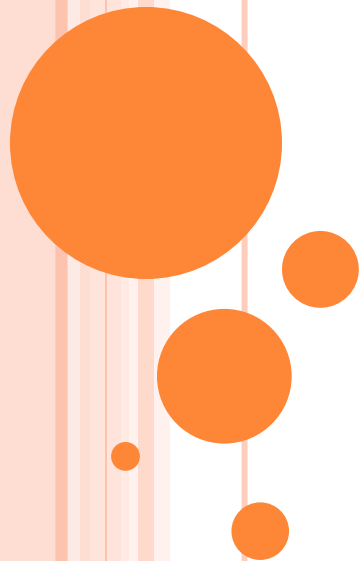


NON-INVASIVE KNEE DEFORMITY CORRECTION USING CUSTOMIZED "FOOT- MATCH" INSOLES AND CUSTOMIZED SHOES

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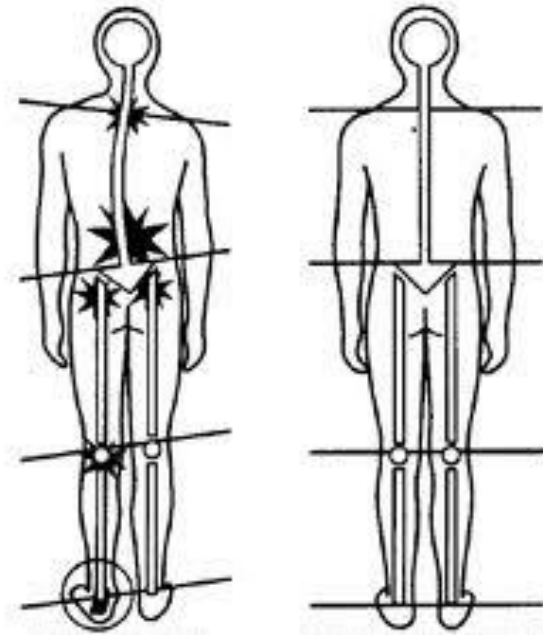
INTRODUCTION

- Elderly people of the society face chronic pains due to various **knee deformities such as osteoarthritis, bursitis, bow legs, knock knees,etc.**
- Knee deformities are thought to be strongly associated with age and affect 2-10% of all adults. These deformities are responsible for almost more than 5% of annual retirement (1).
- It is a **major socio-economic burden** as millions of dollars are spent each year on knee replacement surgeries and medication(1,2).
- Over the decades extensive research has been done on these deformities but the basic treatments have not changed.



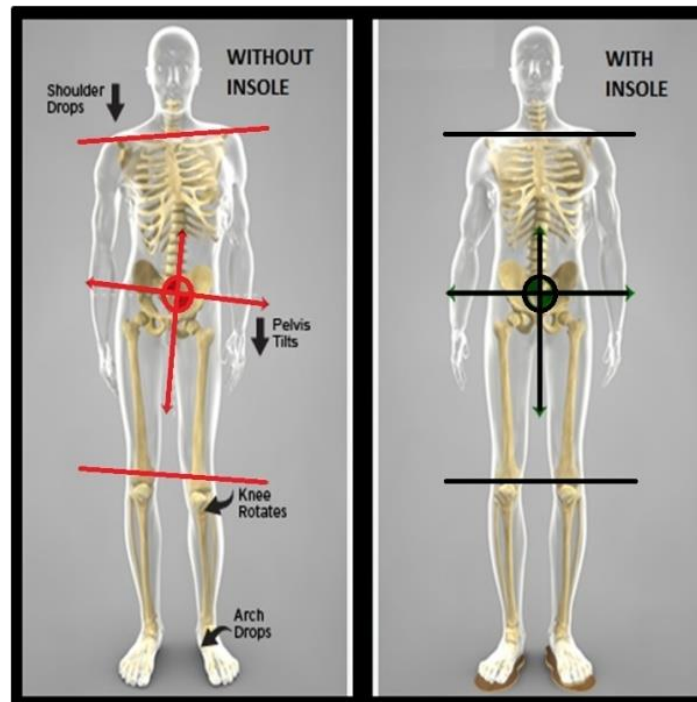
S.No	Existing treatments	Extent of deformity correction	Side effects	Reference
1.	Surgery or osteotomy	Significant symptomatic relief	<ul style="list-style-type: none"> •Limb length discrepancies •Reduced muscle power •Very expensive 	<i>Arabelovic et al (2005)</i> <i>Block et al (2009)</i>
2.	Physiotherapy and exercise	<ul style="list-style-type: none"> •Substantial pain palliation, •Reduces symptoms 	<ul style="list-style-type: none"> •Temporary effect •No evidence of correction of deformity 	<i>Arabelovic et al (2005)</i> <i>Block et al (2009)</i> <i>Hinman et al (2013)</i>
3.	Pharmacologic al therapies	<ul style="list-style-type: none"> •NSAIDS- superior efficacy • Reduce pain and symptoms 	Toxicity, gastric lesions	<i>Arabelovic et al (2005)</i>
4.	Lateral wedge orthotic insert	<ul style="list-style-type: none"> • Reduce medial compartmental loading • Reduce use of NSAIDS 	<ul style="list-style-type: none"> • No significant symptomatic relief • Further deterioration • Efficacy not confirmed • Individual differences not considered 	<i>Arabelovic et al (2005)</i> <i>Block et al (2009)</i> <i>Hinman et al (2013)</i> Toda et al (2004)

- The existing treatments aim at reducing pain and improving function but are they correcting the root cause?
- What is the **ROOT CAUSE** behind **knee deformities**?
- Our study reveals that the **biomechanical misplacement of the foot** leads to excess stress on various joints causing severe pain. The shift of calcaneal line later develops genu varum and genu valgum and further affecting the hip, lower back and spine.
- If these deformed feet are restored to normal neutral position the deformities can be permanently corrected.
- Therefore there is an urgent need for safer and more cost effective methods that will help regain normal foot placement, improve body posture and distribute body weight.



OBJECTIVE

To study the effectiveness of customized “Foot-Match” insoles and Customized Shoes in Bio-Mechanically reducing pain and initiating correction of knee deformities.



METHOD

1. Initial assessment of patient

- 30 patients between the age group of 50-65years suffering from knee deformities such as knock knee, bowleg, osteoarthritis and bursitis were included in the study.
- The medical history of the patients was assessed by Dr. Shalini and Dr. Swapna. Patients were asked to take digital knee X-rays in standing position not more than 6months before the study.



Thorough assessment of their feet 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.



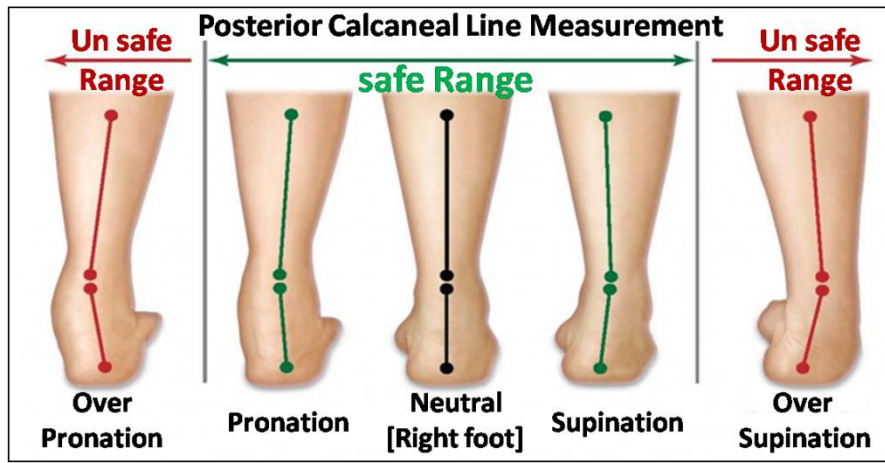
LIMB LENGTH



FOOT VALGUS



TIBIAL ROTATION

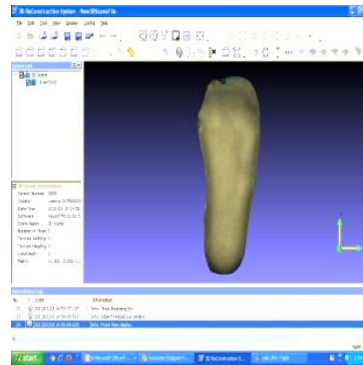
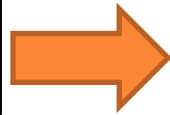


ANTERIOR CALCANEAL LINE MEASUREMENT

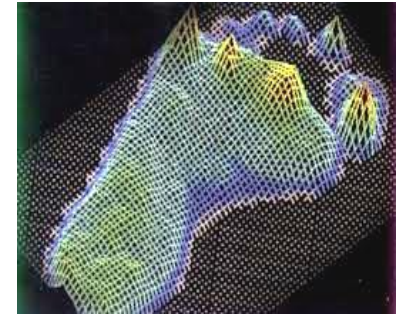
2. Scanning and modification of foot profile



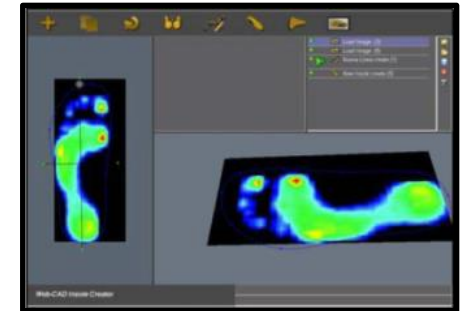
FOOT SCANNING using
Vismach 3D scanner



CAPTURED FOOT IMAGE



3D FOOT IMAGE



3D FOOT MODIFICATIONS

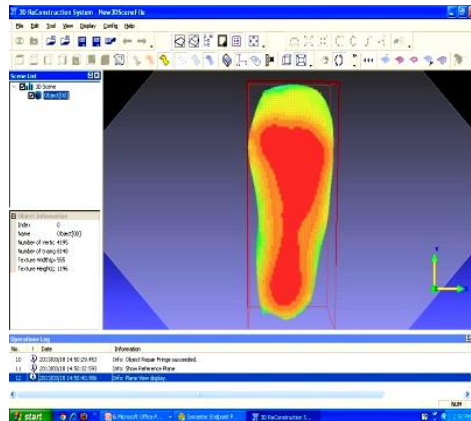
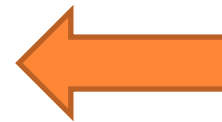


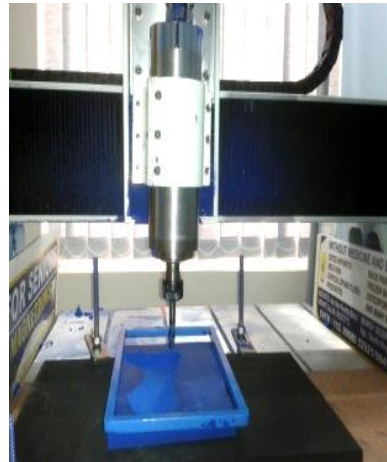
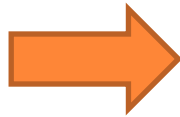
IMAGE FOR MACHINING

COMPUTERIZED MODIFICATION OF FOOT IMAGE TO CORRECT DEFORMITIES BY USING SPECIAL CAD/CAM SOFTWARE PROGRAMS

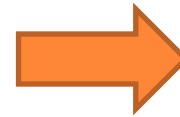
3. Milling using 3D CNC Milling



3D CNC MACHINE



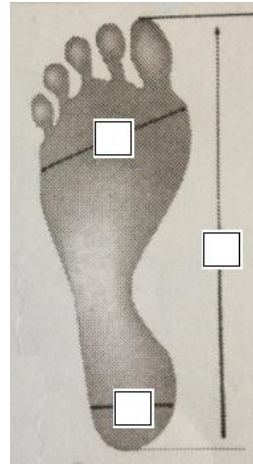
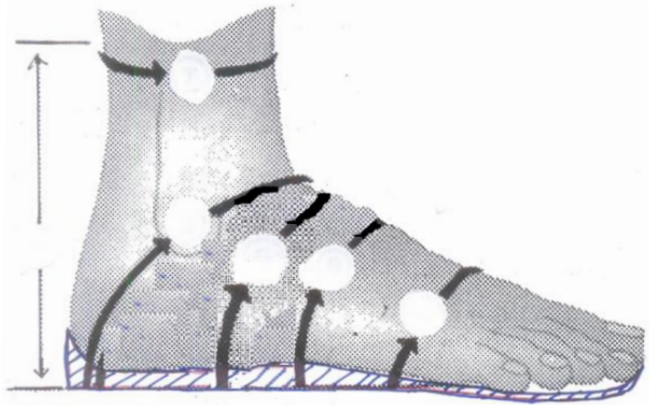
3D CNC MILLING



Customised INSOLES



4. Customized footwear made to patients measurements



- Patients foot measurements taken using this form.
- Customized footwear made by Mr. Vazir to patients exact foot measurement.
- Customized insoles fitted inside these shoes.
- Relief given for various foot ailments in the shoe eg- corn relief.
- Various designs for gents and ladies in sandals and shoes.



5. Final assessment

- 1. Study of gait pattern-** Gait pattern of patients was assessed after 30day period of use of insole and customized shoe. It was measured by visual analysis scale system where score 10- marked improvement, 0- no improvement.
- 2. Centre of gravity assessed using force plate-** Patient centre of gravity assessed using force plate and software for balance assessment. Software gave a score of body balance. This was also assessed based on gait pattern and certain balance posture positions.



3. Pain relief assessed using VAS scale- Patients asked to grade their pain on first day and last day of treatment on a scale of 0 to 10 (where 0-no pain reduction, 10- major pain reduction). Also feeling of comfort was assessed using a similar visual scale.
4. Overall satisfaction- patients were asked to give a feedback on overall satisfaction of the insoles and pain reduction.



RESULTS AND DISCUSSION

1. Assessment of patients

S. No.	No. of patients	Osteoarthritis		Bursitis	Grade of deformity			
		Bow leg	Knock Knee		1	2	3	4
1.	10	-	yes	yes	1 patient	5 patients	2 patients	1 patient
2.	18	yes	-	yes	-	7 patients	6 patients	2 patients
3.	2	-	-	yes	2 patients	-	-	-



2. Final Assessment

1. Study of gait pattern

S.No	Improvement (Score 0-10)	No. of patients
1.	No improvement(0)	1
2.	Limited improvement (1-5)	3
3.	Improvement (5-8)	16
4.	Large improvement (8-10)	10

Patients with knock knee and bow leg showed marked improvement visually in deformity.




2. Centre of gravity assessment

S.No	Centre of gravity assessment(Score 0-10)	No. of patients
1.	No improvement(0)	2
2.	Limited improvement (1-5)	6
3.	Improvement (5-8)	19
4.	Large improvement (8-10)	3

3. Pain Relief

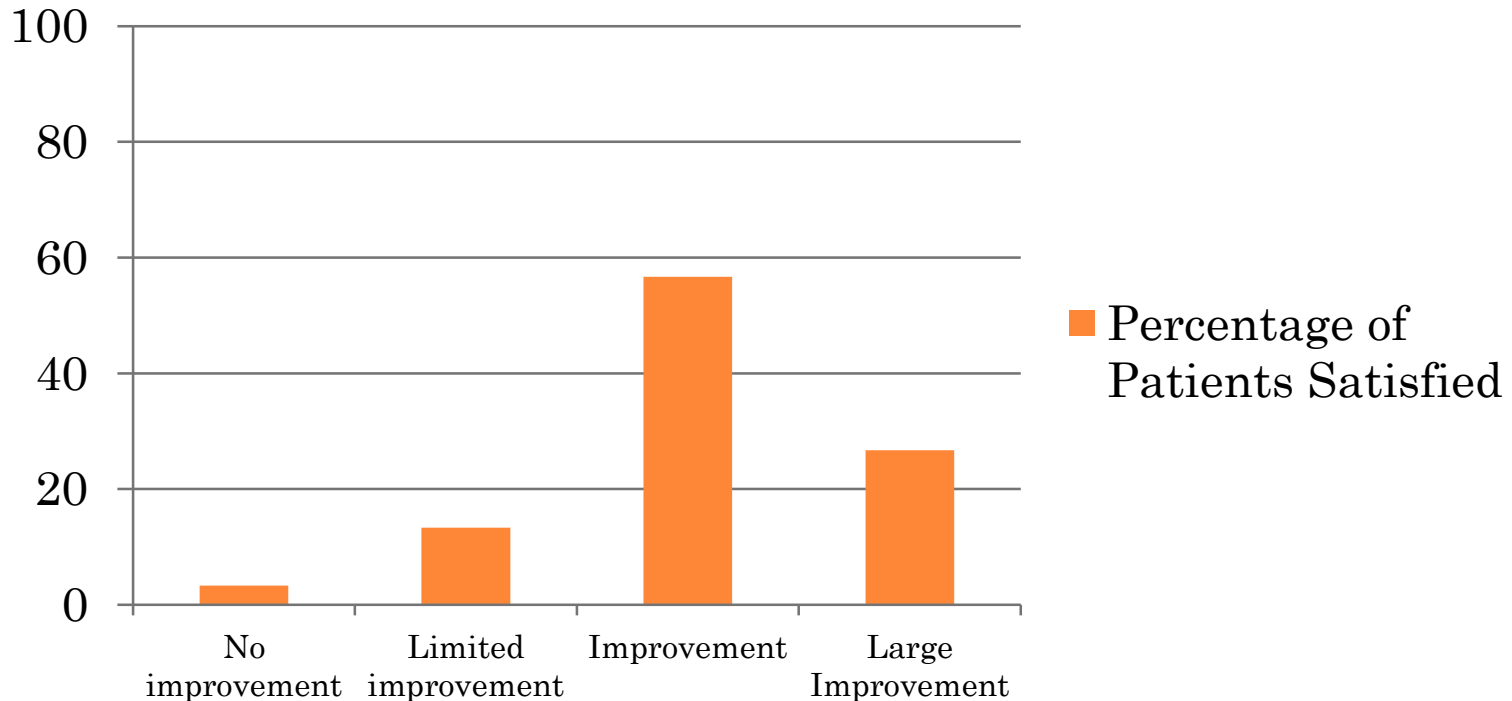
VAS scale was used for assessment.

S.No	Pain relief VAS Scale(Score 0-10)	No. of patients
1.	No improvement(0)	2
2.	Limited improvement (1-5)	3
3.	Improvement (5-8)	15
4.	Large improvement (8-10)	10



4. Overall Satisfaction

S.No	Improvement (Score 0-10)	No. of patients
1.	No improvement(0)	1
2.	Limited improvement (1-5)	4
3.	Improvement (5-8)	17
4.	Large improvement (8-10)	8



CONCLUSION

- By the end of the trial period 82% reported knee pain relief.
 - Subjects with grade 4 deformity could walk well enough for daily life.
 - Grade 3 patients showed improvement in mobility and pain relief.
 - Grade 1 and grade 2 restored normal lives within a period of 3months.
- The study concluded that knee deformities can be reduced by mechanical correction using customized insoles and customized shoes to align feet to natural position at an affordable cost.



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THANK YOU!

