KevinRoot
MEDICAL

Cast to Scanning

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The Best Foot Orthoses For Your Patients

Cast to Scanning

Are you thinking of switching to 3D scanning? Podiatric clinicians are constantly wondering which method to perfectly capture a patient's contour is the most accurate and practically preferred. This document is a brief overview of the history, instructions for usage, pros/cons and costs of switching from a physical casting method to a 3D scanner.

Brief history

According to Modena specialists, 3D scanning began in the late 1960's. At that time, it was created by using projectors, lights and cameras. The technology since then has been rapidly developed and perfected to make it as easy as possible for daily usage. Laser stripe and laser point imaging was developed with varying results until Immersion and FARO Technologies were introduced, creating low cost manually operated digitizers. 2D slices, polygon models and other techniques were the staple at the time (History of 3D Scanners). Currently, the podiatric environment of 3D scanning involves using point clouds, sets of data points in a given space. Podiatric scanners measure the number of points on the external surface of objects. Point clouds are extremely helpful when used for rendering, animation and mass customization applications.

Devices and Software Needed

There are three main ways to capture scans and send them to our lab:

1. Portably, through a software program installed on a compatible Apple iPad with 3D scanner attachment
2. Portably, using Apple iPhone and **Foot ID aplication**
3. Stationary, through a custom software program coupled with a 3D imaging device.

KevinRoot Medical iPad app is available in the App Store for complementary download **HERE**.

KevinRoot Medical iPhone app is available in the App Store for complementary download **HERE**.

Legacy scanning systems (Delcam, TechMed3D, Tom-Cat, etc.) will continue to be accepted.

Portable 3D Scanning

Compatible Apple iPad

Scanner attachment:

- Structure Sensor Mark II

Scanning Software Program:

- KevinRoot Medical iOS App
- TechMed3D
- AOMS TOT by Sharp Shape

iPad, Sensor Attachment & Scanning Program:

- KevinRoot Medical iOS App

Compatible Apple iPhone (the list of **compatible iPhone models**)

Scanning Software Program:

- Complementary **Foot ID** iOS App made by KevinRoot Medical

Stationary 3D Imaging

- VeriScan Podiatric Scanner (VPS)
- Elinvision Scanner
- DelCam iQube (Elinvision rebranded discontinued, still functional)
- TOM-CAT Foot Scanner (discontinued, still functional)
- Sharp Shape 3D Laser Foot Scanner USB3D

Scanning a patient

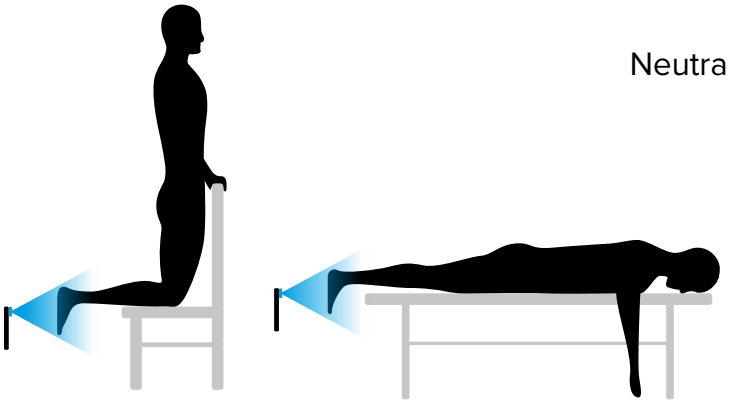
In general, scanning a patient's feet with a portable iPad Scanner is best done when approximately 1 meter away from the object and having an unimpeded 360° path around it. When the patient is placed in a stable position, the scan will capture the image well.

Next, the scanning software program will convert the files to STL files and you will be able to submit them to KevinRoot Medical. Each program may differ, so please refer to the programs' "How to" section on the software developers' page for more details.

In general, scanning a patient's feet with a stationary 3D imaging device requires placing the foot in/on the designated area of the device. When the patient is placed in a stable position, red line-lasers can process and complete an image in a matter of a seconds. Submission to KevinRoot Medical takes another few seconds. Each program can differ because of the customization options for the clinician's office, so please refer to the programs' "How-to" section on the software developers' page for more details.

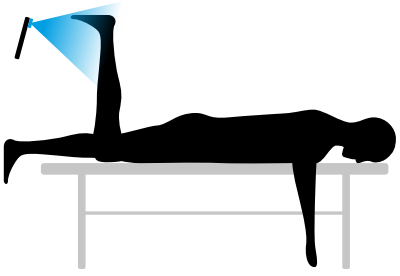
Scanning positions

Neutral Neutral



Manipulated Neutral

Scan for braces



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How 3D scans become orthotics

KevinRoot Medical offers a variety of methods to create orthotic and AFO frames from 3D scans. Preferably, measurements of the arch height and size of the foot are converted to creating a CAD CAM positive model for vacuum forming, but additive manufacturing (3D Printing) and subtractive manufacturing (Direct Mill Frame) are available too. For more information on the processes listed above, please visit here or review Section 3 of the KevinRoot Medical Orthose Reaction Force Guide.

Congruent Accuracy Rating

★★★★★ variation 2-5%
★★★★½ variation 6-9%
★★★★☆ variation 10-13%
★★★½☆ variation 14-17%
★★★☆☆ variation 18-21%
★★½☆☆ variation 22-25%
★★☆☆☆ variation 26-29%
★½☆☆☆ variation 30-33%
★☆☆☆☆ variation 34-37%
½☆☆☆☆ variation ≥38%

Foot Impression and Frame Fabrication Method Outcome Variation Chart

Indicate in special instructions if specific Fabrication Method is desired. Account standards can be set up by emailing **hello@kevinrootmedical.com**

ORTHOTIC FRAME FABRICATION METHOD (LAB PROCESS)	FOOT IMPRESSION METHOD (CLINICIAN PROCESS)						
	Plaster Slipper Cast 2% variation	**Foam Impression** 2% variation	**Existing Positive Model** 1% variation	**STS Slipper Sock** 10% variation	**3D Foot Scanner** 1% variation	**Pedobarography** 15% variation	**Redimold** 0% variation* (shoe size & arch height)
Plaster Positive Model Vacuum Formed 2% variation	★★★★★ 4% (lab standard)	★★★★★ 4% (lab standard)	★★★★★ 3% (lab standard)	★★★★☆ 12%	**N/A**	**N/A**	**N/A**
CAD CAM Positive Model Vacuum Formed 10% variation	★★★★☆ 12%	★★★★☆ 12%	★★★★☆ 11%	★★★☆☆ 20% (lab standard)	★★★★☆ 11% (lab standard)	**N/A**	**N/A**
3D Printed Frame 7% variation	★★★★½ 9%	★★★★½ 9%	★★★★½ 8%	★★★½☆ 17%	★★★★½ 8%	**N/A**	**N/A**
Direct Mill Frame 18% variation	★★★☆☆ 20%	★★★☆☆ 20%	★★★☆☆ 19%	★★☆☆☆ 28%	★★★☆☆ 19%	**N/A**	**N/A**
Redimold Positive Model Vacuum Formed 2% variation	★★★★★* 4%	★★★★★* 4%	★★★★★* 3%	★★★★☆* 12%	★★★★★* 3%	★★★½☆* 17% (lab standard)	★★★★★* 2% (lab standard)

* Because the redimold method has no physical or digital foot impression, the congruent accuracy from patient foot to cast is unavailable. However, the congruent accuracy from positive model to vacuum formed frame has a low degree of variation.

Pros

- Most 3D scanners available are capable of capturing high quality detail in high resolutions, i.e. 0.5mm for Structure Sensor Mark II, and only show a 1% variation in congruence.
- The process of capturing a scan is incredibly simple for a clinician and staff.
- The costs related to plaster, STS socks, impression foam and other supplies commonly used for creating a cast or impression are significantly reduced, while also maintaining a clean practice.
- Sending a digital scan through the internet to the orthotic laboratory eliminates any shipping costs and reduces some manufacturing time.
- At the end of the process, an excellent orthotic or AFO product is produced.

For more information on 3D scanning, please visit here or review Section 3 of the KevinRoot Medical Orthoses Reaction Force Guide.

Cons

- Although 3D scanners are incredibly accurate, the actual manufacturing process does produce a higher variation of congruency when compared to plaster slipper casts or foam impressions.
- KevinRoot Medical offers a general frame congruency chart that can be reviewed on here.

ORTHOTIC FRAME FABRICATION METHOD (LAB PROCESS)	FOOT IMPRESSION METHOD (CLINICIAN PROCESS)						
	Plaster Slipper Cast 2% variation	Foam Impression 2% variation	Existing Positive Model 1% variation	STS Slipper Sock 10% variation	3D Foot Scanner 1% variation	Pedobarography 15% variation	Redimold 0% variation* (shoe size & arch height)
Plaster Positive Model Vacuum Formed 2% variation	★★★★★ 4% (lab standard)	★★★★★ 4% (lab standard)	★★★★★ 3% (lab standard)	★★★★☆ 12%	N/A	N/A	N/A
CAD CAM Positive Model Vacuum Formed 10% variation	★★★★☆ 12%	★★★★☆ 12%	★★★★☆ 11%	★★☆☆☆ 20% (lab standard)	★★★★☆ 11% (lab standard)	N/A	N/A
3D Printed Frame 7% variation	★★★★½ 9%	★★★★½ 9%	★★★★½ 8%	★★★½☆ 17%	★★★★½ 8%	N/A	N/A
Direct Mill Frame 18% variation	★★★☆☆ 20%	★★★☆☆ 20%	★★★☆☆ 19%	★★☆☆☆ 28%	★★★☆☆ 19%	N/A	N/A
Redimold Positive Model Vacuum Formed 2% variation	★★★★★* 4%	★★★★★* 4%	★★★★★* 3%	★★★★☆* 12%	★★★★★* 3%	★★★½☆* 17% (lab standard)	★★★★★* 2% (lab standard)

- The reason for this variation is due to the CAD software program's rendering. CAD technicians are also economically very limited in time to create perfect congruence, and thus shortcuts must be used to shorten production time and an affordable solution. To produce the ideal frame congruence, it would significantly increase costs of production.
- Dependent on the manufacturing process selected by the clinician, some limitations on materials can be applicable.

For more information on 3D scanning, please visit **here** or review Section 3 of the Orthoses Reaction Force Guide.

DPM Opinions

Dr. Dianne Mitchell has stated that she enjoys using the scanners, but valuable lessons need to be addressed. A few examples of the lessons (view all examples here) mentioned are obtaining a scanner will not make-up for poor casting capabilities or patient's being able to sit still for the digital imaging (Mitchell 2008).

Dr. Huppin has written a more detailed article about scanning techniques, i.e. 1st ray plantarflexion techniques, which can be viewed here (Huppin 2009).

Specific Costs

Portable 3D Scanner:

- iPad: $329+ (new device) **BUY**
- Structure Sensor Mark II: $527+ **BUY**
- Elite Scan System: **FREE DOWNLOAD**

Stationary 3D Scanner:

- 3D Imaging: $3,000 (complimentary for qualified clients)
- Foot Plates: $3,500

Comparing the costs to maintain plaster, impression foam or STS socks with the costs of 3D scanning is the next step for a clinician interested in making a change. According to DPM's Lawrence Z. Huppin and Paul R. Scherer, the cost per patient for plaster was $19.96 to $35.43 (converted from AUD in 2/2019). In the same paper, they estimated that digital scanning cost $2.36 to $7.14 (converted from AUD in 2/2019) per patient (Huppin & Sherer 2017).

Conclusion

KevinRoot Medical believes this informative presentation provides a good sample of the starting off point when making a switch from a physical casts to digital ones. It is recommended to review and compare the costs for each option as prices may have fluctuated or changed since the creation of this presentation.

Please contact KevinRoot Medical for any additional questions.

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