CASE REPORT

Acetabular fractures in skeletally immature rugby players

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Accepted 30 January 2016

SUMMARY

Since the introduction of professionalism to the sport of rugby union, an increasing rate of injury has been noted in the playing population. In addition, overall participation numbers have increased globally, with more amateurs and young people involved in the sport. Acetabular fractures are generally seen after violent trauma and can be associated with poor long-term outcomes. We have previously described two acetabular fractures in young patients (16 and 24 years of age) sustained during rugby matches. We present a case series of four closed, isolated acetabular fractures in three skeletally immature male patients (13–16 years of age), two of which required open reduction and internal fixation. Three of these fractures occurred in conjunction with hip dislocations. All injuries were sustained while engaged in playing rugby union, two during seasonal match play and one during a training drill.

BACKGROUND

This is an unusual injury pattern noted in three young patients while playing rugby.^{1–6} These injuries are normally associated with high-energy trauma and poor outcomes. An evaluation of the rules at the breakdown and an emphasis on proper tackling could aid injury prevention.

CASE PRESENTATION**Case 1**

The first case was that of a 16-year-old, Caucasian male patient, schools rugby player weighing 60 kg (body mass index (BMI) = 20.5 kg/m²), who sustained the injury during a competitive match. He was in control of the ball, before being hit by a two person tackle. He fell onto his flexed right knee, with the second tackler falling on top, resulting in the application of an axial load through his hip joint. He felt immediate pain and he was unable to mobilise. He was transferred via ambulance to his local hospital where a posterior fracture-dislocation of his right hip joint was diagnosed. He underwent successful reduction of his hip immediately, although his hip was noted to be unstable. Subsequent CT scan of his pelvis demonstrated a displaced posterior wall acetabular fracture and he was referred to our institution for further management. He underwent open reduction and internal fixation of the posterior wall fragment with a two-hole spring plate via a posterior Kocher-Langenbach approach. He was discharged non-weight bearing on the right leg 3 days post-operatively. He was reviewed 6 weeks postoperatively and progressed to full weight bearing over

the following month. At last follow-up, 5 years postinjury, the fracture was clinically and radiologically united, with no evidence of arthritis. The patient was fully weight bearing without pain. He had returned to playing recreational rugby union without any subjective difficulty or deterioration in capabilities, 18 months after his injury.

Case 2

The second case was of a 13-year-old, Caucasian male patient, weighing 46 kg (BMI=17 kg/m²), who incurred an injury during rugby training. He was stationary over a ruck, with knees mildly flexed and his trunk approximately parallel to the ground. He was then tackled with a downward force applied to his back by another player, falling onto both flexed knees. He felt immediate pain in both legs, more significantly on the right side and was unable to mobilise. He was taken to the regional centre where a posterior fracture-dislocation of his right hip joint was diagnosed (figure 1). Emergent reduction of his right hip was carried out and significant instability was noted. He subsequently underwent CT and MRI of his pelvis demonstrating a displaced posterior wall fracture of his right acetabulum with joint effusion and bone bruising. He was also noted to have an undisplaced fracture of his left acetabulum. He was transferred to our institution for definitive care and underwent open reduction and internal fixation of his right

Figure 1 Obturator oblique view of the pelvis showing a posterior dislocation of the right hip joint with associated fracture of the posterior acetabular wall.

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To cite: Morrissey DI, Good D, Leonard M. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2015-211637

acetabulum via a Kocher-Langenbach approach 4 days after his injury (figure 2). His left acetabular fracture was treated conservatively. He underwent an uneventful recovery and was discharged on the fourth postoperative day. He remained non-weight bearing on both legs for 6 weeks, with subsequent progression to full weight bearing. Three years postinjury, the fracture was clinically and radiologically united, with no evidence of arthritis. The patient was fully weight bearing without pain. He had not returned to any contact sport but otherwise exercises normally. His decision was based on the potential for further injury, rather than as a result of his original trauma.

Case 3

The third case was of a 13-year-old, Caucasian male patient, weighing 45 kg (BMI=19 kg/m²), injured during a rugby match. He was tackled from behind and similar to the two previous cases fell onto a flexed left knee. He felt immediate pain in his left hip and buttock and was unable to mobilise. He was taken by ambulance to our centre where a posterior fracture-dislocation of his right hip joint was diagnosed. He underwent emergent reduction and his hip joint was stable on examination under anaesthesia. He subsequently underwent CT imaging which demonstrated a small posterior wall fracture of his right acetabulum. There were no loose fragments in his hip joint. He was treated conservatively and remained non-weight bearing on his left leg for 6 weeks, with subsequent progression to full weight bearing. Three years postinjury, the fracture was clinically and radiologically united, with no evidence of arthritis. The patient was fully weight bearing without pain. As in case 2, he was concerned about the potential for further injury and had ceased playing rugby. He was, however, still involved in recreational contact sport and had reported no ill effects.

INVESTIGATIONS

Plain radiography and CT in all cases with MRI in one case.

TREATMENT

Emergent hip reduction in three cases with open reduction and internal fixation of posterior wall acetabular fractures in two cases.

OUTCOME AND FOLLOW-UP

One patient was followed up for 5 years and two for 3 years. Full clinical and radiological union without evidence of arthritis in all cases. All three individuals expressed concern about the

possibility of future injury and two patients stated this as the primary reason for ceasing involvement in rugby.

DISCUSSION

Our institution is a tertiary referral centre for acetabular and pelvic surgery in the Republic of Ireland, performing operative intervention on 112 pelvic and acetabular fractures in 2011. Acetabular fractures are an uncommon injury, generally occurring in younger patients as a result of high-velocity trauma such as road traffic accidents.⁷⁻⁹ To the best of our knowledge, this is the first case series of posterior wall acetabular fractures, sustained in skeletally immature patients while playing rugby union. Much of what we understand about acetabular fractures is due to the seminal work of Letournel and colleagues.¹⁰ They delineated reproducible fracture patterns and introduced a classification system still in use today. All of the four cases in this series suffered the same fracture pattern, that of a posterior wall fracture. In three cases, the fracture was associated with a posterior hip dislocation. Posterior wall fractures are the most common elemental acetabular fracture, accounting for approximately 30% of injuries.¹⁰ Several factors are involved in the evolution of these injuries. From a biomechanical point of view, the important issues are the position of the limb at the time of injury in conjunction with the direction and magnitude of applied force. In the setting of concomitant hip dislocation, they result from the application of an axial loading force through a flexed and adducted hip. Marginal impaction of the acetabulum, occurring as a result of force transmission through the femoral head is a poor prognostic marker associated with posterior wall fractures. Following operative fixation, 25% of patients with this specific fracture pattern, have a poor mid-term result.¹¹ There was evidence of marginal impaction in two of the four fractures in this series. This has serious implications, for a young person's sporting career, as well as for their lifestyle and health. Previously published data from this institution shows the majority of our acetabular trauma occurs as a result of high-energy trauma.^{7,8} This has been corroborated in international studies.⁹ We have not previously seen sports-related acetabular fractures occur in the skeletally immature patient although there are case reports in the literature of similar injuries sustained in other sports or in the mature rugby player.¹²⁻¹⁴ The physical profile, training regimens and injury patterns in rugby union have changed significantly, since the introduction of professionalism in 1995.¹³⁻¹⁵ These changes are not limited to professionalism, however, and have permeated to all levels of play, including underage and amateur standard.¹ In the 2003 World Cup, the number of play-related injuries had increased, as had the BMI of players.¹⁵ This physique change has also been noted at amateur level, while increased BMI has previously been associated with a higher injury rate.¹⁶ Increased ball-in-play has also increased the exposure time to potential injury.¹⁵ All four injuries in this case series occurred during the tackle phase of play. In addition, they all occurred as a result of axial loading through a flexed hip with the knee planted on the ground. This position may be encountered during a two man tackle, as one tackler hits low and the other hits high. The lower tackle will plant the feet, occasionally resulting in the knees dropping to the ground. The second can provide the axial loading necessary for acetabular trauma. Further exposure to risk may occur during the phase of play known as the 'ruck', where the bridging player maintains a standing position while bending over the ball. In this position, the player may be susceptible to a significant axial load across the hip as opposition players aim to dislodge them from the ball. It is possible that these conditions lead to acetabular fractures/hip dislocations, although the reports in

Figure 2 Postoperative anteroposterior pelvic radiograph demonstrating a congruent right hip joint with anatomic fixation of the posterior acetabular wall.

Learning points

- ▶ Hip dislocations and acetabular fractures are usually associated with high-energy trauma.
- ▶ We have not previously encountered these injuries in a juvenile sporting population and it is possible that a change in emphasis may have increased the potential for such injuries to occur.
- ▶ In order to prevent the potentially devastating consequences of these injuries, it may be necessary to implement rule changes or size restrictions in the juvenile game.
- ▶ Healthcare providers should be aware of these injuries and the potentially devastating impact that they may have on the growth, sporting participation and lifestyle of young players.

the adult literature are sparse. Here we have seen four such injuries in a skeletally immature population, so it may be that the growing skeleton is more susceptible. Many schools and juvenile rugby clubs have adopted a more professional attitude towards the game, with a significant emphasis being placed on weight training and physical size. In addition to the problems associated with excessive force in an immature skeleton, it should also be noted that players, while chronologically of the same age, may be heterogeneous in terms of size, stage of development and bone age. This heterogeneity may be magnified at the tackle and ruck phases as physically more mature players engage with less mature counterparts, with an associated increase in injury risk. An evaluation of the rules at the breakdown and an emphasis on proper tackling could aid injury prevention.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Garraway W, LEE A, Hutton S, *et al.* Impact of professionalism on injuries in rugby union. *Br J Sports Med* 2000;34:348–51.
- 2 McManus A, Cross D. Incidence of injury in elite junior rugby union: a prospective descriptive study. *J Sci Med Sport* 2004;7:438–45.
- 3 Kaplan K, Goodwillie A, Strauss E, *et al.* Rugby injuries: a review of concepts and current literature. *Bull NYU Hosp Jt Dis* 2008;66:86–93.
- 4 England Rugby Injury and Training Audit 2008–2009.
- 5 Murphy D, Kaliszer M, Rice J, *et al.* Outcome after acetabular fracture. Prognostic factors and their inter-relationships. *Injury* 2003;34:512–17.
- 6 Good DW, Leonard M, Lui D, *et al.* Acetabular fractures following rugby tackles: a case series. *J Med Case Rep* 2011;5:505.
- 7 Davarinos N, Ellanti P, Morris S, *et al.* Epidemiology of pelvic and acetabular trauma in a Dublin tertiary hospital: a 10-year experience. *Ir J Med Sci* 2012;181:243–6.
- 8 O'Neill F, Leonard M, Lui D, *et al.* Pelvic and acetabular fractures. *Ir Med J* 2012;105:306.
- 9 von Heyden J, Hauschild O, Strohm PC, *et al.* Paediatric acetabular fractures. Data from the German Pelvic Trauma Registry Initiative. *Acta Orthop Belg* 2012;78:611–18.
- 10 Judet R, Judet J, Letournel E. Fractures of the acetabulum: classification and surgical approaches for open reduction. Preliminary report. *J Bone Joint Surg Am* 1964;46:1615–46.
- 11 Giannoudis PV, Kanakaris NK, Delli Sante E, *et al.* Acetabular fractures with marginal impaction: mid-term results. *Bone Joint J* 2013;95-B:230–8.
- 12 Nodzo SR, Hohman DW, Galpin RD. Bilateral acetabular fractures in an adolescent after low-energy trauma. *Pediatr Emerg Care* 2012;28:568–9.
- 13 Giannoudis P, Zelle B, Kamath R, *et al.* Posterior fracture-dislocation of the hip in sports. Case report and review of the literature. *Eur J Trauma* 2003;29:399–402.
- 14 Venkatachalam S, Heidari N, Greer T. Traumatic fracture-dislocation of the hip following rugby tackle: a case report. *Sports Med Arthrosc Rehabil Ther Technol* 2009;1:28.
- 15 Brooks JH, Fuller CW, Kemp SP, *et al.* A prospective study of injuries and training amongst the England 2003 Rugby World Cup squad. *Br J Sports Med* 2005;39:288–93.
- 16 Bird Y, Waller A, Marshall S, *et al.* The New Zealand rugby injury and performance project: V. Epidemiology of a season of rugby injury. *Br J Sports Med* 1998;32:319–25.

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