RPNS: 2067 | ISSN: 1817-9088
Volumen 22 (2025)
N° 1 (enero - marzo)

Original Recibido: 22/08/2024 | Aceptado: 20/11/2024

Effect of strength work on muscles affected by hypodermic B burns in the shoulder girdle

Efecto del trabajo de fuerza en músculos afectados por quemaduras hipodérmicas B en la cintura escapular

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Abstract

The use of therapeutic physical exercise in the treatment and integral rehabilitation of the burned patient is a resource of outstanding value to get the capacity of movement back as part of the health care of this entity. The present study aims at identifying the influence of a system of physical exercises in the improvement of the strength of muscles affected by hypodermic B burns in the shoulder girdle. This proposal is determined from the study of a sample of 10 people with hypodermic B burns in the shoulder girdle, 6 women and 4 men, with an average age of 39.4 years (23 minimum and 59 maximum), the data collected in the medical records and the results of the initial and final explorations of the osteomyoarticular system were analyzed. The DeLorme-Watkins Method was applied with the intention of determining the evolution of muscle strength. At the end of the intervention, higher results were

recorded in each of the elements subjected to evaluation. The system of therapeutic exercises created supports shorter recovery times of the burned patient's strength.

Keywords: Burns; Physical therapy modalities; Burned patient; Therapeutic physical exercise; Muscle str

Resumen:

El empleo del ejercicio físico terapéutico en el tratamiento y la rehabilitación integral del paciente quemado es un recurso de extraordinario valor para lograr la recuperación del movimiento como parte de la atención de salud a esta entidad. El presente estudio tiene como objetivo identificar como influye un sistema de ejercicios físicos en la mejoría de la fuerza de los músculos afectados por quemaduras de hipodérmicas B en la cintura escapular. Esta propuesta se determina a través de una muestra de 10 personas con quemaduras hipodérmicas B en la cintura escapular: (6 mujeres y 4 hombres), un promedio de edad de 39.4 años (23 mínimo y 59 máximo), se analizaron los datos recogidos en las historias clínicas y los resultados de las exploraciones del sistema osteomioarticular iniciales y finales. Se aplicó el Método de DeLorme-Watkins con la intención de determinar la evolución de la fuerza muscular. Al final de la intervención se lograron registros superiores en cada uno de los elementos sometidos a evaluación. El sistema de ejercicios terapéuticos creados respalda mejores plazos de recuperación de la fuerza del paciente quemado.

Palabras clave: Quemaduras; Modalidades de Fisioterapia; Paciente quemado; Ejercicio físico terapéutico; Fuerza muscular.ength.

Introduction.

Burns occupy a particular place within the surgical injuries and diseases, which is due to the fact that, along with the local injury, general disorders that can affect all organ systems and functional cycles occur. This occurence definitely determines the evolution of the process entailed to the general and often

prolonged treatment in which local and general therapeutic exercises have equal importance; although in the different phases of the therapeutic evolution one or the other may predominate, the serious disorders make every burn become an important disease that today is still marked by a high level of mortality.

In the words of Xhardez (2018), the burn is "the effect of an aggression on the skin and underlying tissues according to two processes: Destructive, causing tissue necrosis and susceptibility to infection and Evolutionary, the severity may appear after several hours."

In the opinion of Dupin (2020), major burned patients have many consequences, both physically and psychologically, since burns lead to a loss of autonomy, and often to a restriction of the movements that the patients can make. In this sense, it is necessary for the professionals involved in the rehabilitation scheme of these patients to know the elements related to the recovery of the functional state of the muscles involved in it.

With regard to rehabilitation interventions for burned patients, several authors suggest that the preparatory phases of the exercises should have a duration of 5 to 10 minutes of warm-up (Eid, 2020; Grisbrook, 2017; Salmerón et al., 2019). Schouten et.al. 2019), in such sense are in agreement with the results proposed by the American College of Sports Medicine (ACSM, 2000), which recommends this duration because it facilitates the transition from resting periods to activity, increases blood flow, raises body temperature and favors the metabolic rate and activation of the energy source supply system. (Betancourt, 2017), (Soriano, Macías and Banqueris, 2023).

Likewise, studies have revealed the efficacy of muscle strength training programs in burned patients through isokinetic exercise, recommending a duration of between 8 and 12 weeks. Within this period of time, neural adaptations associated with improvements in motor learning, intramuscular synchronization, intermuscular coordination, increased nerve impulses transmitted to motor units and muscle function are generated (Jiang, 2017).

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It is worth highlighting that in the use of the term "rehabilitation", the idea is to restore to the highest possible level the physical, psychological and social adaptation functioning of people with special educational needs. It includes putting all possible means in place to reduce the impact of conditions that are disabling and enable the affected person to reach an optimal level of social integration. (Crespo, et.al, 2022).

Therefore when developing a rehabilitation program for burned patients, the therapist must always take into account the patient's general level of fitness, the type of injury or disease, the recovery phase after the injury and, most importantly, the desired functional outcomes, the best way being through the intervention of a multidisciplinary team, where each professional works to enable the patient to relearn how to reintegrate into their daily life (Crespo, et.al, 2022).

These findings are associated with interventions through eight-week training programs that produce an increase in dynamic strength without producing significant changes in muscle fiber, since during the first weeks of training neural adaptations originate that would allow changes in muscle protein and longer training sessions produce muscle hypertrophy (Soriano, Macias and Fonseca, 2023). It is worth mentioning that the duration variable among physical exercise programs focused on increasing muscle strength differs among authors due to the diversity in sample size, total body surface area affected, length of hospital stay, age, strength training approach and burn etiology (Leao and Duarte, 2022).

As a consequence of the elements analyzed above, the aim of this article is to identify the influence of a system of physical exercises on the improvement of the strength of muscles affected by hypodermic B burns in the shoulder girdle.

Population and sample.

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A pre-experimental study of minimal control, of correlational type, was carried out for a period of 90 days (January to April 2024), and it was conceived to implement 45 minutes of treatment twice a week. The universe was composed of patients with hypodermic burns B in the region of the scapular waist, admitted to the Plastic Surgery and Caumatology Service of the Clinical Surgical Teaching Hospital "Celia Sánchez Manduley" of Manzanillo, Granma and then followed by external consultation for the rehabilitation treatment. The sample comprised 10 patients (6 women and 4 men) with an average of 39.4 years old (23 minimum and 59 maximum) with hypodermic B burns in the region of the shoulder girdle, with affectation in the normal movement patterns of the joints affected by the lesions. All voluntary participants were asked for informed consent after being notified about the characteristics of the research, objectives, possible benefits, risks and alternative treatments in case of exclusion from the study and their right to participate or not and to withdraw their consent at any time without being exposed to limitations in their rehabilitation process.

Burned patients with lesions in other body areas, dermal complications of the lesions and with the need for future surgical events were excluded. The data collected in the medical records and the results of the initial and final explorations of the osteomyoarticular system were analyzed to evaluate the evolution of muscle strength using the DeLorme-Watkins Method (Leao and Duarte, 2022), applying increasing direct loads for muscle potentiation and verified by the progressive increase of expired weights.

In order to use the different modalities of proposed exercises that improve the functional state of the muscles of each patient studied, especially those that reveal a more effective result, it is important for the therapist to be aware of the main movements affected by the injuries and muscles to which the interventions are directed taking into account the severity of the same in the affected limbs and the characteristics of the muscular planes most damaged by the injuries in the areas included in the study in favor of a long-term follow-up of the functional, psychological and physical state, which is important for

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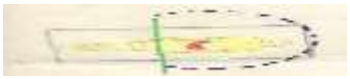
the daily life of this patient. For this purpose, easily performed exercises are provided, which will make it better for the therapist to direct the work with the patient.

For the development of muscular strength, simple exercises with and without implements are applied, which can be combined depending on the stage of treatment. The exercises without implements are performed by means of isometric contractions with the fundamental objectives of obtaining muscular activity when joint displacement is impossible, mobilizing the muscular elements that modify the muscular tone, stimulating the mechanic-receptor system of the joint cavity, thus delaying muscular atrophy. The actions performed with implements are shown in table 1, and are described theoretically and graphically to understand the performance methodology.

Table 1

Exercises with implements (canes weighing ½ -1, 2 and 2.5 kilograms) for increasing shoulder girdle muscle strength in burned patients.

Exercises with varied weight cane		
No	**Theoretical description**	**Graphic description**
1	Supine, raise arms outstretched to the floor.	
2	Standing, raise your arms up to bring them above your head.	
3	Supine, perform wide circles varying the distance of the hands on the cane.	
4	While standing, slide the baton along your back, lowering your arms at the same time without releasing it.	

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5	While standing, slide the baton behind your back while bending your arms.	
6	Standing, alternately extend your arms to one side and the other.	
7	Standing, the baton is held with one hand, perform circular movement with one hand, alternating the movement.	
8	Standing, with the cane held in one hand, make wide circles with it.	
9	Standing, perform number 8's with the tip of the cane held with both hands.	
10	Standing, extend and bend the elbows to describe circles behind the head.	

These exercises should be performed in intervals of time remaining a time of contraction by another of rest that will double the time of work. Those exercises may also be dosed by repetitions starting with 3 or 4 and gradually increasing between 1 and 2 to reach a number of 10 maximum. This type of exercise will be performed on both sides of the body, with emphasis on muscle groups damaged by injuries, with the aim of increasing the tone and strength, allowing you to perform more complex exercises. Its effectiveness should be in correspondence with the increase of tone and strength in areas subjected to immobilization that present risks of muscular atrophy and will be worked from different positions, but the most feasible are the sitting and standing positions, to enhance the patient's control of his body scheme, since assuming other positions results in unnecessary energy spending and loss of time in the treatments.

In relation to the intensities that fluctuate between 50% to 70% of the strength, it should be noted that the American College of Sports Medicine (2000) similarly recommends that programs focused on

muscular strength should start from 60% of the maximum resistance and for beginners from 50% (Tinajero, 2019). Exercises with implements (½,1, 2 and 2.5 kilogram weight stick) allow a more complex physical activity that makes possible the future performance of certain exercises with more rigor and correction allowing to control and materialize in space certain figures of the articular game.

The research work complied with the ethical aspects of beneficence and justice, respecting the confidentiality of the patients who, through an informed consent, authorized and confirmed their participation before the intervention. The ethical aspects are related to maintaining confidentiality with the data information and photographs obtained in the study and the anonymity of the patient.

Analysis of the results.

It is a proven fact that the physiotherapeutic practice confirms that physical exercise achieves changes that counteract the effects of inactivity and muscle atrophy, which are directly related to the loss of muscle strength caused by burn injury. This kind of practice was very remarkable as shown in Figure 1, after the implementation of the physiotherapeutic procedures for the development of muscle strength an increase in the weights overcome by the patient was observed, which denotes a greater potentiation of muscle strength in the area damaged by burn injuries.

The degree of injury caused by a burn in the shoulder region leads to loss of elasticity in muscles and loss of movement of the anatomical structure. On the other hand, contractures often appear due to this lack of mobility during the recovery process, which lead many patients to report restrictions in their activities of daily living due to limitation of movement and permanent pain. Yet, in the present study it was shown that the degree of severity in the functional status of the shoulder girdle muscles could be reduced by including strength exercises in early rehabilitation interventions in burned patients.

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Furthermore, the influence on the state of muscle strength within the rehabilitation of burned patients allows during the first weeks of treatment to originate neural adaptations that make possible changes in muscle protein, demonstrating that treatments of longer duration produce muscle hypertrophy, by working on strength exercises from the initial stages of the rehabilitation process of the burned patient an increase in their values is presented, which indicates a very significant improvement.

The behavior of the injured muscles and their evolution during the treatment shows criteria of functionability applied according to the possibilities of each one of the patients. In general, an increase in strength is observed in the group average. However, during the first 45 days of the application of the strength exercise program, a small increase in muscle strength is observed with respect to the first measurement, since the group has an average of 5.8 kg, which determines that the muscles can perform movements overcoming weights greater than the initial state, a higher category in terms of the rehabilitation indexes described by different authors. (Costa, 2022).

As shown in Figure 1, the averaged group is expressed in an initial increase from 3.1 to 7.5 kg, which translates as improvement, as well as the standard deviation parameters which decreases from 0.99443 to 0.82327, which expresses the decrease of the standard error mean from 0.31447 to 0.26034, confirming the effectiveness during the process. The above is explained in the following graph, which shows the evolution of the values of muscle strength in the patients sampled (Figure 1).

Figure 1

Muscle strength status before and after the performance of strength exercises using the Delorme-Watkins Method in burned patients.

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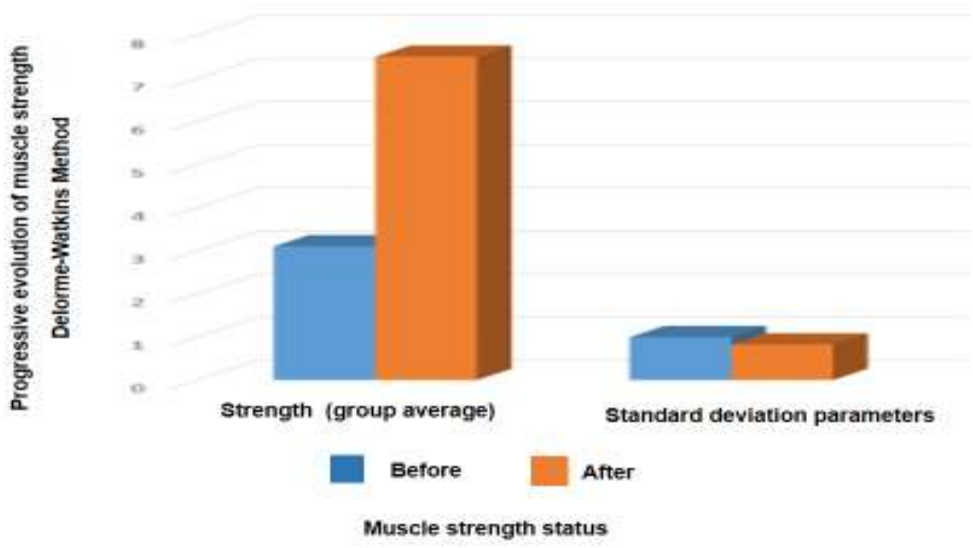

At the end of the intervention process after 90 days of treatment, the group showed quantitatively superior changes with respect to the first measurement, since 50% of the sample presents qualification in terms of the functional behavior of the muscular state that can already perform movements with maximum resistance completing the articular arc, observable in 5 patients. It is observed in 3 patients the evolution of strength when assessing that they can overcome 80% higher than the initial weight, representing 30% of the simple. In 2 patients, representing 20% of the group, it is observed that they can overcome weights but do not exceed 50% of the value of the initial weight measured. These figures remained stable throughout the process because they are influenced by the severity of injuries, associated diseases and the incidence of variables outside the research; however, it is considered in general terms as a positive influence of the treatment applied.

Figure 2 shows the results obtained, initial and final, after applying the Delorme-Watkins Method, which made it possible to corroborate the positive effect of the exercises applied in terms of the recovery of the functional state of the muscles.

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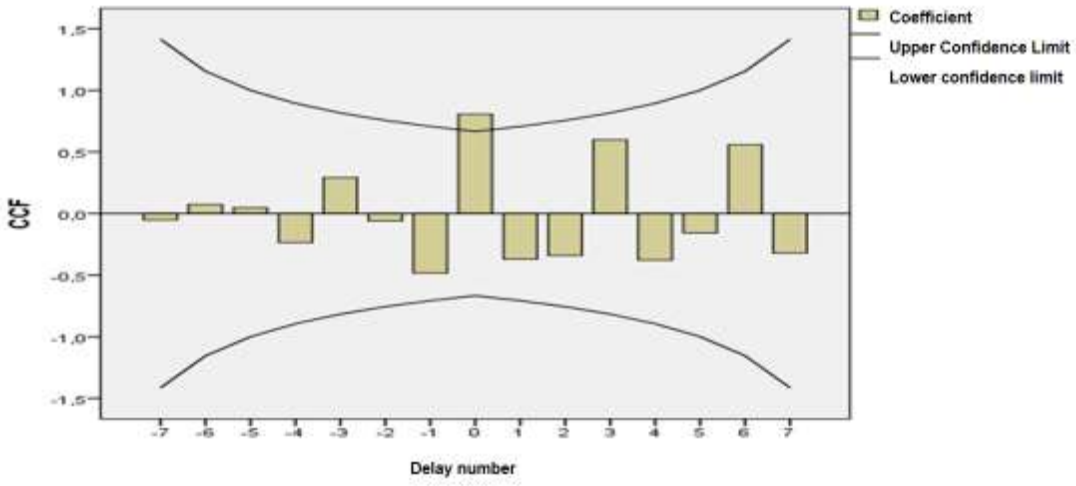
Considering the data analyzed between one stage and the other, the results expressed in an increase in the cross-correlations are listed, allowing a final coefficient of the effects above the upper confidence line. In the end, an increase in values is obtained, indicating a very significant improvement (Figure 2).

Figure 2

Cross-correlations. Confidence coefficient significance analysis (N = 10)



The current development achieved in the field of aesthetic rehabilitation has originated a growing interest in the physiological properties of the osteomyoarticular system as a main element of the comprehensive rehabilitation process of the burned patient, mainly the use of non-invasive techniques such as therapeutic exercise programs that support the results in the social reintegration of this patient. Burns are among the leading causes of disability, adjusted life years lost in low- and middle-income countries, the World Health Organization (WHO, 2018) refers that:

> "Burns are a public health problem worldwide and cause about 180,000 deaths per year, in addition, this injury is one of the main causes of morbidity with various factors in the evolution of the pathology as morphophysiological changes, prolonged hospitalization and disability, having great impact on the social role of the person".

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Therefore, the rehabilitation of this health entity has to be based on an integral approach taking into account the incidence of each of the specialties related to the burned patient, who is in the focus of attention, and the specialist in therapeutic physical activity, family members and medical staff have roles that distinguish them in each moment of intervention.This type of approach allows to contextualize the process as a comprehensive whole in the biopsychosocial sphere, where the exercises cease to be a complement to become a means of the rehabilitation process and their correct determination is of special importance for the correct orientation of the rehabilitation process.

In the recovery of the functional state of the muscles in the burned patient, it is necessary to take into account some considerations on physical exercise for the success of the therapy, such as: pain relief, preservation of joint function, which facilitates ambulation and independent activity, prevents contractures, preserves muscle tone, raises the patient's self-esteem, facilitates the good evolution of the injuries and improves the range of movements and the ease of performing them. The above mentioned makes us reflect on the knowledge that must be taken into account when trying to frame a rehabilitation process from the perspective of therapeutic physical activity, since the specialist must start from the way previous preventive treatments have been carried out in order to focus with better directionality on the ways of applying the different treatments to fulfill the objectives set for the benefit of the comprehensive rehabilitation of these people (Soriano, Macías and Martínez, 2023).

It is important to point out that the aforementioned elements should not be observed independently, but as a multidimensional system of therapeutic exercises that achieve their effectiveness acting together and not separately, since one gives way to the other simultaneously, the patient receiving greater benefit with the systematic exercise regime, so it is necessary to take into account certain requirements for its application such as: the exercises should be performed without delay since the patient should not be expected to assume antalgic positions that disfavor the correct muscular trophism and the correct position

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of the joints that limit their arcs of movements and ease to perform them; they must be individualized, since there are neither two patients nor two burns alike, therefore customizing the exercises is very effective in the treatment of this type of injury.

Taking into account the types of burns and the individual characteristics of each subject, the planning of the exercises becomes more effective and orderly, dosed with a good dosage of each of the elements to be included in the treatment, faster and more effective results will be observed in the complete rehabilitation of these subjects. One of the principles of physical training proven in the increase of the improvement of the most accelerated movements in subjects submitted to the regimen of three weekly sessions is its systematic essence. It is also progressive since the exercises should be progressive both in the amount of structures related to the activity performed and in the complexity accentuated in the rehabilitation process. Finally, it is also dynamic since in the hands of the specialist in therapeutic physical activity it reveals a means to accomplish the objectives set, the sessions should be motivating and respond to the needs of these patients, providing them with a weapon that makes it possible to create better styles of confrontations. (Soriano and Macías, 2022).

An analysis of the general evolution of the group shows that the application of a system of physical exercises improves the strength status of the muscles affected by hypodermic burns B in the shoulder girdle in all patients, which demonstrates that most of the problems of motor function of burned patients is due to the presence of a gradual muscle atrophy in the damaged areas mainly caused by physical inactivity. The severity of the injuries and the positions against the pain that these patients assume will cause more aggressive manifestations with the course of time since elements such as age, loss of strength and maneuverability of the muscles and tendencies of late application of treatments are added, reinforcing the importance of the urgency of the therapeutic physical activity required in these cases.

Conclusions

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The results obtained through the research allowed the knowledge that the therapeutic system used was effective to improve the strength of the muscles affected by hypodermic burns B in the shoulder girdle, experiencing a significantly higher increase in their values after applying the selected exercises.

The importance of the basic principles of Therapeutic Physical Culture as a simple and low-cost way of intervention is demonstrated in terms of the benefits provided by the integral treatment of burns.

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