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Occurrence of chronic low back pain in individuals with flat feet- A cross sectional study

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ABSTRACT

Background

Low back pain (LBP) is a widespread, expensive, and debilitating problem.[1] Though LBP can be caused by acute injuries, biomechanical discrepancies have also been indicated. Approximately 80% of the general population has alterations in the feet; these kinematic changes affect the lower extremity kinetic chain and may lead to pathologies of the lower back later in life. The true prevalence of flatfoot is unknown, primarily because there is no consensus on the strict clinical or radiographic criteria for defining a flatfoot.

Objective

To identify the occurrence of flat feet in chronic low back subjects, determine the factors associated with occurrence of flat feet and to state the relationship between flat feet and chronic low back pain.

Methodology

Study proceeded after ethical clearance from the institutional ethical committee of Nitte University was granted. 71subjects satisfying the inclusion criteria from the period between April 2016 to februray 2017 were included. Assessment of all patients included study specific designed tool, NDT, FPI, VAS and Oswestry Low Back Pain Disability Questionnaire.

Results

The occurrence of flat feet according to the designed tool was 45.07 % in the right foot and 49.29% in the left foot. Severity of pain was not related to the plantar arch.

Conclusion

Presence of flat foot is a common phenomenon among the population with chronic LBP and hence, there exists a need for treatment of LBP to be directed towards the biomechanical corrections of the lower extremity kinetic chain. Future scope of Studies involving assessment of dynamic foot function as well as radiographs of lower extremity and larger sample size can be conducted.

Keywords: Kinectic chain, Biomechanical alteration, Mechanical pain, Pes planus.

INTRODUCTION

Low back pain (LBP) is a typical issue for referral to a physician and positions fifth for being accounted to a primary care center. It influences about 62-80% of the population in any event once all through their lifetime [4, 5]. A family physician is the most consulted professional for chronic LBP (65%) in comparison to an orthopedists (55.9%), physical therapists (50.5%), and chiropractors (46.7%) [3]. The foot is an important element of the postural system as it requires continuous adaptation to the various irregularities arising from the body itself or from the external environment. The bones of the lower leg, foot and ankle, their shapes and attachments act together by combining flexibility and stability [9, 10].

Flatfoot is a frequently encountered pathology in the adult population and is defined as a foot condition that persists or develops after skeletal maturity that is characterized by partial or complete loss (collapse) of the medial longitudinal arch [5]. One of the most important characteristics affecting the incidence of flat foot is the altered configuration of the medial longitudinal arch that causes abnormal stresses on the foot and lower extremity. The altered mechanical stresses on the structures of the lower extremity can aggravate the foot deformity [11, 15, 16]. The foot act as terminal element in the kinetic chain. Hence, changes in the feet can be responsible for causing postural imbalance, as they adjust to the imbalances originating from overlying structures [10, 11]. Foot problems are reported by approximately 70% to 80% of adults and 30% of children. [9]Variations in foot posture, such as pes planus (low-arched foot) or pescavus (high-arched foot), are thought to be an intrinsic risk factor for injury due to altered motion of the lower extremity [12].

During the different phases of gait cycle, there exist a transition of movement in the foot from pronation to supination that aids in adaptation of the lower extremity and thus, the body to uneven terrain. Following initial contact the subtalar joint starts to pronate until the metatarsal head contacts the ground, after which the subtalar joint starts to supinate .This, transition movement converts the foot into a rigid structure for propulsion in the late stance phase. During pronation, balance and the necessary flexibility of the foot are provided by unlocking of the mid tarsal joints. This movement is followed by supination that causes the locking of the mid tarsal joint thus, providing maximum stability and serving as a rigid surface for push off phase [22].

However, in cases of hyperpronated foot, the transition movement from pronation to supination is absent and the foot is positioned with the midtarsal unlocked thus, increasing the mobility at the mid foot. The, force generated by the flexible foot is not efficient for completing the push-off during gait, Hence, a greater demand to stabilize the foot and maintain upright stance is placed on the surrounding neuromuscular structures. Considering the coupling movement between rearfoot inversion/eversion and tibial rotation, an excessive or prolonged pronation of the foot is often linked to excessive or prolonged tibial rotation and larger valgus at the knee [21]. Thus, according to Lin et al. kinematic changes and the resulting gait deviations may lead to lower extremity and lumbar pathologies later in life [22].

A possible link between podiatrical deviations and low back pain has thus been established. In literature excessive pronation has been shown to cause leg length discrepancies leading to pelvic tilts and LBP. Based on these results, ankle and foot deviations can be considered a potential cause for LBP due to the disruption of the kinetic chain from the foot to the back [1].

In clinical practice less importance to treatment of podiatric deviations in preventing low back pain persist. According to theoretical knowledge from biomechanics flat feet can be related to chronic low back pain. Despite the recent advances in chronic low back the kinetic chain alteration and effects on the lower back in clinical aspect lack the necessary data. Literature of flat feet on children has been undertaken however, studies on adult population are comparatively lesser.

MATERIALS AND METHODS

The objective of the study was to identify the occurrence of flat feet in chronic low back subjects, determine the relationship between flat feet and chronic low back pain and the factors associated with occurrence of flat feet. Subjects were selected from Justice K. S Hegde Charitable Hospital, Department of Physiotherapy and Orthopedics, Deralakatte, Mangalore.

Cross sectional study design. Convenience sampling- subjects were recruited into the study according to admission and referral. Subjects qualifying the inclusion criteria from the period between April 2016 to February 2017 attending the Justice K.S.Hedge hospital outpatient physiotherapy and orthopaedic department that is, a total of 71 subjects were included in the study.

Inclusion Criteria

- Subjects 18 to 45 years of age to eliminate significant degenerative joint disease.
- Chronic low-back pain >3 months.
- Understanding and completion of informed consent.
- Subjects willingness to participate.

Exclusion Criteria

- Non-mechanical or pathological low-back pain.
- Foot surgery, lower limb pain or any condition affecting measurement.
- Subjects who had received treatment of their feet or lower back within one week of the consultation
- Outcome Measures were evaluated by the foot posture index (FPI), Navicular drop test, Visual analogue scale, Oswestry low back pain disability questionnaire and the Checklist for assessment of flat feet. Duration was of one year.

RESULTS

To identify the occurrence of flat feet – frequency and percentage were used. To identify the relationship between severity of pain and plantar arch- Spearman's ratio was used. To find the factors associated with occurrence of flat feet likelihood ratio was used. P value <0.05 was considered statistically significant. The occurrence of flat feet according to the designed tool was 45.07 % in the right foot and 49.29% in the left foot. Severity of pain was not related to the plantar arch.

Statistical analysis was performed with the SPSS Version16.0 program. A probability of < 0.05 % was adopted as the level for statistical significance. The reliability of the designed tool was assessed using cronbach's alpha with a value of 0.697 and hence, the tool is stated to be reliable. A pilot study data of 10 subjects was used for reliability calculation. The occurrence of flat feet was determined with frequency and percentage.

The occurrence of different foot type was based on foot posture index, navicular drop test and the designed tool. The likelihood ratio for the same was calculated to be 58.195 which is <0.001 and so there is a difference in the assessment. This, may be attributed to the type of scale were FPI is an observational tool apart from the category of talar head palpation, NDT being an measuring tool and the designed tool incorporating observation, palpation and examination of the foot arches. Out of the 71 participants included in the study, 30 were diagnosed to have flexible flat foot on the right side and 32 on the left side. Majority of the participants had neutral foot both on the left and right side. Only 2 and 3 subjects were diagnosed with rigid flat foot on the right and left side respectively.

Table: 2 Frequency distribution of foot posture based on the designed checklist

Checklist diagnosis	Right foot		Left foot	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Flexible flat foot	30	42.3	32	46.5
Rigid flat foot	2	2.8	3	2.8
Neutral foot	39	54.9	36	50.7

Table 3: Frequency and percentage for foot posture based on NDT.

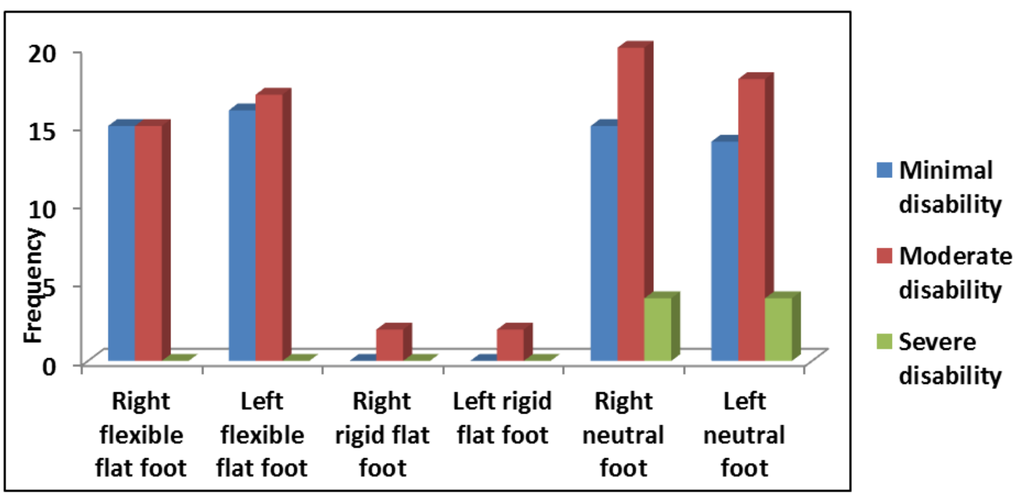
NDT	Right		Left	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Normal	43	60.6	40	56.3
Excess	28	39.4	31	43.7

Here, normal is neutral foot and excessive measure is flat foot.

To identify the relationship between severity of pain and plantar arch Spearman's ratio was used. For VAS and right foot NDT the correlation coefficient was 0.157 and p value was 0.191 which was >0.05 therefore, there exist no relation with severity of pain and right foot NDT. For VAS and left foot NDT the correlation coefficient was 0.110 with a p value of 0.191 which was >0.05 therefore, there exist no relation with severity of pain and left foot NDT. For VAS and right, left FPI Spearman's ration was -0.106 and -0.041with a p value of 0.379 and 0.734 respectively. Hence, there is no relation with severity of pain and FPI for either side foot. VAS and diagnosis determined by the checklist tool for left and right foot had a correlation coefficient of -0.100 , - 0.099 with p values of 0.405 and 0.414.As, the p value is > 0.05 there exist no relation between VAS and plantar arch. Disability arising due to chronic LBP and its association with foot type is represented in the given below graph.

The factors associated with changes in foot poture include ankle ROM, asymmetry in the ankle ROM, height of the medial longitudinal arch, heel eversion, talar prominence, alignment of forefoot to rarefoot, gait, tibial and femoral position, and strength of the tibialis anterior, tibialis posterior, peroneus longus and gastrosoleus muscles.

Graph 3: Depiction of ODQ and foot posture



DISCUSSION

The objective of this study was to identify the occurrence of flat feet in chronic low back subjects and to determine the associated factors and relationships between flat feet and chronic low back pain.

Findings of the study indicated that there is a significant association of chronic mechanical back pain and flat foot. Thus, contradicting the null hypothesis that there exist no relation between flat feet and chronic LBP leading to rejection of the null hypothesis and acceptance of the alternate hypothesis. These findings are different from the study conducted by Hylton B. Menz et.al., in 2013 rationalising their accepted hypothesis by saying that chronic LBP leads to alternation in the normal lumbo pelvic rhythm. However, the presence of flat feet may alter the kinetic chain elements and thus alter or rather may decrease pain [37].

In this study the occurrence of flat feet was more in males compared to females and was associated with overweight. However, the severity of pronation had no relation with the intensity of LBP. Borges Cdos et al., stated that LBP in women is related with the increased longitudinal arch [9] of the foot which is contrary to the findings of this study were no pes cavus were associated with chronic LBP. A moderate correlation between flatfoot and increased lumbar lordosis was found to be present (Brantingham et al., 2006) which could be the case for increase pain supporting this study [27]. In this study, heel eversion was associated with tibial and femoral internal rotation in individuals with flat feet supporting this result a systematic review by O'Leary et al., demonstrated that distortion and deformity of the foot and ankle due to impairment in the lower limb kinematic chain can be considered as one of the possible causes of LBP. There are also some studies that obtained different results and reject the relationship between flatfoot and LBP [1]. Kosashvili et al., in their study stated an association of moderate and severe flatfoot can be associated with a significant increase in the incidence of anterior knee pain and LBP supporting the results of this study [36].

The degree of flat foot did not affect the severity of pain. This, study states that static and dynamic functions of the foot and lower extremity are affected in individuals with chronic LBP due to the kinematic interaction of the lower extremity, an increase in the anterior pelvic tilt was attenuated by the changes manifested in flat foot leading to tightening of the fibrous connective tissues surrounding the sacroiliac joint [38]. Flat foot lead to a cascade of changes in the lower extremity which included adduction and plantar flexion that is, an inferomedial translation of the talus on an everted calcaneum [39] that induced a corresponding internal rotation of the tibia, and hence, lead to internal rotation of the femur [40]. Compensatory movements of the femur and tibia were associated with flat feet that increased the stresses on the lumbar region, thereby contributing to the development of low back pain with altered severity.

Disability caused due to LBP in individuals with neutral foot had an increase occurrence for moderate disability and severe disability compared to individuals with flat feet. The factors associated with changes in foot type include ankle ROM, asymmetry in the ankle ROM, height of the medial longitudinal arch, heel eversion, talar prominence, alignment of forefoot to rarefoot, gait, tibial and femoral position, and strength of the tibialis anterior, tibialis posterior, peroneus longus and gastrosoleus muscles. There was no significant change in the right and left foot and hence, asymmetry in foot posture or function was not noted thus stating no association with low back pain [41, 42]. No association was found between severity of pain and plantar arch this can be rationalized with the fact that chronic LBP is associated with a delayed onset activity of the erector spinae muscle locally and thus, an hypothesis that the surrounding structures in the lumbopelvic region may contribute to the increased severity of pain compared to the altered lower kinetic chain alteration may be stated.

Previous studies that assessed flat foot posture focused more on military [36] population. Clinical samples, included in this study were chronic LBP based population and hence, these findings are more likely to be representative of the general population affected with chronic LBP thus aiding in diagnosing the cause of back pain or a resulting effect of chronic LBP. A recently developed consensus guidelines states that to define LBP in an epidemiological manner, pain should be described based on the duration and severity of symptoms. In this study LBP was defined on this basis [43].

The inclusion criterion was of a comparatively narrow range in comparison to the other studies performed. Many outcomes were used to assess foot posture. A visual and observational measure of foot posture was used rather than using either one. The checklist tool used included observation, palpation and examination of the lower extremity kinetic chain the reliability of which was assessed. The designed tool will aid in biomechanical analysis, diagnosis and appropriate goal setting for standardized treatment purpose. Cut- off range for pain intensity and disability of patients was not stated in the inclusion criteria and hence, the samples included individuals with relatively mild disability and symptom. Thus, generalization of the results for moderate to severe pain and disability is questionable.

Assessment of individuals with LBP was based on severity and symptoms. However, the underlying cause of pain was not assessed for.[44] Dynamic foot function was not assessed only static assessment was noted. Thus, the changes in the foot and its impact on low back pain during dynamic activities are questionable. The main limitation of this study is the inability to confidently infer causation and or reverse causation of chronic LBP. The tool used was time consuming to apply. Studies involving assessment of chronic LBP to determine the underlying cause of pain can be undertaken along with assessment of dynamic foot function and use of radiographs of lower extremity to support the diagnosis can be included.

CONCLUSION

The occurrence of flat feet according to the designed tool was 45.07 % in the right foot and 49.29% in the left foot. This states that the occurrence of flat feet in the patients with chronic LBP is a common phenomenon. Hence, there exists a need for treatment of LBP to be directed towards the lower extremity kinetic chain. Severity of pain was not related to the plantar arch and the factors associated with presence of flat feet included ankle ROM, asymmetry in the ankle ROM, height of the medial longitudinal arch, heel eversion, talar prominence, alignment of forefoot to rarefoot, gait, tibial and femoral position, and strength of the tibialis anterior, tibialis posterior, peroneus longus and gastrosoleus muscles.

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