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Meet Keith Cornell of CJ Socket Technologies in Beverly



Today we'd like to introduce you to Keith Cornell. His team shares his story with us below.

The "CJ" socket was developed in 2010 and patented in the U.S. in 2015 by Keith Cornell CP, FAAOP. He has been practicing prosthetics since 1980 and continually found that he was frustrated because traditional prosthetic sockets for amputees were fixed in volume and therefore not adjustable. Most amputees deal with changes in volume of their amputated limb on an hourly or daily basis. These fluctuations in volume affect the overall fit of their prosthetic socket. If their amputated limb shrank, the traditional solution was for the amputee to add layers of 'socks' over their limb to compensate for that volume loss. Conversely, if their limb swelled, then they would have to remove 'socks' in hopes that they could decrease the overall size of their amputated limb so that their socket would fit again.

Historically, prosthetic sockets are fixed volume sockets. The rigid and semi-rigid socket materials are formed over a mold made from the patient's amputated limb's volume at the time of casting or an image capture (a snap shot of the immediate amputated limb volume). Once the socket is made, its volume is relatively fixed. If the amputated limb's volume changes significantly, weight bearing and skeletal control is reduced in the socket and eventually becomes problematic.



Prosthetists spend significant time dealing with socket issues attributed to their patient's amputated limb volume changes. They can try installing pads, or grinding and flaring the rigid socket material. However, that often sacrifices their intended design to provide comfort and increase their patient's functional ability and therefore their willingness to wear and use their prosthesis.

Transfemoral prostheses (for patient's amputated above their knee) have been particularly problematic for the wearer. They often experience discomfort from sitting on their hard plastic socket. Additionally, these sockets can be difficult to put on if they are overweight or elderly. This cumbersomeness and discomfort contribute to an often overwhelming daily routine, especially for the elderly. Often times, the result of these issues is that the patient simply does not find the prosthesis worth the time and trouble to wear.

The "CJ" socket was designed to address amputated limb volume change. This socket allows the patient to maintain a precise volumetric fit and avoid issues with weight bearing and skeletal control. This socket also dramatically improves comfort and therefore the patient's wearing time and overall success.

How does the "CJ" socket work and who is it for? The "CJ" socket is a significant departure from conventional sockets and is available for all long bone amputations (shin, thigh and arms). It is comprised of 3 main parts;

For an above the knee amputee, the rigid "J" shaped socket covers approximately 50% of the front of the remaining thigh. It transfers the forces from the amputated limb to the prosthesis providing skeletal control.

The "Sail" is made from a special type of non-elastic cloth and it's attached to the rigid "J" shaped socket to contain the back half of the remaining thigh. The "Sail" feels and acts more like clothing rather than a traditional hard plastic socket. It naturally conforms to the individual's shape. The result is a harmonious interface between body and environment. The wearer can feel his or her limb through the cloth and can rub or scratch the back of their leg without having to take off their socket.



The "User adjustable closure" is made from Velcro or Dacron and allows the user to loosen or tighten their socket instantaneously to accommodate the volume changes to their amputated

limb. This ensures that the socket's volume is precise to provide optimal hydrostatic lift and skeletal control.

Upper Extremity prostheses (for amputation below or above the elbow) have been hugely successful using "CJ Socket" technology. These sockets are lighter, less restrictive and more comfortable than solid rigid or semi-rigid sockets. They use hard rigid material for only part of the socket while the remainder is comprised of the "Sail". Snap or magnetic electrodes are easily adapted to this socket and the bulky preamps and wires are built into the inside of the "Sail".

We're always bombarded by how great it is to pursue your passion, etc – but we've spoken with enough people to know that it's not always easy. Overall, would you say things have been easy for you?

It has not been a smooth road as anyone that starts a company will tell you. There are a lot of costs associated with creating a new company and we pride ourselves on not having to use venture capitalist money. Our two biggest costs are;

- 1) Getting the CJ Socket patented in the U.S. and patent pending in Europe.
- 2.) Our marketing budget. We are in the process of updating our website and learning about social media. We also attend several industry trade shows across the country which is costly for a small company.



We'd love to hear more about the business.

When Keith first designed the CJ Socket, he wanted to address some issues in the prosthetic industry that he felt particularly affected a certain segment of the population that typically does not receive a lot of attention. He also wanted to design a product from the amputee's perspective. His first thought was comfort. How do you take a hard plastic prosthetic socket make it

adjustable and comfortable to wear and sit in without sacrificing safety and functionality?

Additionally, he also wanted the socket to feel more like clothing rather than a suit of armor. He played with various types of materials hoping to find that 'magic combination' of hard (for stability) and soft (for comfort). At the end of 2011 he had his 'eureka' moment when he combined a durable, non-elastic fabric on the back half of the socket and traditional hard socket material on the front half.

Keith started to try this novel approach to socket design on his own patients that experienced fluctuation in the size of their amputated limb. A lot of these patients were elderly or had other medical issues that restricted their activity. Previously, these patients spent most of their day sitting in a wheel chair without their prosthetic leg because it was just too uncomfortable for them. Now, they had a new option in socket design. They could sit all day on fabric, not hard plastic, and keep their leg on!

This remarkable device enabled the amputee to be a little more independent because they had the stability and functionality of a second leg if they needed to move from their wheelchair to their bed or a toilet seat. When Keith witnessed the success that his own patients were experiencing with the CJ Socket he knew he had to share his idea with other prosthetists so their patients could benefit as well.



As a company, we are most proud of the fact that we offer a solution for prosthetists who encounter the same issues as Keith did when he set about inventing the CJ Socket. They recognize that there is a real

need for a comfortable, affordable, adjustable prosthetic socket. Making a CJ Socket for their patients is similar to making a traditional prosthetic socket. They use materials that they already have in their lab and there's no requirement to purchase additional, expensive components for fabrication.

What was Keith like growing up?

Keith and his identical twin brother, an Orthotist named Ken, grew up in Salem, MA. Together they own Cornell Orthotics and Prosthetics, having offices in Beverly, Danvers and Peabody, MA. Keith was very active as a child and enjoyed playing baseball and hockey. He was industrious and like to tinker in his grandfather's workshop. His love of building things coupled with pride in his work is evident today in the sockets that he makes for his patients, office furniture that he makes for his employees, or the toy box he made for his grandson.

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