18th International Conference
ENGINEERING MECHANICS 2012
Svratka, Czech Republic, May 14 – 17, 2012

pp. 268–269
Paper #33

MECHANICAL DESIGN OF THE ACTIVE ORTHOSIS

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Abstract: *The paper proposes the design of mechanical components of the device for fully automated rehabilitation of elbow post intra-articular fractures further refered as the active orthosis. Motorized orthoses, which are at present used in physiotherapy, are mostly static and sturdy devices usually fixed with the chair. Active orthosis is (beside more efficient treatment) lighter, more comfortable and easier to handle with, which put specific requirements for its mechanical construction.*

Keywords: ***active, orthosis, rehabilitation, medical aid***

1. Introduction

Rehabilitation of human joints post intra-articular fractures is contemporary realized mostly with assistance of qualified physiotherapists providing full service during the whole process. Utilization of auxiliary electromechanical devices as motorized laths (Homma K., 1997) is ineffective primarily for their limited functions caused by the passive character of the joint movement realization and necessity of the professional personnel attendance. These devices are complex and robust, which makes them stationery therefore bonded to the medical area. The active orthosis is electromechanical device which main advantages are portability and more important active response on patient muscular activity providing assisted movement of the upper limb. Requirements for moderate dimensions, low weight and powerful technical solution make the mechanical design of the device complex task further described in this paper.

2. Mechanical design

The final form of the mechanical design results especially from the requirement on portability which follows demands on low weight and moderate dimensions. The basic concept consist of the frame, mechanical rotational joint supporting the movement of the elbow, actuator and the fastening belts for fixing to the arm. The mechanical design overview is to be seen on figure 1.

The active orthosis provides assisted movement of the upper limb fixed in the fastening elements. The device is able to react on patient muscular activity through tensometric gauge (see picture 1). This sensor is part of the frame and it measures patient's effort to move the injured elbow. Based on this information the actuator helps to move the orthosis through mechanical joint in desired direction and range with according sensitivity.

Action forces in the upper limb were measured by unique device (Zezula M., 2009) which is able to record behavior of forces depending on actual angle of the elbow. Measuring was executed to gain maximal torque which is possible to achieve in human elbow. Obtained values have only informative character considering the various results from each measured person. Actual torque providing by the orthosis will be overdesigned to fit the biggest possible group of patients.

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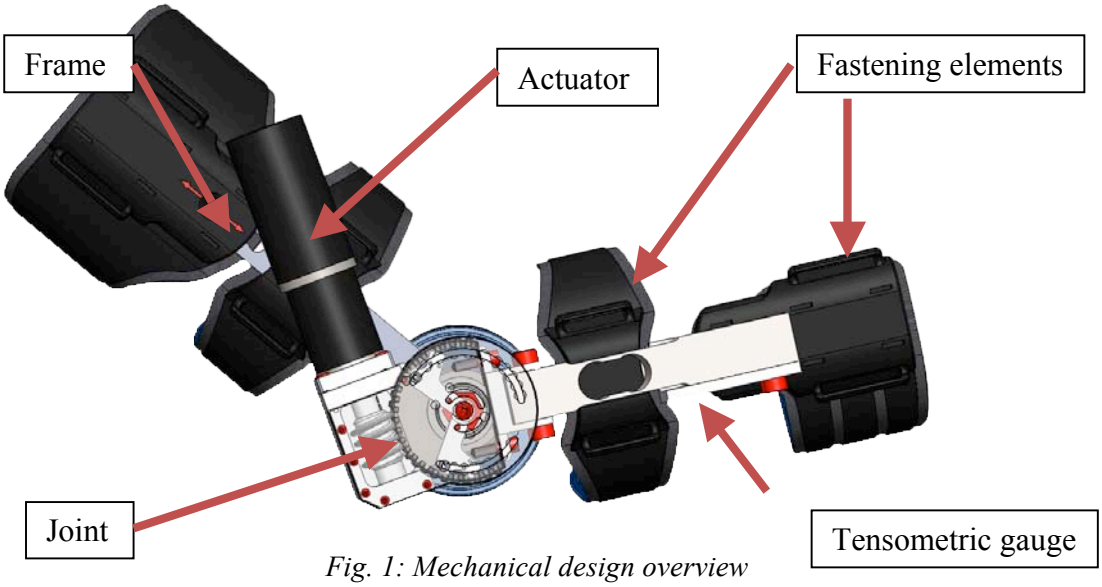

Fig. 1: Mechanical design overview

3. Conclusions

This paper describes mechanical design of unique medical equipment designated for rehabilitation purposes. Active orthosis is easily portable and compact device allowing fully assisted movement of the upper limb on qualitatively higher level than contemporary rehabilitation aids. Using tensometric gauge as the sensor of patients effort to move the arm it allows sensitive and effective treatment of intra-articular fractures.

The mechanical design fulfills requirement for low weight and moderate dimensions making the device easy to transfer and to manipulate with. The main parameters of the orthosis are in table 1.

Tab. 1: Basic parameters

Basic parameters	
Main dimensions	420x130x120mm
Weight	2,2
Voltage	24V
Actuator	DC motor Maxon RE 32 70W
Sensor	Tensometric gauge PW6KRC3
Maximal torque	50Nm
Operation range	100°
Rotation velocity	3rpm

Acknowledgement

Published results were acquired with the support of project FSI-S-11-15 "Design, testing and implementation of control algorithms with use of nonlinear models of mechatronics systems"

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