Journal of Applied Sports Science
March 2015, Volume 5, No. 1

Common Injuries among Male Field Hockey Players According to Playing Positions.

Mohamed Ahmed Mahmoud Ali Ali Badr
Department of Sports Training, Faculty of sports education - Damietta University, Egypt.

Ahmed Mohamed Ahmed Gaballah
Department of Sports Health Sciences, Faculty of sports education - Damietta University, Egypt.

Abstract

The purpose of this study was to examine injury patterns of Egyptian field hockey players and broaden the current base of knowledge by identifying the injury rates among different positions.

Using interviews 75 players from eight teams were surveyed. The participating players played in the Egyptian field hockey league and were professional players. The players were categorized according their playing positions as 8 goalkeepers, 26 defenders, 24 midfielders and 17 strikers. The interview contained questions about observed and experienced injuries, cause of injuries, type of injuries and region of occurrence. Descriptive statistics were derived using SPSS (19) and statistics used frequency method to determine the percentage of all collected data .

The most body region exposed to injury is the pelvic and thigh region with 21% of the total injuries, the common injuries to hockey players in upper limb is low back pain and in lower limb is cramps of posterior thigh muscles. The goalkeepers were the lowest level of injuries in current study, then come defenders and midfielders. The stickers was relatively near percentage to midfielders. The most conclusion in current study was, an attention to adequate warming up and muscles stretching during training and prior matches are vital..

Introduction:

The game of field hockey is the world's second most played team sport after soccer and is played in 132 countries around the world. There are two opposing teams playing outdoors on grass or an artificial surface, which each consist of eleven players (Sherker & Cassell, 2002).

Over the last 20 years hockey has developed into a fast paced game that requires sprinting within restricted areas of play with rapid stop-start actions and sudden changes in direction. All these actions place considerable strain on the joints of the lower limbs (Naicker et al., 2007). The reason that hockey has developed into such a fast paced game is mainly due to the introduction of artificial playing surfaces, new hockey stick technology and new rules that have been introduced over the last 20 years (Lemmink et al., 2004).

Although field hockey is classified as a non-contact sport, the high velocity of both ball and stick, and the relative lack of protective equipment (except goalkeepers), all contribute to the inherent dangers of participation in the field hockey. Rule, surface and equipment modifications, outdoor and indoor seasons, better skilled and trained players; have all, in effect, increased the tempo in all forms of the hockey game and so changed the types and incidences of injuries in the field hockey.

(Dick et al., 2007) conducted a study that aimed to describe the epidemiology of hockey injuries and reported that, the overall injury rate for games was 7.87 percent for the full length of the study. In addition, the most frequently occurring injuries from this study were lower leg injuries which accounted for 43% of injuries occurring during matches and 60% occurring during practices, which is a concerning fact. The study of (Murtaugh, 2001) reported that, the most frequently injured site of the body was the lower limb (51%), followed by the head/face (34%), upper limb (14%), and torso (1%). The most prevalent types of injuries were ankle sprains, followed by hand fractures and head / face injuries.

The position that a hockey player holds may also affect the type and frequency of injury as different playing positions require the utilization of different tactics and techniques. For example, a goalie has to face the shots that are targeted at the goal, while midfield players have to run continuously, placing higher demands on their legs (Dick et al., 2007). In addition, (Dick et al., 2007) discovered that the percentage of injuries that were occurring according to 3 position affected mostly defenders (24%) and midfielders (28%), who had the highest weighted proportion of all injuries.

There is a need to be aware of the occurrence and type of injuries, in order to provide appropriate treatment and management. This becomes increasingly important in elite athletes where the pressure to perform and to be at ones physical best is vital. The extent and nature of the injury problem needs to be clearly identified before effective measures or programmes aimed at preventing injury can be initiated.

The purpose of this study was to examine injury patterns of Egyptian field hockey players and broaden the current base of knowledge by identifying the injury rates among different positions. An understanding of these patterns is crucial for developing conditioning and training programs that could be useful for injury prevention. This information could also be used to address the potential need for rule changes or additional protective equipment.

Martials and methods

Using interviews 75 players from eight teams were surveyed. The participating players played in the Egyptian field hockey league and were professional players. The players were categorized according their playing positions as 8 goalkeepers, 26 defenders, 24 midfielders and 17 strikers. All descriptive data of age, height, weight, body mass index and training experience were outlined in (Table. 1). The interview contained questions about observed and experienced injuries, cause of injuries, type of injuries and region of occurrence. The questionnaire had already been used in previous studies (Dick et al., 2007; Merrett & McLaughlin, 2003; Murtaugh, 2001; Sherker & Cassell, 2002) and published in the website of international field hockey federation (www.fih.ch/en/sport/medical).

The investigator went through the questionnaire with each of the participants separately in order to avoid similar answers, the duration of collected data was between 15. 12. 2013 to 15. 1. 2014. The age, team and league status of each interviewee were recorded. The interviews took place mainly at team clubs.

Table 1
Descriptive data of subjects (values are mean ± SD).

Positions	Nr	Age (year)	Height (m)	Weight (kg)	BMI (kg/m2)	TE (year)
Goalkeepers	8	24.88 ± 5.64	1.80 ± 0.41	80.18 ± 3.91	24.75 ± 0.97	14.50 ± 6.05
Defenders	26	25.30 ± 5.54	1.84 ± 0.64	81.27 ± 5.88	23.92 ± 1.25	15.46 ± 4.47
Midfielders	24	27.21 ± 4.73	1.80 ± 0.63	77.85 ± 5.77	23.10 ± 1.56	14.92 ± 4.15
Strikers	17	23.88 ± 4.03	1.78 ± 0.82	79.30 ± 7.77	24.95 ± 2.08	12.53 ± 3.86
Total	75	25.55 ± 5.04	1.81 ± 0.69	79.61 ± 6.21	24.27 ± 1.58	14.52 ± 4.48
Nr = number of player and TE = training experience						

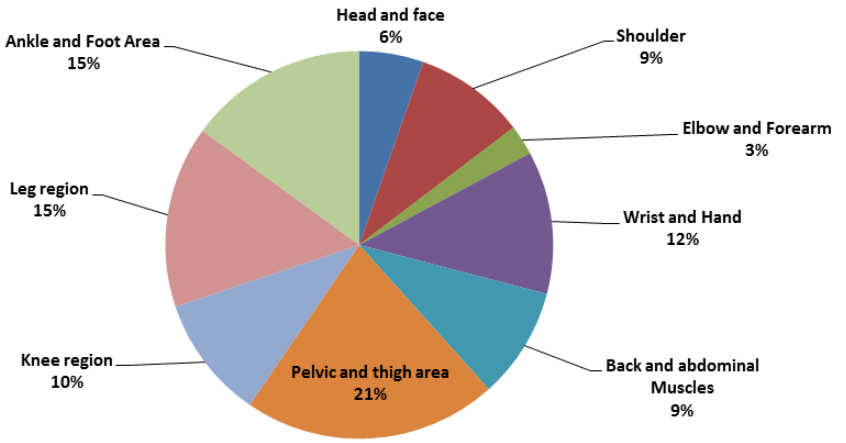
The body regions and injuries, which selected in current study according to the survey in previous studies were identified as head and face, shoulder region, elbow and forearm, back and abdominal muscles, pelvic and thigh area, knee region, leg region, ankle and foot region. Statistical evaluation was performed using the aspects of the playing position and region of occurrence. Descriptive statistics were derived using SPSS (19) and statistics used frequency method to determine the percentage of all collected data.

Results and Discussions

The results of (Figure 1) demonstrate that, the largest percentage occurrence injury was in pelvic and thigh region and occurred 21%. This finding result could be explained by the large proportion to the presence of a large number of muscles and the length of the femur. The leg and ankle and foot regions were similar percentage 15% of occurrence injury, and could be explained by a direct collision of the ball and stick. Wrist and hand reported only 12% and it could be caused by didn't worn the gloves.

The results demonstrate also 10% for knee region, which could be explained by the sudden change directions during play, and leads to knee ligament and meniscus injuries. The back and abdominal muscles and shoulder regions were similar percentage of 9% of occurrence injury, while head and face and elbow and forearm were 6% and 3%, respectively. This findings could be explained by the poor focus on muscle strength training and physical exercises during warm-up time to these regions, and about head and face may be caused by the sudden contact with other opponents or collision of the ball in the face.

Figure. 1:
Anatomical site of injuries to male field hockey players that occurred during a field hockey game or practice

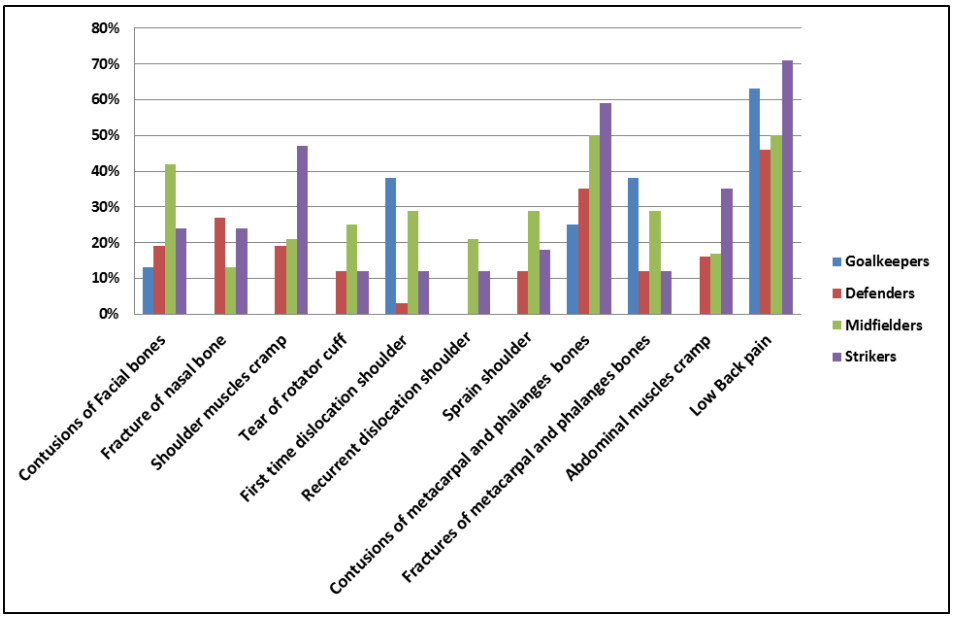


The results of the percentage occurrence injury in current study relatively consisted with previous study by (Sherker & Cassell, 2002), who suggested that, the most common body site that was injured was the upper limb 31.7% and lower limb 12.7%. While, the results of current study and (Sherker & Cassell, 2002) results were conflicted with the results of (Murtaugh, 2001) who reported for lower limb 51% and upper limb 14%. In overview, the higher percentage results by (Murtaugh, 2001) may be due to the different participants, whose were females. Furthermore an accurate comparison cannot be made due to the differentiating incidence rate units utilized.

The results of the percentage occurrence injury in current study conflicted also with study of (Dick et al., 2007), this difference due to the differ between level of players. (Dick et al., 2007) reported that, the participants had a six times higher risk of sustaining a concussion during a match than a practice. It can be said that, the difference in the rate of injuries in large and the lower levels of club hockey seem to be more vulnerable to injuries. This explanation consisted with study of (Stevenson et al., 2000), who revealed that hockey players participating at a non-professional or at a first class level had an incidence of injury of 15.2 injuries per 1000 hours of participation.

The rate of upper limb injuries results in current study according to player positions was outlined in (Figure. 2) and demonstrate that, the percentage of low back pain was the most frequent injury in upper limb by field hockey players. The low Back pain occurred 71% for strikers, 63% goalkeepers, 50% midfielders and 46% defenders. This results could be explained by the mechanism of field hockey sport, which requires flexion of the trunk for extended periods of time. This mechanism could be caused by the constant and repeated contraction of the abdominal muscles and led to occurrence abdominal muscles camp about 35% for strikers, 17% midfielders, 16% defenders and 0% goalkeepers. The reason for the midfielders receiving back pain was described as them having to spend a longer duration at a higher physical intensity with a higher percentage of time spent dribbling the ball.

Figure. 2:
Rate of upper limb injuries according to the site of injury and player positions



In overview, it's not surprising about the low back pain as a reason of the demands field hockey sport nature. The current study finding also consisted with study of (Walker, 2011) who reported that, the injury types which prevalent of hockey teams during the season were contusions 33%, strains 22%, sprains 17%, tears 11%, lacerations 6%, dislocations 6% and scratches 6%, and cleared no differences with previous studies in same direction. About low back pain explanations of current study, (Kjaer, 2003) suggested that, the flexion and torsional sports such as weight lifters, golf and racquet sports are more predisposed to disc disorders and low back pain.

The results of (Figure. 2) also showed that, the injuries of shoulder region was occurred frequently at the upper limb, which appears shoulder muscles cramp injury of 47% for strikers, 21% midfielders, 19% defenders, 0 % goalkeepers. This finding could be explained by the occurrence of this injury for strikers, midfielders and defenders as a reason by the fatigue when player's continuous passing and shooting the ball to multidirectional areas during match play.

The first time dislocation shoulder occurred 38% for goalkeepers, 29% midfielders, 12% strikers, 3% defenders, while the recurrent dislocation shoulder occurred 21% for midfielders, 12% strikers, 0% defenders, 0% goalkeepers. The dislocation shoulder injury occurred for goalkeepers as a reason by the stiffness of some skills such as aerial stick save. However, occurred to midfielders as a most players passed under pressure, touch the ball and friction with opponent and have a large number of offensive and defensive duties. For example, during the pass and receive low and high balls. In addition, sprain shoulder by the midfielders more than rest players as occurred of 29% for midfielders, 18% strikers, 12% defenders and 0% goalkeepers.

In overview, the current explanations confirmed (Hardy et al., 2010) who referred to a good association between shoulder injuries and field sports such as rugby, and cleared that direct force to the shoulder in a violent collision between players. For example, may cause the head of the humerus (upper arm bone) to pull free of the shoulder socket, in the case of dislocation, or to pull partially free, in the case of subluxation.

The current study reported injury occurrence for tear of rotator cuff about 25% for midfielders, 12% strikers, 12% defenders, 0% Goalkeepers. This results could be explained by the poor special stretching during warm-up for shoulder muscles and rotator cuff muscles, exercises such as pendulum, crossover arm stretch and passive internal and external rotation can support field hockey players to avoid this type of injury. This result consisted with (Donatelli, 2011) who suggested that, the etiology of rotator cuff pathologic conditions can be described along a continuum, ranging at one end from overuse microtraumatic tendinosis to macrotraumatic full thickness rotator cuff tears.

The third most frequent injury of upper limb in hockey players was the fractures and contusions of bones injuries. The contusions of metacarpal and phalanges bones

occurred 59% for Strikers, 50% Midfielders, 35% Defenders, 25% Goalkeepers, however the fractures of metacarpal and phalanges bones occurred 38% for Goalkeepers, 29% Midfielders, 12% Defenders, 12% Strikers. This finding could be explained by the collision of the ball and the stick of opponent player, while another player didn't worn the gloves.

This explanation consisted with study of (Dick et al., 2007) who reported 10% of all types of injuries was hand injuries and of these hand injuries the majority were caused by stick contact. In addition, (Livingston & Forbes, 2003) researched a stick entrapment of the thumb in lacrosse. They stated that in sports using stick-like implements players commonly receive acute injuries to the hand and fingers from a forceful blow by an opponent's stick. (Livingston & Forbes, 2003) further report in the case study that the injury occurred to a female and gloves are not worn by females in lacrosse, whereas males wear heavily padded gloves. The use of gloves in hockey is underutilized.

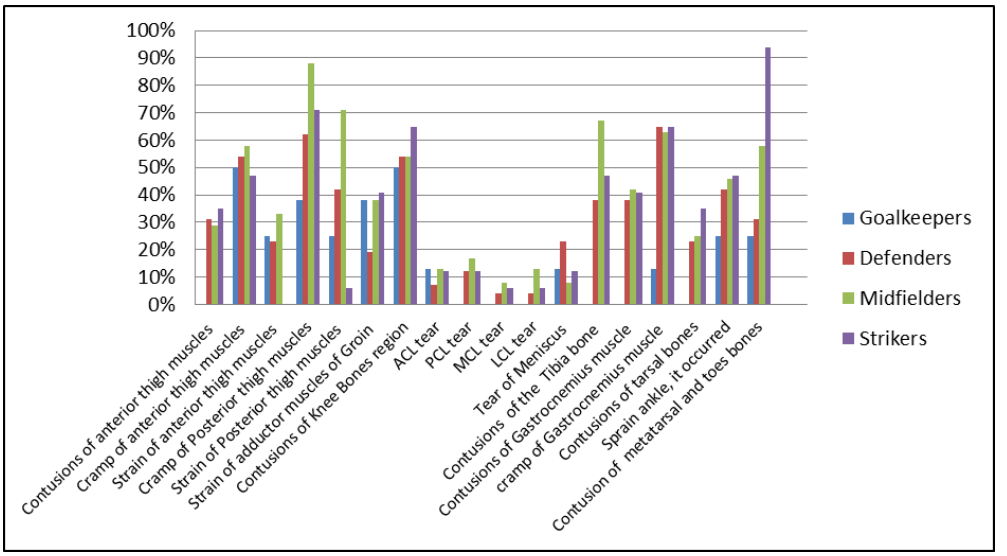
The current study reported percentage occurrence injuries in the contusions of facial bones of 42% for midfielders, 24% strikers, 19% defenders, 13% goalkeepers, and for the fracture of nasal bone injury 27% for defenders, 24% strikers, 13% midfielders and 0 % goalkeepers. The fractures and contusions of facial bones injuries occurred for hockey players as a reason of friction between the players and the collision of the ball and stick with face, however goalkeepers reported 0 %, who wear a secured protective equipment's. On other hand, the percentage of ball and stick injuries indicates that the usage of preventative safety equipment for the face and groin is imperative and is supported by an injury which occurred to a participants face from a stick.

In overview, it could be said that, the position that a hockey player holds may also affect the type and frequency of injury as different playing positions require the utilization of different tactics and techniques. For example, a goalie has to face the shots that are targeted at the goal, while midfield players have to run continuously and placing higher demands on their legs.

The results of (Figure. 3) demonstrate that, the percentage of cramp or spasm of muscles was the most frequent injury in lower limb for hockey players. The cramp of posterior thigh muscles occurred about 88% for Midfielders, 71% Strikers, 62% Defenders, 38% Goalkeepers. While the cramp of anterior thigh muscles occurred about 58% for Midfielders, 54% Defenders, 50% Strikers, 47% Goalkeepers and the cramp of gastrocnemius muscle occurred about 65% for Strikers, 65% Defenders, 63% Midfielders, 13% Goalkeepers.

Figure. 3:

Rate of lower limb injuries according to the site of injury and player positions



The results of (Figure. 3) consisted relatively with study of (Dick et al., 2007) who reported that, the most common types of injuries in matches were; ankle ligament sprains 13.7%, knee internal derangement injuries 10.2%, concussions 9.4%, upper leg muscle strain 7.0%, and finger fractures 6.5%. In practices, upper leg muscle strains were reported to account for 26.9% of all the injuries, this was followed by ankle ligament sprains 15.0%, pelvis-hip muscle strains 9.9% and knee internal derangements 7.8%. Furthermore study of (Dick et al.,

2007) reported that participants had a six times higher risk of sustaining a concussion during a match than a practice.

The results of cramp muscles injury could be explained by the overload training and muscular stress during continues competition matches. Also the artificial surface of play need more physical demands, which reflect a high stress on muscles during a sprinting or sudden change direction. This explanation consisted with (Reilly & Borrie, 1992) who suggested that, the natural grass surfaces are believed to provide a greater cushioning effect and cause less strain to the lower limbs by absorbing 10% more energy on impact than artificial turf.

This explanation consisted with (Walker, 2006) who suggested that, there are a number of factors that contribute to muscle and cramps, the main ones being, a poor flexibility and tight muscles.

The results of (Figure. 3) also demonstrate that, the second most frequent injury in at lower limb was strain of muscles (tear of muscles), the strain of posterior thigh muscles occurred 71% for midfielders, 42% defenders, 25% goalkeepers, 6% strikers. While the strain of anterior thigh muscles occurred 33% for midfielders, 25% goalkeepers, 23% defenders, 0% strikers. In addition, the strain of adductor muscles of groin was 41% for strikers, 38% midfielders, 38% goalkeepers, 19% defenders.

The results of current study consisted with findings of (Murtaugh, 2001; Sherker & Cassell, 2002) who reported 16% and 11% of lower limb injuries was muscle strains of the calf and hamstring. The reason for this has been described as a decrease in length of the hamstring muscles which is a result of a muscle and connective tissue shortening adaptation (Hopper et al., 2005). Another study of (Merrett & McLaughlin, 2003) reported findings that supported (Dick et al., 2007) and (Sherker & Cassell, 2002) review, which were a higher frequency 80% of hockey injuries to the lower extremity limb.

It is evident of (Figure. 3) results, which demonstrate that the midfielders were the most exposed to strain groin muscles injury as a reason of the tactical duties between defense and attack and sprinting. While strikers exposed to strain adductor muscles of groin as a reason of sudden change direction, dodge the ball and make a trickery for defenders. The main factor that contribute to strain groin muscles is inadequate warm-up and lack stretching. In addition, midfielders spend the most time in long area between defender and striker lines, where the number of tackles and the intensity of play is increased. In fact, up to 20% of field hockey injuries have been attributed to tackling. It is possible that the high percentage of midfielder's player was due to greater fatigue or the type of defence that midfielders tend to use during play.

In addition, the results of (Figure. 3) demonstrate that, the third most frequent injury at lower limb was contusion injury, whether it was in the bones or muscles. The highest rates of contusion bones occurred in metatarsal and toes was bones 94% for strikers, 58% midfielders, 31% defenders, 25% goalkeepers. The contusions of knee bones region was 65% for strikers, 54% midfielders, 54% defenders, 50% goalkeepers. The contusions of tibia bone was 67% for midfielders, 47% strikers, 38% defenders, 0% goalkeepers) and the contusions of tarsal bones was 35% for strikers, 25% midfielders, 23% defenders, 0 % goalkeepers.

Occurrence of contusions bones injury of strikers and midfielders could be explained by the jostle with defenders to get the ball to score goals and the collision of the ball and defenders stick. Goalkeepers were the lowest rate of contusions bones injury, may be due to the worn a lot of equipment to protective themselves from injury such as leg protection pads. This equipment was observed in occurrence of contusions of knee bones region at a high rate compared to other injuries, may be goalkeeper skills protect the goal such as double-leg stack slide, aerial stick save and exposed to the collision of land. This explanation consisted with (Elizabeth, 2008) who referred to execute the double leg stack and confirmed that, a goalkeeper who tackle stack should be executed or closer, which depending on his ability to establish a playing distance and pressure the ball.

Contusions muscles injuries occurred in anterior thigh muscles was 35% for strikers, 31% defenders, 29% midfielders, 0% goalkeepers and gastrocnemius muscle was 42% for midfielders, 41% strikers, 38% defenders, 0% goalkeepers. The result of contusions muscle injuries could be explained for strikers by the time that they spend around the goal where there is an increase of tackles on the forwards and a high intensity to score a goal, which supports the highest percentage for forwards 41% in current study. Also midfielders who spend more time high activities of passing and shooting, however goalkeeper showed lowest percentage due to his safe utilities such as facemask, throat guard, chest protector, mouthguard, large thigh pads, extrathick shin guards and large gloves. This explanation consisted with (Andrews et al., 2004) who confirmed that, the muscular contusion is caused by a traumatic force that damages the injured region's musculature. The damage to the region's capillaries leads to a collection of blood that, depending on its severity, may cause pain.

Also, the results of (Figure. 3) demonstrate that, the fourth most frequent injury at lower limb was the sprain ankle, which occurred 47% for strikers, 46% midfielders, 42% defenders, 25 % goalkeepers. In fact, more literatures confirmed this result, (Jelinek & Porter, 2009; Lin et al., 2010) reported percentage 10% to 30% of sport injuries for sprain ankle.

The sprain ankle injury in current study could be explained by two reasons, the first one is the footwear which linked with important proprioceptive functions in foot and the second reason is the water-based artificial surfaces, which occurred a poor traction and a loss of foot support. In addition, the poor balance training exercises could be a reason for sprain ankle injury.

The results of (Figure. 3) reported that, the common injury in lower limb was knee joint injuries. Tear of medial collateral ligament (MCL) occurred 8% for midfielders, 6% strikers, 4% defenders, 0 % goalkeepers. Tear of lateral collateral ligament (LCL) occurred 13% for Midfielders, 6% Strikers, 4% Defenders, 0 % Goalkeepers. Tear of posterior cruciate ligament (PCL) occurred 17% for Midfielders, 12% Strikers, 12% Defenders, 0 % Goalkeepers. The occurrence of knee joint ligaments injuries with a high rate of midfielders could be explained by the lot of multi change directions movements during match play, which exposes them to friction with the opponent players. In addition, sudden stops and the nature of the field hockey mechanism achievement reflect those percentage of knee joint injuries.

Tear of anterior cruciate ligament (ACL) was 13% for Midfielders, 13 % Goalkeepers, 12% Strikers, 7% Defenders. The high rate of goalkeepers compared with other knee ligaments injuries as a reason of goalkeeper demands while repelling the balls, and didn't flex the knee joint from backward to forward and inferiorly. This achievement also similar to mechanism of anterior cruciate ligament injury. The results consisted with studies of (Boden et al., 2000; O'Connor, 2005) who confirmed that, the mechanism of anterior cruciate ligament classified as sudden deceleration prior to a change direction or landing motion, while contact injuries occurred as a reason of valgus collapse of the knee.

The last injury in knee joint was tear of meniscus, which occurred 23% for Defenders, 13 % Goalkeepers, 12% Strikers, 8% Midfielders. The tear of meniscus injury occurrence of defenders, could explained by the position role of defenders which lead them often to pivot on the foot toes to confront dodgers of attackers. In fact, the sudden change of direction occurred the meniscus tear injury mostly. The results consisted with (Hardy et al., 2010) who cleared the reason of meniscus, and refer that, the meniscus commonly associated with sports such basketball and football, and usually could be a reason of forceful and twisting of the leg, when the football is planted on the ground and the knee is flexed.

Conclusions

The most body region exposed to injury is the pelvic and thigh region with 21% of the total injuries, the common injuries to hockey players in upper limb is low back pain and in lower limb is cramps of posterior thigh muscles. The most frequently injuries to goalkeepers in upper limb is low back pain 63%, first time dislocation shoulder with 38% and fractures of metacarpal and phalanges bones with 38%. In lower limb is cramp of anterior thigh muscles with 50%, contusions of knee bones region with 50% and strain of adductor muscles of groin. The most common injuries to defenders in upper limb is low back pain 46%, contusions of metacarpal and phalanges bones 35% and fracture of nasal bone 27%. In lower limb is cramp of gastrocnemius muscle, cramp of posterior thigh muscles with 62%, cramp of anterior thigh muscles with 54%. Most common injuries to midfielders in upper limb is low back pain 50%, contusions of metacarpal and phalanges bones 50%, contusions of facial bones 24%, first time dislocation shoulder 29% and sprain shoulder 29%. In lower limb is cramp of posterior thigh muscles with 88%, strain of posterior thigh muscles with 71% and contusions of the tibia bone 67%. Most common injuries to strikers in upper limb is low back pain 71%, contusions of metacarpal and phalanges bones 59%, cramps of shoulder muscles 47%. In lower limb is contusion of metatarsal and toes bones 94%, cramp of posterior thigh muscles with 71%, cramp of gastrocnemius muscle 65%.

Recommendations

An attention to adequate warming up and muscles stretching during training and prior matches are vital. The special prevention programs are important to reduce the dislocation shoulder injuries for goalkeepers and midfielders. It must be taken in consideration that, the security and safety procedures during training are important and the attention to protective tools to reduce injuries. The agility training is important for defenders and midfielders for avoid injuries, such as sprain ankle, tear of ligaments and meniscus of the knee joint. Muscle strength training for lower limb attacker players is vital to avoid injuries during high speeds and sudden stops. Neuromuscular and balance training programs may reduce the risk of ankle injury. The correct choice of footwear is important in the prevention of overuse type running injuries. Hockey players with a history of ankle sprains should partake in conditioning programs which include balance training exercises.

References

1. Andrews, J. R., Harrelson, G. L., & Wilk, K. E. (2004). Physical rehabilitation of the injured athlete (3 ed.). Philadelphia, Pa. ; London: Saunders.
2. Boden, B. P., Dean, G. S., Feagin, J. A., Jr., & Garrett, W. E., Jr. (2000). Mechanisms of anterior cruciate ligament injury. Orthopedics, 23(6), 573-578.
3. Dick, R., Hootman, J. M., Agel, J., Vela, L., Marshall, S. W., & Messina, R. (2007). Descriptive epidemiology of collegiate women's field hockey injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 through 2002-2003. J Athl Train, 42(2), 211-220.
4. Donatelli, R. (2011). Physical therapy of the shoulder (5 ed.). Edinburgh: Churchill Livingstone.
5. Elizabeth, A. (2008). Filed hockey steps to success (2 ed.). USA: Human Kinetics Publishers.
6. Hardy, M., Summers, D., Edwards, J., & Munro, N. (2010). The BMA guide to sports injuries. United Kingdom: Dorling Kindersley.
7. Hopper, D., Conneely, M., Chromiak, F., Canini, E., Berggren, J., & Briffa, K. (2005). Evaluation of the effect of two massage techniques on hamstring muscle length in competitive female hockey players. Physical Therapy in Sports Med, 6(3), 137-145.
8. Jelinek, J. A., & Porter, D. A. (2009). Management of unstable ankle fractures and syndesmosis injuries in athletes. Foot Ankle Clin, 14(2), 277-298.
9. Kjaer, M. (2003). Textbook of sports medicine : basic science and clinical aspects of sports injury and physical activity. Oxford: Blackwell Science.
10. Lemmink, K. A., Elferink-Gemser, M. T., & Visscher, C. (2004). Evaluation of the reliability of two field hockey specific sprint and dribble tests in young field hockey players. Br J Sports Med, 38(2), 138-142.
11. Lin, C. W., Hiller, C. E., & de Bie, R. A. (2010). Evidence-based treatment for ankle injuries: a clinical perspective. J Man Manip Ther, 18(1), 22-28.
12. Livingston, L. A., & Forbes, S. L. (2003). Lacrosse stick entrapment injury to the thumb. Br J Sports Med, 37(3), 272-273.
13. Merrett, A., & McLaughlin, P. (2003). Positional Related Injury in Elite Female Field Hockey Players. (Master), Victoria University.
14. Murtaugh, k. (2001). Injury patterns among female field hockey players. Med Sd Sports Exerc, 33, 201-207.
15. Naicker, M., McLean, M., Esterhuizen, T. M., & Peters-Futre, E. M. (2007). Poor peak dorsiflexor torque associated with incidence of ankle injury in elite field female hockey players. J Sci Med Sport, 10(6), 363-371.
16. O'Connor, F. G. (2005). Sports medicine : just the facts. New York ; London: McGraw-Hill Medical Pub. Division.
17. Reilly, T., & Borrie, A. (1992). Physiology applied to field hockey. Sports Med, 14(1), 10-26.
18. Sherker, S., & Cassell, E. (2002). A review of field hockey injuries and countermeasures for prevention. Report 143: Monash University Accident Research Centre.
19. Stevenson, M. R., Hamer, P., Finch, C. F., Elliot, B., & Kresnow, M. (2000). Sport, age, and sex specific incidence of sports injuries in Western Australia. Br J Sports Med, 34(3), 188-194.
20. Walker, R. (2006). The meaning of sports injury and re-injury anxiety assessment and intervention. (Ph.D.), Aberystwyth University.
21. Walker, R. (2011). Incidence and mechanism of injury occurring over one season among primer and president league hockey teams of the Nelson Mandela metropolitan university. (Master), Nelson Mandela metropolitan university, South Africa.