



Original Research Article

Time Dependent Changes in Navicular Drop and Plantar Pressures after the Application of Low Dye Taping

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ABSTRACT

Background: - Low dye taping is used for excessive pronation at the subtalar joint of the foot, taping and orthoses are frequently applied to control excessive foot pronation, to treat and prevent musculoskeletal pain and injuries to the lower limb. Studies have predicted that 75% of all running injuries could be linked to excessive pronation.

Aims & Objectives:-This study examines the time dependent changes in Navicular Drop and Plantar Pressures after application of low dye taping.

Methods: - Pre and post quasi experimental design was used. The group consisted of 40 subjects who were asymptomatic and had pronated foot. Each being screened for excessive pronation (navicular drop > 10 mm). Plantar pressures data was recorded, using F Scan. A pre assessment of navicular drop and plantar pressures was done. Each subjects received low dye taping and post assessment of navicular drop and plantar pressures was done, then the subjects walked for 10 minutes and post session 1 readings were taken, similarly the subjects walked for another 10 minutes and again post session 2 readings were recorded.

Results: - Statistical comparison among the navicular drop and plantar pressures were accomplished using one way (ANOVA). There was a significant difference found between the navicular drop and plantar pressures (Mid foot, Medial rearfoot and lateral rearfoot pressure) after the application of low dye taping ($p < 0.05$) and following 20 minutes of exercise.

Conclusion: - After the application of low dye taping and following 20 minutes exercise session 1 and 2, there were time dependent changes seen in navicular drop and plantar pressures.

Key words: - Low dye taping, plantar pressures, navicular drop

INTRODUCTION

The Foot is one of the most important components in interaction of the body with the ground in upright posture. The structure of the foot affects the load absorbed by the bones in the foot and the force transferred to proximal components of

lower extremity when performing exercise with weight bearing on foot. ^[1]

Subtalar joint is a composite joint formed by three separate plane articulating between talus and calcaneus. Together these three articulating surfaces provide triplanar motion around a single joint axis producing

the movements of supination and pronation. In normal gait cycle, pronation occurs immediately after initial contact, permitting foot flexibility at loading response, shock absorption and adaptation of the foot to the weight bearing surface. [2]

A flexible flat foot has an arch that is present in open kinetic chain (weight bearing). A rigid flat foot has loss of the longitudinal arch height in open and closed kinetic chain. Adult flat foot is defined as a foot condition that develops after skeletal maturity and is characterized by partial or complete loss (collapse) of the medial longitudinal arch. It may cause mild limitations to severe disability and pain causing major life impediments. Muscles in the leg and foot tend to fatigue and cramp because of overuse. [3]

Subtalar joint pronation is correlated with internal rotation of the shank causes internal stress at the lower extremity, and may lead to increased strain on soft tissue and compression forces on the joint which can become symptomatic. [4]

ACL tears are a common injury, if excess pronation and tibial rotation contribute to the incidence of injury. Prolonged pronation of the foot and ankle complex produces excessive internal tibial rotation and may produce a preloading effect on the ACL [5]

It has been observed that a person with a postural pes planus foot type is prone to mechanical overloading of their leg and or foot structure. Thus pes planus and its associated relatively low medial longitudinal arch have been linked together to a range of conditions including metatarsal stress fracture, plantar fasciitis, Achilles tendinitis and patella femoral joint pain. [6]

Height of navicular bone is important in maintaining the integrity of medial longitudinal arch as it is situated at the medial side of the tarsus, between the talus behind the cuneiform bones in front.

Medial longitudinal arch height is commonly measured by the measurement of the navicular height. Brody's Navicular drop test is a valid predictor of navicular height in non weight bearing and weight bearing position to characterize the arches of the foot. [7]

Plantar pressures measurement has become an increasingly popular method of gait assessment due to its ease of use and reliability. Dynamic plantar pressure has been used to assess the pressure distribution under the feet of subjects with pathological conditions and under the normal foot during gait. While a direct relationship between plantar pressure and joint motion has not been fully developed. [8]

Low-Dye taping is a common intervention strategy that is used by clinicians to assess the effect of supporting the MLA of excessively pronated. Navicular drop greater than 10 mm has reported that LD taping improves static foot posture immediately after the application of the tape. A variety of different LD taping methods, all modified from the original technique described by Dr. Ralph Dye. [9]

The effectiveness of low dye taping has been examined in various different measures, including static and dynamic measures. Static measure is used assessing vertical navicular height (VNH) and the navicular drop test (ND). Using these measures, in stance it appears that low dye taping increases VNH and reduces navicular drop, with a short term reduction of pronation with low dye taping. [10]

Previous studies have proved the significant effect of low dye taping on plantar pressure and the navicular height. But there have been no studies proving the time dependent changes in navicular drop and plantar pressures after application of low dye taping in hyperpronated foot. So the purpose of this study is to find out the time dependent changes in navicular drop and

plantar pressures after application of low dye taping in hyperpronated foot.

MATERIALS AND METHODS

Approval was obtained from the Research Review and ethical Committee of, ISIC Institute of rehabilitation sciences Research Ethics Committee. Written informed consent was acquired from all subjects.

Sample - A convenience sample of 40 healthy subjects volunteered to participate in the study. Subjects were initially screened for eligibility to enter the study using the navicular drop test. This involved measuring the height of the navicular when standing with the foot placed in the subtalar neutral, and again when the subject was in relaxed standing. The navicular drop greater than 10 mm was necessary for participation, as this is indicative of excessive pronation. Those with a navicular drop of 10 mm less were excluded from the study. The right foot was used for taping in subjects with bilateral excessive pronation.

Inclusion Criteria- Both male and female age group between 20-35 who had bilateral pronated foot, and willing and able to walk independently at a comfortable pace for two 10 minutes walking sessions. Normal BMI subjects ranges between 18.5-24.9 kg/m² were included in the study.

Exclusion Criteria- Subject with any history of lower limb surgery in last 6 months. Subject with any cerebral concussions or visual or vestibular disorder. Any injury to lower limb in the previous 6 months. Any other kind of known lower limb and spinal deformity (other than pronated foot). Subjects should be free from any foot or skin infections. Those who have any type of tape allergy such as (excessive redness/ rash/ skin peeling). Subject with any rheumatoid or orthopedic disease.

Study design- Pre –Post quasi experimental design

Procedure- All the subjects were screened for inclusions and exclusions criteria. Subjects before taping were tested for tape allergy. This involved applying a tape over an area and was left for 24 hours.

A pre assessment of navicular drop and plantar pressures of right foot was assessed and then tape was applied and then post assessment of navicular drop and plantar pressures was measured again.

After a total of 20 minutes exercise was carried out which was divided into two exercise session consisting of 10 minutes each. Subjects after taping walked for 10 min at a normal, comfortable pace and looking straight ahead after 10 min navicular drop and plantar pressures was recorded.

(Post exercise session 1).

Again subject walked for 10 min and again navicular drop and plantar pressures were recorded (post exercise session 2).

Subjects wearing shoe orthotics was removed them during the testing session, so as to ensure that the LD tape was the sole potential supplier of anti-pronatory force.

Material: Foot Scanner (Alfoot Gait View), Leukopremium Tape

Statistical Method:

Statistical comparison among the navicular drop and plantar pressures were accomplished using a One-way (ANOVA). This test was employed to determine the significance of pressure variations in the 6 foot regions under the different time dependent changes, i.e. pre tape, post tape, post session 1 and post session 2.

Pearson product moment correlation was also used to examine the relationship between navicular drop and plantar pressures. There was a significant difference found between the navicular drop and plantar pressures (Mid foot, Medial rearfoot and lateral rearfoot pressure) after the application of low dye taping ($p < 0.05$). But Correlation analysis revealed that there was

no correlation between navicular drop and plantar pressures (mid foot, medial rearfoot

and lateral rearfoot pressure) ($p > 0.05$).



Fig 1: Navicular drop measurement



Fig 2: Low Dye Taping



Fig 3: Plantar pressure Assessment

RESULT

Table 1: Navicular Drop Pre and Post testing

ND	N	Mean	SD	F	Sig
BTND	40	12.9000	1.27702	102.281	.000**
ATND		8.3750	.97895		
A1ND		9.2500	1.23517		
A2ND		10.2750	1.37724		

Table 1 shows there is a highly significant difference at 0.05 level within the before taping navicular drop, after taping navicular drop, after post session1 navicular drop and after post session 2 navicular drop ($p = 0.00$).

Table 2: Midfoot Pressure Pre and Post testing

Variable	N	Mean	SD	F	Sig
BTMfp	40	9.6900	5.01566	7.538	.000**
ATMfp		6.0625	3.13424		
A1Mfp		6.7675	3.90735		
A2Mfp		6.3450	3.04302		

Table 2: shows there is a highly significant difference at 0.05 level within the before taping midfoot pressure, after taping midfoot pressure, after post session1 midfoot pressure and after post session2 midfoot pressure ($p < 0.00$).

Table 3: Medial rearfoot pressure Pre and Post testing

Variable	N	Mean	SD	F	Sig
BTMhp	40	13.0225	7.62400	6.941	.000**
ATMhp		7.6075	7.78702		
A1Mhp		7.7900	7.00549		
A2Mhp		6.8000	4.31877		

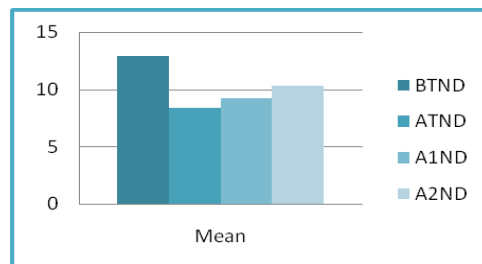
Table 3: shows there is a highly significant difference at 0.05 level within the before taping medial heel pressure, after taping

medial heel pressure, after post session1 medial heel pressure and after post session2 medial heel pressure ($p < 0.00$).

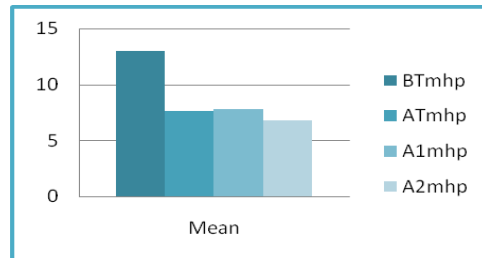
Table 4: Lateral rearfoot pressure Pre and Post testing

Variable	N	Mean	SD	F	Sig
BTLhp	40	11.3475	9.21746	3.333	.021
ALhp		8.0100	7.38810		
ALhp		7.5125	4.76468		
A2Lhp		7.0625	4.46868		

Table 4 shows there is a significant difference at 0.05 level within the before taping lateral heel pressure ,after taping lateral heel pressure, after post session1 lateral heel pressure and after post session2 lateral heel pressure ($p = 0.021$).



Graph 1: Navicular drop Pre and Post test



Graph 2: Medial rearfoot pressures Pre and Post test

DISCUSSION

Low dye taping also reduced the mid foot pressure which lasted for both 10 min session. Low dye taping also produced a greater drop in medial heel pressure immediately after the application of tape. It also increased the navicular height immediately after the application of tape.

This study investigated the effect of low dye taping immediately post application and again after 10 minutes walk session 1 and session 2. We found that the immediate effect of the tape was a highly statistically significant reduction in medial forefoot and medial rearfoot pressure. Following 20 minutes of walk test, lateral forefoot pressure had significantly increased when compared to the baseline taped.

This present study also found the effect of taping on navicular drop that was found highly statistically significant. Following the 20 minutes of walk test, change in navicular height but when compared to the baseline tape, just after the application of low dye taping, navicular had significantly increased.

Buckland and Mcpoil (2007) results showed that a significant increase in lateral midfoot pressure and decrease in central forefoot pressure during both walking and jogging. In our study, we did not measure the lateral and medial midfoot pressures separately but a combined improvement was observed with decrease in mid foot pressure, immediately following the application of low dye taping and a walk of 20 minutes afterwards. [11] It was also observed that the plantar pressures were increased in the lateral forefoot, medial forefoot, midfoot, medial and lateral rearfoot as compared with the time of immediate application.

Bill Vicenzino (2000) results showed antipronation effect with the use of two treatment designs to reduce abnormal pronation. According to this author, antipronation tape is better for controlling

excessive foot pronation to see the immediate effect but foot orthoses has a more effectiveness in case of long term follow up. According to our study, significant effect was observed in navicular drop as well as in different plantar pressures immediately after the application of low dye taping and following the exercise. So it can be concluded that the low dye tape is a better approach to produce the initial immediate increase in navicular height but for is has the deter mental effects in case of long term use So orthoses is a better approach if a long term approach is required. [12]

Mohammad Kolooli et al results showed a significant difference in navicular height after the 8 weeks corrective exercise programme. They concluded that the special corrective exercise can effectively improve pes planus. According to findings of our study, significant improvement was observed in navicular height after the application of taping. A long term follow up of a study is required to observed the combined effect of corrective exercise with application of low dye taping. [13]

The Findings of this study support the hypothesis that antipronation taping is effective in reducing pronation. It has been suggested that some combination of abnormal structure and mechanics in the foot, such as low arch height and pronation, may increase the risk of soft tissue injuries on the medial side of the lower extremity and at the knee. [14] The findings from this study suggest that anti-pronation taping improves navicular height, plantar pressures and may therefore reduce the incidence of such injuries.

This present study found that there was a significant difference seen between the ND and plantar pressures, especially a significant difference is seen between the ND and midfoot pressure after the application of low dye taping and both the

session 1 and 2. This present study also shows that effectiveness of tape between the navicular drop and medial heel pressure (MHP) and lateral heel pressure (LHP) after the application of tape and each exercise session is significantly improved. Alternatively, the tape may have resulted in a passive pull on the plantar soft tissues preventing dorsiflexion of the toes and, therefore, changing the pressure distribution across the forefoot and toes. This passive pull may have provided more incentive for active contribution of the toe flexors.

There was no correlation found between the ND and midfoot pressure, medial rearfoot and lateral rearfoot pressure before and after the application of low dye taping.

Clinical implication- The good antipronation effect produced by Low dye taping immediately after application and after 20 minutes of exercise implicate it as a suitable prophylactic strategy in individuals who have been identified as having a high risk of developing a lower limb overuse injury, especially if participating in high risk sports such as jogging, running etc. The primary use of antipronation tape is that it acts as a predictor for successful subsequent orthotic management.

Limitations of the study- The sample size of the study was small, thus limiting the generalizability of the result. It is important to note that a larger sample size in our study may have lead to significant effect and to get even better results. Thus presenting the duration of the proposed anti pronatory effectiveness of LD tape in a much more positive manner. Subjects were not randomly selected, but were a sample of convenience, and neither subjects nor investigators were blinded to the taping condition, as this was not feasible.

The sample age group was limited to 20 - 35 years, thus limiting the generalizability of the result to all age group.

Other antipronation taping technique (e.g augmented low dye tape) can also be used. This study did not included athletes or did not see the effect of taping in high intensity sports activities.

Future research- In future, this study can be done in sports. The findings suggest that the effect of LD taping are short lived, although the exact length of time for which it may be effective is still unclear. Therefore the study was limited to the short term effects of LD taping on non injured subjects. Future recommendation is required to evaluate if these findings are useful in painful populations, and for how long these effects can be maintained.

In future this study can be done in different BMI levels. This study was limited to the normal BMI range.

CONCLUSION

This study showed that the time dependent changes in navicular drop and plantar pressures after the application of low dye taping in hyperpronated foot.

Low dye taping was demonstrated to significantly alter plantar pressures and navicular drop values during ambulation. Low dye taping significantly reduced pressure under the heel and forefoot regions, and increasing in the navicular height. This study has also demonstrated that LD taping does have immediate effects in redistributed pressure under the foot during gait before and after exercise.

This study also showed that there was a significant difference between the navicular drop and plantar pressures after the application of low dye taping.

Clinical implication- The good antipronation effect produced by Low dye taping immediately after application and after 20 minutes of exercise implicate it as a suitable prophylactic strategy in individuals who have been identified as having a high risk of developing a lower limb overuse injury,

especially if participating in high risk sports such as jogging , running etc. The primary use of antipronation tape is that it acts as a predictor for successful subsequent orthotic management.

REFERENCES

1. Chang YW, Hung W, Wu HW, Chiu YC, Hsu HC. Measurement of Foot Arch in standing Level Walking, Vertical jump and Sprit Start. International journal of Sport and Exercise Science. 2010; 2(2):31-38.
2. Pamela k. Lavangie, Cynthia C .Norkin-Joint structure and function. 5th ed: Chp 12 The ankle and foot complex: 440-449.
3. Aziz Atik, Selahattin Ozyurek. Flexible flatfoot- Istanbul Northern Anatolian Asociatin of Public Hospitals.NCI 2014; 1(1):57-64.
4. Sam K, Ziva Y. Effect of feet hyperpronation on pelvic alignment in a standing position. Elsevier Gait and posture. 2007;25: 127-134.
5. Hadi A, Mojtaba R: Does pronated Foot Predispose the Females to risk of Anterior Cruciate Ligament injury. International Journal of sport studies.2013;3 (5): 492-497.
6. Hunt and Smith: Mechanics and control of the flat versus normal foot during the stance phase of walking. Clinical biomechanics. 2004; 19: 391-397.
7. Umesh A, Watson AS. Normative values of Navicular drop test and the effect of demographic parameters- A cross sectional study. Annals of Biological Research, 2014; 5 (7):40-48.
8. Belinda L, Lucy C. The Effect of Low-Dye Taping on Plantar Pressures, During Gait, in Subjects With Navicular Drop Exceeding 10 mm. J Ortho & Sports Phys Ther. 2004; 34:201-209.
9. Hlavac HF. The Foot Book. Mountain View, CA: World Publications; 1997.
10. Harradine P, Herrington L , Wright R. The Effect of Low Dye Taping upon Rear foot motion and Position before and after exercise. The Foot 200;1:57-60.
11. Buckland, Mcpoil and Vicenzino; Plantar foot pressures after augmented low dye taping technique. Journal of athletic training. 2007;42(3):374-380.
12. Bill V, Griffiths A, Griffiths R, Alison Hadley: Effect of Antipronation Tape and Temporary Orthotic on Vertical Navicular Height Before and After Exercise. Journal of Orthopedic & Sports Physical Therapy.2000;30(6):333-339.
13. Mohammad K, Reza M: Effect of 8 weeks corrective exercise program on the navicular height of teens with flat feet. Asian journal of Multidisciplinary Studies.2014;2(5).
14. Williams DS, Mc Clay IS, Hamill J. Arch structure and injury patterns in runners. Clin Biomech 2001; 16;341-347.

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