

Pathogenesis and Prevention of Scaphoid Fractures in Motocross

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falls. The wrist is very often involved in injuries related to this sport. The main of the present study is to study the mechanism of action of scaphoid fractures in motocross and find preventive measures that can be applied to motocross athletes against scaphoid fracture. A systematic review was carried out in Pubmed and Cochrane Library Plus using the key words mentioned below as a search strategy. We then selected 13 articles, reviewed them, compiled the data and analysed it afterwards. We have found that the main trigger for scaphoid fracture is the hyperextension and hyperflexion of the wrist. A correct wrist immobilization as well as exercising the forearm muscles would lead to a better control of stabilization during the following seconds of a fall. Useful exercises include for example eccentric contraction during 12 weeks. An important aspect of prevention is always regarding the equipment. Wrist guards should always be worn as they significantly reduce the risk of injuries during a fall. A wrist guard can limit hyperextension to an extent with the help of an external stabilizer.

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Key words: Motocross; Scaphoid fracture; Scaphoid nonunion

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ABSTRACT

Motocross is a popular sport that requires both physical and mental dexterity. We have observed that 52% of the most frequent injuries in motocross affect the upper extremity. Some of these injuries are unilateral compartment syndrome in the flexors of the forearm—which requires subcutaneous fasciotomy—, bilateral osteochondritis dissecans of the elbow and, very frequently, scaphoid fracture due to

INTRODUCTION

Motocross is a physically demanding sport both physically and psychologically held in all-weather conditions and with growing popularity^[1]. Accidents within this sport usually involve a high morbidity. A study performed to 250 injured motocross riders concluded that 52% of these injuries belonged to the upper limb^[2].

Several authors have described the common injuries associated

to motocross, such as chronic compartment syndrome of the flexor muscles in the forearm requiring a subcutaneous fasciotomy^[3] or bilateral osteochondritis dissecans of the elbow^[4].

Motocross riders have usually their left arm significantly more developed and stronger, even in right-handed riders. This difference is mainly due to the use of the clutch lever and can be found both in endure and cross-country rally (such as the Dakar Rally). The wrist involvement is described particularly in riders of this type of racings, contrary to riders of road ricing or motorcycle trials, where the most common injuries are those involving the shoulder or clavicle^[5].

The purpose of the present study is to perform a systematic review of the pathogenesis of the scaphoid fracture within motocross riders, as well as reviewing the preventive methods that can be used in order to prevent further scaphoid fractures.

MATERIALS AND METHODS

A thorough research of PubMed and Cochrane was performed with the words 'Scaphoid Fracture' 'Motocross'.

RESULTS

Only one manuscript met all search criteria within the title.

56 manuscripts were found with the keyword 'motocross'. A thorough search of every abstract was performed to obtain the final 19 references used within the present manuscript.

DISCUSSION

Epidemiology

Scaphoid fracture is the most common fracture of the carpal bones, up to 60% of all wrist fractures according to some authors^[6], and the second most frequent fracture of the upper limb behind distal radius fractures.

Approximately 80% of scaphoid fractures take place in young male population, aging from 20 to 30 years old^[6].

Anatomy and vascularization

The scaphoid plays an important role within the carpal bones. 80% of the bone is covered by articular cartilage^[7]. Located in the proximal row of the carpal bones, it articulates with the radius, lunate, trapezoid, trapezium and capitate, working as mechanical link between the proximal and distal row of the carpus and constantly bearing compression and shear forces. This circumstance limits its ligamentous insertions and vascular supply.

Heinzelman *et al* described using CT scan, how the proximal pole is made from thicker and denser cancellous bone^[8]. This fact could help to explain why the majority of fractures are produced through the scaphoid waist.

Gelberman and Menon studied the peculiar vascularization of the scaphoid bone in 15 fresh cadaver specimens by injection and clearing techniques^[9]. The authors concluded that the radial artery provides the major blood supply to the scaphoid bone. Two vascular groups were described: one entering the scaphoid bone through the dorsal ridge, giving branches that supply 70-80% of the proximal pole; and a second group giving its supply from the volar radial artery branches to the region of the distal tuberosity^[9].

This particular vascular distribution determines that a fracture through the scaphoid wrist or through the proximal pole interrupts the blood supply and thus producing a high incidence of avascular necrosis and pseuarthrosis following a scaphoid fracture.

Mechanism of injury

The primary cause of scaphoid fracture is a fall on the outstretched hand with an extended, radially deviated wrist. With an increased wrist extension, the distal carpus becomes more and more unprotected, whereas the proximal carpus belongs to a relatively protected position. Due to this anatomic circumstance it can be understood that an abduction orientation of the carpus together with dorsal extension of the wrist can lead to this particular fracture.

Fryman *et al* observed in a cadavers' study how, depending on the degree of dorsal flexion of the wrist during the impact, the fracture occurred at the forearm or carpus; the more dorsal flexion of the wrist, more distal did the fracture occur^[10]. The study concluded that wrist flexion over 90° would always produce a fracture over the carpus. It was also observed that a certain degree of radial deviation increased the chance of a scaphoid fracture.

Other authors have also studied the importance of the point of impact^[11]. The scaphoid fracture appeared if the contusion was caused halfway through the palm, in a dorsally extended and radially deviated wrist^[11].

A 12-year investigation study over motocross injuries, performed with over 1,500 motocross injuries and 1,870 motocross riders, showed a ratio 5:1 between injuries to the extensor mechanism (Colles' fracture) and lesions of the flexor mechanism within distal radius (Goyrand-Smith fracture or reverse Colles')^[12]. Moreover, prevalence of scaphoid fracture was equally to Colles' fracture^[12]. Therefore, based on this study, it seems that a hyperextension could increase the probability of lesion leading to a scaphoid fracture. On the contrary, an axial force represents the mechanism of injury of distal radius fractures during fall.

Diagnosis and treatment

Clinical diagnosis is the first and foremost important diagnosis for a scaphoid fracture. The patient complains of pain and tenderness over the anatomic snuffbox, together with a compatible mechanism of injury^[13].

A radiological confirmation is always required for evaluation of a suspected scaphoid fracture. Anteroposterior (AP) and lateral radiographic views are the first imaging assessment. When facing any doubts of fracture displacement, a CT scan can be ordered. MRI can also be helpful in case the initial radiography is negative or to evaluate soft tissue injuries. In a study comparing these two imaging methods, authors found the two methods to be equivalents^[14].

As a general rule, in case the plain radiography does not find a fracture line and the patient complains of the compatible symptoms with a scaphoid fracture, it is reasonable to place a short arm cast for two weeks and reevaluate the patient after this period with new radiographic views. If the cast is not applied, the fracture could worsen over the following months.

Nondisplaced fractures of the distal pole are perfectly treated with wrist immobilization. A study comparing short arm casting and thumb spica casting showed that both were just as effective in preventing fracture displacement^[15]. Less agreement is made upon nondisplaced fracture of the proximal pole^[16]. On the other hand, displaced fractures are prone to nonunion and thus candidates to operative treatment^[16].

Davis *et al* performed a cost-utility analysis comparing costs of open surgical treatment versus conservative treatment with cast immobilization^[17]. The authors concluded that the surgical treatment with open reduction and internal fixation was cost-effective and cost saving compared to other widely accepted interventions^[17]. Maybe due to these outcomes or as a result of the improved minimally

invasive surgical techniques, an increase of surgically treated fractures has evolved^[18].

Prevention

As abovementioned, a hyperextension mechanism has an important role within mechanism of injury in scaphoid fracture. Therefore, prevention should be focused in foreseeing this movement and minimizing its consequences.

A correct wrist immobilization as well as exercising the forearm muscles would lead to a better control of stabilization during the following seconds of a fall. Useful exercises include for example eccentric contraction with a Thera-Band FlexBar. An important aspect of prevention is always regarding the equipment. Wrist guards should always be worn as they significantly reduce the risk of injuries during a fall. A wrist guard can limit hyperextension to an extent with the help of an external stabilizer^[19].

CONCLUSION

In conclusion, the main mechanism of injury of a scaphoid fracture during a motocross fall is hyperextension and hyperflexion of the wrist. Clinical suspicion is of the utmost important within this type of fracture, as plain radiography could be negative. Regarding treatment, although conservative treatment can be offered for nondisplaced fractures, surgical treatment is more often offered due to its advances. As always, prevention should be the main aim of sports physicians when advising motocross riders.

CONFLICT OF INTERESTS

There are no conflicts of interest with regard to the present study.

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