

## **Rehabilitation devices for the treatment of motor disability: a necessity in Mexico**

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### **Abstract**

*Muscle atrophy generates a negative impact on people's functionality and quality of life. Current forms of treatment involve the adaptation of specialized spaces and supervisory personnel, causing high costs for the user, which in addition to being a time-consuming and tiring process for the assistant. The present work aims to update the way of treating muscle atrophy through a device that integrates two of the main types of treatment, thus reducing costs for both the user and the service provider, in addition to making the process more efficient and with fewer staff, offering the option of receiving treatment at home.*

**Keywords:** Rehabilitation devices, ankyloses, Muscle atrophy.

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### **I. INTRODUCTION**

Currently, at the height of technological development that facilitates the human activities of all individuals where solutions are given to different problems in the field of health, however, it is still not possible to cover 100% of each of the existing adversities, thus reaching create different needs in the care of diseases that cause deficiencies or disabilities, all people are different and diverse, everyone needs special attention that allows them to lead a "normal" life in all areas: family, social, work. The objective is to give meaning to life for people who find themselves in these conditions, improving their quality of life and that of their families.

Society must be sensitive to the problem of the aforementioned deficiency, which is why providing a comprehensive solution that contributes to integration and a better quality of life will promote the capacity for interaction of people who find themselves in this situation with their environment and the other people.

Correct treatment of these diversities, from a social and psychological point of view, promotes respect, reintegration and care for people who have some type of illness like this, contributing to driving the different variables that cause the differences to be positive or negative. . There are various treatments that attempt to reduce the secondary consequences caused by muscle atrophy, such as physical therapies, medications and the support materials used. These types of interventions seek to minimize the effects of muscle atrophy at a molecular level. The treatment of muscle atrophy caused by any of its variants can result in high costs, since physiotherapy sessions and hiring an expert increase the cost of the treatment; The use of different tools that minimize side effects are not always available, forcing the patient and/or family to travel.

One of the treatment options can be controlled through the stimulation pathway to increase muscle mass. This pathway is achieved with anaerobic exercises, which tend to inhibit muscle degradation pathways. Rehabilitation for muscle atrophy includes electrical stimulation where the muscles are stimulated through small electrical discharges (Zhang, 2006).

The search for a comprehensive solution based on the manufacture of a mechatronic device that manages to reduce costs in improving health and increasing the quality of life of patients with muscular atrophy brings with it the need to engineer a technological solution that responds to This question. Current forms of treatment involve the adaptation of specialized spaces and supervisory personnel, causing high costs for the user. In addition to being a time-consuming and tiring process for the assistant.

### **II. BACKGROUND**

In recent years, the disabled population is a group that has attracted the attention of universities, private institutions and non-governmental organizations from various perspectives. Disability not only affects the person with physical limitations in carrying out their activities, they also show a psychological maladjustment, a limitation in their socio-economic, educational and cultural development (Nordin & Frankel, 2001). In Mexico, according to statistics from the National Population and Housing Census provided by the National Institute of

Statistics, Geography and Informatics (INEGI), there are more than two million people who have a disability, that is, it represents 2.31% of the national population, with motor disability being the most representative above hearing and visual disability (Sandoval et al., 2017).

In daily life, human beings are exposed to injuries to the different joints of the body. The above is due to natural wear and tear due to age, accidents or injuries due to sports activities; this can cause different types of disabilities or atrophy (López et al., 2014). The knees are not exempt from this, regardless of the type of injury present in this joint, the deformation and limitation in its movement are evident according to Bouri et al., (2001), making physiotherapy and rehabilitation treatments necessary. For these treatments, different elements can be used such as prostheses, wheelchairs, crutches, orthoses, exoskeletons that help overcome the limitation at certain levels, which include reducing pain, normalizing mobility, increasing muscles, etc.; and in this way improve the quality of life of the human being who presents them.

It is known that 24% of the injuries suffered by athletes are generated around the lower extremities (Bouri et al., 2001). In some cases, only rehabilitation treatments are applied, but if the injury is more severe, it requires treatment of surgical intervention. After any trauma surgery, it is essential to start a rehabilitation program that guarantees its success through controlled exercise of the muscles, which allows, first, to recover muscle strength, which is basically the muscle's ability to contract and Second, recover endurance, which is the ability to perform the same movement repeatedly.

Most of these processes are carried out manually by the physiotherapist, who cannot acquire exact data on how much tension the muscles require at that moment (Hoppenfeld, S. and V. L. Murthy, 2001). In correspondence with the above, it can be stated that knee rehabilitation entails, in many cases, difficult physical work therapies that do not always produce adequate recovery.

## **2.1 Types of disabilities**

Disability is a restriction or impediment in the ability to perform an activity, under the parameter of what is "normal" (referring to normal as the "majority") for a human being. It is a consequence or situation, with different causal factors, therefore, different types of disability (AH, 2003).

In general, the population perceives disability as a permanent condition. However, there are temporary disabilities and permanent disabilities. For example, breaking your arm or losing vision due to exposure of your eyes to a harmful chemical agent can cause temporary disability. This makes us think that any of us or those close to us were at some point disabled, but we probably do not perceive it that way. On the other hand, there are also levels of disability: mild, moderate or severe (De Andrés, 1997).

## **2.2 Motor disability**

To begin with the topic of motor disability, it is important to understand the function of the nervous system, because motor disability involves the brain functions that send information to the body through the nerves, about how to move and why the appropriate interpretation of the sensations that come to him. The brain fulfills three main functions:

**Sensitive** The brain is capable of feeling certain changes or stimuli inside the organism, that is, the internal environment; also outside of it, that is, the external environment.

**Integrative.** Sensitive information is analyzed, some aspects are stored and decisions are made about the behavior to follow.

**Motorboat.** It is the response that the brain organizes from stimuli; for example, muscle contractions, movements or glandular secretions such as salivation when seeing food. The nervous system is made up of:

Motor disability constitutes an alteration in the ability to move that affects, at different levels, the functions of movement, manipulation or breathing, and that limits the person in their personal and social development.

It occurs when there is an alteration in muscles, bones or joints, or when there is damage to the brain that affects the motor area and prevents the person from moving properly or performing fine movements with precision (De Andrés, 1997).

Motor disability is classified into the following disorders:

**Peripheral physical disorders.** They affect bones, joints, limbs and muscles. They occur from birth (for example, some bone malformations), or they are consequences of diseases in childhood (such as bone and joint tuberculosis). Some accidents or injuries to the back damage the spinal cord and interrupt communication from the extremities (arms and legs) to the brain and vice versa.

**Neurological disorders.** They mean damage originating in the area of the brain (cerebral motor cortex) responsible for processing and sending movement information to the rest of the body. It causes difficulties in movement, and in the use, sensations and control of certain parts of the body. The most common are cerebral palsy, head trauma, and tumors located in the brain.

### **2.3 Disability worldwide.**

It is estimated that more than one billion people live with some type of disability; that is, around 15% of the world population (according to estimates of the world population in 2010). This figure is higher than the World Health Organization's previous estimates for the 1970s, which were approximately 10%. According to the World Health Survey, nearly 785 million people (15.6%) aged 15 years and older live with a disability, while the Global Burden of Disease project estimates a figure close to 975 million (19, 4%).

The World Health Survey indicates that, of the estimated total of people with disabilities, 110 million (2.2%) have very significant difficulties in functioning, while the Global Burden of Morbidity figures at 190 million (3.8%) people with a "severe disability" (the equivalent of disability associated with conditions such as tetraplegia, major depression or blindness). The Global Burden of Disease alone measures childhood disabilities (0-14 years), with an estimated 95 million children (5.1%), 13 million of whom (0.7%) have "severe disabilities."

### **2.4 Disability panorama in Mexico.**

In 2014, according to the results of the National Demographic Dynamics Survey, there are nearly 120 million disabled people in Mexico. Of them, almost 7.2 million report having great difficulty or not being able to do any of the basic activities for which they are being investigated (people with disabilities), around 15.9 million have mild or moderate difficulties in carrying out the same activities (people with limitations) and 96.6 million people indicate that they have no difficulty carrying out these activities. This means that the prevalence of disability in Mexico for 2014 is 6 percent. For their part, people who are at greater risk of experiencing restrictions in their participation or limitations in their activities represent 13.2% of the population and those who do not live with a disability or limitation constitute the remaining 80.8%.

When examining the distribution by sex of these three population groups, it is seen that it is similar, although the proportion of women is slightly higher among the population with disabilities (53.5% compared to 52.7% of the population with limitations and 50.9% of the population without disabilities. or limitation). The age structure of the disabled population shows a greater concentration in older adults, which contrasts with those who do not live with this condition. The largest volumes of people are those under 20 years old. By sex, among the population with disabilities from 0 to 39 years old, the percentage of men exceeds that of women, but from the age of 45, the relationship is reversed, reaching the greatest differences from the age of 65; This situation may be related to the longer life expectancy of the female population and the greater risk of suffering from disability due to age.

### **2.5 Muscular atrophy**

The causes that cause muscle atrophy can be varied, whether due to the use of a segment due to inflammation, pain or immobilization; neurological diseases that cause the patient's motor performance to be limited; or secondary to chronic systemic diseases such as rheumatoid arthritis, diabetes, osteoarthritis and cancer (Jackman & Kandarian, 2004).

Muscle atrophy is a deficiency commonly found in patients seen by physical therapists in the clinical setting. Generalized muscle atrophy of considerable magnitude generates a negative impact on people's functionality and quality of life (A., 2002). Muscle atrophy is a medical term that refers to the decrease in muscle size, losing strength due to the relationship with its mass. It affects the nerve cells of the skeletal muscles, generating paralysis. Paralysis can be partial or complete and usually begins insidiously.

The cause of muscle atrophy can be varied, for example, restriction in the use of a segment due to pain, inflammation or immobilization; neurological diseases that limit the patient's motor performance; or secondary to chronic systemic diseases such as osteoarthritis, rheumatoid arthritis, diabetes and cancer (SC, 2004). The approach that the physiotherapist carries out on muscle atrophy is usually based on its identification and treatment, through intervention strategies that seek to minimize or reverse it, although the molecular mediators of muscle atrophy and the possible effects that at a molecular level can generate The treatment strategies used are not usually taken into account.

Muscle disuse is a common condition in situations of immobility, bed rest, sedentary lifestyle, aging, microgravity or chronic diseases (Powers, 2005) and for more than two centuries, prolonged immobilization of the patient has been used as a therapeutic measure in pathologies such as rheumatic fever, tuberculosis, congestive heart failure among others, without fully recognizing their potential deleterious effects (Harper, 1998). Disuse manifests itself with structural and functional alterations in skeletal muscle that include a decrease in protein content (synthesis/degradation imbalance), in the diameter of muscle fibers as well as a decrease in the capacity to generate tension and resistance to fatigue (Adams & Caiozzo, 2003). Although many physiological and clinical aspects associated with muscle disuse have been described, information regarding the molecular mechanisms involved is less frequent. This review describes those key molecules and signaling

pathways suggested to be responsible for disuse-induced muscle atrophy and the mechanisms related to the increase in protein degradation, as well as the decrease in protein synthesis.

Muscle atrophy opposes signaling pathways that induce muscle hypertrophy, or an increase in muscle size. Therefore, one of the ways that exercise induces an increase in muscle mass is to block pathways that have the opposite effect. Muscle atrophy can be controlled by stimulating pathways that induce muscle hypertrophy or an increase in muscle size or mass. One of the classic ways to increase muscle strength is with anaerobic exercises, which tends to inhibit muscle breakdown pathways.

An important tool in the rehabilitation of muscle atrophy includes the use of functional electrical stimulation to stimulate the muscles. It has been seen to have had great success in the rehabilitation of paraplegic patients (D.Zhang, *Functional Electrical Stimulation in Rehabilitation Engineering: A survey*, 2010). Since the absence of muscle-building amino acids can contribute to muscle breakdown, amino acid therapy may be useful in regenerating damaged or atrophied muscle tissue. Branched chain amino acids or BCAAs (leucine, isoleucine and valine) are critical in this process, in addition to lysine and other amino acids.

### III. CONCLUSION

In Mexico, according to statistics from the 2010 National Population and Housing Census provided by the National Institute of Statistics, Geography and Informatics (INEGI), there are more than two million people who have a disability, that is, it represents 2.31% of the national population, with motor disability being the most representative above hearing and visual disabilities.

In this same census it is mentioned that in Colima there are only 31 associations for the care of people with disabilities, of which only half offer physical rehabilitation therapy, due to the large population in Colima with this type of conditions, the centers do not have the capacity to necessary attention since muscle atrophy and ankylosis are a type of motor disability that are treated with physical rehabilitation techniques such as: muscle electrostimulation, passive mobilization or active mobilization. This is why the need arises to create a device that accelerates the rehabilitation process by doing it in an automated way.

The proposal for this rehabilitation and prevention device arises from the fusion of two therapies, both passive, electro-stimulation and passive physical therapy because they are the best-known forms of treatment for this type of ailment. On the other hand, according to a study carried out by the CESPO (Center for Social Studies and Public Opinion) more than half of the leading companies in medical and rehabilitation devices are North American companies and the remaining European companies, a study in which it does not appear. Mexico, placing it only as an importer, so the intervention of Mexicans in this sector is necessary.

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