Rare disease

Paediatric intrasubstance posterior cruciate ligament rupture

Chloe EH Scott, Alastair W Murray

Department of Orthopaedics, Royal Hospital for Sick Children, Edinburgh, UK

Correspondence to Chloe EH Scott, chloe.scott@luht.scot.nhs.uk**Summary**

The authors present the case of a 4-year-old boy who sustained an intrasubstance posterior cruciate ligament (PCL) tear whilst trampolining. He was managed non-operatively with return to full function by 8 months. A high index of suspicion is required when assessing paediatric hyperflexion/extension injuries at the knee as ligamentous injury may occur without osteochondral fracture and may be missed on routine radiographs. Early MRI can identify such injuries in addition to osteochondral avulsions which are often amenable to acute internal fixation. In the case of paediatric intrasubstance PCL tears, it appears that non-operative management yields a good functional outcome in the short term in the skeletally immature.

BACKGROUND

Posterior cruciate ligament (PCL) injuries in children are rare but are typically associated with an osteochondral avulsion fracture from either their tibial (10 reported cases)^{1–9} or femoral (five reported cases)^{10–13} attachments. Three previous cases of paediatric intrasubstance tear have been reported^{14–16} and have been treated operatively. This represents the first report of non-operative management of which we are aware.

CASE PRESENTATION

A 4-year-old boy presented to the emergency department acutely, having sustained a hyperflexion injury to the right knee during a fall on a trampoline where another child landed on top of him. He complained of pain at the posterior aspect of his right knee which had become immediately swollen. On examination, a large effusion was

present with medial tenderness and an inability to straight leg raise (SLR). A plain radiograph was performed and he was not thought to have a significant osteochondral lesion. He was treated symptomatically in a cylinder cast for one week. At 1 week, the effusion remained, though he was able to SLR with range of motion (ROM) 10–45 and stable collateral ligaments. He was mobilised weight bearing as able in a brace. At 2 weeks, his effusion was settling and an extensor lag was noted with ROM 10–110. At 4 weeks, he continued to complain of posterior pain with a persistent effusion and a positive posterior draw sign was elicited on examination.

INVESTIGATIONS

Plain radiograph at presentation showed a lipo-haemarthrosis and effusion (figure 1). An MRI scan was performed under general anaesthetic at 4 week postinjury confirming

Figure 1 Plain radiograph showing an effusion with a lipo-haemarthrosis but no osteochondral fracture.

Figure 2 MR images showing (a) an intrasubstance PCL tear and (b) a medial meniscal tear. There was no osteochondral defect or bone bruising present.

Figure 3 Posterior tibial sag and positive posterior draw test at 8 months.

Figure 4 Dial test at 8 months. Positive at 90° on the right knee and equal at 30° indicating PCL laxity with an intact posterolateral corner.

an intrasubstance PCL rupture (figure 2a) and a medial meniscal tear (figure 2b). There was no osteochondral defect or bone bruising identified.

DIFFERENTIAL DIAGNOSIS

In the paediatric population, the elasticity of the PCL and comparative weakness of the epiphysal bone would be expected to result in fracture (osteochondral avulsion) in preference to ligament rupture.¹⁷

TREATMENT

Due to the rarity of intrasubstance tears in the paediatric population, there is no consensus regarding their management. PCL reconstruction in the skeletally immature is complex^{14 15} and risks growth disturbance as tunnels for the reconstructed ligament must cross the epiphysal growth plate. Alternatively, tunnels are placed in a biomechanically suboptimal position to avoid the physes. Non-operative management may fail to restore the normal kinematics of the knee and predispose to early degenerative joint disease, though non-operative management of isolated PCL injuries in adults often yields good functional results. This patient was therefore treated non-operatively with a course of physiotherapy.

OUTCOME AND FOLLOW-UP

At 8 month review, he was asymptomatic with no pain or symptoms of instability. He had returned to all normal activities and was able to run, jump, climb and kneel without difficulty. On examination, significant PCL laxity remained with a posterior sag and positive posterior draw (figure 3) and dial tests (figure 4).

DISCUSSION

PCL injuries in children are rare. Only three previous cases of intrasubstance PCL tear have been reported in the literature.^{14–16} In children it is more usual for the PCL to avulse its bony attachment^{1–13} giving rise to an osteochondral fragment amenable to open reduction and internal fixation if diagnosed promptly. PCL injuries are often missed, even in the adult population. Large effusions may mask any posterior sag in the acute setting, especially in the paediatric population. Epidemiological studies have shown that 40% of PCL injuries result from athletic activities and that the most common mechanism (24%) is a hyperflexion injury of the knee with a plantar flexed foot.¹⁸

Prognosis following PCL rupture is very variable. Some longer term studies have suggested at least occasional pain in up to 80% of patients with PCL deficient knees, and radiographic evidence of degeneration increasing with time from injury. Many adult PCL deficient patients suffer no symptoms at all.¹⁹ Sample sizes have been small in these studies and whether these principles can be applied to the skeletally immature is also unclear.

A high index of suspicion needs to be employed when managing knee injuries of significant energy or mechanism to avoid missing the window of opportunity to fix avulsion fractures. This case report shows that children can sustain an intrasubstance tear. Small avulsed fragments may not be seen on plain radiographs and we would recommend prompt MRI or CT scanning of children who develop a

large effusion rapidly following this mechanism of injury to exclude a cruciate osteochondral avulsion or other ligament injury. Ultrasound has also been used to diagnose PCL rupture¹⁶ in the absence of MRI though we have no experience of this. The increase in case reports of PCL injuries in children over the past 10 years may well reflect increased access to MRI scanning rather than an actual increase in incidence of the injury. The rare occurrence of an isolated intrasubstance PCL tear in a child appears amenable to non-operative management.

Learning points

- ▶ Intrasubstance cruciate ligament ruptures can occur in children.
- ▶ They are best imaged with MRI, but CT is useful in excluding osteochondral fracture.
- ▶ Significant ligamentous injury should be suspected in hyperflexion/extension injuries with large and persistent effusions.
- ▶ Intrasubstance PCL ruptures in children can be successfully managed non-operatively.

Acknowledgements The authors thank Steve Stanton, Medical photographer.

Competing interests None.

Patient consent Obtained.

REFERENCES

1. Ross AC, Chesterman PJ. Isolated avulsion of the tibial attachment of the posterior cruciate ligament in childhood. *J Bone Joint Surg Br* 1986;**68**:747.
2. Goodrich A, Ballard A. Posterior cruciate ligament avulsion associated with ipsilateral femur fracture in a 10-year-old child. *J Trauma* 1988;**28**:1393–6.
3. Frank C, Strother R. Isolated posterior cruciate ligament injury in a child: literature review and a case report. *Can J Surg* 1989;**32**:373–4.
4. Quintart C, Elbaum R. [A case of isolated avulsion fracture of the posterior cruciate ligament in a child]. *Rev Chir Orthop Reparatrice Appar Mot* 1999;**85**:617–20.
5. Ugutmen E, Sener N, Eren A, et al. Avulsion fracture of the posterior cruciate ligament at the tibial insertion in a child: a case report. *Knee Surg Sports Traumatol Arthrosc* 2006;**14**:340–2.
6. Pandya NK, Janik L, Chan G, et al. Case reports: pediatric PCL insufficiency from tibial insertion osteochondral avulsions. *Clin Orthop Relat Res* 2008;**466**:2878–83.
7. Tsiaviriy P, Rabemazava AZ, Ruzic JC, et al. [Avulsion fracture of the posterior cruciate ligament in a child: surgical treatment. a case report]. *Arch Pediatr* 2010;**17**:387–90.
8. Warne WJ, Mickelson D. All-epiphyseal semitendinosus PCL reconstruction in a 10-year-old child. *J Pediatr Orthop* 2010;**30**:465–8.
9. Solayar GN, Kapoor H. PCL tibial avulsion with an associated medial meniscal tear in a child: a case report on diagnosis and management. *J Pediatr Orthop B* 2011 <http://www.ncbi.nlm.nih.gov/pubmed?term=Solayar%20GN%2C%20Kapoor%20H%20> (accessed on 25 October 2011).
10. Mayer PJ, Micheli LJ. Avulsion of the femoral attachment of the posterior cruciate ligament in an eleven-year-old boy. Case report. *J Bone Joint Surg Am* 1979;**61**:431–2.
11. Sanders WE, Wilkins KE, Neidre A. Acute insufficiency of the posterior cruciate ligament in children. Two case reports. *J Bone Joint Surg Am* 1980;**62**:129–31.
12. Itokazu M, Yamane T, Shoen S. Incomplete avulsion of the femoral attachment of the posterior cruciate ligament with an osteochondral fragment in a twelve-year-old boy. *Arch Orthop Trauma Surg* 1990;**110**:55–7.
13. Hesse E, Bastian L, Zeichen J, et al. Femoral avulsion fracture of the posterior cruciate ligament in association with a rupture of the popliteal artery in a 9-year-old boy: a case report. *Knee Surg Sports Traumatol Arthrosc* 2006;**14**:335–9.

14. **Lobenhoffer P**, Wunsch L, Bosch U, *et al*. Arthroscopic repair of the posterior cruciate ligament in a 3-year-old child. *Arthroscopy* 1997;**13**:248–53.
15. **Bovid KM**, Salata MJ, Vander Have KL, *et al*. Arthroscopic posterior cruciate ligament reconstruction in a skeletally immature patient: a new technique with case report. *Arthroscopy* 2010;**26**:563–70.
16. **Karabay N**, Sugun TS, Toros T. Ultrasonographic diagnosis of the posterior cruciate ligament injury in a 4-year-old child: a case report. *Emerg Radiol* 2009;**16**:415–7.
17. **Clanton TO**, DeLee JC, Sanders B, *et al*. Knee ligament injuries in children. *J Bone Joint Surg Am* 1979;**61**:1195–201.
18. **Schulz MS**, Russe K, Weiler A, *et al*. Epidemiology of posterior cruciate ligament injuries. *Arch Orthop Trauma Surg* 2003;**123**:186–91.
19. **Boynton MD**, Tietjens BR. Long-term followup of the untreated isolated posterior cruciate ligament-deficient knee. *Am J Sports Med* 1996;**24**:306–10.

This pdf has been created automatically from the final edited text and images.

Copyright 2011 BMJ Publishing Group. All rights reserved. For permission to reuse any of this content visit <http://group.bmj.com/group/rights-licensing/permissions>.
BMJ Case Report Fellows may re-use this article for personal use and teaching without any further permission.

Please cite this article as follows (you will need to access the article online to obtain the date of publication).

Scott CEH, Murray AW. Paediatric intrasubstance posterior cruciate ligament rupture. *BMJ Case Reports* 2011;10.1136/bcr.09.2011.4803, Published XXX

Become a Fellow of BMJ Case Reports today and you can:

- ▶ Submit as many cases as you like
- ▶ Enjoy fast sympathetic peer review and rapid publication of accepted articles
- ▶ Access all the published articles
- ▶ Re-use any of the published material for personal use and teaching without further permission

For information on Institutional Fellowships contact consortiasales@bmjgroup.com

Visit casereports.bmj.com for more articles like this and to become a Fellow