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Orthosis for Impoverished Polio Patients



ISD

International Senior Design (ISD) is a program that began in 2000 taking students to Bolivia and Dominican Republic. Traditionally, ISD involved Civil and Environmental engineering students pursuing canal designs and waste water treatments. This year, Pathway Engineering proudly expands ISD into the Biomedical Engineering program. While in Santa Cruz, Bolivia, Pathway partnered with a local orthotist and a community called Asociacion Casa del Impedidio (ACI), meaning House of the Disabled. Together, they embarked on a journey to develop an orthosis (leg brace) that will aid community members suffering from partial paralysis.

Background

ACI is located in an impoverished area of Santa Cruz. The members of ACI receive no financial or medical aid from the local or federal Bolivian government. Due to discrimination against disabilities, many lack jobs. Satisfying basic needs, such as food and housing, is a struggle. Approximately, sixty percent of ACI members suffer from Paralytic Polio. Polio has been eradicated from Bolivia. However, partial paralysis is still an issue for Polio victims. Medical devices like, wheelchairs, crutches, and orthoses are used to aid this disability. The residents of ACI cannot afford medical devices, and anything they use to aid their disability is either hand made or donated.

Design Considerations

Considering the objectives gathered at ACI and interviews with orthosis users in Bolivia and the US, Pathway's design will consider the following items:

- ❖ Availability of materials to members of ACI
- ❖ Cost of materials in Bolivia
- ❖ Methods needed to produce brace
- ❖ Time needed for putting orthosis on
- ❖ Variability of knee-joint locking positions
- ❖ Adjustability of orthosis (weight gain/loss)
- ❖ Weight of orthosis (user energy consumption)

Design Options

Metal	Advantages	Disadvantages
Titanium	Lightest weight	Most expensive, not available
Steel	Least expensive, available	Heaviest
Aluminum	Light weight, available	Fairly expensive

Straps	Advantages	Disadvantages
Velcro	Most adjustable	Most expensive
Leather	Least expensive	Not as adjustable

Knee-Joint	Advantages	Disadvantages
Ratchet	Wide range of locking positions	Unfamiliar building procedure
Standard	Common building procedure	One locking position

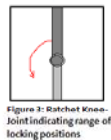


Figure 3: Ratchet Knee-Joint indicating range of locking positions

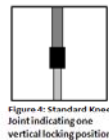


Figure 4: Standard Knee-Joint indicating one vertical locking position



Recommendations

Pathway recommends: An orthosis with a ratcheting knee joint, 3 aluminum and 1 steel supports, and leather straps.

- ❖ Ratchet Knee-Joint: ratchets offer a range of locking positions, which will encourage a more normal gait. The time needed to put on the orthosis with a ratchet is much less than a straight locking orthosis.
- ❖ Aluminum/Steel: aluminum may be slightly more expensive than steel, but it is lighter, resulting in more energy efficient orthosis. Aluminum is also easier to machine. There is one steel portion to accommodate for the steel ratchet weld.
- ❖ Leather: leather is more common, less expensive, and will last longer in Bolivia.

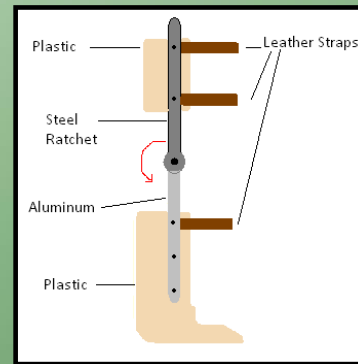


Figure 5: Anterior side view of recommended orthosis design

Cost Analysis

Producer	US (\$)
US	1900
Bolivia	300
Pathway	60

Figure 6: Cost comparison for one orthosis in US dollars

Pathway	US (\$)
Box Ratchet	15
Steel	2
Aluminum	9
Leather Belts	8
Rivets	6
Copolymer	10
Plaster	10
Total	60

Figure 7: Breakdown of Pathway orthosis cost

The prices listed in figure 6 for US and Bolivia have been reported by professional orthotists; cost includes labor. Pathway's reported cost is based on materials used.

Problem Statement

There is a significant need for an affordable orthosis design, because sixty percent of ACI members suffer from partial paralysis due to polio. They need a low cost orthosis that can be rigid at different knee angles to allow for easier mobility on the uneven Bolivian terrain. Pathway has developed an orthosis design, manufacturing procedure, and a prototype that can be implemented by the members of ACI. Therefore, the orthosis is designed using common methods and materials that can be found at local Bolivian markets or from household objects. There is a minimal cost constraint; therefore, the orthosis is designed at minimal cost to the potential user.