New Interface Design Benefits the High-Performance Individual

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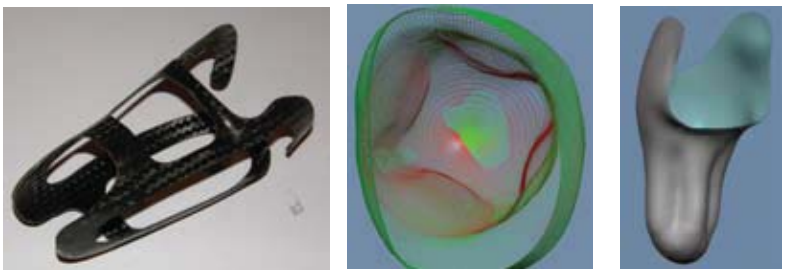

From left to right: The open cage design of this Hi-Fi Radial interface allows for superior cooling. A look down inside this High-Fidelity Femoral interface reveals its motion capture and control system. Computer rendering of a Hi-Fi Humeral positive model illustrating the intricate contouring required to achieve superior biomechanics

One of the most common complaints I hear from prosthetic wearers revolves around their socket or interface (i.e. "It doesn't fit me properly," "it slides off my arm or leg," or "I get too sweaty in my socket," etc.) and yet many prosthetists have often viewed the interface as little more than a means to attach componentry to the wearer's arm or leg. With regard to interface design, the clinician's focus has traditionally been limited to comfort, range of motion and suspension. Subsequently, often little attention is paid to maximizing prosthesis performance above and beyond Activities of Daily Living (ADLs) or its role in helping the wearer to return to work. While this has proved adequate for many individuals intent on low to moderate activity levels, when it comes to high-energy activities, traditional socket designs fall significantly short of what is required to maximize performance.

An interface is the very core of the prosthetic system and has inherent functional responsibilities that go far beyond traditional thinking. In order to allow an individual to perform at the highest levels, more sophisticated approaches integrating superior biomechanics are needed.

In addition to comfort, range of motion, and suspension, the high-performance interface must suitably distribute extreme loads and do so safely, capture and transmit intrinsic skeletal motion (motion of the bone contained within the interface) efficiently, dissipate heat and ensure high-levels of stability and feedback to the wearer.

Traditional Sockets Not Designed for Peak Performance

Many traditional upper and lower extremity sockets do not allow the wearer to maximize their performance potential. This is because hydrostatic pressure (pressures exerted by fluid at rest) in a traditional interface that surrounds the soft tissue in an enclosed, generic shape restricts the amount of control an interface can impart upon the bone buried within this soft tissue.

In this model, there remains a significant amount of soft tissue between the intrinsic bone and the interface wall surrounding it. This soft tissue "barrier" allows significant skeletal motion within the interface prior to the interface responding, and hence the prosthesis partially absorbs rather than captures motion. This redundant motion decreases prosthesis stability, the wearer's positional precision, functional range of motion and overall efficiency of movement, thus increasing energy expenditure while concurrently increasing the perceived weight of the prosthesis. Finally, the traditional design traps incredible amounts of heat – bad for an individual who has already lost skin surface area and often the worst environment for an athlete who is – by the very nature of the activity engaged in – generating significant heat already. Add all this up and it is somewhat obvious that traditional sockets fall far short of what can be done to optimize prosthetic function.

High-Fidelity Interface Provides Higher Level of Response

The patent-pending High-Fidelity Interface* for both upper and lower extremity applications offers a radical departure from the traditional model in that it imparts a high level of intrinsic bone control, by optimizing soft tissue flow and applying localized and focused compression on the intrinsic bone. By allowing much greater amounts of soft tissue to flow out from between the bone and the interface wall, more focused compression at the interfacial boundary (the region within the interface where the rigid portion of the interface wall contacts the soft tissue) is applied.

This optimal compression decreases the effective distance the intrinsic bone must travel before opposing forces reach a critical level and interface response, sufficient to capture or control movement occurs. Rather than absorbing a significant amount of intrinsic skeletal motion before responding, the High-Fidelity Interface immediately captures and controls it, greatly improving interface response.

The design also allows for far greater heat dissipation by creating an open, breathable environment for the athlete or active wearer, using rigid frame members for support only where biomechanically necessary and within the limits of patient load tolerance. High-tech, breathable and flexible materials are used to provide a light compressive force to soft tissue in order to prevent window edema in lower extremity applications, while often a completely open cage is created for upper extremity applications.

Benefits for the Athlete

What does all this mean to athletes or performance-minded individuals? It means that when they reach for a fly ball with their prosthesis, they will be able to do so more quickly and will be more accurate. When they sprint, the prosthesis will change direction during the stride more rapidly, diminishing lag time and increasing positional accuracy with each foot contact. When swimming, each subtle angular change of the limb will be transferred more completely to the paddle, and when they cycle, more efficient pedaling is possible as the motions of the tibia or femur are captured more readily. Throughout all of these activities and others like them, the wearer experiences reduced heat retention and is therefore able to concentrate on the activity, rather than the prosthesis.

Randall Alley, BSc, CP, LP, CFT is the creator of the High-Fidelity Interface and is the ceo and chief prosthetist for biodesigns, inc. (www.biodesigns.com), a high-performance clinical care prosthetic facility that caters to highly active individuals who demand more from their prostheses.

Alley has contributed to five prosthetic textbooks, is a clinical columnist, international speaker, and received a Certificate of Appreciation from the Department of the Army for his upper extremity training of military personnel.