

## EDGE

REPRINT

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## RESIDUAL UPPER-LIMB OPTIMIZATION

## Surgeon and Prosthetist Collaboration

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**"WHEN A PATIENT** shows up in your office with a less-than-ideal residual limb, it can be a pivotal moment. Do you try to work around what they have, or do you contact the surgeon and initiate a discussion? This patient is going to have to live with the limitations of their residual limb for the rest of their life. Now is the time to discuss optimizing the residual limb so that they have the best opportunity for a successful prosthetic outcome."

*John M. Miguelez, CP, FAAOP (D)*

Practitioners conduct a prosthetic evaluation of a patient with burn scars.  
*Photographs courtesy of Arm Dynamics.*

It is not unusual for people with traumatic upper-limb amputations or congenital limb differences to have significant issues with their residual hands or arms. The residual limb may be too long to accommodate components or too short to adequately stabilize the device. There can also be concerns with scar tissue, skin grafts, bony prominences, symptomatic neuromas, and phantom pain. One option that may be considered is surgical revisions to optimize the residual limb.

For patients with challenging residual limbs, wearing a prosthesis can be difficult. Excessive visits to the prosthetist to adjust the socket are frustrating, demoralizing, and can lead to abandonment. It may take years for a patient to find a prosthetist who is willing to suggest revision surgery.

In some cases, it's possible to work around residual limb challenges by creating a customized interface with high temperature vulcanizing (HTV) and room temperature vulcanizing (RTV) silicone or incorporating adjustable features into the socket. These techniques may allow the prosthetist to equalize pressure and reduce shear on the residual limb.

As upper-limb prosthetic specialists, our best practices include informing patients of every available option so they can make the right choice for their individual situations. Revision surgery should be a standard option to consider any time a prosthetist, patient, or surgeon believes that it could be a valuable solution. We have seen revision surgeries drastically improve a patient's ability to successfully use a prosthesis. The length and shape of the limb can be modified, the presentation of the skin can be improved, and neuromas and other sources of pain can be addressed.

Some prosthetists may not have much experience with collaborating with surgeons to achieve better patient outcomes. More often, prosthetic providers do their best to work with the patient's existing residual limb, even when it presents daunting challenges. However, a less-than-ideal residual limb can limit the ability to give a patient a comfortable and functional foundation for a prosthetic device. But what if it was possible to improve the residual limb before fitting a prosthesis? The answer for your patient may be to consider revision surgery.

**CHINO ACOSTA** sustained a left partial hand amputation in an accident at work. “My doctor did surgeries trying to save my hand for over a year.” His residual hand had one finger with no active range of motion and his wrist had limited motion. He had very little function without a prosthesis, and due to his hand presentation, none of the available prosthetic options could significantly improve his function. After Acosta’s initial prosthetic evaluation, the team at Arm Dynamics suggested the possibility of an additional surgical procedure.

“Me and my prosthetist asked the doctor to re-amputate above the wrist so I could wear a prosthesis. The team at Arm Dynamics got me ready for it, attaching electrodes to my left arm and having me practice opening and closing a myoelectric hand on a stand. So when I finally got to put on a prosthesis, I knew how to use it,” says Acosta.

“Since then, my life has changed completely. I use my body-powered prosthesis to work in the yard and spray my flowers and shrubs. I use it to run a Skil saw, chainsaw, Weed Eater, and lawn mower. I wear my myo when I’m doing things inside or when I go out to stores, restaurants, and church.”

### COLLABORATING WITH SURGEONS

Ideally, prosthetists are actively collaborating with surgeons and are available to provide valuable input before, during, or after amputation surgery. Pre-surgical prosthetic consultations are an important way to ensure that a patient’s limb will be a strong founda-

tion for a prosthesis.

Prosthetists are responsible for being knowledgeable about prosthetic materials and technologies, understanding the advantages and disadvantages of components, and knowing how to achieve an optimal fit. Surgeons are responsible for the pre-surgical diagnosis, performing surgical procedures, and providing a post-surgical care plan. However, a surgeon may not know how the final presentation of a residual limb affects prosthetic fitting and may not be aware of best practices for modifying a residual limb. When a prosthetist and a surgeon work together, it creates an opportunity to find the optimal solution for a patient.

For some patients with residual limb challenges, it may be best to go ahead and fit a device. This gives them an opportunity to begin using a prosthesis and directly experience the functional advantage it provides. If issues with the residual limb are making it difficult for the patient to utilize the device, the prosthetist can suggest that revision surgery may be a path to improving their comfort and use. The patient will have had the opportunity to learn that not having a revision will limit his or her performance with a prosthesis. That experience allows the patient to make an informed decision with a reasonable expectation of what the outcome will be.

For example, when a person has a thumb amputation, the surgeon may suggest the option of a toe to hand transfer. The patient might hesitate to make that choice until learning more about the other available op-

tions. By first trying a prosthetic thumb, the patient would have a better understanding of the nuances of prosthetic rehabilitation and be able to make a more informed decision as to whether he or she needs more function.

Proactively collaborating with surgeons allows prosthetic providers to share their knowledge of prosthetics and increase their patient’s awareness of revision surgery as an option.

**IVAN GUROLLA** had extensive scar tissue on his residual limbs from burns and skin grafts. The radius on his right side extended an inch past his soft tissue. He was initially fitted with a custom ultra-cushioning, silicone interface, but after about two weeks of donning and doffing, the sheer force on the radius caused an open wound to form around the bony prominence.

“My prosthetist really tried to work around the condition of my right arm by layering extra silicone inside the socket, but it was still too much pressure on the end of the bone. I couldn’t use it at all. So, we went ahead with the revision surgery.”

Gurolla and his prosthetic team chose a surgeon who specialized in upper-limb revision. The radius was shortened by one inch, scar tissue was removed, and the incision was closed with native muscle tissue and skin, creating a limb that could comfortably tolerate donning, doffing, and wearing a prosthesis.

“Without a doubt, I am glad I did it. It really helped my nerve pain, and I wouldn’t have been able to use a prosthesis on my right side at all without surgery.” ➔



Before and after: Acosta’s left partial hand amputation and his transradial amputation.





## COMMUNICATING WITH PATIENTS

Any time limb revision surgery is being considered, it is important to approach the topic carefully, especially if you're working with a new patient. People who have already undergone multiple reconstructive surgeries may be resistant to any additional surgical interventions.

At Arm Dynamics, we take a holistic approach and use a screening tool that helps us get to know our patients. The Wellness Inventory is a patient-reported questionnaire that explores each patient's unique coping style, perceived quality of life, pain level, and the possibility of depression, post-traumatic stress disorder, and substance abuse. This helps our care team determine if a conversation about revision surgery is appropriate.

If the prosthetist feels that a patient may benefit from revision surgery, he or she may choose to discuss revision surgery with the surgeon before suggesting it to the patient. This ensures that the patient is not disappointed later if the surgeon does not agree that revision surgery is the right approach. The next step is to suggest accompanying the patient to a meeting with the surgeon. The surgeon will discuss the advantages and disadvantages of surgery, and the prosthetist will discuss how it may affect prosthetic fitting. The patient should be encouraged to ask questions, and the information that is shared must be digested over time and agreed upon by the surgeon, prosthetist, and patient. It is important for the surgeon and the prosthetist to remain objective and supportive of the patient's choice, and to ensure the patient understands that the final decision is up to them.

People who have experienced traumatic limb loss are not the only people with limb difference who consider revision surgery. Those with congenital limb differences may also wonder if revision surgery could improve their ability to use a prosthesis.

**SHERRI MCCALL** was born with a trans-humeral limb difference and has worn a prosthesis every day for decades. "A lot of my decision to go forward with revision surgery had to do with my prosthetist. He kept me informed of new options and technologies. I trusted his knowledge, and I appreciated his enthusiasm too. He could explain exactly how revision surgery would benefit me. He connected me with the right surgeon for what I needed."

One of McCall's priorities was to wear a



socket that did not require a harness, but after years of using her prosthesis eight to ten hours a day, her residual limb atrophied to the point that the socket, no matter how tight, could not stay on. Her prosthetist consulted with a surgeon who presented a creative solution: adding a cadaver allograft of a distal humerus to lengthen her limb and provide epicondyles for suspension within the socket.

Her new prosthesis is a sophisticated design with a multidurometer custom silicone socket and an adjustable lacing system. This makes it easy for her to modify the amount of compression while eliminating the need for a suspension harness.

"I'd say it's important to talk to someone who's had this type of surgery. My recovery was a long process. I couldn't wear a prosthesis for almost a year. Now I have an arm that is lighter, it fits better, and the suspension is good. I have more stability when I reach above my head, and that meant I could hang my new blinds by myself."

As McCall mentions, it is helpful to patients when the prosthetist or surgeon provides examples of other people who have had similar revision surgeries. Sharing before and after photos or videos of previous patients is encouraging to someone who is considering this option.

It is even more impactful if the care team can connect the patient with someone who has recovered from revision surgery and is using a prosthesis. This kind of peer-to-peer support is invaluable for patients who are facing a decision.

## PROACTIVE PATIENT CARE

The need to consult with a surgeon about the option of revision surgery can arise at any point along the continuum of care:

- Before patients are fitted with their first prosthesis
- After they've tried using a prosthesis and are struggling with pain, fit, or functionality
- When the residual limb starts to show signs of wear after years of using a prosthesis

While it can be challenging, building deep relationships with surgeons is integral to an evidence-based, holistic model of care. This collaboration can make all the difference in a patient's ability to be successful with a prosthetic device. Being the catalyst for conversation about revision surgery is a role that prosthetists should embrace. In the end, we should do whatever we can to ensure that our patients have the best opportunity for success.



Proactively considering revision surgery is part of the same holistic approach that factors into interface design, prosthetic options, component selection, and the prosthetic rehabilitation plan. By working together, surgeons and prosthetists can help patients achieve better functional outcomes, reduce issues with pain, and advance the science and art of upper-limb prosthetic rehabilitation. **O&P EDGE**

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