EXOSKELETON SPRING ASSISTED SUPPORT FOR LABOURS AND ARTHRITIS PATIENTS

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ABSTRACT

The labours working in production industry, restaurants, assembly work they will get tired after couple of hours. Standing for many hours causes muscular pain and leads to increase the body stress. As like this, the people suffering from the knee disorders such as "Arthritis" have to sit where they needed. For that reason concept of comfortable support is introduced.

In previous researches for this concept pneumatic support and hydraulic system were used. In this project we are replacing pneumatic support and hydraulic system by spring support and mechanical linkages; such that it will reduce the cost and weight of the support.

This support will help to increase the human health and comfort. It will allow the patients of "Arthritis" to sit and get up easily. We will also work to make it economical.

KEYWORDS-Arthritis, knee disorders ,Production industry

1.INTRODUCTION

In manufacturing companies keeping employee healthy is major issue and it is challenging [3]. For the workers standing for hours causes a lot of distress to lower limb [4]. It causes fatigue to the worker and affecting in the production rate and quality. But the concept of compatible chair gives the solution for these types of problems.

In recent researches Cyril Varghese (2016) invented the exoskeleton based hydraulic support system. In which hydraulic cylinder is used to give support [1].

After that, in 2017 Prof. Amit Bhagat and et.al designed and manufactured the wearable pneumatic chair. In this pneumatic cylinders are used for smooth suspension which makes comfort to the human [3].

In current scenario, there are various types of supports are available in the market. In that, hydraulic system and pneumatic support are used to support the human body weight [1][3].

The aim of our project is to reduce the cost and weight of this "Exoskeleton spring assisted support for labours and Arthritis patients" which will be economical for all the people. It will also help to the reduce the knee disorders.

2.METHODOLOGY

Methodology of this work is concentrated on the development of chairless chair to support human body part which is a wearabledevice especially industrial workers need to stand for a long time around 10-12hrs per day[2]. The device consists a frame tohugs the back of the workers leg and it has a belt to avoid slip. Workers can stand and walk like normal, but when they want to sit pushing a button locks the frame into place at the desired angle. So the weight of the body is transferred through the frame to
the floor or the heels.

Six lower limb parameters namely, thigh length (*TL*), lowerleg length (*LLL*), leg length (*LL*), foot height (*FH*), foot breadth (*FB*) and foot length (*FL*) were measured. According to the procedure described by the 'International Biological Program' [14], measurements from the left side of the body tend to be more reliable than the right side [13]. Hence, the measurements in this study were taken from the left lower limbs. Measurements were performed by two investigators, and average values were taken. The measurements were taken in centimeters (*cm*), and were measured to two decimal places.

A. Landmarks and Techniques Used in Taking Anthropometric Measurements

• *Height-Vertex (Stature):*

Stature of the body was measured from the vertex with the head in 'Frankfort horizontal plane' to the heel with the body in supine position.

• *Vertex:*

It is the highest point on the head when the head is in supine position ('Frankfort plane').

• *Instrument:*

Long ruler

• *Technique:*

The body was lying supine, and measurement was taken when the body was fully unclothed. The ruler was held on the table, and measurement was taken from the vertex to heel in that position.

B. Thigh Length (TL)

It is the distance from the midpoint of inguinal line to inferior border of patellar. Surface thigh length has been shown to provide the highest correlation with stature.

• *Instrument:*

Measuring tape.

• *Technique:* The body was lying supine, and measurement was taken by using a measuring tape. The midpoint of groin was held with the measuring tape by the right hand, and movement of the tape was controlled to extend to the inferior border of patella, in oblique plane with regard to
length. No pressure was made on the body surface to reduce possible error in contact measurements.

C.Lower Leg Length (LLL)

It was measured from the lateral knee joint to the heel.

• *Instrument*:

Measuring tape.

• *Technique:*

The measurement was taken from the lateralknee joint by the right hand, and movement of the tape was controlled to extend to the heel.

D.Leg Length (LL):

It is the distance from the lateral knee joint to lower border of lateral malleolus.

• *Instrument*:

Measuring tape.

• *Technique*:

The measurement was taken from the lateral knee joint by the right hand, and movement of the tape was controlled to extend to the lateral malleolus.

E. Foot Height (FH):

It is the difference between *LLL* and *LL*.

F. Foot Breadth (FB):

It is the distance between the distal first metatarsal, the prominence of the medial side of foot, and distal fifth metatarsal, the prominence of lateral side of foot.

• *Instrument:*

Metal sliding calipers.

• *Technique:*

The left foot was held with the heel resting backward, and measurement was taken across the dorsumof foot between the two prominences of side of foot, as in
preceding measurement, in oblique plane with regard to length.

G.Foot Length (FL):

It is the distance from the most prominent part of the heel to the distal part of the longest toe (second or first).

• *Instrument:*
Measuring tape.
• *Technique:*
The measurement was taken across the dorsum of foot between the two prominences of foot as in preceding measurements, in vertical plane with regard to length. In this study, a statistical package (*SPSS* for windows, Version 20.0) was used to analyze the results [15]. The sample size for human samples was sufficient by using the statistical power calculations [16]. The dependent parameters in the samples were represented by six lower limb parameters.
The regressions were produced based on various combinations of the parameters by stepwise regression analysis.

3.MODELING PROCEDURE

Here the two link simple mechanism is used. Based on the Anthropometric study [5] the link lengths of the lower limb are derived. Using the standard design procedure the link dimensions are derived. As per dimensions it is modeled in the SOLIDWORKS modeling software. All the parts are modeled using part model module**.**

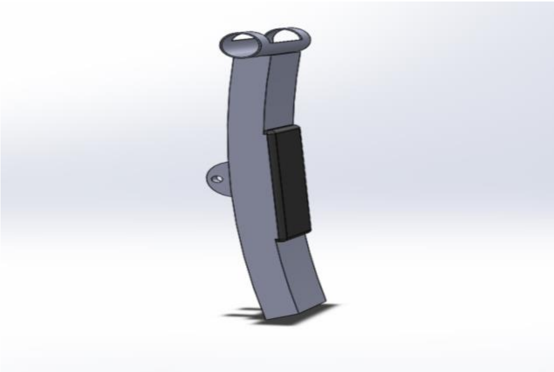

Fig. Lower Limb

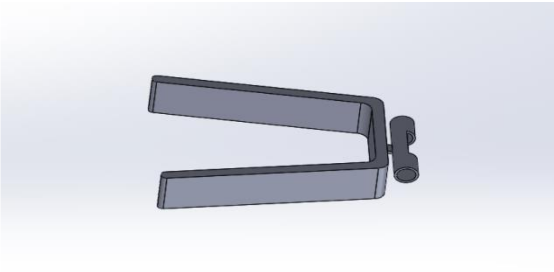

Fig. Heel Support

Fig. Upper Limb

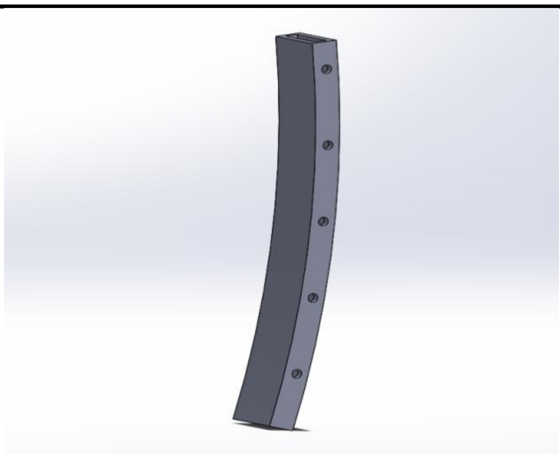

Fig. Extender

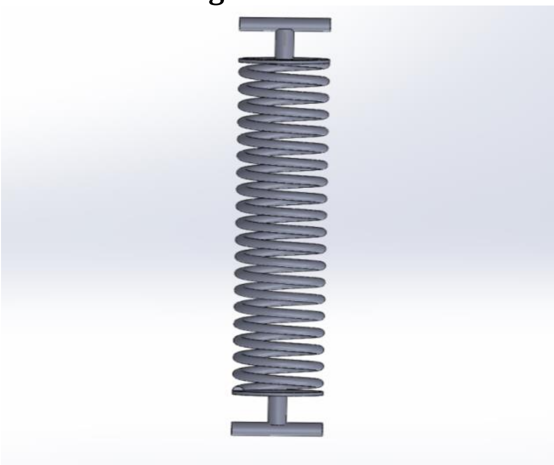

Fig. Spring

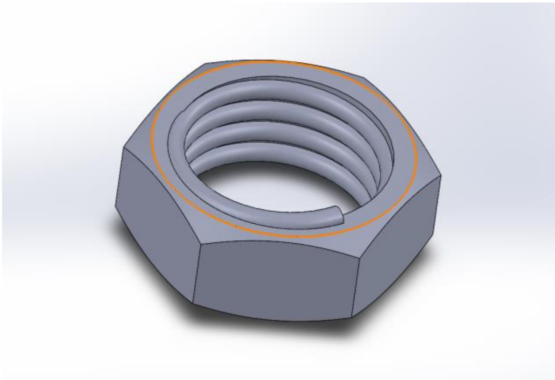

Fig. Nut

Fig. Bolt

The working of this project will be as follows:
1. Firstly procurement of a leather safety shoe for which we will make a frame, which will hold the shoe (shoe holder) is done. The shoe holder is fixed to the heel of the shoe.
2. Now a small round sphere which is pivoted to shoe holder to support from ground level.
3. Here we will use two inter locked springs which are enclosed in the bellows. The stiffness of the spring depends upon the weight of user. In that, small spring will work for the low weight body and large spring will work for the high weight body.
4. Now, a leg holder is made which will hold the thigh and is made by taking 2mm MS sheet bended to the shape of thighs.
5. Two nylon laces are fixed to the thigh holder with the help of pop rivet so that it can hold the leg.
6. The leg holder is pivoted to half roundedholder and holder is fixed to spring [1].

4. ADVANTAGES

- Adjustable height as we want.
- Reduces human efforts and tired free work.
- Easy to operate and wear.
- No frequent maintenance and service.
- High efficiency and increases in production rate
- Can used for seating and lifting

5.APPLICATIONS

The Labours working in a production industry can apply this on their daily job as it can reduce the body stress which increases muscular pain. As well as this is also applicable for the knee disorders like "Arthritis", it can help the patients suffering from the Arthritis to sit anywhere and also to stand without any body or knee pain.

6.CONCLUSION

The exoskeleton spring assisted support system can be fabricated and tested with minimum cost and weight. The result can be expected as the spring will be able to hold up the maximum human body weight. The construction will be compact. In other words, we will be able to provide a better system because it will comfortable and will be able to keep away the people from muscular pain and give the comfort to the workers in the production line and Arthritis patient.

Fig. Final Assembly of Exoskeleton Spring Assisted support

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