Universal Adaptive Seating System

TetraSki Introduction

The TRAILS TetraSki allows athletes with complex disabilities to enjoy skiing. Variations of the TetraSki accommodate a broad variety of disabilities from spinal cord injury to, movement, muscle, and posture disorders.

TRAILS aims to make the TetraSki product more widely available to the public, allowing people to ski who wouldn’t normally be able to.

Adjustable Headrest

Our revisioned headrest has fewer points of adjustment, requires less tools, and is more rigid than before.

1. The Lateral Arms are tooless and serve the purpose of keeping the head and neck aligned. They have a greater range of motion to accompany various helmet sizes.
2. The Back Plate Assembly mounts to the U-Bar and it also serves as postural support allowing fore and aft adjustability on the skiers helmet.
3. The U-Bar mounts to the back of the TetraSki. It allows for vertical adjustment of the entire assembly to fit various heights.

Problem Statement

The current TetraSki doesn’t accommodate below or above average-sized skiers. Plus there is limited range on the parts and they take significant time to adjust.

A primary concern was the headrest a standard wheelchair part, that was impractical for skiing.

Additionally the bucket seat is expensive and ships from Europe causing long lead times.

Objectives

1. Optimize the headrest for quick adjustments.
   a. Prioritize affordability and ease of repair.
   b. Make it more rigid than off the shelf wheelchair components.
2. Create an adjustable seating system for disabled athletes.
   a. Prioritize waist sizes and the angle of recline.
   b. Make it affordable, manufacturable, and easy to integrate with the current TetraSki frame.

Torque Analysis & Testing

Given the parameter that the skier will not experience more than 0.5 G during normal operation it was assumed that the skier’s head will be 5 kg. This results in a 24.5 N force acting on the lateral arm. Where the minimum torque required to prevent rotation is:

$$\tau = F \times L \times \mu$$  \hspace{1cm} (1)

Where F = 24.5 N, L = 269 mm, and \( \mu \) = 0.7 (Al on Al). From equation 1 the torque is 4.61 Nm. Figure 3 shows a test where the lateral arm was subject to a 25 N force.

Conclusion

Using only four points of adjustment, the time spent on adjustments has decreased. The frequency of adjustments has also decreased now that the headrest is more rigid and incorporates better hardware. Ergonomically, the skiers head and neck posture can be aligned quickly so that they are comfortable and do not become fatigued.

Using the TetraSki frame, the new U.A.S.S. will be able to accommodate skiers of larger waist size while still being able to fit the current range of skier sizes. The seat also retains all the points of adjustment needed to support skiers of various levels.

The redesigned U.A.S.S. will increase the accessibility of the TetraSki and the overall ski community.