ADJUSTABLE ORTHOTIC BRACE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of 60/387,030 filed Jun. 4, 2002 and the benefit of 60/373,368 filed Apr. 16, 2002.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to an orthotic brace for an anatomic join and, more particularly, to an adjustable orthotic bracing system.

[0003] An orthotic brace is used to counteract instability in a joint which is typically related to a soft tissue injury or joint deformity. Braces stabilize the joint area and limit joint movement to a defined range of motion, protecting the joint and the natural muscular and ligamentous joint stabilizers. A brace can also be used to prevent injury resulting from excessive motion or force by restricting flexion, extension, rotation, or lateral movement of the articulating joint. Braces are often used to protect joints during certain activities, such as athletics, or as part of physical therapy or a strength augmentation program following an injury or surgery. Ideally, a brace synergistically aids the inherent muscular and ligamentous joint stabilizers throughout a range of motion in resisting rotation and translation forces that might injure the joint. The ideal brace permits a full range of prescribed joint motion while preventing excessive displacement or force that might injure the joint and protects other parts of the limb, the user's body, and other persons from injury as a result of coming in contact with the brace.

[0004] Several types of brace devices are available. A sleeve is an expandable, slip-on device that typically comprises nylon-covered neoprene. Sleeves are simple, easy to fit and relatively inexpensive. Sleeves compress the area around the joint and increase the temperature at the joint. The increased compression and temperature may be a basis of perceived benefits reported by patients, but a simple sleeve does not apply leverage to the joint which is necessary for ligamentous support and lessening the likelihood of joint injury.

[0005] The leverage necessary to limit joint motion and loading is typically provided by one or more sets of articulated bars of a bracing element that are secured to the limb on opposing sides of the joint. Typically, the hinged bars are bound to the soft tissue of the limb by releasable bindings, an elastic sleeve or other similar attaching element. The pivot axis of the hinge of the articulated bracing element is generally aligned with the pivot axis of the joint so that the joint can move through a range of planar motion defined by the articulation of the hinged bars. The hinge of the articulated bracing element commonly includes adjustable stops so that the motion of the bracing element and the corresponding flexing of the joint can be limited.

[0006] In addition, a brace may be used to treat flexion or extension contractures that prevent the joint from being fully extended or fully flexed, respectively. Contractures and joint stiffness are typically the result of disuse of the joint following injury or surgery. Typically, contractures are treated with physical therapy including flexing of the joint against a resistance or weight. Spring-biased splints or braces providing a force to either resist or urge joint motion are commonly used to treat contractures. Hamersly, U.S. Pat. No. 5,472,410 discloses a brace that can apply a force resisting joint flexing.

[0007] Braces are also employed to control compartmental loading or the relative loading on the medial and lateral sides of a joint. The bars of the articulated brace element comprise a lever system controlling lateral displacement of the limb elements on opposing sides of the joint and, therefore, the compartmental loading of the joint. Typically, each of the bars of the bracing element is bound to the appropriate limb element at, at least, two spaced apart locations. The distal and the hinged proximal ends of the bars serve as fulcrums of the levers and the tensioning structures, the limb attaching elements proximal to the joint, are used to apply a reaction force substantially normal to the limb. This force pulls the joint toward the bracing element altering the relative portions of the joint load borne by the medial and lateral sides of the joint. Gildersleeve, U.S. Pat. No. 6,336,909 B2 discloses a brace for medial/lateral joint loading that includes a bracing element that can be semi-permanently deformed to alter compartmental loading and to customize the brace for a particular limb or treatment regimen.

[0008] While the ideal brace would limit joint motion to a prescribed range and support the natural muscular and ligimentous support structure of the joint throughout the range of motion, the control of the joint provided by a brace is limited substantially by the connection of the brace to the soft tissue of the limb. As the limb is flexed, the skin and muscle around the joint stretch and move producing large translations of the tissue to which the brace is attached. The thickening and thinning of muscle groups during joint flexing causes the positions of the bones inside the muscle mass and the shape and size of the limb at the points of attachment to change to substantially during joint movement.

[0009] The protection and efficacy of treatment provided by an orthotic brace are limited by the inability of braces to accommodate the changes in the limb resulting from joint operation. Even a custom fitted brace does not optimally control a joint throughout the range of motion. What is desired therefore, is an orthotic brace that is adjustable to respond to external influences acting on the joint, accommodate changes in the user's body resulting from limb motion, and enhance the effects of a treatment regimen.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] **FIG. 1** is a side view of an adjustable ORTHOTIC brace.

[0011] **FIG. 2** is frontal view of an adjustable orthotic brace.

[0012] **FIG. 3** is a block schematic of an adjustable orthotic bracing system.

[0013] **FIG. 4** is plan view of a portion of an attaching element for an orthotic brace.

[0014] **FIG. 5A** is an upper front perspective view of an electroactive polymer transducer.

[0015] **FIG. 5B** is an upper front perspective view of the electroactive polymer transducer of **FIG. 5A** in an actuated state.