

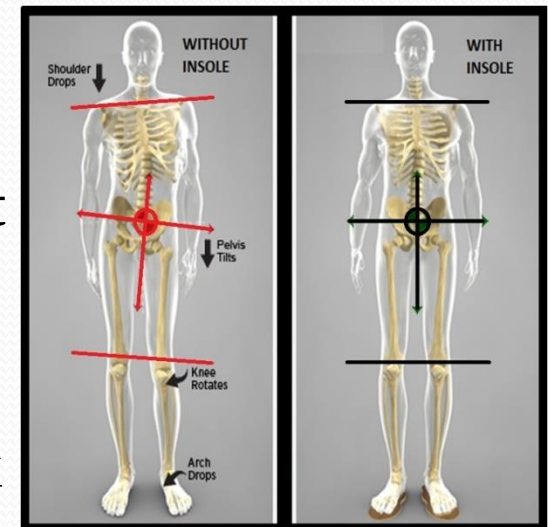
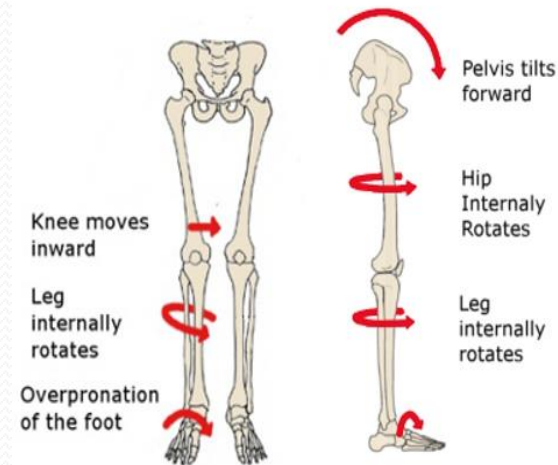
Efficiency Of Customized Insoles In Adult Acquired Flat Foot

Dr. Shalini Nagavarapu*, G.K.Kabra*,
Prachi Kabra* and Dr. Swapna Penugula*.

*Magnetron Therapy Centre

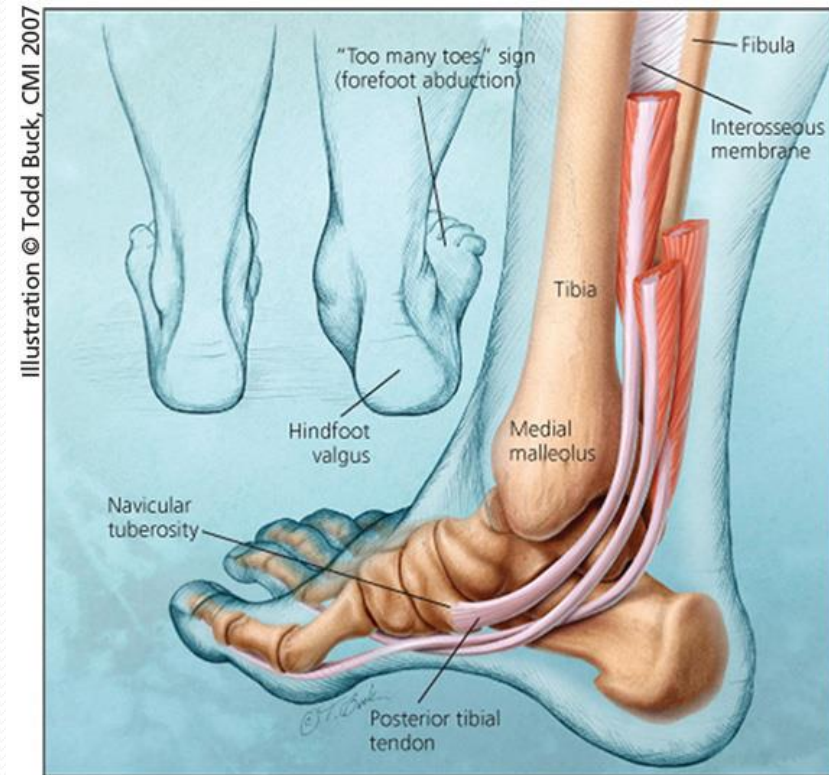
Introduction

- Feet are the **terminal segment of the entire body** which supports the body while weight bearing positions and provides balance by adopting to the uneven ground
- The feet have **three arches medially, laterally and transversely**.
- The medial arch has an important function of **energy transfer and shock absorption** during weight bearing.
- **Decrease in this medial arch causes loss in stability and mechanical misalignment of the lower limb. This is called Flat foot**
- Flat foot results in abnormal pronated foot, shift in calcaneal to the valgus position. This flat foot further leads to genu valgus or knock knees and this may extend up to hip later.



What Is Adult Acquired Flat Foot?

- Muscles, tendons and Ligaments hold these arches in proper neutral position .
- Most adults lose the elasticity in their longitudinal arches leading to **Acquired flat foot**.
- In severe conditions this leads to severe deformities in knee and hip joints.



Objective

The objective of this study is to compare the efficiency of **standard foot insoles** and **customized “Foot-Match” insoles** in reducing the pain and initiating correction of adult acquired flat foot which is more common in elderly people.



VS



Methods

- This is a comparative study conducted at Magnetron Therapy Center.
- The parameters that were checked to compare are
 1. Gait Pattern
 2. Pain Relief
 3. Contact pressures
 4. Asymptomatic side (Control)
 5. Calcaneal Correction
- Subjects included- A group of 30 subjects aged between 50-65 years with asymmetrical flatfoot and abduction of the forefoot were included in the study. Some had pain with swelling and severe calcaneal shift.

Methodology

GROUP A	GROUP B
Given Customized foot match insoles made from 3D scanning, CAD and CAM modifications and CNC milling	Given Standard flat foot insoles available in the market
Total number of patients are 15	Total number of patients are 15
Asked them to use for one month	Asked them to use for one month

1. Initial assessment

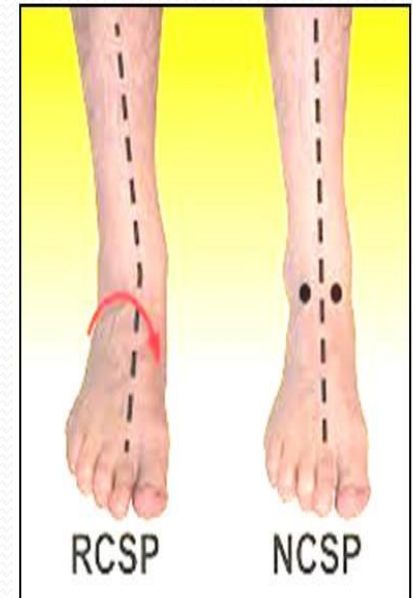
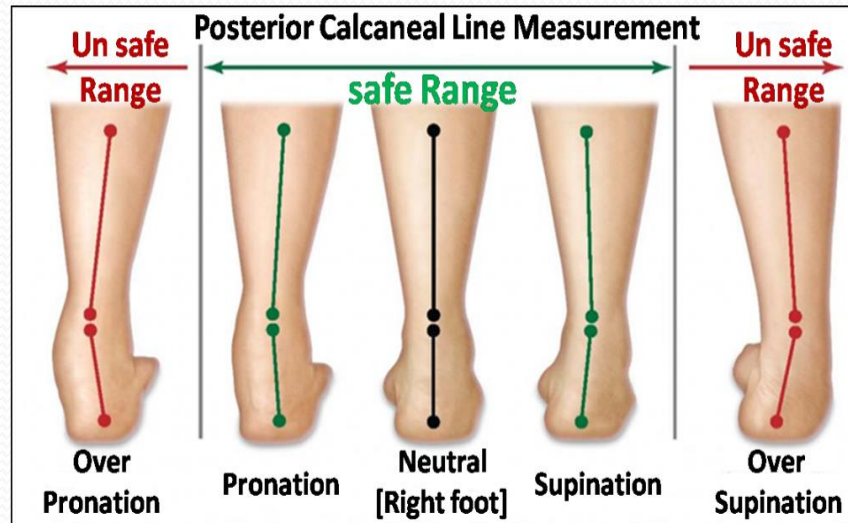
Thorough assessment of the feet of both groups were done using a series of steps and methods such as foot impression, limb length, tibial rotation, foot valgus, anterior calcaneal line measurement and posterior calcaneal line measurement.



LIMB LENGTH



Foot Impression

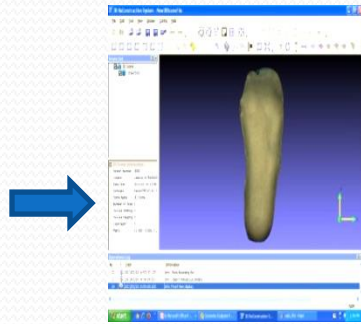


**ANTERIOR CALCANEAL
LINE MEASUREMENT**

2. Making of Customized “Foot-Match insoles



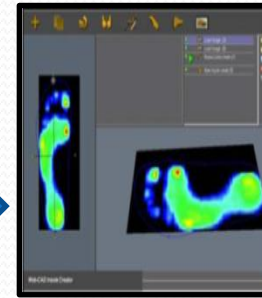
FOOT SCANNING
using Vismach 3D
scanner



CAPTURED FOOT IMAGE



3D FOOT IMAGE



**3D FOOT
MODIFICATIONS**

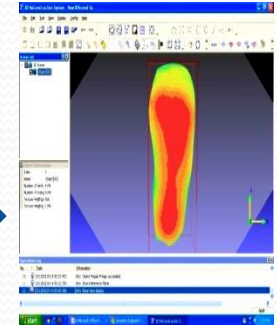
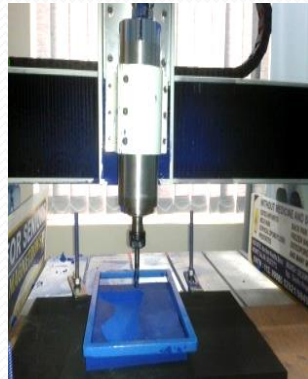


IMAGE FOR MACHINING



3D CNC MACHINE



3D CNC MILLING



3D MILLED INSOLES

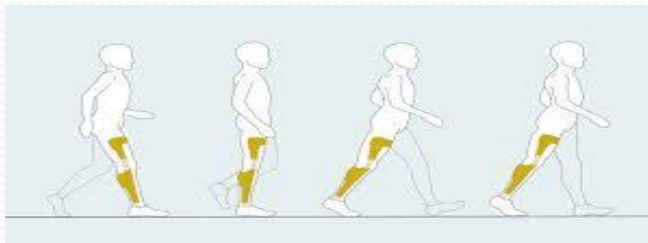


INSOLE WORN IN FOOTWEAR

Results

1. Gait Pattern

	Customized foot match insoles	Standard foot match insoles
Waddling gait pattern	Reduced to a greater extent	Slightly reduced
Heel off	Normal	No significant change
Functional ambulation	Increased push off ability and hence normal gait pattern	Little improvement



2. Pain relief (VAS scale)

	Customized foot match insole	Standard insole
Instant difference (0 to 4 days)	Instant pain relief is not found	Instant pain relief is found
Long term pain relief (one week onwards)	Pain relief is observed.	Once the cushioning on the arch side is gone pain stated again. Lateral side of the foot also started paining due to more contact pressure.
At the end of trail period (30 days)	Total pain relief is found Lateral side is unaffected	Pain persists.

3. Contact pressure

Customized foot match insoles	Standard insoles
Insole is touching all through the foot equally	Insole is touching all through the foot unevenly applying more force on the outer side of the foot
High pressure reduced on the medial side	Cushioning effect is present on the medial side
No pressure on the lateral side of the foot	Maximum pressure on the lateral part of the foot

4. Asymptomatic side

	Customized foot match insoles	Standard insoles
Lateral side of the foot	Un effected	Pain started after one week of usage.

Asymptomatic side of the foot is taken as the control of comparison

5. Calcaneal Correction

	Customized foot match insole	Standard insole
Position of calcaneal line	The calcaneal line brought back from resting calcaneal position to near adjacent to neutral line	No significant change in calcaneal line
Pronation of foot	Decreased	Not effected



Without Insole



With Customized Insole

6. Overall Results

	Gait pattern	Contact pressure	Pain relief	Asymptomatic side	calcaneal correction
Standard insoles(15)	5	12	6	14	-
Customized foot match insoles(15)	15	5	13	-	14

Discussion

- Pain relief is noticed instantly in standard insole group but on the asymptomatic side the contact pressure is more resulting in pain and after 20 days the pain on the symptomatic also returned back.
- Where as in custom insoles instant pain relief is not noted but after one week of usage gradually pain started decreasing. By the end of 30th day no pain at all and asymptomatic side is not effected during the trial period.
- Few subjects who used customized insoles also reported recognizable decrease in knee pain as well.

Conclusion

- Standard insoles provide temporary pain relief due to the cushioning effect that too only at the symptomatic side at the cost of asymptomatic side due to uneven weight distribution.
- In custom foot match insoles due to even weight distribution bio mechanical correction of the flat foot is done giving permanent solution though pain relief is gradual.
- Therefore, this could be a low-cost solution to eliminate pains due to adult acquired flat foot in elderly.

References

- Niki H., et al, (2012). **Outcome of Medial Displacement Calcaneal Osteotomy for Correction of Adult-Acquired Flatfoot.** *Foot Ankle Int* 33: 940, DOI: 10.3113/FAI.2012.0940.
- Roghaye Sheykhi-Dolagh **The influence of foot orthoses on foot mobility magnitude and arch height index in adults with flexible flat feet.** published online 6 March 2014 *Prosthet Orthot Int.* DOI: 10.1177/0309364614521652
- Tammy M. Owings T.M., (2008). **Custom Therapeutic Insoles Based On Both Foot Shape And Plantar Pressure Measurement Provide Enhanced Pressure Relief.** *Diabetes Care*, 31, 5, Pp 839-844.
- Anderson J., Stanek J., (2013). **Effect of Foot Orthoses as Treatment for Plantar Fasciitis or Heel Pain.** *Journal of Sport Rehabilitation*, 22, 130-136
- Crabtree, P., Dhokia, V., Newman, S. and Ansell, M. (2009) **Manufacturing methodology for personalised symptom-specific sports insoles.** *Robotics and Computer-Integrated Manufacturing*, 25 (6). pp. 972-979. ISSN 0736-5845

- K. POSEMA, P. E. T. B um , M. E. v. d. ZANDEJ. v. LIMBEEK,(1998). **Primary metatarsalgia: the influence of a custom moulded insole and a rockerbar on plantar pressure.** *Prosthetics and Orthotics International*, 1998, 22, 3544
- Hinman R. S., et al (2013). **Exercise, Gait Retraining, Footwear and Insoles for Knee Osteoarthritis.** *Curr Phys Med Rehabil Rep* 1:21–28, DOI 10.1007/s40141-012-0004-8.
- Kakihana W., et al (2005). **Effects of Laterally Wedged Insoles on Knee and Subtalar Joint Moments.** *Arch Phys Med Rehabil* Vol (86).
- Butcher C.C., Atkins R. M.,(2003). **Principles of deformity correction.** *Current Orthopaedics* 17, 418-435.

Acknowledgement

- We would like to thank the team of Magnetron Therapy and Research Centre for their help and support.
- We would like to thank the patients for their participation.
- We would like to thank GK Kabras Public Charitable Trust for funding this project.



Thank you!