Socket-less Socket™ cX-Hybrid™

The End of Rigid Brims

MartinBionics PROSTHETICS + RESEARCH

Version 220117

Socket-less Socket™ cX-Hybrid™

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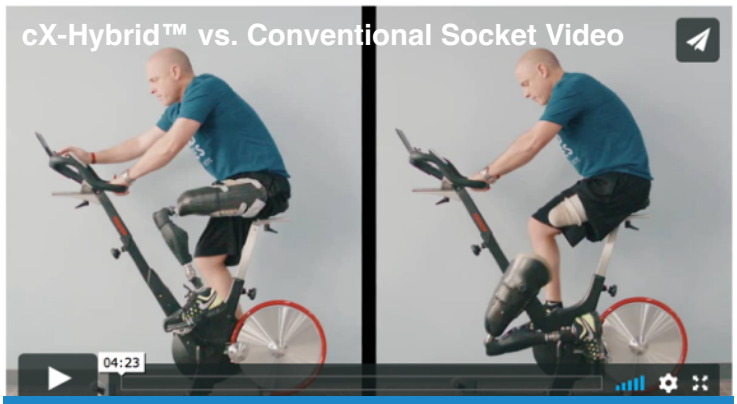
Introduction to the Socket-less Socket™ cX-Hybrid™:



Click to go to: https://vimeo.com/302163014

The cX-Hybrid™ configuration is half conventional socket, and half Socket-less Socket™. It offers the familiar fit and containment of a conventional socket on the lateral wall and distal 1/3, while uniquely providing excellent conformity, heat dissipation, and volume accommodation on the proximal 2/3 and brim areas. Users should no longer feel a hump underneath them while sitting, and they should have unrestricted hip range of motion, as the conforming anterior brim no longer impinges into the abdomen. Not only does the cX-Hybrid™ uniquely provide greater comfort, but its conformity and adjustability maintains much more comfort through the life of the prosthetic, even with limb volume gain or loss.

The majority of above knee Socket-less Socket™ users are typically fit with the cX-Hybrid™ configuration due to its elegant simplicity. The cX-Hybrid™ can often be retrofit or integrated into an existing conventional socket, making it an ideal solution when conventional sockets require brim adjustments or repairs.

The cX-Hybrid™ can be fit to users ranging in sizes from pediatric to adult, petite to obese, and short limbs to long. There is not an above knee limb type that has not been successfully fit into this configuration - except for limbs that are just too short to fit the cX-Hybrid™ components, in which case a SwingBrim™ is used.

Watch these amputees' first reactions to the Socket-less Socket™ cX-Hybrid™. It is rare to find an above knee prosthetic user who prefers a conventional rigid socket and brim over the more conforming Socket-less Socket™, and specifically the cX-Hybrid™ configuration.

Click to go to: https://vimeo.com/906418769

Clinical Services Support:

Martin Bionics now includes Clinical Services support along with the purchase of the Socket-less Socket™ technology so that our trained and experienced clinicians can help ensure that every Socket-less Socket™ user achieves maximum comfort outcomes. Martin Bionics can coordinate to do the fitting alongside you via Zoom or Facetime video-call support.

Schedule a phone or video Consultation or Clinical Fitting Collaboration with our Clinical Services Practitioners:

Clinical Consultation: *https://calendly.com/martin-bionics-clinical-services/consultation*

Clinical Fitting Collaboration: *https://calendly.com/martin-bionics-clinical-services/clinical-fitting*

How To Place a Socket-less Socket'™ Order:

Web: MartinBionics.com/Order

Phone: 844-MBIONIC (844.624.6642) or 405.839.7326 X729

Email: orders@MartinBionics.com

Ordering Option 1 - Integration Kit: The cX-Hybrid™ integration kit can be ordered as a left or a right, and is trimmed to length. It can be assembled onto your own sockets within your clinic. Some practitioners keep these off-the-shelf cX-Hybrid™ integration kits on-hand to offer real-time fittings for their patients, or to even convert existing conventional sockets to a cX-Hybrid™ configuration. It can also be special ordered in pediatric sizes as needed.


Left cX-Hybrid™ kit


Right cX-Hybrid™ kit

Ordering Option 2 - Customized Check Socket Integration: Mail us a well-fitting check socket or definitive socket and we will trim down your socket to the appropriate cX-Hybrid™ trim lines and custom assemble the cX-Hybrid™ components within your socket. This custom assembly should provide a fit that is about 90% complete out-of-the-box. Simply micro-adjusted the cX-Hybrid™ components for a perfect fit.

Keep in mind that since the brim of the conventional socket will be removed and replaced with the conforming cX-Hybrid™ components, the fit and comfort of the conventional socket's brim does not matter. Rather the conventional socket's brim simply needs to be at the correct brim height so that the cX-Hybrid™ can be integrated in the correct position.

Suspension Options:

The Socket-less Socket™ designs can use any form of suspension found in conventional sockets, and more. The quality of the suspension has a significant impact on perceived stability and ambulation confidence, just as in any other socket design. The vast majority of fittings will use pin suspension. Pistoning and rotation issues often experienced in conventional sockets with pin systems are eliminated within the Socket-less Socket™ designs.

If you intend to integrate a sealing liner, such as an Ossur Seal-In system, the cX-Hybrid™ is a great configuration, since the distal end can remain intact. Simply plan your distal trim lines such that they remain high enough for the seal level.

The cX-Hybrid™ comes with our SharkSkin™ material to eliminate micro-movements within the socket and spread the suspension forces 360° around the limb. It's unique unidirectional friction allows the limb to easily slide into the socket for donning, but helps prevent the limb from sliding out until the socket is loosened for doffing. SharkSkin™ is not intended to be the predominant suspension method, but is used as accessory suspension along with pins or lanyards. SharkSkin™ provides the user with a much greater sense of control within the socket, and makes the socket feel lighter weight.

Anatomy of the cX-Hybrid™:

The cX-Hybrid™ uses similar parts as other Socket-less Socket™ configurations, but are specifically and purposefully configured to maximize comfort outcomes for above knee users. Understanding the terminology of these components will be helpful to simplify this training and expedite the fitting process. There are various configuration options for fitting the cX-Hybrid, so that it can be custom tailored each users specific needs.

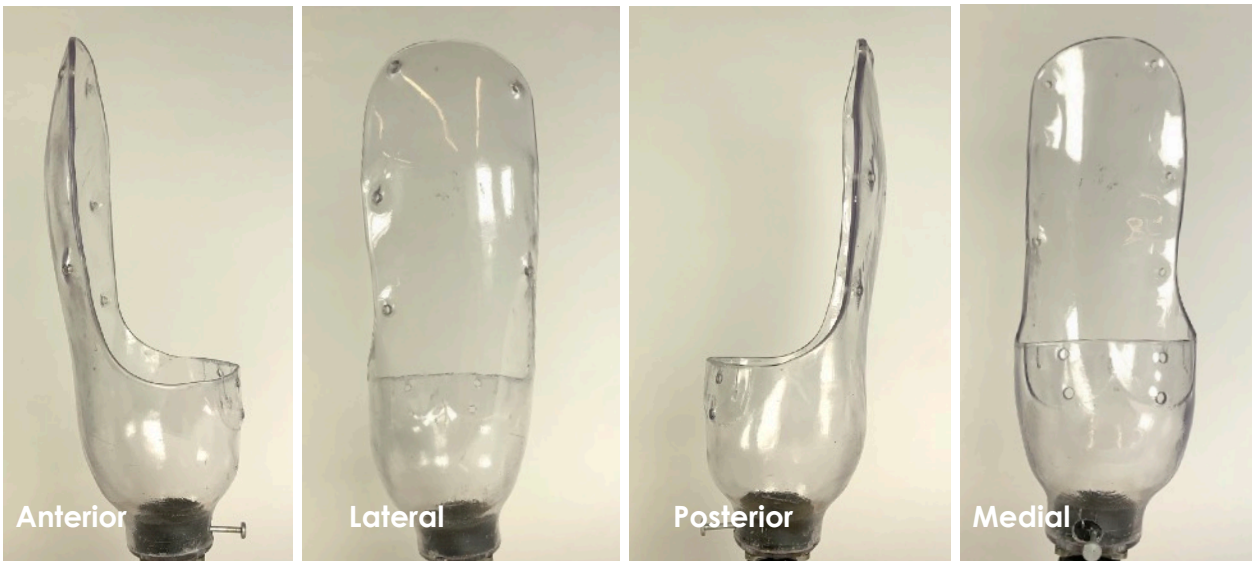
cX-Hybrid™ Rotating with and without Struts

Click to go to: https://vimeo.com/279501704

cX-Hybrid ™ Retrofit and Integration Instructions:

1. Consider Alternative Advanced Fitting Techniques: Check out the *Advanced Fitting Techniques* section toward the end of this training document for alternative socket configuration options and fitting techniques that may be beneficial for your patient or your clinical practice.

2. Adjust the Frame Trim Lines: Begin by modifying the anterior, medial, and posterior trim lines of the conventional socket frame by trimming them down about 1/2 - 2/3 length. This leaves only the lateral wall of the socket at full length, which is preferably 1"-3" higher than the Trochanter level so that it provides sufficient height for cupping the SwingBrim™ under the gluteals.



If you are using a sealing liner, such as the Ossur Seal-In, leave the distal trim lines proximal to the liner's sealing ring.

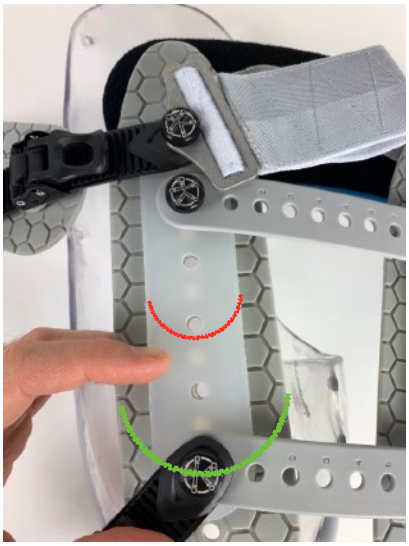
Note the original brim height (i.e. how much frame you cut away), as you will later place the SwingBrim™ at this same brim level.

Ensure that the remaining frame structure has enough rigidity and durability since so much material is being removed. It is important that there is no flex to the frame at all, as it will prevent a successful fit. If the remaining frame does flex, you may need to reinforce it before beginning the fitting.

3. Define the Medial Struts Mounting Positions onto the Frame: Position the posterior medial Strut such that it is positioned directly underneath the Ischial Tuberosity (orange line). Its position is such that the posterior open window between it and the posterior edge of the lateral wall (red line) creates a pocket for the Hamstrings to rest within (green area), and should be

centered facing directly posterior. By doing so, when the user sits on a hard surface, they should be able to 'feel' their leg on the surface, and not hit either the posterior medial Strut (orange line) or lateral wall (red line) onto the surface directly.

The top of the Strut's height should be positioned such that the SwingBrim™ is at the correct brim height. Reference back to the original brim height as a logical starting position. Note where the white plastic Strut intersects with the frame, and cut the Strut to length (red curved line example in the below picture). Trim the adjoining AirHammock™ Petal (green curved line) at least 3 (but preferably 5) holes longer than the white plastic Strut so that you have room to attach the AirHammock™ Petal with two mounting points, skipping one hole in between, and still have room for brim height adjustments if needed. All Brim height adjustments are made by altering the distal end of the white plastic Struts and AirHammock™ Petals and never by altering the top of the assembly.



Mark on the frame where the AirHammock™ Petal's holes line up with the frame (yellow circles), skipping one hole of the AirHammock™ Petal in between. It is helpful to use the AirHammock™ Petal as a guide for defining the hole positions. The white plastic Strut should rest immediately on top of the edge of the frame (orange arrow).

Do the same for the anterior medial Strut assembly. The Velcro Washer that attaches to the blue Arch Pad on the proximal end of the anterior medial Strut (green arrow in the below image) should be placed directly over the

top of the Adductors (and Adductor Longus Tendon) with the Brim at the correct height. Trim the distal end of the white plastic Strut to length so that it rests directly on top of the frame's edge. Be sure to leave an extra 5 holes of length to the AirHammock™ Petal, and note where to drill out the corresponding holes on the frame.

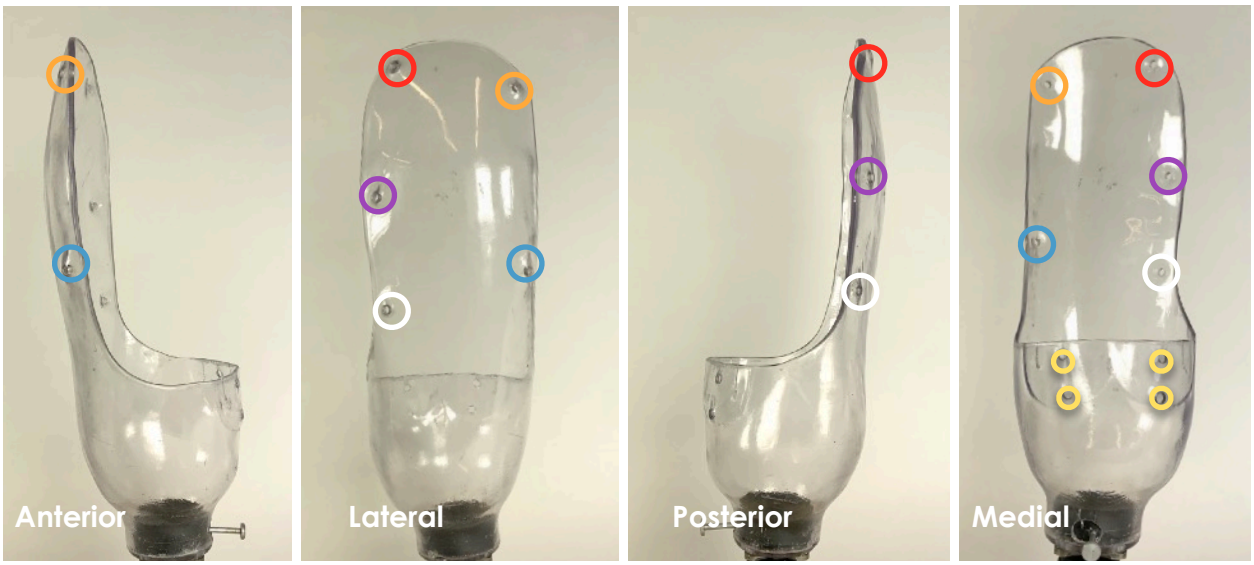
It is typical for the two medial Struts to have a slight V-shape (red lines) - where the proximal Cross Connector is 1 to 2 holes longer than the distal Cross Connector. This allows the two Struts to match the limb's conical shape.

Drill out the 1/4" holes that have been marked on the frame to receive the AirHammock™ Petals for the medial Struts. If integrating the cX-Hybrid™ into a check socket, mount the AirHammock™ Petals to the inside of the check socket, and if attaching to a definitive socket, mount the AirHammock™ Petals in between the flexible inner socket and external frame, so that they anchor only to the frame.

Both medial Struts are typically the same length in most fittings. Each Strut should ultimately sit flat against the limb shape, which will likely be approximately 45° to the line of progression in the transverse plane when they are positioned correctly. The distal band of Cross Connectors will be moved to the distal hole in the white Struts.

4. Drill Holes for the SwingBrim™, Posterior Cross Connectors, and Ratchets: Drill a 1/4" hole at the proximal posterior corner of the lateral wall to mount the SwingBrim's™ 2-Bar Buckle (red circle). It is important that the proximal posterior connection point be as proximal as possible, to adequately load the gluteals for proper weight bearing into the brim. This connection point should create at least 3" of vertical difference between it and where the Ischial tuberosity sits on the medial brim area.

   Drill a second hole 4" below the 2-Bar Buckle mounting point to receive the proximal posterior Cross Connector (purple circle). Drill a third hole for the distal posterior Cross Connector, whose height will be determined by the frame trim lines and the corresponding assembly configuration (white circle). This posterior distal Cross Connector is typically mounted to the second hole from the bottom on the posterior medial Strut, and runs at nearly a horizontal angle just proximal to the frame's trim line.



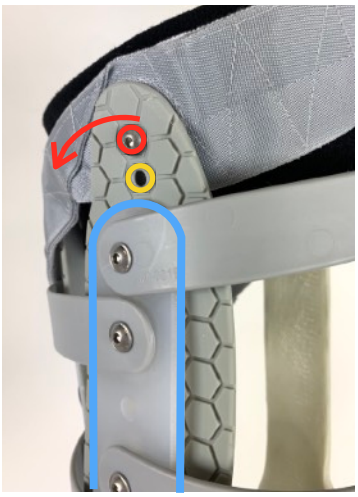
Drill a 1/4" hole at the proximal anterior corner of the lateral wall to mount the proximal Ladder Strap (orange circle). Drill another hole at least 4"+ below to mount a second Ladder Strap (blue circle), if you intend to do so for additional tissue containment. The use of the second Ratchet assembly is optional, and depends on the level of the trim lines and if tissue is protruding that needs to be contained. Most fittings will include the distal Ratchet assembly, unless the limb is just too short to fit it in.

5. Attach the Ratchets onto the Frame: Attach the proximal Ratchet to the proximal anterior corner of the lateral wall of the frame using the included Truss Nuts. The Ratchet assembly is typically between 30°-45° from horizontal. The distal ratchet is typically mounted at 10°-25° from horizontal.

Trim the AirHammock™ Petal to length that is attached to the proximal Ratchet assembly, so that it does not bunch up during tightening, but remains long enough to help prevent the Ratchet assembly from roping into the soft tissue. The same can be added for the distal Ratchet if needed.

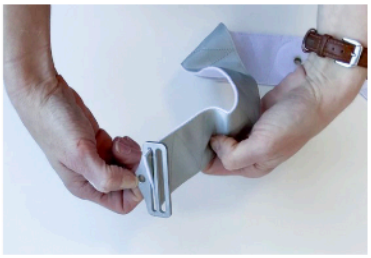
6. Attach the SwingBrim™ Assembly onto the Frame: The SwingBrim™ comes pre-assembled onto the Struts. Be sure to not alter the proximal assembly of the SwingBrim™, as it is defined and purposeful. All Brim heights adjustments should be made to the distal end of the white plastic Struts and AirHammock™ Petals, and never to the proximal end. The Swing Webbing should be positioned such that the sewn-in 15° angle in the webbing is pointed upward, which creates the "hammock" brim shape. There should

always be one free hole (yellow circle) in the AirHammock™ Petal between the proximal anchor point (red circle) and the white plastic Strut (blue line). This allows for the proper amount of flex in the SwingBrim™ connection to the Struts.



Attach the posterior side of the SwingBrim's™ Webbing using the 2-Bar Buckle to the hole in the proximal posterior corner of the lateral wall, using a Truss Nut. The anterior 2-Bar Buckle should already be attached to the proximal end of the anterior medial Strut assembly.

The following steps show how to properly route the Swing Webbing through the 2-Bar Buckles.



1. Thread the webbing through the top slot.

The grey side of the webbing should be facing away from the truss hole.

2. Loop the webbing over the bar and through the bottom slot

The white side of the webbing should be facing out at this point.

3. Fold the tail back towards the buckel and secure with a half moon velcro.

Try to tuck the end just under the bottom edge of the buckle to prevent slipping while the patient walks.

7. Attach the Cross Connectors onto the Frame: Mount the posterior proximal Cross Connector to the hole 4" below the mounting point for the SwingBrim™ 2-Bar Buckle on the lateral wall, using a Thumb Screw for an adjustable attachment point. The other end is always connected to the proximal hole in the posterior medial Strut. Its initial span should be of appropriate length for the limb size, and can be adjusted to length during the fitting process. Attach the posterior distal Cross Connector to the remaining hole on the lateral wall, using a Thumb Screw for an adjustable attachment point. Its

other end is always mounted to the second hole from the bottom of the posterior medial Strut.

The two medial Cross Connectors connect between the anterior medial Strut and the posterior medial Strut. The proximal medial Cross Connector is always mounted in the second from the top hole in the white plastic Struts, and should only be adjusted in length. The distal medial Cross Connector should be positioned at the distal-most hole in the two medial white plastic Struts, which is just proximal to the medial frame trim lines. Both medial Cross Connectors should remain parallel with each other.

The proximal medial Cross Connector is typically 1 to 2 holes longer than the distal medial Cross Connector. There should not be any bowing of the Cross Connectors, as they should both sit flat and tight.

8. Adjust the Swing Webbing and Add the Arch Pad: Before adding the blue Arch Pad, adjust the Swing Webbing to an approximate tightness - using the anterior 2-Bar Buckle to adjust the anterior end of the Webbing, and the posterior 2-Bar Buckle to adjust the posterior end of the Webbing. The span of the Swing Webbing should generally resemble the shape and size of the conventional socket's brim. Just as in positioning a hammock between palm trees on the beach, the tension of this SwingBrim™ hammock will determine how and where the limb will be supported.

   Attach the Arch Pad to the Swing Webbing using the double sided Velcro Dots. The Arch Pad should be completely removed and put back on the Webbing any time the medial portion of the Swing Webbing is adjusted.

   The brim's Arch Pad should be placed onto the Webbing beginning with the anterior Swivel Velcro Washer first, and then laying it onto the Swing Webbing

progressing toward the back. It is helpful to weight into the Webbing as the Arch Pad is being placed so that the Arch Pad rests into a natural weighted position on the Webbing.

The Arch Pad height can be adjusted in position with respect to the webbing, and typically has at least 1/4" - 1/2" of Arch Pad extending beyond the Webbing. The Arch Pad can be trimmed in length or width. Be sure to buff the cut edge so that it is smooth and clean in appearance.

Tissue Containment:

Managing the limb tissue is one of the most important factors in achieving a successful fitting, regardless of which socket configuration is used. The Socket-less Socket™ has a tremendous amount of conformity thanks to its dynamic compliant materials, but once it is donned and tightened to the user it should provide the feel of exceptional stability and containment. If there is insufficient tissue containment the user may experience an "off road shocks" feel from the tissue ballooning out of the socket windows, versus if there is sufficient tissue management the user will experience the preferred "street racing shocks" feel.

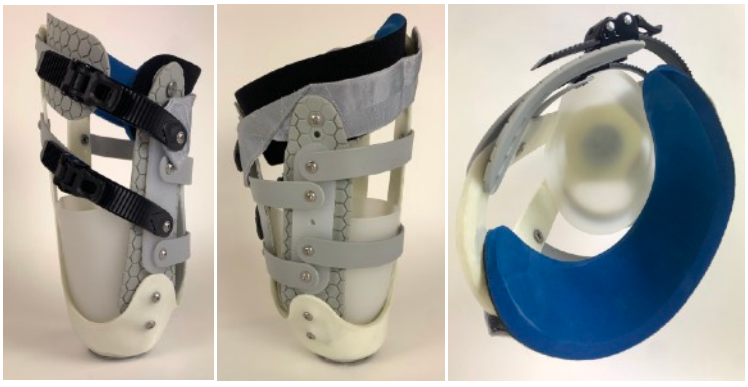
The cX-Hybrid™ is the simplest configuration to achieve good tissue containment, since the distal 1/3 of the frame remains intact and inherently contains limb tissue. The gel liner dynamics provide additional tissue containment. Liners with less stretch and that have an integrated matrix offer better tissue containment than those with more stretch.

If there is excessive pooching of tissue within the open window areas, as can be seen in the anterior and hamstring window areas of this image, there are three methods of better containing the limb tissue:

1. The socket trim lines or configuration can be modified to provide more inherent tissue containment. In this image, an incorrectly fit cX™ configuration was used, whereas a cX-Hybrid™ would have been a better option for this patient. If the cX-Hybrid™ trim lines are too low, they can be raised to provide more tissue containment. For larger patients with more soft tissue, it can be helpful to leave the distal 1/2 of the socket intact, versus trimming off 2/3.

2. An extra Cross Connector spanning across the open window can be added to help further contain limb tissue, or an additional AirHammock™ Petal can be spanned under the Cross Connectors to spread out the containment. This is typically only needed under the anterior Ratchets or under the posterior Cross Connectors, and is not needed along the medial side. This added AirHammock™ Petal under the Cross Connector is integrated just the same as it is under the anterior Ratchet assembly.

3. Integrating a flexible inner socket within the cX-Hybrid™ can help provide additional tissue containment area, while minimizing the rigid frame trim lines. The flexible inner socket can be fabricated at the time of fitting based on the check socket shape, or it can often be retrofit into the existing socket shape if the frame trim lines are cut very low to accommodate for the tissue mobility. Watch this video to see how a flexible inner socket can be integrated within the pre-fit socket. While this video is specific to a cX™ configuration, the same principles can be used for a cX-Hybrid™ with low frame trim lines.



cX-Hybrid ™ Fitting Adjustments:

1. Know What to Adjust, and What Not to Adjust: As a general rule of thumb, only adjust the spans of the Cross Connectors, lengths of the Struts and related AirHammock™ Petals, and the span of the SwingBrim™. The specific positions that the Cross Connectors are attached to the Struts, and the general sub-component assembly is defined and purposeful and should not be modified. Too often when practitioners attempt creative freedom of re-assembling the Socket-less Socket™ with their own creative flair, the fitting will be unsuccessful. There is specific purpose in why the Socket-less Socket™ is configured the way it is.

2. Adjust Cross Connector Lengths: Once the socket is donned, adjust the Cross Connectors to place the two medial Struts in their correct positions around the limb, ensuring that they are placed under the Ischial Tuberosity and directly over the Adductors. If for instance the posterior medial Strut needs to shift slightly more posterior, you would tighten the posterior Cross Connectors, and lengthen the medial Cross Connectors to move it. If you find that the Struts' attachment points on the frame are placed incorrectly, then move the Struts attachments points into a better position.

   The medial Cross Connectors need to be snug between the two medial Struts, with no bowing. In most fittings, the proximal medial Cross Connector will be one to two holes longer than the distal medial Cross Connector, as the two Struts will have a slight V-shape since the limb is typically larger in circumference toward its top.

   The posterior distal Cross Connector will be contoured to the limb shape tight enough to prevent the distal end of the medial Strut from bowing under load,. The proximal posterior Cross Connector should be tightened very snug against the limb, with the Swing Webbing initially slightly loose.

   Each multi-hole Cross Connector has numbered holes (0-19). Holes 1 to 19 are 1/2" apart. The distance between holes "0" and "1" however is 3/4". This allows for down to a 1/4" resolution in adjustability. If for instance a Cross Connector is connected between adjoining Struts using the holes number 1 and number 8, the span is 3 1/2" between the two anchor points. If the span needs to increase by 1/2", you would move the anchor from hole number 8 to hole number 9. However if 1/2" increase in span is too much and only a 1/4" increase is needed, the Cross Connector can be repositioned from holes 1 and 9, to holes 0 and 7, and the resultant decrease is 1/4" less in span.

3. Adjust the Brim Tightness: In conventional sockets with rigid brims, the specific brim contouring is critically important, as it is challenging to provide any significant amount of body weight support through a rigid brim without being uncomfortable. However, in the Socket-less Socket™, the SwingBrim's™ unique conformity enables the user to comfortably take a significant amount of load in the brim, similar to sitting in a hammock or ergonomics rock climbing harness, where the full body weight is comfortably supported in the brim area alone. With the SwingBrim™ tightened correctly, it should eliminate point-specific Ischial loading and Ramus area sensitivity.

With both medial Struts in their correct positions, and the proximal posterior Cross Connector sufficiently tight across the limb, then tighten the posterior SwingBrim™ Webbing until the proximal posterior Cross Connector begins to appear more loose since the user's weight will be loaded through the SwingBrim™ and not the proximal Cross Connector. This ensures that the user is taking their weight in the gluteals through the SwingBrim™. The brim is like a hammock, and needs to be sufficiently tight to support the limb.

Next adjust the medial SwingBrim™ Webbing length where it attaches to the anterior medial Strut to contour and support in the medial brim area. Make sure that the medial brim is being fully supported by the SwingBrim™ Webbing, and not by resting onto the Struts.

If the posterior medial Strut appears to be pressed downward as the user's weight is applied into the brim, it is likely a sign that the SwingBrim™ is not sufficiently tight enough to act as a hammock. The posterior medial Strut is not intended to be Ischial support, but rather simply holds orientation of the SwingBrim™ around the limb. The majority of the weight is suspended by the "hammock-like" SwingBrim™, and not the posterior medial Strut.

4. Adjust the Brim Height: You can adjust the height of the brim by lengthening or shortening the two medial Strut assemblies. If the brim is too tall, consider trimming down the length of one or both of the anterior medial or posterior medial Struts assemblies. Always make the length adjustments from the bottom of the Struts (and never from the top). The proximal assembly of the sub-components of the two Struts is purposeful and should never be altered. Be sure that the trimmed end of the white plastic Strut still rests immediately on top of the frame's trim lines. However, if you need to raise the brim, and

hence lengthen the Strut, it is typically still acceptable for the Strut to be within 1/2" - 3/4" of the frame trim line when it is raised.

5. Adductor Area Adjustments: In conventional socket brim shapes (left image) there is typically a pocket created for the adductors (green circles). In the Socket-less Socket™ however, the proximal end of the anterior medial Strut assembly rests directly on top of the adductor, versus a pocket for it. This Strut's position should be at 45° to the line of progression, which helps prevent roping-in of the conforming brim materials and provides full comfort in most fittings (middle image). If the anterior medial Strut is positioned too far anterior (right image), and/or if there is excessive Swing Webbing span between the anterior medial Strut and the posterior medial Strut (right image), it causes the adductors to get pinched into a corner, and is less comfortable. Likewise if the Strut is too far posterior similar roping occurs.

6. Adjust the Ratchet Tightness: The proximal anterior Ratchet should be tightened until it appears to be roping into the limb's soft tissue. Since it lies between muscle groups it can sink in and should remain comfortable.

   If the anterior proximal Ratchet it too loose, the user can lose anterior/posterior support and may slide forward off the posterior SwingBrim™. Sufficient Ratchet tightness will push the limb posterior onto the SwingBrim™ and provide better limb support. The tighter the brim, the more body weight can be supported through the brim, and the more offloading occurs for the remainder of the limb, increasing comfort. In conventional sockets this is not possible, but in the Socket-less Socket™ the user can take a significant amount of body weight through the brim and maintain full comfort.

   If the Ratchet is not able to be fully tightened due to running out of room of the Ladder Strap or if the limb is too large and the patient is unable to get the Ratchet started, then a Cross Connector can be added in-line with the Ratchet to provide more span. Alternative Ratchet options are available upon request.

7. Alignment: The cX-Hybrid™ uses standard AK socket alignment principles. Attach the prosthetic knee and foot components to the socket with a standard 4-hole pyramid, just as you would with a conventional socket.

Troubleshooting

When you first try the socket on the patient, make sure that the assembly setup is appropriate for the limb size and shape. Look specifically for:

1. Is the brim at the correct level? If the brim feels too high, it may need shortened, or if it is too low and not containing the Ischial/Ramus areas it may need raised. There is fundamentally no reason that the SwingBrim™ should not be comfortable for any user once it is correctly positioned and tightened. See *Adjust the Brim Height* and *Adjust the Brim Tightness* sections if needed.

2. Is there any impingement or discomfort with the Adductors? The anterior medial Strut assembly can be shifted in position anterior or posterior through Cross Connector and medial SwingBrim™ length adjustments, or up and down through Strut and AirHammock™ Petal length adjustments. For instance, if the anterior medial Strut is correctly positioned over the Adductors but there is discomfort, try lowering the anterior medial Strut slightly, or the proximal end of the anterior medial Strut assembly can be slightly adjusted forward or backward by adjusting both the length of the proximal medial Cross Connector and the length of the medial SwingBrim™ Webbing. The blue Arch Pad will need to be removed and re-attached in order to make this SwingBrim™ adjustment. Typically only minor anterior repositioning of the anterior medial Strut solves any discomfort, and the Strut should still remain generally over the top of the adductors, and not forward or behind them. See also *Adductor Area Adjustments* if needed.

3. Is the frame correctly contoured to the user's limb shape? If there is an inward bowing or step-off where the AirHammock™ Petals anchor to the distal medial frame (as shown in the image), it may be an indication of:
   - Lamination frame shape is too large, such as if the patient has lost significant volume.
   - Too much space between the bottom of the Strut and frame. The distal end of the Strut should rest on top of the lamination trim line.

4. Are the Struts correctly positioned under the Ischial Tuberosity and over the Adductors, See *Attach the Medial Struts onto the Frame* and *Adjust Cross Connector Length* sections if needed.

5. Are the Cross Connectors snug to the limb shape without any bowing or gaping? See *Attach the Cross Connector onto the Frame*, and *Adjust Cross Connector Length* sections if needed.

6. Is the limb tissue ballooning out within the open windows, without enough tissue containment? Try adding more Cross Connectors, adding AirHammock™ Petals under Cross Connectors, or expanding the trim lines of the frame. See *Tissue Containment* section if needed.

7. Is the frame too flexible and causing loss of stability? Especially for check socket fittings where the frame material is inherently more flexible, it is important to ensure that the lateral wall, and hence the SwingBrim™ hammock support is rigid enough to not flex under load. If needed, stiffen the frame to ensure that it is not flexing under load.

Advanced Fitting Techniques:

Click to go to: https://vimeo.com/277228627

1. Real-Time Cast-Fitting: Instead of integrating the cX-Hybrid™ into a check socket, it can be fit in real-time during the casting process, and eliminate the use of plaster, modifying, or thermoplastics. The cast itself is the check socket. Watch this below video for a step-by-step process of how to fit the cX-Hybrid™ with this technique.

This "real-time cast-fitting" method was originally developed for fitting the cX-Hybrid™ in developing nations where there isn't the luxury of expensive fabrication equipment to fit prosthetics. It has been found to be a very useful tool for typical clinic settings as well, and makes for a significantly more efficient clinical practice. The entire cX-Hybrid™ socket can be cast, assembled, and ready to fit to the user within about an hour once familiar and proficient with how to do this method.

Using the aluminum Struts to form the lateral wall allows the contouring of the lateral wall to be modularly adjusted to the user. It also provides for a more open and breathable socket design. Distally the aluminum Struts are mounted to the frame by at least 3 Truss Nuts each. A Cross Connector should be mounted between the proximal ends of the aluminum Struts to increase their stability and reduce their flexibility.

The distal micro-frame can be as minimalistic as desired, and is fundamentally just a connector of the Socket-less Socket™ to the prosthetic knee, to establish alignment. A thermoplastic inner socket can be incorporated to provide the distal tissue containment as shown in this video.

2. Hard-Mounting the Anterior Medial Strut:

If additional stability is needed, hard-mount the anterior medial Strut onto the frame to give added brim stability, instead of only mounting it to the frame with the AirHammock™ Petal. This can be accomplished by replacing the white plastic Strut with a longer version, or an aluminum Strut, that extends

past the frame trim line so that it can be directly mounted to the frame. By eliminating the 'living hinge' dynamics of the anterior medial Strut it will provide a more solidified socket feel. This is not required in most fittings, though can be helpful for some, especially for very active users. The posterior medial Strut remains attached with only the AirHammock™ petal, as it needs to remain dynamic.

If the anterior medial strut is hard-mounted to the frame, the anterior proximal end of the lateral wall can be also be trimmed back further, and the proximal Ladder Strap attachment point can be mounted more posteriorly. The height of the lateral wall is not altered, just the width, taking off material from the front of the lateral wall. Since the proximal Ratchet is now able to wrap further around the limb, it offers increased adjustability, increased contouring to the limb shape, and increased hip flexion. This also helps to press the limb further posterior onto the SwingBrim™, which provides better support.

Coincidently, this modification makes the cX-Hybrid™ more similar to a cX™ configuration, which also uses a hard-mounted anterior medial Strut and a hard-mounted posterior lateral Strut, versus two hard-mounted lateral Struts of the true cX-Hybrid™ configuration.

Finishing Out the Socket:

Attention to detail is very important, and the patient deserves it, so please ensure that the final fabrication and assembly has the quality workmanship you'd be proud to put your name on.

Final Lamination: The final fabrication can be completed within your own clinic or through Martin Bionics central fabrication services. If you fabricate the definitive lamination in your clinic, make sure the lamination is strong enough to not flex under load, considering the micro-frame trim lines.

Before fabricating the lamination, pre-plan to recess any Truss Nut's within the lamination, so that the inner side of the Truss Nut does not protrude toward the limb past the lamination thickness. Alternatively you can countersink them after the lamination is completed. Likewise, you can recess AirHammock™ Petals within the lamination as well.

Smooth Cross Connectors: Swap out all multi-hole Cross Connectors with smooth Cross Connectors by drilling the corresponding holes in the smooth version at the same mounting positions and trimming them to length. Do not leave multi-hole Cross Connectors on the definitive socket, and do not leave extra length of Cross Connector protruding past the Truss Nut attachment points, as this results in an un-cosmetic appearance and lacks attention to detail.

Truss Nuts: Swap the Thumb Screws for the low profile Screws in the final assembly, as the Thumb Screws are only meant for check socket use within the clinic setting. **Be sure to apply Loctite 242 to ALL Truss Nuts prior to delivery of the socket**, as the cX-Hybrid™ does not come with Loctite pre-applied. If they are not Loctited, they will back out over time. If they are Loctited and sized appropriately, they should not back out.

The Truss Nuts are available in 1/16" increments, and it is very important to ensure that for any parts that need freedom to swivel, including all Cross Connector and Ratchet/Ladder adjustors, that the Truss Nut length is 1/16" longer than the build height of the various sub-components that are being attached together. If the Truss Nuts are clamped where swivel movement is desired, the screw may back out over time.

Finishing out the SwingBrim™: SwingBrims™ must be finalized before a user takes a final product home or for out-of-clinic use. The SwingBrim's™ 2-Bar Buckles are only intended for in-office check socket fittings, as they allow the brim length to be adjustable during the fitting process. Although the Buckles and Velcro hold the Webbing length secure in the office, it can loosen if the patient walks long distances, so do not use the 2-Bar Buckles for out-of-clinic use.

Once the appropriate Swing Webbing length has been determined, the 2-Bar Buckles will be removed and anchor points will be sewn into the webbing for mounting it to the frame, using the steps on the following page.

Keep in mind that the Swing Webbing can very slightly stretch over time. If the Webbing needs to be tightened in the future, a tuck can be sewn in the Webbing. If it needs to be made longer, a Cross Connector can be added at the end of the Webbing to the frame.

Assembly Technique: Finalizing the SwingBrim™ Webbing

https://vimeo.com/433836593/cf13082076

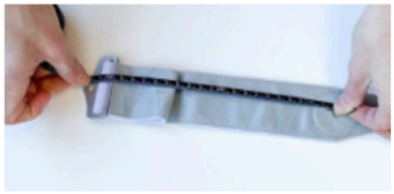
What do you need:

a. Swing Brim Webbing*
b. Torch
c. Tape Measure
d. Truss**
e. 2 Small Nylon Washers
f. Scissors
g. Pen or Sharpie
h. Hole Burning Tool***

** This should be the webbing used during the patient's fitting. Be sure to remove the webbing from the socket with the swing brim buckles attached.*

*** 5/16"-1/2" should work just fine.*

**** It's preferable to use a ¼" diameter steel tube, 12" long. Using something hollow, like a tube allows material to be cleanly cut, leaving the discarded portion inside the tube (like a cookie cutter). Using a wrench or awl pushes the materail out of the way and leaves a glob of melted goo on the webbing and it will not sit flat on the socket or cause the screw to be raised/angled.*



1.Measure the posterior (or flat) side of the webbing.

Use the grey side of the webbing, keep the material taught. Measure from the edge of the washer hole to the center of the swing brim buckle hole.

2. Remove the buckle and velcro. Mark the distance you just mesured.

Make sure you use the center weave stitch of the webbing to keep the hole in the center of the webbing.

3. Make 2 additional marks: 3cm and 6cm further away from the washer than your original mark.

This distance will space out the holes to accomodate the washer.

4. Measure the anterior (or angled) side of the webbing.

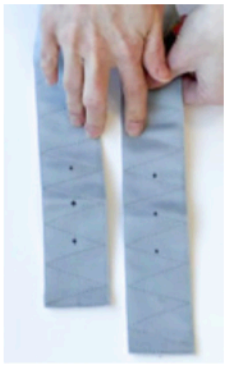
Use the grey side of the webbing, keep the material taught. Measure from the edge of the washer hole to the center of the swing brim buckle hole.

5. Remove the buckle and velcro. Mark the distance you just measured.

Make sure you use the center weave stitch of the webbing to keep the hole in the center of the webbing.

6. Make 2 additional marks: 3cm and 6cm further away from the washer than your original mark.

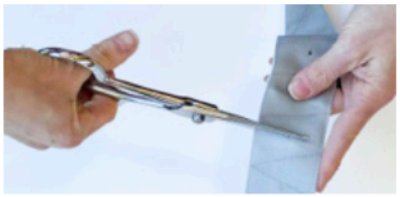
This distance will space out the holes to accomodate the washer.



CHECK POINT

At this point you should have 6 marks, 3 on each side of the webbing.

We will cut at the **6cm** marks and burn holes at the remaining 4 marks.

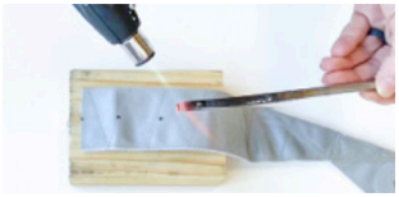


7. Cut at the 6cm (or furthest mark) on each end of the webbing.

Use clean and sharp scissors. Try to keep the cut as clean and straight as possible.

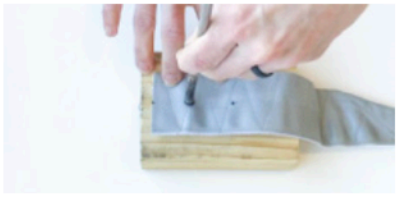
8. Lightly singe the edges you just cut.

This prevents the material from fraying over time. Try no to overdo it and burn the material.



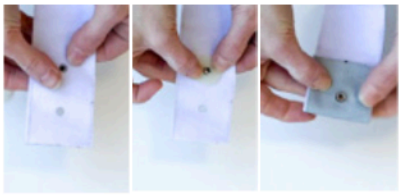
9. Heat the burning tool until red hot.

It may be helpful to place a block of wood under the webbing in lieu of burning into the bench top.



10. Burn holes at the remaining 4 marks.

Be sure to keep the burning tool straight up and down and gently turn the tool 1/4 turn to seal the edges of the hole. Avoid "wollowing" or spinning the tool in the hole. It can make the hole too large. It also does not create a clean finish to the product.



11. Using the truss to keep the holes aligned, sandwitch a washer inside the webbing.

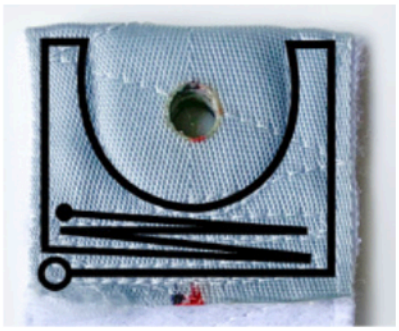
Press a truss through the hole closest to the fold. Add a nylon washer to the truss. Fold the remaining portion of the webbing over the washer and push the truss through the remaining hole.

12. Sew the webbing to secure it around the washer.

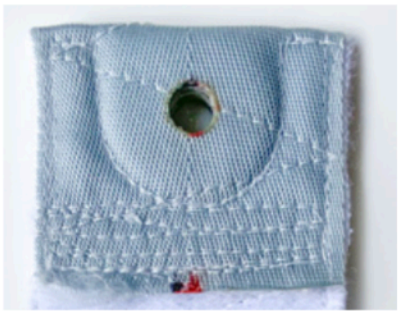
Keep the truss n the webbing to ensure the washer stays centered and the holes stay aligned. The webing can be sewn in one pass with the following pattern:

Sew the bottom and one side of the webbing. Sew around the washer. Sew own the other side and end with some kind of zig zag pattern. (see photo to the right - start at the open circle and end at the black dot)

Repeat Steps 11 and 12 on the opposite end of the webbing.



FINAL SEWN END OF SWING WEBBING:



Increased Muscle Use:

In conventional sockets, users often complain that they feel like their limb muscles are hitting a rigid wall when they try to flex. Conventional sockets do not promote muscle contraction during walking, and most amputees experience considerable limb muscle atrophy over time.

"I actually feel as I'm walking that the muscles in my residual limb are trying to perform as they used to when I had my original foot."

Joel, Socket-less Socket™ User

The Socket-less Socket's™ conforming materials and open structure allows the limb muscles to freely flex and results in the user feeling like they are using their limb muscles again, similar to how they used them when walking with a sound limb. Many Socket-less Socket™ users find that for the first few days of walking in the Socket-less Socket™ that their limb muscles can feel sore - similar to the feeling of having not been to the gym in a year, and having just completed a large workout. Within a few days the muscles acclimatize to being used again and the feeling goes away.

Many users declare that their limb feels stronger and looks more muscular after a few weeks of use. The inherent adjustability that the Socket-less Socket™ uniquely offers allows the socket to remain fitting well, while accommodating for increased muscle growth.

Other Features and Benefits of the cX-Hybrid™:

Nearest to a Conventional Socket: For patients who desire a more simplified and streamlined appearance but who want the unique Socket-less Socket™ benefits of unrestricted range of motion, decreased sweating, increased sitting comfort, self-adjustable volume accommodation, and excellent comfort, the cX-Hybrid™ is an excellent choice.

More of a "Solid Feel": This design offers greater sensory feedback from the ground, since there is not a distal Receptacle, as is often used in the cX™ design. A more solid feel is generally a beneficial quality for bilateral patients or those with considerable contralateral issues.

The Lowest Clearance: The cX-Hybrid™ has the same distal build height as a conventional socket since there is no distal Receptacle in this configuration.

Users Love the Micro-Adjustability to Their Fit: The Socket-less Socket™ uniquely offers user-adjustable volume accommodation. We've found that even those who do not fluctuate in volume (less than 2 ply per day) still love the ability to micro-adjust the socket fit in real-time. For long periods of sitting such as a car ride or plane flight, many users will loosen the socket, and then tighten it back up upon standing. In most cases these adjustments can even be made through pants, without the need to remove pants to adjust socket fit as in conventional sockets. Most users can 'feel' the difference of just one click of the Ratchets tighter or looser - which is only about 2mm of circumferential tightening.

The Socket-less Socket™ Simplifies Donning, Especially for Geriatric Populations: The Socket-less Socket™ is simpler to donn in sitting or in standing, and it does not require pushing or pulling of soft tissue into a static contained bucket.

Excellent Durability and Long Life Expectancy of the Socket-less Socket™: The dynamic and conformable materials used in the Socket-less Socket™ system are incredibly durable and are designed to give a long life-expectancy. The brim's webbing for instance is designed and rated for nearly 4000 pounds of force, and is made of a material that is similar to a seat-belt, but thinner. We see very few durability related issues, but if something were to need replaced, our unique modularity allows the socket to be repaired quickly and easily and is often field serviceable. More importantly, the socket should remain comfortable for much longer than a traditional socket, as the user-adjustable conformable materials match the socket to the user, versus the user's limb having to match to a static piece of plastic. The human body is very dynamic, and making the socket's fit dynamic as well provides a longer lasting comfortable socket.

Contraindications of the cX-Hybrid™:

Very Short Limbs Do Not have Enough Room for the cX-Hybrid™ Components: The uniquely conforming anatomical contouring of the Socket-less Socket™ enables for an incredibly secure fit even with short limbs. However, if the limb length, and hence socket length, is too short, there may not be sufficient room for the cX-Hybrid™ components to fit. The cX-Hybrid™ components should have at least 2 holes of length to the medial white plastic Struts (2" long). If there is not sufficient space, consider fitting a SwingBrim™ configuration instead. For short limbs consider also using the Martin Bionics' modular Lateral Stabilizer™ to provide increased lateral stability, which is a more advanced replacement to a Silesian Belt. This mounts to the proximal ends of the two lateral Struts, or equivalent.

Socket-less Socket™ cX-Hybrid™

cX-Hybrid™ Coding:

Medicare has approved coding for the Socket-less Socket™. The Socket-less Socket™ has numerous possible configurations including selecting various forms of suspension and tissue management options. You will bill according to the socket design you make for your patient, using existing coding. For many fittings, the coding will be similar to the code set that may be used with a conventional socket.

Code(s)	Description
L5321, L5590, or L5701	Base Code - Above Knee Prosthesis, Definitive, Preparatory, or Replacement Socket
L5631	Addition to Lower Extremity, Above Knee or Knee Disarticulation, Acrylic Socket
L5649	Addition to Lower Extremity, Ischial Containment ,Narrow M-L Socket
L5950	Addition, Endoskeletal Systsem, Above Knee, Ultralight Materials
L5651	Addition to Lower Extremity, Above Knee, Flexible Inner Socket, External Frame (when applicable)
L5920	Addition, Endoskeletal System, Above Knee, Alignable System
L5624	Addition to Lower Extremity, Test Socket (when applicable)
L5650	Addition to Lower Extremity, Total Contact (when applicable)
Suspension Codes	Pin/Lanyard, Suction, Vacuum, or others

Certification of Training and CEU Credits:

All practitioners fitting this Martin Bionics technology are required to confirm that they have completed this Martin Bionics socket training by clicking on the button below before fitting this technology.

Through completing this training you are eligible to receive CEU credits from the American Board for Certification. Click the button below, input your name and credential numbers, and we'll provide you with a quiz for CEU credits.

Click Here to Complete the Training and to Register to Fit the cX-Hybrid™

Warranty and Credits

Thorough review and understanding of the Socket-less Socket™ training materials has a significant impact on the success of the socket fitting. The Martin Bionics' Clinical Services team will support your Socket-less Socket™ fittings to help maximize comfort and ensure that every fitting is as successful as possible. In the event there are challenges in the fitting process, our Clinical Services team can join you via a Zoom or FaceTime call, where we can typically help diagnose and resolve the issue with specific socket adjustment suggestions.

If the socket is ultimately not the correct configuration for the end-user, we can re-configure the socket to another configuration to better match the user's clinical needs.

If even after the Clinical Services support the patient rejects the Socket-less Socket™, we will provide a credit toward fitting another patient, at the actual Socket Component invoiced price, less check socket, final fabrication, and shipping expense as applicable. All Socket-less Socket™ components will need to be returned within 30 days and the original invoice paid in order to issue the credit toward another fitting.

While we rarely find the need to repair or replace socket sub-components, the modularity of the Socket-less Socket™ allows it to be easily repaired. Martin Bionics will support replacement parts if premature wear and tear are found based on a flaw in Martin Bionics workmanship.

You can find the most recent and additional training resources at MartinBionics.com/Socket-Soft, as we update our training regularly.

If you have any questions during your socket fitting, contact our Clinical Services team at 844-MBIONIC, or schedule for our trained and experienced Clinical Services team to join you via phone or video-call for a Clinical Consultation or Clinical Fitting Collaboration using the links below.

Clinical Consultation: https://calendly.com/martin-bionics-clinical-services/consultation

Clinical Fitting Collaboration: https://calendly.com/martin-bionics-clinical-services/clinical-fitting