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Relationship of Anterior Knee Pain and Flat foot: A Cross-Sectional Study

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ABSTRACT

Background: The collapse of medial longitudinal arch is called Flat Foot. In medical word, flat foot is associated with pronated foot. The prevalence of flatfoot is 17.1% in 7-14 years of age, 16.4% in 6-13 years and 17.2% in 6-12 years of age. Idiopathic anterior knee pain in nonathletic population without any history of any knee injury is mainly attributed to abnormal alignment and muscular imbalance. Flat foot is one of the contributing factors to development of anterior knee pain.
Objective: The aim of present study is to find out the association between anterior knee pain and flat foot in young adults in Vadodara City**.**
Method: Total 284 subjects were taken from the Vadodara city and assessed. Google form was created and circulated through digital media, Clarke's Angle was measured from the foot print and Kujala Score was calculated from the Google form. Pearson Correlation test was used to analyse the data.
Result: Result of the current study showed that there is negative correlation between flatfoot and anterior knee pain, which means changes in the variables taking in opposite direction.
Conclusion: The present study concluded that there is negative correlation between flatfoot and anterior knee pain, which means reduction in the Medial longitudinal Arch can increase knee pain. Reduction of medical longitudinal arch can malalign the knee joint, which ultimately alter the biomechanics of knee joint that can lead to increase in severity of knee pain. More reduction of Clarke's angle, more the severity of anterior knee pain.

Key Words: Anterior Knee Pain, Flat foot, Clarke's Angle, Kujala Anterior Knee Pain Scale

INTRODUCTION

The human foot is a very complex structure, which allows it to serve many diverse functions. During standing, it provides base of support. During gait, the foot must be stable at foot strike and push-off. [1] The bones of the foot are classified into three segments: the Hindfoot (Talus & Calcaneus), the Midfoot (navicular, cuboid, & the three cuneiforms), and the Forefoot (metatarsals and phalanges). These bones and the associated ligaments form three arches: the Medial Longitudinal Arch, the Lateral Longitudinal Arch and the Transverse Arch. [2] The structure and dynamicity of foot arches are essential for functions of foot like shock absorption, body weight transmission and to act as a lever for propelling the body forward during locomotion. The height of Medial longitudinal arch is higher than the lateral longitudinal arch and during weight bearing, its curvature may change to variable degree. [3]

The collapse of medial longitudinal arch is called Flat Foot. In medical terminology, flat foot is associated with pronated foot. The term pronated describes

the position of the foot when it is flexed upward, turned away from the body and the heel is rolled outward at the same time. [4] The feet appear to be flat in infants due to presence of fat. The arches start appears when the child start walking and foot bears the weight. Arches rapidly develop between 2-6 years and become matured around 12-13 years. Prevalence of flat foot in children is higher due to ligament laxity and declines with age. [3] There are two types of flatfooted deformities, the first type is Rigid or Congenital in which calcaneus is found in valgus position, whereas the mid tarsal region is in pronation, the talus faces medially and downward, and the navicular is displaced dorsally and laterally on the talus. In flexible or Acquired flatfoot, deformity is similar to rigid flatfoot, but the foot is mobile and the arch appears when the patient stands on tiptoes. [5] The prevalence of flatfoot is 17.1% in 7-14 years of age, 16.4% in 6-13 years and 17.2% in 6-12 years of age.[6,8] In Israel Defence Force, prevalence of flexible flat foot in male is 16.23%, in female 11.31% and prevalence of rigid flat foot in male is 0.94% and 0.34% in female. [7]

In clinical practice Flatfoot may be diagnosed through different procedures, such as clinical diagnosis, radiological study and footprint analysis. [9] Clarke's angle was measured from the Flatfoot prints. Clarke's angle was defined as the angle between the tangent at the medial margin of the footprint and the line connecting the longest perpendicular distance from the medial border of the foot and the point at which the medial tangent crosses the margin of the front foot. [10]

Knee joint is a modified hinge joint formed by the articulations between Tibia, Femur and Patella. The synovium around the joint is extensive, it communicates with many of the bursa and pouches around the knee joint. Although the synovial membrane encapsulates the entire knee joint, its distribution within the knee joint is such that the cruciate ligaments are extra capsular. The space between the tibia and femur is partially filled by two menisci that are attached to the tibia to add congruency which are medial and lateral meniscus.[5]

Idiopathic anterior knee pain in nonathletic population without any history of any knee injury is mainly attributed to abnormal alignment and muscular imbalance. Flat foot is one of the contributing factors to development of anterior knee pain. The aetiology of this may be tendency for medial shift in weight bearing.[9] The prevalence of anterior knee pain among individuals with rigid flat foot is 0.34% in female, 0.94% in male and 11.31% in female and 16.23% in male with flexible flat foot.[7]

Within the fields of orthopaedics and sports medicine, the Kujala Anterior Knee Pain Scale (AKPS) has been widely used to identify and study the prevalence of patellofemoral knee pain.[11] The Anterior Knee Pain Scale (AKPS) was developed with a focus on determination of the inquiries which work most relevant to determine patellofemoral pain. The development of the scale by these authors was based on the modified Larson scale and the questions were systematically developed which supported three criteria. "(1) Some questions should specifically address anterior knee pain symptoms; (2) the patient should complete the questionnaire independently; and (3) the scores should be easily and quickly calculated". The development of this highly respected knee scale also related objective measures of patellar alignment and position to subjective questions. The AKPS resultant, it is a self-reported questionnaire with 13-items that evaluates responses which are subjective to specific activities and symptoms that are to be thought to correlate with anterior knee pain syndrome. The scores of AKPS can be given in points from minimum score of 0 to maximum score of 100 points. Lower scores indicate greater pain and disability. [13]

The aim of present study is to find out the association between anterior knee pain and flat foot in young adults in Vadodara City.

METHODOLOGY

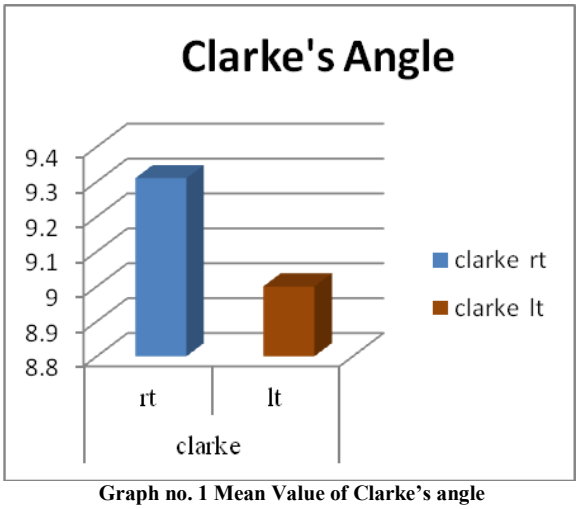
This is a cross-sectional study to find out the association between anterior knee pain and Flatfoot in adolescents and young adults. 300 participants were assessed from Parul University and Baroda, out of which 16 subjects were dropped out, as some of them didn't send clear foot print and some prints were not up to mark of acceptance. So, total 284 subjects were included in the study. Inclusion criteria were (1) individuals with age between 18 to 40 years (2) both gender (3) individuals having flat foot and anterior knee pain. Exclusion criteria were (1)any previous knee injury (2)any knee joint deformity (3)surgery of knee joint (4)any neurological deficits of legs. An online Google Form was prepared and distributed through digital platform. Google form included Demographic data, Kujala Anterior Knee Pain Scale Questionnaire and photograph of foot prints on blank paper with water colour or ink. Subject filled the form with suitable responses and uploaded image of flat foot print taken on paper. Clark's angle was measured from the prints. Kujala Anterior Knee Pain Score was recorded from the responses filled in the form. All the data was collected and analysed by Pearson Correlation test in SPSS software.

RESULT

In the present study, total 284 subjects aged between 18-40 years were taken for the examination. Pearson Correlation test was used to check the relationship between flat foot and anterior knee pain at the level of 0.95 significance. Statistical software SPSS 2020 was used to analyse the data.

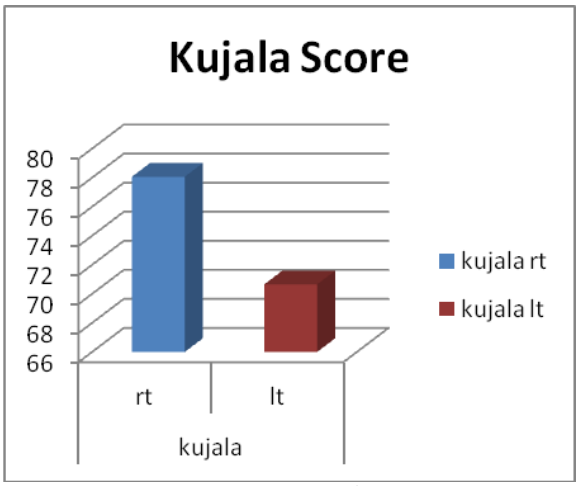
Table no. 1 Mean and SD of Clarke's angle and Kujala Score of both side

		Mean	SD
Clarke Angle	Right	9.31	3.34
	Left	9.00	3.87
Kujala Score	Right	78.06	15.87
	Left	70.65	15.59



Graph no. 1 Mean Value of Clarke's angle

Mean ± SD value of Clarke's angle of left and right is 9.00±3.87 and 9.31±3.34 respectively.

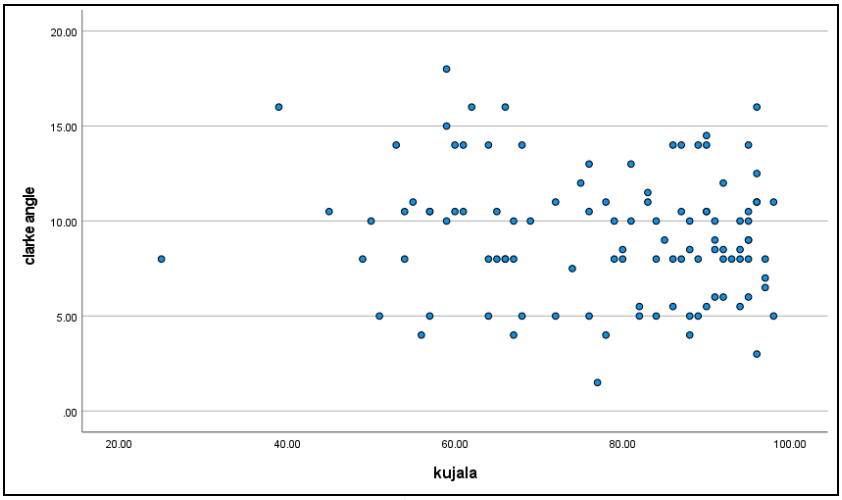


Graph no. 2 Mean and SD of Kujala Score

Mean ± SD value of Kujala Score of left and right side is 70.65±15.59 and 78.06±15.87 respectively.

Table no. 2 Correlation between Clarke's angle and Kujala Score of Right side

Correlations			
		Clarke's angle right	kujala right
Clarke's angle right	Pearson Correlation	1	-.153
	Sig. (2-tailed)		.113
	N	108	108
kujala right	Pearson Correlation	-.153	1
	Sig. (2-tailed)	.113	
	N	108	108

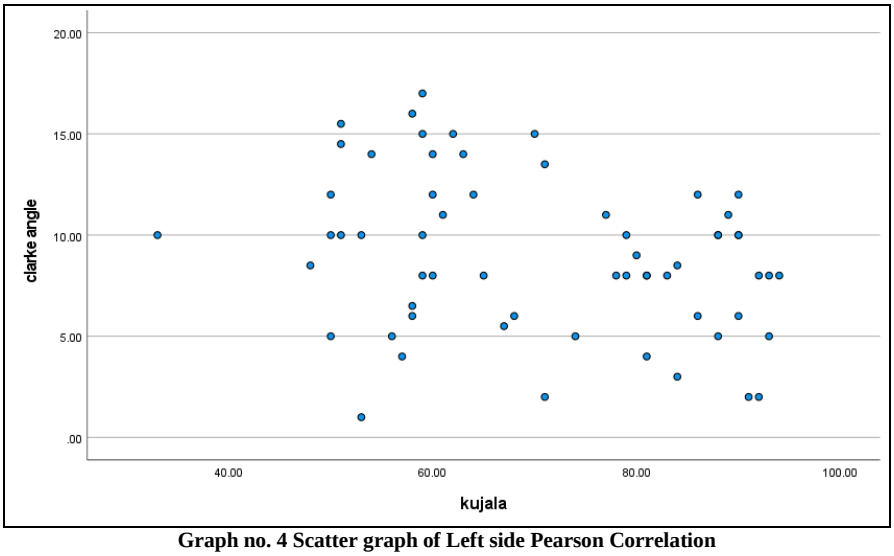


Graph no. 3 Scatter graph of Right Side Pearson Correlation

Pearson Correlation value indicates that there is negative correlation between Clarke's angle and Kujala Score. r value of -0.153 interpret that there is low degree of correlation between two variables.

Table no. 3 Correlation between Clarke's angle and Kujala Score of Left side

Correlations			
		Clarke's angle lt	**kujala lt**
Clarke's angle lt	Pearson Correlation	1	-.294*
	Sig. (2-tailed)		.021
	N	61	61
kujala lt	Pearson Correlation	-.294*	1
	Sig. (2-tailed)	.021	
	N	61	61
*. Correlation is significant at the 0.05 level (2-tailed).			



Graph no. 4 Scatter graph of Left side Pearson Correlation

Pearson Correlation value indicates that there is negative correlation between Clarke's angle and Kujala Score. r value of -0.294 interpret that there is low degree of correlation between two variables.

DISCUSSION

This cross-sectional study examined the relationship between flatfoot and anterior knee pain. In this study, total 284 subjects were included aged between 18-40 years, in which 56% females and 44% were males. 16 subjects were dropped out from

the study, they filled the Google form sheet, but some of them didn't uploaded the images of foot print, some prints were not recognisable and some prints were not up to mark of acceptance, so they were not counted in the study. In the present study, Pearson correlation test was used to analyse data. The result of current study revealed that there were negative correlation between flatfoot and anterior knee pain, which indicates changes in Clarke's angle and kujala anterior knee pain scale score taking place in opposite direction. Mean ± SD value of Clarke's angle of left and right is 9.00±3.87 and 9.31±3.34 respectively. Mean ± SD value of Kujala Score of left and right side is 70.65±15.59 and 78.06±15.87 respectively. Clarke's Angle < 30° could be said that person is having flatfoot.[25]

Flatfoot is relatively common condition.[7] The deformation into flatfoot induced when the Medial Longitudinal Arch is excessively relaxed to the extent that the arch cannot be maintained & cause the foot to excessively pronated, so that the heel may go into eversion & body weight may shift medially & compress the Medial Longitudinal Arch.[18] The loss of arch height affects the weight bearing of the foot, resulting to pain irritation, or discomfort in the foot and other lower limb joints due to the synchrony in their biomechanics.[19] Therefore, unusual or prolonged stress on the foot can affect the biomechanics and functioning of proximal joints, which commonly translates into pain at knee, hip, pelvis, and lower back.[19] Anterior knee pain without any trauma or injury can mainly cause by the misalignment of bony structures or muscular imbalance.[7] Pes Planus (Flatfoot) disorder had been found to be associated with frequent knee pain and medial tibiofemoral cartilage damage. The flattening of the foot causes this pain and damage within the knee by forcing the tibia to rotate internally increasing the rotational pressure on the tibiofemoral joint.[20] The tibia medially rotates when the foot pronates. If the tibia medially rotates, the knee flexes and moves into a valgus position. These knee positions, in turn, cause the thigh to adduct and medially rotate and the hip to flex.[21]

Flatfoot is closely linked to frequent knee pain in adults.[14,15] According to previous study report, in the flat feet subjects reporting to knee pain, there was a greater incidence of knee pain in adolescent females as compared to same age group of males which may be related to the increased valgus angulation of tibiofemoral joint in both limbs.[15] This could be explained by the fact that the disturbance of biomechanics in foot may lead to excessive stresses at knee resulting in pain and the development of some degree of knee deformities such as genu valgus.[15,16] The severity of pes planus correlates with the prevalence of essential anterior knee pain. Moderate or severe pes planus is associated with nearly double the rate of anterior knee pain, while mild pes planus had no additional correlation for the symptoms.[17] The increased prevalence of anterior knee pain with severe and moderate flat foot may imply that, it is the degree of the longitudinal arch flattening that is correlated rather than the rigidity of the flat foot. This correlation could be derived from the influence of the flat foot severity over the rotational mechanical axis in the weight-bearing regions.[17] Gross et al. posited that such association between foot changes and knee pain might be expected if the postural alterations which accompany flatfoot morphology, also results in a tendency for the femur to accompany the tibia in internal rotation.[19]

Foot plays important role in absorbing the mechanical stresses of ground contact and sculpting the pattern of postural alignment and joint motion at the knee and throughout the lower extremity.[22] During most weight-bearing activities, the posture and motion of the foot and knee are coupled within a closed kinematic chain. Closed chain coupling may link excessively flatfoot morphology to excessive internal rotation of the lower extremity, this may have effects on mechanical stress across the knee, possibly resulting in increased rotational

stress on the load-bearing tissues of the tibiofemoral compartment and increased contact between the articulating surface of the lateral patella and the lateral trochlea femoris. Their interdependence biomechanics may contribute causally to some knee pathologies.[22] The presence of bilateral flatfeet, but not unilateral flatfoot is associated with worse knee pain compared to no flat feet.[23]

In the present study, there were more females (56%) compared to men (44%). The result showed that there was more prevalence of anterior knee pain in females compared to male. The most obvious reason why women have more anterior knee pain that men is the difference in lower extremity orientation and alignment. Compared with the pelvis of a male, the pelvis of a female is larger relative to the individual's overall structure. In addition to a broader pelvis, females have a higher prevalence of increased femoral anteversion, which in turn affects the biomechanics of the patellofemorl joint. With a pronated foot, there is an accompanying increased rotation of the tibia during the stance phase of running and walking. The increased rotation of tibia leads to increased patella motion and subsequent patella overuse.[24]

CONCLUSION

The present study concluded that there is negative correlation between flatfoot and anterior knee pain, which means reduction in the Medial longitudinal Arch can increase knee pain. Reduction of medical longitudinal arch can malalign the knee joint, which ultimately alter the biomechanics of knee joint that can lead to increase in severity of knee pain. More reduction of Clarke's angle, more the severity of anterior knee pain.

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