CASE REPORT

Bilateral knee extensor disruption in severe crouch gait

Yahya Elhassan,¹ Damien Kiernan,¹ Tim Lynch,² Tim O'Brien¹

¹Gait Laboratory, Central Remedial Clinic, Dublin, Ireland
²The Dublin Neurological Institute, Mater Misericordiae University Hospital, Dublin, Ireland

Correspondence to
 Professor Tim O'Brien,
 proftobrien@hotmail.com

SUMMARY

Crouch gait is one of the most troublesome abnormal gait patterns in ambulant patients with spastic diplegic cerebral palsy (CP). Although CP is a non-progressive condition, crouch gait can result in knee extensor disruption (KED) causing deterioration or cessation of ambulation. Diagnosis of KED in crouch gait is often overlooked. We report a seminal case of a 28-year-old active woman with diplegic CP with severe crouch gait who was referred for gait analysis due to subjective decreased walking speed and endurance. Gait analysis showed kinematic features typical of KED and radiology confirmed the diagnosis.

BACKGROUND

One of the most common pathological gait patterns in spastic diplegic cerebral palsy (CP) is crouch gait, defined as excessive flexion of the knee throughout the stance phase of gait.¹ During normal gait the first phase of knee movement in the sagittal plane involves a flexion of the knee to approximately 20° in early stance. Eccentric contraction of the quadriceps meets torque demands across the knee and acts as a shock absorber. In mid-stance there is a relative extension of the knee as the body's weight passes over the stance phase limb. With the ground reaction vector line anterior to the knee joint centre an extension moment is created and knee extension occurs passively. However, if the ground reaction force remains behind the knee, as happens in crouch, it generates a strong external flexion moment that must be resisted by the quadriceps.² When this force becomes excessive the extensor mechanism fails.³ Although CP is classically thought of as a non-progressive condition, deterioration in gait occurs when there is a fracture of the knee extensor mechanism that is, fracture of the patella or avulsion of the tibial tubercle.

Fracture of the patella and avulsion of the tibial tubercle in CP has been described by Rosenthal *et al*⁴ who suggested no treatment was required unless there was knee pain. In 1985 Lloyd-Roberts *et al*⁵ highlighted its correlation with deterioration of walking but no gait data was provided. Topoleski *et al*⁶ in 2000 considered the radiographical findings of patella alta as a universal finding in CP and not necessarily significant. None of these papers looked at the kinematic or kinetic analysis of these patients. We have previously described unilateral knee extensor disruption in mild CP diplegia⁷ while this report describes the two radiographical lesions of extensor disruption occurring in one patient.

Video 1 Severe crouch gait associated with bilateral knee extensor rupture.

CASE PRESENTATION

A 28-year-old ambulant woman, who is known to have CP spastic diplegia and severe crouch gait, was referred to a neurologist due to deterioration in her walking distance and duration. On clinical examination painless patella alta was identified on both sides with tight hamstrings, flexion contractures of both knees and bilateral quadriceps lags. Kinematic gait analysis showed she walked with severe crouch gait of 70–80° flexion of both knees (video 1). Gait speed was reduced at 0.8 m/s (normal is 1.13–1.35 m/s), with reduced step length. She had the features of extensor mechanism failure, which are loss of knee 'shock absorption' in early stance and loss of the return to extension' movement at mid-stance (figure 1). Electromyography showed

Figure 1 Sagittal kinematics of both knees (right—red and left—blue) demonstrating poor shock absorption and severe knee crouch bilaterally.

To cite: Elhassan Y, Kiernan D, Lynch T, *et al*. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2013-010337

Figure 2 Lateral radiograph of left knee showing an un-united displaced fracture of the patella with patella alta.

excessive rectus femoris activity throughout stance phase consistent with crouch gait. Radiography of both knees revealed the two common fractures of KED, an avulsion fracture of the right tibial tubercle and a fracture of the left patella (figures 2 and 3).

Figure 3 Lateral radiograph of right knee showing an un-united displaced avulsion fracture of the tibial tubercle with patella alta.

DISCUSSION

We report an adult patient with crouch gait due to CP. She attended a neurologist because of a subjective complaint of gait deterioration. Her gait analysis and radiographs confirmed KED at two different anatomical levels, a fracture of the patella on the left and an avulsion fracture of the tibial tubercle on the right. These fractures are radiographically not recent in origin and it was thought that her recent gait deterioration was due to fatigue following an increase in body mass. Although these fractures are stable, the lengthened knee extensor mechanisms exacerbate the knee crouch. CP is considered to be a non-progressive condition; however, knee crouch that results in fractures of the extensor mechanism causes increased crouch and decreased mobility. KED typically occurs at the anatomical locations shown in this case. We have no explanation as to why this patient suffered the fractures at the two different locations in the different legs. We have anecdotal evidence suggesting that the traction fracture of the tibial tubercle occurs at an earlier age than the patellar fracture. As both of these fractures were not accompanied by pain we cannot date them. In view of the significant alteration in knee kinematics associated with these fractures we disagree with an opinion in the literature that these are insignificant in CP.

Learning points

- ▶ The effects of diplegic cerebral palsy (CP) crouch gait are not static.
- ▶ A fracture of the knee extensor mechanism causes significant deterioration in an already compromised individual.
- ▶ When a patient with diplegic CP presents with significant deterioration of gait, we recommend knee X-rays be performed along with gait analysis

Correction notice This article has been corrected since it was published online 27 Jun 2013. Video 1 which was previously omitted, has now been included.

Contributors YE identified the case and collected the data. DK provided the figures and the video. TL is the neurologist who referred his patient for gait analysis and prepared first draft. TOB oversaw preparation of the report and approved the final draft of the case report and finalised the writing.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Sutherland D, Davids J. Common gait abnormalities of the knee in cerebral palsy. *Clin Ortho* 1993;288:139–47.
- 2 Gage J, Schwartz M, Koop S, et al. *The identification and treatment of gait problems in cerebral palsy*. London: Mac Keith Press, 2009:556.
- 3 O'Sullivan R, Walsh M, Kiernan D, et al. The knee kinematic pattern associated with disruption of the knee extensor mechanism in ambulant patients with diplegic cerebral palsy. *Clin Anat* 2010;23:586–92.
- 4 Rosenthal RK, Levine DB. Fragmentation of the distal pole of the patella in spastic cerebral palsy. *J Bone Joint Surg Am* 1977;59:934–9.
- 5 Lloyd-Roberts GC, Jackson AM, Albert JS. Avulsion of the distal pole of the patella in cerebral palsy. A cause of deteriorating gait. *J Bone Joint Surg Br* 1985;67:252–4.
- 6 Topoleski TA, Kurtz CA, Grogan DP. Radiographic abnormalities and clinical symptoms associated with patella alta in ambulatory children with cerebral palsy. *J Pediatr Orthop* 2000;20:636–9.
- 7 Elhassan Y, O'Sullivan R, Walsh M, et al. Knee extensor disruption in mild diplegic cerebral palsy: a risk for adolescent athletes. *BMJ Case Rep*. Published Online: 20 Feb 2012. doi:10.1136/bcr-2012-008120

Copyright 2013 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.

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