

Summary

Current methods of taking impressions for orthotic devices include plaster bandage, fiberglass, and laser-optical scanner. This poster presents an alternative impression and fabrication technique for foot orthoses, ankle-foot orthoses, knee-ankle-foot orthoses, and thoracolumbar-sacral orthoses that utilizes the dilatancy principle (vacuum packing) initially investigated in the 1940's by WJ Mead.

To date, the foot orthosis and the ankle-foot orthosis systems have been tested on both able-bodied subjects and subjects with impairment. The knee-ankle-foot orthosis and the thoracolumbar-sacral orthosis systems are under development.

Objective

To create a potentially better, cheaper, faster, and greener approach for cost-effective services in both developing and developed countries.

Methods

This development project consists of 3 stages:

- Pre-clinical tests using a plaster model
- Test a minimum of 3 able-bodied subjects
- Test a minimum of 3 subjects with impairment

Each stage follows these steps:

- Take impression (negative mold)
- Convert impression to positive sand model
- Measure positive sand model to confirm accuracy

On subjects, additional steps are:

- Apply reliefs to positive sand model
- Fabricate orthosis
- Fit device to subject
- Ask subject to rate comfort of
 - The impression process
 - The fabricated orthosis

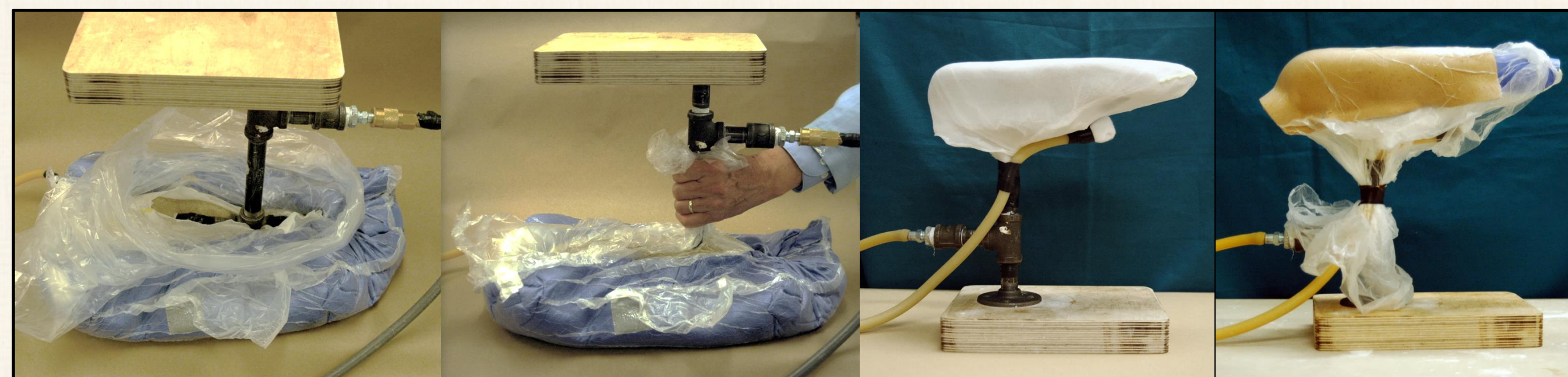
Researchers evaluate and modify system based on observations and subject feedback.

Results

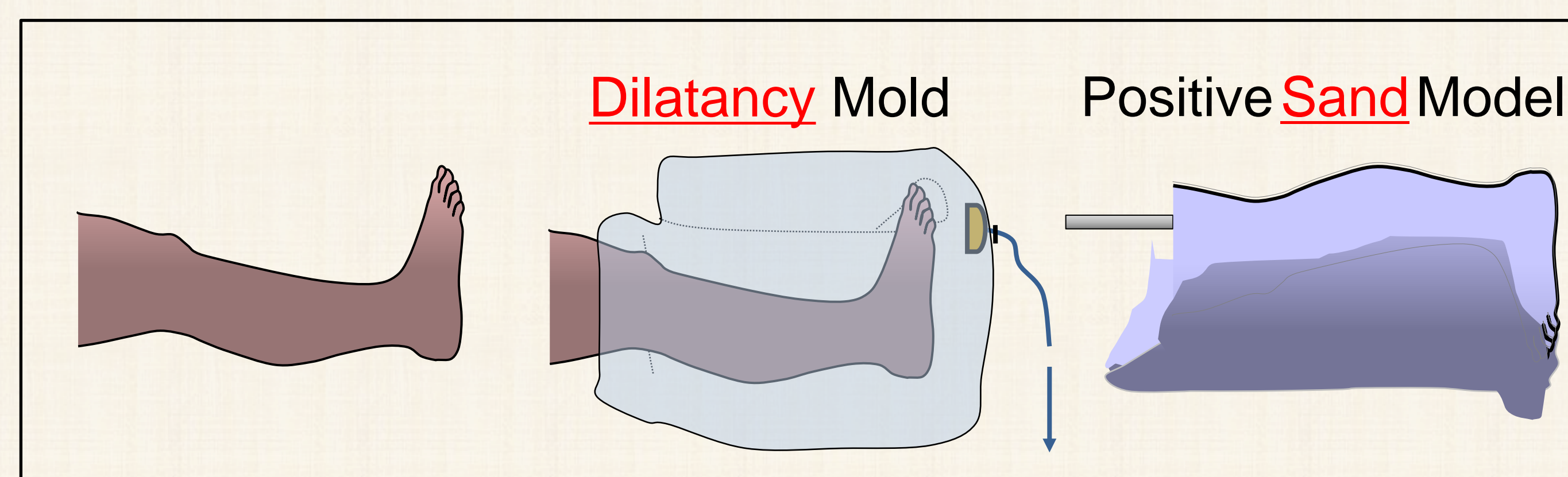
Dilatancy Process



Taking negative impressions for fabricating foot orthoses (FO)



Converting impression to positive sand model for thermoforming



Taking an ankle-foot orthosis (AFO) impression and converting to positive sand model



Negative mold to positive sand model to AFO

Feedback

ABLE-BODIED SUBJECTS

	FO		AFO		KAFO		TLSO	
	Impression	Fitting	Impression	Fitting	Impression	Fitting	Impression	Fitting
# of Devices	10	10	13	13	1	1	0	0
Avg Rating	0.9	1.2	1.0	1.8	1.0	2.0		

SUBJECTS WITH IMPAIRMENT

	FO		AFO		KAFO		TLSO	
	Impression	Fitting	Impression	Fitting	Impression	Fitting	Impression	Fitting
# of Devices	6	6	3	3	0	0	0	0
Avg Rating	0.8	2.3	1.0	1.0				

NOTE: 0 - most comfortable; 10 - least comfortable

Conclusion

Benefits of dilatancy plaster-less systems are:

- inexpensive set-up and maintenance
- light-weight and portable
- clean
- minimal wastage

Finally, the dilatancy systems enable practitioners to take fast, accurate impressions and fabricate devices for patients in a single clinic visit. This technology will be particularly beneficial in resource-limited areas.

References

- Mead W. Method for making and maintaining an impression of the shape of objects; 1949. U.S. Patent 2,472, 754.
- Robinson C, Wu Y, Michael M. Low-Cost Dilatancy System for Orthotics, AOPA's 2012 National Assembly. Boston, September 6 - 9, 2012.
- Wu Y, Conner L, Robinson C, Casanova, H, Michael J, Gard S. Development of a low-cost dilatancy-based casting system for fabrication of AFO: ISPO 2013 World Congress, India.

Acknowledgements: The content covered on this poster is funded by the National Institute on Disability and Rehabilitation Research Field Initiated Grant Number H133G110266. The opinions reflected on this poster do not necessarily reflect those of the Federal Government or Department of Education.

Team photo courtesy of RJ Garrick.