19 - THE USE OF THE THERAPEUTIC ULTRASOUND IN THE CALCANEUS TENDON AIMING FOR THE INCREASE OF THE MOVEMENT AMPLITUDE

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INTRODUCTION

The therapeutic ultrasound is a modality of deep penetration capable of producing change in the tissues. Contrary to the majority of the other modalities electrically conducted, the ultrasound energy does not belong to the electric magnetic spectra placing itself in the acoustic spectra. Depending on the frequency of the waves the ultrasound is used for the image diagnoses, therapeutic healing of tissues or tissues destruction (STARKEY, 2001).

The ultrasound is produced by an alternate current, which flows through a piezoelectric crystal such as quartz, plumb zirconium or titanate, lodged into a transduction. The piezoelectric crystals produce positive and negative electric charges when contracting or expanding themselves. An inverted piezoelectric effect occurs when an alternate current goes through the piezoelectric crystal resulting into the contraction and the expansion of the crystals. The ultrasound is produced by the inverted piezoelectric effect. The vibration of the crystals causes the mechanic production of high frequency sound waves. (STARKEY, 2001).

According to PARTRIDGE (1990), the outlet frequency of an ultrasound generator is measured by megahertz (MHz) and described as the number of waves that occur in a second. The absorbing level and, consequently, the diminishment increase as the frequency of the ultrasound increases. Ultrasound generators of high frequency (3 MHz) are used for superficial tissue treatment since the energy is quickly absorbed. The most used generator, the 1 MHz generator, offers a deep penetration. The potency produced by an ultrasound is measured in watt (W) and represents the quantity of energy produced by a transduction. The spatial average intensity describes the quantity of energy, which goes through a specific area, and it is measured by watt per square centimeter (W/cm^2). The dosages of conventional treatment vary from 0.5 to 5 watts per square centimeter.

The therapeutic ultrasound is used on a routine basis in the physiotherapy clinic practice intending to reduce the infection symptoms and manifestations. It can perform an effect on the cells and tissues by means of two physical mechanisms: thermal and non-thermal. The thermal effect of the therapeutic ultrasound and its effect on the extension property of the collagen, in particular the calcaneus tendon in the ankle articulation will be the purpose of this research (DYSON, 1987).

The tendons are lengthened cylindrical structures that connect the skeleton muscles to the bones. Due to its richness in collagenous fibers, they are white and non-extensible. Parallel threads of collagenous fibers form them and among them there is little amount of fundamental amorphous substance and fibroblasts with their own certain characteristics. These fibroblasts have lengthened nucleus parallel to the fibers and slender cytoplasm with extensions that tend to wrap around the collagen threads (JUNQUEIRA and CARNEIRO, 1995).

The collagen threads of the tendon (primary threads) form a group (secondary threads) wrapped around by a loose conjunctive tissue, which contains blood vessels and nerves. Finally, the tendon is wrapped around on the outside by a hem of a dense conjunctive. In some tendons this hem is divided into two layers: one attached to the tendon and another linked to the neighboring structures. This way, it creates a cavity covered by flat cells and of a mesenchymateous origin that contains a viscous fluid similar to the synovial fluid of the articulations, which contains water, proteins, glycosaminoglycans, glycoprotein and ions. The function of this fluid is to ease the sliding of he tendon inside its hem (JUNQUEIRA and CARNEIRO, 1995).

The calcaneus tendon or Aquilles is considered the thickest and strongest tendon in the human body through which the muscles of the calf apply their strength on the rear part of the foot during the propulsive period of many activities such as walking, running and jumping. It can bear strength of approximately 1000Kg in the medium adult. The calcaneus tendon is part of the rear part of the ankle (PALASANGA et. al. 2000).

According to KENDALL et. al. (1995) the ankle is an articulation in ginglymus or hinge formed by the tibia, the fibula and the talus. It is an articulation projected to give stability as well as movement to the end structures of the lower limb. The ankle and the foot are able to adjust themselves in such a way that they absorb pressure and adapt themselves on irregular surfaces. They also need to be able to become a rigid structural lever in order to push the body ahead during walking and running.

Only two active movements happen in the ankle articulation: flexion and extension. The axis where the movement occurs extends obliquely from the rear lateral face of the fibular malleolus to the front medium face of the tibia malleolus. This oblique axis goes through the talus body. Besides the active movements, the ankle articulation has six more accessory movements: rear-front, lower rear, longitudinal towards the cephalic, longitudinal towards the tail, median rotation and lateral rotation (CORRIGAN and MAITLAND, 2000).

The flexion (plantar flexion) is the foot movement during which the plantar surface moves towards the tail and rear. The extension (dorsal flexion) is the foot movement during which the dorsal surface moves towards the skull and front. When the foot is in plantar flexion the narrower rear part of the talus moves forward in the concavity (KENDELL, 1995).

Accessory movements of the fibula occur with the flexion and extension of the ankle. As the plantar flexion occurs the fibular malleolus turns medially and it is pulled down and the two malleoluses approach each other. In the superior articulation the fibula slides down. The opposite occurs with the dorsal flexion (KISNER and COLBY, 1998).

The gastrocnemius biarticular muscle and the soleus une-articular muscle firstly cause the plantar flexion. They are located inside the calcaneus bone via Aquilles tendon. The rear tibial, the long flexor of the halux, the long flexor of the toes and the long and short fibular also contribute to this movement. The dorsal flexion is created by the action of the front tibial muscle and by the long extensor of the halux, the long extensor of the toes and front fibular (CORRIGAN and MAITLAND, 2000).

The ankle articulation has as movement amplitude from 15 to 20 degrees of dorsal flexion and from 35 to 40 degrees of plantar flexion whereas the goniometer is the most used instrument for measuring the movement arches (CORRIGAN and MAITLAND, 2000).

This research has as its goal to evaluate the thermal effect of the therapeutic ultrasound in the extensibility of the collagenous of the calcaneus tendon.

METHODOLOGY

Fifteen volunteers of both sexes took part in the research being chosen at random. As a criterion of taking part in the research, the age of being over 18 has been used respecting the maturity of the growing epiphysis. They were all in accordance and they freely and consciously signed the consent form.

The volunteers were submitted to the same protocol of evaluation and the movement amplitude (dorsal flexion) of the articulation of the ankle was measured with the Carci goniometer before and after using the ultrasound. The same researcher performed the goniometria. The foot was in an anatomic position and the lateral surface of the articulation has been used to obtain the measures. The stable arm of the goniometer was set beside the lateral face of the fibula and the mobile arm was set beside the lateral surface of the fifth metatarsus while the axis was set in the ankle articulation together with the lateral malleoluses at the distal end of the fibula. The Quark Proseven 977 therapeutic ultrasound has been used in a continuous way. A gel substance, as a way of transferring, the frequency of 1 MHz and the intensity and length of the treatment have been previously determined. The final results were written down and analyzed.

RESULTS

The participants' average age of the experiment was 28 years old whereas 7 women and 8 men have participated. Chart I shows the measures of the amplitude of the movement (dorsal flexion) before and after the therapeutic ultrasound has been used. Chart II estimates the variation in degrees of the amplitude of the movement (MA). Based on this data one can conclude that the average of the movement increase was 3.6 degrees.

Chart I – MA measures before and after the therapeutic ultrasound (US)

N	MA before US	MA after US
1	65	65
2	74	75
3	69	71
4	78	80
5	69	71
6	81	83
7	84	87
8	78	81
9	82	86
10	73	79
11	73	79
12	78	84
13	68	74
14	80	86
15	84	90

Chart II – MA variation in degrees

N	Variation
1	0º
2	1º
3	2º
4	2º
5	2º
6	2º
7	3º
8	3º
9	4º
10	6º
11	6º
12	6º
13	6º
14	6º
15	6º

DISCUSSION

The warming up of the structures formed with fiber tissue such as the tendons can cause a temporary increase of its extensibility and therefore a joint stiffness diminishment. The temperature of the joint influences the resistance to the movement. These alterations of the amplitude of the joint movement can partly be due to the changes in the viscousness of the synovial fluid (LOW and REED, 2001).

The ultrasound with continuous pattern increases the tissue temperature more effectively if the intensity is high enough and if it has been used to increase the extensibility in the structures rich in collagenous, diminishing the non flexibility of the joints (PAULA, 1994). This author's finding is in agreement with the MA of the heel articulation.

When an ultrasonic wave goes through a biologic tissue, it gets warm when absorbing part of the ultrasonic mechanic energy. The increase of the temperatures causes a temporary increase of the extensibility of the structures rich in collagenous such as the tendons, the ligaments and the joint capsules (BASSOLI, 2002). In this current research the average of the amplitude increase of the movement was 3.6 degrees. Thus, our results are in accordance with other authors who state that with high temperatures the viscous properties of the tendon become clear leading to a reduction of the tensile resistance.

According to SRARKY (2001) the thermos effect of the extensibility increase of the tissues rich in collagenous can be considered in an advantageous way by adding amplitude movement exercises after using ultrasound continuously. Smooth, active or passive stretching is necessary.

CONCLUSION

According to the current research, it has been verified that the use of therapeutic ultrasound in the calcaneus tendon is very important for the increase of the extensibility of the collagenous and causes greater amplitude of movements even if they are temporary.

This temporary increase though, can become permanent if associated with other physiotherapeutic techniques, reducing the joint stiffness and improving the quality of the patient's movements.

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THE USE OF THE THERAPEUTICAL ULTRASOUND IN THE CALCANEAL TENDON AIMING THE INCREASE OF THE AMPLITUDE OF MOVEMENT

ABSTRACT

This work had as objective to prove the effectiveness of the therapeutical ultrasound in the increase of amplitude of movement of ankle dorsiflexion. The calcaneal tendon was chosen as object of the research, which had its superficial anatomical seating, facilitating the absortion of the ultrasonic waves. The study had the participation of 15 volunteers. The average of increase of movement was 3,6º.

Key-words: Ultrasound, Calcaneal tendon, Ankle joint

L'EMLPOI D'ULTRA-SON THERAPEUTIC DANS LE TENDON DU CHEVILLE EN VISAND L'AUGMENTATION D'AMPLITUDE DU MOVIMENT

RESUMÉ

Ce travail a eu comme objectif la confirmation d'éfficace d'ultra-son therapeutic sur le gain d'amplitude du moviment de dorsiflexion du chéville du pied. Le tendon du cheville a été choisi comme l'object de cette recherche, du a son disposition anatomic superficiel en facilitand l'absortion des ondes ultra-sonies. L'étude a eu la participatiàn de 15 volontaires. La moyenne d'augmentation du moviment a été de 3,6º.

Mots clef: Ultra-son, Tendon du cheville, Articulation du chéville

El USO DEL ULTRASONIDO TERAPEUTICO EM EL TENDON CALCÂNEAR VISANDO EL AUMENTO DA AMPLITUD DEL MOVIMIENTO

RESUMEN

Este trabajo tuvo como objetivo comprobar la eficacia del ultrasonido terapeutico en el gano de amplitud de movimiento de dorsiflexion del tornozelo. El tendon calcanear fue escojido como objeto de la pesquisa, devido a su disposicion anatomica superficial, mejorando la absorcion de las ondas ultrasonicas. El estudio tuvo la participacion de 15 voluntários. La média de aumento de movimiento fue de 3,6º.

Palabras clave: Ultrasonido, Tendon calcanear, Articulacion del tornozelo

O USO DO ULTRA-SOM TERAPÊUTICO NO TENDÃO CALCÂNEO VISANDO O AUMENTO DA AMPLITUDE DE MOVIMENTO

RESUMO

Este trabalho teve como objetivo comprovar a eficácia do ultra-som terapêutico no ganho de amplitude de movimento de dorsiflexão de tornozelo. O tendão calcâneo foi escolhido como objeto da pesquisa, devido a sua disposição anatômica superficial, facilitando a absorção das ondas ultra-sônicas. O estudo teve a participação e 15 voluntários. A média de aumento do movimento foi de 3,6º.

Palavras chave: Ultra-som, Tendão calcâneo, Articulação do tornozelo