Methods and Materials

Materials
1. 6064-T6 Aluminum Frame and Structural Components
2. Sprockets, Bearings, Chains from McMaster-Carr
3. Pneumatic Air Cylinders from Bimba

Methods
The construction of the device after the many hours spent machining, required only the use of a Phillips head screwdriver, an M5 Allen wrench, and a set of pliers were all that were required to construct this device. The final constructed prototype of the Lower Limb Rehabilitation Device for Passive and Active Motion.

The machining was mainly done on a horizontal band saw, to cut the pieces to length, and the radial drill press, to create holes for the bolts. Two pieces, the two chain attachments, had to be machined using the vertical end mill. The mill was used in combination with drill bits, mill bits, and taps to create one of the most important pieces in the design. Lastly, all of the axles, and other circular shafts were modified using the lathe. This helped take off some of the rough finish from the axles allowing them to turn more smoothly in their bearings. In addition, a lathe was used to make the cylinder connectors. The cylinder connectors had to be turned down to fit to the rod end, thread on one side with a ½–20 die, and threaded on the opposite side with an 8–26 die.

As the test results show, the device performs exceedingly well in the criteria originally set out by this team:

1. It is stable and easy to control through the complete cycle of motion.
2. It is effective at guiding patients of any size through a nearly complete range of motion.
3. It is comfortable, secure, and intuitive to use, as reported by each subject.
4. Its system of adjustable resistance is effective.
5. It is light enough to easily carry.

Recommendations
Four key design changes would greatly improve the functionality and comfort of the device:

1. A waist strap should be added at the seat of the device, so that the patient’s hip is more secure throughout the use of the device and the motion of the patient’s leg is more regular.
2. The geometry of the device at the patient’s thigh should be widened, so as to comfortably accommodate patients of various proportions.
3. The position of the air cylinders should be slightly shifted, as the current location is too close to the medial thigh.

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