

# Knee Traction Device

## Product Design Specifications

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*Client:* Kim Skinner

### **Problem Statement:**

With the growing need for knee replacement surgery, finding methods to stave off risky operations is becoming increasingly important. Knee replacement surgery, in particular, is rarely a one-shot deal, often requiring multiple replacements, physical therapy, and frequent doctors appointments throughout the life of the patient. Mechanical traction is used as a treatment intervention for degenerative joint disease, particularly in the knee. Our goal is to create a device to offer rehabilitative joint distraction for those with chronic knee problems while aiming for simplicity, portability, and affordability.

**Function:** The device will provide mechanical distraction to the knee joint by gently separating the upper and lower portions of the leg.

### **Client requirements:**

- The device must be affordable, i.e. within a \$400 project budget.
- The device must be easy to transport, i.e. lightweight and compact.
- The device must be aesthetically pleasing.
- The height of the device must be adjustable.
- The angle must be adjustable around 30°.
- The force applied to separate the joint should be adjustable around 30 lbs.
- The device should be comfortable to use.
- The device should be simple to operate and suitable for home-use.
- The device should be designed with marketability in mind.

### **Design requirements:**

#### **1. Physical and Operational Characteristics**

a. *Performance requirements:* The device is intended for daily use, at approximately 20 minutes per application. It should be able to provide a constant, consistent force to separate the joint, approximately 30 lbs.

b. *Safety*: The device will provide mechanical distraction at the knee joint, and as such, care must be taken that any potential failure will not harm the user. Padding will be used where necessary, and no sharp edges/points will come in contact with the user.

c. *Accuracy and Reliability*: The device will include a gauge to measure the applied force, and must be designed to administer said force consistently and repeatedly.

d. *Life in Service*: The device should be able to reliably operate for at least five years under continuous usage with the possibility of minimal maintenance.

e. *Shelf Life*: Provided the device is stored under reasonably temperate conditions (i.e., within the home), one should expect it to last indefinitely when not in use.

f. *Operating Environment*: The device is intended for home or clinical use, by anyone from patients to licensed physical therapists.

g. *Ergonomics*: The device is intended for use on a human leg only. The height, knee angle, and applied force will be adjustable to suit most, ideally all, patients.

h. *Size*: The device should be compact, possibly collapsible, and designed in such a manner that it may be unobtrusively stowed.

i. *Weight*: The device should be designed with elderly patients in mind, therefore it should be as lightweight as possible. However, durability will not be sacrificed in pursuit of lower weight.

j. *Materials*: There are no restrictions on materials; they will be chosen based on cost and weight.

k. *Aesthetics, Appearance, and Finish*: Given that potential marketability is a goal, the device must appear polished and aesthetically pleasing.

## **2. Production Characteristics**

a. *Quantity*: One prototype, with reproducibility in mind

b. *Target Product Cost*: \$400 or less

### **3. Miscellaneous**

a. *Standards and Specifications:*

- FDA approval
- Possible IRB approval for human testing

b. *Customer:* The device must meet all client specifications listed above.

c. *Patient-related concerns:* None foreseen

d. *Competition:* Similar products exist for other joints of the body, and surgical knee distraction devices as well. However, no home or clinical use devices are on the market.