

## **Mal-Alignment as a Risk Factor for Lower Extremity Overuse Injuries: A Case Control Study**

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**Abstract:** *Engaging in sports activities has various health benefits, but also carries the risk of injury. Overuse injuries in young adults is one of them which is challenge to the treating clinician. In the present study, we studied the association of mal-alignment as a risk factor for overuse injuries of lower extremity in young adults. In this prospective case-control study, we enrolled all the adult patients engaged in unorganized sports activity presented with various lower extremity overuses injuries as cases and the without any overuse injury as controls. After making a clinical impression, all patients were subjected to relevant X-rays to diagnose the mal-alignment, if present or not. A total of 471 cases and 857 controls with overuse injuries were included. The mean age at diagnosis of overuse injuries was 25.5(16-30) yrs in cases and 24.3 (18-30) yrs in controls. The recreational running was the commonest unorganized activity in both males (38.2%) and females (62.5%). Correlation of the mal-alignment with overuse injuries found to be statistically significant (p=0.003). In conclusion overuse injuries in young adults are significantly associated with mal-alignments. Better understanding of these mal-alignments is better for the management of these injuries.*

**Keywords:** *Overuse Injury, Mal-alignment, Unorganized Activity, Risk factors of overuse injuries.*

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### **I. Introduction**

The Sports activities have many health benefits, but also carry the risk of overuse injury [1-3]. Beside of age, competitive and recreational athletes may carry various soft tissue, tendon, bone, ligament, nerve injuries etc. that usually caused by direct trauma or by the repetitive stress [4-5]. Mild discomfort along with pain after or during the physical activity may denote that the amount of sports activity is perhaps "too much," "too fast," or "too soon" and may cause overuse injury [6]. Different sports activities are associated with different patterns and types of injuries. However age, gender and type of activity influence the prevalence of injuries [1,7-8]. Overuse injuries in the young adults vary both in anatomical and physiological manner and is difficult to analyse the actual impact of these injuries.

Amongst the overall overuse injury patients, it has been observed that only 5% of mature athletes avail the treatment [9]. Beside of higher incidence of overuse injuries in young athletes (about 8% to 10%), limited studies not able to clarify the contribution of mal-alignment abnormalities as a risk factor for overuse injuries [10]. Also because of negligence or if risk factors are not addressed properly, reoccurrence may occurs in the rehabilitated patients [11]. Beside the athletes who are trained in controlled environment, the real burden remains with unorganized sports or exercise activities. Exploring the risk factors for these overuse injuries will open a new horizon in treatment of these injuries and also by early identification these overuse injuries, by explaining the type of activities to be done and not to be done, the overuse injury can be avoided.

In the present case-control study, the investigator tries to analyze the association of mal-alignment with overuse injuries in wide variety of unorganized sports activities in the young adult population.

### **II. Material and Method**

In this prospective case-control study conducted from 2012-2015, after obtaining ethical clearance from institutional ethical review committee, All the patients between 18 -30 years of age giving the consent to be included in the study (with or without known overuse injuries) and which may be exposed to unorganized exercise and physical activities; was included in this study. The patient with overuse injury enrolled as cases and without overuse injury as controls. However, patients having obvious deformity of lower limb, with old history of injury of lower limbs (old fractures, burns etc), those engaged in organized sports (patients having qualified supervision, such as in sports colleges, in stadium or under sports teachers at schools etc), patients with catastrophic sports related injuries (head injuries, obvious fractures etc.) and person having apparent / known intrinsic factors (as list given above) making them more prone to overuse injuries were excluded from the study.

After the written informed consent, demographic data of all enrolled cases as well controls were collected. The diagnosis of the malalignment were only done by standard clinico-radiological methods (see

TABLE-1), as restriction of resources was our limitation. Any anatomical abnormality in the relationship of the bones forming the joint that affecting the joint kinematics was considered as ‘mal-alignment abnormalities’.

Certain characteristics can clue us in to the possible cause of overuse injuries. Mild discomfort or soreness after physical activity, rating no higher than 2 or 3 on a pain scale of 0 to 10, is common. If pain exists during the sports activity and persists even after activity rating to higher than 3 / 10 on visual pain scale (VAS),[6] then that amount of sports activity (whether single shot or after multiple episodes of these activities) is perhaps "too much," "too fast," or "too soon" and were considered as overuse injury in that particular adult.

### III. Results

In the present study, case (n=471) and control (n=857) were enrolled during the study period from 2012 to 2015. All the demographic data of the enrolled cases and controls, divided on the basis on their gender shows the non-significant difference in both groups (TABLE-2). The mean age at diagnosis of overuse injuries was 25.5(16-30) yrs in cases and 24.3 (18-30) yrs in controls. The age of onset of overuse injury was earlier in females for all conditions. There is no any significant difference was seen between the genders of the overuse cases (TABLE-3). In cases, the most common overuse injury in both genders was sprain ankle (23.1%). However, association of overuse injury with mal-alignment was statically significant (p= 0.01, Fig-1). The distribution of both genders according to unorganised activity in cases was shown in TABLE -4. The type of mal-alignment was also shows statistically non-significant difference in between the genders of both cases and controls (TABLE-5 & 6). There is no significant difference between mal-alignment is controls and the controls with no mal-alignment (p>0.05). Also there is no significant difference between number of mal-alignment is controls and mal-alignment in cases (p>0.05). However there is significance difference between number of no mal-alignment is controls and no mal-alignment in cases (p= 0.01). Correlation of the mal-alignment with overuse injuries also found to be statistically significant (p=0.003; TABLE-7).

The recreational running was the commonest unorganized activity in both males (38.2%) and females (62.5%). Amongst all patients most of the unorganized activity was performed on hard surface (n=387; 82.2%), than on soft surface (n=84; 17.8%). Out of these 297 (63.0%) had overuse injuries performed on hard surface and 15 (03.2 %) on the soft surface.

### IV. Figures and Tables

**Table-1: Clinico-radiological Assessment of Mal-alignments**

Clinical Assessment	Radiological Assessment
Wt. bearing foot prints – planus / cavus	Genu Valgum / Varus (wt. bearing)
Hallux valgus	Femoral Neck-Shaft angle
Valgus heel	Q-angle
Clinical test for subtalar movements	Tibial – Metaphyseal angle
Q-angle	Carrying Angle
Distance between med. femoral condyles with both feet touching	
Distance between two med. malleolus with knees touching	
Lateral thigh / leg angle	
Patella Alta (LP/LT)	
Tubercle Sulcus Angle	
Clinical tests for patella mobility	
Inter malleolar axis	
Tibial torsion	
Femoral Torsion	
Carrying Angle	

**Table-2: Patients demographic data**

CASES				
Parameters	Male (n=327) n (range)	Female (n=144) n (range)	Overall (n=471) n (range)	P-Value
Age	25.5 (16-30)	24.3 (16-28)	24.9 (16- 30)	1.000
Weight	65.1 (58-82)	60.1 (45- 71)	62.6 (45-82)	0.8090
Height	161.5(155- 172)	155.5 (146- 158)	158.5(146- 172)	0.8139
BMI	24.96	24.85	24.9	1.1600
Average Duration of Unorganised Activity	7.5 (5-19)	6.7 (3-12)	7.1 (3-19)	0.7515
CONTROLS				
Parameters	Male (n=466) n (range)	Female (n=391) n (range)	Overall (n=857) n (range)	P-value
Age	26.3 (18-30)	25.6 (18-25)	25.95 (18- 30)	0.7005
Weight	64.5 (47-80)	62.3 (45- 68)	63.4 (45-80)	0.7181
Height	161.9((155- 174)	156.1 (145- 160)	159(145- 174)	0.8141
BMI	24.61	24.75	24.68	1.1541
Average Duration of	6.3 (5-17)	5.9 (3-11)	6.1 (3-17)	0.5157

Unorganised Activity

Type Of Overuse Injury	Male (n=327) n (%)	Female(n=144) n (%)	Overall (n=471) n (%)	P-value
Planter fasciatis	68 (20.8)	17 (11.8)	85 (18)	0.0516
Osgood – Schlatter disease	30 (9.17)	10 (6.94)	40 (8.49)	0.5906
Osteochondritis	18 (5.5)	08 (5.55)	26 (5.52)	1.00
Sprain Ankle	84 (25.68)	25 (17.36)	109 (23.14)	0.1287
Stress fracture	21 (6.42)	02 (1.38)	23 (4.88)	0.323
Sinding- Larson Johansson Syndrome	19 (5.8)	11 (7.63)	30 (6.36)	0.5418
Sever’s Disease	25 (7.64)	07 (4.86)	32 (6.79)	0.4257
Stenosing Tenosynovitis Ankle	30 (9.17)	08 (5.55)	38 (8.06)	0.2702
Retrocalcaneal Tendinitis	36 (11)	08 (5.55)	42 (8.9)	0.1184
Anterior Knee Pain	37 (11.31)	09 (6.25)	46 (9.76)	0.1304

**Table-3: Overuse Injuries According to Gender in Cases**

**Table-4: Type Of Unorganised Activity Among the Young Adult in Cases**

Type Of Unorganised Activity	Male (n=327) n (%)	Female (n=144) n (%)	Overall (n=471) n (%)	P-value
<b>Recreational running</b>	<b>125 (38.22)</b>	<b>90 (62.5)</b>	<b>215 (45.85)</b>	<b>0.0042*</b>
Short Running (100 mt)	42 (12.84)	63 (43.75)	105 (22.29)	0.0010*
Longer Running (>100 mt)	83 (25.38)	27 (18.75)	110 (23.35)	0.2455
<b>Recreational Jogging</b>	<b>92 (28.13)</b>	<b>24 (16.66)</b>	<b>116 (24.62)</b>	<b>0.0389*</b>
<b>Recreational Playing</b>	<b>110 (33.63)</b>	<b>30 (20.83)</b>	<b>140 (29.72)</b>	<b>0.0424*</b>
Cricket	60 (18.34)	15 (10.41)	75 (15.92)	0.0747
Football	23 (7.03)	06 (04.16)	29 (06.15)	0.3028
Badminton	15 (4.58)	05 (03.47)	20 (04.24)	0.8045
Lawn Tennis	12 (3.66)	04 (2.77)	16 (3.39)	0.7859

\*Significant

**Table-5: Type Of mal-alignment among in cases**

Type Of Mal-Alignment	Male (n=213) n (%)	Female (n=92) n (%)	Overall (n=305) n (%)	P-value
Heel Varus	14 (6.57)	09 (9.78)	23 (7.54)	0.392
Heel Valgus	15 (7.04)	10 (10.86)	25 (8.19)	0.3679
Flat Feet	25 (11.73)	16 (17.39)	41 (13.44)	0.2822
Tight TA	43 (20.18)	19 (20.65)	62 (20.32)	1.00
Internal Tibial Torsion	54 (25.35)	22 (23.91)	76 (24.41)	0.8893
External Tibial Torsion	40 (18.78)	09 (9.78)	49 (16.06)	0.1239
Abnormal Q angle	22 (10.32)	07 (7.6)	29 (9.5)	0.6708

**Table-6: Type Of mal-alignment in controls**

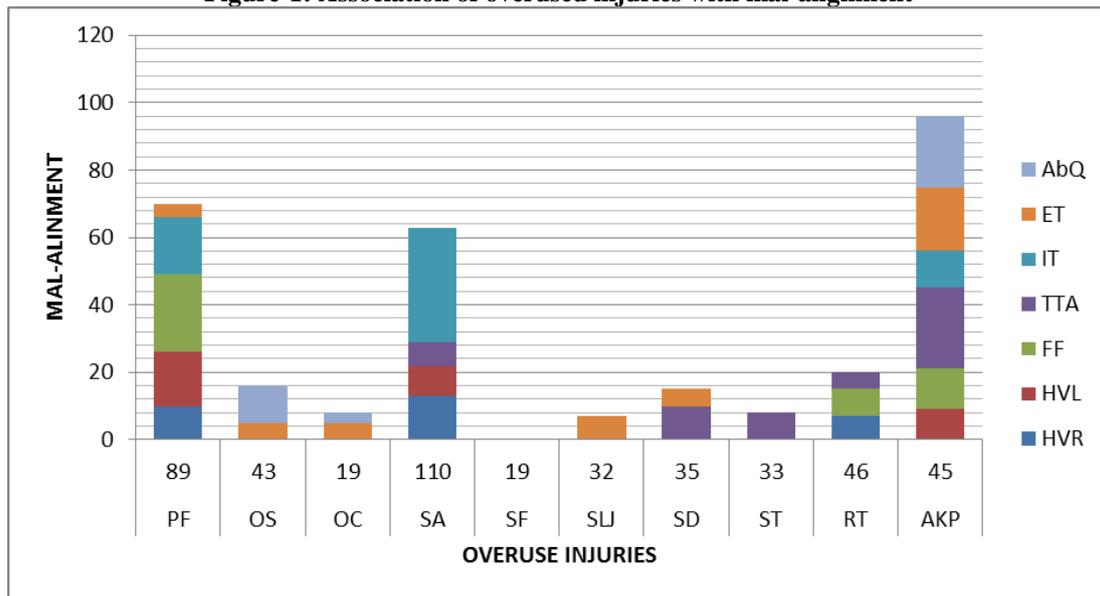
Type Of Mal-Alignment	Male (n=144) n (%)	Female (n=103) n (%)	Overall (n=247) n (%)	P-value
Heel Varus	05 (3.47)	07 (6.79)	12 (4.85)	0.375
Heel Valgus	10 (6.94)	04 (3.88)	14 (5.66)	0.4103
Flat Feet	23 (15.97)	24 (23.3)	47 (19.02)	0.2625
Tight TA	26 (18.05)	21 (20.38)	47 (19.02)	0.7485
Internal Tibial Torsion	36 (25)	24 (23.3)	60 (24.29)	0.8842
External Tibial Torsion	29 (20.13)	13 (12.62)	42 (17)	0.2339
Abnormal Q angle	15 (10.41)	10 (9.7)	25 (10.12)	1.00

**Table-6: Correlation of overused injuries with mal-alignment**

Correlation Coefficient (r)	95% CI	Coefficient of determination	P-value
0.7735	0.4661 – 0.9143	0.5983	0.003**

\*\*Significant

Figure-1: Association of overused injuries with mal-alignment



### V. Discussion

Participation in sports may be beneficial for individuals of all ages, such as combating obesity and enhancing cardiovascular fitness [12]. However, ill effect of musculoskeletal injuries during sports may compromise function in future, like limiting the ability to experience pain-free mobility and engage in fitness-enhancing activity [13].

The acute injuries draw immediate attention, however the overuse injuries occur slowly and are not dominant at early stage, and therefore these injuries are often neglected or misdiagnosed. The process starts when repetitive activity fatigues a specific structure such as tendon or bone.

Overuse injuries occur when a tissue is injured due to repetitive submaximal loading. Tissue with sufficient recovery after a vigorous activity may further demand and may able to undergo further loading without injury [14]. However, without complete recovery, stimulates the body's inflammatory response due to micro trauma that further damage the local tissue [11]. These cumulative micro traumas ultimately causes clinical injury may further leads to degenerative changes, weakness, loss of flexibility, and chronic pain [15]. Thus, overuse injuries is the problem of acute tissue inflammation as well as but chronic degeneration.

The study by Bruns et al., [16] and Leok Lim Lau et al., [17] Singh et al., [18] found the significant association of mal-alignment as a risk factor for overuse injuries in unorganized activities. The present study also focuses on the overuse injury mainly due to unorganized activity. As the unorganized exercises and physical activities need more attention as compare to the exercise/ activity carried out in organized/controlled manner. This is basically due to following reasons, i.e. Impact of overuse injuries in unorganized activities is many fold more than the organized sports and may affect a large population; lack of proper documentation and follow up.

In the present study, the most common overuse injury in cases was sprain ankle (23.1%). Plantar fasciitis was the most common injury of plantar fascia in other studies [19-25]. In our study, we found plantar fasciitis as the second most common overuse injury next to sprain ankle. However, we also landed up with the same conclusion and found significant association of overuse injury with mal-alignment (p= 0.01). The correlation of the mal-alignment with overuse injuries also found to be statistically significant (p=0.0003). This study may have the similar finding as other studies by Bruns et al.,[16] and Leok Lim Lau et al., [17] Singh et al., [18]. However, the small sample size is only the limitations of the present study that may affect the proper knowledge and reliability of the study result.

### VI. Conclusion

Overuse injury is an inherent risk in sports participation. Injury may lead to incomplete recovery, residual symptoms, drop out from sports, and can cause joint degeneration in the long term. Our present study observations conclude that overuse injuries in young adults are frequently associated with mal-alignments. Therefore an adequate understanding of the adult anatomy may facilitate better primary care treatment. Further, it is also suggested that health professionals should be aware of organized and unorganized activities as well as their risk and safety factors.

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