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Prevalence of Functional Ankle Instability and Its Association with risk factors In Basketball Players of Punjab

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Abstract

Background: Ankle injuries are the most common injuries in the game of basketball with high rate of recurrence owing to development of subsequent functional ankle instability (FAI). The prevalence of Functional Ankle Instability following ankle sprain in Indian basketball players is not reported.

Objective: The aim of this study was to determine the Prevalence of FAI and examine its Association with extrinsic and intrinsic risk factors in Basketball Players of Punjab.

Methods: Sample of this survey comprised of 213 (M-112, F-101) basketball players of age group 17-25 years (mean age = M-20.85±2.10, F-20.35±2.15). Scheduled interview and measurement of Evertor – Invertor strength by strain gauge and range of motion by universal goniometer was the tool of data collection. Presence of FAI was determined by Cumberland Ankle Instability Tool (CAIT) Score using the score of 28 and below as cutoff point for ankle instability. Cross tabulation with chi square and t-test were the tools for statistical analysis.

Results: The prevalence of functional ankle instability (FAI) was 57.74%. Players with FAI had significantly less evertor strength (t-2.03) and decreased range of motion of inversion (t-3.00). History of previous ankle sprain (OR-0.062) inadequate treatment (OR-8.61) and irregular stretching during warm up (OR-2.03) were the risk factors significantly associated with FAI.

Conclusion: Prevalence of FAI among basketball players is high. History of recurrent ankle sprain, poor evertor strength, decreased range of inversion and inadequate physiotherapy has emerged as the major risk factors of FAI. These deficits could be corrected by designing exercise program emphasising on evertor strengthening, proprioceptive training as well as range of motion exercises for ankle joint.

Keywords: Functional ankle instability, Prevalence, Evertor-invertor strength, Basketball players, Punjab

1. Introduction

Injury to lateral ligament of ankle is the most frequent (Agel *et al.*, 2007; Deitch *et al.*, 2006; Starkey, 2000) ^[1, 7, 30] and recurrent injury (Cumps *et al.* (2007) ^[6] among basketball players. The predominance of repetitive jumping, landings and cutting manoeuvres, and contact with other players expose players of basketball to a high risk of ankle sprain (Hosea *et al.*, 2000; Starkey 2000) ^[20, 30]. One of the residual complications of lateral ankle sprain is Functional ankle instability or Feeling of giving way in ankle during sporting activities. It is considered as a main cause of recurrent ankle sprain (Arnold *et al.*, 2009) ^[3]. The construct of FAI represents occurrence of sudden uncontrolled joint motion not exceeding the normal range during functional activity (Kaminski *et al.*, 2002) ^[21]. Freeman *et al.* in 1965 first introduced the concept of FAI for classifying patients with ongoing complaints of “giving way” of the ankle. It is estimated that 20% - 40% of all ankle sprains develops FAI (Braun *et al.*, 1999; Chan *et al.*, 2011) ^[4, 5]. Gerber *et al.* (1998) ^[12] reported that following acute ankle injury 40% of subjects continued to experience feeling of giving way even after 5 months.

Proprioception deficits, delayed neuromuscular response (Konradsen *et al.*, 1998) ^[24], impairments and imbalance in muscle strength, decreased range of motion (Kaminski *et al.*, 1999) ^[22] persistent ligamentous laxity, impaired balance (Tropp *et al.*, 2002) ^[32], the presence of localized scar tissue (Kofotolis *et al.*, 2007) ^[23] etc are proposed as some of the contributing factors of FAI.

Information on the magnitude of FAI in basketball players is limited. The investigator could not identify any study on prevalence of FAI and its association with risk factors in basketball players of Punjab. The purpose of this study was to describe the epidemiology of FAI in basketball players with reference to prevalence, impact and risk factors.

Methods

213 basketball players (112 males, 101 females) aged between 17 and 25 years, participated in this cross sectional survey that was approved by Institutional Clinical Ethical Committee (I.C.E.C.) of Punjabi University. Basketball players of age group 17-25 years involved in competitive basketball at a minimum of state level and have at least engaged in basketball for more than one year were included. The criteria of exclusion was traumatic ankle injury at the time of survey and history of surgery to the lateral ankle ligament complex or ankle joint. The subjects were selected from Punjabi University, Patiala, National Institute of Sports, Patiala, Polo Ground, Patiala, Physical Education College, Patiala, All India Interuniversity Basketball Tournament - Girls at Lovely Professional University, Jalandhar, Punjab held during 19th October, 2013 - 22nd October, 2013), and All India Interuniversity Basketball Tournament – Boys at Murthal held during (9th January, 2104 – 11th January, 2014. the intension was to include maximal possible number of subjects satisfying the selection criteria. The study consisted of two parts: schedule interview and evaluation of strength and range of motion of inversion and eversion of both ankles.

Schedule interview

Schedule interview was conducted using questionnaire consisting of 55 questions, focusing on demography, training profile, present and past ankle injury, impact of ankle injury and medical service utilization. Functional ankle instability was measured using Cumberland Ankle Instability Tool CAIT (Hiller *et al.*, 2006) [18]. It is a 9-item self reported questionnaire that gives a score between 0 and 30 with Scores less than 28 represent FAI (Hiller *et al.* (2006) [18]. It is a valid, reliable and sensitive tool to detect FAI that has been used in previous studies (Arnold *et al.*, 2009; de Noronha *et al.*, 2006; Gutierrez *et al.*, 2011) [3, 10, 15]

Strength testing

Evertor and Invertor strength testing was done using strain gauge as per the protocol described by Smith *et al.* (2012) [29]. Subject sat on a chair with ankle placed on the floor in a neutral position. One end of stain gauge was fixed to the ground with a screw and other end was tied to the foot with a strap through its hook. The stain gauge was placed laterally to the test foot for inversion strength measurement. For evertors strength strength testing the position of stain gauge was shifted medially. Subject was asked to pull the strap inwards and outwards for inversion and eversion respectively without moving the heel and hold the maximally pulled position for 3 seconds. (Figure 3.6). The force of applied pull displayed on the screen of strain gauge was recorded. 3 recording were taken for each muscle and an average of the three was taken for data analysis. The interater reliability of strain gauge for evertor and invertor strength testing established on 10 players by two physiotherapists was found acceptable (r=0.99)

ROM measurement

Universal goniometer was used to measure the joint range of motion for inversion and eversion using standard protocol (Norkin and white, 2004) [28].

Criteria of considering as afflicted with CAI

An athlete with CAIS score below 28 in one or both legs was considered as afflicted with FAI.

Data reduction and Statistical Analysis

Subjects were grouped in two categories: players with FAI and other group. Unpaired t-test was used to see the difference in the continuous variable whereas Pearson chi square test was used to determine association of categorical variables. For analysis of strength and ROM data the players presently afflicted with ankle sprain were excluded. The significance level was set at $p \leq 0.05$ for all statically tests. Results are reported as mean, SD and percentage.

Results

57.74 % (123 out of 213) subjects were found afflicted with FAI among them 43.90 % (54 out of 123) had experienced more than two episodes of ankle sprain in the last 2 years (Fig. 1). Overall 45.07% players (96 out of 213) reported sustaining more than one episode of ankle sprain in the last two years.

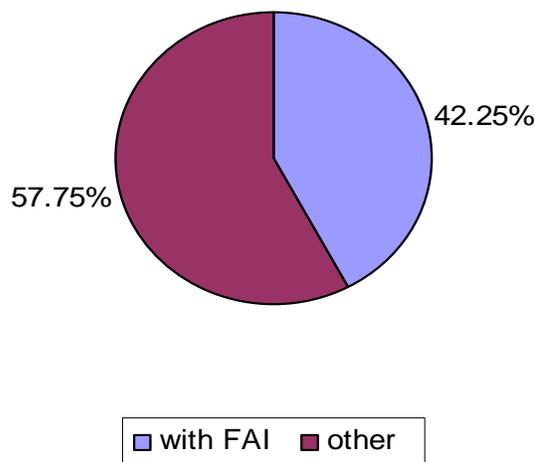


Fig 1: Prevalence of FAI in basketball players of Punjab (N= 213)

A higher proportion of players with FAI experienced irregular training, reduced performance and had significantly higher recurrence rate of ankle sprain in the last two years (Table 1). The strength and ROM findings are presented in Table 2. **Players with FAI** demonstrated significantly ($p < 0.05$) reduced strength of evertor muscles and range of inversion motion.

Table 1: Impact of FAI

| Impact of Injury | players with FAI (n=123) n (%) | Other group (n=90) n (%) | Chi sq (χ^2) |
|--|--------------------------------|--------------------------|---------------------|
| Past Ankle Sprain | 103 (83.7%) | 22 (24.4%) | 72.94** * |
| Recurrence of ankle sprain in last 2 years | | | |
| Twice | 33 (26.8%) | 5 (5.6%) | 14.63** * |
| 3-5 times | 44 (34.8%) | 4 (4.4%) | 27.45** * |
| >5 times | 10 (8.1%) | 0 | 5.97 |
| Missed competition | 28 (22.76%) | 4 (4.44%) | 12.26** |
| Absent from training | 75 (60.97%) | 14 (15.55%) | 42.22** * |
| Reduce performance | 59 (47.96%) | 06 (6.66%) | 39.89** * |
| Irregular training | 54 (43.90%) | 05 (5.55%) | 36.27** * |
| Mental agony | 26 (21.13%) | 03 (3.33%) | 12.53** |

P (χ^2 (1, 0.05)) ≤ 5.99 * P (χ^2 (1, 0.01)) ≤ 9.21 ** P (χ^2 (1,0.001)) ≤ 13.82 *** NS-Non significant

Table 2: ROM and strength findings of players with FAI and other group

| | Players with FAI n=123 | Other group n = 90 | t |
|----------------------------|---------------------------|-----------------------|-------------|
| | Mean and SD | Mean and SD | |
| Evertor Strength (in kgs) | 9.11 ± 3.18 | 9.75 ± 3.22 | 2.03* |
| Invertor Strength (in kgs) | 9.31 ± 3.37 | 9.80 ± 3.23 | 1.49 |
| E-I Ratio | 0.99 ± 0.164 | 0.99 ± 0.10 | 0.43 |
| Eversion Rom (in degree) | 19.22 ± 5.13 | 19.71 ± 5.19 | 0.92 |
| Inversion Rom (in degree) | 30 ± 6.20 | 31.74 ± 5.63 | 3.00** * |

Table 3 presents the association of risk factors with the occurrence of FAI. No treatment (OR =8.61)) and irregular stretching during warm up (OR= 2.03) were the risk factors significantly associated with FAI. Age, sex, height, level of play, training hours, warm and cool down practices were not found associated with occurrence of FAI.

Table 3: Association of Functional Ankle Instability with risk factors

| Risk factors | Players with FAI n=123 | Other group n=90 | Chi / t | OR |
|--------------------------------------|---------------------------|---------------------|---------------------|------|
| Height | 174 ± 12.58 | 173.94 ±12.74 | 0.036 | |
| Weight | 66.81 ± 13.37 | 63.74 ± 12.07 | 1.74* | |
| Sex | | | 1.179 ^{NS} | |
| Male | 70 (56.9%) | 42 (46.7%) | | |
| Female | 53 (43.1%) | 48 (53.3%) | | |
| Level of Play | | | 1.743 | |
| State | 39 (31.8%) | 31 (34.4%) | | |
| National | 81 (65.8%) | 54 (60%) | | |
| International | 03 (2.40%) | 05 (5.6%) | | |
| Years into Active Training | | | 0.367 | |
| 1-2 Year | 8 (6.5%) | 7 (7.8%) | | |
| 2-3 Year | 12 (9.8%) | 9 (10.0%) | | |
| 3-4 Year | 24 (19.5%) | 15 (16.7%) | | |
| >4 Years | 79 (64.2%) | 59 (65.6%) | | |
| Weekly training hours | 6.04±0.56 | 5.92±0.60 | 1.45 | |
| Monthly training hours | 8.68±1.54 | 8.37±1.63 | 1.37 | |
| Cool down (irregular) | 72 (58.6%) | 54 (60%) | 0.005 | |
| Warm up(irregular) | 27 (21.9%) | 13 (14.4 %) | 2.325 | |
| Stretching during warm up(irregular) | 47 (38.2%) | 21 (23.3%) | 4.63* | 2.03 |
| Past Ankle Sprain | 103 (83.7%) | 22 (24.4%) | 72.94*** | 0.06 |
| No treatment of past ankle sprain | 84 (68.2%) | 18 (20%) | 46.7*** | 8.61 |
| Use of specific foot wear | 99 (80.5%) | 79 (87.8%) | 1.15 | |

*P ≤ 0.05 ** P ≤ 0.01, ***P) ≤ 0.001

Discussion

The high prevalence of FAI (57.74%) along 43.66% of 2 years prevalence of recurrent Ankle sprain observed in this study indicate that ankle sprain and its residual sequelae of FAI are very common among the basketball players of Punjab. Previous works reported 20 to 50% prevalence of ankle instability following ankle sprain in sporting as well as general

population (Leumann *et al.*, 2010; Arnold *et al.*, 2009; Hiller *et al.*, 2008; Timm *et al.*, 2005) [25, 3, 19, 31]. Leumann *et al.* (2010) [25] reported the prevalence of ankle instability as 50% in individuals with acute ankle sprain. Prevalence of ankle instability in collegiate sports was ranged between 20-40% (Arnold *et al.*, 2009) [3]. Another study reported 36% prevalence of FAI in adolescent dancers (Hiller *et al.*, 2008) [19]. Investigator could not find literature on the prevalence of ankle instability in basketball players and to best of the knowledge of researcher this might be the first study to report the prevalence of functional ankle instability in basketball players of Punjab.

In present study, FAI was observed in 123 subjects out of them 87 (70.7%) had experienced more than one episode of ankle sprain. This observation supports the notion that recurrent sprain is significantly associated with ankle instability (Hiller *et al.*, 2008; Mandarakas *et al.*, 2014; Hertel *et al.*, 2002; Herten, 2000; Glasgow *et al.*, 1980) [19, 26, 17, 16].

FAI had a considerable impact on the performance of basketball players. 60.97% players of the unstable group remained absent from the training sessions 47.96% players had shown decrease in their performance and 22.76% number of players missed their competition. 43.90% number of players had experienced irregular training whereas 21.13% had reported experiencing mental agony. Similar finding have been reported previously. In the study of Starkey (2000) [30], 7.7% of players had missed their training sessions because of ankle injury. In another study one episode of ankle injury had resulted in an average time loss of 7.01 sessions (Kofotolis, 2007) [23].

Evertor weakness has been suspected as a reason for recurrent ankle sprain and also as a causative factor for the FAI. Biomechanically the evertor muscles are responsible for controlling excessive inversion and plantar flexion - the most common mechanism of lateral ankle sprain. When the foot touches the ground the inverted position of ankle results in a varus thrust from an inversion lever through the subtalar axis. If the evertor muscles are not strong enough to counteract this motion, the applied force may exceed the tensile strength of the lateral ligaments and produce injury to lateral ligament of ankle (Willems *et al.*, 2002) [33].

Conflicting finding reported in the literature with regard to muscle strength in FAI. Yildiz *et al.* (2003) [34] reported significantly reduced strength of evertor muscle and decreased range of inversion motion. On the other hand Goharpey *et al.*, (2007) [14] found significant difference not in evertor strength but in the invertor strength between subjects with chronic ankle instability and healthy subjects. Reduced invertor strength of the affected ankle in comparison with non injured ankle was reported by Munn *et al.*, (2003) [27] in subjects with unilateral ankle instability. In both these studies criteria of considering a subject as afflicted with functional instability was not clearly described. The finding of this study is in agreement with Yildiz *et al.* (2003) [34]. They used isokinetic equipments for strength testing whereas in the present study improvised strain gauze was used.

The occurrence of FAI was significantly associated with no treatment of past ankle sprain (OR =8.61) and Lack of stretching during warm up (OR= 2.03). Improper management of ankle sprain is known to result in long term disability and instability (Anandacoomarasamy *et al.*, 2005; Denegar *et al.*, 2002; Derscheid *et al.*, 1985) [2, 8, 9]. Most of the players did not follow any organised rehabilitation plan. The persistence of evertor muscle weakness and stiffness in inversion range of motion may be attributed to absence of proper treatment. A

high percentage of players 54% (n=115 out of 213) self-managed their injury without seeking any professional help.

This study indicates that the prevalence rate of FAI among Basketball players of Punjab is high and active steps should be taken to address this problem. Poor evetor strength, decreased range of inversion and inadequate rehabilitation has emerged as the major risk factors of FAI. Most of these factors can be reduced by active intervention of physiotherapy. It is essential that after every ankle sprain players should be prescribed exercises for evetor strengthening and the range of motion of ankle joint should be checked periodically so that any identified deficits can be corrected by appropriate exercise therapy intervention.

Limitations of the study include relatively small sample size, no use of radiological investigation and one time examination of the player. Method of enquiry was a retrospective recall having its own limitation. The psychological factor that might have affected the response could not be controlled. There is a need to cross validate the findings on a larger sample. The study was delimited to Punjab. Conducting similar studies in other states of India would help gain insight into the magnitude this problem at national level.

Conclusion

In conclusion this study indicates that the high prevalence of FAI among basketball players of Punjab with most of the players with FAI demonstrating decreased strength of evetor group of muscles and deficits in inversion ROM. These anomalies can be easily corrected by a systematically designed exercise program by physiotherapist. It is important to educate coaches and players and to make them aware about the risk factors and to provide them knowledge about preventive strategies.

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References

- Agel J, Olson DE, Dick R, Arendt EA, Marshall SW, Robby S. Descriptive Epidemiology of Collegiate Women's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988-1989 Through 2003-2004. *Journal of Athletic Training* 2007; 42(2):202-210.
- Anandacoomarasamy A, Barnsley L. Long term outcomes of inversion ankle injuries. *British Journal of Sports Medicine* 2005; 39:136.
- Arnold BL, Linens SW, de la Motte SJ, Scott E, Ross SE. Concentric Evetor Strength Differences and Functional Ankle Instability: A Meta-Analysis. *Journal of Athletic Training* 2009; 44(6):653-662.
- Braun BL. Effects of Ankle Sprain in a General Clinic Population 6 to 18 Months after Medical Evaluation. *Arch Fam Med*, 1999; 8:143-148.
- Chan KW, Ding BC, Mroczek KJ. Acute and Chronic Lateral Ankle Instability in the Athlete. *Bulletin of the NYU Hospital for Joint Diseases* 2011; 69(1):17-26.
- Cumps E, Verhagen E, Meeusen R. Prospective epidemiological study of basketball injuries during one competitive season: Ankle sprains and overuse knee injuries. *Journal of Sports Science and Medicine* 2007; 6:204-211.
- Deitch JR, Starkey C, Walters SL, Moseley JB. Injury Risk in Professional Basketball Players: A Comparison of Women's National Basketball Association and National Basketball Association Athletes. *The American Journal of Sports Medicine* 2006; 34(7):1077-1083.
- Denegar CR, Miller SJ. Can Chronic Ankle Instability Be Prevented? Rethinking Management of Lateral Ankle Sprains. *Journal of Athletic Training* 2002; 37(4):430-435.
- Derscheid GL, Brown WC. Rehabilitation of the ankle. *Symp Rehabilitation Injury Athlete* 1985; 3:527-544.
- DeNoronha M, Refshauge KM, Herbert RD, Kilbreath SL. Do voluntary strength, proprioception, range of motion, or postural sway predict occurrence of lateral ankle sprain? *British Journal of Sports Medicine* 2006; 40:824-828.
- Freeman MA. Instability of the foot after injuries to the lateral ligament of the ankle. *British Journal of Bone and Joint Surgery* 1965; 47:678-685.
- Gerber JP, Williams GN, Scoville CR. Persistent disability associated with ankle sprains: a prospective examination of athletic population. *Foot and Ankle International* 1998; 19:654-660.
- Glasgow M, Jackson A, Jamieson AM. Instability of the Ankle After Injury to the Lateral Ligament. *The Journal of Bone and Joint Surgery* 1980; 62(2):196-200.
- Goharpey S, Sadeghi M, Maroufi N, Shaterzadeh M. Comparison of Invertor and Evetor Muscle Strength in patients with Chronic Functional Ankle Instability. *Journal of Medicine and Science* 2007; 7(4):674-677.
- Gutierrez GM, Knight CA, Swanik CB, Royer T, Manal K, Caulfield B *et al.* Examining Neuromuscular Control During Landings on a Supinating Platform in Persons With and Without Ankle Instability *The American Journal of Sports Medicine* 2011; 20(10):1-9.
- Hertel J. Functional Instability following Ankle Sprain. *Sports Medicine* 2000; 29(5):361-371.
- Hertel J. Functional anatomy, pathomechanics and pathophysiology of lateral ankle instability. *Journal of Athletic Training* 2002; 37(4):364-375
- Hiller CE, Kilbreath SL, Refshauge KM, Bundy AC, Herbert RD, Kilbreath SL. The Cumberland Ankle Instability Tool: A Report of Validity and Reliability Testing. *American Academy of Physical Medicine and Rehabilitation* 2006; 87:1235-1240.
- Hiller CE, Refshauge KM, Herbert RD, Kilbreath SL. Intrinsic predictors of lateral ankle sprain in adolescent dancers: a prospective cohort study. *Clinical Journal of Sports Medicine* 2008; 18:44-48.
- Hosea TM, Carey CC, Harrer MF. The gender issue: Epidemiology of ankle injuries in athletes who participate in basketball. *Clin Ortho Rel Res* 2000; 372:45-49.
- Kaminski TW, Haretsell ST. Factors Contributing to Chronic Ankle Instability: A Strength Perspective. *Journal of Athletic Training* 2002; 37(4):394-405.
- Kaminski TW, Perrin DH, Gansnedter BM. Eversion Strength Analysis of Uninjured and Functionally Unstable Ankles. *Journal of Athletic Training* 1999; 34(3):239-245.
- Kofotolis N, Kellis E. Ankle sprain Injuries: A 2-Year Prospective Cohort Study in Female Greek Professional Basketball Players. *Journal of Athletic Training*. 2007; 42(3):388-394.
- Konradsen L, Olesen S, Hansen HM. Ankle sensorimotor control and eversion strength after acute ankle inversion injuries. *American Journal of Sports Medicine* 1998; 26:72-77.

25. Leumann A, Zuest P, Valderrabano V, Clenin G, Marti B, Hintermann B. Chronic ankle instability in the Swiss orienteering national Team. *Sports Ortho Trauma* 2010; 26:20-28.
26. Mandarakas M, Pourkazemi, Sman A, Burns J, Hiller CE. Systematic review of chronic ankle instability in Children. *Journal of Foot and Ankle Research* 2014; 7:21-31.
27. Munn J, Beard DJ, Refshauge KM, Lee RYW. Eccentric Muscle Strength in Functional Ankle Instability. *Medicine and Science of Sports and Exercise* 2003; 35(2):245-250.
28. Norkin CC, White JD. Measurement of joint motion: A guide to goniometry. 4th edition, 2004.
29. Smith BI, Docherty CL, Simon J, Klossner J, Schrader J. *Journal of Athletic Training* 2012; 47(3):282-288.
30. Starkey C. Injuries and Illness in the National Basketball Association: A 10-Year Perspective. *Journal of Athletic Training* 2000; 35(2):161-167.
31. Timm NL, Grupp-Phelan J, Ho ML. Chronic ankle morbidity in obese children following an acute ankle injury. *Arch Pediatr Adolesc Med* 2005; 159:33-36.
32. Tropp H. Commentary: Functional Ankle Instability Revisited. *Journal of Athletic Training* 2002; 37(4):512-515.
33. Willems T, Witvrouw E, Verstuyft J, Vaes P, deClercq D. Proprioception and Muscle Strength in Subjects With a History of Ankle Sprains and Chronic Instability. *Journal of Athletic Training* 2002; 37(4):487-493.
34. Yildiz Y, Aydin T, Sekir U, Hazneci B, Komurcu M, Kalyon TA. Peak and End Range Eccentric Evertor/Concentric Invertor Muscle Strength Ratios in Chronically Unstable Ankles: Comparison with Healthy Individuals. *Journal of Sports Science and Medicine* 2003; 2:70-76.