

Creating distraction at the knee joint: a treatment option for osteoarthritis (Knee Traction)

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Function:

Knee osteoarthritis affects millions of Americans and people around the world. It is a painful, degenerative disease for which there is no cure. Thus far, no treatment option has been shown to halt or reverse tissue damage. However, joint distraction has been shown to increase cartilage thickness, decrease denuded bone area, decrease pain and improve functional ability. It is a procedure that gradually separates the two bony ends of a joint for a specified period of time. This principal can be applied to the knee joint. We will be creating a non-surgical device that can be used as a home-based intervention to create joint distraction in the knee. No such device currently exists. The theory is that when used regularly, someone could potentially delay or eliminate the need for a knee replacement.

Client Requirements:

- A device that will distract the knee in order to stop or slow the progression of osteoarthritis.
- A device simple enough to be used at home by patients who may have limited mobility.
- Reach a maximum of 311.4 N (70 pounds) of pressure to distract the knee joint apart.
- Fit a wide range of patients in weight and size.
- Provide a constant force to maintain distraction for 20 minutes.
- Keep knee at a 30° angle from the horizontal, or the “open pack” position, to optimize separation of the knee joint.
- Take caution to not distract the ankle and hip joints.

1. Physical and Operational Characteristics

A. Performance Requirements: The device must be able to keep a patient’s knee distracted for a period of 20 minutes. The device must also reach a maximum pull of 311.4 N (70 pounds) and be easily stored in the home. It must be functional for a wide range of patients regarding size and dexterity.

B. Safety: The device must provide enough pressure to distract the knee but not cause injury to the joint or distract the hip or ankle. It also must be stable so that when force is applied, there is no extra movement that would put the user at risk.

C. Accuracy and Reliability: The device must be able to maintain a constant pressure up to 311.4 N (70 pounds) for a period of 20 minutes, multiple times a day. The force used to

distract the knee joint will be easily adjusted by a patient based on their needs. The knee must also be kept at an angle of 30 ° to maintain an “open pack” position.

D. Life in Service: The device should maintain function for a minimum of 15 years. Ideally, the product should last a lifetime.

E. Operating Environment: The finished device will be used in the home on a firm, flat surface, and the user should be seated in a firm chair that is 0.5 meters (19 inches tall).

F. Ergonomics: As this device will be used by a range of patients at varying heights and weights, ergonomics is extremely important. The device must be functional for anyone weighing from 100 to 400 pounds. The prototype must also be adjustable, user friendly, and easily transported.

G. Size: The traction unit must be shorter in length than one meter, 0.5 meters tall, and wide enough to accommodate a wide range of leg sizes.

H. Weight: The traction unit must be lightweight so that it can be lifted by a patient who suffers from osteoarthritis in the knee. However, it should not be so lightweight that it impedes functionality or usability.

I. Materials: The materials used should be strong and durable for the device to last many years, as well as be nonabrasive to the skin. Materials used are nylon coated cables, wood covered in foam padding with a layer of vinyl fabric, pulleys, cotton straps, Velcro straps, cylinder mounting clips, and an air cylinder with a hand pump and gauge.

J. Aesthetics, Appearance and Finish: Since this device will be used in homes, it must be aesthetically pleasing and have a smooth, streamline design.

2. Production Characteristics

A. Quantity: We will be constructing one device.

B. Target Product cost: The target product cost will be at or below \$500.

3. Miscellaneous

A. Standards and Specifications: If marketed, the product will require approval from the FDA.

B. Customer: The intended customer for this device is anyone who may suffer from knee osteoarthritis that would prefer a way to ease their pain and prolong the amount of time before knee replacement surgery is needed by using an at home system. The patients will be of varying height, weight and ability level, therefore the product must be compatible to many different body types. All of these requirements must be considered in designing a final product.

C. Patient-related Concerns: The device must not be harmful to the user in any way and be comfortable so as to not put the patient in any more discomfort than already caused by their knee osteoarthritis.

D. Competition: Currently, there is no competition as there is no at home product for distracting the knee available on the market. Knee distraction is only done in a clinical setting and even then is very cumbersome to execute.