Prosthetic Ankle-Foot System That Adapts to Sloped Surfaces

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The anatomical ankle is capable of providing adaptation to sloped surfaces, a function that is unavailable in most traditional lower limb prostheses. Commercially available prostheses that are claimed to adapt to surfaces have limitations such as high cost, delay in response, reduced stability, and loss of energy through damping. The purpose of the present work was to develop a prototype prosthetic ankle that adapts to sloped surfaces and is sufficiently durable for short-term field trials. The prototype switches between low and high rotational stiffnesses by means of a wrap spring clutch, and demonstrates a change of the ankle alignment in the ankle moment-angle curves when subjects walked with the unit on surfaces of different slopes, suggesting the prototype was providing slope adaptation. The arbors of the wrap spring clutch demonstrated significant wear when tested to 100,000 cycles based on ISO 10328 standards, yet the adaptable ankle continued to hold testing loads. Further efforts to reduce the weight and size of the prototype are essential, and continued refinement of the clutch engagement mechanism is recommended.

Low-Intensity Ultrasound Alleviates Osteoarthritis In Vitro and in a Rabbit Model

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Low-intensity ultrasound (LIUS) is a special type of sonic waves that can stimulate and/or regulate various cellular functions, and thereby regulate status of related diseases. In our previous study, LIUS was shown to relieve pain and progression of osteoarthritis (OA) in a rabbit model, when co-treated with hyaluronan. In this study, we investigated the LIUS effect on the repair of OA in vitro and in a rabbit OA model at the molecular level. The rabbit OA model was created by dissecting the anterior cruciate ligaments (ACLs) and medial meniscus on the right knee joints of adult male New Zealand white rabbits. The left knee joint was mock-operated as a sham control. The right knee joints with surgery were mock-treated or treated with LIUS every day for 10 min at a frequency of 1 MHz and an intensity of 100 mW/cm^2. The rabbits were sacrificed at 2 and 4 weeks postoperatively. In the histochemical analyses of joint cartilages, LIUS was shown to reduce progression of OA-phenotypes such as loss of cells, decrease in the levels of sulfated glycosamionoglycans (GAGs) and type II collagen, and increase in the expression of type X collagen and matrix metalloproteinases (MMP-9 and MMP-13). In the experiment in vitro, rat chondrocytes were treated with interleukin-1? (IL-1 beta) to induce OA-phenotypes. Then, LIUS was treated every day for 20 min from day 0 at varying intensities of 30 mW/cm^2, 70 mW/cm^2, and 100 mW/cm^2. When analyzed at 1, 2, and 3 days, IL-1 beta reduced the expression of cartilage-specific genes of type II collagen and aggrecan and induced the expression of type X collagen, MMP-9 and MMP-13. In contrast, co-treatment of LIUS reversed the activity of IL-1 beta particularly at 30 mW/cm^2 and 70 mW/cm^2. These results showed that LIUS inhibited the changes in the expression of OA-related genes. The results of this study confirmed our previous result on the LIUS effect at the molecular level and further suggest that LIUS could be a potent intervention to OA and cartilage disorders in clinics.