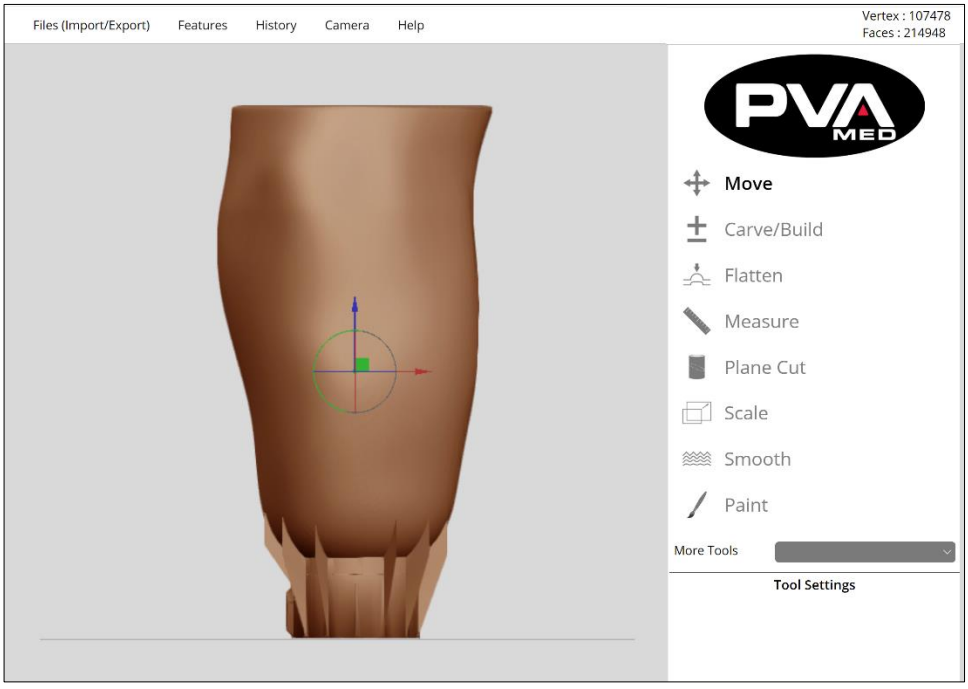
ALL THE TOOLS YOU'LL NEED TO FABRICATE DEVICES IN-HOUSE.



RAPID PLASTER® Software

User Manual

Revision F

PVA Med
Six Corporate Drive
Halfmoon, NY 12065

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1. Introduction

Before you operate this system, read the operation and setup manual. This will help you to become familiar with the product and ensure successful operation.

If any questions or problems arise, contact PVA's Technical Support department.

1.1 PVA Med Contact Information

Main Office **PVA Med**

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Fax +1-518-371-2688

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Email: med@pva.net

Customer Support

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Email: cs@pva.net

1.2 Document History

Revision	Revision Date	Reason for Changes
REV F	August 2021	WalkStrong
REV E	February 2021	AK By Numbers Updates
REV D	December 2020	Updated Screens. New Measure, Plane Cut, Paint, and AK By Numbers section
REV C	August 2020	AK By Numbers
REV B	August 2020	Software Screenshot Updates
REV A	January 2020	Initial Release

Note: All photographs and CAD model representations in this document are a "general representation" of the system and its components. The actual appearance of the system and its components can differ based upon customer specific configuration.

2.PVA Med Dashboard

2.1 Dashboard – Getting Started

The PVA Med Dashboard is included in the Emergence PRO™ O&P Package. As part of the onboarding process, you will receive a username and password to access all the dashboard's features and functions including access to the PVA Med RAPID PLASTER® Computer Aided Design (CAD)/Computer Aided Manufacturing (CAM) software.

2.2 Log In to Your Account

RAPID PLASTER® software requires Chrome for some of the functions so the latest version of the Google Chrome internet browser must be installed. If you do not have Google Chrome, you can download an installation file from Google for free **here**.

1. Navigate to My Account at **https://rapidplaster.pva.net/my-account/**. You should see the following screen.

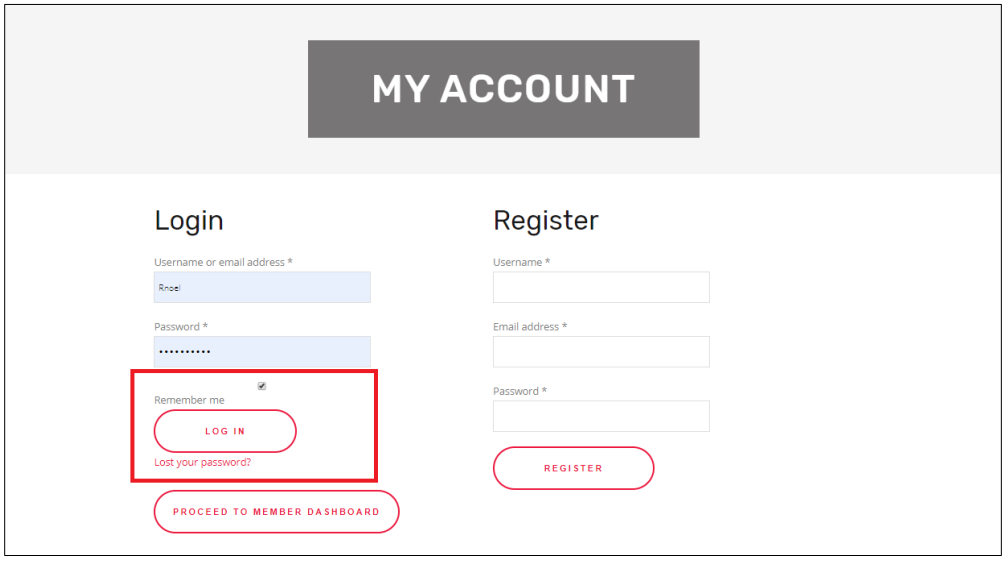


Figure 1: Dashboard My Account

A login is required to access Rapid Plaster, the software program used to digitally design and 3D print check sockets.

2. Enter your username or email address and password and click **Log In**. Select **Remember Me** to stay logged in on the device*. If unchecked, you will be required to log in each time you access the Dashboard.

***To use Remember Me, cookies must be enabled in Google Chrome (default setting).**

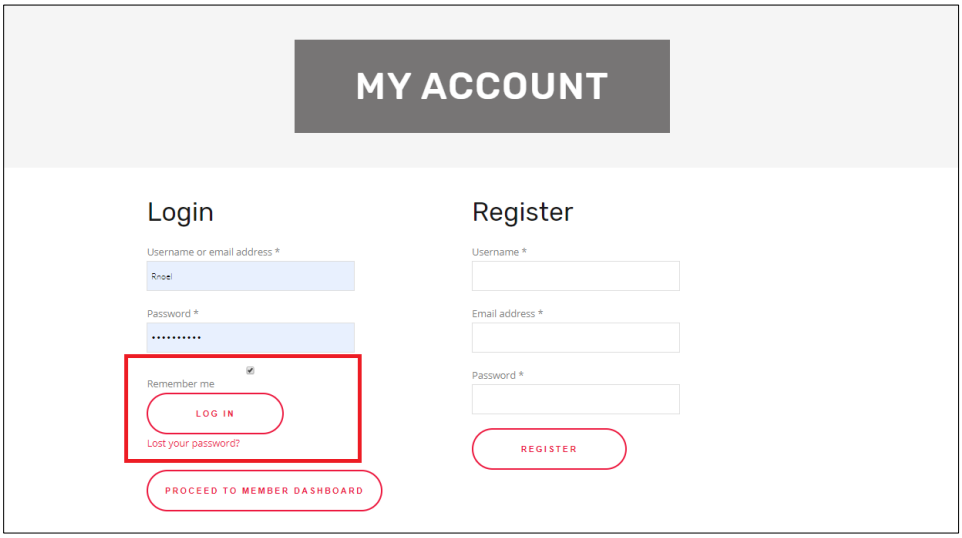


Figure 2: Dashboard My Account

Note: If you lose your password, click the "Lost your password?" link to request a password reset, then follow the instructions of the email that you will receive. If you do not receive an email with password reset instructions, call PVA Support at 518-371-2684 or email cs@pva.net to initiate a support ticket.

3. Once logged in to the Account Page, click the **Proceed to Member Dashboard** button. This will bring you to the Dashboard.

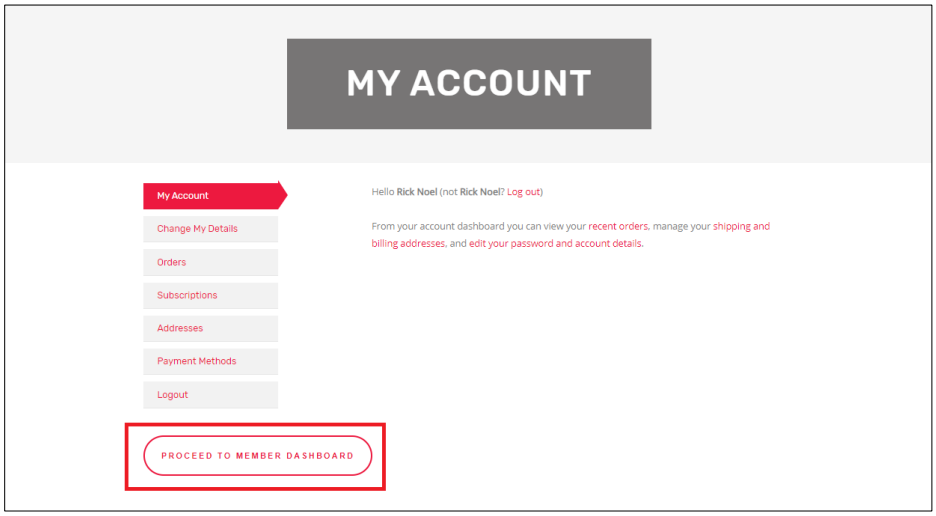


Figure 3: Member Dashboard

Note: If you are already logged in, the Dashboard can be accessed directly by navigating to: https://rapidplaster.pva.net/dashboard.

2.3 Dashboard Overview

The PVA Med Dashboard provides customers with exclusive online access to valuable digital fabrication resources. Each button in the Dashboard represents a PVA Med service or support feature for customers.

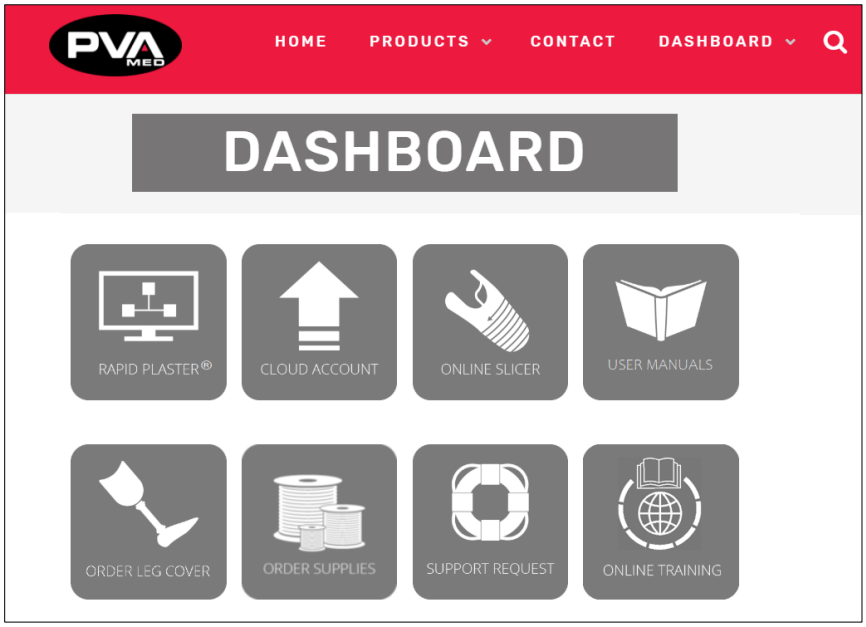


Figure 4: Dashboard Overview

The Dashboard can be viewed as your "virtual cockpit" containing all the tools, training and support needed to drive digital workflows in your practice. The following section provides a brief overview of each individual resource.

RAPID PLASTER®: PVA Med's proprietary CAD/CAM modification software. It gives practitioners the ability to make digital modifications to their positive models and then translate those models into printable devices that are preconfigured to run on the PVA MED printers for the recommended materials for a specific application (e.g. ClearFit™ for check sockets). RAPID PLASTER® will be covered in detail in the Modify Section.

Cloud Account: A secure location for you to share, store, and retrieve files including scanned 3D-models, modified positive models, and printer ready G-codes. The files within the PVA Med Cloud Account are accessible from within RAPID PLASTER®. The Cloud Account provides PVA customers with a secure, HIPAA-compliant mechanism to manage all files related to the Digital Workflow from scan, modify, print, and fit.

Online Slicer: PVA Med maintains an online slicing program for those utilizing CAD programs outside of RAPID PLASTER®. Users upload their modified positive model, select the model of the PVA Med printer, and select a slicing profile for the device to be printed. Once submitted, the user will receive an email with a printable G-code within a few minutes. Note: The online slicer feature is not for Emergence PRO™ customers who will access the Online Slicer within RAPID PLASTER®.

User Manuals: Provides quick, searchable access to the Emergence PRO™ manual which includes information designed to get PVA Med customers up and running with 3D printing devices for their patients as quickly as possible. The comprehensive manuals includes everything from printer unboxing, to verification prints, information about operating and maintaining your printer as well as helpful troubleshooting guides for resolving issues as you learn.

Order Leg Cover: Quick and easy access to our leg cover order form online. Also includes information about the ordering process.

Order Supplies: Offers users the ability to purchase recommended filament, tablet/scanner and more from PVA Med's online store.

Support Request: Click to enter a ticket, search PVA Med's knowledge base for answers to the most common questions. For questions not addressed in the knowledge base, users can create a support ticket as well as check the status of a ticket. Users will be contacted within one business day with solutions or request for more information. Pictures are extremely useful in diagnosing problems.

Online Training: PVA Med's online training is set up with seven modules to cover each step of the process in the workflow. Each module builds on the material covered in the previous module, so it starts with Module 1 and then moves onto the subsequent modules. For questions related to the training or to get help, send an email to med@pva.net or call us at 518-371-2684.

2.4 Cloud Account

Box is a cloud-based file storage system that is HIPAA-compliant and allows us to upload files to your PVA Med Cloud Account. This Cloud Account allows you to easily store and access all your scans, positive models, and G-codes in one place.

If you are using the recommended Comb app, a completed scan will be saved to the Comb Portal. Once saved, the scan can be downloaded to your computer or uploaded to Box for easy access when you modify in RAPID PLASTER®. You should have received your Cloud Account password when you purchased your printer package with your Dashboard subscription.

If you are using the Comb App that is included with the O&P package, scan the patient limb or positive model, then save your scan as either an OBJ file which save colors with scan or as an STL if you prefer your shape to be monochrome. Your saved scan will now be accessible from the Comb Portal. To access the scan in Rapid Plaster, download the scan file from the Comb Portal and save on the device running Rapid Plaster. Once downloaded, the file can be open in Rapid Plaster by selecting the option to Open File from Computer. Alternatively, the Comb Scan, once downloaded from the Comb Portal, can be uploaded to the PVA Med Cloud and made available to some or all users of that Cloud account.

2.5 Uploading Scan to Box

2.5.1 Structure Scanner User

Users can upload files to the Cloud Account by using the email address in the pre-configured tablet. Simply send to the Raw Scans email address preconfigured in your tablet Contacts.

Since this is a system generated email address, it is best accessed from the tablet Contacts application. Uploaded email recovery requests should be sent to med@pva.net with the subject: "**Need Cloud upload email address**". Users that need to recover their Box.com password can email recovery requests to med@pva.net with the subject: "**Need PVA Med Cloud password**."

2.5.2 Comb Scan Users

For Comb Scan users, once the file is downloaded from the Comb Portal to a device with email access, the user can then upload the scan file to the Raw Scans folder by sending download scan to the Cloud upload email address. Since this email address is a system generated email address, it is best to add a new user named Raw Scans to your address book, then associate the system generated upload email address with the Raw Scans contact to simplify the process while reducing the likelihood of mistyped email addresses.

3. Digital Workflow

3.1 Digital Workflow

You will be using a digital workflow when creating customized 3D printed devices with the PVA Med platform. The following four steps make up the digital workflow: **1**) **Scan 2**) **Modify 3**) **Print** and **4**) **Fit**.

1. **SCAN** the patient's residual limb, cast, or plaster model. The data from the scan is then imported into our modification (CAD) software, RAPID PLASTER®, to generate a 3D model.
2. **MODIFY** the 3D model in RAPID PLASTER® using a mouse or touchscreen. When the clinical modifications have been completed, the output is an STL file, a file format native to CAD software. Printers cannot interpret STL files and the STL file needs to be translated to a G-code. This process is called "slicing". The PVA Med Platform automatically slices all STL files supported by RAPID PLASTER®.
3. **PRINT** the device on the PVA Med printer.
4. **FIT** the device on the patient. Make any necessary adjustments.

3.2 Emergence PRO™ 3D Printing Platform

The Emergence PRO™ 3D Printing Platform is a digital workflow that takes your patient's check socket from start to finish.

The Emergence PRO™ 3D Printing Platform will make a 2.5, 3.0, or 4.0 mm-thick check socket with good visibility for fitting. The socket is printed in ClearFit™ or PCTG, which is a rigid, strong material that can withstand heat-forming and grinding. The check socket prints without trim lines, allowing you, the practitioner, to draw and grind your trim lines as desired.

As with all our 3D printed sockets, we recommend reinforcement for weight-bearing applications. The advantages of the check socket are clarity, short print times, and ease in modification. We recommend using fiberglass tape to reinforce your socket for a dynamic fitting in the office.

4.Scan - Step 1

4.1 Scanning with Comb Scan

For the first system you purchase, a Comb App scanning device will be installed for you. Additional compatible devices can be setup by downloading the Comb Scan app from the App Store at the link below:

https://apps.apple.com/us/app/comb-3d-scanner/id1508576484

Comb is compatible with the following devices:

- iPhone 12, 12 mini, 12 Pro, 12 Pro Max
- iPhone 11, 11 Pro, 11 Pro Max
- iPhone XR, XS, XS Max
- iPhone X
- iPad Pro 12.9" (3rd-4th generation)
- iPad Pro 11" (1st-2nd generation)

To complete the setup process for each device, you will need to sign up for a Comb Portal account (one account per device).

Go to https://www.combscan.com/sign-up-for-free-trial to sign up for a 10-day trial which will be converted to a one-year subscription for one device included in the O&P package. After you sign up for a trial account, you will receive an email requiring that you verify your email address and activate your Comb account. After verifying your email, you will receive a welcome email with helpful resources to help you get started.

The first time you log into Comb from your device, the license for the Comb Scan App, you will be asked to register the device. This process will tie your Comb license to that device. Only one device can be registered to a Comb account at any given time. After 90 days, the device registered to the Comb account can be switched if/as needed.

Additional licenses can be purchased from PVA Med as/when needed.

The Comb Portal account is necessary to use the Comb Scanning App. You will need to log into the Comb Portal before you can scan.

To see how to scan with the Comb Scan app, view the following instructional video:

https://player.vimeo.com/video/382823396?app_id=122963

4.2 Scanning with Tablet and Attached Structure Sensor Scanner

To scan a patient, a 3D scanner is used to generate a 3D scan of the patient's residual limb.

For the first system you purchase, the tablet and Structure Sensor scanner will be set up for you. If you need to set up additional tablets and scanners, download the following structure sensor apps onto your tablet and then follow the instructions in Section 4.2.

- **Structure Sensor Sample app by Occipital Inc.**
    - https://itunes.apple.com/us/app/scanner-structure-sensor-sample/id891169722?mt=8
- **Structure Sensor Calibrator app by Occipital Inc.**
    - https://itunes.apple.com/us/app/structure-sensor-calibrator/id914275485?mt=8

4.3 Scanner Calibration

Prior to using the Structure Sensor attached to the tablet to accurately scan, it must be calibrated. Once the calibration has been completed successfully, scanner calibration will only need to be repeated if/when experiencing issues with scanning.

Figure 5: Scanner Calibration

4.3.1 Structure Sensor Calibrator 4+, Occipital, Inc.

- Calibration is necessary to ensure appropriate scaling of the 3D models.
- An Internet connection on the device attached to the Structure Sensor is required to begin the calibration process.
- To calibrate, the Structure Sensor scanner should be plugged in to the tablet and the Structure Sensor Bracket placed flat against the tablet. Avoid covering the camera. See picture below for correct placement.

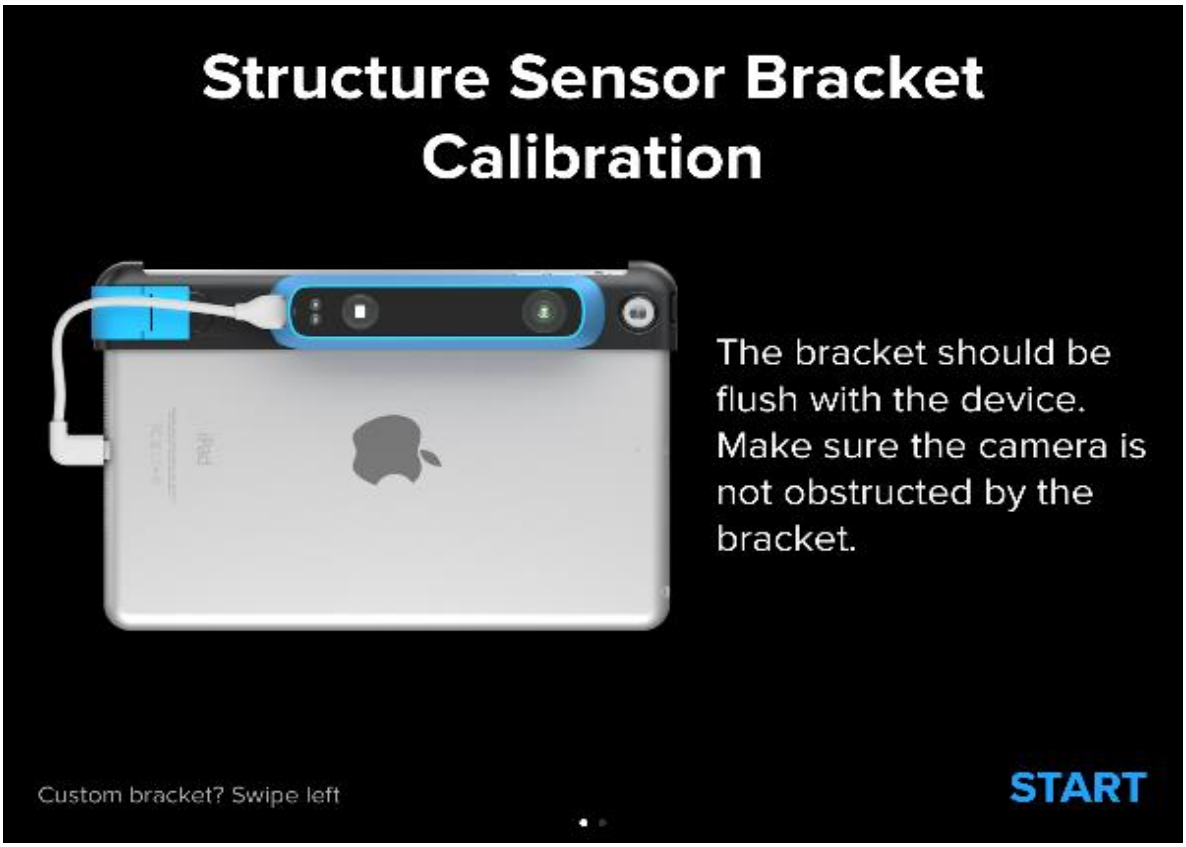


Figure 6: Structure Sensor Bracket Calibration Placement

- When starting the Structure Sensor Calibrator app, if you see the message "**Please Connect the Structure Sensor**," the Structure Sensor needs to be reinitialized.
    - Disconnect the cable that connects the tablet to the Structure Sensor, wait five seconds, then reconnect.

- Sunlight or a well-lit room are required for successful calibration. Move to a sunlit area, outside or near a window with sufficient sunlight. The option to calibrate the sensor indoors will become available once sufficient light is available. You may have to try several positions to be able to **Enable Indoor Mode** (advanced).

Figure 7: Insufficient Sunlight

- Structure Sensor Calibrator in-app tutorials will walk you through the process of scanning and aligning the calibration. When completed, click **Save Calibration** to upload it to your sensor.
- Users who select Indoor Mode will see a pop-up warning that must be acknowledged by clicking the **OK** button to continue.

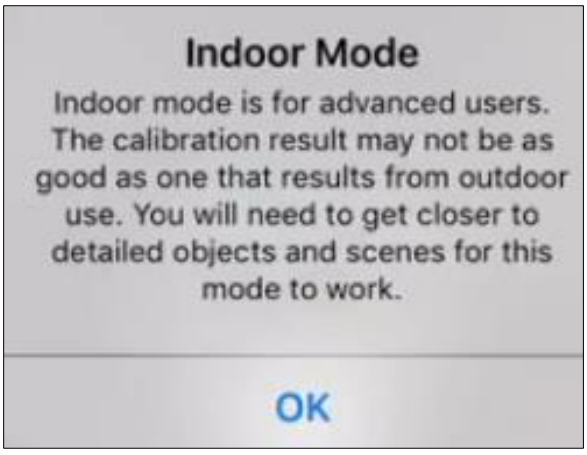


Figure 8: Indoor Mode

4.4 Preparing for a Scan

- The model/cast should be matte and placed on a flat reflective surface as to direct the scanner to pick up only the model and not the background. We suggest placing the model/cast on a stool covered in white copoly plastic.
- Avoid having objects that are not part of the model you are scanning, in the background while taking the scan.
- If something is shiny, put a tight sock or nylon over. This should not change the shape or size of model.
- For best results, use fluorescent or flat lighting to eliminate shadows. Ideally scan in an interior room, eliminating interference from natural light (i.e. from a window).

4.5 Taking and Exporting a Scan

- Using the Structure Sensor sample app, adjust the virtual box that appears on the tablet to fit around the model by pinching the screen.
- Slowly walk around the model and follow the directions given by the app. Red spots mean that you are too close to the model.
- When completed, inspect and rotate the virtual model to ensure it is an accurate scan with no holes or objects in the background. Use the Back button to take another scan, if needed.
- **Scans do not automatically save.** You must click **Email** to export and save the scan using your own email or a Box/Cloud Account email provided by PVA Med.
- If you send your scan to your email, save the attachment to your hard drive and then upload it to RAPID PLASTER® by selecting **Open from Computer** in the File menu.
- If you send your scan to your Box/Cloud Account, it will go to your clinic folder in a sub-folder called **Raw Scans**. The scan will email as a file called "**Model.zip**" with a preview image. PVA Med recommends renaming this file to easily find it later.

4.6 Using Other CAD/CAM Software and Scanner

The Emergence PRO platform offers a comprehensive, pre-integrated solution with components that work together seamlessly and utilize standards-based files. However, there are few constraints on using third-party 3D scanners and CAD/CAM software within the workflow. Advanced users may choose to use different scanners or programs due to personal preference or existing investments.

Any 3D scanner that produces an OBJ or STL file may be used in the workflow. Be sure to check the scanner specifications as many 3D scanners come with different degrees of accuracy.

Any CAD software that supports importing scan files and converting to an OBJ or STL file may be used to modify your positive model. Be sure to check the CAD software's capabilities as some programs may require you to convert from an OBJ or STL file before making modifications and then convert back to an OBJ or STL file.

Any CAM software that works with an OBJ or STL file may be used in the workflow. We recommend using Rapid Plaster as it is already configured to work with your printer. If you use a third-party CAM software, make sure that settings in the software are properly set to work with your printer. Running a print without the proper settings may lead to poor prints or, in severe cases, damage to printer components.

5. Modify - Step 2

5.1 Modify with RAPID PLASTER® CAD/CAM Software

After scanning the patient, plaster model or cast, the data is emailed to the Cloud Account and can be imported into RAPID PLASTER®. The modification software is used to modify the positive model digitally then prepare a printer-ready G-code file for the desired device type (e.g. AK/BK puck luck/closed distal, etc.) so the device can be printed.

RAPID PLASTER® supports importing .OBJ files, a leading industry standard format for scans. RAPID PLASTER® also supports importing .STL, digital shape files, which is a leading standard for digital 3D models.

Note: RAPID PLASTER® runs on any device that runs Google Chrome Internet browser. The only software environment requirement is to use the latest version of Google Chrome for the best user experience. The latest version of Chrome is available to download for free at https://www.google.com/chrome/browser/.

5.2 Access a File

The first step to access a file is to import the 3D model into RAPID PLASTER® by opening a scan or positive model. This can be done by opening a file on your computer (i.e. device) or from the Cloud. When launching RAPID PLASTER®, a welcome message displays presenting users with two options to open a digital scan or existing positive model: **Open From Cloud** or **Open From Computer**.

Figure 9: RAPID PLASTER® File Options

5.2.1 Log In To Cloud

PVA Med currently uses Box.com for HIPAA-compliant file storage and sharing. To open a scan or positive model from your Cloud Account, click the **Log In** button under **Files** (**Import/Export**) → **Cloud Account**.

Note: The first time you log in to your Cloud from within RAPID PLASTER®, you will have to log in to Box (from within RAPID PLASTER®) and authorize RAPID PLASTER® to access your Cloud Account. Click Grant access to Box button.

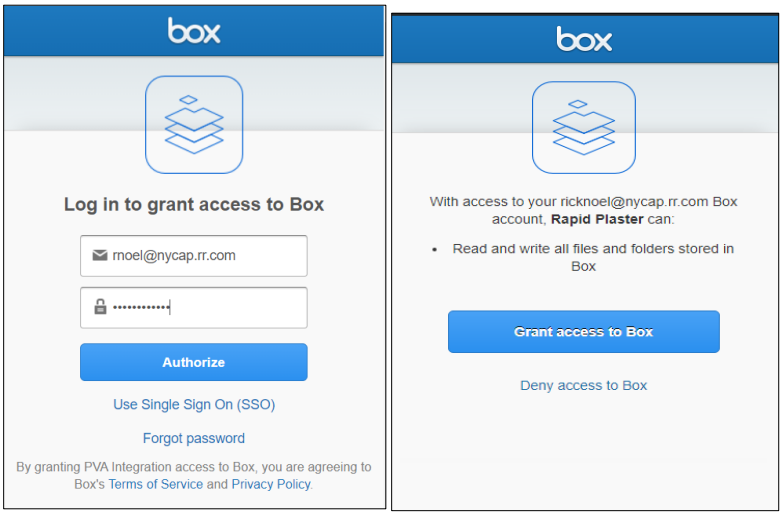


Figure 10: Box Login

After authorizing RAPID PLASTER® to access your Box account, you will now see the option to **Open From Cloud** in the RAPID PLASTER® File Menu.

5.2.2 Open From Cloud

1. From the Files (Import/Export) menu, select **Open From Cloud**.

Figure 11: Open From Cloud

2. Navigate to the folder and file that you want to open.

3. Click on the file to download it from the cloud and open in RAPID PLASTER®. Users can select any .OBJ, .STL or .RP file types to modify in RAPID PLASTER®.

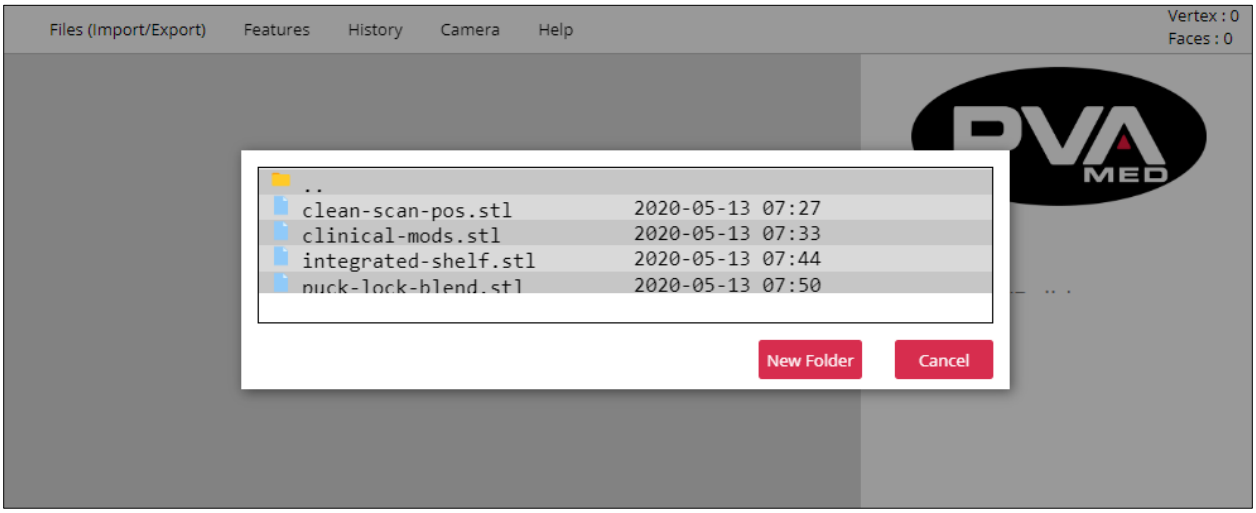


Figure 12: Select RAPID PLASTER® File

5.2.3 Save To Cloud

PVA Med recommends saving all files, including raw scans, modified positive models, and G-codes to the Cloud Account for secure storage while supporting collaboration between clinicians, technicians, and anyone else involved in the digital workflow.

1. Select **Save To Cloud** from the File Menu.

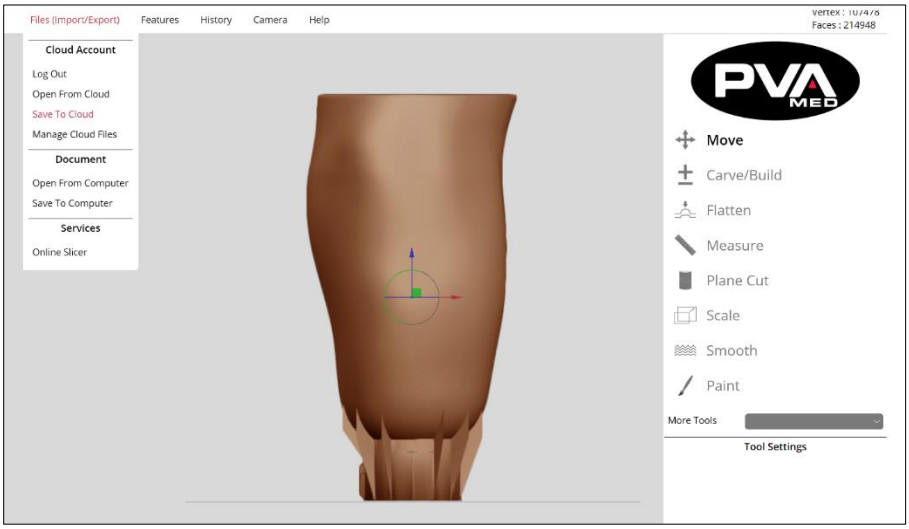


Figure 13: Save To Cloud

2. Navigate to the desired destination folder within the Cloud Account.
3. Enter a file name and click the **Save** button. This will save the modified digital model to your Cloud Account.

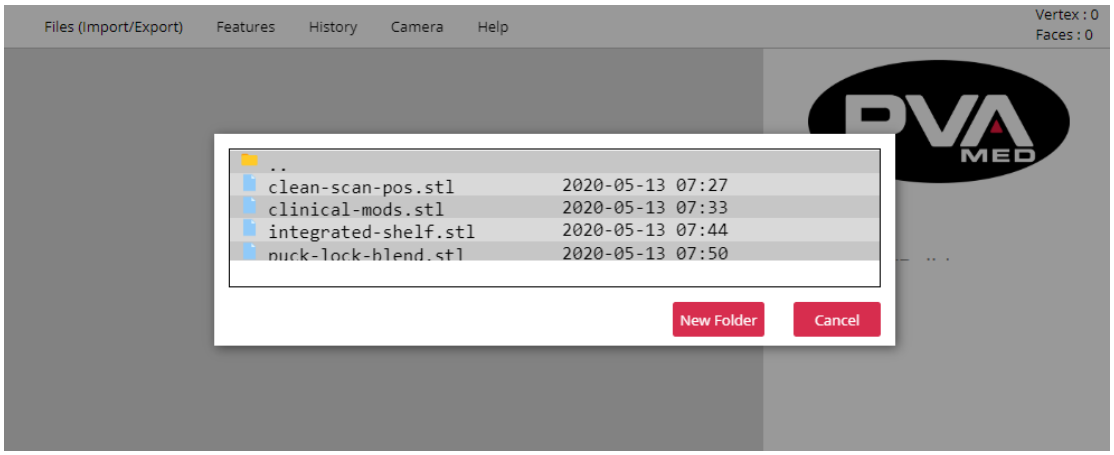


Figure 14: Enter File Name

5.2.4 Manage Cloud Files

To rename or delete files and/or folders or change the folder hierarchy without leaving RAPID PLASTER®, click **Files** (**Import/Export**) → **Cloud Account** → **Manage Cloud Files**.

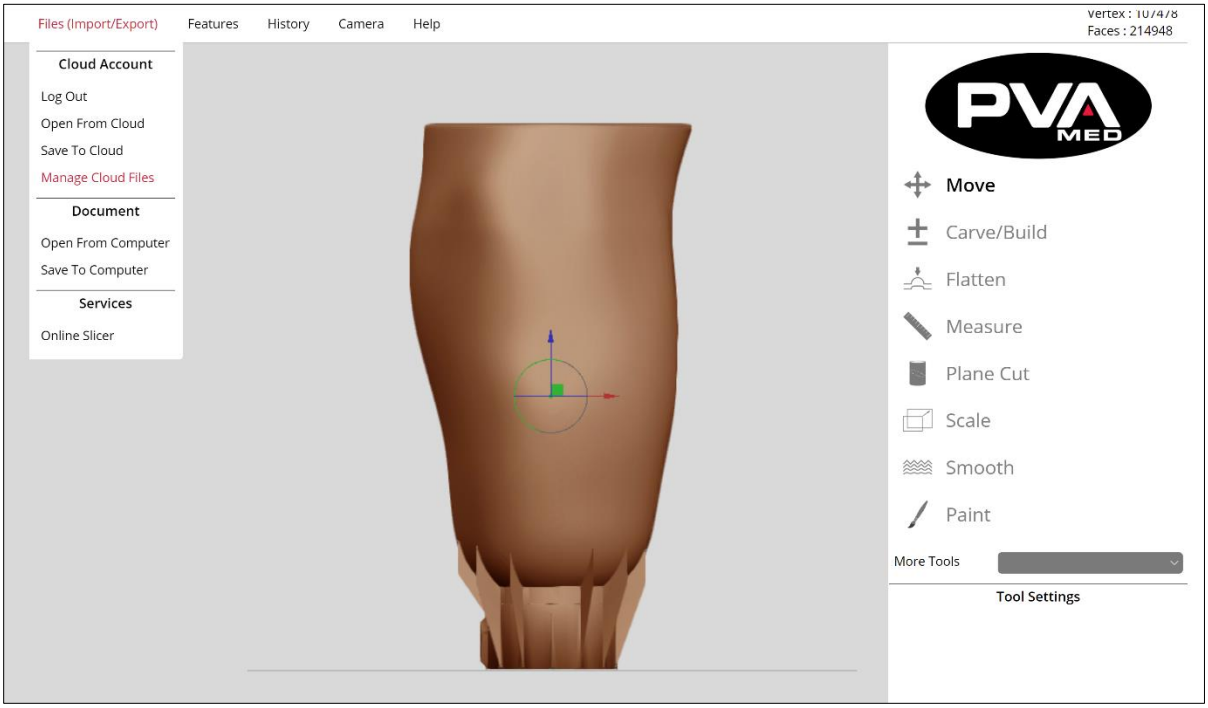


Figure 15: Manage Cloud Files

You can also access this feature by selecting **Cloud Account** from the Dashboard.

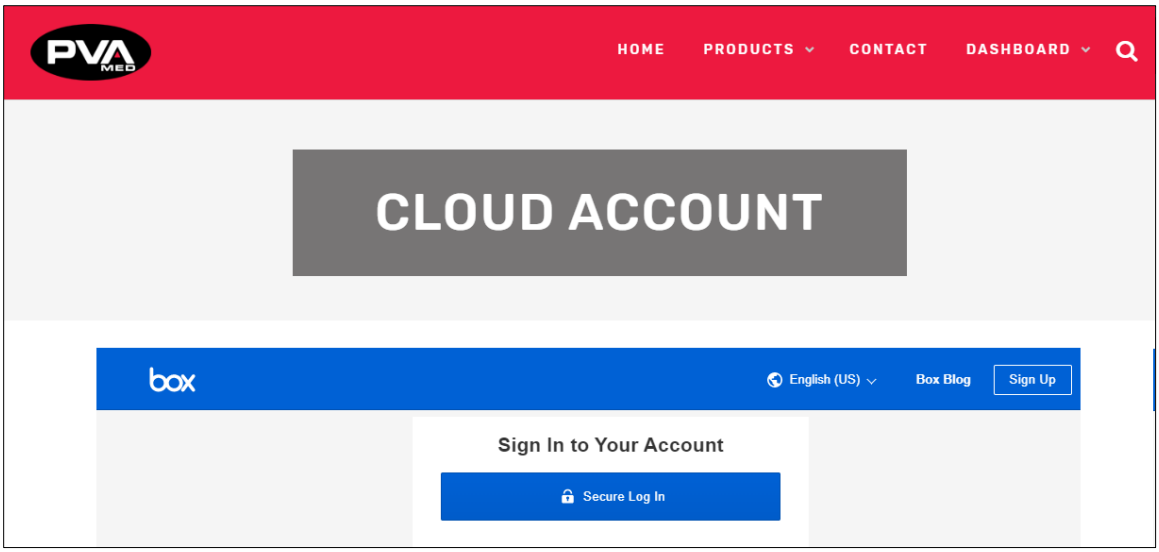


Figure 16: Cloud Account

To access your Cloud Account files, simply log in to your Cloud Account by clicking the **Secure** Log In button, entering your Box credentials, and clicking **Go to Your Files**.

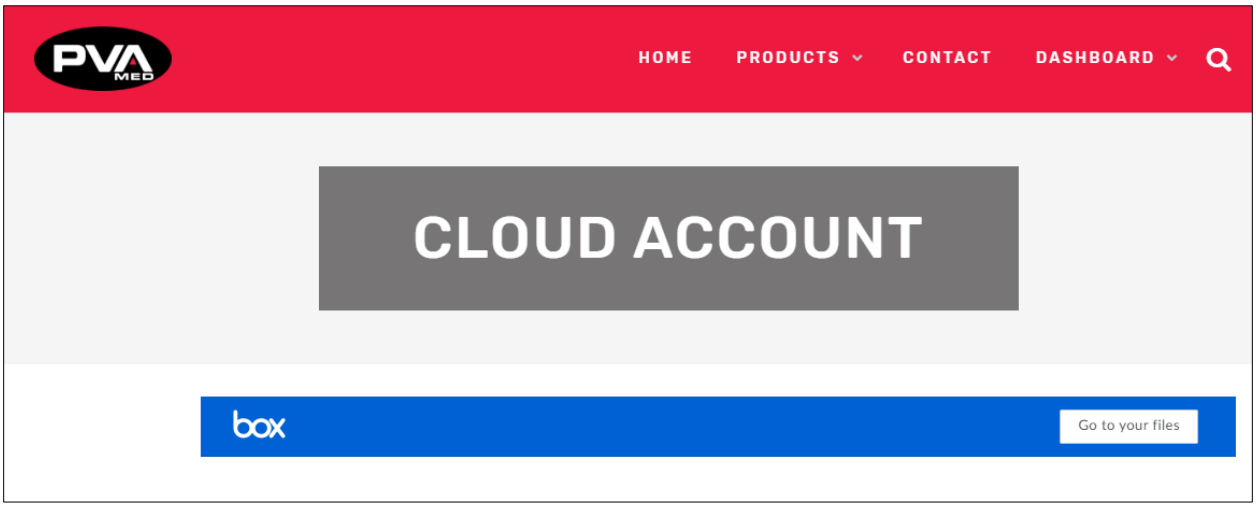


Figure 17: Go To Your Files

After clicking **Go to Your Files**, drag the white cloud into the dark cloud to complete the cloud authentication and authorization process.

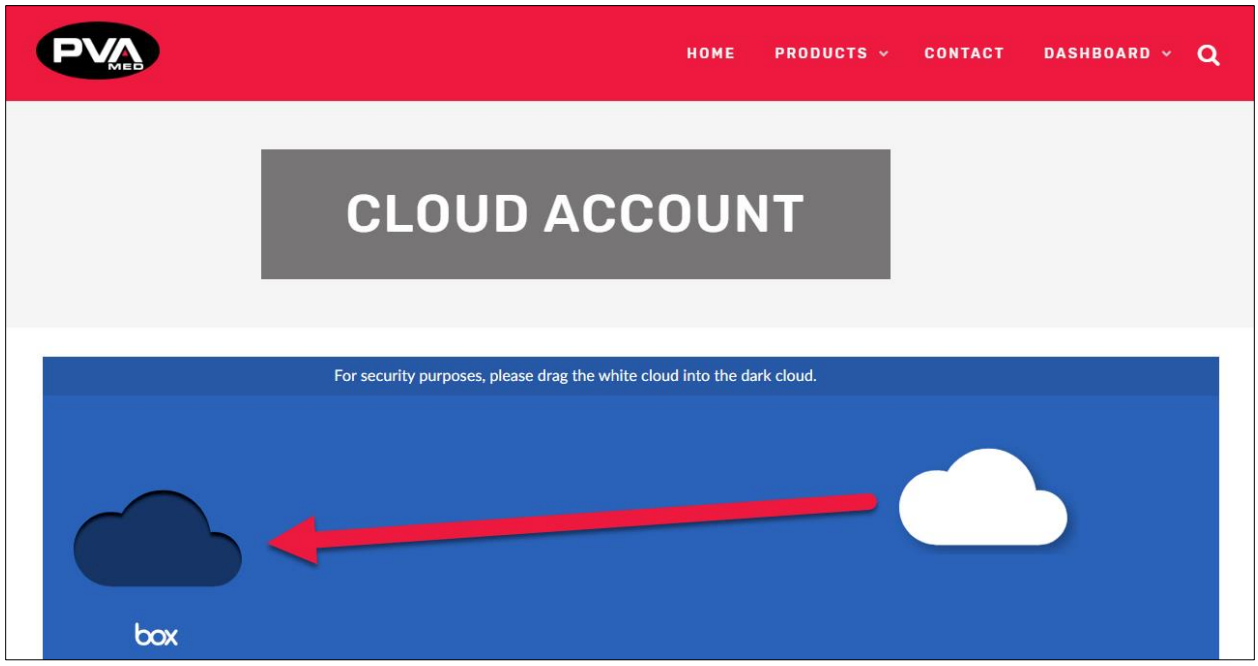


Figure 18: Cloud Authentication

Once Box is authorized to access the RAPID PLASTER® application, Cloud Account files can be managed directly from within RAPID PLASTER®.

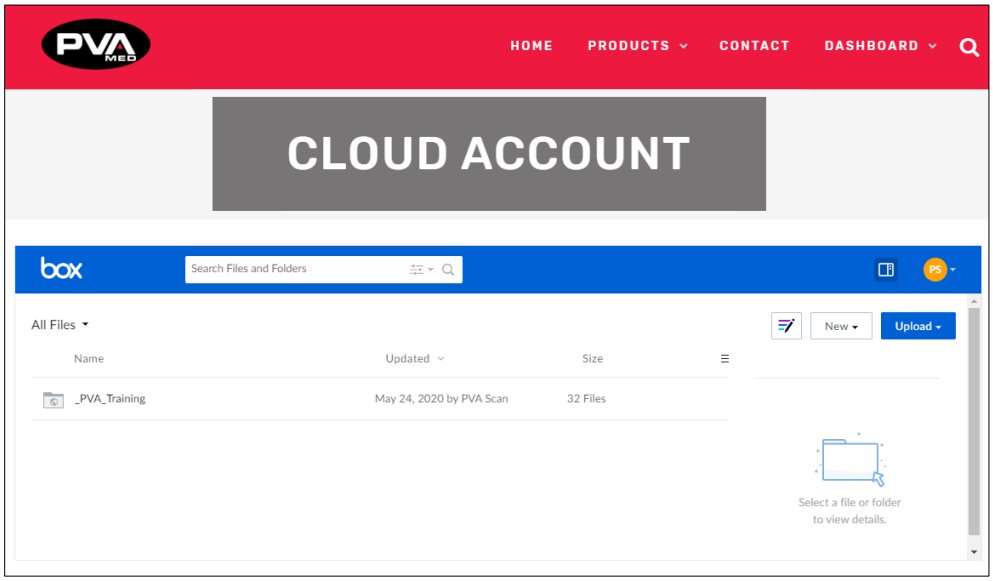


Figure 19: Cloud Account Files

5.2.5 Open From Computer

For users who wish to work with files locally, they have the option to open and save files to their device. To open a file locally, navigate to the **Open From Computer** option from the **Files** menu. This will bring up the File Open dialog box where the user can select which file they want to open in RAPID PLASTER®.

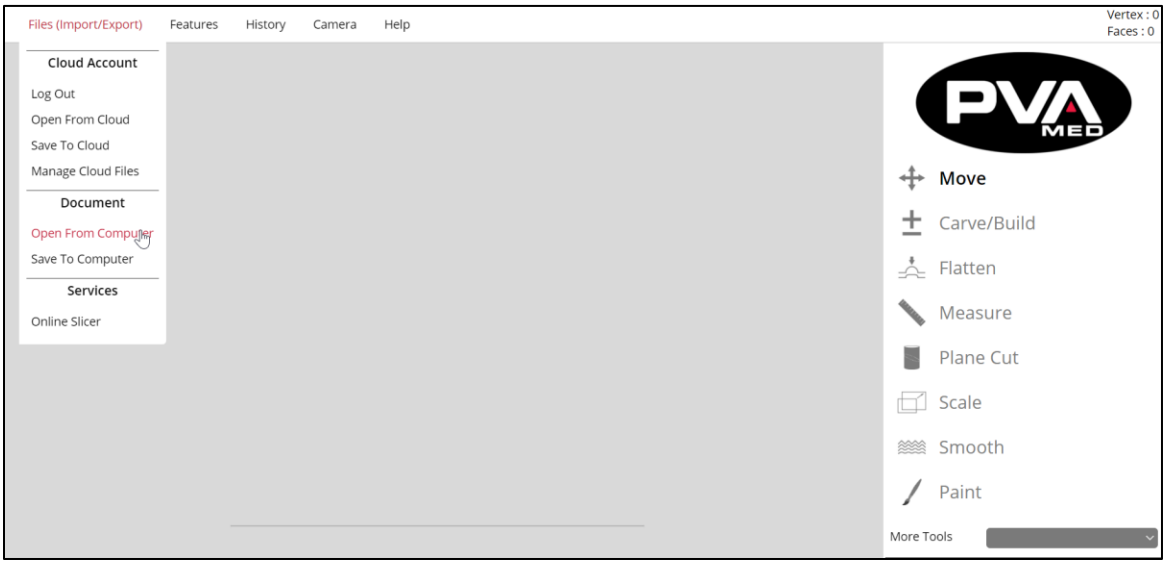


Figure 20: Open From ComPuter

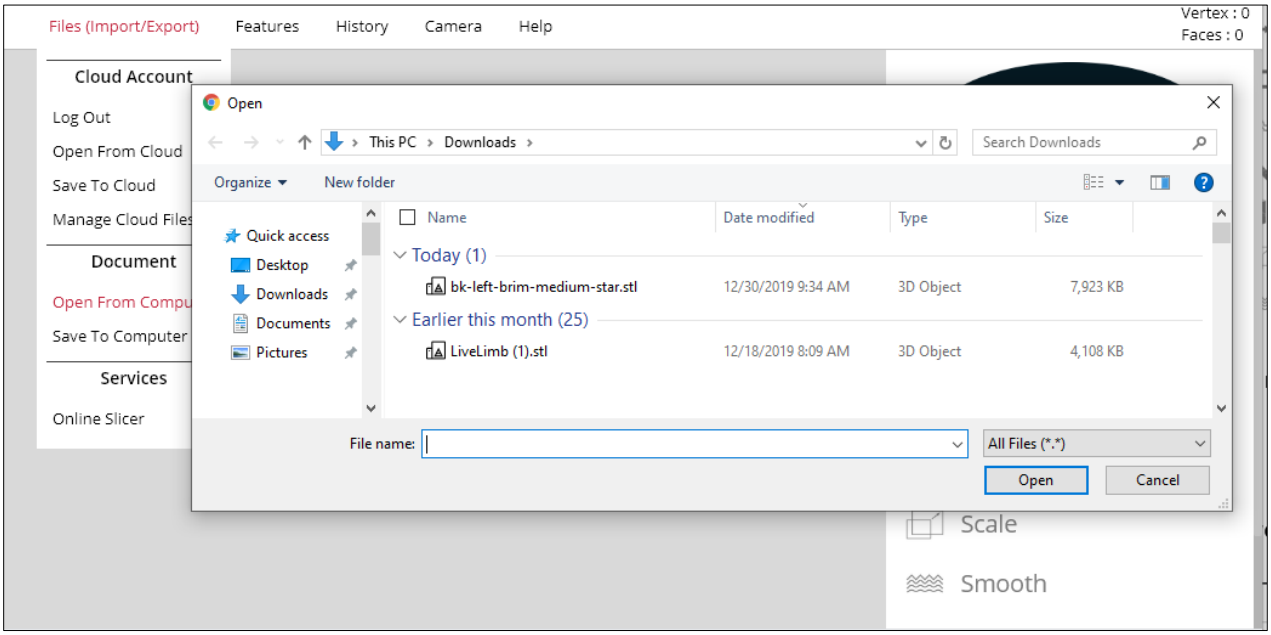


Figure 21: File Open Dialog Box

5.2.6 Save To Computer

1. To save your modified positive model to your device, click on **Save To Computer** from the File Menu.

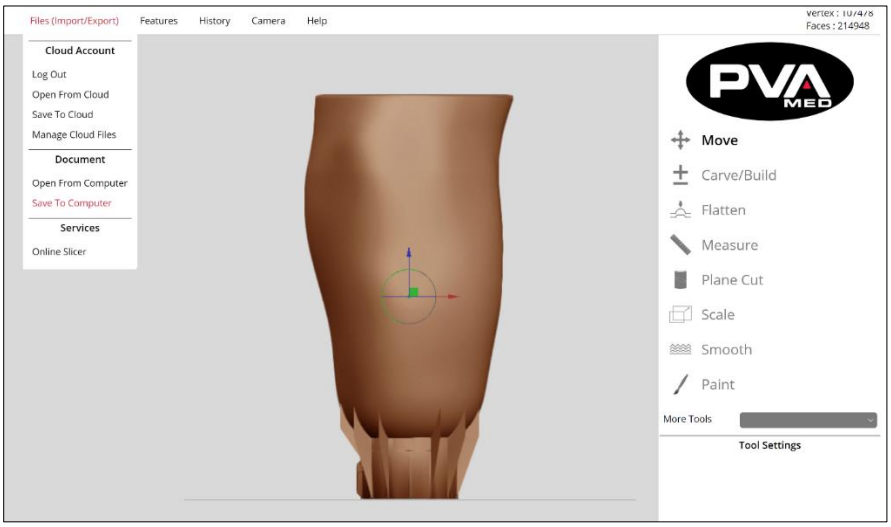


Figure 22: Save To Computer

2. Enter the name of the file that you would like to save to your computer (or device such as phone or tablet).

3. Click **Download** to save. This will save a copy of your modified positive model in the default download folder of the device.

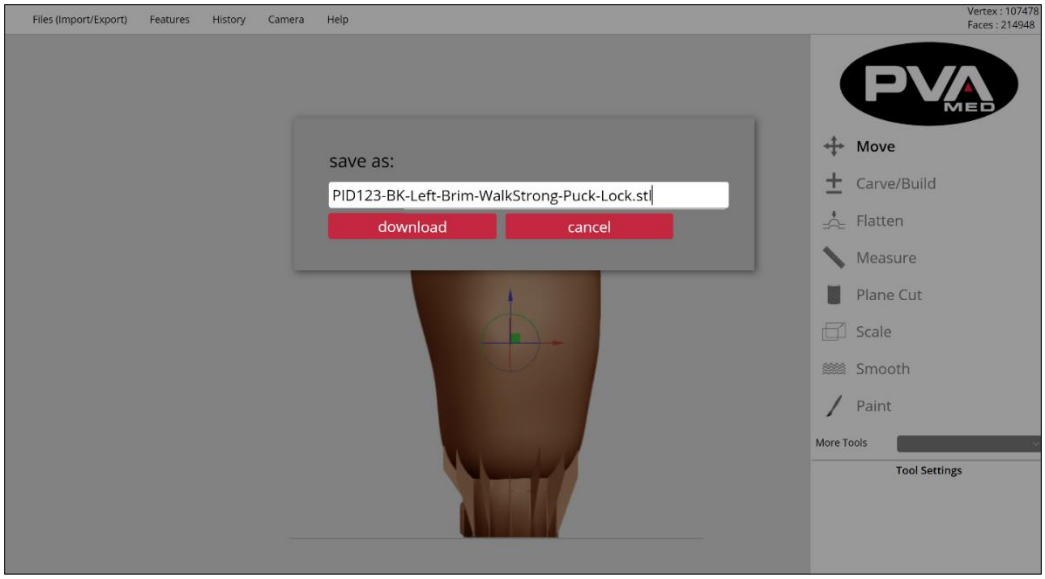


Figure 23: Save Modified Positive Model

5.2.7 Online Slicer

After modifying the model with the determined clinical modifications, you can slice the model for a G-code. Under “Files (Import/Export)”, move the cursor down to “Online Slicer”. The online slicer in RAPID PLASTER® currently supports the following PVA printers:

- **Emergence PRO™ Version 2**
- **Emergence PRO™ Version 1**
- **Create 5400**
- **Create 1400**

Move the cursor over your printer, then move the cursor over the material with which you plan to print. Finally, click on the distal attachment you have merged with the socket.

For example, **Emergence PRO™ v2 → ClearFit™ Material → WalkStrong™ Puck Lock 3 mm**.

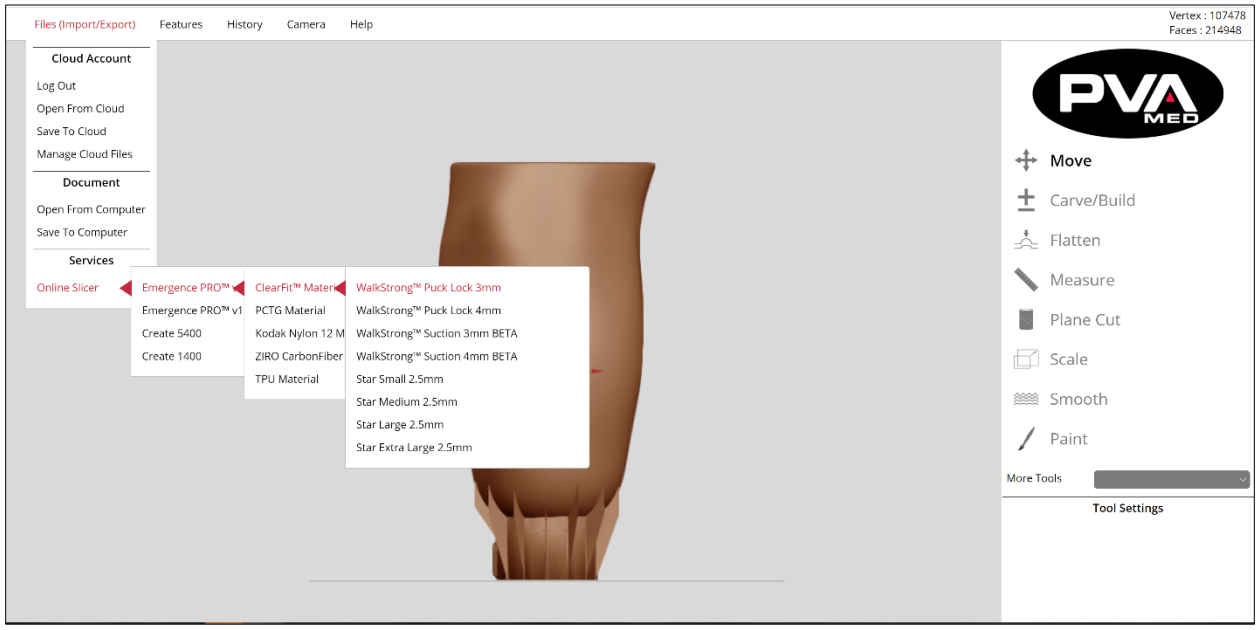


Figure 24: Online Slicer

Slicing a WalkStrong Socket

1. Navigate to the main menu.
2. Select **Files → Online Slicer**.
3. Select either **Emergence PRO™ v2** or **Emergence PRO™ v1**.
4. Select **ClearFit™ Material**.
5. WalkStrong sockets can be printed with a uniform 3 mm or 4 mm wall thickness. Based on factors such as patient weight and activity level, select the corresponding slicing profile to prepare your WalkStrong socket for printing (ex. WalkStrong™ Puck Lock 3 mm or WalkStrong™ Puck Lock 4 mm).

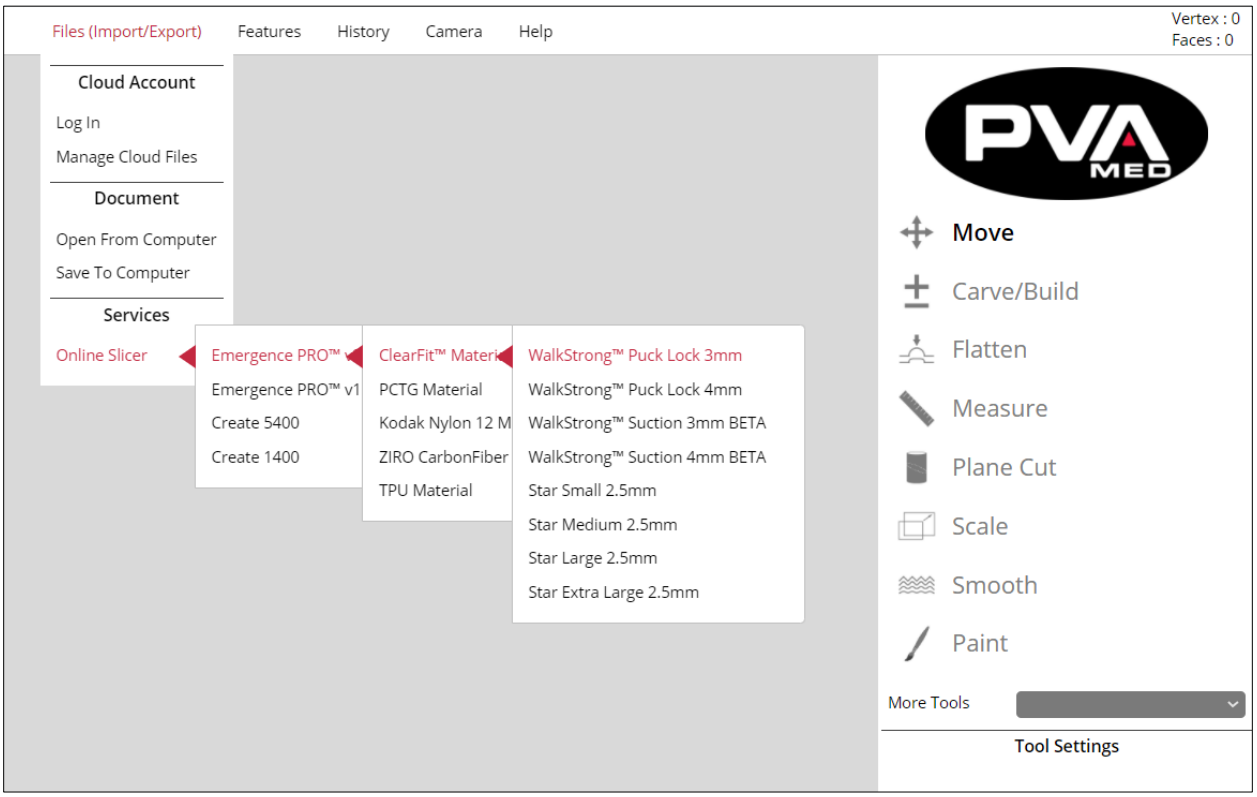


Figure 25: Slicing WalkStrong Socket

5.3 Modify Model Using Tools

Once the positive model has been imported to RAPID PLASTER®, you can begin modifying the model. The software tools are designed to mimic tools commonly used to modify physical models, simplifying the learning process and integrating them into your workflow.

The positive model can easily be modified using a mouse or a touchscreen. The light gray line below the model is the print bed. It will appear as a horizontal grid and acts as a reference for orienting the model.

All software tools are listed on the right side of the screen, beneath the PVA Med logo. There are additional tools accessible through the **More Tools** dropdown menu at the bottom of the list.

Begin your clinical modifications by selecting the desired tool and adjusting the tool options.

Note: Tool options differ between tools and are dependent upon the active tool. The tools and their options will be further defined in the following descriptions.

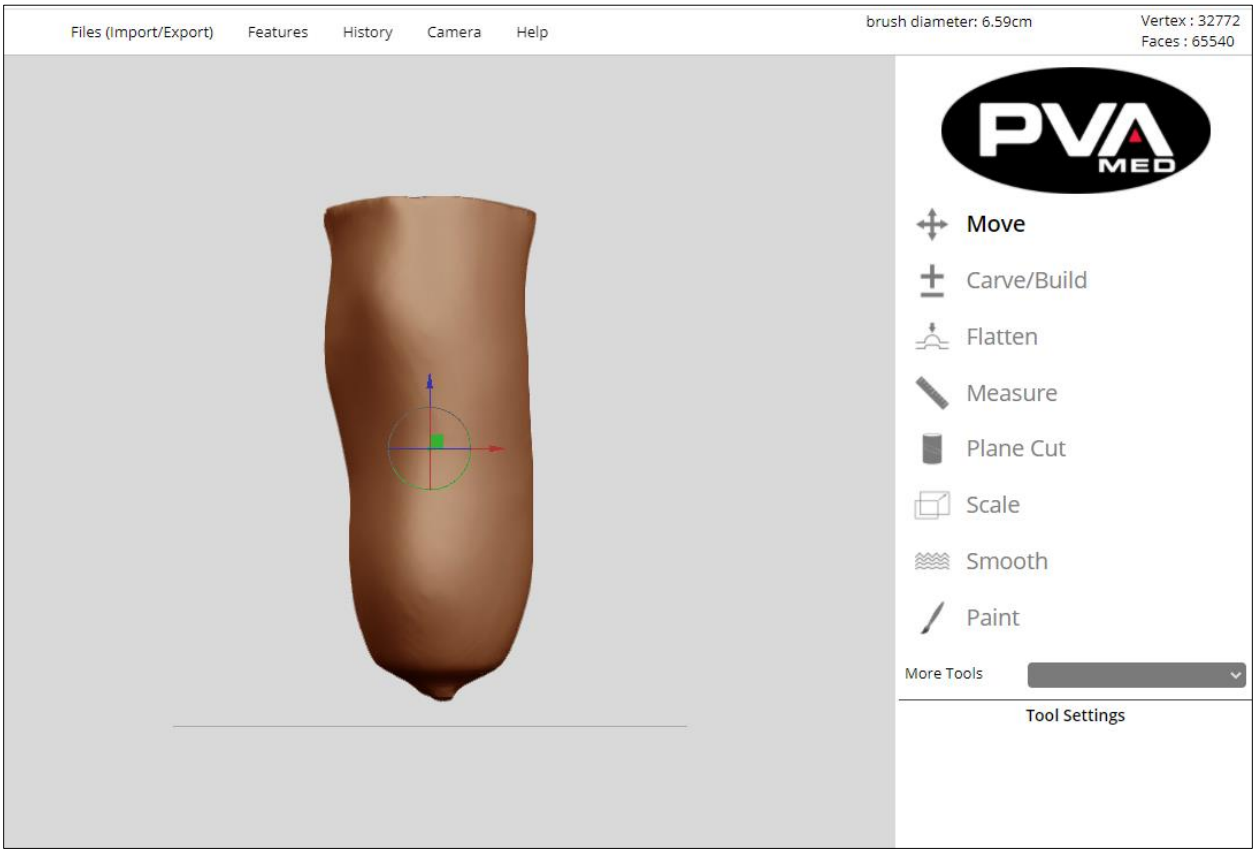


Figure 26: Modification Tools

5.3.1 Move

The Move Tool is the default tool when RAPID PLASTER® is opened.

- Use the arrows to slide the model up or down, or left to right, to position it into the correct location. To use the arrow keys, start by selecting the desired arrow which will turn yellow to indicate that it is selected.
- While selected, hold down the left mouse key or using the touch screen to drag the model in the direction indicated by both the head and the tail of the arrow. The arrow must remain selected during any move as indicated by the yellow color.

In the example below, the model can be dragged up or down in the vertical direction while the vertical arrow is selected.

Figure 27: Move Tool

- Use the half circles to rotate the model.

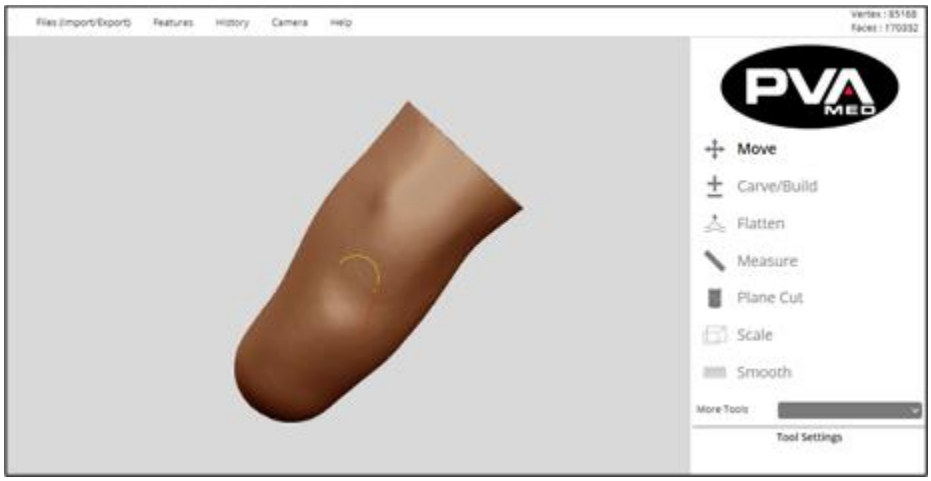
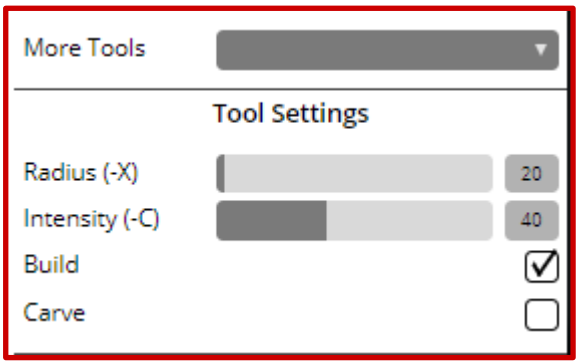


Figure 28: Rotate Model

5.3.2 Carve/Build

The Carve/Build tool is used to remove/add “virtual material” to the digital positive model that are reflective of the modifications that a clinician or technician would make on a patient’s plaster positive model.

Screen Display



Tool Settings

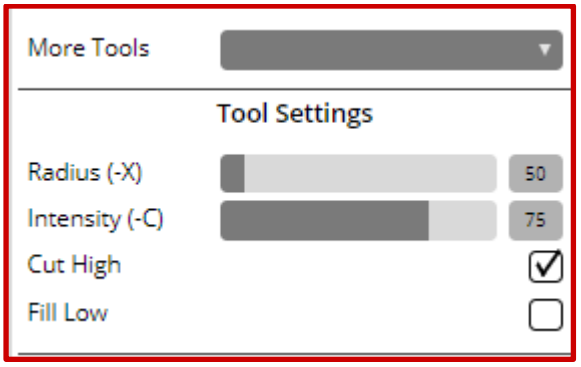
- **Radius (-X):** Changes the size of your brush. The larger the brush, the larger the affected area is.
- **Intensity (-C):** Changes the severity of the modification. A larger value will make the modification more prominent.
- **Build**: Check this box to add material to the positive model with each tool stroke.
- **Carve**: Check this box to remove material from the positive model with each tool stroke.

Figure 29: Carve/Build

5.3.3 Flatten

Removes material to create a level surface.

Screen Display



Tool Settings

- **Radius (-X):** Changes the size of your brush. The larger the brush, the larger the affected area is.
- **Intensity (-C):** Changes the severity of the modification. A larger value will make the modification more prominent.
- **Cut High:** This option is used to flatten the high points or peaks of an uneven surface.
- **Fill Low:** This option is used to fill the low points or creases of an uneven surface.

Figure 30: Flatten

5.3.4 Measure

The Measure tool consists of five modes: **Circumference**, **A/P Measurement**, **M/L Measurement**, **Point to Point**, and **Height**.

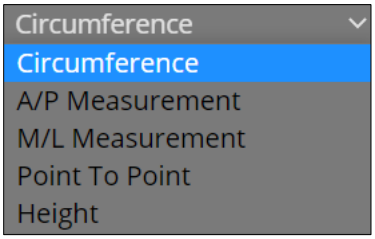


Figure 31: Measure Menu

All measurement tools rely on the model to be correctly oriented within Rapid Plaster. Correct orientation is defined as the anterior portion of the model facing the user with the posterior away from the user. The model should be oriented with the distal end of the model perpendicular to the print bed as represented by the light gray horizontal line and the proximal end of the model away from the print bed.

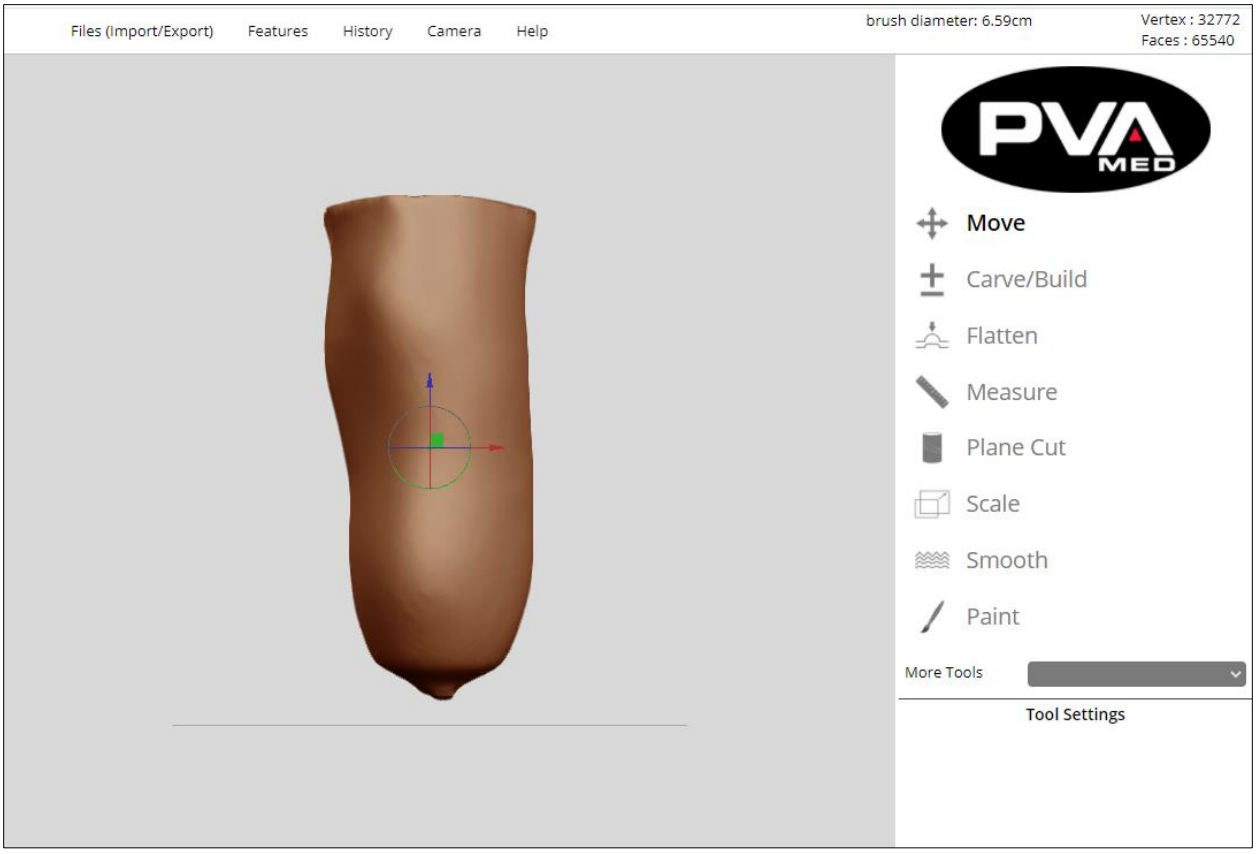


Figure 32: Model Orientation

Circumference Mode (Default)

The Circumference Mode tool is used to measure circumferences of the positive model. To use this tool, select **Measure** from the tool palette. Circumference is the default mode for the Measure tool. Use the mouse or mouse pad to move the cursor over the positive model. As the cursor moves vertically over the positive model, you will see circumference measurements display.

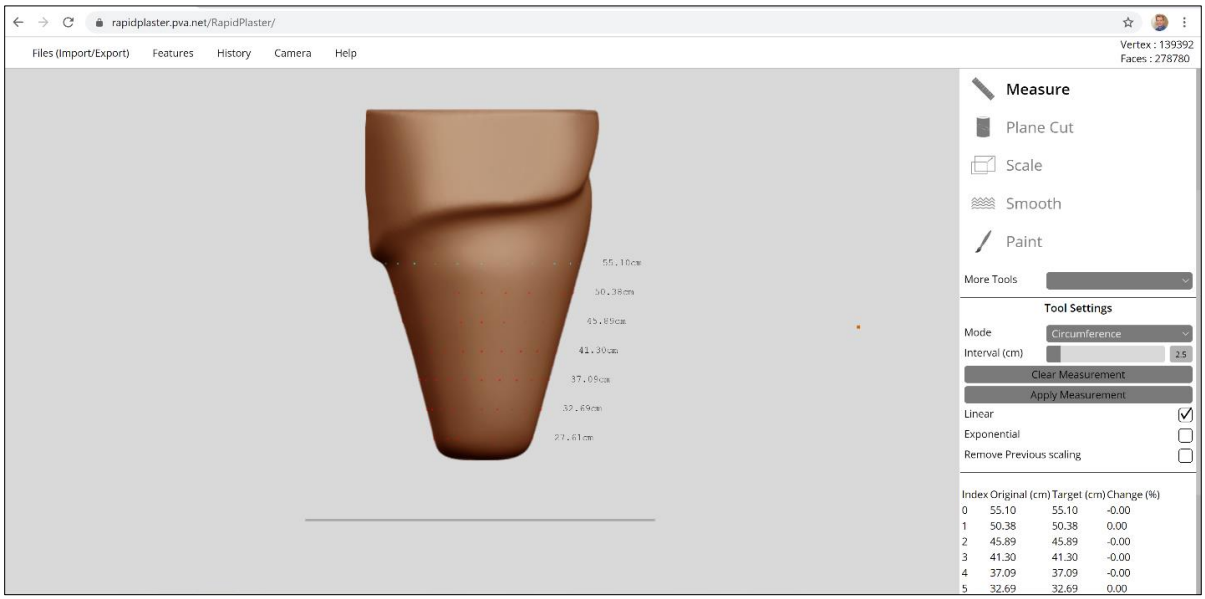


Figure 33: Circumference Mode

There is an **Interval (cm)** setting that defaults to 2.5 cm. This value is the interval between circumference measurements on the model. The smaller the interval, the more measurements will be displayed.

Left click on the mouse to pin the circumference measurements to the model, with the first measurement (baseline measurement) at the level of the cursor at the time the mouse click is registered. Additional measurements for each interval, starting from the baseline and moving towards the distal tip, will also be displayed, both next to the positive model and in a measurement table.

The measurement table, created by left clicking, is indexed by circumference measurement at each interval, with the first row as **Index 0**. The column labeled **Original (cm)** contains the circumference measurement when the mouse was clicked. The **Target (cm)** and **Change (%)** columns tracks changes in circumferences between original in cm and percent, respectively. These changes are tracked based on any modifications made to the model, up to the point at which the measurements are cleared. Measurements can be cleared by either clicking the **Clear Measurement** button or left clicking the mouse again on the model.

The user can also directly modify the model by altering the values in the **Target** (cm) or **Change** (%) columns to scale the model in the X,Y dimensions (cm, %) at any of the indexed circumference intervals.

Clear Measurement: Unpins measurements from the model, removes measurement table; once the measurements have been cleared, all **Original**, **Target**, and **Change** values are permanently cleared and cannot be retrieved.

Apply Measurement: Applies any modifications made to the target measurements to the positive model; there are three options that can be selected which include:

- **Linear**: Results in a sharper transition between circumference intervals.

The example uses exaggerated inputs to highlight the difference between linear, exponential options when applying the updated measurements.

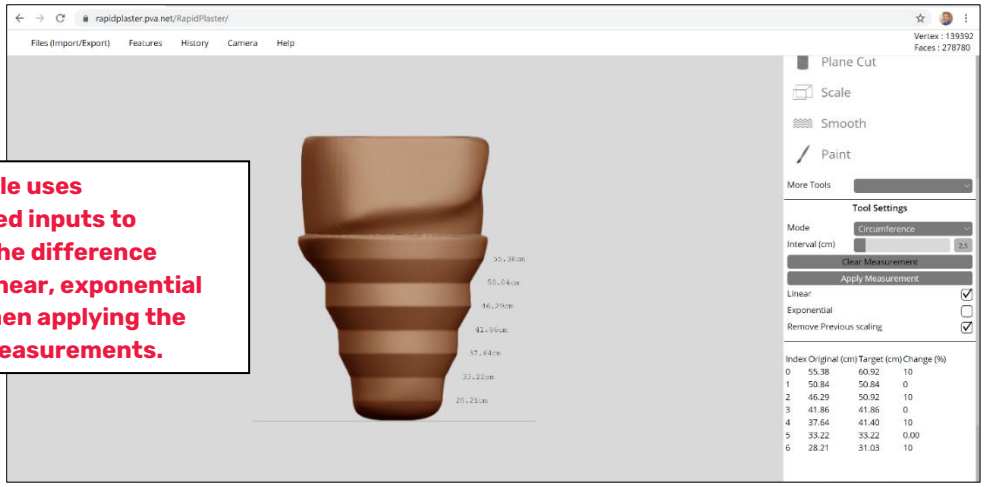


Figure 34: Linear

- **Exponential**: Results in a more blended transition between circumference intervals.

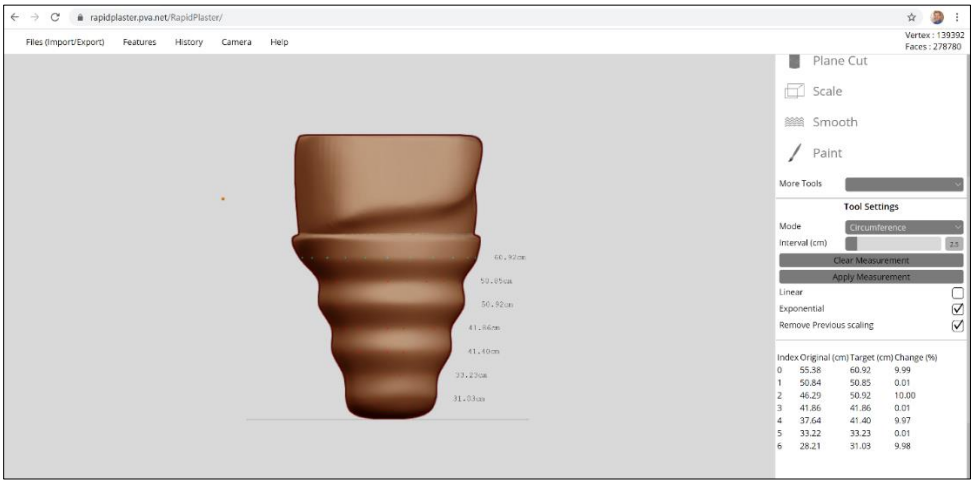


Figure 35: Exponential

- **Remove Previous Scaling**: Helps restore the positive model if you need to undo the XY scaling.

By default, the Linear Option is selected. The Linear option and Exponential options are mutually exclusive, meaning that only one of these two options can be selected at a time.

The **Remove Previous Scaling** option can be selected with either the Linear or Exponential options and is recommended to be selected so that any undo operation can be facilitated.

A/P (Anterior/Posterior) Measurement

The **Measure** Tool in A/P Measurement mode is used to measure A/P segments anywhere on the positive model to facilitate comparing to patient A/P reference measurements as captured from the patient's limb.

To capture an A/P measurement at a point in the model, complete the steps below:

1. Select the **Measure** tool in the Tool palette.
2. Select **A/P Measurement** Mode in the Tool Settings dropdown.
3. Scroll to the height on the model to capture the A/P measurement at that height.
4. The tool will show the A/P line which can be seen when viewing the model slightly rotated off the A/P line.

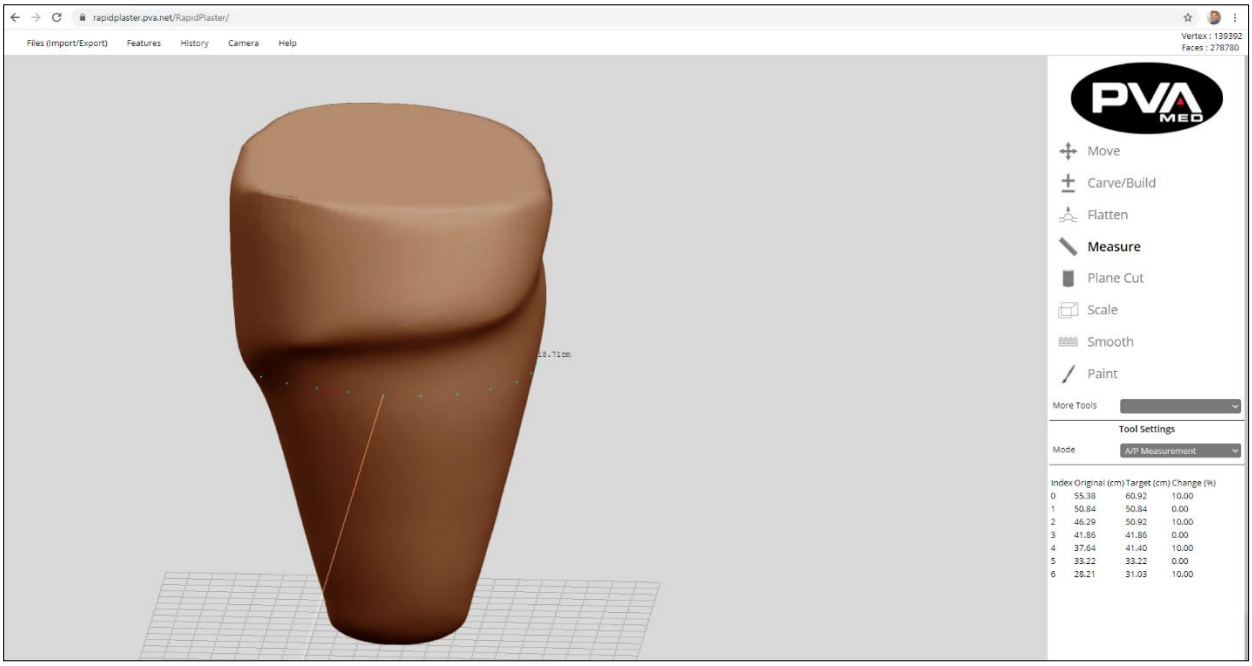


Figure 36: A/P Measurement Tool

M/L (Medial/Lateral) Measurement

The **Measure** Tool in M/L Measurement mode is used to measure M/L segments anywhere on the positive model to facilitate comparing to patient M/L reference measurements as captured from the patient's limb.

1. To capture an M/L measurement at any point within the model, select the **Measure** tool in the Tool palette.
2. Select **M/L Measurement** Mode in the Tool Settings dropdown
3. Scroll to the height on the model to capture the M/L measurement at that height.
4. The tool will show the M/PL line which can be seen when viewing the model slightly rotated.

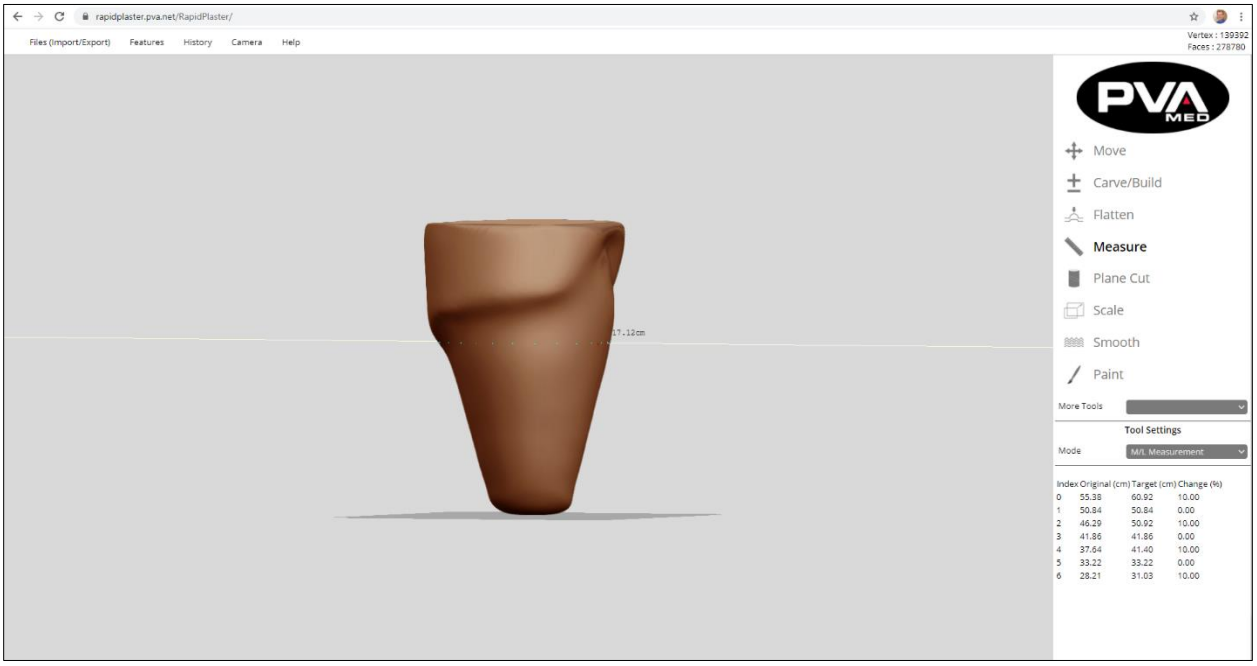


Figure 37: M/L Measurement Tool

Point to Point Measurement

The **Measure** Tool in the **Point to Point** mode is used to measure the distance between any two points on the model.

1. Select the **Measure** tool in the Tool palette.
2. Select the **Point to Point** Mode in the Tool Settings dropdown.
3. Click on the first of two points to measure between.
4. Move the cursor to the second point and click.
5. The distance in centimeters between the two points will be displayed in the upper right-hand corner of Rapid Plaster.

Note: The tool measures a straight line between the two points even if that line transects the model.

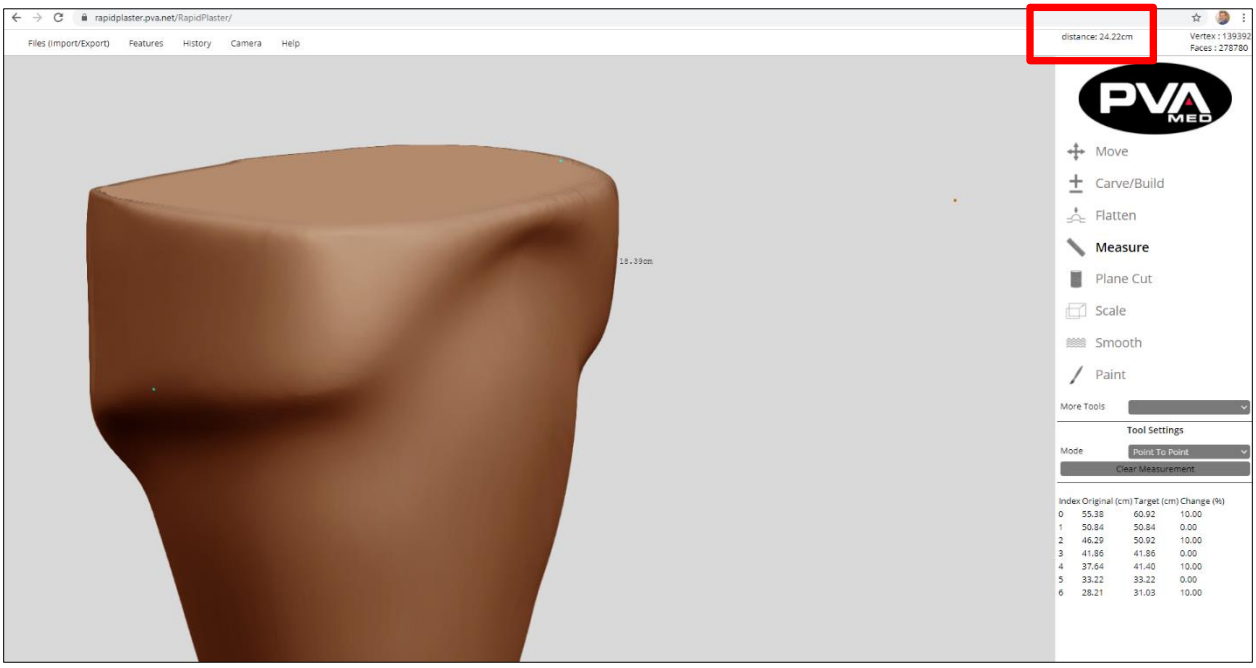


Figure 38: Point to Point Measurement Tool

Height Measurement

The **Measure** Tool in the Height Mode is used to measure the height as defined as the distance between the distal most point on the model to the level of the cursor.

1. Select the **Measure** tool in the Tool palette.
2. Select **Height** Mode in the Tool Settings dropdown.
3. Move the cursor to the point on the positive model at which to measure the height.
4. The height is displayed to the right of the model at the height of the cursor.

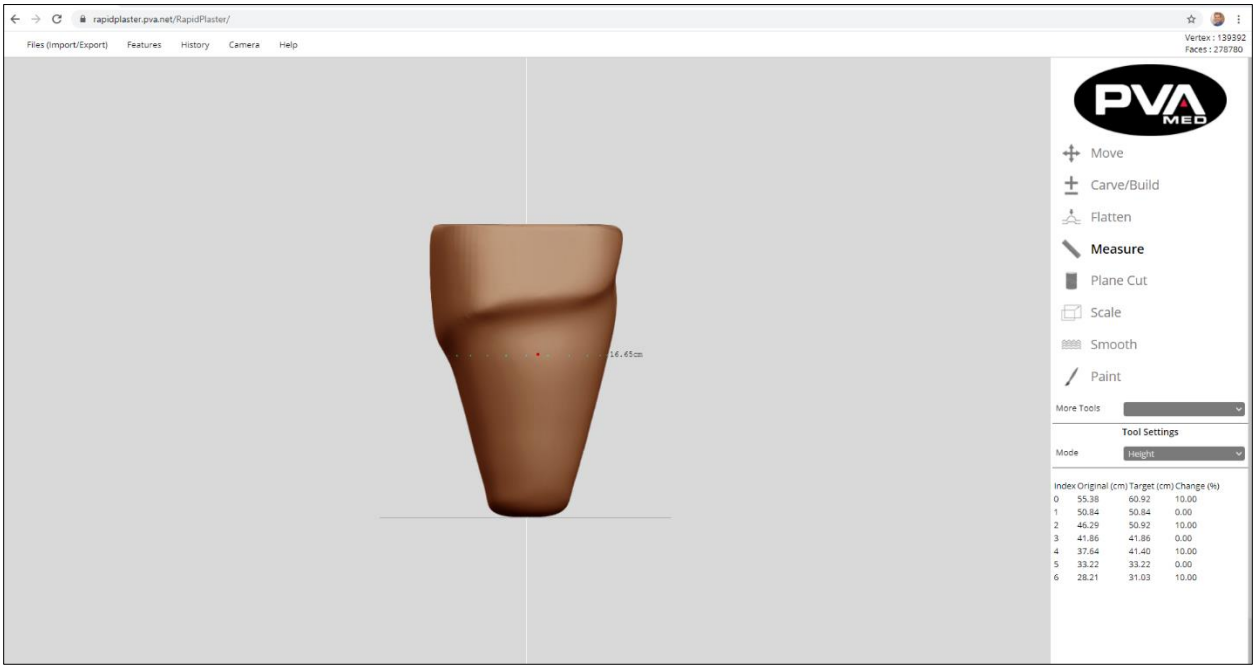


Figure 39: Height Measurement Tool

5.3.5 Plane Cut

The **Plane Cut** tool enables users to remove unwanted portions of an object such as an imported scan or positive model. A user can perform two types of plane cuts: **Horizontal Cut** and **Plane Cut**.

Plane Cut Tool (Horizontal Cut)
The horizontal plane cut can be used to divide an object or group of objects along a plane that is parallel to the print bed.

1. To perform a horizontal plane cut, select the Plane Cut tool from the tool palette.

Note: The horizontal plane cut is the default plane cut option.

2. Position the model relative to the print bed. The print bed can be used as a guide.

3. Position the cursor at the level of the plane to cut along, then left click the mouse.

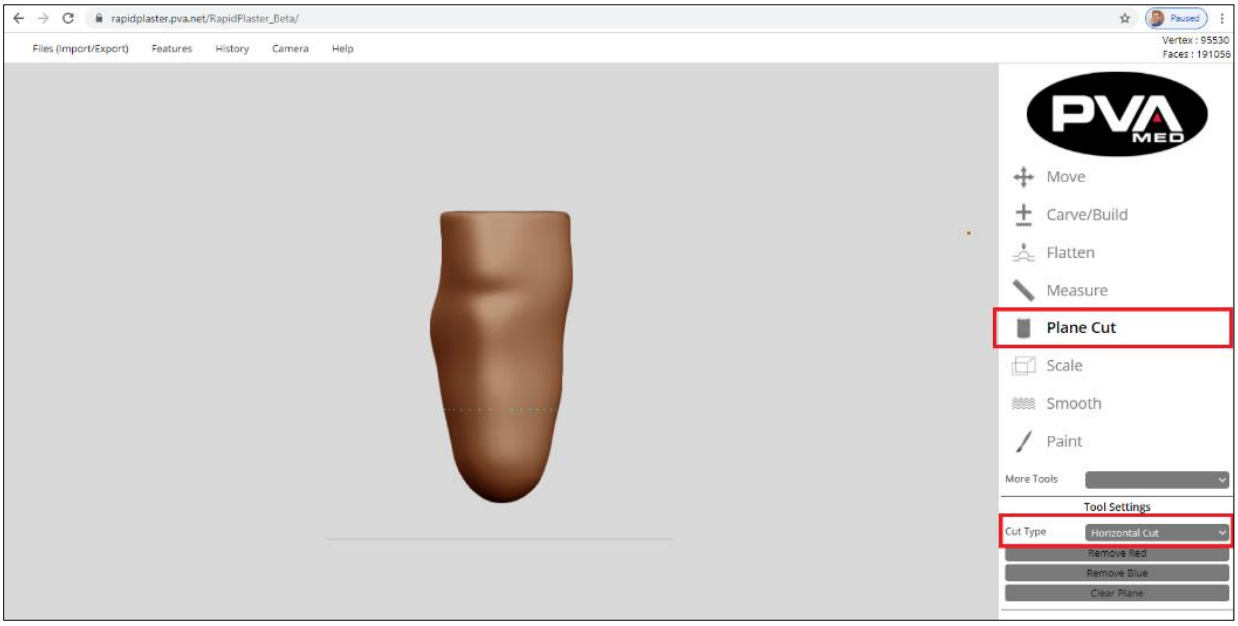


Figure 40: Horizontal Plane Cut Tool

4. Once the click is registered, the object(s) in the workspace will now be colored either red or blue, depending on which side of the selected plane they are positioned in.

5. The color indicator makes it clear which portion of the object(s) will be removed depending on whether **Remove Red Button** or **Remove Blue** is selected.

6. To clear the selected plane prior to performing the plane cut, select **Clear Pane**.

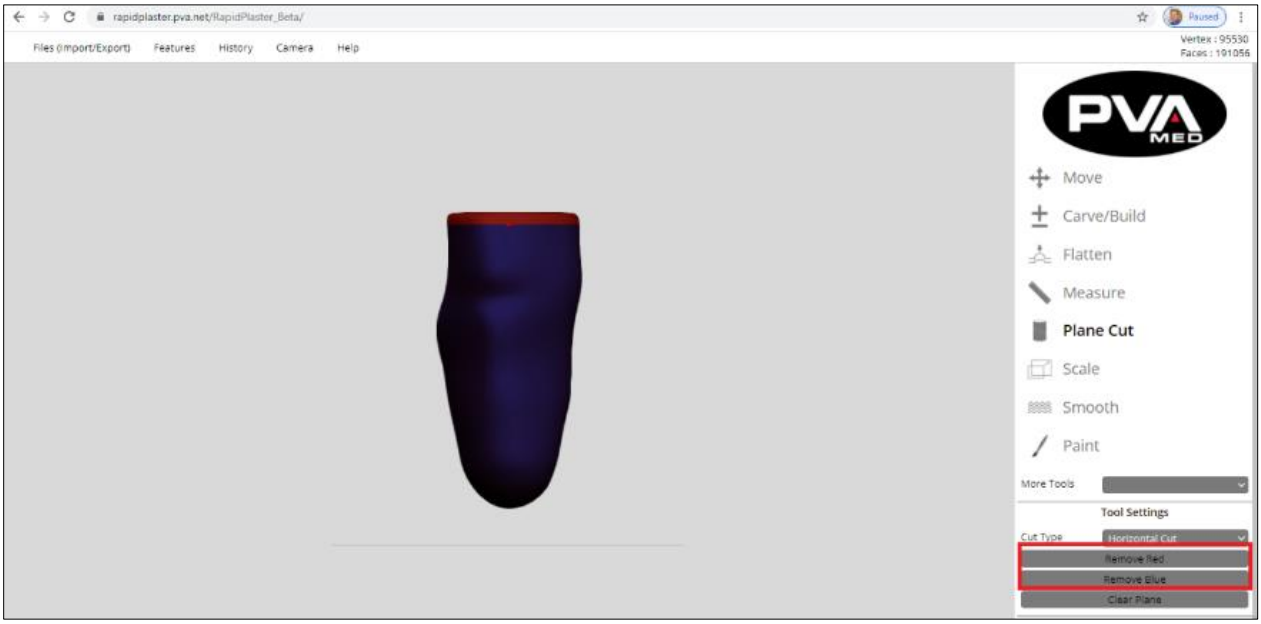


Figure 41: Horizontal Plane Cut 2

Plane Cut Tool (Angle Cut)

The plane cut tool can be used to cut object(s) along a user defined planed that cuts at angle to the print bed. To perform a plane cut at an angle, select the Plane Cut tool from the tool palette then select the **Angle Cut** type from the Tool Settings.

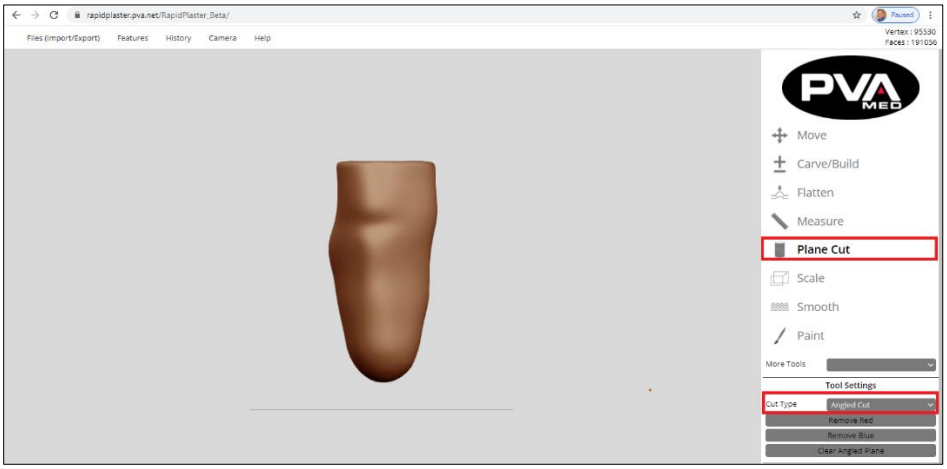


Figure 42: Angle Plane Cut

Left click the mouse once at three locations on the model. Each time the user left clicks the mouse with the cursor over the model, a blue point will be recorded on the model. On the third left mouse click, the blue point will be recorded and the user defined plane will become visible.

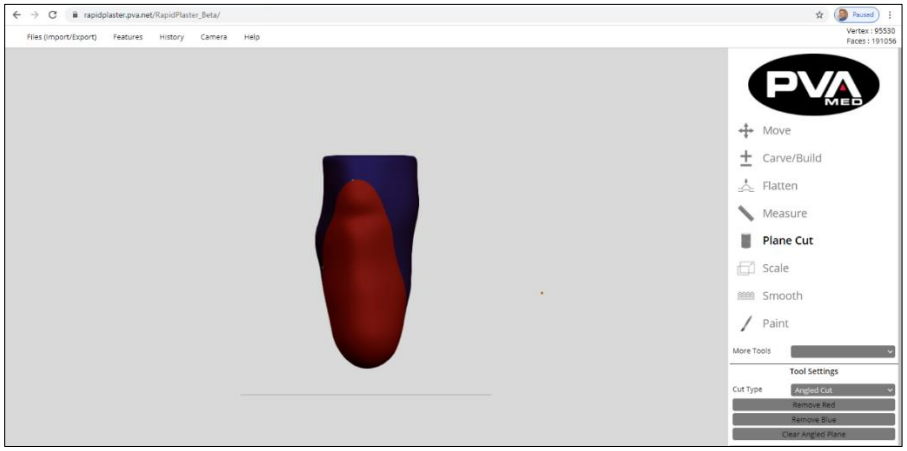


Figure 43: Angle Plane Cut 2

The user can now select to remove the red or blue portions of the object by clicking either the **Remove Red** or **Remove Blue** buttons, respectively. To clear the user defined plane, click the **Clear Angle Plane** button.

Shapemaker AOP File Import

To open a Shapemaker file in Rapid Plaster, go to **File → Open From Computer**. Navigate to the folder containing the desired .AOP file. Select the desired file and click **Open**.

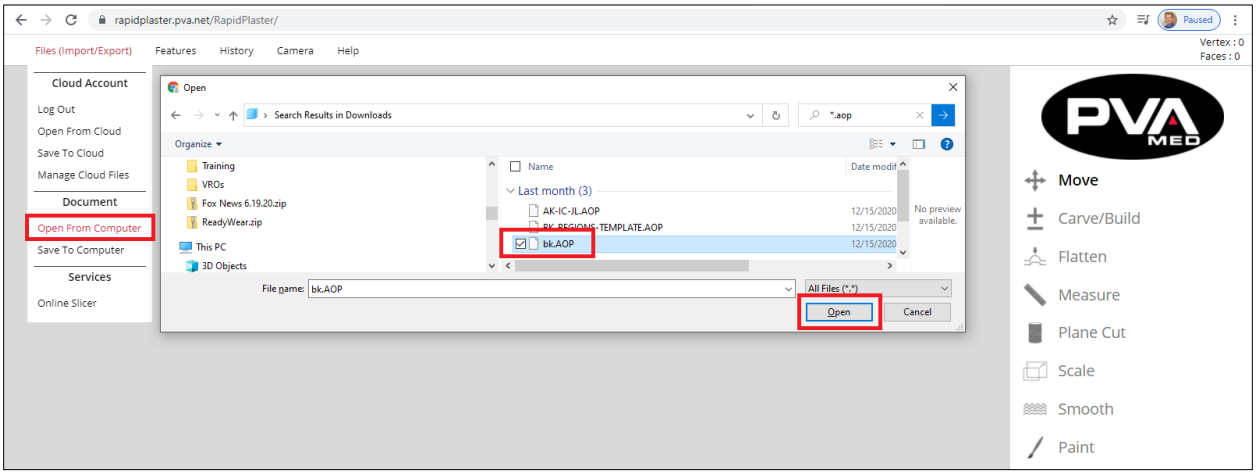


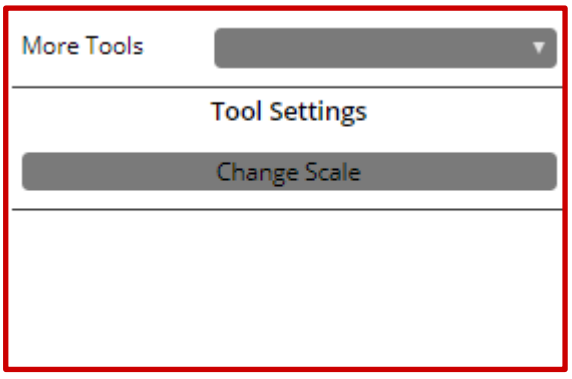
Figure 44: Open Shapemaker File

Once imported into RapidPlaster, the Shapemaker shape can be manipulated using all of the Rapid Plaster features and tools.

Note: Landmarks, regions, and other Shapemaker meta data are not imported or used by Rapid Plaster.

5.3.6 Scale

Allows you to proportionally scale the entire model as a percent of the original size.



1. Click the **Scale** icon in the Tools area. Once clicked, the tool settings area will include a Change Scale button.
2. Click the **Change Scale** button.
3. Enter the desired scale factor value and click **OK**. The scale factor should be viewed as a percentage of the original dimensions. For example, to increase scale by 10%, enter 110 as the scale factor. To decrease scale by 3%, enter a scale factor of 97.

Figure 45: Scale

Depending on the scale change, as well as the current size and complexity of the positive model, the scaling operation may require several seconds to a minute. The visual size of the object will change after a scaling operation but may not be immediately noticeable. You should recheck the model measurements using the **Circumference**, **AP Measurement**, and **ML Measurement** tools.

When you perform a scaling operation, you change the base size of the positive model for future scaling operations. If you were to adjust the scale of a model by +5%, the new model would have a new base size equivalent to 105% of the original model. If you adjust the scale of the new model by +5%, it is not the same as increasing the original model by 10%. The resulting model will be 105% of the new model, not 110% of the original model.

The scale tool scan be used to scale in one or more of the following dimensions: x, y z. The scale tool defaults to scaling the x and y dimensions. For example, if you want to increase the M/L and A/P lines by a percentage without impacting the height, you would use the default scaling in the x and y dimensions only.

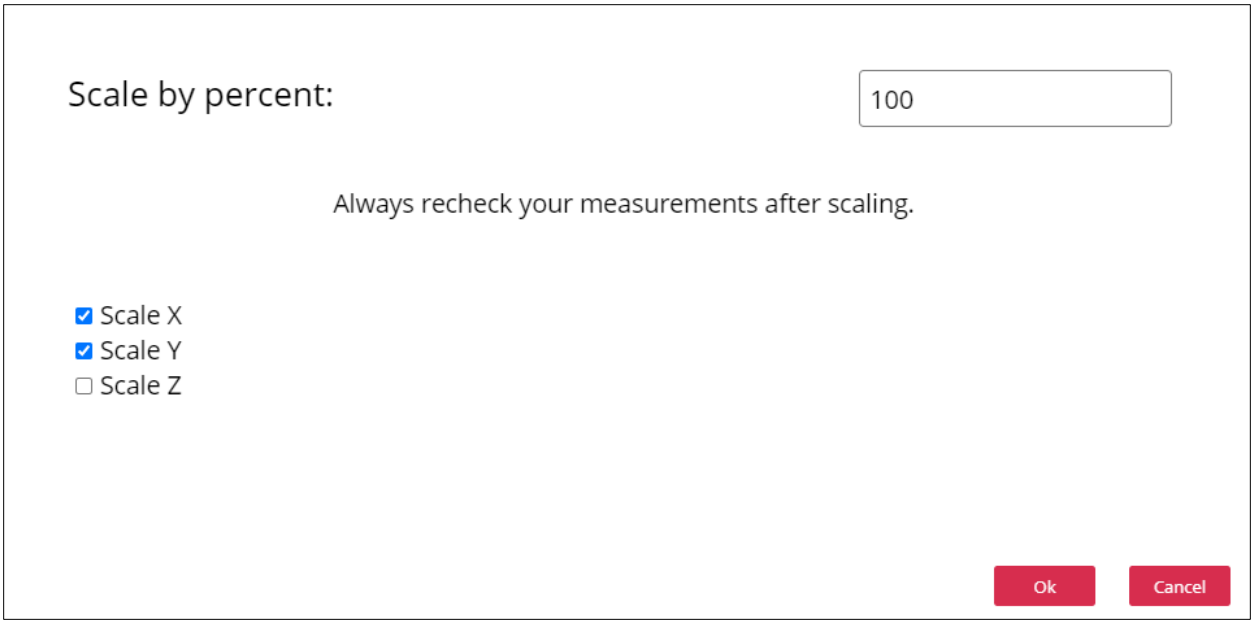
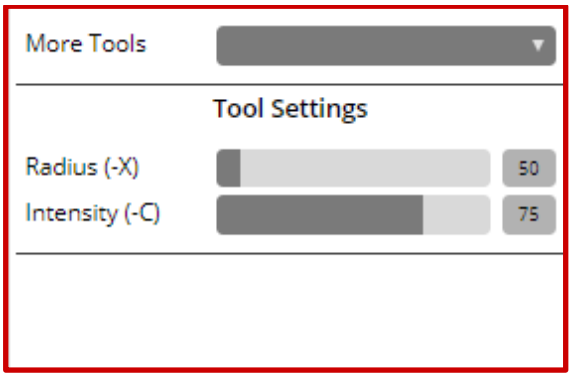


Figure 46: Scale By Percent

5.3.7 Smooth

The Smooth tool allows you to create a more even surface. For minimal smoothing, select a low intensity and use minimal passes. Using a higher intensity and more passing will result in a lot of smoothing. Smoothing neither ads nor removes material but instead redistributes material to create a smoother finish.

Screen Display



Tool Settings

- **Radius (-X)**: Changes the size of your brush. The larger the brush, the larger the affected area is.
- **Intensity (-C)**: Changes the severity of the modification. A larger value will make the modification more prominent.

Figure 47: Smooth

To automatically run the smoothing operation over the entire scene, click the **Global Smooth** button. Adjust the intensity to account for increased or decreased effect of each click of the **Global Smooth** button.

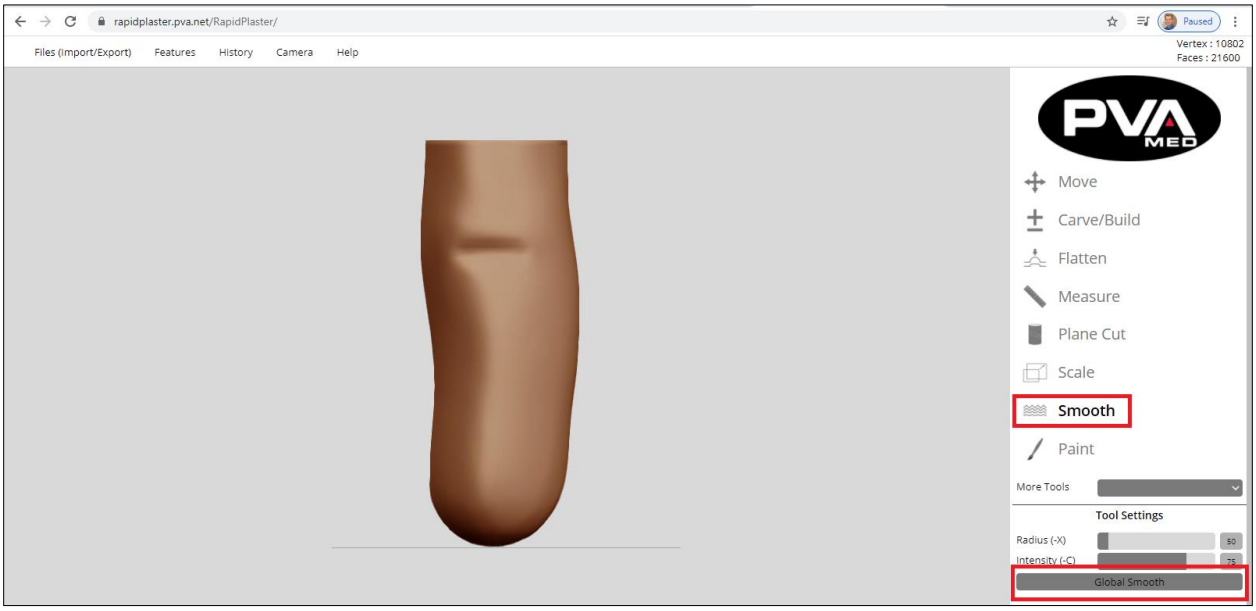
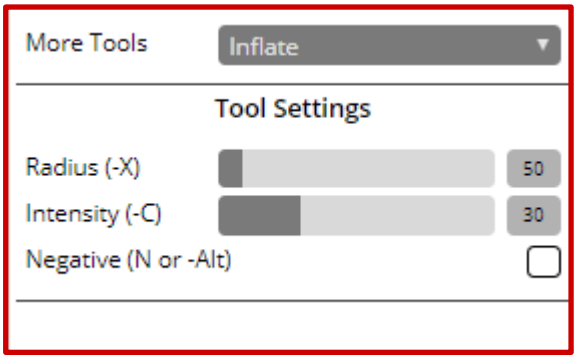


Figure 48: Global Smooth Tool

5.3.8 Inflate

Inflate adds material to your model. Click and drag where you would like material to create a buildup. Inflate tool also adds volume to your 3D model but in a rounder, bubblier shape than the Brush tool even with same radius and intensity.

Screen Display



Tool Settings

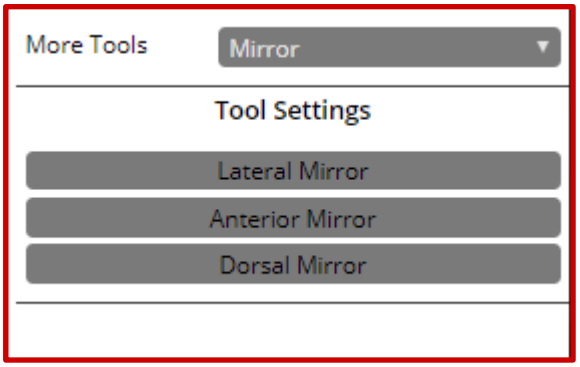
- **Radius (-X):** Changes the size of your affected area. The larger the Radius, the larger the affected area.
- **Intensity (-C):** Changes the severity of the modification. A larger value will make the modification more prominent.
- **Negative (N or -Alt):** Performs the opposite of the selected tool. Since the Inflate tool adds material, selecting the negative will activate a Deflate function, which removes material.

Figure 49: Inflate

5.3.9 Mirror

The Mirror Tools allows users to transform their positive model by mirroring the model from different perspectives, namely lateral, anterior and dorsal orientations.

Screen Display

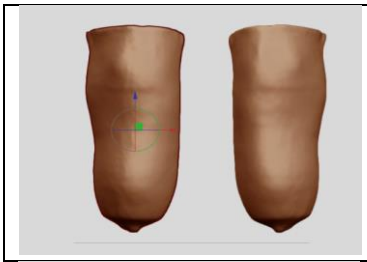
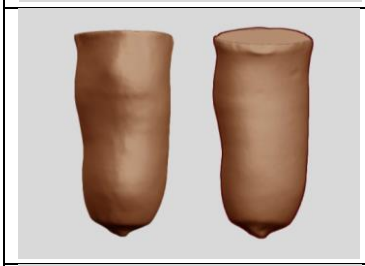
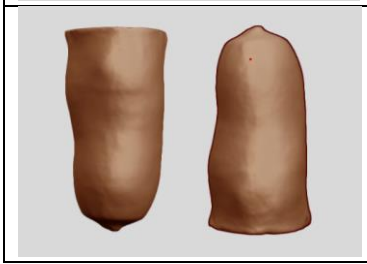


Tool Settings

- **Lateral Mirror:** Modifies the positive model to create a mirror of the original model from the lateral orientation.
- **Anterior Mirror:** Modifies the positive model to create a mirror of the original model from the anterior orientation.
- **Dorsal Mirror:** Modifies the positive model to create a mirror of the original model from the Dorsal (Top) orientation.

Figure 50: Mirror

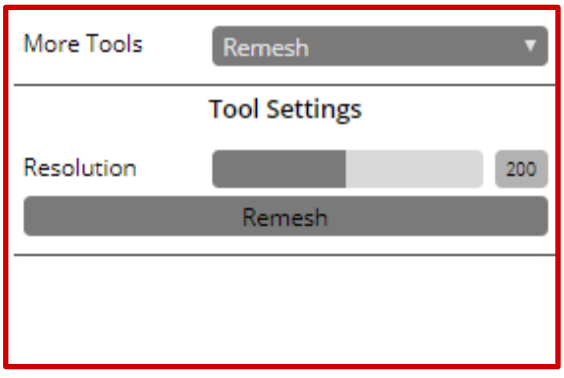
Examples

	**Lateral Mirror Example** The model on the left is the unmodified version and the model on the right is the same model with the Lateral Mirror tool applied.
	**Anterior Mirror Example** The model on the left is the unmodified version and the model on the right is the same model with the Anterior Mirror tool applied.
	**Dorsal Mirror Example** The model on the left is the unmodified version and the model on the right is the same model with the Dorsal Mirror tool applied.

5.3.10 Remesh

The Remesh tool is used to increase or decrease resolution of the digital positive model.

Screen Display

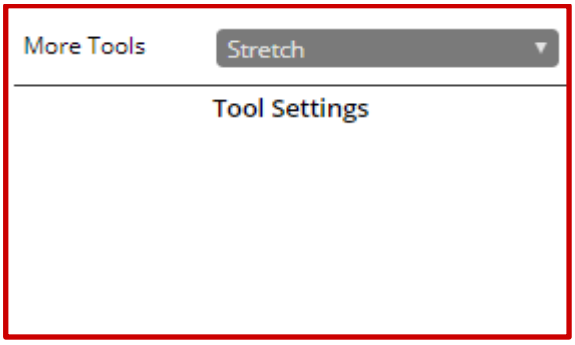


Tool Settings

- **Resolution**: The higher the resolution, the greater the detail. The valid resolution ranges from 8 to 400, with a default value of 100.

Figure 51: Remesh

5.3.11 Stretch



The Stretch tool stretches an object by moving some of its selected vertices. The equivalent action is editing the object and moving the points manually to a new position.

Figure 52: Stretch

5.3.12 Paint

The **Paint** tool can be used to highlight landmarks and other characteristics of the patient's limb, liner, cast, or plaster model being scanned. Marks applied to the positive model with the Paint Tool will remain on the positive model as it modified.

Figure 53: Paint Tool

1. To use the Paint Tool, select Paint from the Tool Palette.
2. Under Tool Settings, the user can adjust using the Radius, Intensity and Hardness by either moving the slider control to the left (to decrease) or to the right (to increase) or by entering a numeric value to the right of the slider control:
    - **Radius (-X)**: The size of the paint brush tool. Valid values range from 5 to 500.
    - **Intensity (-C)**: Opacity of the color as applied to the model. Valid values range from 0 to 100.

In the example below, the red mark on the left was created using an intensity setting of 25 whereas the mark on the right was created using an intensity setting of 100.

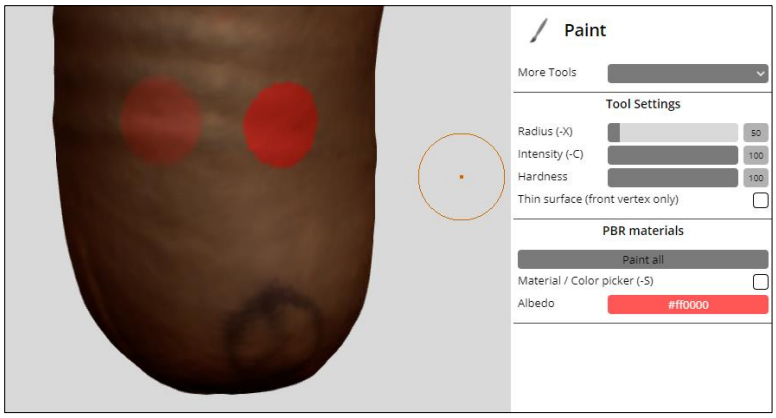


Figure 54: Intensity Example

Hardness: How much of the brush stroke is applied. Valid values range from 0 to 100. At 100, the entire radius is used to apply a uniform coat. Lower values will use the center of the radius to provide a uniform coat and then fade towards the perimeter.

In the example below, the red mark on the left was created using a hardness setting of 50 whereas the mark on the right was created using an hardness setting of 100.

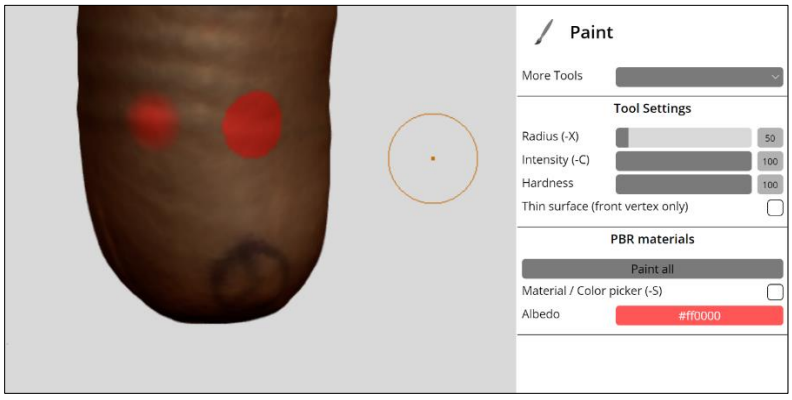


Figure 55: Hardness Example

Option for Thin surface (front vertex only): If you check this box, you will only paint the part of the model that is visible to you. If you uncheck this option, you have the potential to paint surfaces that are not currently visible (i.e. posterior).

Material / Color picker (-S): When selected, this tool option allows the users to pick the color as sampled by clicking the mouse. The paint color will be set to the color sampled on the positive model at the position of the cursor when user clicked.

5.4 Features

5.4.1 Merge All

The **Merge All** feature will connect all the objects in RAPID PLASTER® and fix their orientation relative to one another. This feature can be used when adding a distal attachment such as a puck lock or integrating a brim. The Merge All feature will help users define alignment through fixing the position of the distal attachments relative to the device and the patient's residual limb. Prior to selecting the Merge All feature, each object in RAPID PLASTER® can be moved independently from one another. After Merge All, all objects will be controlled by one Move Tool.

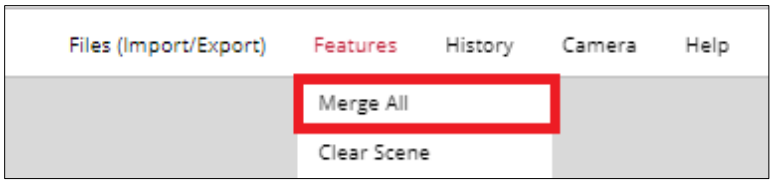


Figure 56: Merge All

5.4.2 Clear Scene

The **Clear Scene** feature is used to clear all objects from RAPID PLASTER® and is the first step in starting a new project. If it is not used, opening new models will be added to the existing model(s) currently open in RAPID PLASTER®.

Figure 57: Clear Scene

Once selected, a warning will be display to confirm the Clear Scene action. Once selected, this feature cannot be undone. Click **OK** to confirm intent or **Cancel** to resume work on the current Scene and avoid unintentionally losing your modifications.

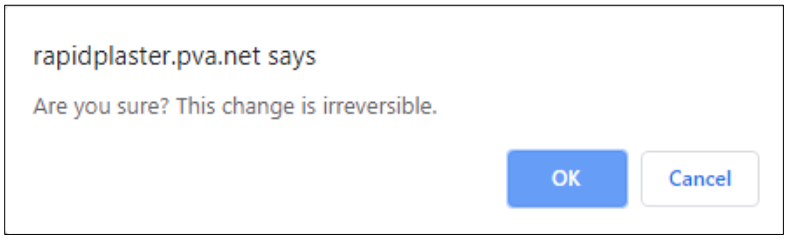


Figure 58: Clear Scene Confirmation

5.4.3 Add Attachment

When you are finished with your clinical modifications, the next step is to add a distal attachment.

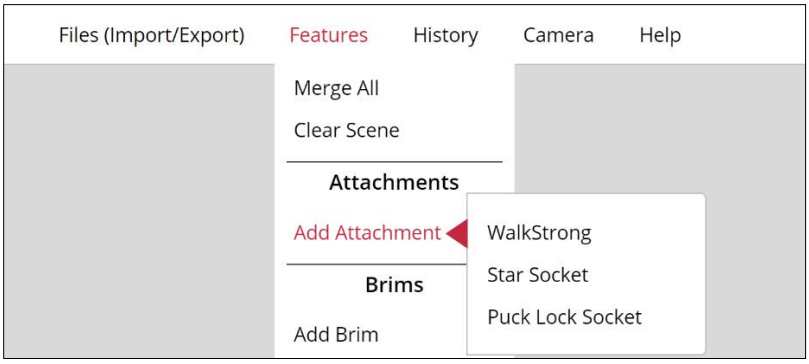


Figure 59: Add Attachment

There are two types of sockets that can be made using the **Attachments** feature.

- **Attachment Sockets** - These include easily selected templates for adding:
    - **WalkStrong™**: WalkStrong attachments are to create a 3D printable check socket with automatic reinforcement ribs built in to increase the strength of the check socket at the critical distal attachment site. These ribs are designed to provide the maximum strength with the least amount of support material, reducing the likelihood of a catastrophic failure when performing a dynamic fitting on a patient. See Section 5.4.4 for more information on how to select the right WalkStrong attachment and how to position it relative to the positive model during design.

Figure 60: WalkStrong™ Socket

- **Puck Lock**: Will create a space to add a 65 mm Bulldog-style puck at the distal end.

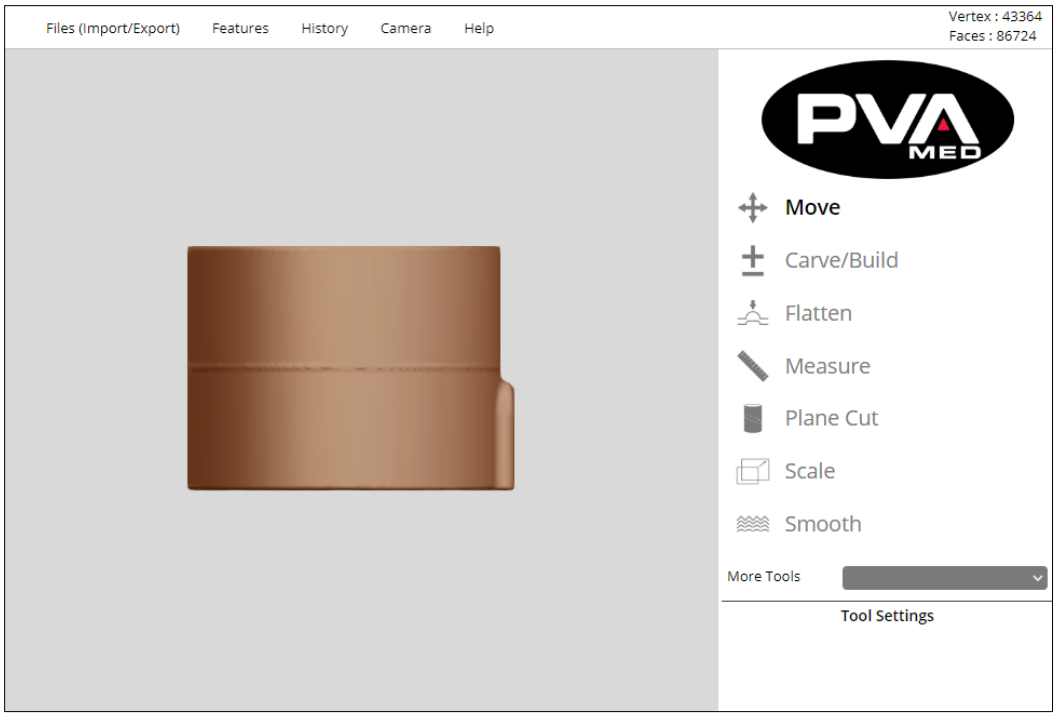


Figure 61: Puck Lock

- **Star Sockets** - Easy selected templates for adding an external star-shaped support piece to the distal end, which allows for a closed distal end socket to be printed. The star support piece comes in four sizes to fit different sized sockets. These include: Small, Medium, Large, and Extra-Large.

Figure 62: Star Socket Sizes

To select the right Star Socket, start by selecting the middle/medium sized star. If that is too large, select a smaller size. If the medium star is too small, select a larger size. Below is a top view of what the Star Attachments look like within RAPID PLASTER®:

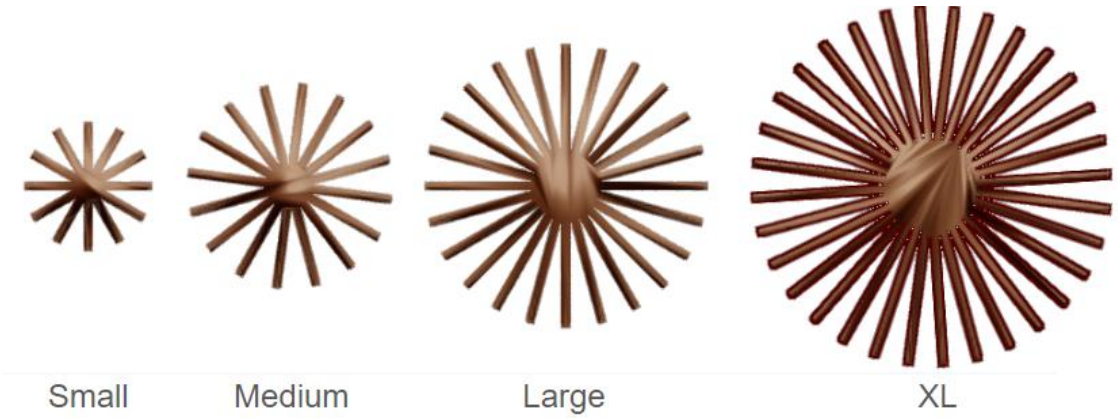


Figure 63: Star Sockets Top View

Attachments are automatically brought into the center of the print bed. Therefore, we recommend that you use the **Move Tool** to position the positive model relative to the attachment. This will ensure that it is placed centered on the bed which is the optimal placement for printing. After aligning, the attachment will be connected to the positive model using the **Merge All** feature.

PVA recommends switching from Perspective View (default) to Orthographic View to align the distal end. To switch views: **Go to Camera** → **Projection** → **Orthographic**.

5.4.4 How to Design a WalkStrong™ Socket

The WalkStrong™ socket currently supports pin lock suspensions. Suction and vacuum will be available in a future release. This document explains how to design a WalkStrong socket using the features available in Rapid Plaster®.

Selecting the WalkStrong Attachment

When selecting the WalkStrong attachment, the goal is to select the attachment that provides the greatest support in the transition from the prosthetic components interface to the socket distal end while adding the fewest number of extraneous supports (reinforcing ribs). This approach will minimize print time and material use. When the best WalkStrong attachment is selected, the reinforcement ribs should blend in flush with the socket surface at the top of the ribs. The best WalkStrong attachment choice for a given socket is based on size and shape of distal aspect.

1. Align the model in the workspace with the most distal aspect of the positive model closest to the print bed. The proximal end should be facing away from the print bed and the anterior should be facing the user.
2. In the Camera tool, select left or right handedness of the limb.
3. Select the measurement tool in default circumference mode.
4. Place the cursor on the distal most aspect of the positive model.
5. Start moving the cursor proximally until the first and second measurement interval appears.
6. Left click to pin the circumference measurements for the first two intervals.
7. Note the measurement that is away from distal end (ex 23.50 cm in figure below).

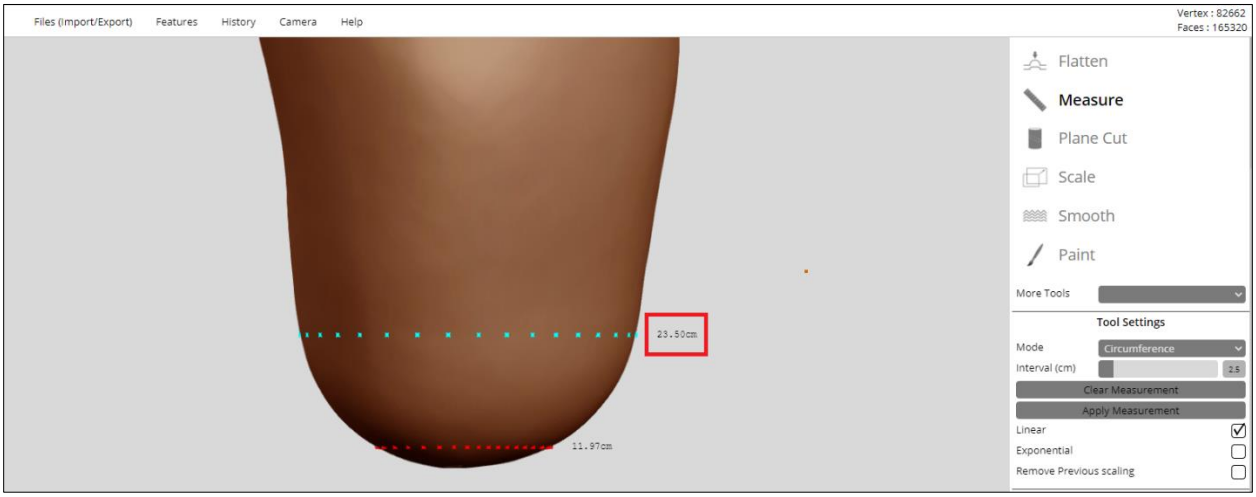


Figure 64: Select WalkStrong Socket

8. Select the attachment that is closest to that circumference. Do not select an attachment that is larger.

In the example on the next page, the 22 cm is the recommended choice as it is the attachment that is closest to the second measurement interval, but not larger.

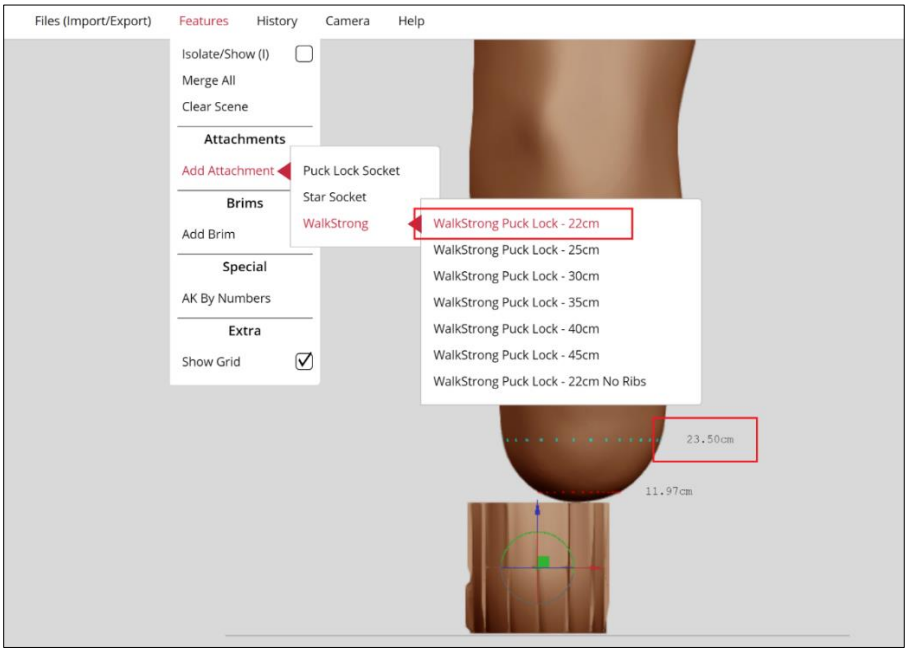


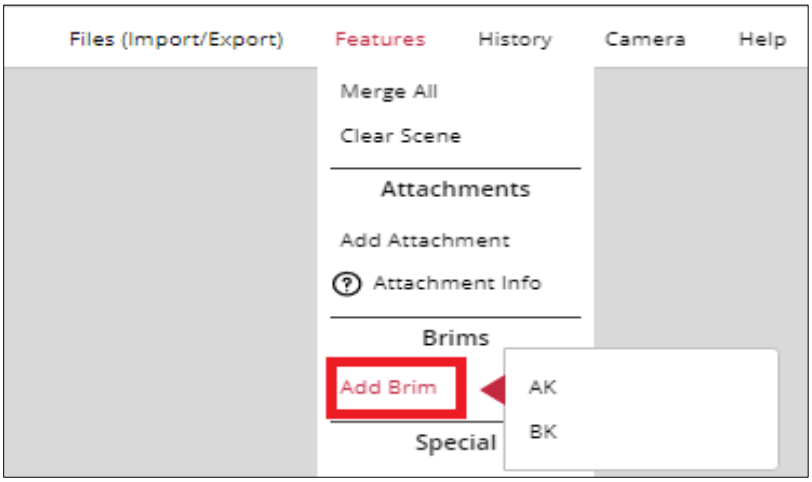
Figure 65: WalkStrong Attachment

Align Attachment Relative to Positive Model

1. Use the puck line on the attachment to position the positive model so the most distal aspect of the positive model is at or slightly below the puck line.

2. Align the pin release port on the medial side or rotate the attachment to provide the patient with their desired access to pin release.

5.4.5 Add Brim



RAPID PLASTER® includes a number of Brim templates to easily integrate different brims for AK (Above Knee) sockets and posterior shelves for BK (Below Knee) sockets. To access these, go to **Features → Add Brim**.

Figure 66: Add Brim

To add a brim to an AK socket, select **Features → Add Brim → AK → Left/Right**. There are a number of AK brim options to select from. AK brim styles exist for left and right sockets.

Figure 67: Brim Options

To add a brim to a BK socket, select **Features → Add Brim→ BK → Left/Right**. There are a number of BK brim options to select from. Posterior BK brims styles exist for left and right sockets.

Posterior Brims can be resized using the **Stretch** and **Scale** tools. The Posterior BK 1 Brim was designed with a shelf that has a 45°angle optimized for 3D printing without the need for printing supports. Shelfs with angles of greater than 45° can be adjusted using a heat gun after the print is complete.

Figure 68: BK Brim Options

Posterior BK 1 Brim **Posterior BK 2 Brim** **Posterior BK 3 Brim**

5.4.6 AK By Numbers

This feature enables users to design a transfemoral socket based on measurements.

1. Under the **Features** menu, select the **AK by Numbers** menu option.

Figure 69: AK By Numbers Option

2. The AK By Numbers input data form will appear. Select whether the socket is for the Left or Right limb by clicking the associated radio button.

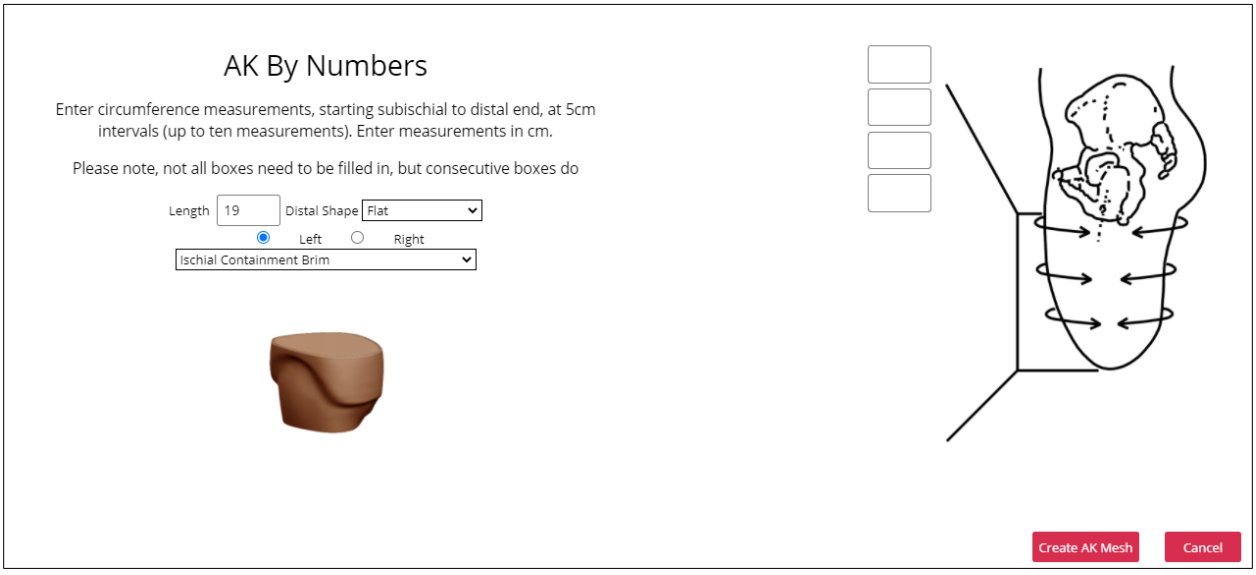


Figure 70: AK By Numbers Input Form

3. Enter the **Length** of the patient's limb in centimeters. Once entered, the length will drive the number of circumference inputs required.

4. Select one of the three **Distal Shapes** available:
    - Flat (default selected)
    - Round (most commonly used)
    - Conic

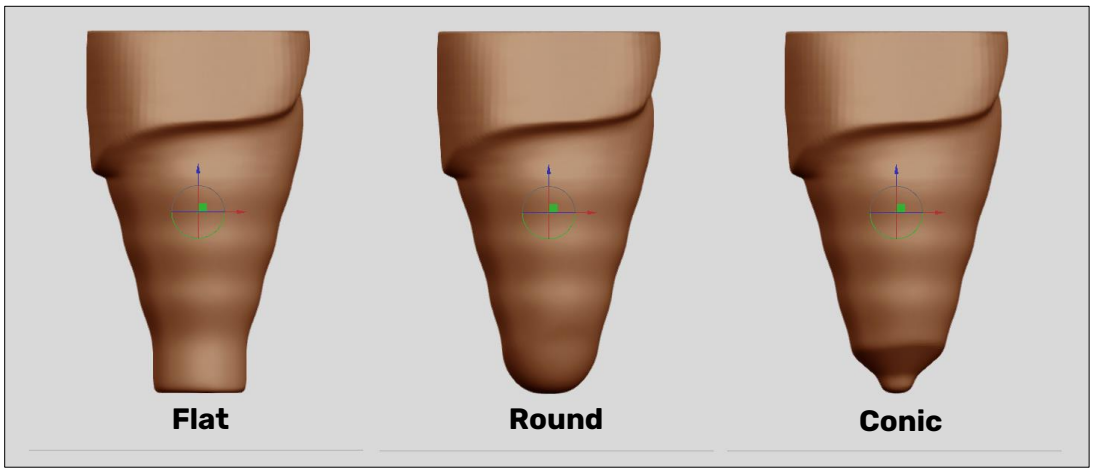


Figure 71: Distal Shape Examples

5. Select the desired brim style from the dropdown menu. There are four brim styles to choose from.
    - Ischial Containment Brim
    - Quad Brim
    - Hybrid Brim
    - Soft IC Brim

Note: The brim style selected will heavily influence the shape of the socket, from the proximal edge of the brim, down to the distal attachment.

6. Measure the patient's limb, starting subischial to distal end, at 5 cm intervals.
7. The number of measurement inputs are determined by the length entered. Enter the circumference measurements for each interval in centimeters then click **Create Mesh** to generate the positive model.

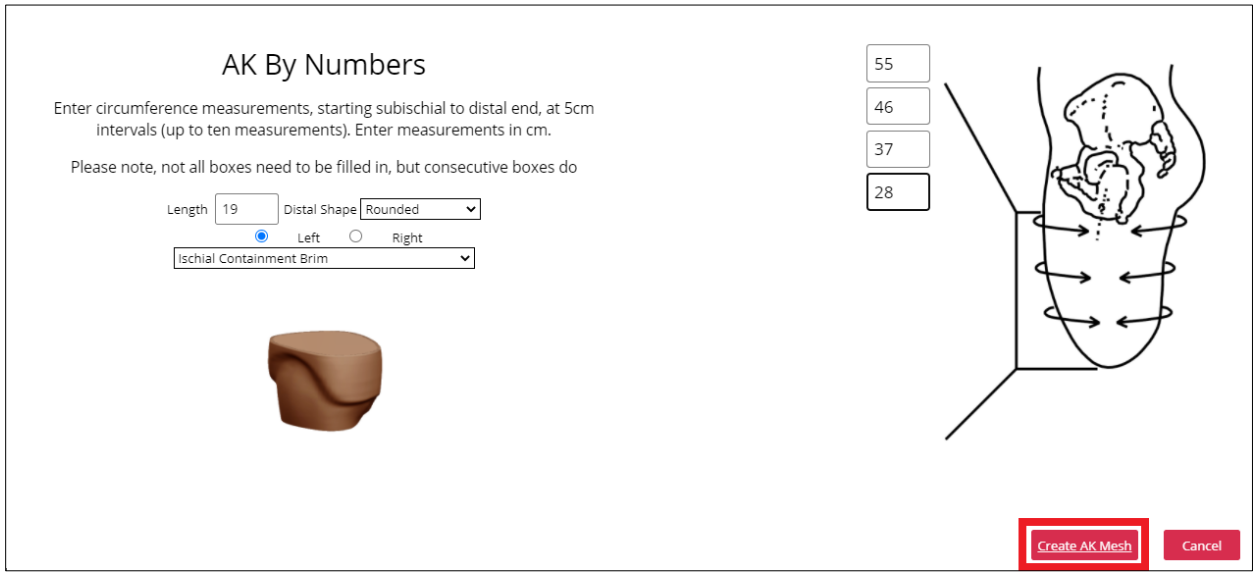


Figure 72: Enter Measurements

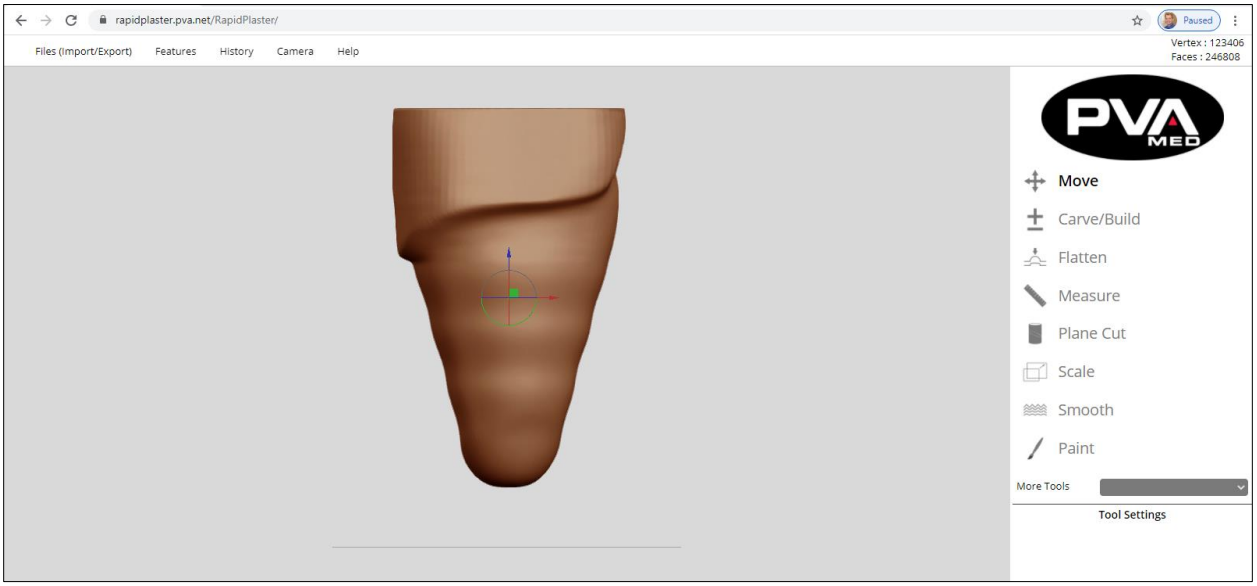


Figure 73: Create AK Mesh

Modify Your Positive Model

Modify your initial AK check socket design; this includes smoothing the transitions between the circumferential inputs while ensuring the measurements in Rapid Plaster track to the patient measurements.

Smoothing the Transitions

Use the Carve/Build tool to fill in low spots in transition points on the positive model generated by entering the patient measurements.

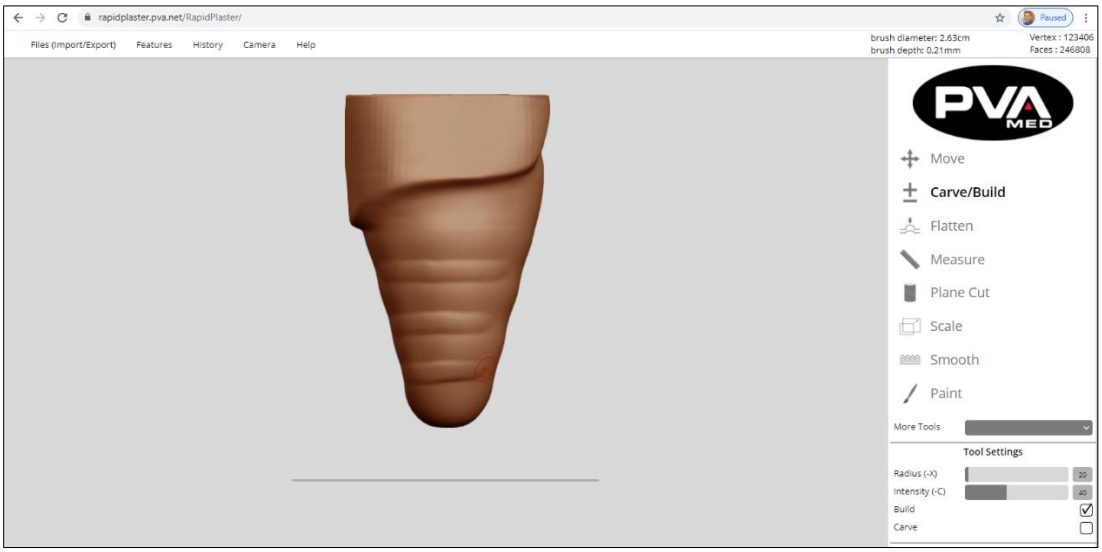


Figure 74: Carve/Build Tool

To do this, select the Carve/Build Tool from the tool pane in the right side of the interface. Set Radius to 20 and intensity to 40. These can be set using the slider controls or by entering the numeric value in the space provided.

Make sure the Build option is selected so that we can add material to the low points on the positive model. Using the Camera Tool, starting from an Anterior view, begin filling in the low spots. Next select Medial view from the Camera tool and continue filling low spots. Repeat for the Posterior and Lateral views. At this point, you should have filled all low areas of the positive model between circumferential measurement points.

Smooth Transition Points

Use the Smooth tool on the transition points that were filled in on the precious step. The goal is to design a socket with smooth transitions between all the measurement lines.

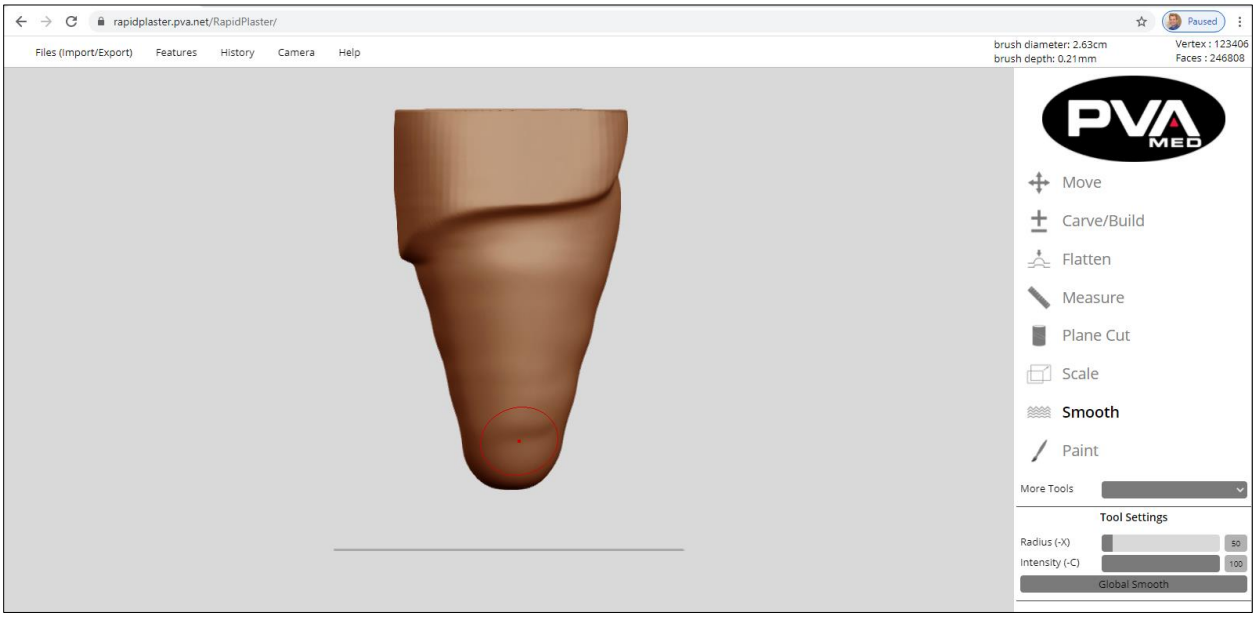


Figure 75: Smooth Tool

1. To do this, select the **Smooth** Tool from the tool pane in the right side of the interface.
2. Set Radius to 75 and intensity to 100. These can be set using the slider controls or by entering the numeric value in the space provided.
3. Using the Camera Tool, starting from an Anterior view, begin smoothing all transitions.
4. Select Medial view from the Camera tool and continue smoothing all transitions. Repeat for the Posterior and Lateral views. At this point, you should have smoothed all areas of the positive model to result in a smooth shape of your modified positive model.
5. Save the modified positive model prior to adding the distal attachment or adjusting length. This will allow for easy future edits such as global scales or switching between distal attachments in the future.

Check Circumferential Measurements Against Patient Measurements

In the process of filling then smoothing the transition points on the positive model, it is likely that the circumferences that were set based the measurements of the patient's limb were impacted.

1. To check these circumference measurements, select the Measurement Tool with the Circumference Mode selected.
2. Place the cursor just below the brim and click to set measurement intervals. The measurements will be displayed next to the positive model.
3. The measurements will also be displayed in a table where the target values can be edited, either by modifying the **Target** or **Change** values.

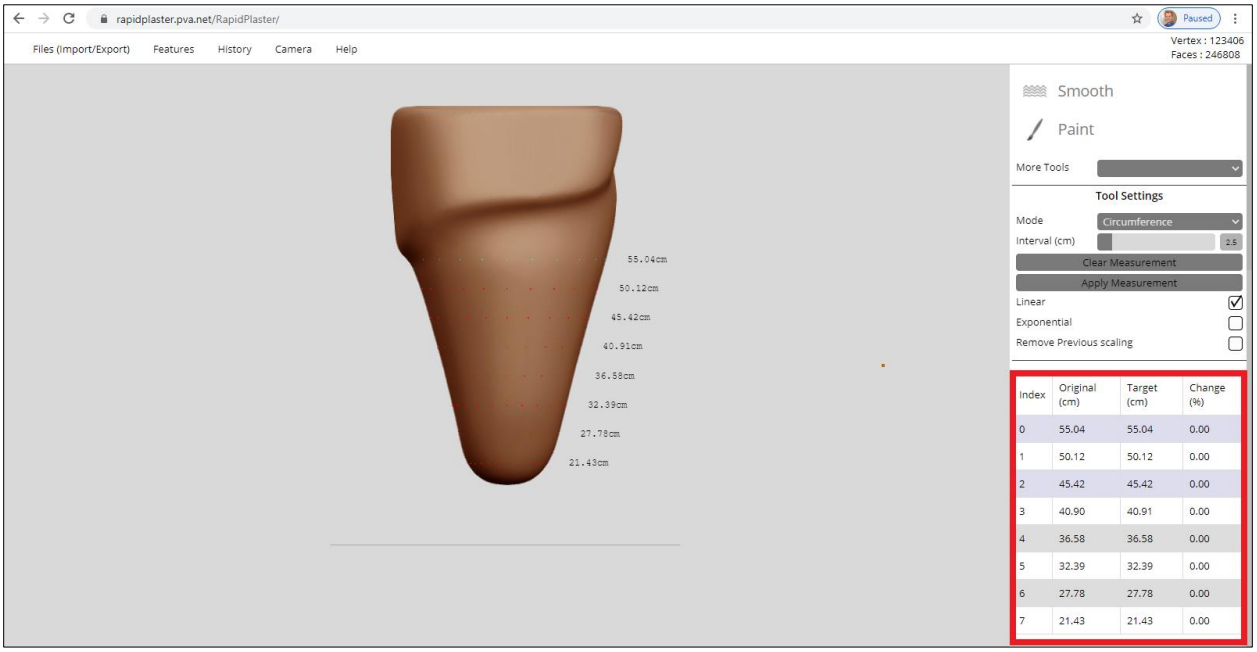


Figure 76: Modify Target/Change Values

4. Once these values have been modified, the user clicks the **Apply Measurements** button to apply the modified circumference(s) to the positive model.
5. The newly applied values displayed next to the positive model will be updated after the user edits have been applied.

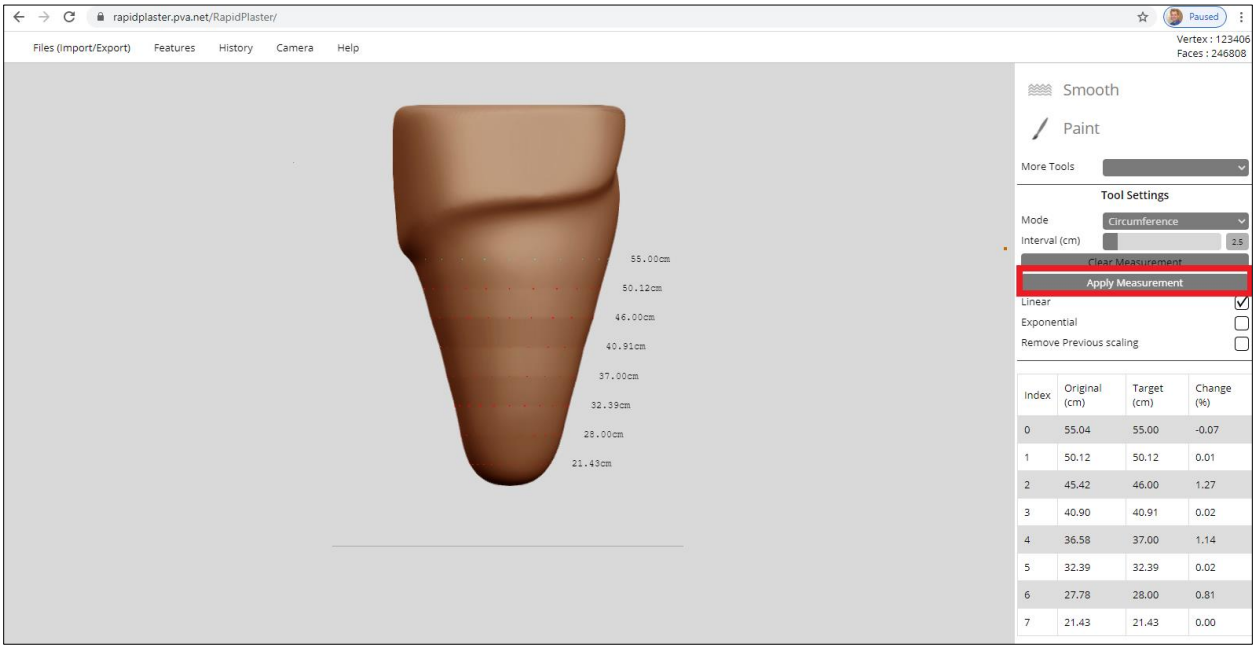


Figure 77: Apply Measurements

Once the Model is completed, be sure to save the file in PVA Med Cloud.

1. To save, go to Files (**Import/Export**) > **Save To Cloud**.
2. Within the Save dialog box, navigate to the **Training Exercises > Module 5** folder.
3. Enter **5.8-ak-pre-distal.stl in** space provided and then click the **Save** button.

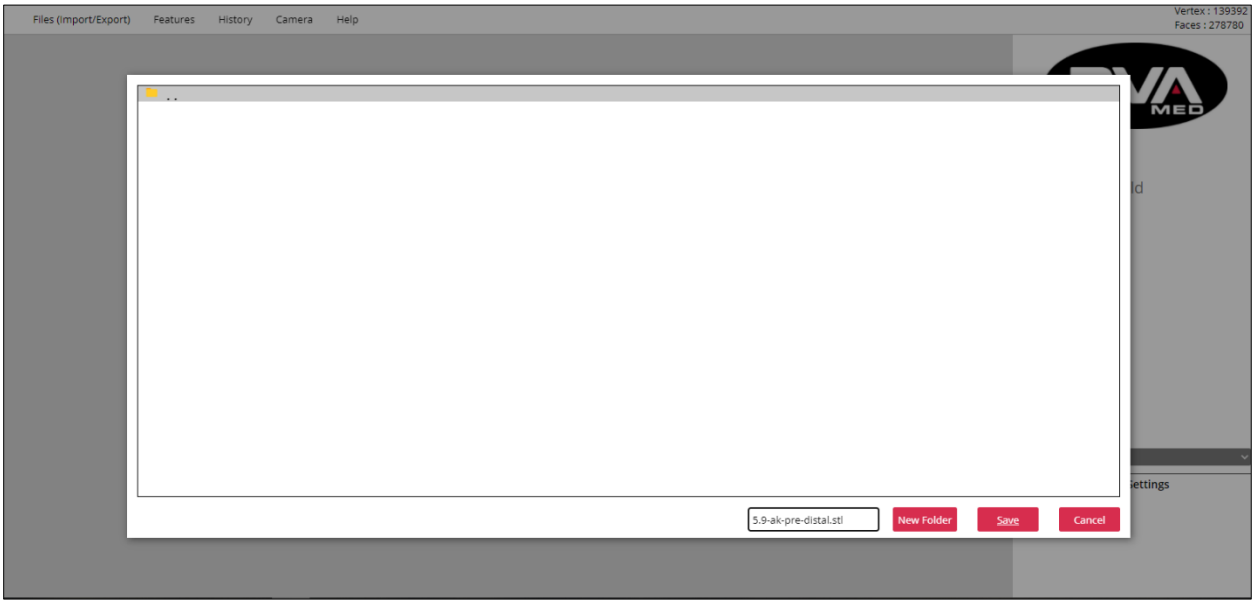


Figure 78: Save File

Add Distal Attachment

To fit the patient, it will be necessary to be able to attach componentry up to and including the foot. In Rapid Plaster, the user can choose between a WalkStrong Socket, Star Socket, or Puck Lock Socket.

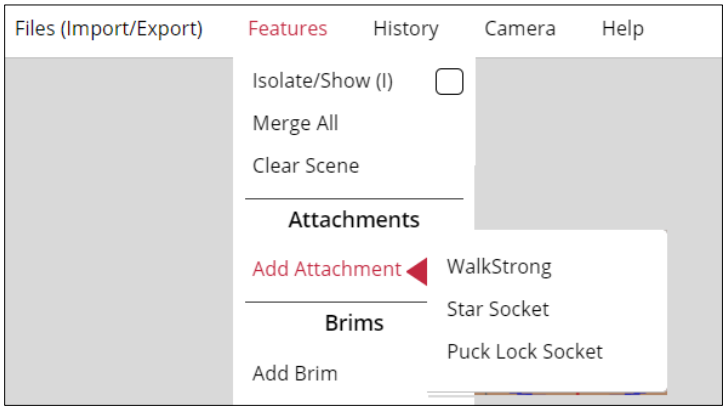


Figure 79: Attachments

WalkStrong Puck Lock and Puck Lock Attachments supports patients with pin lock suspensions. The Star Socket supports patients with suction and vacuum suspensions.

For **Puck Lock Sockets**, the user can select **WalkStrong Puck Lock** or **Puck Lock** to be added to the workspace. Once selected, the puck lock dummy will be brought into the center of the printer bed in the workspace. The user can then use the **Move** tool to align the positive model relative to the puck lock dummy prior to merging.

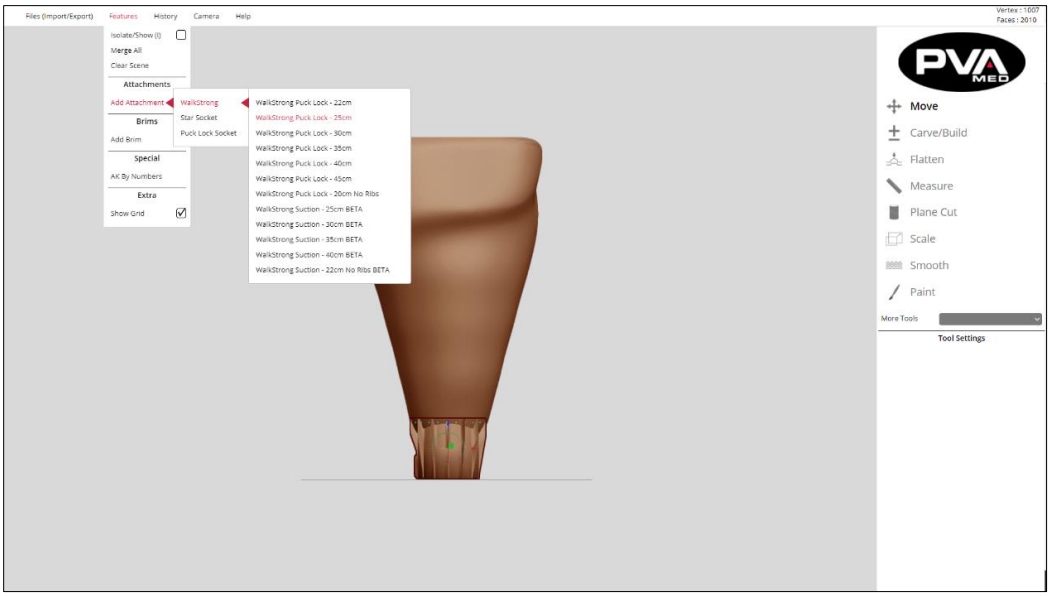


Figure 80: WalkStrong Socket

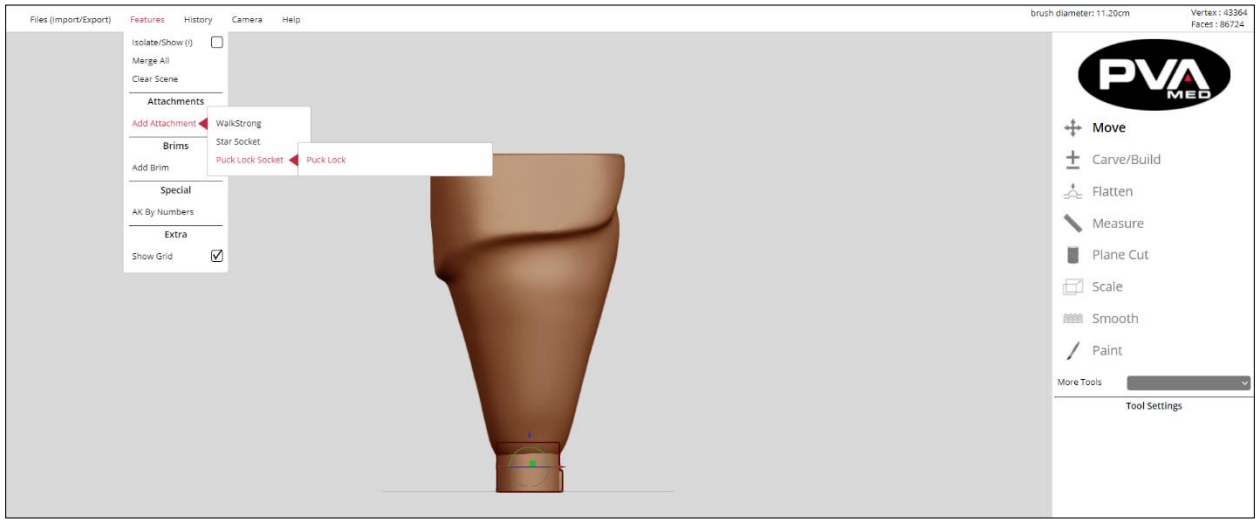


Figure 81: Puck Lock

Once satisfied with the alignment, select **Features** > **Merge All** to merge the puck lock dummy with the positive model.

For **Star Sockets**, select one of the Small Star, Medium Star, Large Star, Extra Large options to bring it on to the workspace.

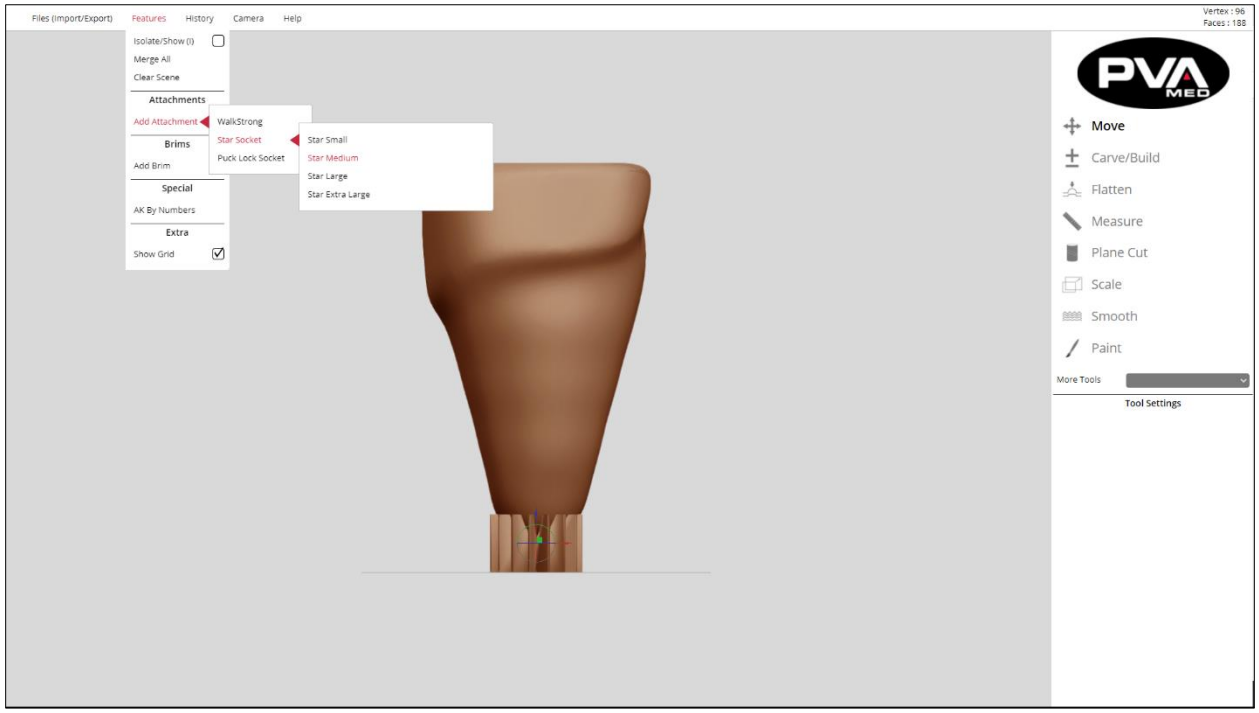


Figure 82: Star Socket

Ensure the option selected will support the entire distal end of the socket. Start by picking the smallest star that will adequately support the check socket to be printed.

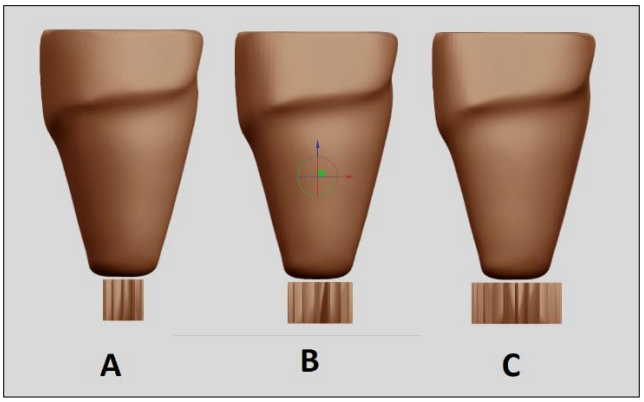


Figure 83: Star Socket Options

In the figure above, A shows the Small Star option, B the Medium Star and C, the Large Star. For the positive model pictured, we can see that A is probably too small and may not have adequate support to hold the print in place. C is likely more support than needed, resulting in wasted time and material. For the positive model pictured, B, the Medium Star, appears to be the best choice for this Star Socket example.

Align and Merge the Star

1. Using the **Move** Tool, position the positive model over the star, paying special attention to position the distal end of the positive model within 1-2 mm of the print bed.

2. As long as the positive model is selected, the outline of the positive model will be shown on the Star so the user can see where within the positive model is relative to the bottom of the Star and the Printer Bed.

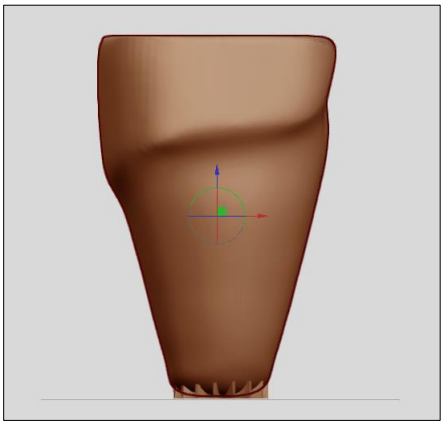


Figure 84: Align and Merge Star

3. Once satisfied with the alignment of the check socket as defined by the position of the Star relative to the positive model, select **Features > Merge All** to merge the Star support to the positive model.

4. When printed, only the part of the Star that protrudes outside the positive model will be printed. The portion of the Star that is inside the positive model when merged will be ignored.

5. Convert the shape file in Rapid Plaster to a file that will 3D print the associated Check Socket as designed. This process is the CAM (Computer Aided Manufacturing) step, otherwise known as slicing. Select **Files > Online Slicer > (select your printer) > ClearFit™ > Star Medium 2.5 mm** for this example.

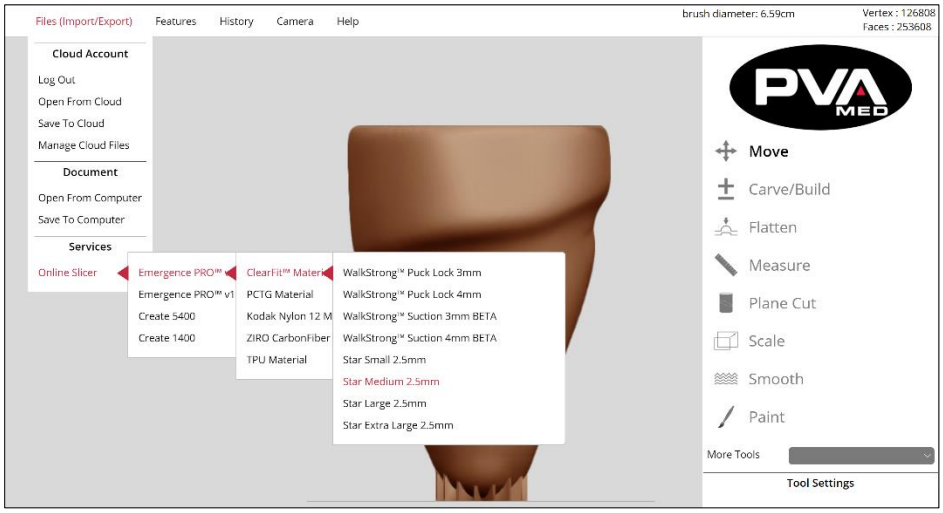


Figure 85: Online Slicer

If a Large Star selected in previous step, then the user would select **Files > Online Slicer > (select your printer) > ClearFit™ > Star Large 2.5 mm**. The slicing profile chosen should always align with the Socket Type and Attachment Type chosen during the modify process.

6. After selecting the slicing profile, name the file that will be the print file for the AK socket as designed. In this example, we name the file **Pid-123-EPv2-Star-Med** with the first part of the filename associated with the patient (Pid-123). The latter part of the filename of "EPv2-Star-Med" describes the socket type and slicing profile use to create.

Note: The filename chosen should be meaningful so that it will be recognized on the printer or printer microSD card. You should who the print file is for as the printer can save and store and accumulate many print files.

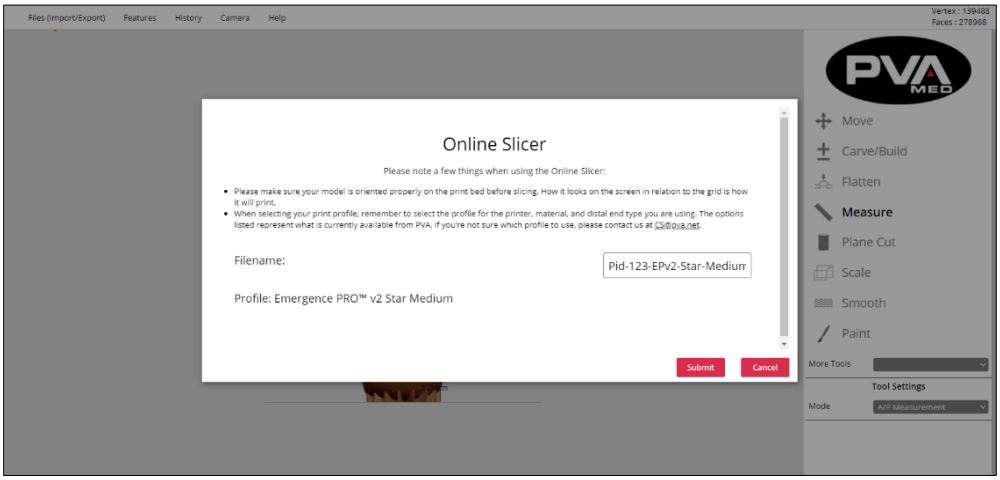


Figure 86: Submit Online Slicer

7. After entering the filename, click the **Submit** button to slice your AK Socket design into a 3D printable file optimized for your printer.

Please note a few things when using the Online Slicer:

- Please make sure your model is oriented properly on the print bed before slicing. How it looks on the screen in relation to the grid is how it will print.

- When selecting your print profile, remember to select the profile for the printer, material, and distal end type you are using. The options listed represent what is currently available from PVA Med. If you are not sure which profile to use, please contact us at cs@pva.net.

8. Save the completed modified, slice-ready positive model so that you can reference it in the future, should the need to access it become necessary.

Print Preview

Once the Online Slicer completes the creation of the 3D print file for the AK socket, the user will receive confirmation that the 3D print file is ready for preview and download.

1. Click the **Preview GCode** button to bring up the **GCode Viewer**.

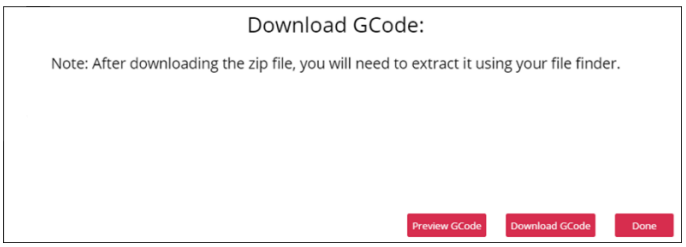


Figure 87: Preview G-code

2. Use the cube in the upper left-hand corner to navigate to different views of the print preview. Left clicking a mouse while moving the cursor on the print preview is an alternate way to view the device as it will look once printed.

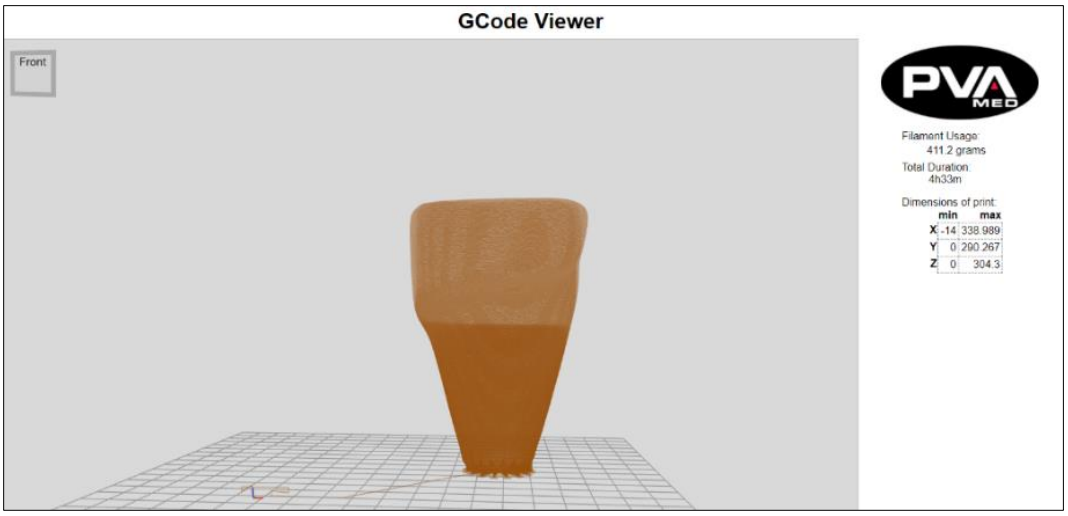


Figure 88: G-code Viewer

Some key information to note include **Filament Usage** (grams) and **Total Duration** (hours, minutes). This will help ensure that you have sufficient filament loaded to complete the print. The duration will help with planning and sequencing prints based on work schedules and printer availability.

3. After previewing the print and capturing the key information, close the print preview by clicking the X in the upper right-hand corner of the window.

Download the GCode

1. Click the **Download GCode** button to download a compressed GCode file.

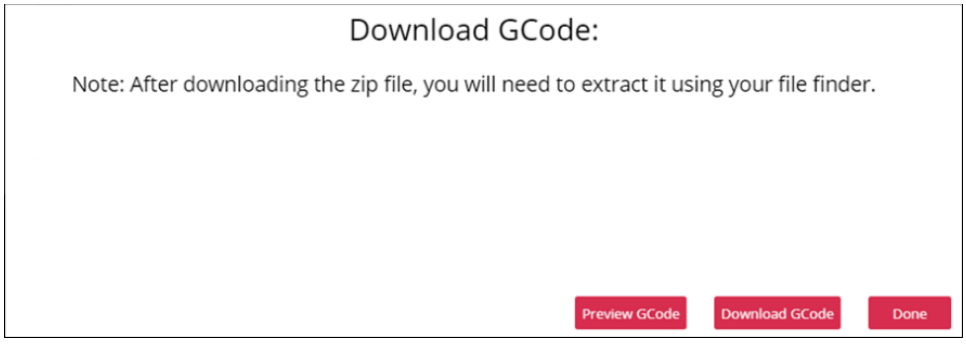


Figure 89: Download G-code

2. Rapid Plaster will then bring up a Windows File Save dialog box. From here, you can choose the folder where to download to.

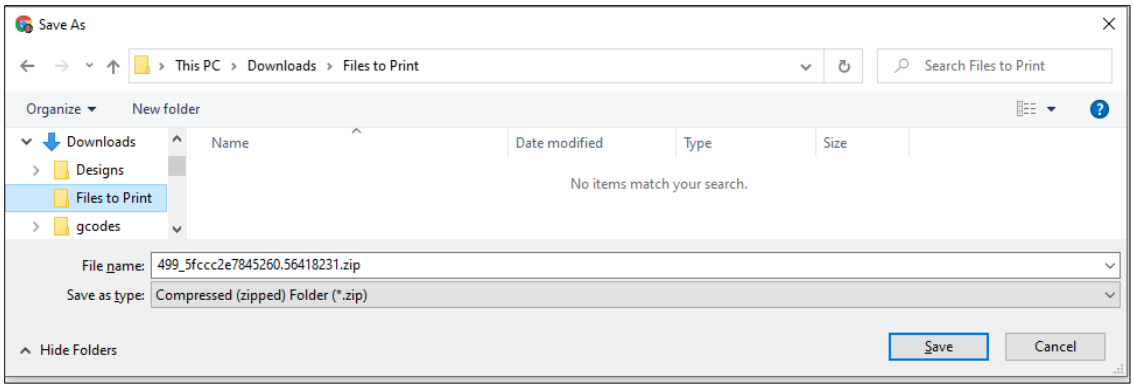


Figure 90: Save G-code

3. Once download is complete, you should see a confirmation in the Chrome Download Status bar at the bottom of your Chrome window.

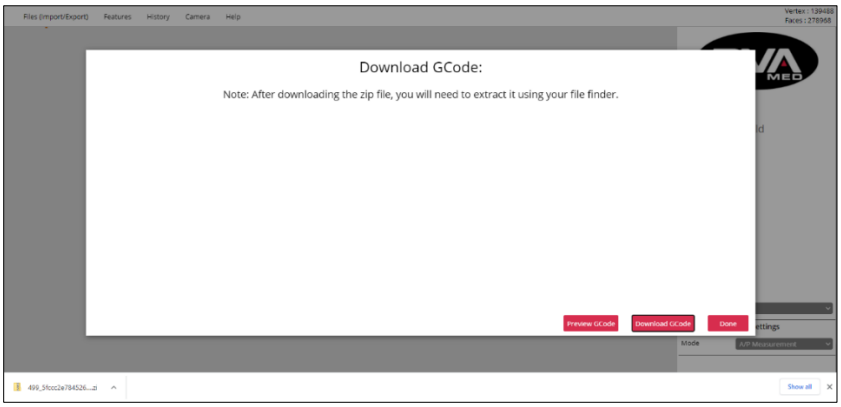


Figure 91: Chrome Download Status

4. Click the carrot(ˆ) next to the filename, 499_5fccc2e7845260.56418231.zip in this example and select **Open**.

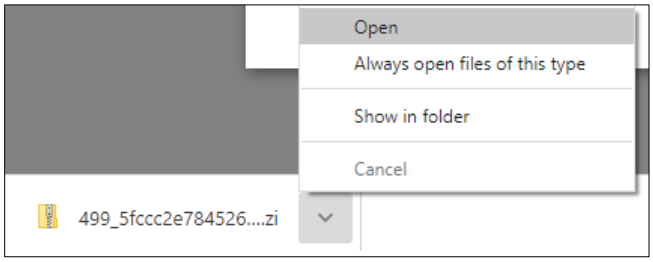


Figure 92: Open Download

5. The following dialog box will appear.

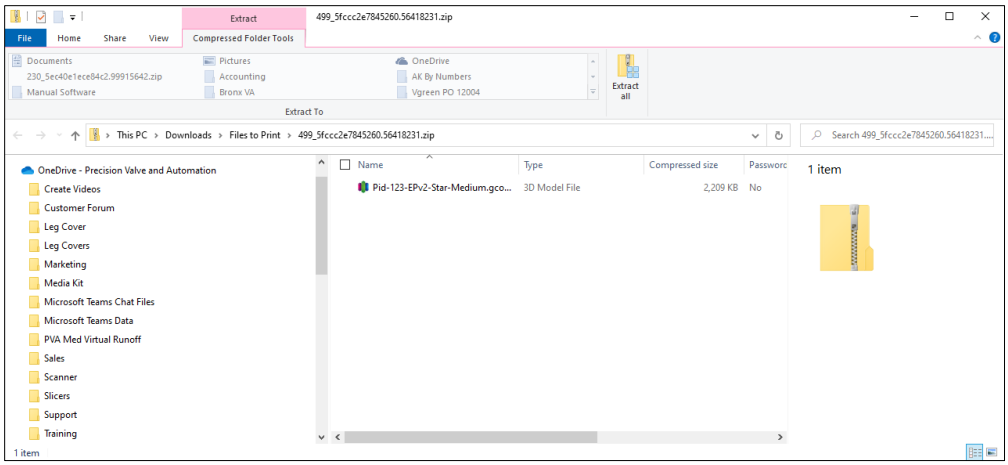


Figure 93: G-code File in Folder

6. Click the Extract all icon in the Compressed Folders Tools.

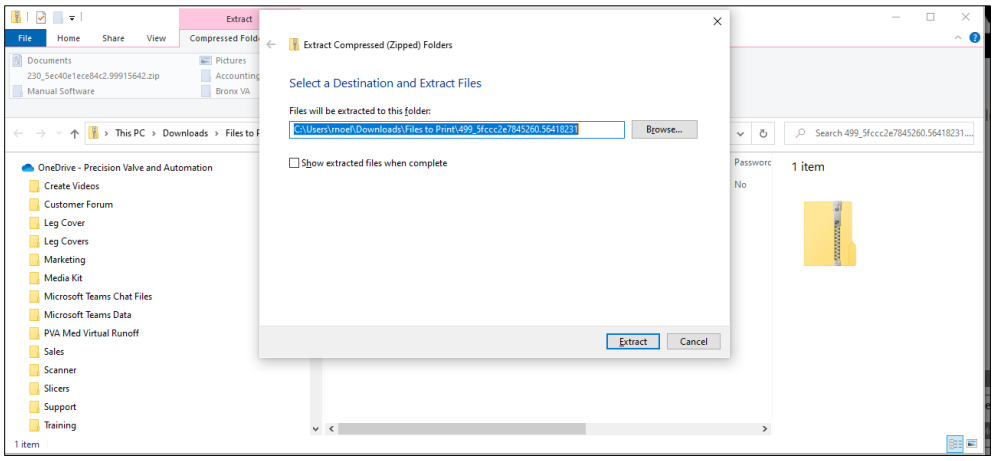


Figure 94: Extract

7. In the Extract Compress (Zipped) Folders, select a destination of where the G-code file will be extracted.
8. Insert the microSD card into the SD card adapter.
9. Insert the SD card adapter into your computer.
10. Click the Browse button to locate, then select the microSD card and click Save.

5.4.7 Show Grid

Show Grid - This feature turns the grid On/Off. Select **Features → Extra → Show Grid.**

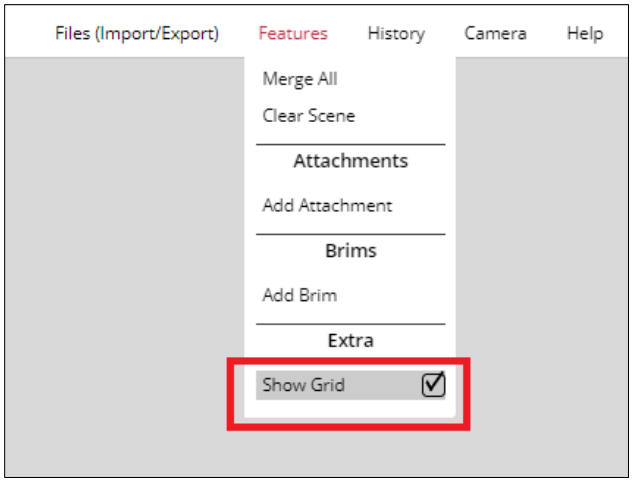


Figure 95: Show Grid

This grid represents the print bed.

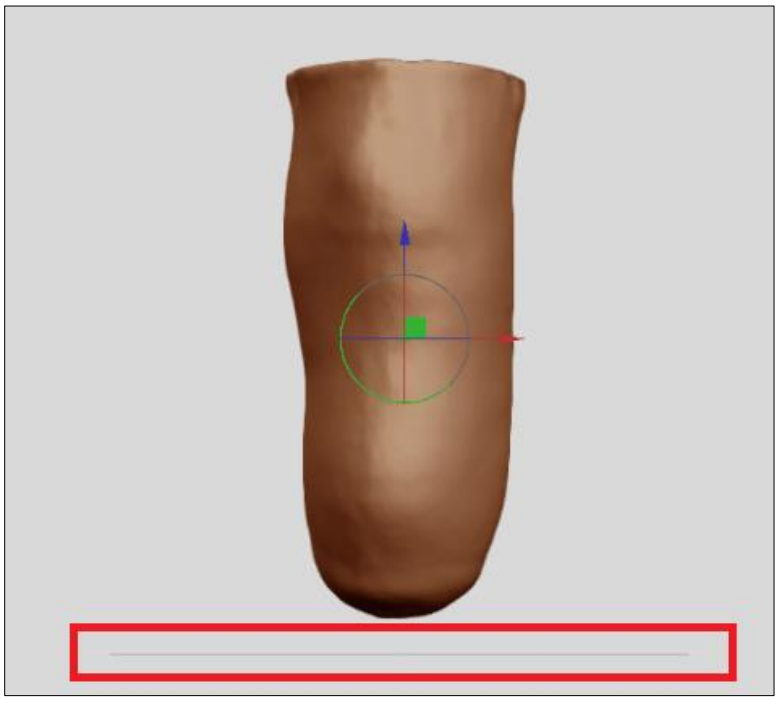


Figure 96: Print Bed Parameters

5.5 History

5.5.1 Undo and Redo Feature

This feature allows the user to undo or repeat actions performed in RAPID PLASTER®.

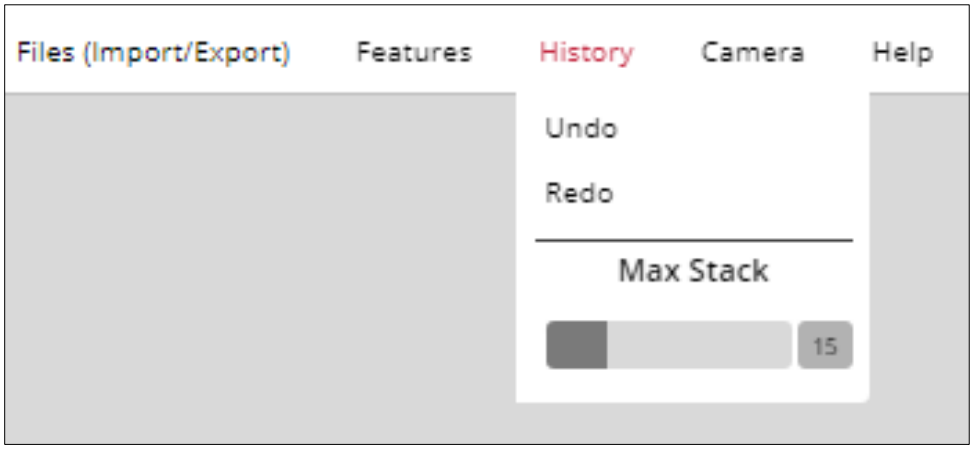


Figure 97: Undo/Redo Feature

5.5.2 Max Stack

This option specifies the maximum number of actions that will be available to be undone or redone. The Max Stack option defaults to a value of 15 actions and can be increased up to 50 by typing in the box and replacing 15 with the desired value. The slider control can also be used to set the Max Stack value. Keyboard shortcuts can also be used for Ctrl-Z for undo and Ctrl-R for redo.

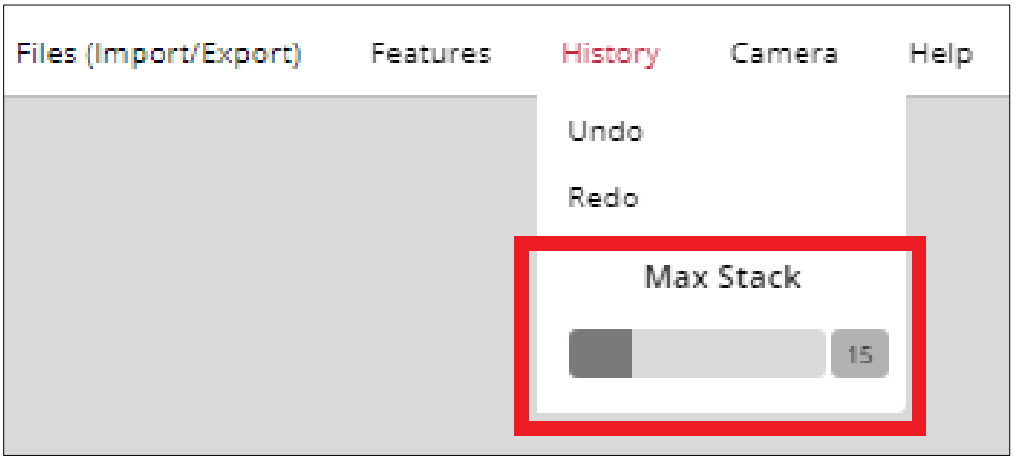


Figure 98: Max Stack

5.6 Camera

The Camera feature relies on the positive model to be in a default orientation. Specifically, the anterior portion of the positive model should be facing the user with the posterior portion hidden, away from the user. The distal portion of the model should be closest to the print bed, with the print bed represented by the horizontal grey line in Rapid Plaster, and the proximal end of the positive model should be the furthest away from the print bed. If there was an imaginary line running through the center of the model, it would intersect the print bed at 90°.

Figure 99: Camera Feature

The Camera Tool takes limb side into account. Left or Right is set in the Camera Tool menu.

Once the Left or Right input is selected, the Camera Tool understands the context necessary to display Medial and Lateral views, rotating the view based on selected context.

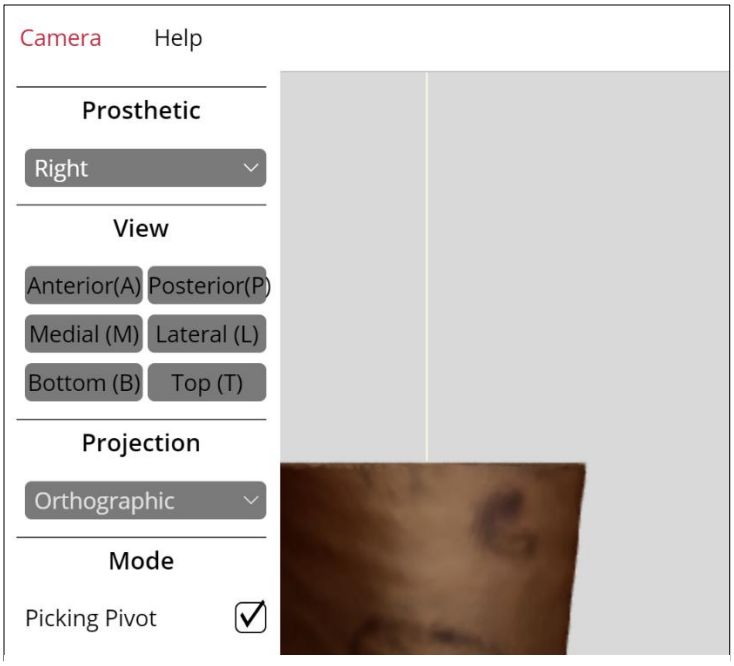


Figure 100: Limb Side and Camera Shortcuts

The Camera Tool also supports shortcut keys and the user can use the keyboard to quickly switch view of the positive model as follows:

- **A** – Anterior
- **P** – Posterior
- **M** – Medial
- **L** – Lateral
- **B** – Bottom
- **T** – Top

5.6.1 Camera View

- **Reset (Bar)**: Click to reset the default orientation, which is the anterior of the object with the distal end closest to the print bed. This should be done as the first step after modifying any positive model.
- **Anterior (F)**: Click to orient the object view to anterior (front) with the distal end closest to the print bed. Subsequent clicks toggle between Anterior/Posterior views.
- **Medial (L)**: Click to orient the object view to Medial view with distal end closest to the print bed. Subsequent clicks toggle between Medial/Lateral views.
- **Top (T)**: Click to orient the object view to Top view looking top down from the Proximal end closest. Subsequent clicks toggle between Top/Bottom views.

5.6.2 Camera Projection

Camera Projection provides two views. In the Perspective view, objects which are far away are smaller than those nearby. In the Orthographic view, all objects appear at the same scale.

- **Orthographic** (**Default**): This option makes it easier to compare two parts of the positive model, as there is no question about how the viewpoint may affect the perception of distance.
- **Perspective**: This option gives more information about depth and is often easier to use when processing virtual/spatial data.

6.Step 3 - Print

6.1 Slicing Your Model (.STL) File To Create A Printable Device (.G-code) File

Once you have made all of your desired changes to the positive model, including adding a distal attachment, brim, or posterior shelf, the next step in the workflow is to generate a printer-ready file from your model. This can be visualized as pulling a virtual check socket over the modified positive model. Before slicing the model, you will need to properly orient it on the print bed. The model's orientation on the bed matches how it will print. When selecting the print profile, remember to use the profile corresponding to your printer, material, and distal end choices. The listed options represent those options currently available. If you are not sure which profile to use, please review our support article covering online slicing or contact us at med@pva.net for additional help.

6.1.1 Select Slicing Profile

The first step in slicing is to select the slicing profile to be used in slicing your model. This will be determined by the type of distal attachment added. In the following example, a WalkStrong Puck Lock attachment has been added. There are several relevant options to select from. In this example, we selected **Online Slicer → Emergence PRO TM → ClearFit™ Material -> WalkStrong Puck Lock 3 mm**. This choice is based on printing on an Emergence PRO printer, using ClearFit™ material and printing a 3 mm wall thickness for a puck lock device.

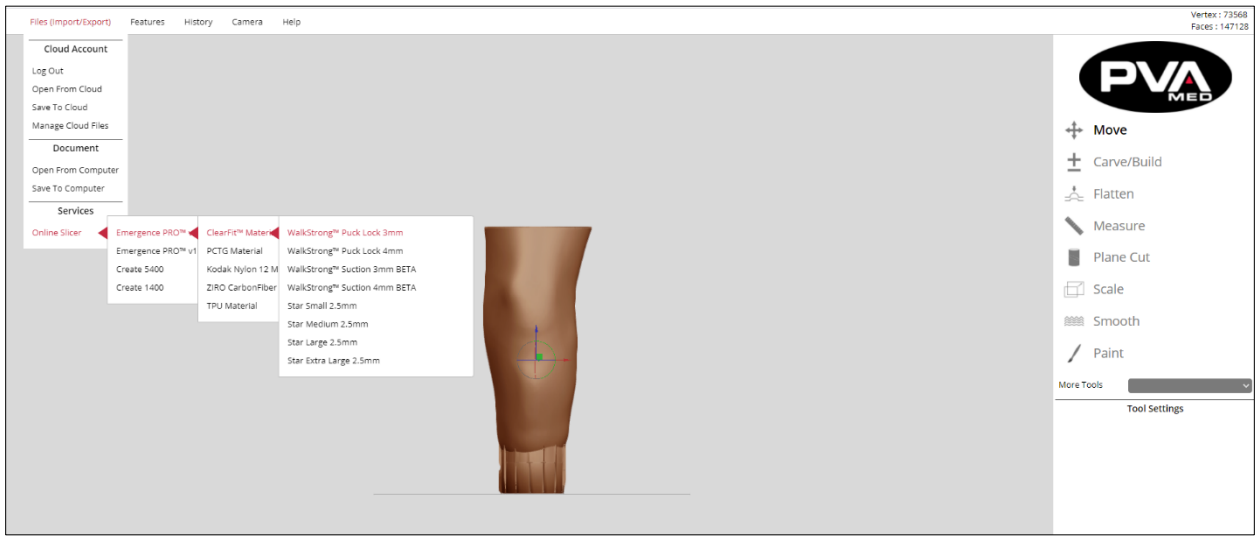


Figure 101: Select Slicing Profile

6.1.2 Name G-code Printer File

Once the slicing profile is selected, supply the name of the G-code file that will be created by the model on the screen as sliced by the slicing profile selected. Typically, this file name will provide an identifier that will allow the technician or clinician to map the G-code to a patient. In the example that follows, we combine a faux patient ID (pid1234) and slicing profile abbreviation (EP-PL-4 mm) to name the G-code file.

The name entered will be the name of the resulting G-code file that will be created as a result of a successful slicing operation. Once the desired name has been entered, the next step is to click the submit button to upload the positive model file to the slicer.

Figure 102: G-code File Example

A status bar will then indicate upload status. Once the file is uploaded, the slicer will then create the G-code file based on the slicing profile selected. This may take up to a minute or two depending on the quality of your network connection.

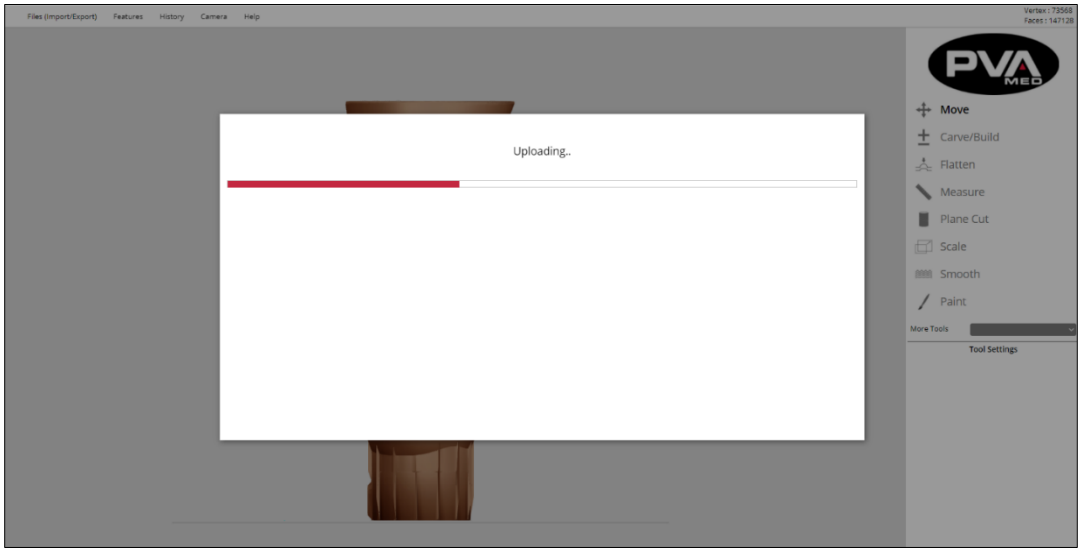


Figure 103: G-code Status Bar

Once the slicing has completed, the **Download G-code** status message box will indicate that the slicing operation completed successfully. Prior to downloading and submitting the G-code file to the printer, it is recommended that the user preview the G-code to verify that the rendering of the printed device looks as expected.

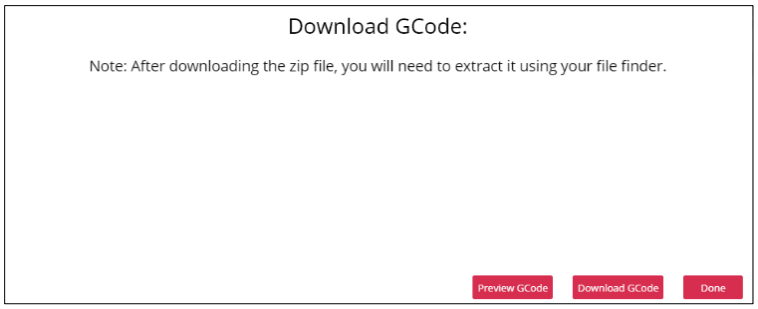


Figure 104: Download G-code Status Message

6.1.3 Preview G-code

To preview the G-code created by the slicer, click **Preview GCode**. Depending upon your network connection and the size of the model, this operation may take a few minutes. The preview displays the tool path of the hot end. In addition to displaying anomalies along the tool path, the preview will display the estimated mass and time of the print. The Dimensions of Print will display the maximum travel distance in the X, Y, and Z axis.

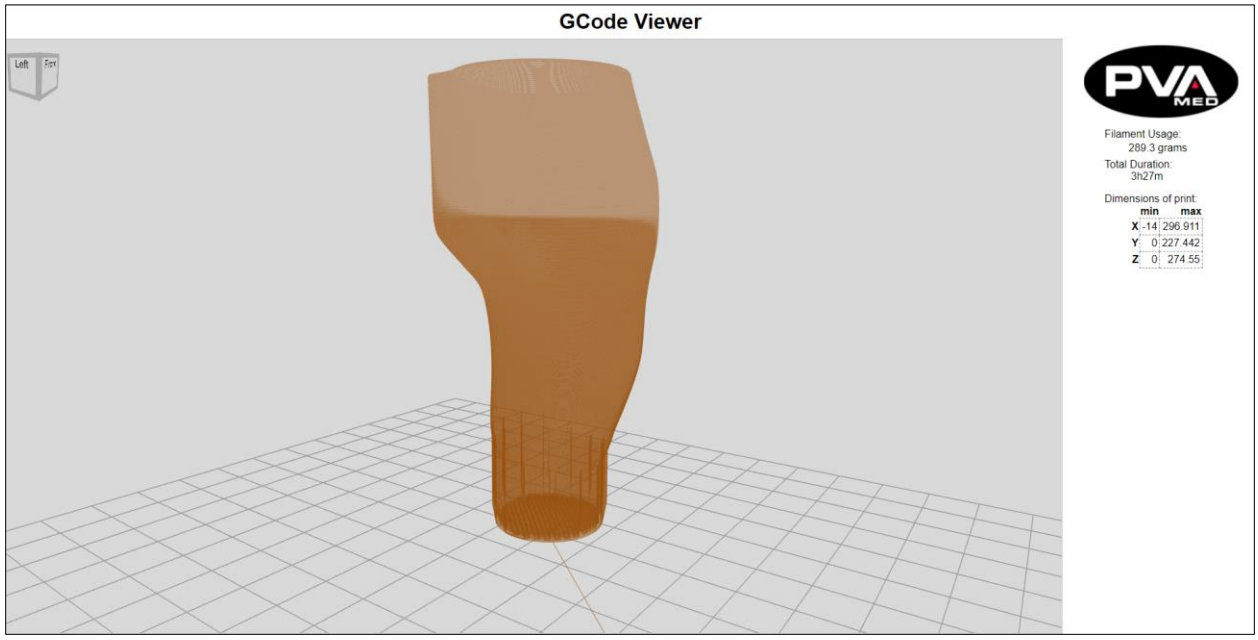


Figure 105: G-code Viewer

6.1.4 Download G-code and Print

The last step in the slicing workflow is to download your G-code and send to the printer. Note that the file that will be downloaded will be compressed into a .zip file. Extract the G-code from the .zip file and place on an SD card to be inserted into the printer. Alternatively, the G-code file can be uploaded to the printer via Wi-Fi using the Duet Web Interface.

6.2 Print a WalkStrong™ Socket

Note: WalkStrong sockets are designed exclusive for the Emergence PRO platform.

1. Load the ClearFit™ filament and ensure that it is extruding properly.
2. Install the Hot End with the 1.5 mm nozzle installed.
3. Upload and start the Gcode.

7. Check Socket Modification Workflow

7.1 BK Socket with Posterior Shelf and Puck Lock Attachment

1. Open digital scan file in the **Raw Scans** folder within your Cloud Account.

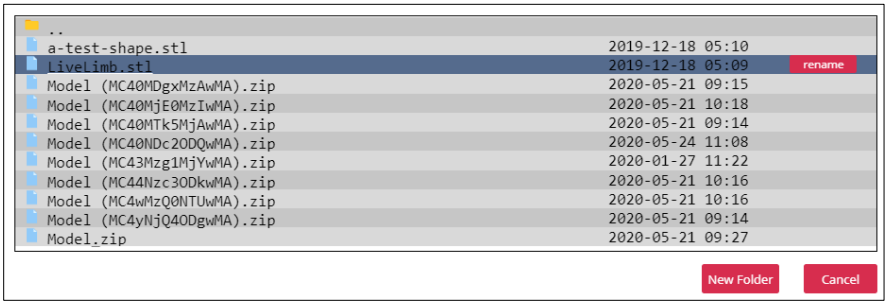


Figure 106: Raw Scans Folder

2. Perform a Plane Cut operation to remove any artifacts such as vacuum tube, scanning table surface, or any other items encountered when scanning a live limb.

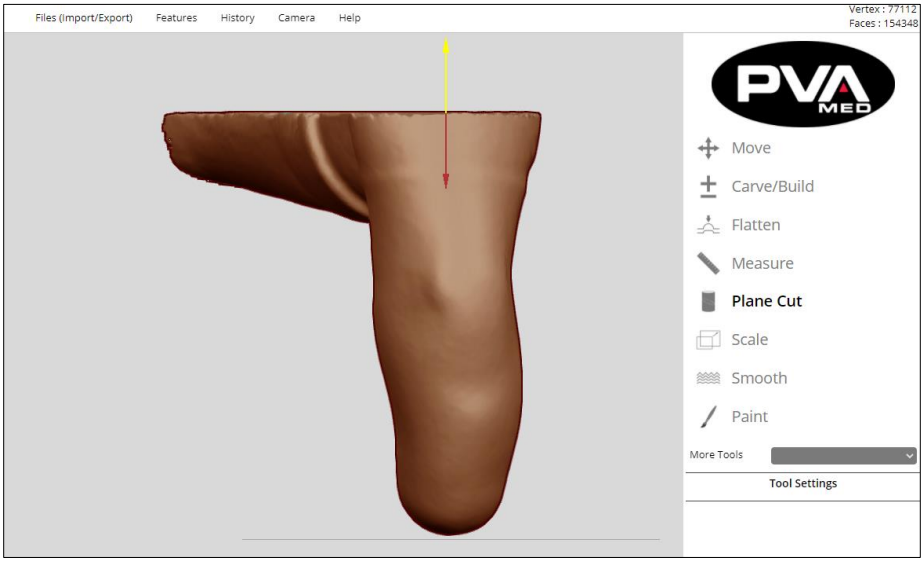


Figure 107: Plane Cut Example

3. Plane cut always bisects the model parallel to the print bed as indicated by the gray line at the bottom of the screen. Use the mouse cursor to specify plane cut height relative to the print bed. The plane cut tool always splits the object into blue and red regions, allowing the user to select which region to discard.

4. If a user receives an undesired result from the plane cut operation, use the **Ctrl-Z** keyboard shortcut or **History → Undo** menu to restore the positive model to its pre-plane cut state. Multiple plane cuts may be required, especially when operating on a scan of a live limb with multiple artifacts.

5. Orient the model using the Move tool so that the distal end of the model is at the bottom and the anterior edge is facing the user. The posterior edge should be facing away from the user.

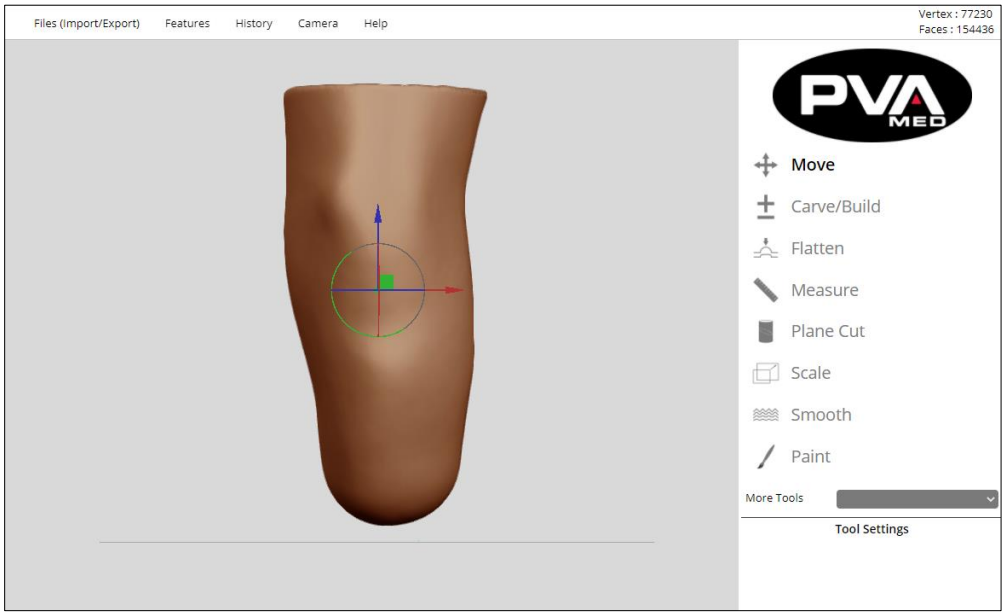


Figure 108: Orient Model

6. The distal end should be positioned closest to the print bed and the proximal end away from the print bed. Medial and lateral edges should be perpendicular to the print bed.

7. Using the measurement tool, verify circumferences with measurements of patient's limb at the key landmarks. This will ensure that the scale is correct.

8. Click the **Camera → Reset** button to fix the default model orientation. Once the default model orientation is set, the other camera buttons will allow easy and rapid perspective navigation by using the Camera buttons to toggle between:

    - **Anterior (F)**: Anterior/Posterior
    - **Medial (L)**: Medial/Lateral
    - **Top (T)**: Proximal/Distal
    - **[Optional] Add Brim**: AK/BK, Left/Right

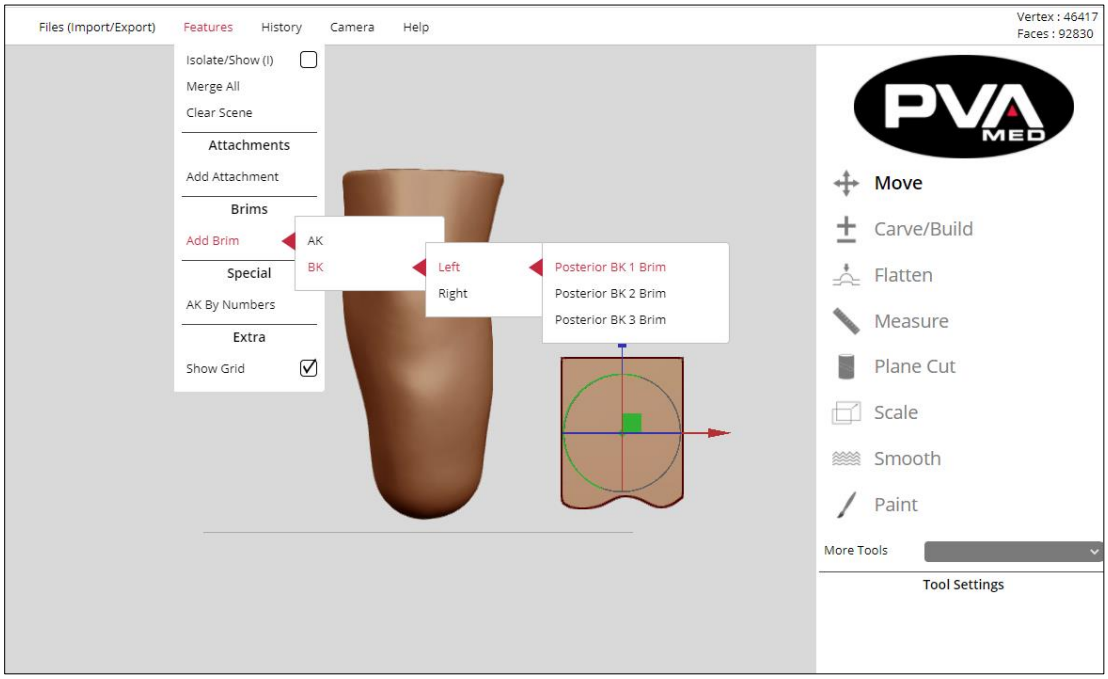


Figure 109: Add Brim Example

For this example, the patient is a BK left and the posterior shelf will be selected.

9. Position the brim relative to the positive model using the Move Tool.
10. Check the position of the shelf from multiple perspectives using the Camera feature.

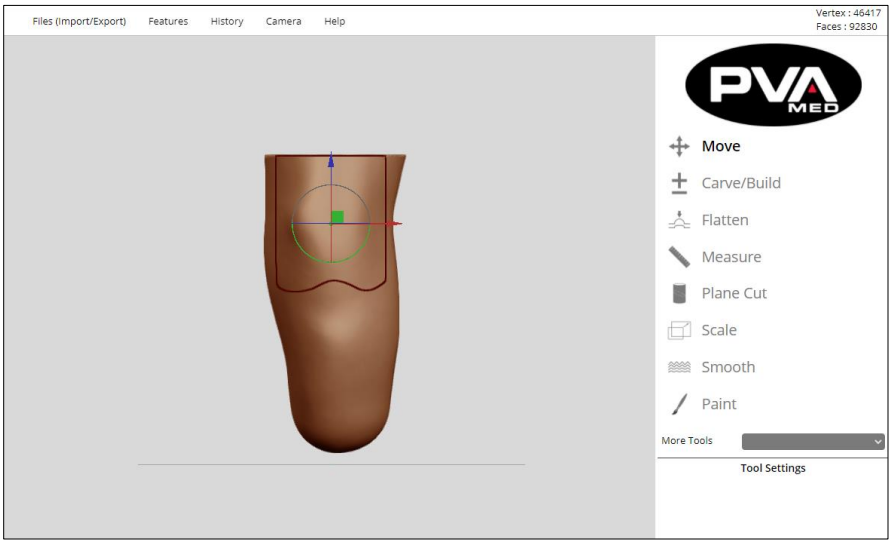


Figure 110: Anterior Example

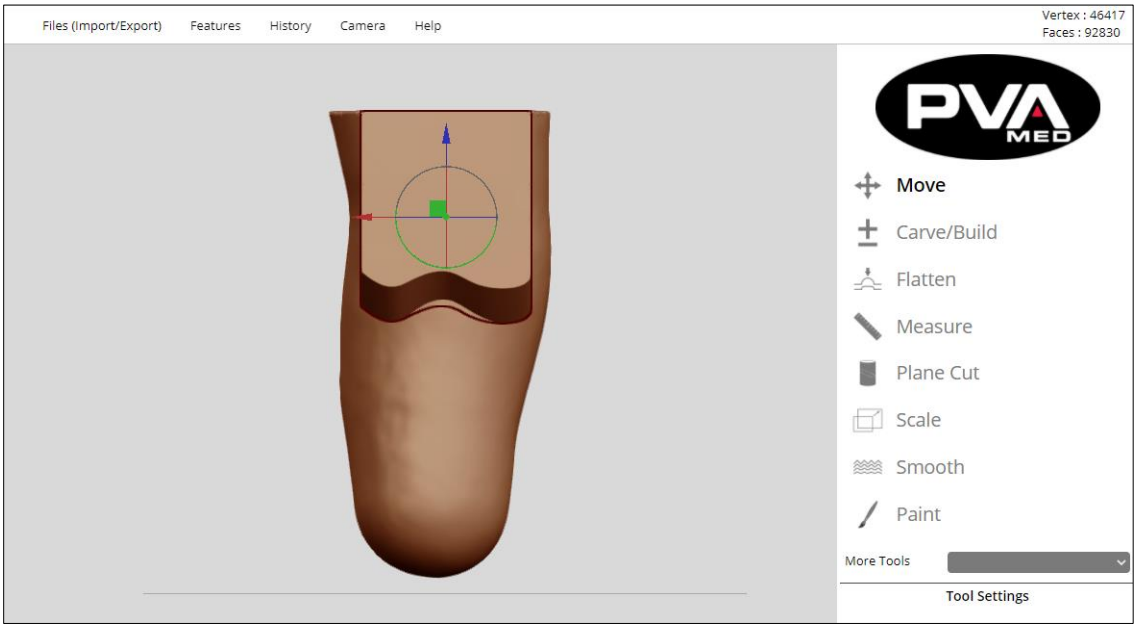


Figure 111: Posterior Example

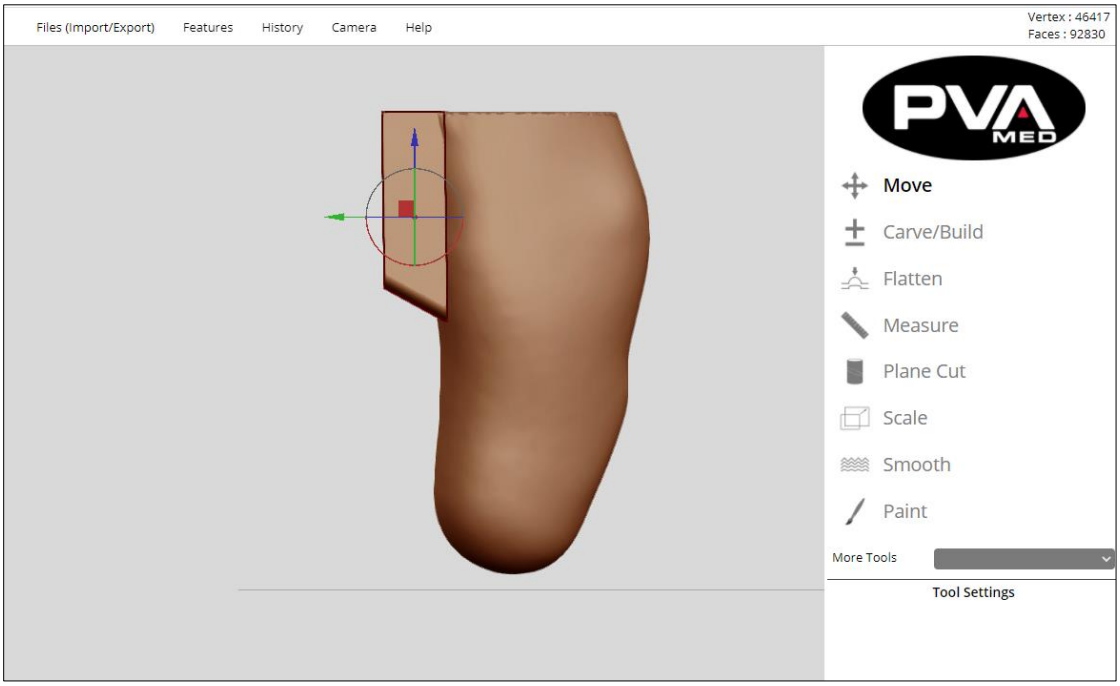


Figure 112: Medial Example

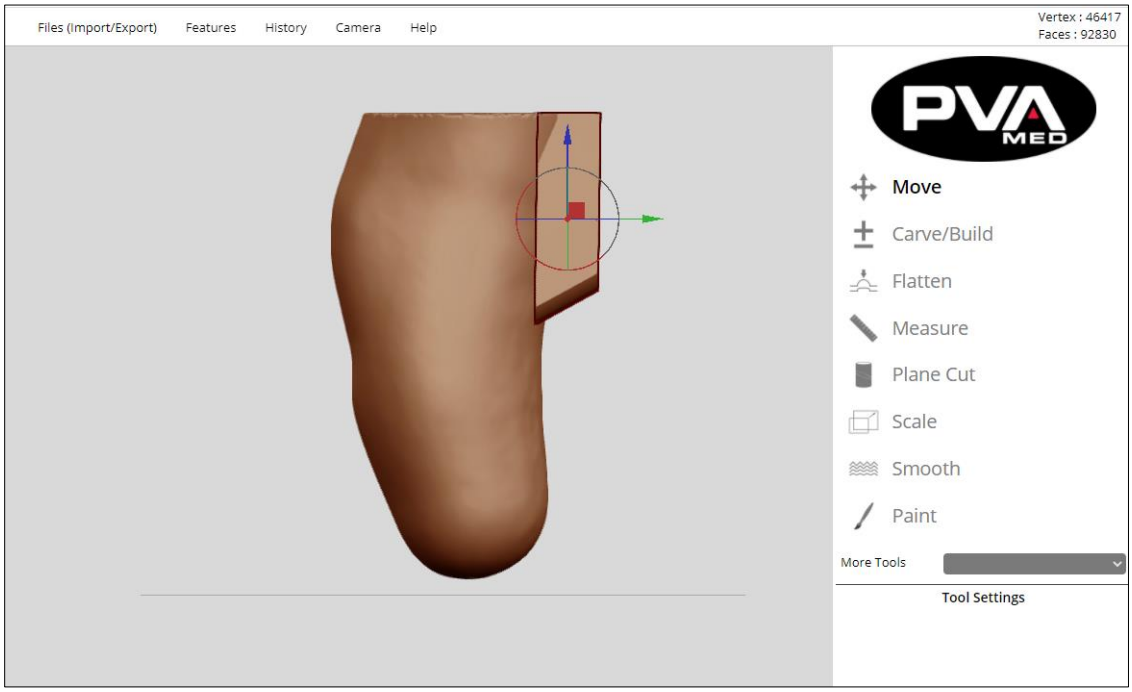


Figure 113: Lateral Example

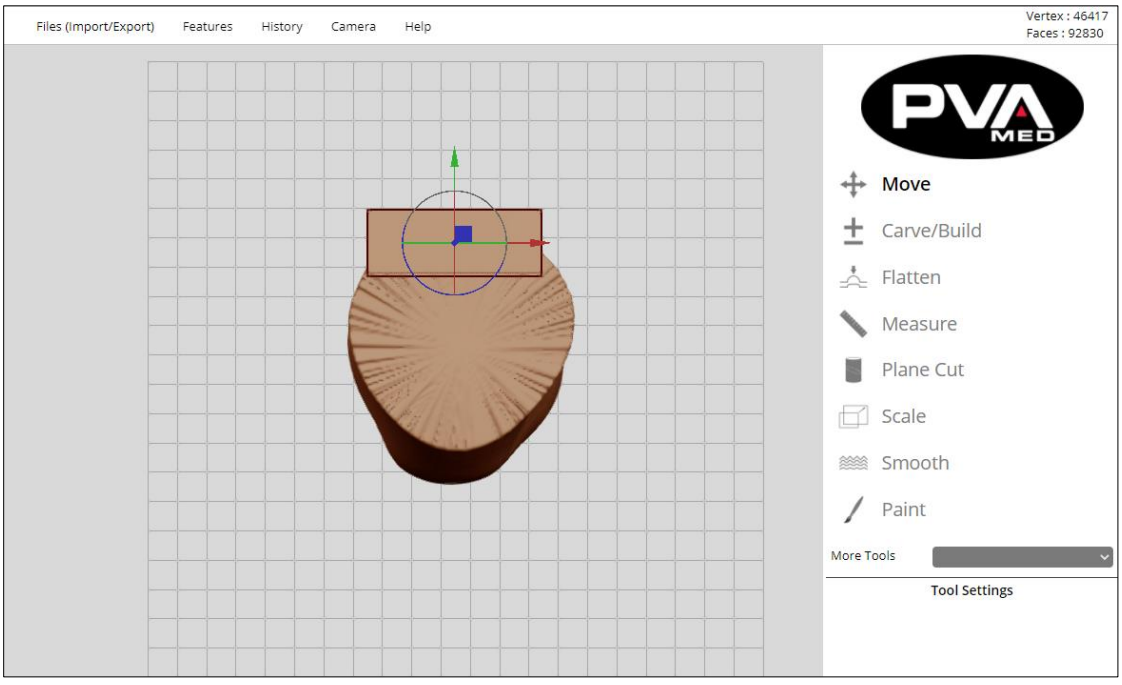


Figure 114: Proximal Example

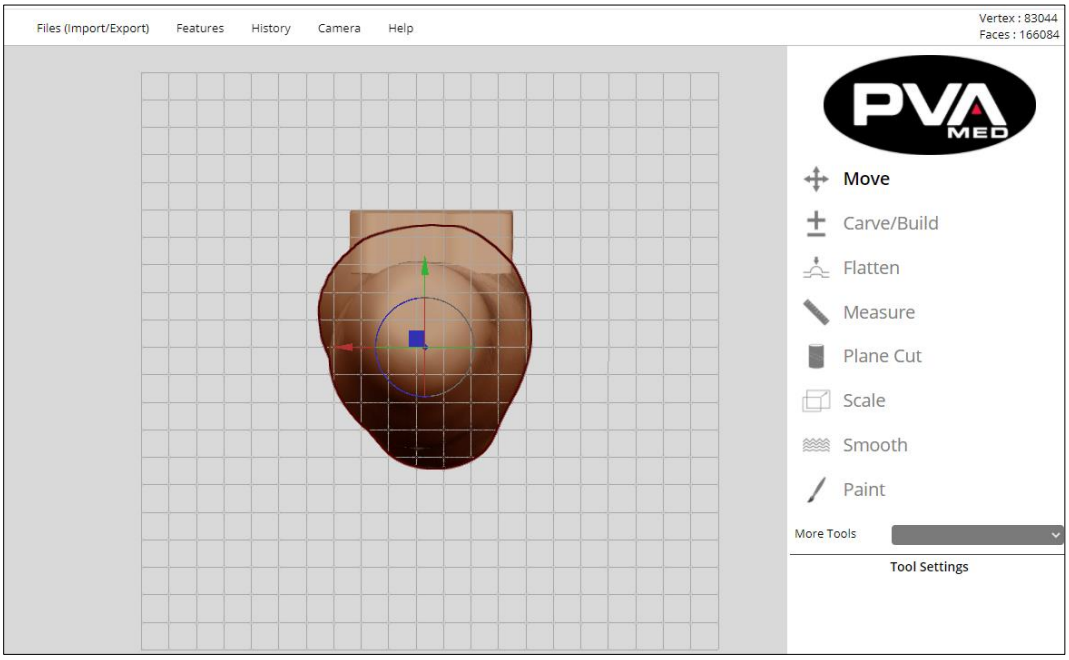


Figure 115: Distal Example

11. Use the Stretch tool to resize the brim for the desired fit prior to merging. The **Merge All** feature fixes the position of the brim relative to the positive model.

12. After merging the brim, use the Remesh tool to remesh the merged model to a resolution of 200. This will simplify the process of blending the merged positive model with the brim.

13. Blend the brim with the positive model merge point.

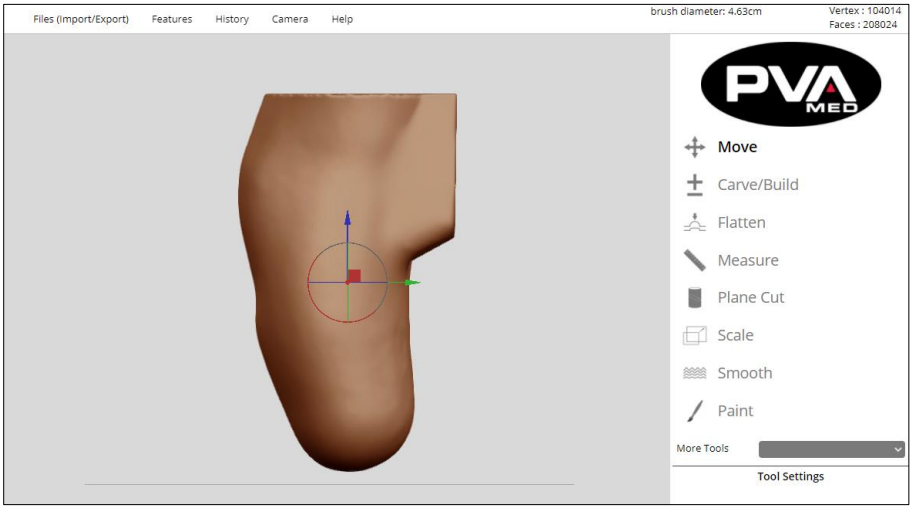


Figure 116: Blend Brim Example

14. Blend brim using a combination of the following tools:

    - **Flatten tool**
    - **Carve/Build tool**
    - **Inflate tool**
    - **Smooth tool**
    - **Remesh tool**

15. Perform any model modifications (optional).

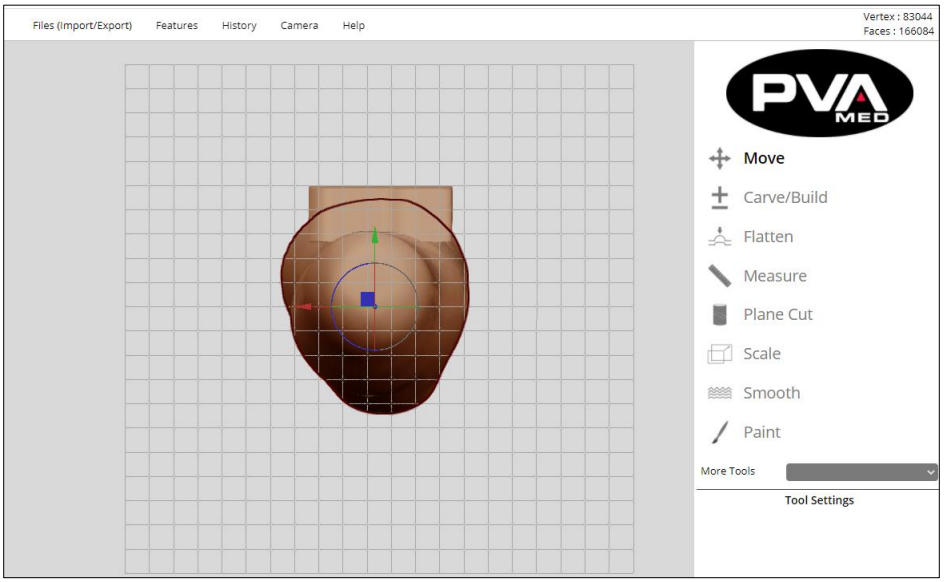


Figure 117: Build Up on Tibia

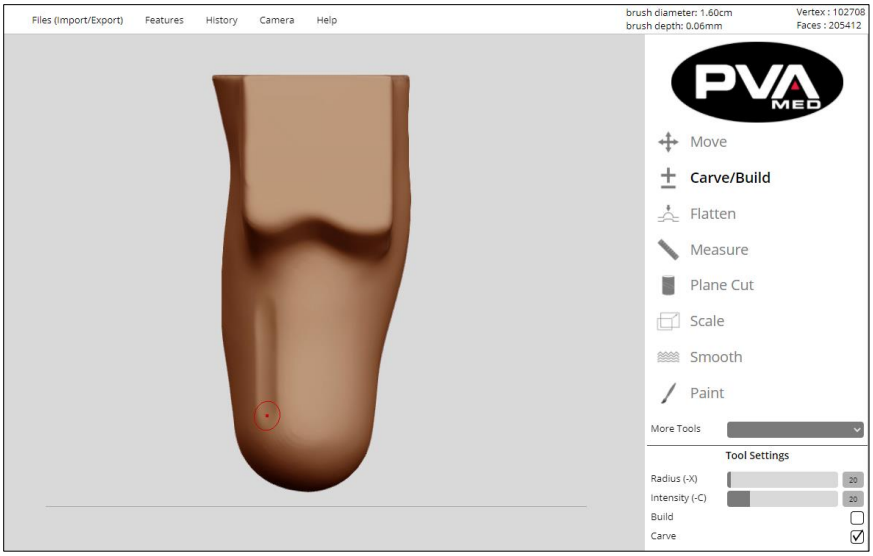


Figure 118: Carve Relief Points on Posterior

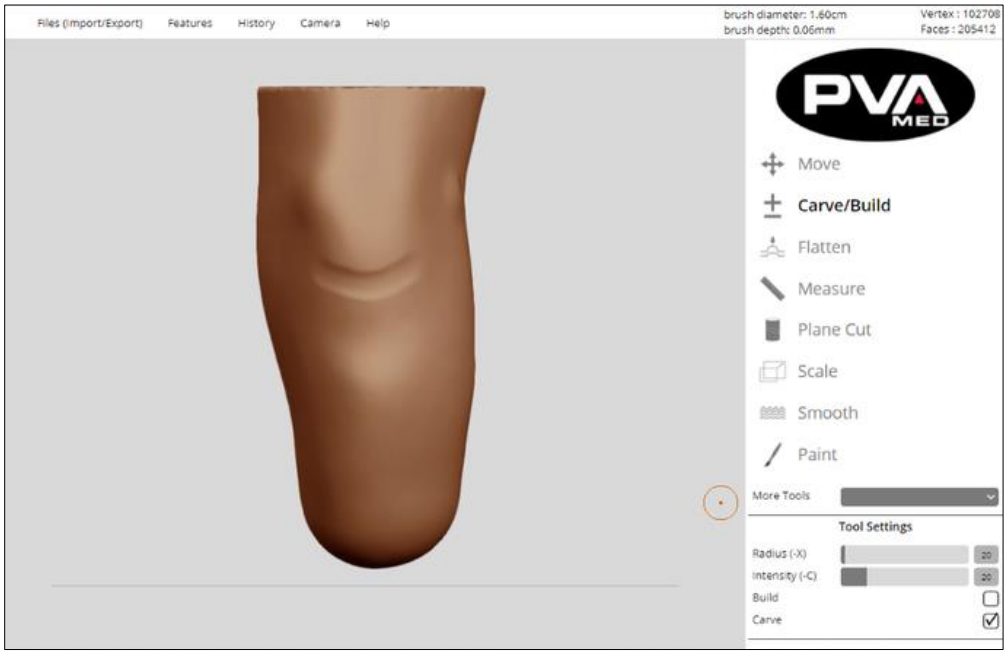


Figure 119: Carve Out Around Patella Tendon

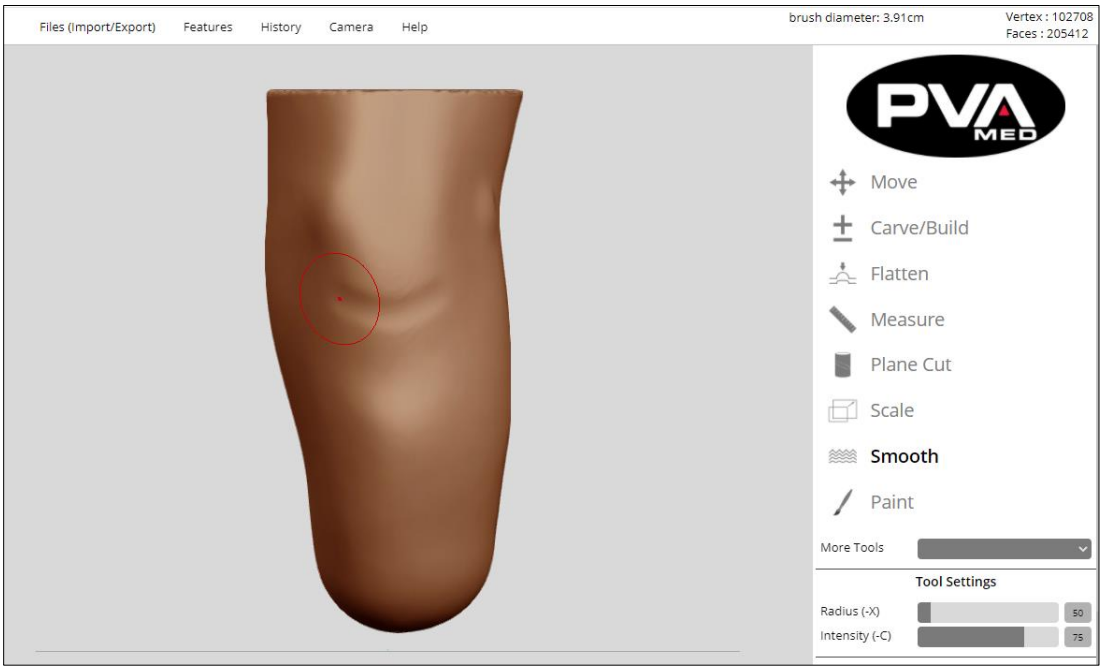


Figure 120: Smooth Transition Points

16. Verify measurements for circumference and height.

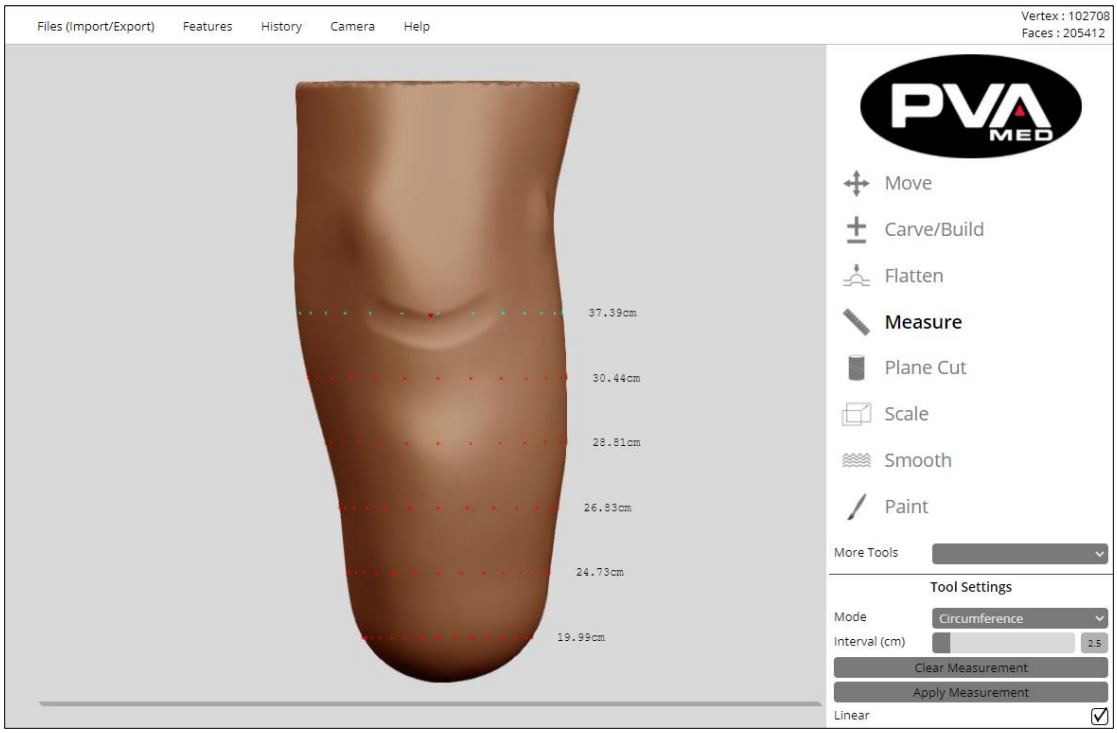


Figure 121: Verify Measurements (Circumference)

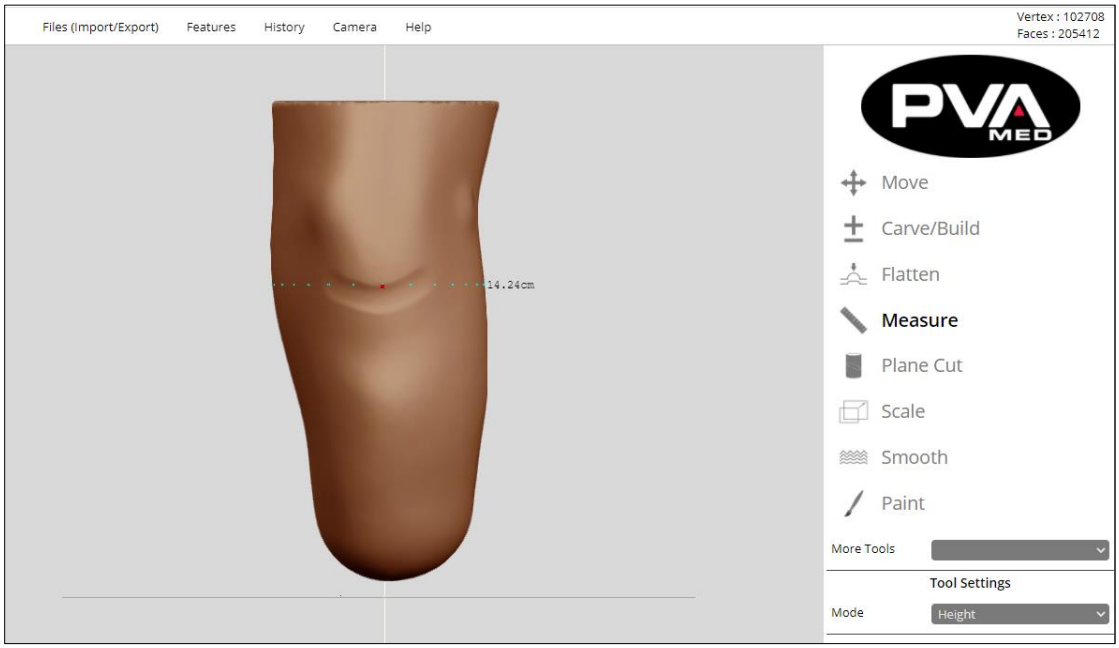


Figure 122: Verify Measurements (Height)

17. Save the model to your Cloud Account prior to adding the distal attachment. This will save time in the event you need to update the design or change distal attachments.

18. Add the desired distal attachment.

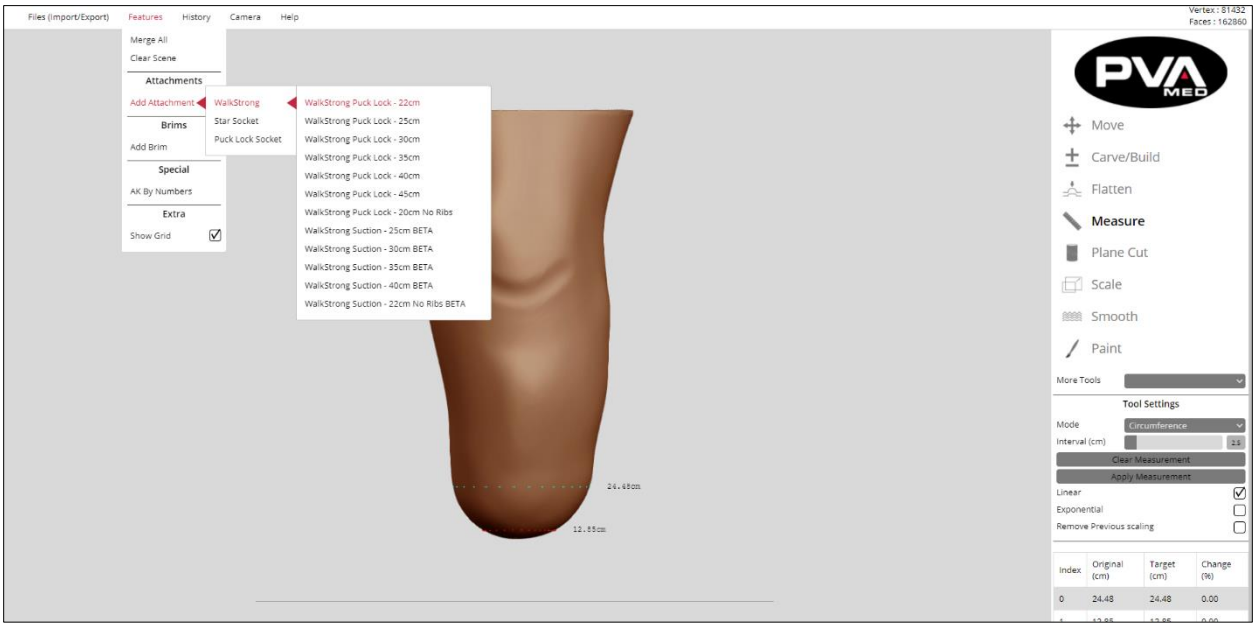
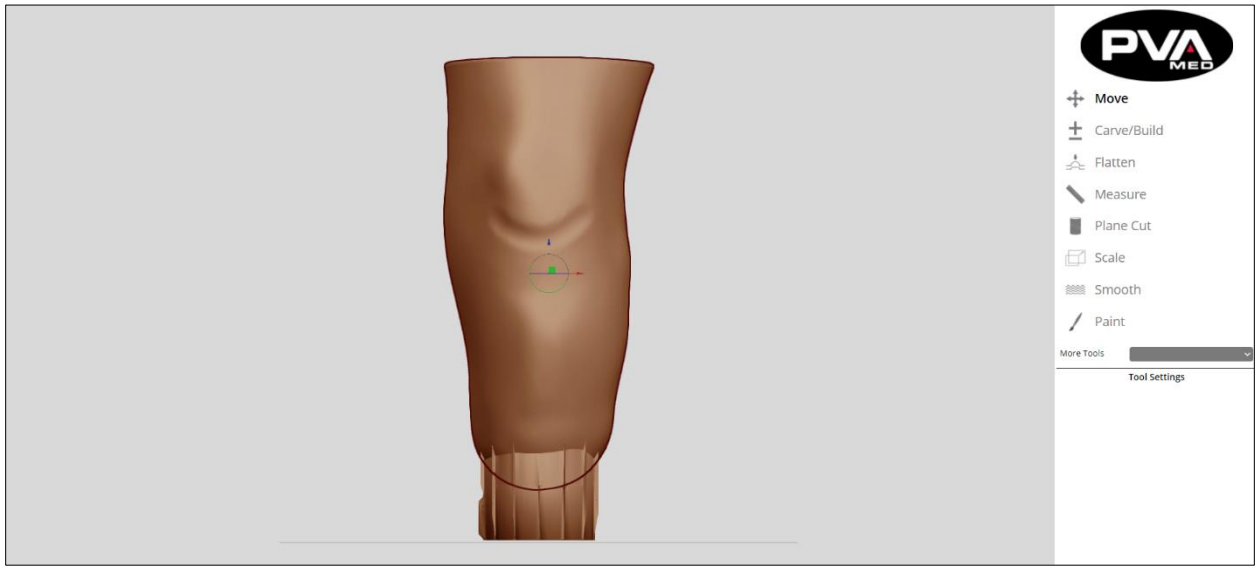


Figure 123: Add Attachments Example

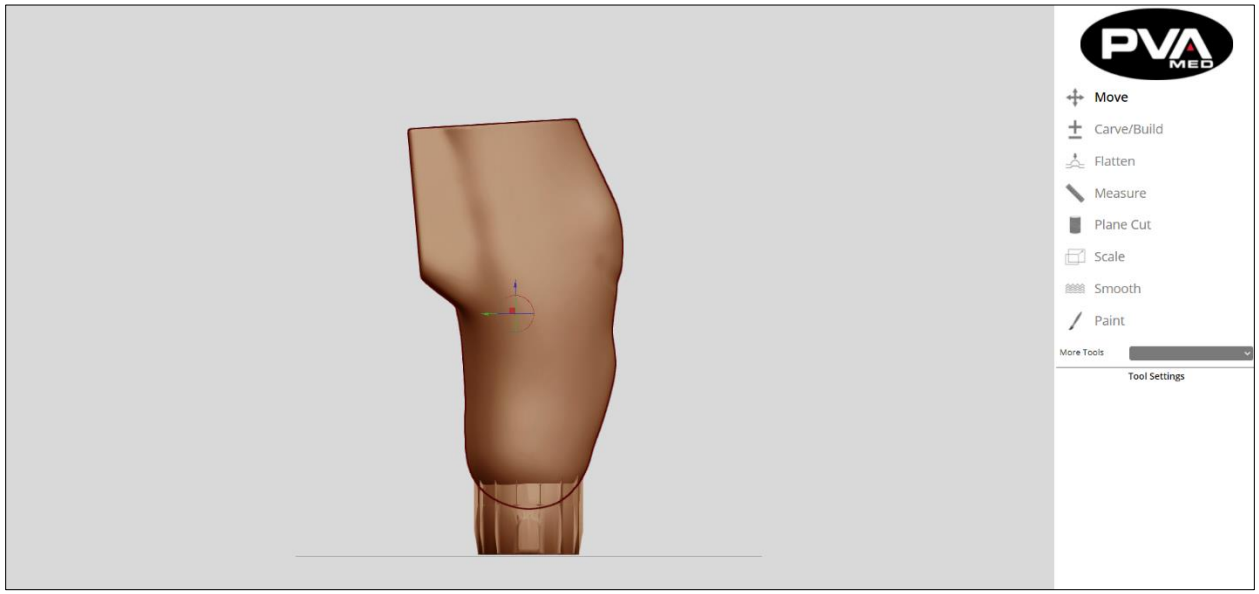
19. RAPID PLASTER® will import the selected object and center it flat on the print bed.

20. Fix the alignment by orienting the positive model relative to the distal attachment. Check the alignment of the distal attachment from multiple perspectives using the Camera feature.

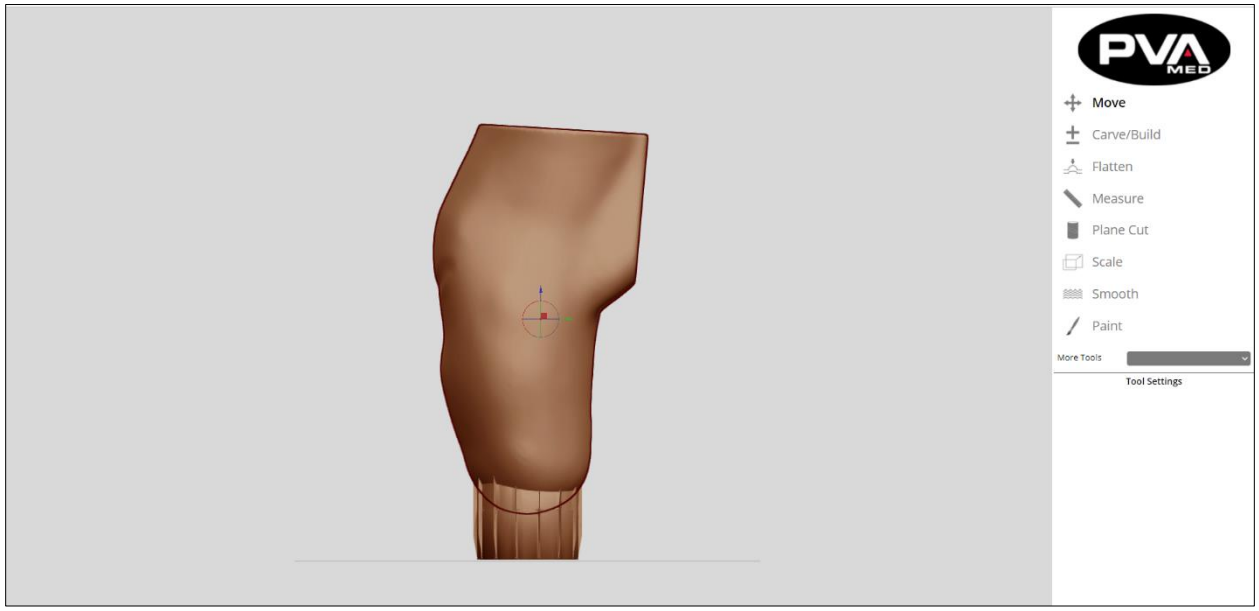


Anterior

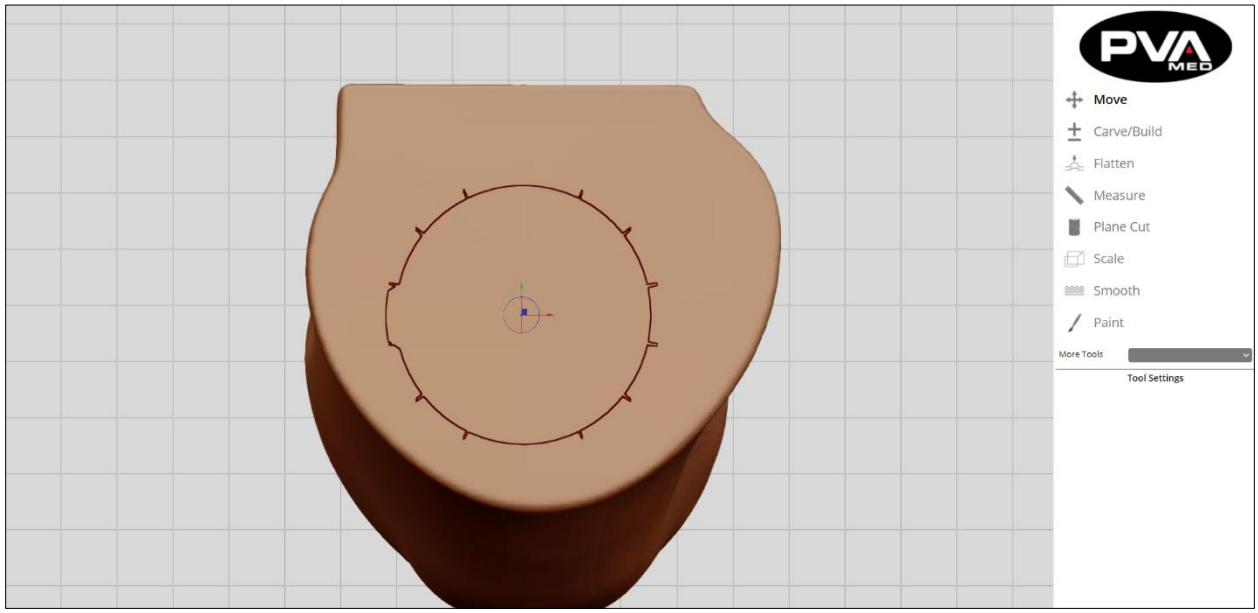
Posterior



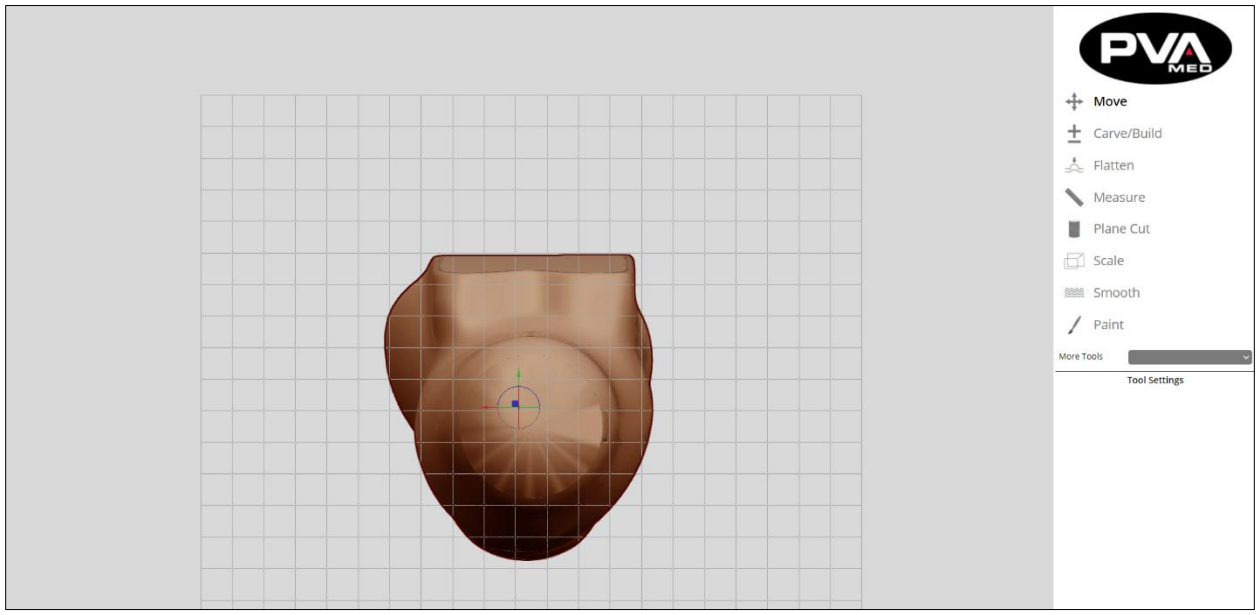
Medial



Lateral



Proximal



Distal

21. Since the distal attachment placement now defines the print bed center, move the model and orient it relative to the distal attachment.

22. Once satisfied with the alignment, use the **Merge All** function to fix the position of the model and distal attachment. Save the model prior to slicing. This will enable you to easily modify later or re-slice using another relevant slicing profile.

23. Slice the model using a relevant slicing profile that factors in printer model, material, and attachment type.

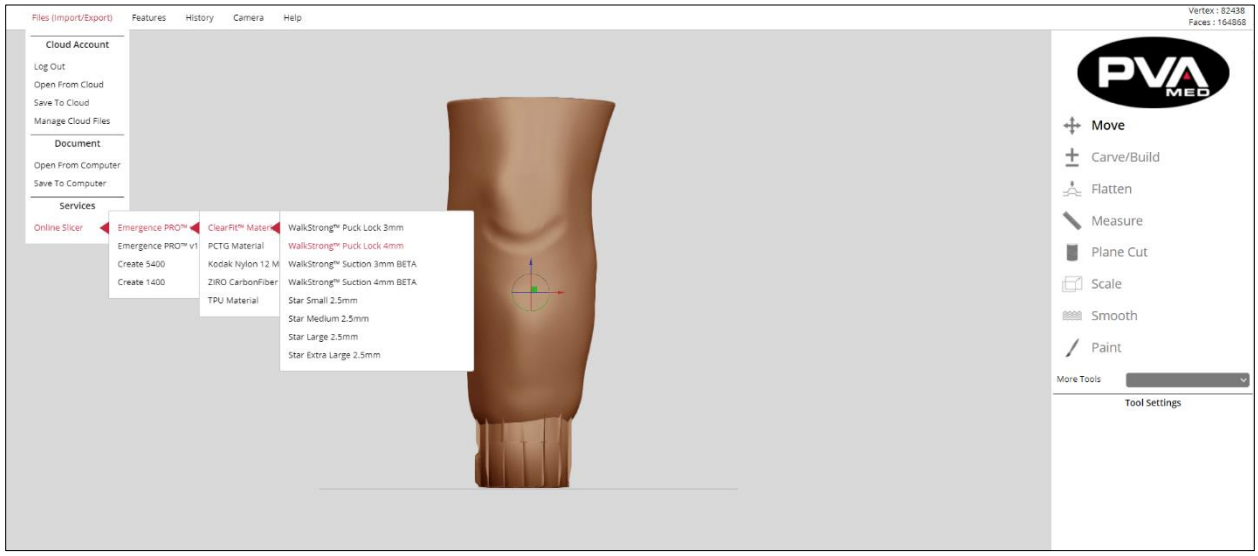


Figure 124: Slice Model Example

24. Once the model is uploaded and successfully sliced, the following confirmation should appear.

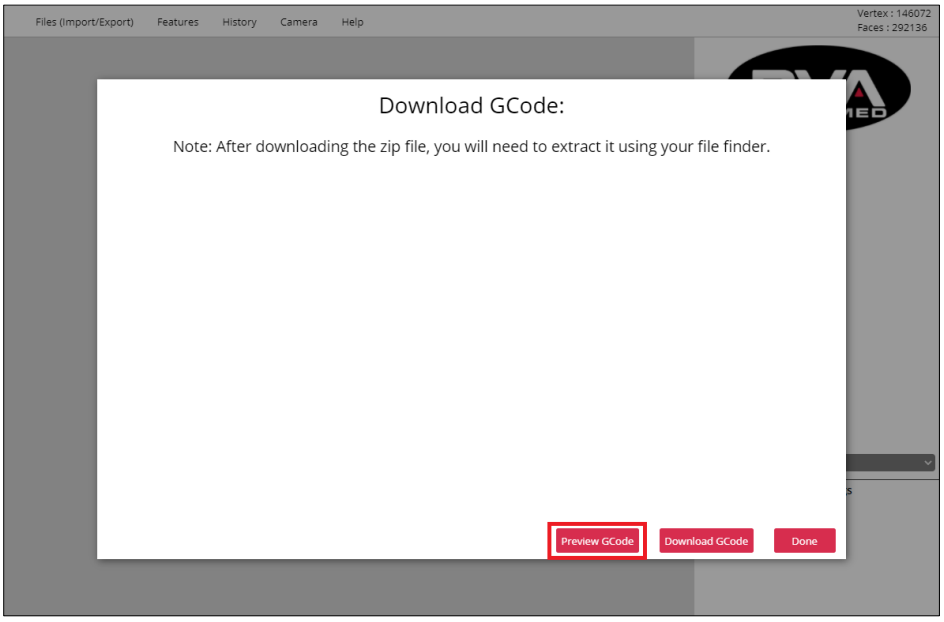


Figure 125: Preview G-code

25. Click the **Preview G-code** button to preview the resulting G-code with the G-code Viewer prior to downloading. This can identify issues prior to printing, saving time and filament.

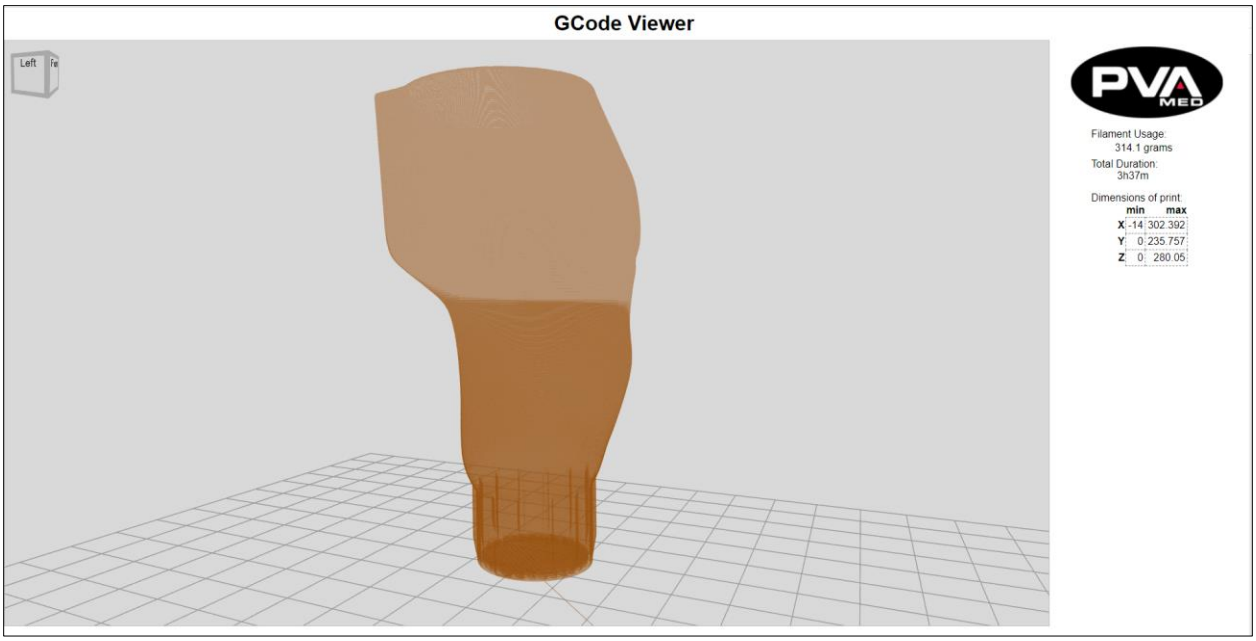


Figure 126: Preview G-code Viewer

The G-code should have the device to be printed centered on the print bed and ready for printing. If the preview looks good, the printer-ready G-code file can be downloaded by clicking **Download**.

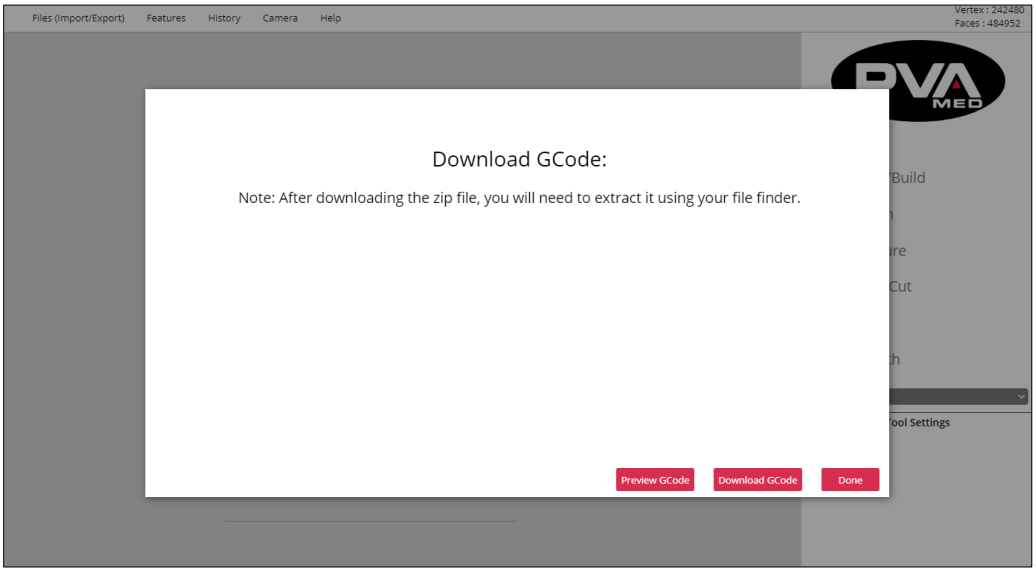


Figure 127: Download G-code

The compressed G-code will be downloaded to the device's default download folder.

26. Unzip the G-code file using the free Windows 10 zip extractor (or any file compression utility that can unzip a compressed file) so that the G-code file is ready to be copied to an SD card.

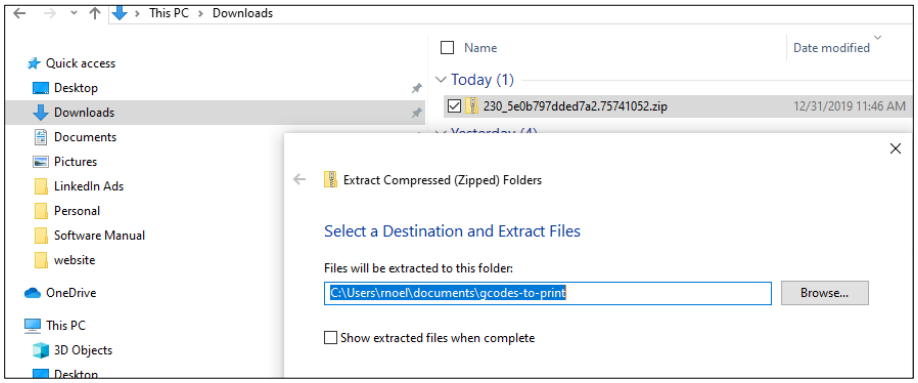


Figure 128: Extract Files

27. Copy the G-code file from the unzipped directory to the SD card. Insert the SD card into the printer for printing. Alternatively, files can be sent to the printer wirelessly via the Emergence PRO™ Web interface (Emergence PRO™ only).

28. Print the G-code file.

For more information on how to print the G-code file, see Emergence PRO Printer Operation Manual, Section 3.2: Starting The Print.

8.O&P-Specific Information for Printer

8.1 Printer and Filament Details

When loading the filament, set the hot end temperature on the display as follows:

Filament	Hot End Temperature
ClearFit™	270°C
PCTG	240°C
FlexyFit™	235°C
Nylon 12	275°C
PLA/Carbon Fiber	210°C

Figure 129: Filament Hot End Temperature

The type of hot end to be used with each material are as follows:

Material	Device Type	Filament Size	Hot End
PCTG	Check Socket	1.75 mm	2 mm brass 3 mm brass (4 mm single pass)
FlexyFit™	Leg Cover	1.75 mm	0.6 mm brass
PLA	Z-Plate	1.75 mm	0.6 mm brass
Nylon 12	Experimental Socket	1.75 mm	2 mm steel
PLA/Carbon Fiber	Experimental Socket	1.75 mm	2 mm steel

Figure 130: Filament Material Recommendations

8.2 Color Reference for FlexyFit™ Filaments

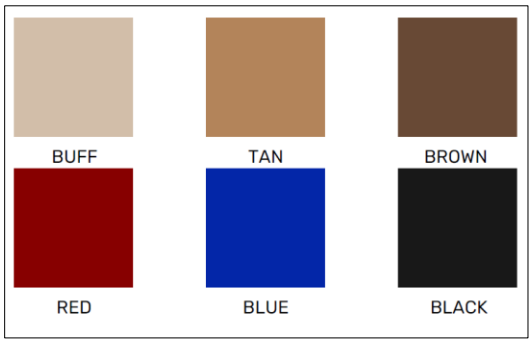


Figure 131: FlexyFit Filament Colors

9. Fit - Step 4

9.1 Grinding Trim Lines

Use 80 grit or higher sanding cones to grind your check socket. Lower, more coarse grit can crack your check socket. To smooth the edges, use a finer grit once you have your trimlines determined.

9.2 Heat Forming

- You can use a heat gun or a torch. With either method, the plastic used in a check socket may heat faster than usual. Proceed with caution and make sure you do not overheat the socket.
- Once the material is adequately warm in the spot you want to modify, you can manipulate it just like you would any other traditional check socket.
- When you have completed modifications, set it aside and let it cool.

Note: If extensive modifications are necessary, PVA Med recommends returning to RAPID PLASTER® and modifying the shape there. Excessive heat modification could cause weak spots in your check socket.

9.3 Adding Distal Component

Rapid Plaster supports three options for adding a distal component to the check socket: the WalkStrong Socket, the Star Socket, and the Puck Lock Socket.

The WalkStrong socket is designed with reinforcement ribs at the distal end for added strength. It integrates with a Bulldog style puck lock. The star socket prints with a closed distal end. The puck lock socket also allows for integration with a puck lock and in order to fix the puck lock in place, a z-plate is attached to the bottom of the attachment socket.

The z-plate is designed with a groove for the grounded distal end of the attachment socket. The z-plate is also designed with the four-hole pattern for the four-hole pyramid lock. Z-plates come in two different sizes to accommodate the 2.5 mm and 4 mm check sockets.

Attaching the z-plate is performed by applying a generous bead of epoxy in the z-plate's groove, aligning the check socket with the four-hole pattern, and pressing the attachment socket into the z-plate groove.

9.4 Fitting a WalkStrong Socket

1. Drill holes using a four-hole jig.
2. Grind and cut the trim lines.
3. Attach prosthetic components.
4. Walk the patient on parallel bars to perform a dynamic fitting.

9.5 Warnings

- The responsibility of reinforcement for both the static and dynamic use of the check socket lies solely with the treating clinician.
- The distal end options listed above are not designed for dynamic alignment (gait) without fiberglass reinforcement.
- PVA Med cannot accept any liability for damage or injury due to insufficient reinforcement over the 3D-printed socket.

10. Warnings and Warranties

10.1 Check Socket Use

10.1.1 Socket Modification

The check socket is made from materials that can be heat-adjusted and ground like conventional diagnostic sockets. The check socket is not printed with trim lines. The practitioner is required to grind their own trim lines. 80 grit or higher sanding cones are suggested as lower grit can crack the socket during grinding. As with conventional prosthetics, fabrication requires experience and acquired skill.

10.1.2 Intended Use

Check sockets are custom-made for a specific residual limb. Therefore, our sockets should not be switched between different patients. Check sockets are made for diagnostic purposes and should not be used outside of a controlled environment supervised by a licensed practitioner.

Warning: The responsibility of reinforcement for both the static and dynamic use of the check socket lies solely with the treating clinician. Check sockets are not designed for dynamic alignment (gait) without fiberglass reinforcement. In select cases, according to practitioner judgement, the distal end may be used for static alignment without reinforcement. PVA Med cannot accept any liability for damage or injury due to insufficient reinforcement over the 3D-printed socket.

10.2 Warnings

Failure to follow the directions below can result in serious injury.

- Check sockets are designed only for a licensed practitioner to use and fit and are not for use outside a clinical setting.
- Always reinforce the distal end of a check socket with fiberglass casting material prior to ANY weight bearing applications.
- Inspect your check socket before fitting and when removing. Do not use it if it is cracked, warped, damaged, discolored beyond simple cosmetic blemishes, or has indications of weak layers. A matte or cloudy finish can be an indication of poor quality.
- If attached to another device, make sure the other device is functioning properly.
- Check sockets are not intended for daily use or outside any clinical setting.
- Do not store or use your check socket for a prolonged period at temperatures above 100°F, or below 0°F. Prolonged exposure to high temperatures can cause the socket to deform.
- If you need to clean your check socket, use a soft cloth and mild soap only. Do not use harsh detergents, bleach, alcohol, or other disinfectants. Dry thoroughly with a soft towel or let air dry before using.
- Excessive heat modifications during socket modification can result in weak spots.
- Always follow the post processing and fitting instructions provided by PVA Med for proper and safe use of your check socket.

10.3 Intended Warnings

PVA Med covers are custom-made to one patient's specific prosthetic components including a particular socket and/or knee and foot. Therefore, covers should not be switched between different prostheses or users. PVA Med covers are made for light to moderate activity levels and should not be placed in high stress activities.

10.4 **Leg Cover Care**

Failure to follow the directions below can result in a serious injury.

1. The PVA Med cover should always be fitted and prescribed by a licensed prosthetist under the supervision of a physician.
2. Make sure any appliance or body part the cover is attached to is free from signs of irritation or infection. Examples are reddening, rash, blisters, bleeding, etc. If these conditions develop, discontinue use of the cover and seek immediate medical attention.
3. Make sure the cover is assembled in accordance with the instructions supplied by the manufacturer and healthcare professional. If the prosthetic assembly is loose or does not feel structurally sound, immediately discontinue use of the cover and contact a prosthetist. Do not wear the cover until it has been approved by a prosthetist.
4. The patient should inspect the cover before putting it on and when taking it off. It should not be used it if it is torn, cracked, warped, damaged, or discolored beyond simple cosmetic blemishes. Make sure any moving parts are working properly and moving freely. If attached to another device, make sure that the other device is functioning properly.
5. The cover is not designed to be weight bearing. Make certain the underlying prosthetic device is properly in place before standing or walking.
6. Do not store or use the cover for a prolonged period of time at temperatures above 100°F, or below 0°F. Do not leave it in car trunks or on car dashboards, attics, basements, or in checked luggage on airplanes. Do not store in direct sunlight or damp conditions.
7. Keep the cover clean using a soft cloth and mild soap only. Do not use harsh detergents, bleach, alcohol, or other disinfectants. Do not wash in a dishwasher, washing machine, or dry in a laundry dryer. Dry thoroughly with a soft towel or let air dry before using.
8. The cover is fragile, just like any other body component. Treat the device the same as any other able-body limbs.
9. Follow the attachment instructions provided for proper installation. Full access slit covers are the ONLY covers that should be installed or removed without a certified prosthetist.

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12. Warranty

PVA Warranty Policy

PVA warrants the enclosed product against defects in material or workmanship on all components for one year from the date of shipment.

The warranty does not extend to components damaged due to misuse, negligence, or installation and operation that are not in accordance with the recommended factory instructions. Unauthorized repair or modification of the enclosed product, and/or the use of spare parts not directly obtained from PVA (or from factory authorized dealers) will void all warranties.

All PVA warranties extend only to the original purchaser. Third party warranty claims will not be honored at any time.

Prior to returning a product for a warranty claim, a return authorization must be obtained from PVA's Technical Support department. Authorization will be issued either via the telephone, facsimile, or in writing upon your request.

To qualify as a valid warranty claim, the defective product must be returned to the factory during the warranty period. Upon return, PVA will repair (or replace) all components found to be defective in material or workmanship.

(Retain this for your records)

Product Information:

PRODUCT: _____

SERIAL NUMBER: _____

DATE OF PURCHASE: _____