

# Double Trouble of “Double Segmental” Fractures – A Report of Two Cases

Nitish Bansal<sup>1</sup>, Gitesh Singh<sup>2</sup>, Punit Tiwari<sup>3</sup>, Harmeet Kaur<sup>4</sup>

## Learning Point of the Article:

A single intramedullary implant is a better choice for double segmental fractures.

## Abstract

**Introduction:** A “double segmental” fracture is an injury pattern that has three fracture sites and four fracture segments in a single bone. It is extremely rare, with only three “Double segmental femoral fracture” and only four “double segmental tibia fracture” cases reported in the literature. These fractures are associated with difficulty in deciding the implant for fixation, segment reduction, maintenance of reduction, maintaining blood supply of segment during fixation, and the high risk of post-operative complications.

**Case Report:** We present two unique cases, one of “double segmental femur fracture” and the other of “double segmental tibia fracture,” fixed with intramedullary nailing. When Schanz screw or Steinman pins were used to reduce the intermediate fragments and hold them in place, they interfered with the reaming due to the protruding part in the narrow canal. This problem could be solved using weber clamps to hold reduction as they do not obscure the canal. All the fractures united uneventfully at 9 months follow-up.

**Conclusion:** A “single intramedullary device” to fix “all the segments” can help provide stabilization without compromising soft-tissue attachments and viability of the intermediate fracture segments in “double segmental” fractures.

**Keywords:** Double segmental fracture, intramedullary nailing, trifocal fracture, femur, tibia, fracture.

## Introduction

“Double segmental” fractures are unique as there are three fracture segments, two individual intermediate fracture segments, each surrounded by at least two fracture lines, between the proximal and distal fragments. These fracture segments have their own cortex and medullary cavity, along with blood supply from surrounding soft-tissue attachments, making them true segments [1]. Thus, they differ from “trifocal fractures,” in which the intermediate fragments may not be complete segments.

These fractures are associated with difficulty in deciding the implant for fixation, segment reduction, maintenance of reduction, maintaining blood supply of segment during fixation, and the high risk of post-operative complications.

We present two cases, one each of femur and tibia, and their subsequent management technique.

## Case Report

### Case 1

A 63-year-old male presented to emergency with a history of a road traffic accident, in which the patient was riding pillion and was struck by a car moving at high velocity. After emergency stabilization and application of skeletal traction in the trauma bay, he was transferred to the orthopedic unit. The radiographs revealed a “double segmental” fracture of the right femur with no other associated injuries (Fig. 1a-d). The patient was taken up for intramedullary fixation with a cephalomedullary nail the next

## Author's Photo Gallery



Dr. Nitish Bansal



Dr. Gitesh Singh



Dr. Punit Tiwari



Dr. Harmeet Kaur

<sup>1</sup>Department of Orthopaedics, Government Medical College, Patiala, Punjab, India,

<sup>2</sup>Department of Orthopaedics, All India Institute of Medical Sciences, Bathinda, Punjab, India,

<sup>3</sup>Department of Orthopaedics, Maharishi Markandeshwar Medical College and Hospital, Solan, Himachal Pradesh, India,

<sup>4</sup>Department of Radiodiagnosis, All India Institute of Medical Sciences, Bathinda, Punjab, India.

### Address of Correspondence:

Dr. Harmeet Kaur,

Department of Radiodiagnosis, All India Institute of Medical Sciences, Bathinda, Punjab, India.

E-mail: kaurh28@yahoo.com

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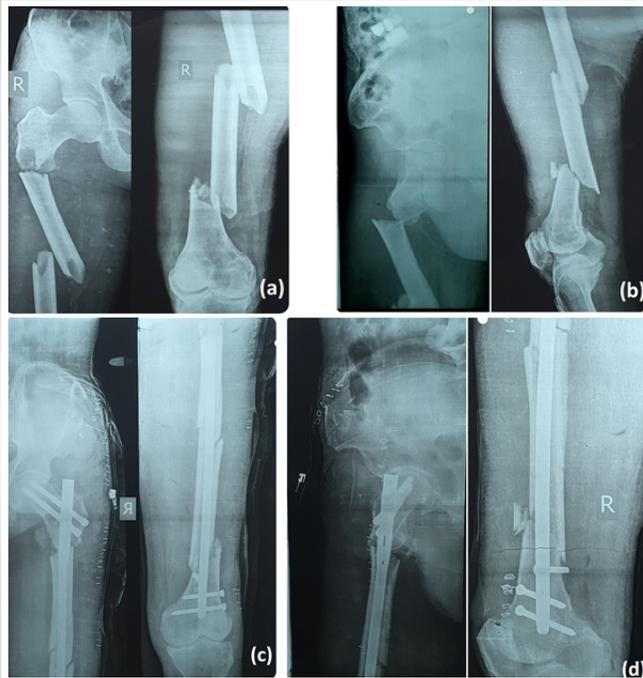
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**Figure 1:** (a): X-ray AP View of the right femur showing a double segmental fracture of the femur. (b): X-ray lateral view of the right femur showing a double segmental fracture of the femur. (c): Post-operative X-ray AP View of the right femur showing an intramedullary interlocking nail with a polar screw in the distal-most fragment in situ. (d): Post-operative X-ray lateral view of the right femur showing an intramedullary interlocking nail with a polar screw in the distal-most fragment in situ.

day. Initially, we tried using Schanz screw to reduce the intermediate fragments and hold them in place, but they interfered with the reaming due to the protruding part in the narrow canal. Subsequently, weber clamps were used on the proximal and intermediate fragments to correct their respective displacements and hold the fracture fragments in reduced positions. The use of a polar screw helped in centering the guidewire in the distal fragment.

The patient was mobilized with toe-touch weight-bearing on the affected limb from the 3rd day to 4 weeks. After 4 weeks, the patient was allowed weight-bearing as tolerated. All the fractures united uneventfully at 9 months follow-up with good hip and knee range of motion.

## Case 2

A 60-year-old female presented to us after a road traffic accident. She was a rear seat passenger in a car that hit another car moving at a high velocity. The patient suffered blunt trauma to the left side of the chest with a rib fracture and hemothorax, along with injury to her right leg. A chest tube was placed, the leg splinted and elevated over a Bohler-Braun splint. The radiographs revealed that she had a “double segmental” fracture of the right tibia and segmental fracture of the fibula (Fig. 2a-d). The patient was taken up for closed intramedullary nailing of the tibia after 15 days when her condition stabilized. Meticulous entry was made with particular emphasis to avoid flexion and valgus deformity. The reduction was maintained using a Schanz



**Figure 2:** (a): X-ray AP view of the right leg with Kramer wire splint in situ showing the double segmental fracture of tibia with segmental fracture of the fibula. (b): X-ray AP view of the right leg with Kramer wire splint in situ showing the double segmental fracture of the tibia. (c): Post-operative X-ray AP view of the right leg with a tibial intramedullary interlocking nail in situ. (d): Post-operative X-ray AP view of the right leg with a tibial intramedullary interlocking nail in situ.

screw in the proximal fragment and weber clamps on the intermediate and distal fragments. Post-operatively, a splint was applied for 2 weeks till suture removal.

She was kept on toe-touch weight-bearing walking till 6 weeks and from there onward on weight-bearing as tolerated. She was followed up monthly for 3 months. Unfortunately, the patient was lost to follow-up after that due to the ongoing COVID pandemic.

## Discussion

“Double segmental” fractures are extremely rare, with only three femoral cases reported in the literature [2, 3, 4], and there are a total of four reported cases of double segmental tibia fracture [5, 6, 7, 8] (Table 1).

These fracture patterns are depictive of severe mechanisms of injury. A direct blow to bone at three different sites simultaneously or the phenomenon of direct and indirect injury, wherein two direct forces exerted at the bone are countered by a third indirect force that acts as a fulcrum between the forces, further leading to segmentation of the large intermediate segment [6].

A significant challenge in all such cases is the choice of implant for internal fixation. An extramedullary implant can help in easier and anatomical reduction through open reduction of the fractured fragments. However, it leads to excessive soft-tissue dissection, subsequently compromising bone vascularity and

Table 1: "Double segmental" fractures in the literature.

Study	Age/sex	MOI	Bone	Type of injury	Treatment modality	Time to union	Outcome
Velmurugesan <i>et al.</i> [5]	40/M	MVA	Femur	Open	Femur external fixator followed by intramedullary nailing followed by plate augmentation and bone grafting for non-union	15 months	Good
Loganathan <i>et al.</i> [4]	45/M	MVA	Femur	Closed	Intramedullary nailing	9 months	Good
Sarmiento <i>et al.</i> [7]	*	*	Femur	*	Proximal femoral nail A2 along with 3.5mm DCP for proximal fragment	*	Good
Baliet <i>et al.</i> [8]	50/M	MVA	Tibia	Closed	Conservative (plaster cast followed by functional cast bracing)	*	Good alignment, Shortening
Baliet <i>et al.</i> [8]	50/M	MVA	Tibia	Open	Intramedullary nailing with ETN after 10 days with primary bone grafting	5 months	Good
Singhet <i>et al.</i> [9]	51/M	MVA	Tibia	Open	Intramedullary Nailing followed by secondary bone grafting after 6 months	9 months	Good
Kurani <i>et al.</i> [10]	55/M	MVA	Tibia	Closed	ETN after 5 days	6 months	Good

leading to an excessive stress riser at the junction of the plates [1].

These issues can be addressed using an intramedullary implant [1, 2, 4, 7, 8]. Furthermore, separate versus single implants have been debated in the literature.

Arastu *et al.*, in their cadaveric study, found that reaming was a major risk factor for rotational displacement and subsequent devascularization, with long segments rotating more than shorter segments. They strongly recommended clamping the fracture fragments during reaming [9]. This technical issue is more pronounced in double segmental fractures due to the existence of 2 intermediate fragments, which both need to be held individually.

It can be managed using Schanz screw, Steinmann pins, Weber clamps, Farabeuf clamp, and reduction forceps through mini-open incisions and temporary unicortical plating to reduce fracture fragments and maintain reduction during reaming and insertion of nail [9, 10].

The problem of the prominence of Schanz screws, Steinmann pins into the medullary canal leading to further obliteration of a narrow canal may arise, as was the case in our patients. This can be avoided using weber clamps to hold reduction as they do not

obscure the canal.

There are higher chances of malunion and non-union between the various fragments, in which union happens at one or two sites. Non-union can be managed using bone grafting with plate augmentation or revision nailing. Primary and secondary bone grafting has been used in three of the reported cases, with union achieved in all cases.

The primary use of Ilizarov for tibial segmental fractures has also been described in the literature, but the authors believe that it may be better used as a secondary procedure in case of septic and gap non-union.

## Conclusion

Skillful reduction, minimal soft-tissue disruption, maintaining the vascularity of intermediate segments, and meticulous post-operative care form the cornerstone to successfully treating these complicated injuries. Single implant in form of an intramedullary nail has given desired results in our patients.

## Clinical Message

The choice of the implant in "segmental" fractures has been debated for long. Intramedullary versus extramedullary, as well as, single versus separate implant, for each fracture segment, have been suggested. The situation becomes even more tricky in "double segmental" fractures. The use of weber clamps to hold the intermediate segments during reaming prevents their rotation and maintains vascularity. Single implant in form of an intramedullary nail can give desired results even in "double segmental" fractures if done skillfully.

**Declaration of patient consent :** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient's parents have given their consent for patient images and other clinical information to be reported in the journal. The patient's parents understand that his names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil **Source of support:** None

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