Assisted Leg Holding Device For Medical Procedures

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Team 1

Funded by:
Rehabilitation Education Research Center

Client Contact Information:
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Overview

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Introduction

- In the United States, about 51.2 million people are disabled
  - Arthritis, rheumatic conditions, back problems, orthopedic injuries, paralysis etc.
- Leg holding devices are required for many medical procedures
  - Knee surgery, physical check-ups
  - Important for patients to have a positive experience as to keep up with preventative screenings and to reduce anxiety
- Patients with the physical disabilities often have problems with traditional leg-holding devices.
  - Lack of adjustability, patients outside the “normal” range
  - Practitioners have difficulty positioning patients who are overweight or have severe disabilities
A modification to existing technology is desired by the medical society that opposes gravity, in order to simplify the positioning process.
Requirements

- Comfortable
- Versatile (can be used by a wide variety of patients)
- Adhere to medical standards
- Low cost
- Compact and easy to relocate
- Easy to sterilize
- Not imposing or intimidating
- Durable and reliable
Product Research

- Allen YellofinTM Lithotomy Stirrups
  - intra-operative repositioning of patients
  - mimics natural motion of the hip
  - prevents excessive pressure on the calf
  - Accommodates patients up to 500 lbs
Product Research Cont.

- Allen R Deluxe Arthroscopic Legholder System for Knee Surgery
  - accommodates all patient sizes
  - uni-directional locking mechanism ensures a rigid fixation
  - able to apply pressure both medially and laterally
  - straps allow for easy adjustment
Patents

- **2714541**
  - approved in August, 1955
  - One of the earliest patents found pertaining to this subject, stirrup only supports the patient’s foot
  - extremely compact and can be easily stored to maximize space within the operating room

- **4809687**
  - approved in September 1989
  - cushioned shell that supports a patient’s foot and lower leg
  - accommodates for patients with joint or muscle disease

- **5802641**
  - approved in September 1998
  - can be adjusted to support a patient against gravity
  - uses a motorized system
Objective

- Design anti-gravity leg holding device for medical purpose
- Design the device to incorporate with various weights and heights of the patients.
- Provide user-friendly leg holders for disabled people
Methods

The problem that must be solved in order to design the assisted leg holding device
Schematic of the proposed device
Part A: Propelling device

- Needed to oppose gravity and assist the practitioner in lifting the patient’s legs
- Possible methods:
  - Spring, hydraulic, crank, or motor
- Must allow for motion in three directions:
  - Internal/external rotation, adduction/abduction, flexion/extension
- Must be able to lock into place, unlock to adjust
Free body diagram of proposed device

\[ \sum F \equiv -W_{\text{leg}} - W_{\text{device}} + F_{\text{app}} \]
Part B: knee support
- Foam padding => increased patient comfort
- Extra support => accommodates amputees, decreases stress on patients with weak muscles

Part C: knee lift
- Adjustable for patients of different heights or in various positions
Part D: bar
- Foundation of device
- Attaches to parts C and E
- Must be sturdy, adjustable

Part E: boot
- Foam padding => increased patient comfort, adjustability
- Sliding motion => adjustable for patients of different heights or in various positions

Part F: handle
- Controls movement of device by practitioner
- Controls the lock/unlock capability of the device
Patients benefiting from this device:

- **Phylis** rheumatoid arthritis, joint stiffness, pain
- **Jerry** Parkinson’s disease, tremor, rigidity, and decreased range of motion
- **Jamie** T11 spinal cord injury
- **Betty** limited and asymmetrical lower extremity range of motion, limited strength in her right leg, pain caused by her hip
- **Violet** short stature
- **Paul** two below-the-knee amputations
<table>
<thead>
<tr>
<th>Material</th>
<th>Cost Range (U.S. dollars)</th>
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</thead>
<tbody>
<tr>
<td>Lift Options:</td>
<td></td>
</tr>
<tr>
<td>- Hydraulic</td>
<td>200.00-350.00</td>
</tr>
<tr>
<td>- Springs</td>
<td>40.00-60.00</td>
</tr>
<tr>
<td>- Crank</td>
<td>60.00-120.00</td>
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<tr>
<td>- Electric Motor</td>
<td>100.00-250.00</td>
</tr>
<tr>
<td>Metal</td>
<td></td>
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<tr>
<td>Surgical Stainless Steel</td>
<td>70.00-200.00</td>
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<tr>
<td>Titanium</td>
<td>150.00-250.00</td>
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<tr>
<td>Surgical Form</td>
<td>20.00-60.00</td>
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<tr>
<td>Rotation Device</td>
<td>15.00-60.00</td>
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<tr>
<td>Clamps</td>
<td>60.00-90.00</td>
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<tr>
<td>Velcro</td>
<td>20.00-30.00</td>
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<tr>
<td>Medical Table</td>
<td>175.00-300.00</td>
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<tr>
<td>Boot (pair)</td>
<td>275</td>
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<tr>
<td>with rod</td>
<td>375.00-450.00</td>
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<td>Knee support (pair)</td>
<td>380</td>
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<tr>
<td>Other</td>
<td>100.00-150.00</td>
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<tr>
<td>Screw/Nuts/Bolts etc</td>
<td></td>
</tr>
<tr>
<td>Medical vinyl</td>
<td></td>
</tr>
<tr>
<td>Paint/aesthetics</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1175.00-1960.00</td>
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</table>
Ideally, the cost of the prototype is roughly 35% of the price of available, similar units currently on the market.

It should also be noted that not all units currently available will include all the options that are proposed for the prototype, and this should be considered when comparing costs.

<table>
<thead>
<tr>
<th>Device Name</th>
<th>Cost (U.S. dollars)</th>
<th>35 % of Cost (U.S. Dollars)</th>
<th>Difference between prototype and 35% of cost (U.S. Dollars)</th>
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</thead>
<tbody>
<tr>
<td>Candy Cane Stirrups by CinTech</td>
<td>450</td>
<td>157.5</td>
<td>-1017.5</td>
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<tr>
<td>Leg Positioners by CinTech</td>
<td>990</td>
<td>346</td>
<td>-829</td>
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<tr>
<td>Assisted leg lifting device</td>
<td>4395</td>
<td>1538.25</td>
<td>363.25</td>
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</table>
Future Work

- Product search for lower prices $$$
- Work on Alternative designs
- Prepare parts to be ordered
- Building the prototype
- Testing the prototype
Conclusion

The purposed design will
- be low cost, durable and compact than the traditional leg holders.
- provide orthotic leg support to disabled patients
- be flexible for the patients or the practioners to position the leg for comfort
Acknowledgement

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Dave Price

References

- http://www.newexamtable.com/_ACCESSORIES.html