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THE USE OF VIRTUAL REALITY IN FROZEN SHOULDER MOBILIZATION

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Abstract: *Virtual reality is: "a way for humans to visualize, manipulate and interact with computers and extremely complex data" [Aukstakalnis & Blatner, 1992] (the way through which people can visualize, manipulate and interact with computers and complex data) more precisely it can be an advanced form of a human-computer, an interface that allows the user to interact in an environment generated by an almost real, natural computer, just like in airplane, train, car simulators in which pilots train for the development skills. The same environment can be created to develop and recover cognitive and functional abilities, bringing interactive scenarios designed to meet the needs of patients or create tasks similar to the real world. Adhesive capsulitis, also known as frozen shoulder, is a condition that causes a significant loss of both active and passive range of motion of the shoulder that occurs in the absence of preceding pathology.*

Key Words: Virtual Reality, Frozen Shoulder, Mobilization, Human-Computer, Pathology.

INTRODUCTION

There are two types of frozen shoulder, primary and secondary. In the first type, patients have no findings on clinical examination, radiography or in their history that would explain the loss of range of motion. Primary frozen shoulder is the most common type and is idiopathic in nature. The Secondary Type develops after events such as upper extremity surgery or trauma. The limb is constantly unused and held in a position of internal rotation, shoulder adduction with elbow flexion. Consequently, the anteroinferior aspect of the joint approximates and shortens, resulting in a restriction of movement.

The objectives of using virtual reality in physical therapy are to combat pain, increase joint mobility, increase muscle mass and correct body postures depending on each phase.

Phase 1 or painful phase is characterized by pain by the appearance of diffuse pain lasting over a period of 2 to 9 months and nocturnal pain and progressive limitation of movement. The second phase or the blocking phase is highlighted by limitation of movement, with constant pain, with accentuation of pain when overcoming the limits imposed by immobilization. It is between 4 and 12 months. Phase 3 or resolution phase in which the relief of symptoms and the gain of joint mobility takes place, is between 5 and 26 months. [table 1.]

Phase 1 The pain is often the most severe in this phase, and the exercises will focus on light joint mobilizations of the shoulder in the tolerated range of motion, changed with hot / cold, electro analgesic and anti-inflammatory applications. Mobilizations could be easier to bear if patients are introduced to virtual reality during joint mobilization exercises, the brain would no longer be connected to pain, and we could cooperate and mobilize the patient more easily.

Phase 2 is highlighted by limitation of movement, with constant pain, with accentuation of pain when overcoming the limits imposed by immobilization. It is recommended to warm the joint before mobilization or exercises to facilitate the adhesion of the capsulitis. The exercises are focused on stretching the posterior multiculture of the shoulder, the scapula lift, the thoracic muscles, the rotator cuffs. Strength exercises are added to maintain muscular endurance, isometric contractions. Exercises are added in virtual reality because it is reached approximately through the month of 5-6
recovery and monotony occurs, the patient needs to disconnect from "reality" plus he needs real-time feedback of the gain made each day of recovery.

Phase 3 or remission phase takes place to improve symptoms and gain joint mobility, the patient records a gradual return of joint mobility and decreased pain. It is important to gain normal range of motion as soon as possible and muscle strength. In this phase exercises in the virtual environment will focus on endurance and speed exercises, and gain muscle strength. The performance will be in a more relaxed environment, to stimulate the psycho-emotional effects of the patient. [fig.5 HarborVR]

The aim of the research is to highlight the involvement of the virtual space in the physiotherapy programs of the adhesive capsulitis, to highlight the contribution it brings on the perception of pain during the physiotherapy session.

Research objectives.

• Studying the theory and practice in the field of adhesive capsulitis

• Analysis and appreciation of the contribution brought by virtual reality on the perception of pain during joint mobilizations

• Analysis and appreciation of the means of physiotherapy in combination with Virtual Reality in the physiotherapy programs of the painful shoulder

• Elaboration of the structure and content of the recovery program by combining the means of physiotherapy with Virtual Reality in adhesive capsule

• Experimental validation of the efficiency of the recovery process by kinetotherapy based on Virtual Reality in adhesive capsule

• Finding and elaborating a Virtual Reality scenario as appropriate as possible in which the sensation of pain is less

Scientific novelty. The most important question is: Why use virtual reality? Does it help us to create a more complex physiotherapy program? Does it help the PATIENT to recover faster and to maintain a better condition after finishing the treatment? Helps the PATIENT feel less pain

Virtual reality offers us the possibility to bring the complexity of the physical world in the controlled environment of our office. RV offers the possibility to create a totally new and ecological world, with a better control and coordination due to the feedback created by the computer in real time. The introduction of graded motor images is easier due to the computer-created design in which the patient can visualize his limbs in such a way that the sensation of pain can be masked.

Research design and hypothesis. Involvement of virtual space in the development of the adhesive capsulitis physiotherapy program, creating / finding a suitable environment so that patients can be in a state of comfort in which the sensation of pain decreases, because the somatosensory cortex is less active when patients use reality virtual (studio) and the more intense and interactive the activity in VR, the more the perception of time and the sensation of perceived pain change.

Duration of the experimental physiotherapy program 15 .09. 2019 - 01.07. 2021 on a number of 20 volunteers with adhesive capsule

The group of volunteers receive the same joint mobilization techniques for 7 minutes because the RV scenario lasts 7 minutes, the pain threshold is measured in real and virtual environment by pressing a dynamometer in the deltoid mass and the upper limbs are immersed in ice water. observing the duration of resistance in the real doctor as well as in the virtual one, it was also observed the perception of the duration of the time spent in VR

Eligibility criteria. Each patient should be between 30-70 years of age with adhesive capsulitis in the first two phases, with moderate pain according to the Visual Analogue Scale (VAS) 4-6.

Exclusion criterion. Patients were excluded if they were in the remission phase of adhesive capsulitis and any contraindications for affected upper limb exercises (eg, venous thrombosis, lymphedema).

Research procedures: 5 VR volunteers viewing a scenario in which they interacted with dolphins (dolphin group), 5 VR volunteers interacting with dinosaurs (dinosaur group), 5 VR volunteers walking in a mountain rousse (mountain rousse group) and 5 volunteers without VR control group.

Oculus Quest type glasses with a QLED display and a resolution of 1440 x 1600 with a refresh rate of 72 Hz were used. . It is observed: the intensity of the pain during the joint mobilizations, the endurance threshold during the pressures and the pressure force applied with dynamometer, the resistance of the body during the immersion of the upper limbs in cold water with ice depending on each scenario he followed in virtual reality and without virtual reality. It was also observed the perception of the duration of the time spent in RV, the CONCENTRATION ON THE PAINFUL AREA DURING THE USE OF THE GLASSES.

Its pain is classified and is numbered according to the classification system Visual analog scale (VAS 0 - 10, which remains the most used in clinical practice: mild pain VAS <4, moderate pain VAS 4-6 and severe pain VAS greater than or equal to 7) every day, at the beginning of the session / during / after performing the joint mobilization techniques, and after performing the dynamometer and ice water test.

CONCLUSIONS AND RESULT

The use of RV showed a real benefit during joint mobilizations and during tests performed on the shoulder joint:

Patients reported the following

Control group without VR

Subject 1 female 45 years: - during joint mobilizations a VAS 5. The maximum force of pressing the dynamometer until the appearance of maximum pain was 2.4kg / cm2 Resistance to cold stimulus was 40s

Subject 2 females 39 years: - during joint mobilizations a VAS 5, The maximum force of pressing the dynamometer until the appearance of maximum pain was 2.7kg / cm2 Resistance to cold stimulus was 1m.25 s

Subject 3 male 50 years: - during joint mobilizations a VAS 6, The maximum force of pressing the dynamometer until the appearance of maximum pain was 3.8kg / cm2. Resistance to cold stimulus was 2.36 s

Subject 4 female 55 years: - during joint mobilizations a VAS 6, The maximum force of pressing the dynamometer until the appearance of maximum pain was 2.1kg / cm2. Resistance to cold stimulus was 1m.01 s

Subject 5 male 42 years: - during joint mobilizations a VAS 6, The maximum force of pressing the dynamometer until the appearance of maximum pain was 2.9kg / cm2. Resistance to cold stimulus was 1m.21 s

VR group dolphins

Subject 1 female 55 years: - during the joint mobilizations VAS 5, the maximum force of pressing the dynamometer until the appearance of the maximum pain was 2.6kg / cm2. Resistance to cold stimulus was 1m.15s

Subject 2 males 37 years old: - during joint mobilizations VAS 4 The maximum force of pressing the dynamometer until the appearance of the maximum pain was 4.0kg / cm2. Resistance to cold stimulus was 2.6s

Subject 3 male 48 years: - during joint mobilizations a VAS 4, The maximum force of pressing the dynamometer until the appearance of maximum pain was 4.7kg / cm2. The resistance to the cold stimulus was 2m

Subject 4 females 70 years: - during joint mobilizations a VAS 6, The maximum force of pressing the dynamometer until the appearance of maximum pain was 1.1kg / cm2. Resistance to cold stimulus was 30s

Subject 5 female sex 39 years: - during joint mobilizations a VAS 5. The maximum force of pressing the dynamometer until the appearance of maximum pain was 2.8 / cm2 and in. Resistance to cold stimulus was 1.25 s

Dinosaur VR group

Subject 1 male sex 52 years: - during the joint mobilizations VAS 3, the maximum force of pressing the dynamometer until the appearance of the maximum pain was 3kg / cm2. Resistance to cold stimulus was 2m.17s

Subject 2 male 41 years: - during joint mobilizations VAS 2 The maximum force of pressing the dynamometer until the appearance of maximum pain was 4.1kg / cm2. Resistance to the cold stimulus was 3.26s

Subject 3 male 60 years: - during joint mobilizations a VAS 4, The maximum force of pressing the dynamometer until the appearance of maximum pain was 2.9kg / cm2. The resistance to the cold stimulus was 2.48m

Subject 4 female 64 years: - did not resist in the virtual environment, he was scared

Subject 5 female 44 years: - during joint mobilizations a VAS 4. The maximum force of pressing the dynamometer until the appearance of maximum pain was 2.6 / cm2. Resistance to cold stimulus was 2m.42 s

VR mountain rousse group

Subject 1 female 60 years: - during joint mobilizations VAS 2, the maximum force of pressing the dynamometer until the appearance of maximum pain was 3.6kg / cm2. Resistance to cold stimulus was 2m53.s

Subject 2 males 55 years old: - during the joint mobilizations VAS 3 The maximum force of pressing the dynamometer until the appearance of the maximum pain was 4.4kg / cm2. Resistance to the cold stimulus was 3.33s

Subject 3 males 48 years: - during joint mobilizations a VAS 2, The maximum force of pressing the dynamometer until the appearance of maximum pain was 3.8kg / cm2. Resistance to cold stimulus was 2m37s

Subject 4 male 52 years: - during joint mobilizations a VAS 2, The maximum force of pressing the dynamometer until the appearance of maximum pain was 3.3kg / cm2. Resistance to cold stimulus was 2m48s

Subject 5 male 62 years: - during joint mobilizations a VAS 2. The maximum force of pressing the dynamometer until the appearance of maximum pain was 4.2 / cm2 and in. Resistance to cold stimulus was 3m49s

Patients had a lower perception of time spent in the virtual environment by about 35% compared to reality and a decrease in pain relief during joint mobilizations depending on each work scenario. The dolphin group reported almost the same sensation with a slight decrease in pain compared to the control group. The biggest changes were observed in the mountain rousse group with about 50% compared to the control group because the minds of the subjects being concerned with the virtual environment did not think about the problem area and this led to a lower perception of pain and a lower perception of time

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