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A Novel Physiotherapeutic Approach For The Treatment Of Os Naviculare: A Case Study.

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ABSTRACT

Background: Os naviculare in general alters the functional and anatomical balances of the longitudinal plantar arch. A substantial number of the posterior tibialis tendon fibers insert on the accessory ossicle instead of its insertion on tarsal and metatarsal bones resulting in unbalanced stress forces on the tendon. The presence of an accessory navicular type II or type III is a risk factorfor PTT tendinopathy and possible PTT tear.
Methodology: In this single subject case study, the participant reported with the pre-diagnosed Os naviculare. On examination at initial presentation, the navicular tuberosity of the affected foot was prominent as compared tothe contralateral limb. The site was tender on palpation.
Ankle range of motion was within normal ranges except ankle dorsiflexion was slightly compromised. Mild pain on active and resisted was noted. Functional tests like star excursion balance test, single leg standing could not be performed due to pain. Pre and post protocol assessment was graded and measured on Cumberland ankle instability tool. The tenderness was recorded using numeric pain rating scale. Star excursion balance test was performed one on 8th day and post protocol. MWM was performed at distal tibiofibular joint on 6 days every week for 3 weeks alongside the conventional regime exercises and ultrasound was applied post treatment session.
Result: Result of this study suggested that addition of MWM of distal tibiofibular joint in theconservative exercise protocol was effective in the reduction of pain, dysfunction and improveddynamic control.
Conclusion: The results of this study suggests that the addition of MWM of distal tibiofibular joint alongside conservative management shows

CC License CC-BY-NC-SA 4.0	appreciable effect in improving dysfunction, dynamic stability and reducing pain in individual with congenital Os naviculare. ***Keywords: Os Naviculare, Os Trigonium, Mobilisation with movement***

INTRODUCTION

In general, the navicular bone has a roughly pyriform shape whose major oblique axis is oriented in the dorsoplantar and lateromedial directions, adapting itself to the angle of rotationof the head of the talus. Its round base is situated dorsolaterally, whereas its apex is oriented plantarmedially.

The accessory ossicles are small, well-corticated supernumerary osseous structures that are frequently encountered in the region of the foot and ankle. They could be ovoid or nodular, unilateral or bilateral, bipartite or multipartite, and may be present near a bone or an articulation. Accessory bones originate from ossification centres that have failed to fuse with the main bone. They are considered developmental anomalies and can occur either bilaterally or unilaterally; more of anatomical and radiological variants rather than pathological findings.The majority are asymptomatic and usually incidentally detected on plain radiographs. However, these accessory ossicles can occasionally become fractured, dislocate or undergo degenerative changes, resulting in pain and reduced range of motion. It was first described by *Bauhin in 1605*. This ossicle is one of the most common accessory bones of the foot and is considered a normal anatomic and skeletal variant with a reported incidence of 4–21%. Bilateral location occurs in 50–90% of cases and there is a higher prevalence in females. Depending on the accessory navicular bone's morphology and position, as well as on whether there is synchondrosis with the navicular bone, *Weitch in 1978*, divided it into three types.

Type I. Os tibiale externum, naviculare secundarium or accessory navicular. This type represents 30% of the total. Located within the tendon of the posterior tibialis muscle, this sesamoid bone presents an ovoid morphology of about 2 mm to 3 mm.

Type II. Prehallux or bifurcate hallux. This type is found in 50% to 60% of cases and shows a triangular morphology of about 12 mm at its major axis. Formed from a secondary ossification center of the navicular bone, it is found joined to this bone by fibrocartilage or hyaline cartilage which creates a synchondrosis.

Type III. The accessory navicular bone is a prominent navicular tuberosity known as a cornuated navicular [41] and is considered to be the last stage in the fusion of type II. This boneis considered to be an asymptomatic variant, although when it suffers trauma, it can cause painful symptoms.

From a biomechanical point of view, os naviculare in general alters the functional and anatomical balances of the longitudinal plantar arch. A substantial number of the posterior tibialis tendon fibers insert on the accessory ossicle instead of its insertion on tarsal and metatarsal bones resulting in unbalanced stress forces on the tendon. The presence of an accessory navicular type II or type III is a risk factor for PTT tendinopathy and possible PTT tear.

As early as 1926, *Zadek* stated that the importance of os naviculare was that it was associated with an abnormal insertion of the tibialis posterior tendon. Three years later, Kidner verified the association of os naviculare with pes planus and the resulting altered biomechanics of posterior tibialis tendon. Current surgical techniques advocate either the removal of the accessory navicular and reinsertion of the PTT or the fusion of the primary and accessory navicular bone. The final goal is pain relief and restoration of the dynamic support of the longitudinal plantar arch in cases of flat-foot deformity.

The multi-ossicle configuration can be thus explained as a complication of repetitive microtrauma and fatigue fracture of the secondary ossification center leading to an appearance similar to osteochondritis. A similar but slightly different pathogenetic theory might be suggested considering the biomechanical forces of the PTT. In other words, the presence of multi-ossicles could be the final outcome of an avulsion injury upon an os naviculare variant. The fractured bone fragment eventually becomes a secondary ossicle giving rise to the multi- ossicle configuration.

It can cause be the cause of mid-foot pain and consequently may lead to flat foot. The patient usually presents with pain and swelling on the medial aspect of the foot with difficulty on walking. Also, accessory navicular syndrome can cause pain that is localized to the medial aspect of the navicule and bone marrow edema can be observed on MRI. Most cases are asymptomatic but in a small proportion, it may cause painful tendinosis due to traction between the ossicle and the navicular.

These ossicles are detected incidentally by radiological examinations. They are generally of little clinical significance and are rarely associated with painful syndromes. However, they are increasingly being reported in the literature due to the pain directly related to them, especially following overuse and trauma, the restricted range of motion, or the misinterpretation of them as fractures. Diagnostic imaging is necessary to deliver

pertinent information that has to be considered in the workup of the patients.
On the other hand the clinical efficacy of Mulligan's MWM techniques has been established for improving joint function, with a number of hypotheses for its cause and effect. This concept is related to minor positional faults that occur secondary to injury and that lead to mal-tracking of the joint, resulting in symptoms such as pain, stiffness, or weakness. This theory in conjunction with the prescription of MWMs is still advocated in Mulligan's latest edition and remains unchanged. The cause of positional faults has been suggested as changes in the shape of articular surfaces, thickness of cartilage, orientation of fibers of ligaments and capsules, or the direction and pull of muscles and tendons. MWMs correct this by repositioning the joint, causing it to track normally. Subsequent research to date also suggests that the mechanisms behind the effectiveness of MWMs are based on mechanical dysunction and therefore positional fault correction. More recent studies have investigated further mechanisms and effects that may underpin MWM techniques, including hypoalgesic and sympathetic nervous system (SNS) excitation effects. Further research has established theeffectiveness of MWMs for increasing joint range of motion (ROM). The purpose of this research is to observe the effect of addition of MWM of distal tibiofibularjoint to the conventional regime on pain, dysfunction and dynamic stability.

Methodology:

For this single subject case study, a 18 year old girl, pre-diagnosed with Bilateral congenital Os naviculare presented to Jaipur Rehab Physiotherapy Clinic at Jaipur, Rajasthan. Since the participant was assigned for the study, a formal consent was procured prior to the commencement of the study after which a musculoskeletal examination was carried out. The study continued for 21 days and dynamic balance was assessed using SEBT on 8th day and post intervention i.e on 21st day. Likewise, CAIT and NPRS were filled by the subject in day 0 and day 21 and level of instability and pain respectively were measured as pre and post-test readings. Interventions administered included Heel raises, Single leg balance, Stepping, Side walk progressing, side jog, running, Vertical jump, Figure of 8 agility walk, Resisted plantarflexion with inversion, Intrinsic strengthening. Mulligan's Mobilisation with movement (MWM) was given at distal tibiofibular joint. The joint was stabilised medially and a postero-superior glide was sustained at distal fibula and 10 plantarflexion and inversion motions were actively performed by the participant in 3 sets. Therapeutic Ultrasound was also applied over the navicular area. (Duty cycle: 20%, Intensity: 1.1 W/cm^2, Duration: 6 mins, Frequency: 1 Mhz).

Results

Result of this study suggested that addition of MWM of distal tibiofibular joint in the conservative exercise protocol was effective in the reduction of pain, dysfunction and improved dynamic control. The Cumberland ankle instability tool and Numeric pain rating scale were used in this study as an outcome measure, is measured pre and post intervention to see the results. CAIT shows significant changes as functional limitations of the subject were overcome with the help of suggested intervention. NPRS pre and post data shows significant improvement in pain. The CAIT is a measure of ankle stability and function.It is measured using a self-determined scale. The pre and post-test values came out to be 4 and 27 respectively. Pain was measured using numeric pain rating scale. The pre and post-test values for NPRS were 8 and 2 respectively. Star Excursion Balance Test (SEBT) was used for dynamic stability. Its pre & post-test values in Anterior direction came out to be 38.7 & 57.3; Posterior direction came out to be 37.3 & 56.2; Medial direction came out to be 40.3 & 60.8; Lateral direction came out to be 39.5 & 59.3; Anterolateral direction came out to be 42.8 & 62.1; Anteromedial direction came out to be 38.4 & 56.3; Posterolateral direction came out to be 39.7 & 58.5; Posteromedial direction came out to be 41.5 & 60.3.

Discussion

The following discussion intends to explain observations made and results obtained through this study in the light of available evidences. This study sought to determine the effects of addition of MWM of distal tibiofibular joint in conservative exercise protocol on pain and dysfunction in patient with congenital os naviculare. Navicular coonects ankle to mid foot. In about 10% cases, the two ossification centres do not fuse during childhood leading to the formation of an accessory navicular bone. Both the bones are connected by cartilage. Most people are asymptomatic. However, sometimes due to overactivity,traumatic injury, ankle sprain or chronic rubbing from a shoe can elicit pain over the medial area of foot.pain Symptoms generally include pain on medial side of mid foot, swelling or inflammation next to the navicular tuberosity ,a visible prominence corresponding to the accessory navicular. In this study, the treatment protocol consisted of conservative strengthening exercises with respective repetitions and sets alongside Plantarflexion Inversion MWM glide,6 times a week for 3 weeks After the protocol ultrasound was applied over the navicular tuberosity. The CAIT and NPRS score taken on day 0 and day 21st (Pre and post treatment) The distances covered in every direction in SEBT on day 14 were recorded. The overall conclusion of study turns out that addition of plantar flexion MWM alongside conservative protocol can be effective in decreasing pain and improving function and dynamic control. Natalie Collins et al, 2004 studied the initial effects of MWM with movement technique on dorsiflexion and pain in sub acute ankle sprains on 14 subjects with grade II lateral ankle sprain. The subacute ankle sprain group studied displayed deficits in dorsiflexion and local pressure pain threshold in the symptomatic ankle. Significant improvements in dorsiflexion occurred initially post-MWM ($P = 0.002$), but no significant changes in pressure or thermal pain threshold were observed after the treatment condition. Results indicated that the MWM treatment for ankle dorsiflexion has a mechanical rather than hypoalgesic effect in subacute ankle sprains. *Matthew C Hoch. et al* (2014) in a randomised control trial to study the effects of joint mobilization on chronic ankle instability concluded that joint mobilization techniques applied to subjects suffering from CAI were able to improve ankle DFROM, postural control, and self-reported instability. Hence, joint mobilization could be applied to patients with recurrent ankle sprain to help restore their functional stability. Implications for Rehabilitation. The mobilization with movement technique presented by Mulligan, and based on the joint mobilization accompanied by active movement, appears as a valuable tool to be employed by physical therapists to restore ankle function after a recurrent ankle sprain history. ROM restriction, subjective feeling of instability and dynamic postural control are benefiting from the joint mobilization application. *Phong Nguyen et al* (2021) in a pragmatic and randomized clinical trial, 51 participants were recruited to study the effects of MWM in sub-acute lateral ankle sprains. More than 80% of participants with subacute lateral ankle sprains responded well to the MWM approach. Three sessions of pragmatically determined MWM provided a significant and clinically meaningful benefit in dorsiflexion range of motion and Y-balance test performance compared to a sham treatment.

Conclusion

The results of this study suggests that the addition of MWM of distal tibiofibular joint alongside conservative management shows appreciable effect in improving dysfunction, dynamic stability and reducing pain in individual with congenital Os naviculare. It helped in improving CAIT and NPRS scores decreasing the level of functional limitation and improving overall function.

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