CLINICAL ARTICLE

Posterior fracture dislocation of the hip joint in motor vehicle occupants

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Abstract

Between July 1994 and January 2000 one hundred and ten posterior fracture dislocations in 109 patients presenting to Groote Schuur Hospital required open reduction and internal fixation.

Motor vehicle accidents accounted for 88 (80%) of the injuries equally divided between drivers and passengers. Eighty-one per cent of comminuted grade III injuries occurred on the right side. Of these, 71.5% occurred in vehicle drivers. Only 48% of the simple fractures were right-sided and 64% occurred in passengers.

We concluded that the driver of a motor vehicle is more likely to sustain a right-sided fracture dislocation which is of greater severity than other occupants. These findings should alert the motor industry to take steps to minimise this injury.

Introduction

The first description of the mechanism of this injury in the literature according to Griswold and Herd[4] was extreme abduction with the femur acting as a lever arm and forcing the femoral head out through the inferior capsule. Their interpretation was that the musculature 'located' the head in the typical posterior position.

With the advent of motor vehicles hip fracture dislocation became more commonly encountered and it was recognised that this injury was not from abduction but more likely from a blow over the knee in a flexed hip. Funsten *et al*[3] reported on 13 cases that sustained what they termed 'dashboard dislocation of the hip'.

Urist[7] published a series collected from US army personnel who were mostly involved in jeep accidents. Armstrong[1] who collected cases from RAF hospitals found that more than half of his cases occurred after aeroplane accidents.

Stewart[6] was the first to observe a difference between the type of injury sustained by the driver of a vehicle and the passenger. He observed that 'the driver of an automobile who sustains a posterior dislocation usually has a more severe injury than a passenger. Because of the difference in hip position between the two occupants, the driver sustains a postero-superior injury and the passenger with a more flexed hip has less damage.'

Epstein[2] makes the point that in a hip that sustains an abducting force, an anterior dislocation is more likely. This is in contrast to the original description by Griswold and Herd. Extensive descriptions of the mechanics of acetabular fractures by Judet[5] showed that a loading force applied to a flexed hip in neutral will most likely result in a posterior hip dislocation with an associated simple posterior wall fracture. When the hip is adducted the direction of maximal force is directed increasingly laterally with increasing adduction, and a pure dislocation is more likely to occur. As the leg is abducted from neutral, the point of maximum impact is 'mapped out' medially in an arc across the acetabulum. Epstein referred to this part of the acetabulum as the 'floor' of the acetabulum.

The abducted hip is therefore likely to sustain, in addition to the posterior wall fracture, an associated acetabular floor fracture. Once the abduction exceeds 60° the force is the same as for a blow over the trochanter with the hip in neutral, and the likelihood of a posterior dislocation almost nil.

Materials and methods

All traumatic posterior fracture dislocations of the hip joint from whatever cause presenting to the Department of Orthopaedic Surgery at Groote Schuur Hospital that required open reduction were studied prospectively. During the period July 1994 to January 2000, 110 cases in 109 patients were treated surgically and were eligible for review. The cause of injury was recorded in all cases. The fracture patterns were recorded at surgery with specific reference to the degree of comminution of the posterior wall. Each injury was graded according to the Selvey and Siboto[8] modification of the Thompsen and Epstein classification *(Table I),* then assigned to one of two groups. Group 1 comprised grade IB (requiring surgery) and grade II injuries; and Group 2 comprised grades IIIA, with grade IIIB and grade IV injuries being included in either Group 1 or 2 depending on the degree of comminution of the acetabular wall fracture.

An analysis of the vehicle occupant status and the grade of injury sustained was then carried out.

Results

Of the 110 cases, 22 injuries from causes other than motor vehicle accidents were excluded from this analysis. The remaining 88 cases were occupants of motor vehicles (80%). Forty-five patients were drivers of vehicles and 43 were passengers. The right hip was involved in 55 (62.5%) and the left in 33. There were no bilateral simultaneous dislocations. One patient who sustained an injury to both hips in separate incidences during the study period was a driver when he sustained his first injury and a passenger when he sustained his second injury. He sustained a grade II fracture in both accidents.

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Group 1 injuries (simple fractures) comprised 50 injuries of which 18 occurred in motor vehicle drivers (36%). Twenty-four were on the right side (48%).

Group 2 injuries (comminuted fractures) occurred in 38 injuries of which 27 were in motor vehicle drivers (71.1%). Thirty-one were on the right-hand-side (81.6%) – see *Table II.*

Of the 27 drivers, in Group 2, 22 occurred on the right side (81.5%).

Of the 18 drivers in Group 1 injuries, 11 were on the right side (61.1%)

Thirty-two of 43 passengers sustained a Group 1 fracture (74.4%).

Thirteen of these 32 Group 1 injuries occurred on the right side (40.6%).

Of the eleven Group 2 injuries in passengers nine occurred on the right side (81.8%).

Discussion

The classic 'dashboard injury' of Funsten is in fact a description of only a small group of patients in this series and, had pure dislocations been included, there would most likely have been a greater number. The 'brake-pedal injury' describes the more common fracture dislocation injury sustained by the driver (or the alert or nervous passenger) and is shown here to carry a higher risk of comminution.

Due to its anatomy the extended hip in the neutral position, as the hip is held during braking or while bracing for impact, is in a position of optimal stability.

To dislocate the hip from this position by a force applied along the long axis of the extended leg is practically impossible without an accompanying acetabular fracture.

Table I: The Siboto Selvey classification[8] modified from that of Thompsen and Epstein

Grade of injury	
IA	Pure dislocation with or without minor fracture
IB	Dislocation with minor fracture of posterior rim, which becomes incarcerated during reduction and requires removal (either via arthrotomy or arthroscopy)
IIA	Dislocation with simple posterior wall fracture with no comminution or very small amount of fracture 'dust' in the presence of a large fragment (making reconstruction straightforward and relatively easy)
IIB	As above with an associated acetabular floor fracture (usually infra-tectal or juxta-tectal)
IIIA	Dislocation with associated comminution of the posterior wall (with or without a major fragment)
IIIB	As above with an associated transverse fracture of the acetabulum (usually trans-tectal or juxta-tectal)
IV	Dislocation with an associated fracture of the femoral neck or head

Table II: In these 88 cases the more severe comminuted injuries, Group 2, have a higher association with drivers and injury to the right side, while passengers tend to sustain less severe injury

Total No.: n=88		
Group	1	2
Number	50	38
Driver (n=45)	18 (36%)	27 (71.5%)
Passenger (n=43)	32 (64%)	11 (29.5%)
Right side – driver	11 (61.1%)	22 (81.6%)
Right side – passenger	13 (40.6%)	9 (81.8%)

If deviation from the neutral position is permitted as occurs with adduction (or abduction), the more laterally (or medially) directed force will result in less severe or comminuted acetabular injury and the point will be reached where the hip will dislocate without a wall fracture.

In this series, the comminuted, grade III injuries occurred predominantly on the right-hand-side and almost three-quarters of these injuries were incurred by the driver. This implies that the driver, while attempting to avoid a collision, maintained as much force as possible by the right foot on the brake pedal until impact, and is therefore at greater risk of sustaining a comminuted injury. The resultant force transmitted through the hip held in relatively neutral position results in the more comminuted injury. However, if the hip is free to adopt a position other than the neutral position, such as a passenger sitting with the leg slightly oblique or if the passenger's position shifts due to lateral or rotational forces other than the deceleration forces of impact, the hip may adopt a more 'favourable' position resulting in a less severe injury.

In our series the simple grade II posterior wall fractures occurred with almost equal frequency in each hip (48% right-sided). It is possible that a passenger bracing against impact may do so with both legs thereby sharing the load in both hips and reducing the forces proportionately. This may explain in part the lower incidence in passengers. If the occupant simply sustains a blow on the knee with the hip flexed such that they sustain a grade II injury then each hip is at equal risk of injury.

The more force involved in inflicting the injury, the greater the comminution and the greater the articular cartilage damage at impact

The overall risk for a comminuted fracture dislocation was much lower for passengers – about 25% of all cases as compared to drivers (60%); however, the risk for a comminuted fracture dislocation for passengers and drivers was equal. A weakness of this study is a failure to stratify the results according to the handedness (right or left) of the patients.

Although not studied here, as with other intra-articular fractures, the more force involved in inflicting the injury, the greater the comminution and the greater the articular cartilage damage at impact. Both factors have significant implications for the onset of early osteoarthrosis.

Thus any attempt at minimising such damage would have an additional long-term benefit. The prevalence of this injury in drivers should be recognised by the motor car industry in order to introduce innovations to minimise the injury as has been done with seat belts, air bags and 'crumple zones' to minimise occupant injury overall.

Conclusion

There is a significant correlation between the mechanism of injury and the type of posterior acetabular wall fracture associated with a posterior dislocation of the hip joint. The more stable extended hip requires more force to dislocate resulting in a more severe injury. Its prevalence of right-sided injury especially in drivers should alert the motor vehicle industry to introduce innovations to eliminate this problem.

The authors have taken an active role in the compilation of this article and are willing to discuss it in detail.

The authors further confirm that the article is original, that it is not under consideration by another journal, and that it has not been previously published.

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