CASE REPORT

Bilateral sleeve fractures of the patella in a 12-year-old boy with hereditary spastic paraparesis and crouch gait

Ailish Malone, Damien Kiernan, Tim O'Brien

Central Remedial Clinic,
Dublin, IrelandCorrespondence to
Dr Ailish Malone,
ammalone@crc.ie**SUMMARY**

This is the first reported case of bilateral sleeve fractures of the patellae in a child with crouch gait. A 12-year-old boy with hereditary spastic paraparesis (HSP), who was found to have mid-stance crouch of 20° on previous gait analysis, presented with pain of gradual onset and limited mobility. There was no history of trauma. Three-dimensional gait analysis showed that extensor mechanism function during loading response was intact, but knee flexion in swing was significantly reduced, indicating protective guarding by rectus femoris. X-rays showed bilateral minimally displaced sleeve fractures of the patellae. These were treated with immobilisation in cylinder casts in extension for 4 weeks. Follow-up X-rays showed that the fractures had successfully united and the patient progressed to full weight bearing and mobility as tolerated.

BACKGROUND

Crouch gait is a walking pattern characterised by excessive flexion of the knee during stance and is common in cerebral palsy (CP).¹ Hereditary spastic paraparesis (HSP) is not classically associated with crouch gait. Instead, people with HSP tend to walk with knee hyperextension and stiff knees in swing due to spasticity of rectus femoris.²⁻⁴ Nonetheless, it is conceivable that crouch may occur due to poor selectivity and weakness, or as an evolution of apparent equinus.⁵ The consequences of crouch gait in HSP could be assumed to be similar to CP.

The risks of crouch gait in CP have been well documented.⁶⁻⁹ Failure to extend the knee in mid-stance creates a prolonged and increased knee extensor moment. This places undue strain on the knee extensor mechanism, leading, in some cases, to knee extensor disruption (KED), a condition characterised by a distinct kinematic profile.⁶ In situations where the extensor mechanism is injured but not displaced, it is conceivable that the eccentric function of quadriceps in loading response may be intact. Early identification of such a scenario would require urgent intervention to preserve knee extensor function and prevent displacement.

CASE PRESENTATION

We present a case of a 12-year-old boy with a working diagnosis of HSP. His early developmental history was normal but his mother became concerned when he was 18 months old as he was toe walking with stiff lower limbs. MRI scans were normal and family history was unremarkable. He

was diagnosed with HSP by a neurologist based on his clinical presentation. He underwent bilateral gastrocnemius recessions at the age of 9 years to alleviate toe walking.

The child was subsequently assessed in our gait laboratory in October 2012 aged 11 years. Clinical examination at that time showed full lower limb strength, tight calves and spasticity of hip adductors and rectus femoris. Gait kinematic data identified mild mid-stance crouch of 20° with reduced knee flexion in swing and dynamic ankle equinus. Kinetic data demonstrated an abnormal knee extensor moment in terminal stance secondary to a failure to achieve knee extension. He was prescribed a pair of ankle-foot orthoses in an attempt to control crouch.

He was re-referred to our gait laboratory on the request of his mother when he reported of a sudden onset of bilateral knee pain without trauma in June 2013, aged 12 years. His knees were painful on weight bearing and he required crutches intermittently. Clinical examination revealed bilateral infrapatellar swelling, early knee flexion contractures (3° right, 5° left) and mild weakness of quadriceps, as well as spasticity of rectus femoris, hip adductors and gastrocnemius. Body mass index had increased from 20.5 to 22.3 due to growth and weight gain. Gait speed was considerably slower at 0.65 m/s compared with a speed of 1 m/s on the previous analysis. Kinematic data showed no change in knee flexion for shock absorption at loading response, consistent with a functioning extensor mechanism (figure 1). Mid-stance crouch was unchanged at 20°. In swing, the knees were considerably stiffer, with peak knee flexion angles of 43° (left) and 41° (right) compared with 52° (left) and 58° (right) on the previous analysis. Gait

Figure 1 Sagittal knee kinematics of two gait analyses showing mild bilateral crouch and rectus guarding in the recent analysis.

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To cite: Malone A, Kiernan D, O'Brien T. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2013-202217

analysis essentially confirmed that he had not suffered a disruption to the knee extensor mechanisms, but the increased knee stiffness in swing phase was an indicator of pathology.

INVESTIGATIONS

Plain film X-rays of the knees showed bilateral sleeve fractures of both patellae with minimal displacement (figures 2 and 3).

DIFFERENTIAL DIAGNOSIS

In any child with crouch gait, the main concern with the onset of knee pain and impaired mobility is KED.⁶ In this case, the kinematic data confirmed that the shock absorption function of the knee extensors on loading was intact; however, the stiffness in swing indicated guarding by the rectus femoris and suggested the presence of pathology. The X-rays confirmed sleeve fractures of the patellae, which gave rise to the splinting effect of rectus femoris, but as the fractures were not displaced the extensor mechanisms could function normally.

TREATMENT

The child was treated with bilateral cylinder casts in full extension for 4 weeks. On removal of the casts weight bearing was progressed as tolerated and an exercise programme to increase range of movement at the knees was followed.

OUTCOME AND FOLLOW-UP

Follow-up X-rays taken 9 weeks after first application of the casts showed that the areas of fracture separation had filled with new bone producing a double cortex and indicating successful union (figures 4 and 5).

DISCUSSION

The gait pattern of HSP is characterised by hyperextended knees in stance and stiff knees in swing due to spasticity and weakness of the lower limbs.²⁻⁴ This child's preinjury gait analysis showed mid-stance knee flexion of 20°, which would be classified as mild crouch.¹⁰ Crouch is unusual in HSP. It is possible that he may have been predisposed to crouch by bilateral gastrocnemius recessions at age 9, when his main problem was

Figure 3 Radiograph of the right knee demonstrating periosteal elevation.

toe walking. KED has been reported in children with diplegic CP with mild crouch,⁷ suggesting that even mild crouch gait carries significant risks to the knees due to the strain induced by excessive knee extensor moments. A case series found a mean premorbid mid-stance flexion angle of 21.6° in 10 children with diplegic CP who went on to develop disruption of the knee extensor mechanism.⁶

The present case is of significant interest as it is the first to report spontaneous injury to the knee extensor mechanisms in a child with spasticity due to HSP. The premorbid crouch was an indicator of the risk of injury, and the onset of bilateral knee pain in this child was an important symptom. This case is unique as the extensor mechanisms were intact allowing for shock absorption through eccentric knee flexion at loading

Figure 2 Left knee radiograph demonstrating periosteal elevation typical of a sleeve fracture.

Figure 4 Healed left fracture.

Figure 5 Healed right fracture.

response and no increase in crouch. However, the actual injury was suggested by the 9° and 17° decrease in peak knee flexion in swing on the left and right, respectively. This stiffening of the knees in swing indicated a splinting action by rectus femoris. X-rays confirmed the presence of minimally displaced sleeve fractures. The likely mechanism of injury was the tension caused by prolonged and excessive knee extensor moments which maintain upright stance against gravity and prevent collapse of the knees into further flexion in the presence of crouch. This tension over time caused eventual fatigue whereby the patellar tendon pulled the periosteum off the bony surface of the patella at its insertion, leading to sleeve fractures. Immobilisation in cylinder casts for 4 weeks was sufficient to treat the fractures and ensure that they united successfully. The child will however require ongoing monitoring to manage his crouch and optimise his gait pattern as he grows.

Learning points

- ▶ Crouch gait can occur in hereditary spastic paraparesis and, as for cerebral palsy, creates a similar biomechanical strain and risk of injury to the knee extensor mechanisms.
- ▶ Gait analysis accurately documents knee pathology in knee crouch.
- ▶ Knee pain in children with crouch gait is not a benign symptom and may indicate excessive strain on the extensor mechanism.

Contributors AM performed the gait analyses and wrote the first draft. DK collected data and produced the figures. TOB supervised and wrote the final report.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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