Differentiating between Orthotics and Prosthetics

Part 1:

Prosthetics (and the practice of Prosthetics) involves the treatment of the person suffering from *limb loss*. Prosthetic devices involve complicated designs, componentry and treatment criteria. Depending on the limb involved in *amputation*, the *level of the limb loss* (relative to the distance from the body) upper extremity; above the elbow, below the elbow or at the wrist. Lower limb; above the knee, at the knee, below the knee, at the ankle or part of the foot.

There are no simple reasons for someone to suffer from the loss of a limb (or limbs). The *reasons for the limb loss* are many. Some of the most common are:

- Birth defect[i] or medical mistake;
- Trauma: slip, trip or fall, or auto accident; and
- Medical condition: Diabetes[ii] or circulatory issues.[iii]

Prostheses (artificial limbs) Prosthesis (singular) designs come in many different designs, hard outside (exoskeletal) or soft on the outside and modular tube construction (endoskeletal). The receptacle that the residual limb (stump) fits into is custom fashioned for each individual person or residual limb is called the socket (some residuum are longer lengths than others depending on the extent of damage to the limb, such as in a traumatic amputation or blood supply available, such as with a diabetic person or vascular insufficient person or extremity).

Other major components of the prosthesis are:

- **Prosthetic Socket**; the purpose of the prosthetic socket is to create an intimate connection between the residual limb (residuum or stump) and the mechanical prosthesis.
- The **below knee** (trans-tibial) prosthesis socket tends to be more involved, as far as intimacy of the socket vs. the residuum, the tibia and fibula (bones of the lower leg) are prominent and the normal limb has muscles (that offer padding over bony prominences) and essentially there is just skin covering the bones in the front of the residual limb. The instances of the below knee amputated limb developing abrasions, blisters or ulcerations from overuse, mal-fit or design are higher than wearers of the above knee prostheses.
- The **above knee** (trans-femoral) prosthetic socket need for an intimate fit is the same as other levels of limb amputation; however, as there is only a single bone when amputated above the knee (the Femur[iv]) *control,* of the residual limb in the trans-femoral prosthetic socket is achieved by both the intimate fit of the soft tissue of the limb, as well as the design of the top part (proximal) of the prosthetic socket. It is important that the brim design is properly shaped to the patient's pelvis anatomy, but does not impinge on the bony prominences. If this happens, the gait[v] of the wearer will be affected as they will place the residuum in abnormal positions to try to alleviate the painful pressures.

- **Suspension;** (the prosthetic device is held onto the residuum) can be by strap, negative pressure[vi] (suction), sleeve or a number of combinations.
- **Prosthetic Feet;** are designed for actual anatomical foot size and shape, heel height of the particular shoe being worn, activity level of the individual using the prosthesis, sport or work applications and individual patient weight. They can be attached to the prosthetic device by a bolt, glue or lamination onto the shank (or shin) of the prosthetic limb.
- **Prosthetic Knee;** There are many different designs, too many to list here; however, the basic functions are: locked, free swing, stance control[vii] (to help stabilize the prosthetic knee unit to reduce the risk of an uncontrolled fall from a trip or a higher level of function while ambulating of Microprocessor[viii] (computer controlled) design. Current technology allows the incorporation of the knee and ankle,[ix] or an entire knee/ankle foot system to be computer controlled within the prosthesis. This technology utilizes the computer to allow control of the valves in the device to speed up, slow, or limit the articulation of the mechanical joint. This control provides the wearer of the prosthesis the ability to function at a level not previously available to users with simple mechanically articulated knees and ankle units. Current devices require the unit to be recharged with normal use every 24 – 72 hours depending on the manufacturer and activity level of the prosthetic user.

Part 2:

Orthotics[x] (bracing) is a general term for a device for the extremities, trunk, head / neck or spine that corrects a malformation, weakened area or straightens the affected area. An **orthosis** (singular) can be for one limb, the trunk (for a weakened spine as in a fractured spinal vertebra from a slip or fall or accident).

The materials used in various orthoses are often fabric, plastic, metal, carbon fiber or leather. The typical device is designed to support or splint a weakened extremity. Some designs enhance function of the affected limb, such as allowing a damaged limb to allow motion, such as the Stance Control Orthotic knee joint[xi] or multifunctional ankle joints[xii] that enable the user to navigate uneven terrain without stumbling or decreasing the risk of a fall.

The typical orthotic device is secured to the affected part of the body with straps, velcro, elastic material or combination of materials. These are normally attached to the device with rivets, glue or lacing.

- **Upper Extremity Bracing**; designed to splint or support the anatomical joints of the shoulder, elbow, Wrist and or Hand. These types of devices are typically fashioned from fabric, leather metal, carbon or a combination of the aforementioned. The mechanical joints can be prescribed to lock in position, limit or assist in motion or function. These devices can be sourced from 'off the shelf' or custom fitted (sized for mmall, medium, large etc.), custom fashioned from measurements or impression (cast).

- **Lower Extremity Bracing**; primarily prescribed and designed to support the damaged or weakened limb.
- **Fracture Devices**[xiii] for the lower limb are prescribed and designed to support a damaged area of the extremity. The reasoning for the orthosis could be to initially stabilize the limb post-incident, after a surgical procedure to allow healing or allow or enable ambulation post-incident. These devices are almost always custom fitted or custom fabricated from measurements or impression (cast). They can encompass the entire limb, local to the damaged area (e.g., the knee or ankle[xiv]). The materials utilized in these types of devices, like most of the types described previously, most often are fashioned from fabric, leather metal, carbon, or a combination of the aforementioned.
  Nerve or Spinal Cord Damage Bracing; Most, if not all, of these types of devices are prescribed by specialized physicians. The type of device (orthosis) varies greatly depending on the functionality desired to be achieved but the fact that current technology dictates that the orthosis is applied to the exterior of the limb. The devices referenced in this paper are always of exoskeletal design and are designed for the most part to allow or enable risk minimized ambulation for the extremity in focus.
  Most are rigid devices that transfer this rigidity to the weakened or damaged area of the extremity. In the past, this rigidity was achieved through the use of metal sidebars that were positioned on the inside and/or the outside of the limb, but changes in materials now available allow the use of carbon fiber[xv], acrylics and plastics that can envelope the entire area of focus or just a narrow band of material to *support* or *enhance* a specific area or the entire extremity. Orthotic designs for the neck and trunk vary in style, firmness, height, and material depending upon the reason for the design of the prescribed device.

- **Head and Neck Orthoses**; The cervical spine is very fragile when subjected to trauma or higher than normal forces of stresses. The resulting damage to such forces is often Cervical Hyperflexion[xvi] and Cervical Hyperextension[xvii] injuries or instability. Orthotic treatment prescription regimes vary depending upon the level of the injury and the amount of associated instability. Normally, level of perceived pain does not initially affect the type of orthotic device prescribed; however, after the initial injury, if the level of pain persists and the amount of instability decreases or remains constant; the type of cervical orthosis design recommendations may change.

  As a rule, the higher the level of injury or degree of instability, the more involved type of cervical orthosis[xviii].

- **Trunk Orthoses;** known also as spine supports or body jackets[xix], these types of braces have a variety of clinical indications. Like all bracing devices, these devices are designed to support or strengthen areas of the human spine.

The length or height of these spinal devices is determined by the specific area of support or stabilization needed. In the example of lumbar pain or damage, such as a workplace injury claim, could warrant the prescription of a 'back brace' for the most common area of injury; the lower back. Rule of Thumb: the more severe pain or structural damage from a slip, trip or fall, lifting injury complaint or repetitive motion complaint. The device could range from a simple circumferential flexible lower back device[xx] (corset) for both male and female persons to a custom orthosis that supports the area from the neck to the pelvis. These devices can be held in place on the body with simple Velcro straps, laces or heavy duty straps and buckles. Many have pads inside to help in providing more support or stability in the specific area of injury or weakness.

The Highly Specialized Field of Orthotics and Prosthetics and the determination of the most appropriate or mis-management of your client's treatment can be confusing at best. It is imperative that when your firm is retained for a case involving the utilization of prosthetic or orthotic device, your legal plan MUST include a board-certified prosthetist and orthotist expert to maximize your legal defense plan.

About the Author:

The expert has more than 40 years of experience that has allowed him vast knowledge and experience in clinical practice, prosthetic and orthotic component development, design and manufacturing. He is considered to be an expert in his field and continues to be asked to consult on clinical best practices by physicians, third-party payors, peers and patient users on the most appropriate component utilization and outcome measurements. The expert is a published author, consultant and clinical board examiner. He has treated and been involved with the treatment of persons of all ages with congenital birth defects, limb weakness and loss, spinal cord injury. The expert is intimately knowledgeable in prosthetic and orthotic clinical practice and management, component prescription recommendation, selection and utilization for all patient ages and levels of function that makes him an excellent resource for you as an expert witness and consultant.

He has particular expertise in the determination of the most appropriate prosthetic and orthotic component recommendation, utilization and failures due to improper manufacturing processes, prescription appropriateness, clinical applications and negligence directly related to limb weakness and loss, as well as spinal cord injury and treatment, wrongful death investigation and determination, limb damage and loss in diabetics as related to footwear.

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[i] http://www.cdc.gov/ncbddd/birthdefects/UL-LimbReductionDefects.html

[ii] http://www.dlife.com/diabetes/complications/foot/limb-loss

[iii] http://www.hopkinsmedicine.org/heart_vascular_institute/media/video/transcriptions/peripheral_arterial_disease.html

[iv] http://www.bing.com/images/search?q=transfemoral+amputation&qs=OS&sk=OS4&FORM=QBIRMH&pq=trans%20femoral%20&sc=8-14&sp=5&qs=OS&sk=OS4

[v] http://www.bing.com/images/search?q=above%20knee%20prosthetic%20gait%20deviations&qs=RI&form=QBIRMH&pq=prosthetic%20gait%20deviations&sc=8-26&sp=5&sk=AS3SC1

[vi] http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/2792/Lang%202008.pdf?sequence=3

[vii] http://www.rehab.research.va.gov/jour/68/5/2/61.pdf

[viii] http://www.amputee-coalition.org/inmotion/nov_dec_08/prosthetic_knees.html

[ix] http://www.bing.com/images/search?q=microprocessor%20foot%20ankle&qs=n&form=QBIR&pq=microprocessor%20foot%20ankle&sc=1-25&sp=-1&sk=

[x] http://cirrie.buffalo.edu/encyclopedia/en/article/250/

[xi] http://www.oandp.com/articles/2008-03_02.asp

[xii] http://www.hindawi.com/journals/tswj/2014/867869/

[xiii] http://www.maramed.com/articles/article_reprint_2/

[xiv] http://orthosurg.ucsf.edu/patient-care/divisions/sports-medicine/conditions/ankle-and-foot/ankle-fracture/

[xv] http://www.bing.com/images/search?q=carbon+fiber+leg+bracing&qpvt=+carbon+fiber+leg+bracing+&qpvt=+carbon+fiber+leg+bracing+&FORM=IGRE

[xvi] http://www.bing.com/images/search?q=Hyperflexion+Injury&FORM=IRMHRS

[xvii] http://www.bing.com/images/search?q=hyperextension+injury+neck&qs=AS&sk=IM1AS3&FORM=QBIRMH&pq=hyperextension%20injury&sc=8-21&sp=5&qs=AS&sk=IM1AS3

[xviii] http://stores.oandpstudyguide.com/downloadable-version-of-the-complete-halo-fitting-manual/
http://www.bing.com/images/search?q=HALO%20cervical%20fixation&qs=n&form=QBIRMH&pq=halo%20cervical%20fixation&sc=0-19&sp=-1&sk=

[xix] http://www.bing.com/images/search?q=spinal+orthosis+tlso+body+jacket&qpvt=spinal+orthosis+tlso+body+jacket&qpvt=spinal+orthosis+tlso+body+jacket&FORM=IGRE

[xx] http://www.bing.com/images/search?q=back%20braces%20and%20supports&qs=IM&form=QBIR&pq=back%20brace&sc=8-10&sp=6&sk=IM5