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Case Report

Post-Traumatic Acquired Clubfoot in a Basketball Player- A Case Based Kaleidoscope on its Management and Recommendation of Proper Shoes for Prevention

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Abstract

Subtalar joint dislocation also known as "acquired clubfoot", involves dislocation of the talocalcaeneal and the talonavicular joints with a normal tibiotalar joint. It constitutes 1-2% of all dislocations. Subtalar joint dislocation following basketball injury is a rare occurrence. We report a case of medial subtalar joint dislocation in a 19 year old male while playing basketball managed with prompt closed reduction with percutaneous kirschner-wire fixation and by immobilisation for 6 weeks followed by progressive weight bearing, physiotherapy and rehabilitation.

In this case report, we discuss the mechanism of injury and the treatment of subtalar dislocation. This case report highlights the use of appropriate shoes customised to the anatomy of the player's foot and demand during the game as the need of the hour to prevent such ankle injuries.

Keywords: Subtalar; Basketball; Injury; Prevention; Shoe

Introduction

Subtalar joint dislocation is a rare occurrence in orthopaedic practice and accounts for 1-2% of all dislocations [1]. Subtalar dislocation is defined as simultaneous disruption of both the talo-calcaneal and talo-navicular joints, without involvement of the calcaneo-cuboid and tibio-talar joints and without fracture of the neck of the talus [2]. In 1852, Broca described three types of subtalar joint dislocations: medial, lateral and posterior subtalar dislocations. The fourth type, anterior subtalar joint dislocation was described by Malgaigne and Burger in 1856 [3]. In medial subtalar dislocation, the talus is found laterally and in lateral subtalar dislocation, the talus is displaced medially. Medial subtalar dislocation and lateral subtalar dislocation has also been referred to as an "acquired clubfoot" and "acquired flatfoot" respectively [4]. Medial subtalar dislocation is the most commonly observed type (80%) and occurs approximately four times more frequently than lateral type (17%). Incidence of posterior and anterior dislocations is 2.5% and 1% respectively [2,5,6].

Subtalar dislocations are commonly seen among young active males and occur as a result of high-energy injury such as fall from height, sporting injuries, or road traffic accidents. Granthamand Milesreported that medial dislocations can also result from simple inversion of the foot in basketball related injuries [7,8]. According to a recent literature review of 359 subtalar dislocations, by Hoexum., *et al*, 50% to 80% were caused by a high energy and just few cases result from rather trivial injuries or during sports ("basketball foot").[9]Open injury occurs in 10-40% of all subtalar dislocations and is commonly associated with lateral dislocation. They result from high-energy injury and have poor prognosis. Osteochondral fractures were especially evident in the patients who had lateral dislocation.[4] Articular fractures of the subtalar joint and the talar dome are seen in open dislocation which often leads to osteonecrosis of the talus and osteoarthrosis of the subtalar joint [10].

Case Report

A 19 years old male presented in the casualty with pain and deformity in the right foot 7 hours following injury while playing

basketball. The injury had occurred when he landed on the ground with forced inversion of the right foot. On examination, the foot and ankle was swollen. Laceration was seen on the lateral aspect of the ankle. The head of the talus was felt prominently on the dorsolateral aspect with associated tenting of the overlying skin. The rest of the foot was displaced medially (Figure 1). The dorsalis pedis artery and the posterior tibial artery pulsations were palpable.

The diagnosis was confirmed with radiographs that showed medial subtalar dislocation of the right foot (Figure 2).

Figure 1: Clinical picture of acute medial subta lar dislocation. (a) Prominent talus with tenting and laceration of overlying skin. (b) Medial displacement of the foot in relation to the leg.

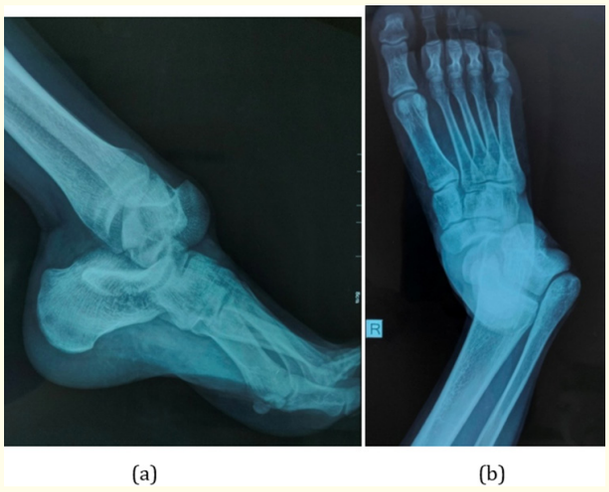

Figure 2: Radiographs showing medial subtalar dislocation of right foot. (a) Lateral view (b) Anteroposterior view.

Closed reduction was performed under spinal anaesthesia. Firm manual traction was given at the foot along with counter traction of the leg. The foot was gently everted and digital pressure was applied on the prominent head of the talus. Reduction was achieved with an audible clunk. The stability of the reduction was checked under C-arm. Some amount of subluxation was observed at the talonavicular joint. Hence, to maintain the stability of the reduction, percutaneous k-wires were passed across the talonavicular and the talocalcaneal joints with the foot slightly dorsiflexed. The foot was then immobilised using a short leg plaster slab and the limb was elevated. Post reduction radiographs (Figure 3) and computed tomography (Figure 4) was done to confirm the reduction and presence of any ostochondral fracture was ruled out. Immobilisation was done for 3 weeks followed by k-wire removal. The patient was given an ankle brace and ankle range of movement exercises was started. Patient was allowed progressive weight bearing after 3 weeks.

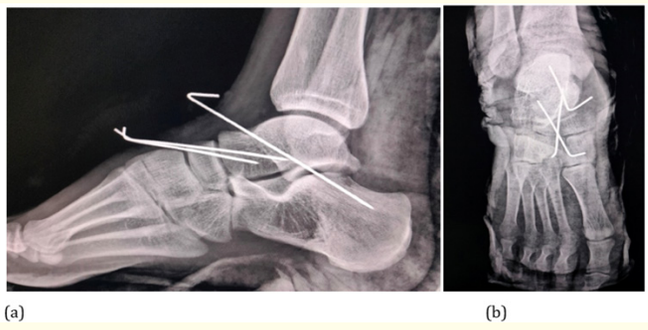

Figure 3: Post reduction radiograph of subtalar dislocation with K-wires in situ (a) Lateral view (b) Anteroposterior view.

Figure 4: CT image of reduced subtalar dislocation.

Discussion

31.2% of basketball injuries occur while taking a rebound and can also due to fall back on the floor [11]. Landing on both feet after a rebound loads each leg with forces that can exceed five times a player's body weight which explain the high number of rebounding injuries. In addition, it may cause inversion stress if the athlete lands on the lateral aspect of one foot [12].

Mechanism of injury

The talo-calcaneal and the talo-navicular joints act as hinge, transmitting load and movement between the ankle and the foot. In the plantigrade position under load, the calcaneus is pronated and abducted; there is maximum contact and an almost congruous fit between the articular surfaces of the talo-calcaneo-navicular complex with the maximum supporting ligamentous tension [13-15]. When the foot is plantarflexed and supinated, the calcaneus is flexed, supinated and adducted and the sustentaculum tali moves towards the posteromedial tubercle of the talus. In this position, the acetabulum pedis offers less containing capacity to the head of the talus with less supportive ligamentous tension. Subtalar dislocation can occur with relatively minor injury, such as a simple inversion sprain of the foot injuries in this position. The posterior part of the talus is pressed against the sustentaculum tali, which acts as a fulcrum. The force acting on the ankle during rebound induces rotatory subluxation and subsequent dislocation of the talonavicular joint and talocalcaneal joint. This explains the absence of associated fractures [12,15,16]. During forced eversion or inversion, the strong calcaneonavicular ligament resists disruption and the force is dissipated through the weaker talonavicular and talocalcaneal ligaments and allowing either medial or lateral displacement of the calcaneus, navicular, and all distal bones of the foot as a unit [17,18].

Treatment

Prompt and gentle reduction of the subtalar dislocation under anaesthesia is the first line of treatment. The technique for closed reduction of a medial subtalar dislocation involves flexing of the knee to relieve the deforming force of the gastrocnemius, and firmly grasping the foot while an assistant applies countertraction to the thigh. The traction through the heel with the foot plantarflexed disengages the dislocation. Application of gentle pressure over the talonavicular joint will re-engage the head of the talus in the navicular. The foot should then be dorsiflexed to neutral and everted or pronated [19]. Closed reduction is usually accompanied by a clunk as the joint reduces. The adequacy of reduction is demonstrated by the normal alignment of the foot and a normal, stable range of motion of the subtalar and midtarsal joints. Radiographs and CT scan should be done to confirm the reduction and should be inspected closely for small osteochondral fractures that might have been missed on the initial radiographs of the distorted foot. All open injuries must be thoroughly debrided at the time of reduction, and the wound should be left open, with delayed primary closure anticipated in 3 to 5 days [4].

However, in 10% of medial subtalar dislocations and in 15-20% of lateral dislocations, closed reduction cannot be achieved.[18]This unsuccessful reduction was attributed to interposition of tibialis posterior tendon in lateral subtalar dislocation, or bony blocks like an impaction fracture of the talar head in medial subtalar dislocation. Open reduction is indicated in such cases.

The optimal period of immobilisation following reduction still remains controversial. De Lee and Curtis stated that more than 3 weeks immobilisation gives poor outcome [5]. Zimmer and Johnson, however, stated that a minimum of 4 weeks of immobilisation is appropriate in older patients without associated fractures, and with low activity demands.[2]Heppenstall found that up to 80% of patients developed significant limitation of subtalar movement, with 30% developing severe arthritis following 6 weeks of immobilisation [18]. Buckingham found that most patients immobilised for 6 weeks developed limitation of movement [20]. Perugia., *et al.* recommended 4 weeks of immobilisation in cases with no associated fractures and an early and aggressive rehabilitation programme is essential to prevent joint fibrosis and to regain movement of the subtalar and midtarsal joints [1].

Our patient had a closed medial subtalar dislocation following landing on a plantarflexed and inverted foot while playing basketball. Prompt closed reduction was achieved under spinal anaesthesia and stability was assured by passing k-wires through the talonavicular and talocalcaneal joint. The wires were removed after 3weeks of immobilisation. Vigorous rehabilitation with range of movement exercise was given and progressive weight bearing was allowed.

Medial subtalar dislocations have a better prognosis than lateral dislocations. Prompt and early reduction gives excellent outcome. Open subtalar dislocations and closed dislocations with associated osseous and cartilaginous injuries have a poor prognosis.

Prevention

Basket ball is a fast paced game with a lot of lateral and sideways movement of the foot. The players need to jump and land on hard surfaces and should be able to grab rebounds and score points. Understanding the factors that cause injuries by excessive inversion including the anatomy of the player's foot (which can place him or her at higher risk) and the athlete's level of conditioning (including

strength and quickness training) can help prevent such injuries. Gait analysis and 3D foot mapping can be done to understand the pronation type and help find the appropriate shoe.

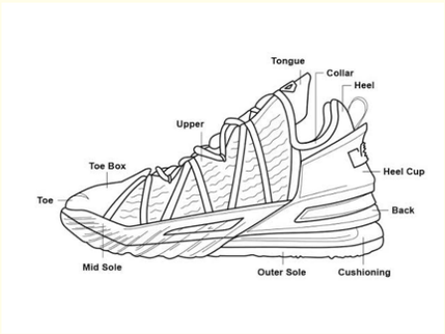

Figure 5: Parts of a basketball shoe.

Under pronators need a lot of cushioning to avoid impact injuries. Flexible shoes with adequate mid sole cushioning will help evenly distribute the forces of impact. Neutral pronators need neutral cushioned shoes that promote natural foot motion. In overpronators, maximum support, structured cushioning and stability is needed. Medial post support and firm mid soles for arch support are required.

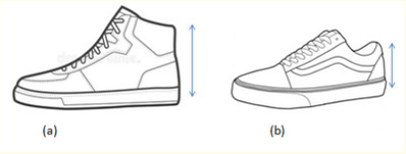

Figure 6: (a) High top shoe (b) Low top shoe.

Subtalar dislocations areuncommon among competitive basketball players because they wear high-topshoes and play on an energy absorbing surface. However, wearing low-topshoes and playing on cement or blacktop may place recreational players at a relatively higher risk of this injury [12]. A study investigating preliminary design criteria for basketball shoes noted that cushioning in both forefoot and rear foot should be of prime consideration because of the high vertical loads associated with rebounding. It was noted that shoe design must provide protection for the considerable amount of lateral movement involved in the game [21]. Stacoff., *et al*. found that high-top basketball shoes provided greater lateral stability than low-top shoes, and helped reduce supination. High-top shoes provide proprioceptive warning signals in addition to direct mechanical support which results in better muscle coordination [22]. Low top shoes provide minimum stability and can be dangerous for the feet in fast paced games.

A systematic review in 2019 summarised that: 1) better shoe cushioning or softer midsole is related to better impact attenuation in the passive/unanticipated situations; 2) high-shoe collars are effective in improving ankle stability in jumping and cutting tasks; 3) increased shoe traction and forefoot bending stiffness can improve basketball jump, sprint, and/or cut performances, and; 4) lighter shoe mass results in better jump and/or cut performances when the shoe mass is being aware of [23].

Basketball players need shoes that provide ankle support, shock absorption and stability without hindering movement. Recreational basketball players should avoid the use of low collar shoes and should prefer use of high top shoes that provide better stability to prevent injury to the ankle.

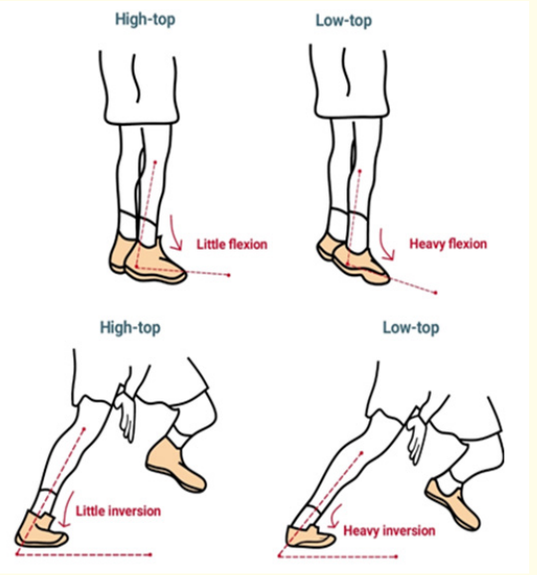

Figure 7: High top shoes give more stability than low top shoes by decreasing the plantarflexion and inversion of the foot.

Conclusion

Limited literature is available on subtalar dislocation in basketball players. We have concluded that early diagnosis, prompt reduction and rehabilitation are necessary for a good outcome following subtalar dislocation. Hence, it is imperative for the physician to be aware and to be able to recognize such an injury in a basket ballplayer. Early prompt treatment can save the injured athlete from losing their career. Restoring back the foot biomechanics back to preinjury state requires understanding the anatomy of the athlete's foot and its biomechanics. In order to prevent such ankle injuries, preventive measures individualised to each athlete including the use of appropriate customised shoes should be adopted. In this case

report we have recommended the use of well cushioned, high collar shoes for both professional and recreational basketball players.

Conflict of Interest

None.

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