SKIPP: Enhancing Mobility for Pressure Ulcer Patients with SCI
Need Finding, Kinematic Principles, Design Concept

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**Consumer Need**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Need</th>
<th>Approach</th>
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<tr>
<td>SCI + Pressure ulcer</td>
<td>Avoid use of standard wheelchair for months</td>
<td>Mobility device in prone/kneeling position</td>
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**Need Finding**

- **Improved sociability**
- **Comfort**
- **Ease of Mobility**
- **Safety**
- **Ease of bed/device transfer**

**Existing SKIPP Concept**

Supported Kneeling Inclined Power Platform

- Kneeling chest up with head support
- Kneeling chest up without head support
- Prone position
- Kneeling chest down

Fits most people with easy and fast adjustability; leased from medical facilities

**Issues to be Addressed**

- Comfort and Ergonomics
  - Follows human natural motion
  - Provides adjustability
  - Provides unnatural positions
- Safety
  - Prevents pinch device
  - Mounts to a power base
  - Creates no new health issues
- Already addressed
  - Reduces shear
  - Provides handles to adjust position
  - Avoids additional pressure points

**Evaluation base on the requirement**

- Red = Inadequate
- Orange = Unsatisfactory
- Green = Satisfactory

**Quantitative and Qualitative Evaluation**

Observation of natural body position and motion on current SKIPP prototype

**Requirements**

- No shear
- Knee weight shift
- Upright position

- No back curve
- Hip angle adjustability
- Small turning radius

**Kinematic Principles**

- 45° RCM instead of 90° trunk rotation
- No vertical surface while resting
- Bent legs in rest position
- 45° thigh angle in rest position
- Changing knee contact point

- Easier design
- Better weight repartition
- Small wheelchair footprint
- No back hyperextension
- Better weight shift

**SoarFree Concept**

<table>
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<tr>
<th>Function</th>
<th>Solution</th>
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<tr>
<td>Base Rotation to Move the Thigh (max 90°)</td>
<td>Belt &amp; pinion mechanism to move a rail guided between 4 rollers</td>
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<tr>
<td>Trunk Rotation (max 45°)</td>
<td>Combining 2 curved racks &amp; 4 pinions to put RCM on hip CR</td>
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<tr>
<td>Shin Support Flap (max 90°)</td>
<td>Using a worm drive mechanism</td>
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Adjustability to the User’s Measurements
- Translation of cushions: Shin cushion in the vertical direction
- Thigh and chest cushions in the horizontal direction

**Discussion**

**Future Work**

- User control of actuators
- Cushion translation system
- Mounting to the power base
- User restraint system
- Evaluation of human motion for different body types

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