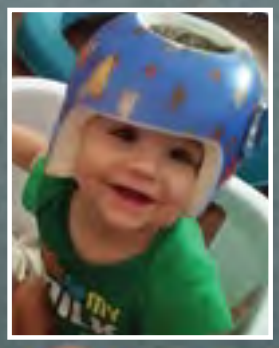
# smallMiracles

PROSTHETIC & ORTHOTIC MAGAZINE

ISSUE 9 • SUMMER 2016

Patient Profile

## This Little Warrior Wears His Helmet Proudly – and Wins!



i-limb™ Continues to Improve

Battle Continues for Legislation to Benefit O&P Providers and Patients

Patellar Tendon Brace Considered to be Underutilized Orthotic Device


# i-limb™ Continues to Improve User's Dexterity and Function

Since the i-limb's inception, Touch Bionics has been building and improving on their concept of motorized components in each of the 5 digits. Historically, prosthetic hands have had motorized components in the thumb, index, and middle finger, but thanks to new developments, the i-limb has taken the functionality of prosthetic hands to a higher level. Patients are now capable of preforming tasks they never thought could be possible.

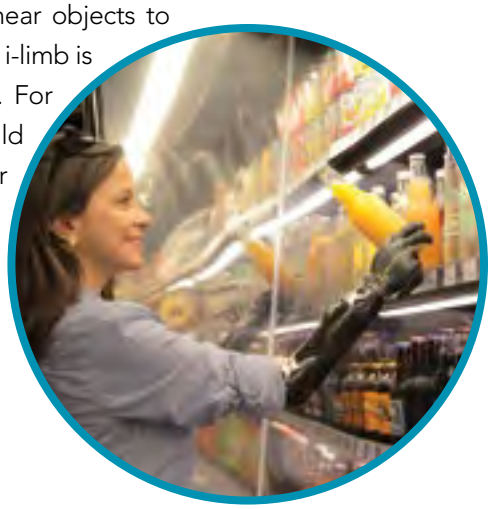
Like most myoelectric hands, the i-limb is controlled by muscle contractions and electrodes positioned properly on predetermined areas around the residual limb. The muscle contractions are detected by the electrodes, which cause the prosthetic hand to respond. As the user's ability to control the muscle contractions improves, the prosthetic hand can be programmed to maximize the dexterity and function.

## Some Unique Features of the i-limb

**1. Gesture Control -** This allows the user's pre-programmed grip options to change with one of four simple gestures. (Moving the i-limb in one of four directions or gestures activates the grip option.)

**2. App Control -** In any given day users may require numerous different grip options. Users can select up to 24 pre-programmed grip options and customize an additional 12 grips using the ***my i-limb app*** on their mobile device, which is synched to their prosthetic hand.

**3. Proximity Control -** Bluetooth-enabled devices called "grip chips" can be placed near objects to activate a grip when the i-limb is placed close to the chip. For example, grip chip could be placed close to your computer keyboard to automatically enable a grip with the index finger pointed for keyboard typing.



FREEDOM
KINNEX™
MICROPROCESSOR ANKLE/FOOT SYSTEM

## Introducing the newest innovation in microprocessor controlled ankle/foot technology.

Kinnex™ integrates the world's fastest responding microprocessor ankle technology and a carbon fiber foot to provide users with a uniquely stable and natural walking experience. Whether on flat, angled, smooth or uneven terrain, users will enjoy the heightened confidence that comes from staying firmly grounded and feeling connected with every step — in both wet and dry environments!

www.freedom-innovations.com

#freedomkinnex

*Stay Grounded.* Feel Connected.



FREEDOM INNOVATIONS

# This Little Warrior Wears His Helmet Proudly – and Wins!

Dressed for battle, 10-month old Paul Hassler is happy, confident, and winning his war with plagiocephaly and torticollis, thanks to the otherworldly headgear he will soon outgrow.

Cheryl Hassler, Paul's mother, experienced the same perplexity and concern as any new mother when she recognized a flat spot on the right side of his head at birth (plagiocephaly). Following the doctor's advice, his parents kept an eye on it for a time, and noticed that Paul's head was also tilted to the right side.

Born a twin, Paul's cramped position in the uterus he shared with his brother may have resulted in a tightness in the muscle that connects the breastbone and collarbone to the skull, his parents discovered. This condition (torticollis) caused Paul to continue to tilt his head, and to preferentially lie with his head on that side—increasing the tendency of the plagiocephalic flat spot to develop further.

While the flat spot itself was not an issue, Cheryl also noticed what appeared to be a "lazy eye" on his right side. The physical therapist to whom they were referred, however, diagnosed the condition promptly, identifying a 10 mm rightward shift of his eye and ear.

The Hasslers eventually found their way from their home in Coatesville, PA, to Lawall Prosthetics and Orthotics, where orthotist Harry Lawall III, CPO discussed the need for a cranial orthotic—a custom-created helmet with shape-correcting capabilities.

Left unchecked, the danger of the rightward shift of Paul's eye and ear continuing was very real. At that time, when he was nearly seven months old, his right eye and ear had shifted more than half an inch, according to Lawall.

"He started at 5/8 inch of a diagonal difference, which is a little above average for this condition. Our goal by the end of treatment is to get the diagonal difference down to about 1/4 inch," he explained.

Since experts believe that a baby's skull resists reshaping as the bone thickens, 12 months of age is generally regarded as the "deadline" date beyond which such therapies are ineffective.

After just two months of treatment, however, Paul's measurements indicated that his deviation from center had then been corrected to only 3/8 inch—already a ¼ inch improvement from the original measurement—and was now only 1/8 inch away from their goal.

"He's been wearing the helmet for five weeks now," Cheryl confirmed, "and the first time he was re-measured,

he was down 1/8 inch, and this time he was also down another 1/8 inch, so it's working. Harry (Lawall) thinks it should be off by Paul's first birthday—which is in October. It all depends on the child, but in Paul's case, he's taken to it and is doing great."

From the first time he donned the helmet she made a game, telling him he was a football star in training. "To this day, when I put it on, I'll use my nails and tap it and say, 'Is it on? Is it okay?' He even reaches for it and wants it back on when he comes out of the pool," she marveled.

## Top Technology to the Rescue

Lawall Prosthetics & Orthotics has been a leader in cranial orthotics since receiving one of the first twenty scanners in the country back in 2003. The company recently added state-of-the-art SmartSoc™ 3D scanning systems to three of three of their office locations.

"Paul was one of my first scanned patients," said Lawall, "which made the fitting much easier than doing a traditional plaster mold of his head shape, and allowed less room for error in the final fitted helmet. A bad scan is better than a great cast, they claim, and although we are still seeing great results with the casts, fitting pediatric patients with a scanner is just less taxing for both the family and the orthotist."

The anxiety level of a young child can be greatly increased by being wrapped in plaster, he pointed out. "With the scan, I just take 12 pictures of the head, rotating around it, and we're done. It takes about two minutes."

The most advanced device is only half the battle, however. A lot depends on compliance, Lawall said.

"Paul is a very compliant patient, so we're seeing good results. These helmets also require a lot of follow-up visits; it's a big commitment for the families. We're constantly measuring, constantly making sure that the helmet is fitting correctly and needed adjustments are made promptly."

Instead of creating a new helmet each time to keep up with the child's growth, he explained, the original helmet is designed to accommodate anticipated growth, with interior layers that can be removed as necessary.

"We include about four layers of padding; then, as the head grows and begins to reshape, we take out layers in the flat area to promote growth in that quadrant.

The helmet, which must be worn 24 hours a day except when bathing or in the pool, is something the child adjusts to gradually.

"The first day it was only an hour, then we increased it and now he's up to 23 hours a day. He sleeps in it," Cheryl noted. "It was kind of weird, but in our case, he seemed to just take to the helmet, and didn't mind wearing it, so he was a good patient, really."

## Concerns and Discoveries

She confessed to the natural anxiety of a mother faced with fitting an alien device on her baby's head, initially blaming herself for Paul's condition before learning that twins are simply more vulnerable to this condition due to the added pressures of a crowded womb where movement is constricted; it's not predictable or preventable.

Premature singletons are also more susceptible to positional plagiocephaly, she learned—because while kept in hospital care, they are typically placed on their backs; pressure on the back of their skulls can allow a flat spot to develop.

(Paul and his twin, Cody, were born five weeks prematurely, and spent their first five days in the neonatal intensive-care unit (NICU).)

"We also had anxieties about what Cody was going to think about the helmet —because they were used to seeing each other every day," Cheryl recalled. "Believe it or not, it doesn't bother him. He gave Paul a weird look the first day, but that was it. Then he just kind of went 'Whatever,' and moved on. They both adapted to it without any issues."

The helmet weighs about a pound, and the added weight may play a role in correcting the effects of the torticollis, helping to strengthen the neck and address any muscular deficit there.

Although it's not difficult to put on and take off the helmet, it took a few days for Cheryl and her husband Bill to learn and get comfortable with the process.

"Sometimes it needs adjusting; Harry just added some more padding to the back because the helmet kept shifting forward," she said. "It also needs simple daily maintenance, in the form of cleaning and disinfecting with alcohol."

There are other small adjustments that become necessary, she reported. "When we feed him a bottle, he has to lay his head in a certain way; I'd rather have him in a comfortable position than me."

Their greatest challenge, however, has been the extreme heat.

"Because he is so little, his body has to work harder to regulate the temperature, and he sweats badly inside the helmet. We've been trying to keep him inside, in the air conditioning, on these ungodly hot days."

## Dressed for Success

Does wearing the helmet slow Paul down? –hinder de-

*(Continued on page 8)*

# Battle Continues for Legislation to Benefit O&P Providers and Patients

It has been more than a year since the O&P community (made up of providers and patients) united like never before to oppose the Draft Local Coverage Determination (LCD) bill for lower limb prostheses. Since then, there have been a couple more important instances that have alerted key congressional offices to the fact that the two groups are aligned on the majority of issues when it comes to healthcare policy.

Generally speaking, what benefits patients usually benefits providers. Therefore, while providers and patients continue to lobby together on most issues, health plans, businesses, and other payers typically take the opposite stance.

This common interest between providers and patients was on full display recently, when this past spring, the Amputee Coalition held a Congressional Lobby Day and the following week the American Orthotic & Prosthetic Association (AOPA) hosted a Policy Forum. These two events were designed to educate members of congress on the needs within the O&P field and also focus the field's efforts to fight for the best orthotic and prosthetic coverage.

On the Amputee Coalition's Lobby Day, more than 25 leaders of the O&P profession met in Washington, DC to educate members of Congress on issues effecting the field and its patients. The key issues discussed were the LCD bill and the federal fairness bill (formerly known as parity). This bill is centered on the idea of requiring insurance plans to cover orthotics and prosthetics as they cover other medical benefits. For example, it would prohibit arbitrary limits or exclusions of devices. The federal fairness bill is focusing on getting the nearly 30 states that don't have parity to pass this legislation. The federal fairness bill is also looking to address the fact that large businesses that self-insure their employees are exempt from following state insurance laws.

AOPA's Policy Forum was well attended by practitioners, patients and other leaders within the O&P field. Former Senator Bob Kerrey set the tone of the forum and the end result was a one-page bill that listed the key O&P policy priorities.

"Those priorities were as follows:

**Separation of Orthotics & Prosthetics from Durable Medical Equipment -** This would separate orthotics & prosthetics (O&P) from durable medical equipment (DME) in federal law and regulations to ensure that the O&P field does not continue to be subjected to DME-based restrictions.

**Provider Qualifications and Recognition of Clinical Notes -** This would require implementation of the Medicare, Medicaid and SCHIP (State Children's Health Insurance Program) Benefits Improvement and Protection Act of 2000 (BIPA) Section 427. BIPA is a federal law enacted in 2000, but Section 427 was never implemented through regulations. The provision prohibits Medicare from paying for custom orthotics and prosthetics unless provided by a qualified practitioner or supplier. In addition, it would ensure that such practitioner's clinical notes are recognized as part of the patient's medical record for purposes of determining medical necessity.

**Expansion of Competitive Bidding -** This item opposes efforts to further expand competitive bidding to all prosthetics and orthotics, as the Obama Administration has proposed in its most recent federal bidding proposals, and presses for clarification that competitive bidding only applies to off-the-shelf orthotics that are subject to minimal self-adjustment.

**Draft LCD for Lower Limb Prostheses -** This would rescind, or at least place a moratorium on issuance of the Draft LCD for Lower Limb Prostheses and ensure that any future LCD is

developed in a transparent way with robust stakeholder input to ensure it does not restrict access to appropriate patient care."

Separation from the umbrella of DME care would be a great step because it would lay the groundwork for many desired policy changes. None of the four points highlighted in this bill are new ideas. They are concepts that have been proposed by various O&P organizations for years. The advantage now is the strong level of engagement and participation the whole O&P community had in creating the bill and the focus on overall reform concepts. Former Senator Kerrey took the process a step further by meeting with former colleagues in the senate to help push the bill forward. In the days following Kerrey's meetings O&P community members met with their Congressional leaders to increase the impact. At this point it seems if Congress is able to pass a Medicare bill, the O&P bill will also go through. But the reality of Congress being able to pass a Medicare bill is debatable.

*Thomas, Peter W. "How Patients Benefit From O&P Policy Reforms" The O&P Edge, June 2016.*

# Certified Orthotist Joins Lawall's Hershey, PA Staff

**Erin Aulicino, CO, LO recently joined the Lawall Prosthetics & Orthotics team, and is working at our Hershey, PA facility located inside the Penn State Hershey Medical Center. She received her Masters of Science in Prosthetics & Orthotics from the University of Pittsburgh and worked as an orthotist for five years in Pittsburgh.**

(Patient Profile continued from page 5)

# This Little Warrior Wears His Helmet Proudly – and Wins!

velopment or activity levels?

Cheryl laughed. "Not so you'd notice! He's not only keeping up, he's surpassed his twin! We have them in walkers and he is a crazy child! He runs into everything at full steam ahead. The other day he actually crashed through a baby gate, then looked back at me and laughed, like 'Ha-ha! I got through it!'

"We wondered if it's giving him a false sense of security, since now he whacks his head and doesn't feel anything!"

Lawall acknowledges that families are sometimes concerned because their child has been wearing the helmet for six months, and has grown accustomed to having this 24-hour protective barrier in place.

"After they're done with treatment, sometimes the helmet will still fit, so we can do a weaning off process," he explained. "You leave the helmet on for two hours, then take it off for two hours—just so they get accustomed to having it off."

The bottom line, however, is that it's working, said Cheryl, and it's working much more quickly than she had expected. "People who haven't seen Paul for a while can actually see the difference, now. I was expecting him to make slow and gradual progress, but this, to me, is going fast!"

## Advice to Other Parents of Plagiocephalic Children:

Cheryl and Bill Hassler stress the importance of (a) finding an experienced, progressive and trustworthy orthotic provider to guide and support you and your child through the process, (b) researching the subject and asking your doctor lots of questions—and above all, (c) not hesitating, but moving forward as quickly as possible after the diagnosis.

"The Lawall folks have absolutely been helpful—just terrific to us," Cheryl noted. "Harry explained to us that although there will be some shifting in shape as the child's head grows, once it reaches a certain point it will not correct itself. So you only have that brief window of opportunity and need to make your decision in time. Waiting to see what happens is a good way to run out of time. Don't hesitate. Get it done."

Bill agreed strongly, "You are your child's advocate right now. We didn't want Paul to have issues as he was older, if we did not have it corrected. Your child will have to live with your decision for a long time, so it ought to be the right one."

"I would highly recommend the cranial helmet to anybody whose child has this problem," added Cheryl. "Don't hesitate to talk to your doctor about it, and don't hesitate to get it. I've seen firsthand what it's doing for my son."

# Lawall Practitioner Attends International Symposium

Matt Moran, CPO, of Lawall Prosthetics & Orthotics, attended the First International Symposium on **Innovations in Amputation Surgery & Prosthetic Technologies (IASPT).** This was a two-day event held at the Rehabilitation Institute of Chicago for surgeons/physicians, prosthetists, physical and occupational therapists. The main objective for prosthetists at this symposium was to instruct them on advanced prosthetic issues, particularly for patients with unique surgeries and implantable devices.

In recent years, many innovative surgical techniques and technologies have been developed that have the potential for greatly enhancing the quality of life for persons with limb loss. With the field's rapid evolution, it is essential that all surgery for people with amputations is performed in light of current and coming technologies. Therefore, the symposium also focused on promoting recent innovations regarding upper and lower limb surgeries, therapies and prostheses.

Some of the topics that were discussed were implanted sensory motor systems, osseointegration/direct skeletal attachment, Targeted Muscle Reinnervation (TMR) for treatment of painful neuromas and for enhanced prosthesis control, and residual limb lengthening. One of the most exciting parts of the course was the patient demonstration. Attendees had the opportunity to see and speak directly with patients who were actually using these new cutting edge technologies.

Lawall strongly encourages our practitioners to continually seek continuing education within the field. It is through participation in seminars and classes that we can better serve our patients and ensure them they are continuously being offered the latest technology available.

RIC
Rehabilitation Institute of Chicago

# A Frequently Overlooked Orthotic Option: The Patellar Tendon Brace

Lawall practitioner, Bo Powers, CPO, had the privilege of assisting Rachelle Pretz, PT, DPT, Cora Brown, MD, William Hughes, MD, and Eric Altschuler, MD, PhD, of Temple University Hospital in a case study of a patient who suffered from an electrical burn and was prescribed a Patellar Tendon Brace (PTB).

The purpose of this study was to determine if the PTB offloaded the patient's foot and ankle enough to allow healing while promoting mobility. Patellar Tendon Braces are custom braces designed to offload the foot and ankle by dispersing pressure to the patellar tendon and popliteal area of a patient's leg. The PTB was designed in 1958, but it is currently underutilized within the field of orthotics.

The candidate for this case study was a 26-year-old male, who suffered a high voltage electrical injury resulting in 70% of his body having 2nd and 3rd degree burns. "The patient's left ankle sustained a severe circumferential third degree burn necessitating a fibulectomy; multiple wound debridement procedures, dermal template placement and skin grafting." (Pretz, 1) Prior to his injury the candidate led a normal life, he was independent and able to work.

After his injury the patient had a strong desire to ambulate independently and wanted to decrease his family's burden of having to care for him. Prior to therapy he was very dependent and required assistance getting food for himself, dressing, toileting, and other aspects of self-care due to the severity of his wounds. His level of motivation would serve him well throughout his rehabilitation process.

Initially, the patient was only able to walk about 5 feet with the support of two therapists using maximum assistance. His pain scale while doing this was a 10-10. His physicians decided to fuse his ankle once the wounds healed and made him non-weight bearing for one month. "The patients functional status slowly improved throughout his hospitalization. Four months after the injury he was able to ambulate 30 feet with a right platform shoe and a left PTB orthosis at supervision level without an assistive device. The patient demonstrated fair dynamic and static standing balance. For sit-to-stand, the patient was at a minimal assistance to supervision level. He remained at maximal assistance with upper and lower extremity dressing, including donning and doffing the PTB orthosis on his ankle, who was able to walk with a PTB orthosis without other assistive device. The PTB orthosis was introduced in 1958 (2), but it is used rather rarely now. There are only a few published reports on the brace (1, 2, 4–7), typically reporting great benefit, but for specialized uses (1, 4, 5) and only one of the papers (6) has been cited even a few times. The case described here is an exemplar of how the PTB orthosis could be of great and common use potentially for many thousands of patients with injuries due to natural disasters, war or other traumas. In the acute care phase of hospitalization, specialized teams are present for a short time (8) and an ankle or foot can be operated on or set and casted, then the patient can walk independently, with the PTB orthosis allowing the foot and ankle to remain non-weight-bearing, with the orthosis being discarded when no longer needed. Improvements in materials, scanning technology, manufacturing techniques, 3-D printing, and supply chain fulfilment and delivery mechanisms over the past 6 decades should permit custom PTB orthoses to be available when needed. The ability to ambulate is of great functional benefit and prevents secondary complications, such as decubitus ulcers. There advantages should vastly offset the cost of what, in some cases, will be a possibly disposable orthotic. In addition, the psychological benefits of being able to walk independently are immeasurable.

With an intact knee a patient can use a PTB in lieu of strict offloading through the foot. The PTB orthosis gives patients the ability to have more normalized gait, bear weight through the long bones of the affected leg, and decrease the amount of assist needed by the upper extremities and contralateral leg, which could result in overuse injuries. Another orthosis that would unload weight-bearing on the foot and ankle is a Charcot Restraint Orthotic Walker (CROW) boot, although the effect is not significant as with a PTB orthosis.

Limitations of the PTB orthosis also need to be considered. Skin integrity of the weight-bearing surface (patellar tendon) needs to be closely monitored for tears, abrasions, and irritation. Equinus deformity of the involved leg will necessitate more lift or platform to the contralateral leg. Also, some skill is needed to don the PTB brace, to ensure that the patient is only putting weight through their patellar tendon.

Initially, the patient was only able to walk about 5 feet with the support of two therapists using maximum assistance. His pain scale while doing this was a 10-10. His physicians decided to fuse his ankle once the wounds healed and made him non-weight bearing for one month. "The patients functional status slowly improved throughout his hospitalization. Four months after the injury he was able to ambulate 30 feet with a right platform shoe and a left PTB orthosis at supervision level without an assistive device. The patient demonstrated fair dynamic and static standing balance. For sit-to-stand, the patient was at a minimal assistance to supervision level. He remained at maximal assistance with upper and lower extremity dressing, including donning and doffing the PTB orthosis on his ankle, who was able to walk with a PTB orthosis without other assistive device. The PTB orthosis was introduced in 1958 (2), but it is used rather rarely now. There are only a few published reports on the brace (1, 2, 4–7), typically reporting great benefit, but for specialized uses (1, 4, 5) and only one of the papers (6) has been cited even a few times. The case described here is an exemplar of how the PTB orthosis could be of great and common use potentially for many thousands of patients with injuries due to natural disasters, war or other traumas. In the acute care phase of hospitalization, specialized teams are present for a short time (8) and an ankle or foot can be operated on or set and casted, then the patient can walk independently, with the PTB orthosis allowing the foot and ankle to remain non-weight-bearing, with the orthosis being discarded when no longer needed. Improvements in materials, scanning technology, manufacturing techniques, 3-D printing, and supply chain fulfilment and delivery mechanisms over the past 6 decades should permit custom PTB orthoses to be available when needed. The ability to ambulate is of great functional benefit and prevents secondary complications, such as decubitus ulcers. There advantages should vastly offset the cost of what, in some cases, will be a possibly disposable orthotic. In addition, the psychological benefits of being able to walk independently are immeasurable.

With an intact knee a patient can use a PTB in lieu of strict offloading through the foot. The PTB orthosis gives patients the ability to have more normalized gait, bear weight through the long bones of the affected leg, and decrease the amount of assist needed by the upper extremities and contralateral leg, which could result in overuse injuries. Another orthosis that would unload weight-bearing on the foot and ankle is a Charcot Restraint Orthotic Walker (CROW) boot, although the effect is not significant as with a PTB orthosis.

Limitations of the PTB orthosis also need to be considered. Skin integrity of the weight-bearing surface (patellar tendon) needs to be closely monitored for tears, abrasions, and irritation. Equinus deformity of the involved leg will necessitate more lift or platform to the contralateral leg. Also, some skill is needed to don the PTB brace, to ensure that the patient is only putting weight through their patellar tendon.

Future research should identify more populations in a variety of healthcare systems that may benefit from a PTB orthosis.

In conclusion, the utilization of the PTB orthosis has been described in several clinical settings, but reports of its use are limited in treating burn patients who are unable to bear weight via the foot-ankle complex due to high-degree burns. The case reported here shows that the PTB orthosis could be an excellent bridging therapy to assist burn patients in ambulating independently while waiting for definitive surgical management of the ankle. Our case suggests that the PTB orthosis may also be useful in other trauma and disaster situations.

*Conflicts of interest.* The authors report no financial or other conflicts.


J Rehabil Med 2016 Preview

CASE REPORT

MAXIMIZING FUNCTIONAL MOBILITY IN AN ELECTRICAL BURN PATIENT USING A PATELLAR TENDON BEARING ORTHOSIS

Rachelle Pretz, PT, DPT[1], Cora Brown, MD[2], William B. Hughes, MD[3] and Eric L. Altschuler, MD, PhD[1,2]

*From the [1]Department of Physical Medicine and Rehabilitation Temple University Hospital, [2]Department of Physical Medicine and Rehabilitation, Lewis Katz School of Medicine at Temple University and [3]Temple University Hospital Burn Center, Philadelphia, PA, USA*

**Objective: Injury to the foot and ankle without involvement of the knee, requiring a patient to become non-weight-bearing or even needing amputation, is a common problem resulting from diverse causes, including diabetic foot ulcers and trauma. The patellar tendon bearing orthosis may be a good option for patients who would functionally deteriorate, attempting to live their lives without the use of a leg. This brace was introduced 58 years ago; however, it is underutilized clinically and under-represented in the literature.**

**Case report: A 25-year-old man with severe electrical burn injuries resulting in an unstable ankle who, through the use of patellar tendon bearing orthosis and therapeutic rehabilitation, was able to walk at a supervision level without additional assistive devices.**

**Conclusion: The patellar tendon bearing orthosis is recommended, not only for other burn patients who are unable to weight-bear through their ankle-foot complex, but for other patients, such as trauma patients, to allow for ambulation.**

*Key words:* patellar tendon bearing orthosis; electrical injury; burn injury; non-weight-bearing.

J Rehabil Med 2016; 00: 00–00

*Correspondence address: Rachelle Pretz, Department of Physical Medicine and Rehabilitation, Temple University Hospital, Philadelphia, PA, USA. E-mail: rachelle.pretz@tuhs.temple.edu or Eric L. Altschuler, Department of Physical Medicine and Rehabilitation, Lewis Katz School of Medicine at Temple University, 3401 N. Broad Street, Philadelphia, PA 19140, USA. E-mail: eric.altschuler@temple.edu*

Accepted Apr 21, 2016; Epub ahead of print XXX 7, 2016

INTRODUCTION

Complications of third-degree burns are numerous, ranging from hypertrophic scar, contracture formation, infection, electrolyte imbalances to tissue loss. Extensive tissue and muscle loss around the weight-bearing joints of the lower limbs, such as the heel-ankle complex, can lead to immobility in patients with deep tissue burns. To mitigate this challenge, the patellar tendon bearing (PTB) orthosis was designed to offload the foot-ankle joint and to shift weight-bearing onto the knee joint. The PTB orthosis has been studied in diabetic patients with tissue loss of the lower limbs (1). A review of the literature on burns reveals that PTB orthosis has been used to treat one paediatric patient with equinovarus deformities post-thermal injury (2).



Journal Compilation © 2016 Foundation of Rehabilitation Information. ISSN 1650-1977

We describe here the first case of a patient who was unable to bear weight through the foot-ankle complex due to a fibulectomy resulting from a severe circumferential third-degree burn, but who could ambulate successfully with the use of PTB orthosis and make progress in his daily rehabilitative programme.

CASE REPORT

We treated a 26-year-old man who sustained a severe high voltage electrical injury with 70% total body surface thermal burns of second- and third-degree level of injury when he came into contact with an electrical transformer. Prior to injury the patient had had normal independent functional and vocational levels.

Physical examination revealed second- and third-degree burns over the right side of the face, anterior chest, trunk, abdomen, groin (excluding the scrotum), bilateral upper limbs, anterior thighs and ankles. Computed tomography (CT) scan of the spine revealed a T12 superior endplate fracture, but no fracture of cervical and lumbar spines, requiring a thoracolumbosacral orthosis (TLSO) brace wear for approximately 12 weeks when the patient was out of bed. Hospital course included multiple escharotomies and skin grafts to the left ankle and exploratory laparotomy due to abdominal compartment syndrome. He was initially intubated for airway protection, then extubated.

The patient's left ankle sustained a severe circumferential third-degree burn (Fig. 1A) necessitating a fibulectomy (Fig. 1B); multiple wound debridement procedures, dermal template placement and skin grafting.

Neuromuscular examination revealed bilateral hands with flexion contractures at the proximal and distal interphalangeal joints. Active range of motion (ROM) of bilateral elbows was normal. Active and passive ROM of bilateral shoulders was limited to 100° scaption secondary to scarring. Active ROM of the lower limbs was notable for bilateral hip flexion deficits secondary to pain from open gluteal wounds. Bilateral knee active ROM was normal. The patient had right ankle passive dorsiflexion to neutral. The left ankle was in a plantar flexion deformity with passive range of motion limited by pain to 15 degrees from neutral. There was no equinovarus deformity. Sensory examination revealed decreased sensation to light touch and pin prick in all dermatomal distributions of the upper and lower limbs.

Motor examination was performed using manual muscle testing and grading on the Medical Research Council scale.

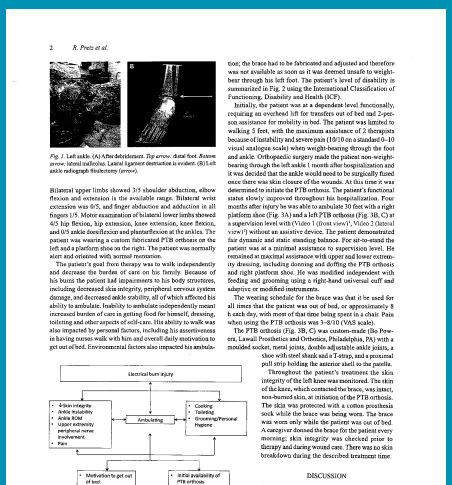

2 R. Pretz et al.




*Fig. 1.* Left ankle. (A) After debridement. *Top arrow:* distal foot. *Bottom arrow:* lateral malleolus. Lateral ligament destruction is evident. (B) Left ankle radiograph fibulectomy (*arrow*).

Bilateral upper limbs showed 3/5 shoulder abduction, elbow flexion and extension is the available range. Bilateral wrist extension was 0/5, and finger abduction and adduction in all fingers 1/5. Motor examination of bilateral lower limbs showed 4/5 hip flexion, hip extension, knee extension, knee flexion, and 0/5 ankle dorsiflexion and plantarflexion at the ankles. The patient was wearing a custom fabricated PTB orthosis on the left and a platform shoe on the right. The patient was normally alert and oriented with normal memories.

The patient's goal from therapy was to walk independently and decrease the burden of care on his family. Because of his burns the patient had impairments to his body structures, including decreased skin integrity, peripheral nervous system damage, and decreased ankle mobility, all of which affected his ability to ambulate. Inability to ambulate independently meant increased burden of care in getting food for himself, dressing, toileting and other aspects of self-care. His ability to walk was also impacted by personal factors, including his assertiveness in having nurses walk with him and overall daily motivation to get out of bed. Environmental factors also impacted his ambulation; the brace had to be fabricated and adjusted and therefore was not available as soon as it was deemed unsafe to weight-bear through his left foot. The patient's level of disability is summarized in Fig. 2 using the International Classification of Functioning, Disability and Health (ICF).

Initially, the patient was at a dependent level functionally, requiring an overhead lift for transfers out of bed and 2-person assistance for mobility in bed. The patient was limited to walking 5 feet, with the maximum assistance of 2 therapists because of instability and severe pain (10/10 on a standard 0–10 visual analogue scale) when weight-bearing through the foot and ankle. Orthopaedic surgery made the patient non-weight-bearing through the left ankle 1 month after hospitalization and it was decided that the ankle would need to be surgically fused once there was skin closure of the wounds. At this time it was determined to initiate the PTB orthosis. The patient's functional status slowly improved throughout his hospitalization. Four months after injury he was able to ambulate 30 feet with a right platform shoe (Fig. 3A) and a left PTB orthosis (Fig. 3B, C) at a supervision level with (Video 1 (front view)[1], Video 2 (lateral view)[1]) without an assistive device. The patient demonstrated fair dynamic and static standing balance. For sit-to-stand the patient was at a minimal assistance to supervision level. He remained at maximal assistance with upper and lower extremity dressing, including donning and doffing the PTB orthosis and right platform shoe. He was modified independent with feeding and grooming using a right-hand universal cuff and adaptive or modified instruments.

The weaning schedule for the brace was that it be used for all times that the patient was out of bed, or approximately 8 h each day, with most of that time being spent in a chair. Pain when using the PTB orthosis was 3–8/10 (VAS scale).

The PTB orthosis (Figs. 3B, C) was custom-made (Bo Powers, Lawall Prosthetics and Orthotics, Philadelphia, PA) with a moulded socket, metal joints, double-adjustable ankle joints, a




*Fig. 2.* Level of disability using the International Classification of Functioning, Disability and Health (ICF).



shoe with steel shank and a T-strap, and a proximal pull strip holding the anterior shell to the patella.

Throughout the patient's treatment the skin integrity of the left knee was monitored. The skin of the knee, which contacted the brace, was intact, non-burned skin, at initiation of the PTB orthosis. The skin was protected with a cotton prosthesis sock while the brace was being worn. The brace was worn only while the patient was out of bed. A caregiver donned the brace for the patient every morning; skin integrity was checked prior to therapy and during wound care. There was no skin breakdown during the described treatment time.

DISCUSSION

We describe here the case of a patient with a very severe electrical burn injury, non-weight-bearing

[1]http://www.medicaljournals.se/jrm/content/?doi=10.2340/16501977-2114

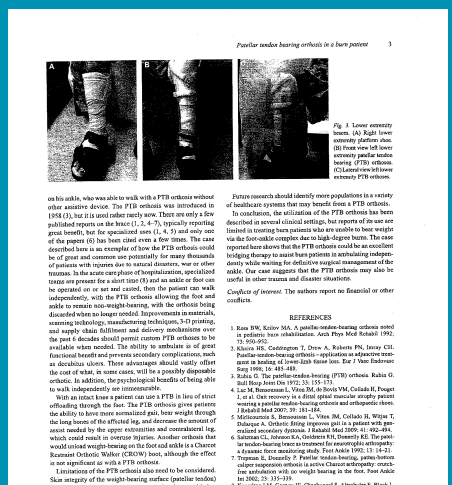

Patellar tendon bearing orthosis in a burn patient 3






*Fig. 3.* Lower extremity brace. (A) Right lower extremity platform shoe. (B) Front view left lower extremity patellar tendon bearing (PTB) orthosis. (C) Lateral view left lower extremity PTB orthosis.

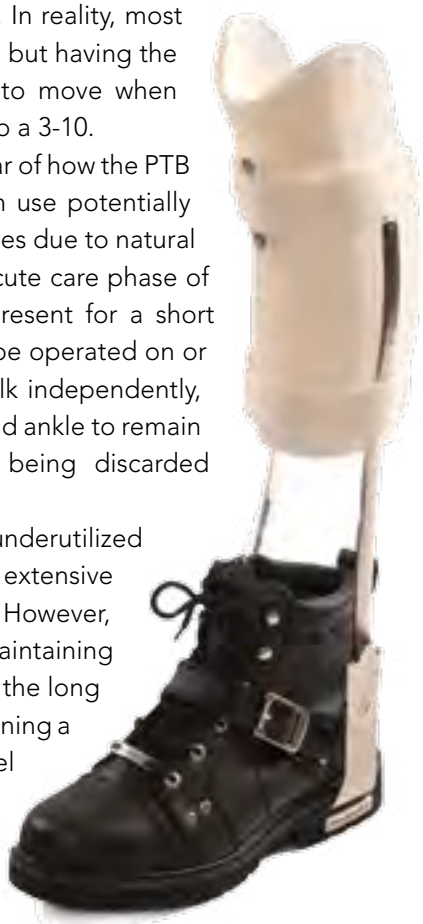
REFERENCES

1. Ross BW, Kelley MA. A patellar-tendon-bearing orthosis noted in pediatric burn rehabilitation. Arch Phys Med Rehabil 1992; 73: 950–952.
2. Khalsa HS, Caddington T, Drew A, Roberts PN, Jaciuy CH. Patellar-tendon-bearing orthosis – application as adjunctive treatment in healing of lower-limb tissue loss. Eur J Vasc Endovasc Surg 1998; 16: 485–488.
3. Rubin G. The patellar-tendon-bearing (PTB) orthosis. Rubin G. Bull Hosp Joint Dis 1972; 33: 175–178.
4. Lac M, Bonnemoure L, Vinet JM, de Bovis VM, Collado H, Pouget J, et al. Early recovery in a distal spinal muscular atrophy patient wearing a patellar tendon-bearing orthosis and orthopaedic shoes. J Rehabil Med 2007; 39: 181–184.
5. Mirlicourtois S, Bensoussan L, Vinet JM, Collado H, Witjas T, Dahlquist A. Orthotic fitting improves gait in a patient with generalized secondary dystonia. J Rehabil Med 2009; 41: 492–494.
6. Saltzman CL, Johnson KA, Goldstein SS, Donnelly KE. The patellar tendon-bearing brace as treatment for neuropathic arthropathy: a dynamic force measuring study. Foot Ankle 1992; 13: 14–21.
7. Trepman E, Donnelly P. Patellar tendon-bearing, patten-bottom caliper suspension orthosis in active Charcot arthropathy: crutch-free ambulation with no weight bearing in the foot. Foot Ankle Int 2002; 23: 193–199.
8. Knowlton LM, Gosney JE, Chandegraid S, Attenhofer E, Wiark L, Burkle FM Jr, et al. Consensus recommendations regarding the multidisciplinary care of complex amputation patients in disaster or humanitarian crisis/complex: report of the 2011 Humanitarian Action Summit Surgical Working Group on amputations following disasters or conflict. Prehosp Disaster Med 2011; 26: 438–448.

orthosis and right platform shoe." (Pretz, 2)

Bo Powers, CPO fabricated the PTB orthosis with a custom molded socket, double adjustable joints, steel shank in the shoe, a T-strap, and a proximal pull strap to pull the molded anterior shell into the patella tendon area and maximize load bearing. The patient's skin integrity had to be monitored closely, and he was instructed to wear the brace at all times when weight bearing or at least 8 hours a day. In reality, most of his day was spent in a seated position, but having the brace on gave him the independence to move when necessary, it also reduced his pain level to a 3-10.

"The case described here is an exemplar of how the PTB orthosis could be of great and common use potentially for many thousands of patients with injuries due to natural disasters, war or other traumas. In the acute care phase of hospitalization, specialized teams are present for a short period of time and an ankle or foot can be operated on or set and casted, then the patient can walk independently, with the PTB orthosis allowing the foot and ankle to remain non-weight-bearing, and the orthosis being discarded when no longer needed" (Pretz, 3).



As mentioned earlier, the PTB is an underutilized orthotic device. Perhaps because it is an extensive brace and can initially be seen as costly. However, upon closer analysis, the benefit of maintaining mobility can reduce medical expenses in the long run. And the emotional benefit of maintaining a level of independence through some level of mobility and being able to progress in therapy is an invaluable benefit to any patient.

*Rachelle Pretz, PT, DPT, Cora Brown, MD, William B. Hughes, MD, and Eric L. Altschuler, MD, PhD "Maximizing Functional Mobility In An Electrical Burn Patient Using A Patellar Tendon Bearing Orthosis," Journal of Rehabilitation Medicine Vol 48, 2016 pp 1-3.*

## Patellar Tendon Brace HIGHLIGHTS

**The Patellar Tendon Brace (PTB) can be designed with either a custom foot section and a walking base or attached to a patient's shoe, depending on the patient's needs and anatomical presentation. Below are some photos highlighting the unique designs of the PTB:**

1. **Patella Tendon Bar with popliteal push. By pushing into the patella tendon and popliteal area the pressure is transferred and the foot and ankle are offloaded.**
2. **The back wall is dipped to allow room for the medial hamstring and increase comfort while sitting.**
3. **Custom shaped anterior shell increases the weight-bearing surface and locks the patient into the orthosis and prevents migration within the device.**
4. **Proximal strap helps insure the maximum squeeze between the patellar tendon and popliteal is achieved.**
5. **The walking base with a rocker bottom allows a patient with a custom foot section to ambulate on any surface. But more importantly, the rocker bottom helps ensure the patient quickly rolls over and minimizes the time-spent weight bearing. But more importantly, the rocker bottom helps ensure the patient quickly rolls over and minimizes time spent weight bearing on the leg.**
6. **When the PTB is attached to a shoe, a double adjustable joint is used with metal uprights and steel shank is placed inside of the shoe.**

LAWALL
PROSTHETIC & ORTHOTIC SERVICES

8028 Frankford Avenue
Philadelphia, PA 19136

# OFFICE LOCATIONS

## PENNSYLVANIA

### Philadelphia
8028 Frankford Avenue
Philadelphia, PA 19136
Phone (215) 338-6611
Fax (215) 338-7598

### Pottstown
Sunny Brook Village
800 Heritage Drive
Suite 803
Pottstown, PA 19464
Phone (610) 705-5797
Fax (610) 705-5795

### Willow Grove
701 North Easton Road
Willow Grove, PA 19090
Phone (215) 657-3344
Fax (215) 657-3742

### Springfield
Crozer-Keystone
Medical Pavilion II
100 West Sproul Road
Suite 123
Springfield, PA 19064
Phone (610) 544-1281
Fax (610) 544-1387

### Hershey
Hershey Medical Center
30 Hope Drive, Suite 2100
Hershey, PA 17033
Phone (717) 531-5882
Fax (717) 531-4309

### Harrisburg
883 S. Arlington Avenue
Harrisburg, PA 17033
Phone (717) 541-1605
Fax (717) 541-1607

### Yardley
906 Floral Vale Boulevard
Yardley, PA 19067
Phone (215) 504-1932
Fax (215) 860-2068

### Coopersburg
551 E. Station Avenue
Coopersburg, PA 18036
Phone (610) 705-5797
Fax (610) 705-5795

## NEW JERSEY

### Lawrenceville
86 Franklin Corner Road
Lawrenceville, NJ 08648
Phone (609) 895-1141
Fax (609) 844-0284

### Cherry Hill
1030 N. Kings Highway
Suite 301
Cherry Hill, NJ 08034
Phone (856) 616-1885
Fax (856) 691-7147

### Vineland
3071 E Chestnut Avenue
Suite C
Vineland, NJ 08361
Phone (856) 691-7764
Fax (856) 691-7147

### Cape May Court House
1261 South Rt. 9
Cape May Court House
NJ 08210
Phone (609) 463-1042
Fax (856) 463-1070

## DELAWARE/ MARYLAND

### Dover
514 North DuPont Highway
Dover, DE 19901
Phone (302) 677-0693
Fax (302) 677-0930

### Wilmington
A.I. DuPont Institute
1600 Rockland Road
Wilmington, DE 19899
Phone (302) 429-7625
Fax (302) 429-7683

### Wilmington
1822 Augustine Cut-Off
Wilmington, DE 19803
Phone (302) 427-3668
Fax (302) 427-3682

## FLORIDA

### Orlando
Nemours Children's Hospital
13535 Nemours Parkway
5th Floor
Orlando, FL 32827
Phone (407) 567-5190
Fax (407) 567-5191

**www. LAWALL.com**