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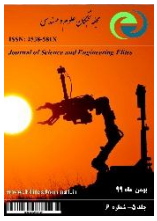

Study of Elbow Flexion Orthosis with Design and Thermal Analysis

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Abstract

Nowadays, the importance of orthosis has increased to people of different ages due to the type of activity and the increase in activity of musculoskeletal disorders and stimulation of the elbow, such as elbows, in order to prevent and cure diseases including The range of motion of various parts including the elbow, such as the elbow, is of interest, where the orthosis is designed in the Solidworks software. The purpose of this orthosis construction is to assist normal elbow movements by using elastic structures such as springs with a lock-like structure, orthopedic designs that can perform flexion at various angles. By releasing any of the screws in the articulation, it can extend it further into the flexion or allow the articulation to return to the full extension. Repeating this operation, the individual is in the process of recovery. In this study, the types of elbow orthosis are examined. At the end, the frequency and thermal analysis is investigated and the results are reported.

Keywords: Elbow orthosis, Solid work software, Thermo-plastics, Aluminum, Thermal & force frequencies.

1- Introduction

1-1-Types of orthosis

Orthosis is an external device used in the rehabilitation of patients with neurological, skeletal and muscular disorders. The word orthosis is derived from the Greek concept of straightening. An orthopedic device is an orthopedic device used to support, correct, prevent or correct part of the body or to improve the function of moving parts of the body. Some of the other common words that refer to specific artisanal designs includes to crest, compression and armband [1]. Orthosis are auxiliary devices that are used to restore a person's lost abilities, in other words, orthosis refers to all auxiliary devices that are designed to prevent and correct malformations or to maintain and fix different parts of the body in parallel. The organs are used.

2- Ideal orthosis

From the point of view of the patient using orthosis, two important success factors of orthosis include comfort and the extent to which the device is in line with the needs and goals of the patient. [2] Hard and overwhelming will remain unusable. An ideal orthosis only controls abnormal or undesirable movements and allows movement when normal [3]. Patients in need of orthosis, if the orthosis is well-fitted and fit to the body area, maintaining good suspension, resistant to environmental factors) repetitive loading, severe cold and heat, sweating other body fluids (and reliable to perform tasks) Design of orthosis should be based on a detailed biomechanical analysis of the person that wants to use the device, after selecting the appropriate components and design features. Its use is more convenient as well as easy to wear, remove, clean and maintain [4]. People who wear orthosis often want their workouts to be well-dressed so that they can be worn with handicaps and not overly noticeable [5]. The word cost can be used to refer to either of the two concepts of energy consumption or economic cost of the device. In the term energy consumption, although orthosis will allow the wearer to perform decent performance, the energy consumption must be specified. If the use of orthosis generates too much energy, the wearer often decides not to use it [6]. The monetary cost of an orthosis is determined by the materials used and the time and skill required to measure, construct and fit the orthosis [7].

3- Elbow Orthotic

3-1- Static orthotic elbow

Properties that are manned in place of high-speed software can be upgraded and remotely operated. They are, on the one hand, and apart from their type of structure, they serve as a mechanism for maximizing their content. They should be exacerbated by the overwhelming and intensifying forces operating in the army, which are under the influence of the black and white. Therapeutic exercise should be directed at us without having to remove anaphylactic wounds, without any form of scarring, and without it. Orthotic static elbows to reduce structure soft tissue around the elbow and functional limitations are used to develop this orthosis can be after an injury or surgery are used if Structure flexion of the elbow, the beginning and problems with the increase in muscle It is most commonly used in mites with C51 spinal cord injury. In 2006, Serap Alsancak et al. described a single elbow orthosis in the department of Prosthetics and Orthoses of Ankara University as a custom structural orthosis to improve elbow extension. Five children with post-traumatic elbow flexion contraction were treated using progressive static elbow orthosis. None of the patients received any physical therapy or surgery for flexion contraction. The findings show that elbow orthosis is a safe and effective treatment for children with flexion elbow contraction [22].

3-2- Dynamic orthotic elbow

These types of elbow flexion orthosis are used to drive axial loads in the canal. Their long-term, place, plans and hours should be met by the application of the work periodically and made of durable materials and materials in their premises. For help to elbow flexion, there is a special addition to the mechanic and a strong point in the structure. Those looking for brachial plexus injury, birth defects are only at the elbow problem, with the help of suitable candidates for use of the elbow flexion orthosis are considered [9,10]. In 2011, B. Dimitriu designed and presented a dynamic orthotic device. His research is an inexpensive and modular device that can be used in a large recovery area for various human joints: knee, shoulder or ankle. The lower production cost than the devices currently on the market makes this device the best choice for burn injury. Better results can be obtained in the recovery of trauma in orthopedics using a double system, internal-lateral, connected to ankle orthoses or knee orthoses[23].

[1] The cervical (or C5) nerve goes to the deltoid muscles and then (biceps) for motor and skin function on the shoulder and upstream for sensory function [8].

4- Design steps and analysis

First, the orthosis is designed according to the shape. Then, using auxiliary software, the outline is prepared. In this orthosis, aluminum with mechanical properties is used in Table 1.

Table 1- Mechanical Properties of Aluminum and Thermal properties [11,12&13]

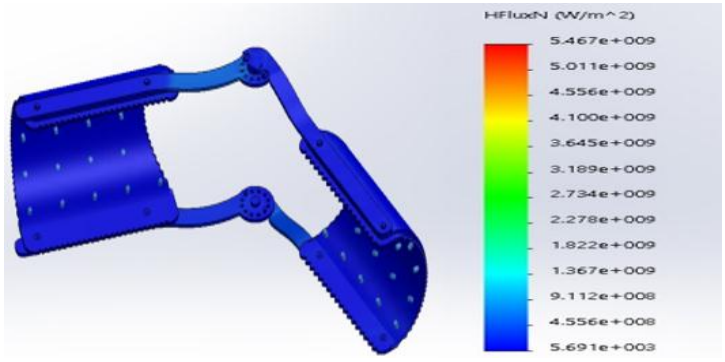
property	Value, units
Poisson's Ratio	0.33
Tensile streng	124–290 MPa
Shear Modulus	2.6e+010 N/m^2
Mass Density	2.70 g/cm^3
Yield Streng	55148500 N/m^2
Elastic Modulus	6.9e+010 N/m^2
Melting temperature	585 °C
Thermal conductivity	151–202 W/(m·K)
Spacifc heat	897 J/(kg·K)

5- Result

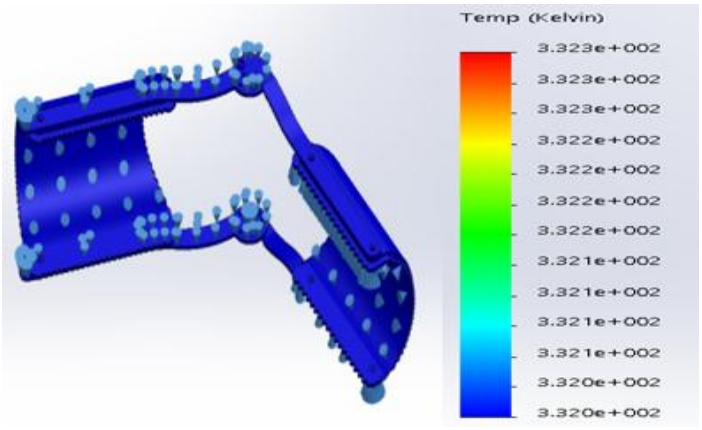
After Zinkovich et al. in 1965 stated that the finite element method could be used in many field problems such as heat transfer, fluids, etc., a new discussion of the application of this method opened up. The geometric complexity, the complex behavior of the material, the boundary conditions, as well as the various loads on the problems, have made the reality of achieving the exact solution very difficult. Using approximate solutions with acceptable accuracy that can be achieved in a limited and specific time is a huge opening in solving these problems [24-25].

Thermoplastic sheets are used to hold the hand in the desired shape. These sheets are molded to fit the orthogonal molds, depending on their properties, after they are easily warmed. [14] After considering the above with respect to the properties of the materials shown in Table 1, orthosis had been studied in terms of heat transfer, conduction and radiation. The temperature distribution of orthosis has also been studied, fig1. Use of appropriate materials that can protect one against heat is one of the most effective factors [15]. Excessive exposure can lead to conditions such as hot flashes that indicate the importance of appropriate substances [16]. Other effects include fatigue and adverse effects; such as changes in cognitive functions proportional to heat stress [17]. In some cases, laser treatments are tailored to the individual's needs and increase blood flow, increasing the importance of heat of the orthosis [18]. Rehabilitation equipment uses various types of rehabilitation equipment. Some cases include pneumatic or hydraulic systems in addition to drilling, weights, etc. Given this, we should use a system that minimizes damage to the individual and their tissues [19]. The orthotic joints are used to make this orthosis.

The movement towards the orthosis is one of the important factors that can affect the ligament and other muscular tissues. Therefore, the tensile and compressive force created by the hand is very important given the structure of the hand [20]. Depending on the cases examined, it should have sufficient orthosis strength and durability. In addition to resistance, it can accomplish rehabilitative goals. According to the above, the orthosis has been studied in terms of force, twisting and deformation [21], and the results of its frequency analysis have been obtained, Fig2. After analyzing the results of the analysis it was found that if the force is applied to the orthosis, it will cause less damage to the orthosis.



A. Temperature (kelvin).



B. Resultant heat flux (w/m^2).

Figure 1- Thermal analysis

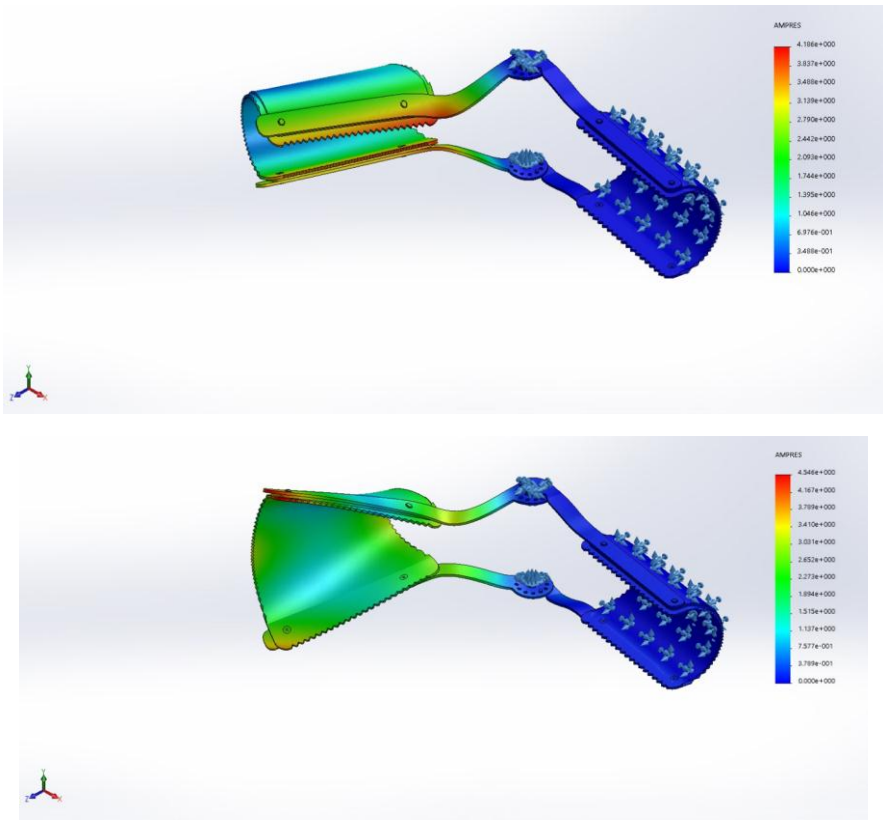


Figure 2- Frequency analysis

Table 2- Frequency check in less than one minute

Frequency Number	Rad/sec	Hertz	Seconds
1	430.59	68.53	0.014592
2	577.07	91.843	0.010888
3	1401.7	223.09	0.0044825
4	3107.7	494.6	0.0020218
5	5021.4	799.18	0.0012513

After comparing the results, it is important to note that one of the most important things to do for orthoses is heat transfer and heat dissipation in the patient, which can be done using a layer of foam. It easily reduced this heat and prevented the patient from getting confused and reduced sweating. The use of materials that are similar in thermal properties to the skin can help the patient and the client.

The use of strong and light materials according to the obtained analysis can help in the use of orthoses for a long time. Therefore, the use of appropriate materials with appropriate thermal properties helps the patient. So the use of materials considered it can be a good option for orthoses.

6-Conclusion

The elbow flexion orthosis is designed to help normal elbow movements and uses elastic structures such as springs to make the joints easier about flexion and extension with changes in the joints. Also, by releasing any available screws, which are of sufficient strength and lightweight, are used. instead of locks, the joint can extend it with greater flexion range or allow the joint to extend. Complete with the individual recovering. Depending on the orthosis and the patient as the orthosis uses lightweight materials such as thermo-plastic and aluminum, so it is more capable and will not be deformed to the extent that the patient uses it unless the applied force is in a direction other than the orthotic motion.

7- Suggestions for future research

Considering the sports and rehabilitation needs, the study of the interaction between skin and orthosis is one of the most important things that is very important in daily life and these thermal effects can be examined in terms of molecular dynamics. Also, the study of lighter and more efficient materials in Rehabilitation is one of the things that can be examined. Due to the damage that orthoses are used in, it can be examined simultaneously from a software point of view and give a more accurate view to the therapist in improving and making a newer orthosis and help to the patient to treat more.

8- Nomenclature

c_p specific heat capacity

k thermal conductivity

x axis along the horizontal direction

y axis along the vertical direction

k Kelvin Temperature Unit

m Meter, unit length

g unit length

Hz Frequency Unit

W Watts

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