

Design and Evaluation of Patient Transfer Device

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Introduction

Patient transfer devices are electromechanical or mechanical apparatus that are made to help transfer patients with disabilities. Transfers are done over both commercial and private locations and should be conducted by qualified individuals.

Problem Description

Healthcare workers perform the most patient transfer jobs, and they suffer from lower muscle back pain and shoulder muscle pain due to the high number of transfer cycles they complete.

Transfer devices help improve the transferring process better for both patients and caregivers. However, most devices have a low adoption rate due to products in the market being expensive, high setup time and limited portability. Not having proper devices means patient transfers are done manually or using devices that require lifting using back muscles.



Objective

The project aims to design a portable and easy-to-use patient transfer device. The primary objective is to reduce the stress on the lower back of healthcare worker and to evaluate the device to understand posture improvements

Scope and Assumptions

The project team limits their project scope to transferring patients between the bed and wheelchair to help develop a working prototype. Assumptions for this project were that our test subjects did not have any special physical needs.

Methods

Design:

- Researching different models, the functionality of existing transfer devices in the market
- Brainstorming and creating individual sketches of prototype design
- Designing 3D Model using AutoCAD 2021 (Computer Aided Design)
- Creating detailed drawings to show dimensions, tooling requirements, materials, and quantity.
- Anthropometric static data were used for arm reach length from the center of the wrist, foot length

Posture Analysis:

3D Static Strength Prediction Program

- Spinal compression forces for the three tasks using different devices (pivot disc, sliding board, prototype) were determined.
- Center of pressure and leg loads were determined for four different tasks.

Rapid Entire Body Assessment(REBA):

- Utilizing REBA assessment worksheet as well as the Ergo Plus software to assess the postural demand during transfers.

Design of Experiment:

- Collect pre and post usability data using survey. The sample size was 5 university students, and 1 nursing student served as a caregiver.

Design Results

The prototype of our device (Figure 1&5) has incorporated a new motion of patient transferring. It utilizes a standing push/pull motion as opposed to high-risk back lift postures done manually or using manual devices.

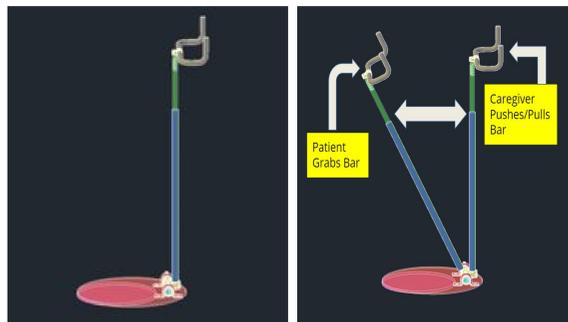


Figure 1: 3D AUTOCAD Model of Prototype

Posture Analysis Results

- Predictions for spine compression force of prototype versus other devices were reduced from 1530 lbs. for males and 1525 lbs. for females (Figure2)

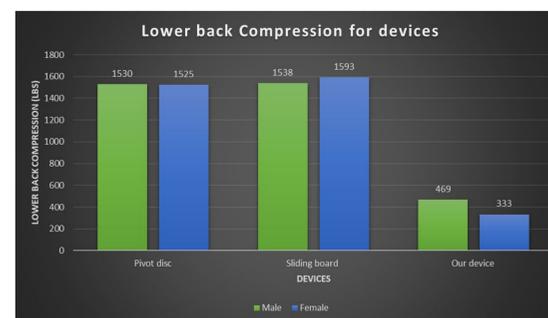


Figure 2: Results for Lower Back Compression

- The center of balance was predicted to be acceptable for transfer completed with our prototype. Load distribution was predicted to be at 100% (Figure 3).

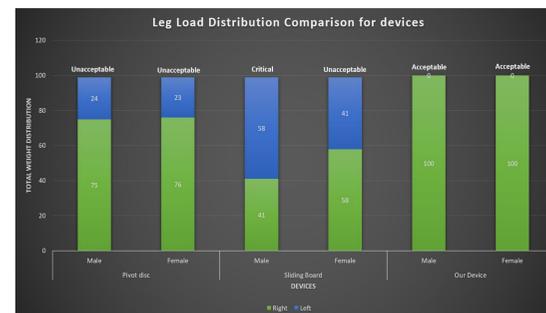


Figure 3: Results for Leg Load Distribution

- Results for REBA (Figure 4) suggests that our prototype scored 5 (acceptable posture, low to no risk injury) compared to sliding board and pivot disc scoring 10 (unacceptable, high risk of injury)

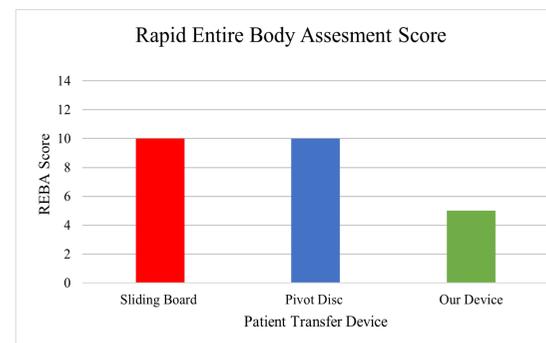


Figure 4: Results for REBA comparisons



Figure 5: Prototype used by certified nurse on test subject

Conclusions & Future Suggestions

The team was successful in designing, prototyping and evaluating a patient transfer device within the budget of \$200. Results were analyzed using two separate work measurements. Transfer device prototype reduced spinal compression forces with the correct implementation.

For improvements, alternate lighter and stronger materials (e.g., carbon alloy) for rods and base plate can be used for a rotation disc for the bottom.

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