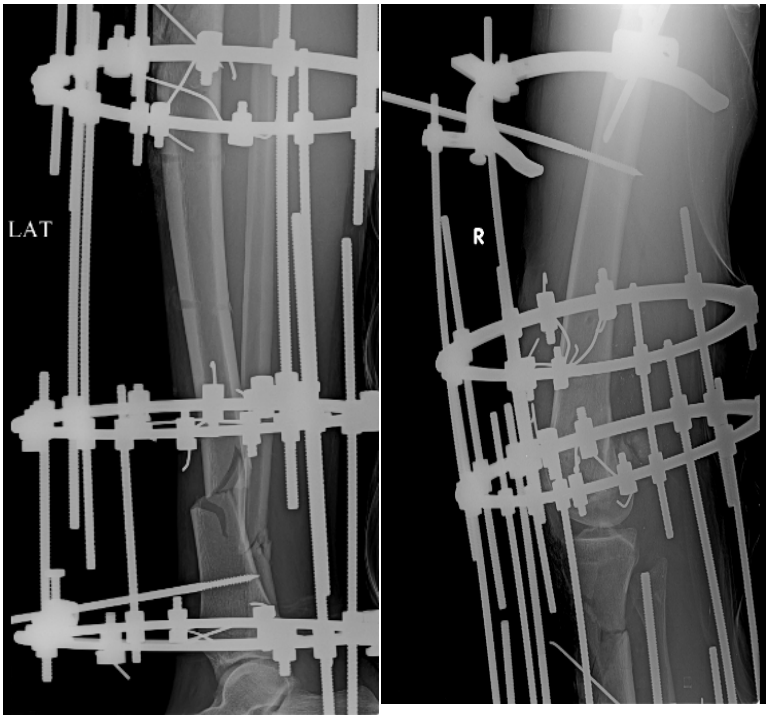



*Fig. 9:* Showing immediate post-operative x-ray right leg and knee lateral view following ilizarov fixator.

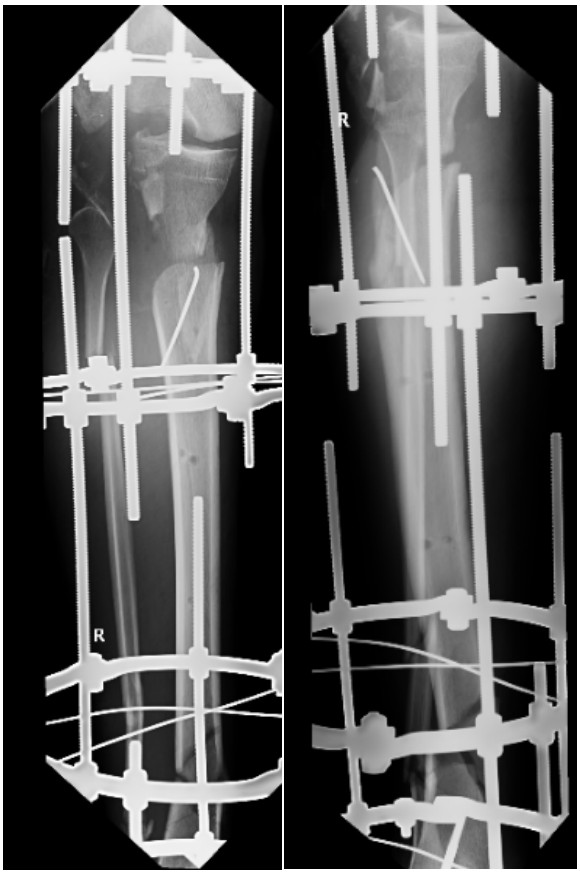



*Fig. 10:* Showing 1 month post-op x-ray right leg AP and lateral views.



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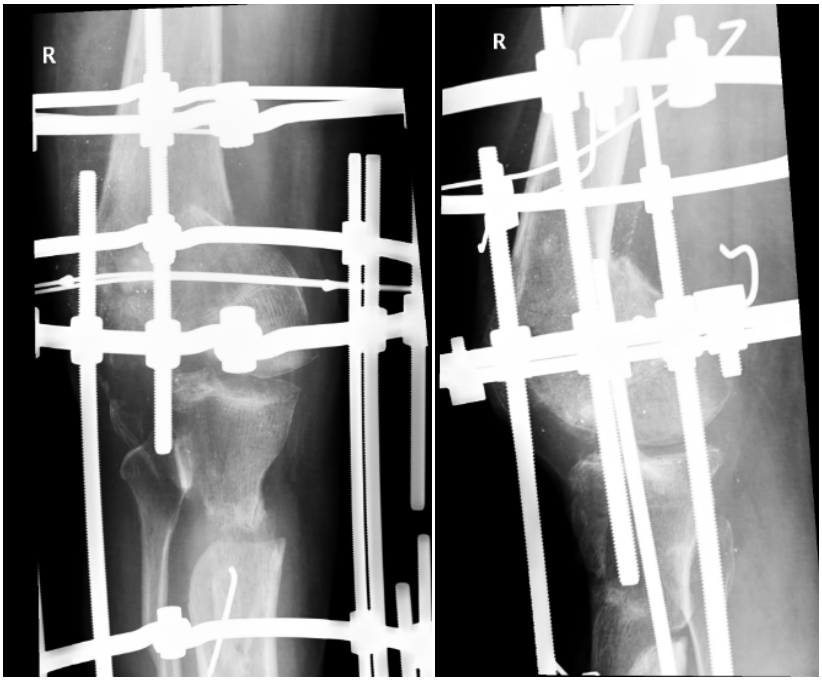



*Fig. 11:* Showing 3 month post-op x-ray right knee AP and lateral views.

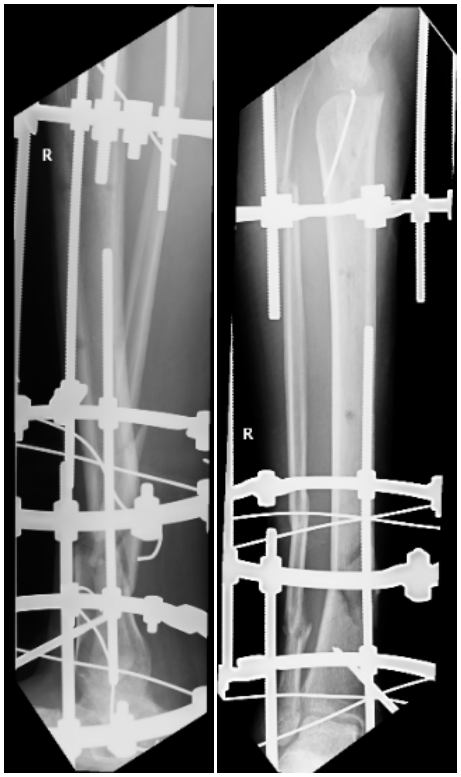



*Fig. 12:* Showing 3 month post-op x-ray right leg AP and lateral views.



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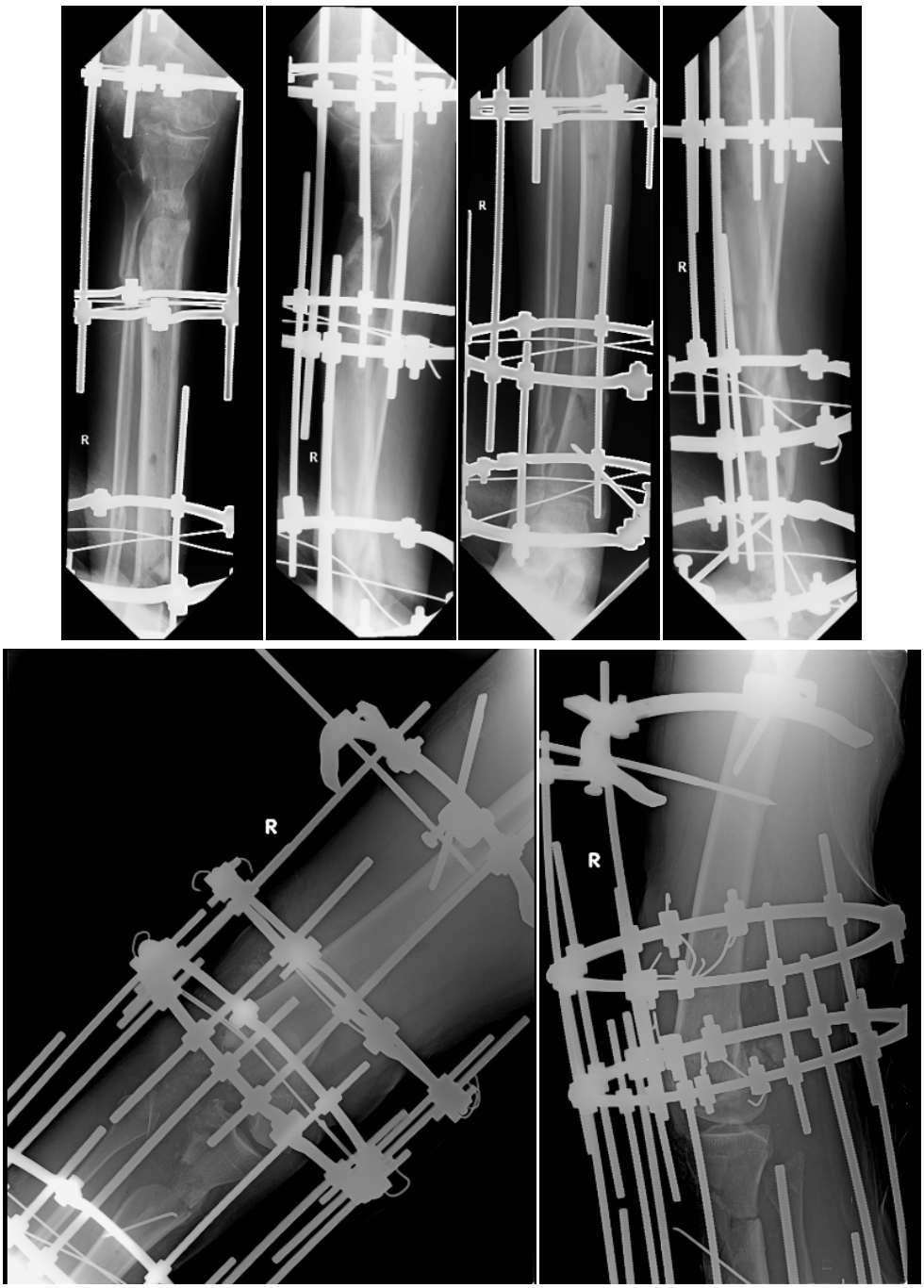



*Fig.13:* Showing 6 month post-op x-ray right leg, knee and ankle AP and lateral views.



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*Fig. 14:* Showing 12 month post-op x-ray right leg and knee AP and lateral views.



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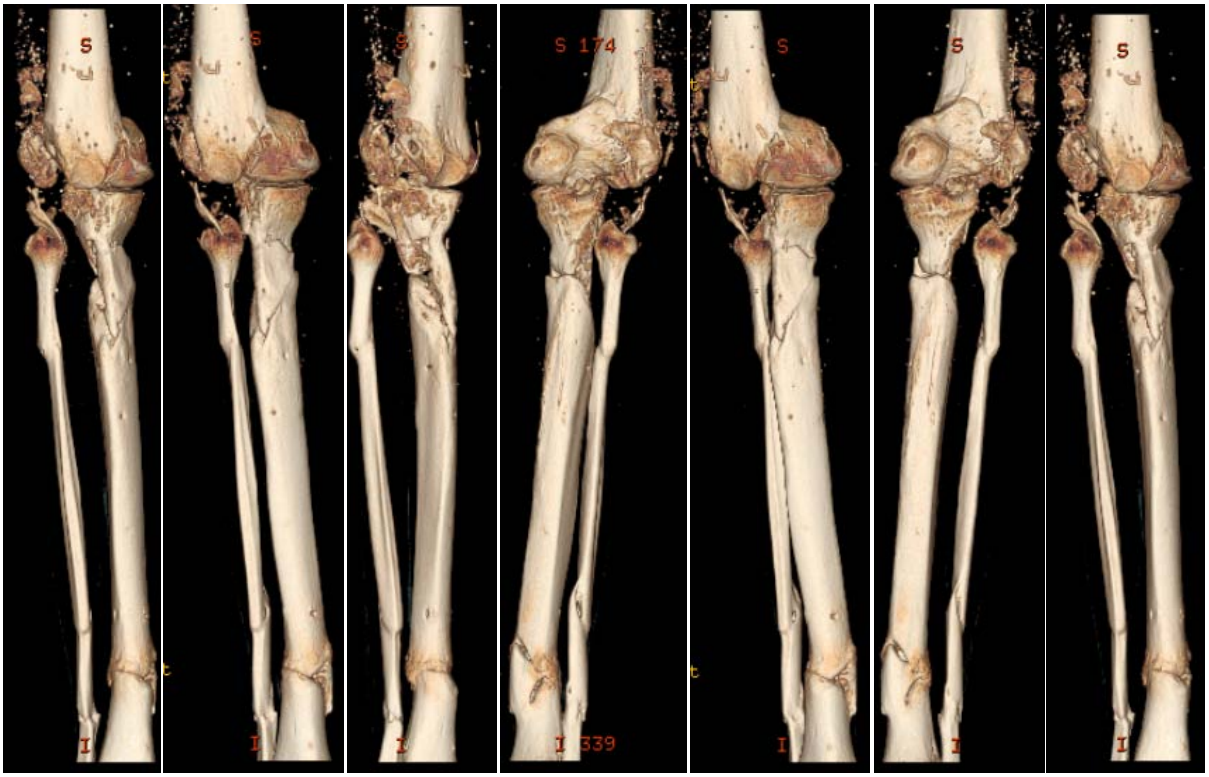


*Fig. 15:* Showing 12 month post-op CT scan 3d reconstruction of right distal femur, knee and leg.




*Fig. 16:* Showing 18 month post-op x-ray right knee and leg AP and lateral views.



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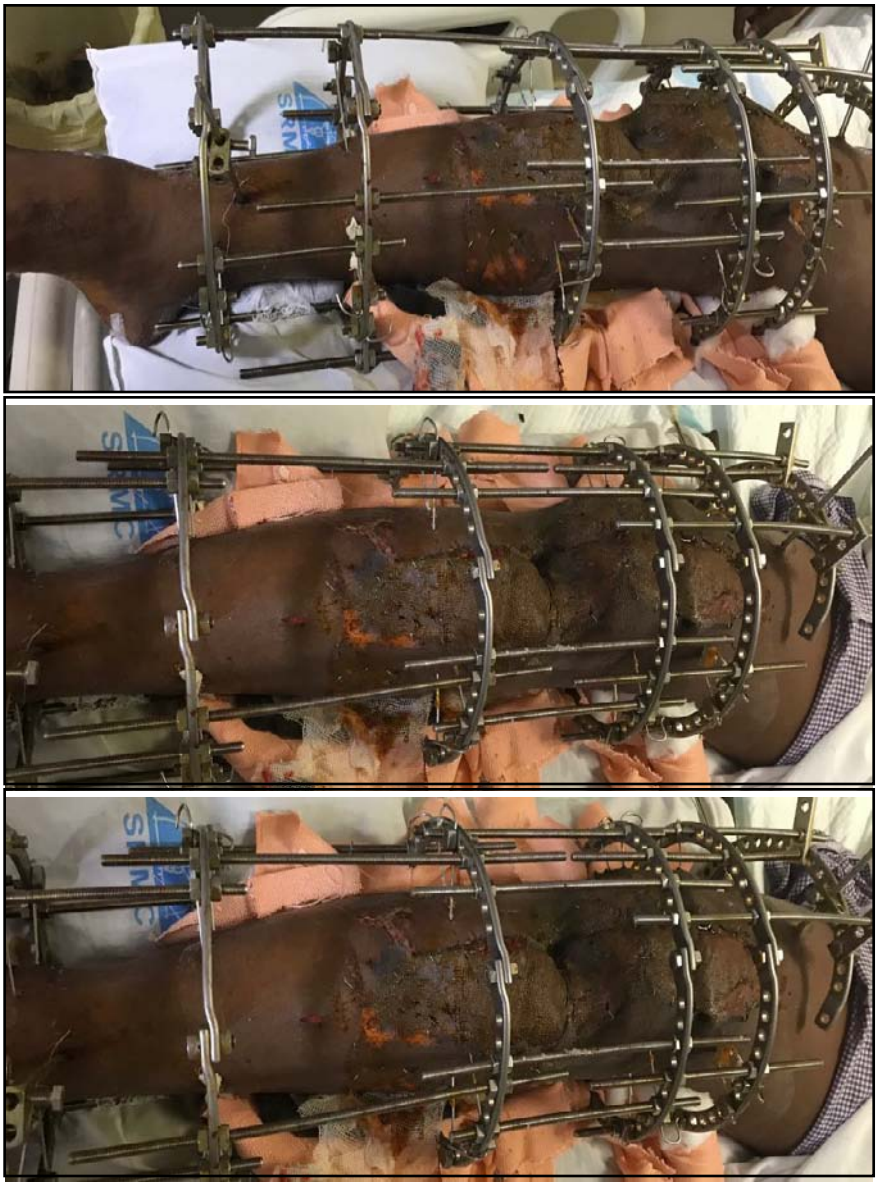


*Fig. 17*: Immediate post-operative clinical wound images after right limb reconstruction.





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*Fig. 18:* Postoperative 12 months clinical images.




*Fig. 19:* Modified Fraser's classification for open floating knee injury.



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**Acknowledgments**

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

**Declaration of funding sources**

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

## Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

***Manuscript Style Instruction (Optional)***

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

***Structure and Format of Manuscript***

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



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## Format Structure

***It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.***

All manuscripts submitted to Global Journals should include:

**Title**

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

**Author details**

The full postal address of any related author(s) must be specified.

**Abstract**

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

**Keywords**

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

**Numerical Methods**

Numerical methods used should be transparent and, where appropriate, supported by references.

**Abbreviations**

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

**Formulas and equations**

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

**Tables, Figures, and Figure Legends**

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

**Figures**

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

## Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

## Tips for writing a good quality Medical Research Paper

***1. Choosing the topic:*** In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

***2. Think like evaluators:*** If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

***3. Ask your guides:*** If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

***4. Use of computer is recommended:*** As you are doing research in the field of medical research then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

***5. Use the internet for help:*** An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



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***6. Bookmarks are useful:*** When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

***7. Revise what you wrote:*** When you write anything, always read it, summarize it, and then finalize it.

***8. Make every effort:*** Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

***9. Produce good diagrams of your own:*** Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

***10. Use proper verb tense:*** Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

***11. Pick a good study spot:*** Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

***12. Know what you know:*** Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

***13. Use good grammar:*** Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

***14. Arrangement of information:*** Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

***15. Never start at the last minute:*** Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

***16. Multitasking in research is not good:*** Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

***17. Never copy others' work:*** Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

***18. Go to seminars:*** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

***19. Refresh your mind after intervals:*** Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

***20. Think technically:*** Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

***21. Adding unnecessary information:*** Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

***22. Report concluded results:*** Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

***23. Upon conclusion:*** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

## Informal Guidelines of Research Paper Writing

***Key points to remember:***

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

**Final points:**

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

*The introduction:* This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

**The discussion section:**

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

**General style:**

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

**To make a paper clear:** Adhere to recommended page limits.



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*Mistakes to avoid:*

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

**Title page:**

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

**Abstract:** This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

*Reason for writing the article—theory, overall issue, purpose.*

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

**Approach:**

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

**Introduction:**

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

*The following approach can create a valuable beginning:*

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

**Approach:**

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

**Procedures (methods and materials):**

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

**Materials:**

*Materials may be reported in part of a section or else they may be recognized along with your measures.*

**Methods:**

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

**Approach:**

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

**What to keep away from:**

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



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**Results:**

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

**Content:**

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

**What to stay away from:**

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

**Approach:**

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

**Figures and tables:**

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

**Discussion:**

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

**Approach:**

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

## The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

*Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection*.

*Segment draft and final research paper:* You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

*Written material:* You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

## Criterion for Grading a Research Paper (Compilation) by Global Journals

**Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.**

| Topics | Grades | | |
|---|---|---|---|
| | **A-B** | **C-D** | **E-F** |
| ***Abstract*** | Clear and concise with appropriate content, Correct format. 200 words or below | Unclear summary and no specific data, Incorrect form Above 200 words | No specific data with ambiguous information<br>Above 250 words |
| ***Introduction*** | Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited | Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter | Out of place depth and content, hazy format |
| ***Methods and Procedures*** | Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads | Difficult to comprehend with embarrassed text, too much explanation but completed | Incorrect and unorganized structure with hazy meaning |
| ***Result*** | Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake | Complete and embarrassed text, difficult to comprehend | Irregular format with wrong facts and figures |
| ***Discussion*** | Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited | Wordy, unclear conclusion, spurious | Conclusion is not cited, unorganized, difficult to comprehend |
| ***References*** | Complete and correct format, well organized | Beside the point, Incomplete | Wrong format and structuring |

# Index


## A

Amputate · 17, 21, 23
Anatomical · 11
Arduous · 12
Arthrotomy · 8
Asymptomatic · 4

## F

Femoral · 2, 4, 5, 7, 8, 10, 11, 12, 15, 16, 18, 21

## H

Horrendous · 21
Humerus · 1, 2, 4, 5

## P

Pneumatic · 12
Protracted · 21
Protruding · 8
Proximal · 1, 2, 4, 5, 8, 12, 18, 4

## Q

Quadriceps · 2, 12, 19

## R

Retrograde · 8, 11, 16, 21

## S

Supine · 5, 8, 12

## T

Trochanter · 1, 8






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