CASE REPORT

Conjoined bicondylar coronal plane fracture of the distal femur associated with incarcerated patella

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Accepted 1 May 2016

SUMMARY

Conjoint bicondylar coronal plane fracture is a rare orthopaedic injury, associated with high-velocity trauma. The proposed mechanism is axially directed shear forces in a flexed knee. To the best of our literature search, only 2 cases of conjoint bicondylar coronal fracture have been published in English literature—1 each in adult and paediatric age group. Conjoint bicondylar coronal plane fracture with incarcerated patella has not yet been reported and hence this is the first report of its kind. We report on the clinical presentation, management and outcome of such a complex injury, along with a comprehensive, up-to-date literature review. Prompt open reduction and internal fixation coupled with early knee mobilisation is the key to achieve good functional outcome.

BACKGROUND

Conjoint bicondylar coronal plane fracture is a rare injury. Although exact incidence is not yet known, Nork *et al*,¹ described 38% incidence of coronal plane (Hoffa) fracture in association with supracondylar-intercondylar fractures. The coronal plane fracture usually involves single femoral condyle (medial or lateral). Hoffa² first described this entity for lateral condyle of the femur. These injuries usually follow high-velocity trauma directly on a flexed knee. Bicondylar involvement is infrequent, and only a handful of cases have been reported in the English literature so far,^{3–12} (table 1); still rarer, is the occurrence of its ‘conjoint’ variant. Association of conjoint bicondylar coronal plane with incarcerated patella has not yet been reported in the literature. In this article, we describe a case of irreducible lateral patellar dislocation with conjoint bicondylar coronal plane.

CASE PRESENTATION

A 32-year-old man presented with a history of road traffic accident to our level I trauma centre. The patient was pillion rider on a motorbike and had a side-on collision with a four-wheeler and sustained injury to his left knee and leg. On physical examination, the knee was tender and swollen with restriction of movements. Patella was found laterally dislocated and was immobile. There was associated open fracture of the ipsilateral tibia and fibula (Gustilo-Anderson grade IIIA)¹³ (figure 1).

INVESTIGATIONS

Plain radiographs showed fracture involving both the femoral condyles with lateral patellar dislocation and both leg bone fracture. CT scan of the

knee showed coronal plane fracture of the distal femur with an intact bridge of bone (conjoint bicondylar coronal plane fracture) (figures 2–4).

TREATMENT

The patient was operated under regional anaesthesia in supine position on a radiolucent operating table. Thorough debridement and lavage of the open wound on the leg were performed. The external fixator was applied for stabilisation of the tibial fracture. The extremity was redraped to address the knee injury. Midline skin incision was given and standard medial parapatellar approach was used. The patella was found incarcerated at the fracture site, lateral to lateral femoral condyle and the medial patellofemoral ligament (MPFL) was found torn at the patellar attachment. The medial retinaculum was also found torn (figure 5). The patella was levered out of the fracture site and reduced onto the femoral trochlea. The reduction of conjoint coronal plane fracture was achieved by inserting Kirschner wire (K-wire) into both condyles to act as a joystick and additionally using bone hook to hold the intercondylar intact bony bridge. The reduction was provisionally held with smooth K-wires. Definitive fixation was carried out with partially threaded cannulated screws (PTCS)—two screws for medial condyle (one 6.5 mm diameter PTCS and one 4 mm diameter PTCS) and one screw for lateral femoral condyle (6.5 mm diameter PTCS). All the three screws were placed anteroposteriorly through the non-articular surface of the femoral condyle. Both the menisci, cruciate and collateral ligaments were found intact. MPFL was repaired with non-absorbable sutures (Ethibond) and medial retinaculum sutured with vicryl. Intraoperative patellar tracking was checked and found stable.

OUTCOME AND FOLLOW-UP

Postoperative above knee slab was applied and kept for 3 weeks. In our case, there was extensive soft tissue injury associated with articular fracture. The MPFL and the medial parapatellar retinaculum were also torn. Our aim of immobilisation was to protect the repair of these vital structures, which play a pivotal role in the optimal functioning of the extensor mechanism. After 3 weeks, the tibial external fixator was removed, and definitive fixation with reamed interlocking tibial nail and bone grafting was performed. The postoperative period was uneventful. Initial rehabilitation focused on isometric quadriceps-strengthening exercises. Mobilisation of the knee was started at 4 weeks. Vigorous

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To cite: Kishan R, Saibaba B, Kumar V, *et al*. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2015-213579

Table 1 Literature review on Hoffa fracture and its management

Serial number	Author and year	Age and sex	MOI	Open/close	Associated injury	Conjoint/NO	Diagnosis	Approach	Management	FU	Outcome
1	Zeebregts et al, 2000	17/M	RTA	Close	No associated bony injury	Non-conjoint	X-rays	Midline and lateral	4 PTCS 6.5 mm, PA	21 months	0–145 ROM
2	Calmet et al, 2004	24/M	RTA	Open, grade II	Extensor mechanism rupture, I/L femur #	Not mentioned	X-rays	Midline	4 PTCS, 6.5 mm, AP	24 months	0–130 Neer score 90
3	Calmet et al, 2004	19/M	RTA	Open, IIIA	I/L distal radius	Not mentioned	X-rays	Midline	4 PTCS 6.5 mm, AP	36 months	0–130 Neer score 96
4	Agarwal et al, 2004	20/F	RTA	Close	SOF # Clavicle #	Non-conjoint	X-rays	Lateral With tibial tubercle osteotomy	4 3.5 mm, cortical screws	2 months	10–100
5	Papadopoulos et al, 2004	39/M	Fall	Close	No	Not mentioned	X-rays	Midline, and lateral	3 PTCS 6.5 mm, AP	24 months	0–140 After knee arthrolysis
6	Neogi et al, 2008	35/M	RTA	Close	I/L patella #	Non-conjoint	X-rays, CT	Midline and lateral	5 4.5 mm, PTCS PA and AP both	39 months	0–100
7	Dua and Shamshery, 2010	40/M	RTA	Close	No associated bony injury	Non-conjoint	X-rays, CT	Swashbuckler	5 6.5 mm PTCS, AP and lateral buttress plate	3 months	0–100
8	Lal et al, 2011	9/M	Fall	Close	No associated bony injury	Conjoint	X-ray	Arthroscopic assisted	2 4.5 mm PTCS AP	36 months	Not mentioned
9	Ul Haq et al, 2013	24/M	Fall	Close	No associated bony injury	Conjoint	X-rays CT	Swashbuckler	5 PTCS 6.5 mm, AP	18 months.	0–145
10	Mounasamy et al, 2013	22/F	RTA	Open	I/L patella fracture, calcaneum # C/L patellar ligament tear	Non-conjoint	X-rays	Transverse through open wound	7–8 Screws Diameter non-specified	12 months	110
11	Kondreddi et al, 2014	17/M	RTA	Close	Patellar dislocation	Non-conjoint	X-rays	Midline with lateral parapatellar arthrotomy	4 PTCS 4.5 mm	9 months	120
12	Our case, 2015	32/M	RTA	Close	Incarcerated patella, MPFL tear, both bone of the leg # Open, IIIA	Conjoint	X-rays, CT	Midline with medial parapatellar arthrotomy	2 6.5 mm, 1 4 mm PTCS	12 months	0–120

#, fracture; AP, anterior to posterior; FU, follow-up; I/L, Ipsilateral; MOI, mechanism of injury; MPFL, medial patellofemoral ligament; PA, posterior to anterior; PTCS, partially threaded cancellous screw; ROM, range of motion; RTA, road traffic accident; SOF, shaft of femur.

Figure 1 (A) Clinical photograph depicting the wound on the left leg. (B) Clinical photograph depicting grossly swollen left knee with patellar prominence on the lateral side.

physiotherapy under regular supervision was conducted aiming at regaining quadriceps function and knee range of motion. The patient was kept non-weight-bearing for the initial 4 weeks, followed which gradual weight-bearing was allowed as tolerated. At our final follow-up of 12 months, clinically the patient is pain-free, able to walk unassisted, with good knee range of motion of 0°–135° and fractures are united (figures 6–8). However, in spite of our best rehabilitative efforts, patient had an extensor lag of 10° possibly due to residual quadriceps (vastus medialis obliquus) weakness.

DISCUSSION

Bicondylar coronal plane fracture is a rare type of knee injury that typically follows high-energy trauma. This peculiar fracture configuration is the result of shear failure of the femoral condyles as a result of transmission of axial forces across a flexed knee. The pattern of condylar fracture depends on the degree of flexion of knee at the time of impact of injury. Increased

Figure 2 (A) Anteroposterior and (B) lateral view of left knee joint showing bicondylar Hoffa fracture and laterally incarcerated patella.

Figure 3 (A) Anteroposterior and (B) lateral radiographs showing ipsilateral fracture of both bones of the leg.

incidence of coronal fracture of the lateral femoral condyle is attributed to physiological genu valgum.¹⁴ As these injuries are due to high-velocity trauma or fall on the knee from height, there might be associated fractures of the patella, tibial spine, ligamentous disruption of knee joint and even fracture of ipsilateral extremity or pelvis, thus requiring careful clinicroadiological examination,^{10–12} and evaluation. It is also essential to check for any distal neurovascular deficit on the involved side. In our case, the impact force was probably profound, which caused bicondylar coronal plane fracture along with lateral patellar dislocation and ipsilateral tibia and fibular fracture. Traumatic disruption of the medial supporting structures of the patella including MPFL and medial retinaculum must have caused lateral patellar dislocation. Since the laterally displaced patella was incarcerated at the fracture site, the patellar dislocation was irreducible.

The AO classification of this Hoffa fracture is 33-B3.3.¹⁵ Besides standard anteroposterior and lateral radiographs of the knee joint, non-contrast CT (NCCT) scans of the knee with 3 mm coronal, axial and sagittal cuts, are essential for a better delineation of fracture morphology and for planning the surgical approach.

Non-operative treatment of coronal plane fracture by close reduction and cast results in an unacceptably high rate of malunion, non-union and stiffness of the knee joint.^{5 14} As these injuries are highly unstable, these kinds of fractures should be addressed with open reduction and internal fixation with partially threaded cancellous screws or headless screws. Open anatomical reduction and stable internal fixation allow early range of motion of the knee joint. Various authors have described different surgical approaches for the surgical management of bicondylar Hoffa fracture. Zeebregts *et al*,³ and Papadopoulos *et al*,⁵ described a combined medial and lateral approach (dual approach) to address the fracture of medial and lateral condyle separately. Mounasamy *et al*,⁹ used the transverse approach because of associated patellar fracture and traumatic transverse arthrotomy in his case. Anterior midline approach,^{4 12} and modified anterior^{7 11} (swashbuckler) approach are now the standard operating procedure for closed bicondylar coronal plane fracture. In our case, we utilised the anterior midline approach with medial parapatellar arthrotomy as patella was laterally dislocated and found to be irreducible even under anaesthesia. By this approach, we were able to reduce the

Figure 4 Three-dimensional CT—scan depicting conjoint bicondylar fracture.

conjoint-type bicondylar coronal plane fracture, laterally dislocated patella and repair the torn MPFL and medial retinaculum.

After adequate fracture reduction lag screw may be used to secure the reduction (either partial or fully threaded screws). The direction of screws may be anteroposterior or vice versa. Jarit *et al*¹⁶ did an experimental study using eight matched pairs of embalmed femur to compare the relative strength and stability of direction of screws and concluded superior fixation with lag screws placed in the posteroanterior direction. But posteroanterior directed screws is difficult to insert in the clinical scenario. Most of the authors used anteroposterior lag screw.^{4 5 7 8 12} Controversy exists about the number and diameter of the screws used while most authors used 4–5 large-fragment PTCS.^{3 4 11} Two to multiple screws,⁹ either cortical screws,⁸ or small-fragment cannulated screws,^{6 12} have also been used and described.

There is no consensus in the literature regarding the post-operative management of bicondylar coronal plane fracture. Calmet *et al*,⁴ did not advise immediate postoperative immobilisation and advocated immediate range of motion exercises and weight-bearing at 6 weeks, but other authors agreed on cast

immobilisation for 2 weeks followed by gradual range of motion exercises and full weight-bearing at 2–3 months.^{6 7 10 11} Early knee mobilisation is essential to prevent knee stiffness. In our case, there was extensive soft tissue injury associated with articular fracture. The MPFL and the medial parapatellar retinaculum were also torn. Our aim of immobilisation was to protect the repair of these vital structures which play a pivotal role in the optimal functioning of the extensor mechanism. Even in such cases, aggressive physiotherapy after adequate immobilisation might be successful in achieving a good range of motion.

Figure 5 Intraoperative photograph, arrow showing bicondylar Hoffa fracture with torn medial patellofemoral ligament and medial retinaculum; black asterisk depicting laterally incarcerated patella.

Figure 6 (A) Anteroposterior and (B) lateral radiographs showing Bicondylar coronal plane fracture union and patella in its anatomical location.

Figure 7 (A) Anteroposterior and (B) lateral radiographs showing union of fracture of both bones of the leg.

Figure 8 (A and B) Clinical photograph at 12 months follow-up showing 0°–110° range of motion of the left knee joint.

Patient's perspective

I would like to share my experience at the PGI trauma centre where I was taken for an emergency treatment. I was hit by a heavy truck and had fractured my leg bone and injured my knee 1 year ago. I had swollen knee, not able to bear weight and was not able to extend my knee. I was referred to PGI from the civil hospital considering multiple fractures. At this centre all my injuries were taken care of. I was operated on the same day of admission and the treating surgeon had applied fixator on my leg bones and fixed some screws to aid healing of my knee. Three weeks later the fixator was removed and I was given some plaster. Later I was operated on with interlocking nail for my leg bone fracture. They suggested physiotherapy. Now I am able to bear full weight on my leg and also able to bend my knee. Institutes like the PGI provide the light at the end of tunnel for a better health treatment.

Learning points

- ▶ Conjoint bicondylar Hoffa fracture is a rare injury, usually associated with high-velocity trauma to a flexed knee.
- ▶ It may be accompanied by an irreducible patellar dislocation. High index of suspicion is necessary to detect such injuries.
- ▶ CT scan is essential for the diagnosis. Prompt operative treatment allows for early functional rehabilitation and for favourable clinicoradiological outcome.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Nork SE, Segina DN, Aflatoon K, *et al.* The association between supracondylar-intercondylar distal femoral fractures and coronal plane fractures. *J Bone Joint Surg Am* 2005;87:564–9.
- 2 Hoffa A. *Lehrbuch der Frakturen und Luxationen*. 4th edn. Stuttgart: Ferdinand Enke Verlag, 1904:453.
- 3 Zeebregts CJ, Zimmerman KW, ten Duis HJ. Operative treatment of a unilateral bicondylar fracture of the femur. *Acta Chir Belg* 2000;100:104–6.
- 4 Calmet J, Mellado JM, García Forcada IL, *et al.* Open bicondylar Hoffa fracture associated with extensor mechanism injury. *J Orthop Trauma* 2004;18:323–5.
- 5 Papadopoulos AX, Panagopoulos A, Karageorgos A, *et al.* Operative treatment of unilateral bicondylar Hoffa fractures. *J Orthop Trauma* 2004;18:119–22.
- 6 Neogi DS, Singh S, Yadav CS, *et al.* Bicondylar Hoffa fracture—a rarely occurring, commonly missed injury. *Injury Extra* 2008;39:296–8.
- 7 Dua A, Shamsheery PK. Bicondylar Hoffa fracture: open reduction internal fixation using the swashbuckler approach. *J Knee Surg* 2010;23:21–4.
- 8 Agarwal S, Giannoudis PV, Smith RM. Cruciate fracture of the distal femur: the double Hoffa fracture. *Injury* 2004;35:828–30.
- 9 Mounasamy V, Hickerson L, Fehring K, *et al.* Open bicondylar Hoffa fracture with patella fracture: a case report and literature review. *Eur J Orthop Surg Traumatol* 2013;23:261–5.
- 10 Lal H, Bansal P, Khare R, *et al.* Conjoint bicondylar Hoffa fracture in a child: a rare variant treated by minimally invasive approach. *J Orthopaed Traumatol* 2011;12:111–14.
- 11 Ul Haq R, Modi P, Dhammi I, *et al.* Conjoint bicondylar Hoffa fracture in an adult. *Indian J Orthop* 2013;47:302–6.
- 12 Kondreddi V, Yalamanchili RK, Ravi Kiran K. Bicondylar Hoffa's fracture with patellar dislocation—a rare case. *J Clin Orthop Trauma* 2014;5:38–41.
- 13 Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses. *J Bone Joint Surg Am* 1976;58:453–8.
- 14 Lewis SL, Pozo JL, Muirhead Allwood WF. Coronal fractures of the lateral femoral condyle. *J Bone Joint Surg Br* 1989;71:118–20.
- 15 Orthopaedic Trauma Association Committee for Coding and Classification. Fractures and dislocations compendium. *J Orthop Trauma* 1996;10:41–5.
- 16 Jarit GJ, Kummer FJ, Gibber MJ, *et al.* A mechanical evaluation of two fixation methods using cancellous screws for coronal fractures of the lateral condyle of the distal femur (OTA type 33B). *J Orthop Trauma* 2006;20:273–6.

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