Deanship of Graduate Studies

Al-Quds University

A Randomized Comparative Study between High-Intensity Laser Therapy and Ultrasound Therapy on Chronic Neck Pain among Adult Patients

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M.Sc. Thesis

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Thesis Approval

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Dedication

First and foremost, I would like to dedicate this effort to the God; thank you for your direction, strength, power of mind, guard, and for giving me a healthy life.

This study is wholeheartedly dedicated to my beloved family, they have given me power when I considered giving up and they continuously deliver their moral, spiritual, and emotional support.

I dedicate this work to my father Zeen Aldeen and to my beloved mother for her nonstop and continuous support and inspiration throughout the completion of my academic journey.

To my siblings, relatives, friends, and work colleagues who shared their words of advice and encouragement to finish this study.

This thesis is especially dedicated to Dr. Hadeel Halaweh who encouraged and helped me stay motivated throughout the completion of my thesis.

Thanks to Al-Quds University members, and lecturers for always inspiring me to grow as a researcher.

Declaration

This thesis is submitted in partial fulfillment of the requirement for the Master's degree in physical therapy.

I declare that the content of this thesis (or any part of the same) has not been submitted for a higher degree to any other University or institution.

Signed *Adel Ashour*

Date: 5/April/ 2022

Acknowledgement

I would like to express my highest gratitude to Allah for guiding me towards the successful completion of my thesis, earning my master's degree has probably been the most challenging pursuit of my life. The overall experience of my master's journey has been a great privilege at the Faculty of Health Professions at Al-Quds University.

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A Randomized Comparative Study between High-Intensity Laser Therapy and Ultrasound Therapy on Chronic Neck Pain among Adult Patients

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Abstract

Background: Neck pain is a common musculoskeletal disorder, if it persisted for more than 3 months classified as a chronic neck pain (CNP). This permanent pain leads to much physical, psychological, and social impairment, also it is considered the 4th leading cause of disability. Many non-invasive interventions are applied to treat CNP, such as medication, psychotherapy, and physical therapy. Conventional physical therapy may use ultrasound therapy (UST), massage, hot-packs, and exercise. However, high-intensity laser therapy (HILT) has arisen recently as a new non-invasive, painless, and safe physical therapy intervention.

Objectives: This study aims to investigate the impact of HILT on patients with a non-specific chronic neck pain, and to compare between the effect of HILT and UST on pain severity, cervical mobility, and the functional ability among patients with CNP.

Design: This study is a single-blinded randomized comparative trial.

Materials and methods: a number of 43 (males and females) patients participated in this study with the age range 20-50 years. Patients randomly assigned into two groups, the first intervention group received HILT with exercise, and the second group received UST with exercise. The program of intervention included 2-3 sessions a week for 4 weeks. The outcomes measures were pain intensity by visual analog scale (VAS), cervical range of motion (ROM) by clinometer, and functional activity by neck disability index (NDI) score. Statistical analysis was performed via the Statistical Package for the Social Sciences (SPSS) package, version 23, Statistical significance was set at $P < 0.05$.

Results: Both HILT combined with exercise, and UST combined with exercise groups showed significant improvements between the baseline and the discharge scores. The outcome measures; VAS, NDI, and cervical ROM improved significantly at the discharge point in the two groups ($P<0.05$). Both treatment modalities significantly affect different aspects of chronic

neck pain assessed by NDI. However, no significant improvement in favor to any group at post-test in all outcome measures (VAS, NDI, and ROM) (P>0.05). Furthermore the age and gender aren't correlated to the improvement.

Conclusion: This study shows that HILT with Exercise as well as UST with Exercise were effective in the treatment of CNP.

Keywords: chronic neck pain, high intensity laser therapy, ultrasound therapy, physical therapy and cervical exercise.

دراسة مقارنة بين تأثير العلاج الطبيعي باستخدام تقنية الليزر عالي الكثافة والعلاج بالموجات فوق الصوتية على آلام الرقبة المزمنة لدى البالغين

إعداد: عادل زين الدين يوسف عاشور
إشراف: الدكتوره هديل حلاوه

ملخص عن الدراسة باللغة العربية

هو بحث يهدف لفحص تأثير العلاج الطبيعي بإستخدام جهاز الليزر عالي الكثافة على أوجاع الرقبة المزمنة لدي البالغين ومقارنته بالعلاج بإستخدام جهاز الموجات الفوق صوتية على المرضى البالغين الذين يعانون من أوجاع مزمنة في الرقبة

التدخل العلاجي يقوم به أخصائي العلاج الطبيعي بهدف تحسين شدة الوجع والمدى الحركي والأداء الوظيفي للمرضى. من خلال برنامج علاجي يتضمن 10 جلسات من العلاج بإستخدام الليزر على مدار 4 أسابيع بالإضافة إلى مجموعة من التمارين العلاجية الخاصة بأوجاع الرقبة. وفي المجموعة الضابطة سيتم عمل برنامج علاجي يتضمن 10 جلسات من العلاج بإستخدام الموجات الفوق صوتية بالإضافة إلى نفس التمارين العلاجية للمجموعة الأولى. وسيتم عمل مقارنة بين النتائج في كلا المجموعتين.

المقدمة: أوجاع الرقبة المزمنة تعتبر من الإضطرابات الشائعة التي تصيب الجهاز الهيكلي والعضلي. يعاني الناس من هذه الأوجاع في مختلف الفئات العمرية وخاصة البالغين، وتؤثر هذه الأوجاع بشكل كبير على الشخص وعلى أداءه الوظيفي وحياته اليومية، وقد تستمر هذه الأوجاع لعدة أشهر او لسنوات. العديد من الأساليب تستخدم في علاج هذه الأوجاع مثل الأدوية والعلاج النفسي والعلاج الطبيعي وغيرها من الأساليب.

العلاج الطبيعي هو مهنة صحية تشارك في علاج العديد من أمراض الجهاز الهيكلي والعضلي ؛ حيث يلعب العلاج الطبيعي دورًا رئيسيا في علاج هذه الأوجاع، ومساعدة المرضى في تخفيف الوجع وتحسين الأداء الوظيفي والنشاط اليومي ، و المحافظة عل صحة العضلات والمفاصل من خلال الحركة والتمارين.

هدف الدراسة: المقارنة بين تأثير العلاج الطبيعي بإستخدام تقنية الليزر عالي الكثافة والعلاج بالموجات فوق الصوتية على آلام الرقبة المزمنة لدى البالغين.

المنهج المتبع للدراسة: هذه الدراسة هي دراسة تجريبية، حيث تم دراسة 43 مريض ومريضة يعانون من أوجاع الرقبة المزمنة. مجموعة الليزر (ذكور=9، اناث=14) ، متوسط العمر لمجموعة الليزر هو 34.35 عام ، بينما كان في مجموعة الموجات فوق الصوتية حوالي 32.30 عام. تم تقسيمهم لمجموعتين بشكل عشوائي وموزعين على كتل مبنية على العمر والجنس : المجموعة الأولى هي مجموعة الليزر تلقت العلاج بإستخدام الليزر عالي الكثافة (23 مريض) ، والمجموعة الثانية هي مجموعة الموجات فوق الصوتية حيث تلقت العلاج بالموجات الفوق صوتية (20 مريض). جميع المرضى في المجموعة الأولى تلقوا 10 جلسات من العلاج بإستخدام الليزر عالي الكثافة بالإضافة إلى التمارين العلاجية خلال 4 أسابيع.

بينما المجموعة الثانية تلقت 10 جلسات من العلاج بإستخدام الموجات الفوق صوتية بالإضافة إلى نفس التمارين العلاجية خلال 4 اسابيع.

خضعت جميع العينة للإختبارات القبلية والبعدية لشدة الوجع، الأداء الوظيفي ، والمدى الحركي للرقبة. تم إستخدام برنامج SPSS نسخة ٢٣ في التحليل الإحصائي، قام الباحث بإستخدام paired sample t-test لتحليل كلا المجموعتين قبل وبعد التدخل العلاجي لفحص أثر العلاج ومن ثم إستخدام independent sample-test لمقارنة الفرق بين المجموعتين بعد العلاج ومن ثم قام الباحث بفحص العلاقة بين جميع الفحوصات المستخدمة مع العمر والجنس عن طريق Pearson's correlation test

نتائج الدراسة: أظهرت النتائج تحسن معنوي في كلا المجموعتين بين نتائج الإختبار القبلي والبعدي ($P<0.05$). وكما أظهرت النتائج بأنه لا يوجد فرق معنوي لصالح أي من المجموعتين في نتائج الإختبار البعدي في جميع المقاييس (شدة الألم ، الأداء الوظيفي ، ومدى حركة الرقبة) ، إضافة إلى ذلك أظهرت النتائج أن عاملي الجنس والعمر غير مرتبطين بنتائج التحسن في العينة.

الإستنتاج: العلاج بالليزر عالي الكثافة بالإضافة إلى التمارين والعلاج بالموجات فوق الصوتية بالإضافة إلى التمارين يقلل شدة الألم ويحسن الأداء الوظيفي ويزيد مدى حركة الرقبة.

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List of abbreviations

- HILT: High Intensity Laser Therapy, high power laser > 500 mw
- US: Ultrasound
- UST: Ultrasound Therapy
- LBP: Low Back Pain
- CNP : Chronic Neck Pain
- ADL: Activity of Daily Living
- IVD: Inter-Vertebral Disc
- PBMT: Photobiomodulation Therapy
- LLLT: Low Level Laser Therapy
- MSD: Musculoskeletal Disorders
- RCT: Randomized Controlled Trial
- ROM: Range Of Motion
- AROM: Active Range of Motion
- HPLT: High Power Laser Therapy
- Nd:YAG: Neodymium-doped yttrium Aluminum Garnet
- BMI: Body Mass Index
- NDI: Neck Disability Index
- VAS: Visual Analog Scale
- OA: Osteoarthritis

Chapter one

1.1 Introduction

1.2 Problem statement

1.3 Study justification “Rational”

1.4 Study Objectives

1.5 Study Hypothesis

1.6 Terminology

1.1 Introduction

Neck pain is the second most common musculoskeletal disorders after low back pain affecting people around the world. Neck pain is described as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage” in the neck region, which starts at the superior nuchal line and continues down to the level of the scapular spine (Bier et al., 2018). Chronic neck pain (CNP) which continues for more than 3 months, is considered the fourth leading cause of disability according to the global burden of disease study, and the presence of CNP leads to psychological, social, and physical problems (Cohen, 2015).

The annual prevalence of CNP is ranging about 30% of population according to many epidemiological studies, the highest numbers in the middle age, also, females were reported to have a higher prevalence than in males (Cohen, 2015; Genebra, Maciel, Bento, Simeão, & Vitta, 2017; Jiménez-Trujillo et al., 2019). CNP may be associated with several comorbidities such as back pain, headache, depression, and arthralgias (Cohen, 2015). Neck pain includes cervical muscles pain, whiplash-associated disorders, cervicogenic headache and cervical radicular syndrome (Bier et al., 2018). The management and treatment of neck pain is considered the most difficult due to the sensitivity and great mobility of the cervical region, and due to different sources of cervical disorder (Haładaj, Pingot, & Topol, 2017).

Different methods used by physical therapists to treating the CNP; conventional physical therapy such as hot packs, ice packs, electrical stimulation, massage, and exercise are commonly used (Bier et al., 2018). Conventional physical therapy is available, and not costly for the most of physical therapists, but the duration of applying it may reach to one hour every session, also, there is a debate in the evidence about it is effect on CNP. A systemic review results show that the use of multi techniques may be more effective for CNP. (Damgaard, Bartels, Ris, Christensen, & Juul-Kristensen, 2013).

A clinical practice guideline for non-specific neck pain set many recommendations depends on the severity of pain, started by hands off therapy by advices plus simple home exercise, followed by mobilization or manipulation plus home exercise (Bier et al., 2018). Also, in a European clinical practice guideline for neck pain, there were recommendations including: education, manual therapy and therapeutic exercises (Corp et al., 2021). However, HILT and UST weren’t mentioned in these guidelines that could be due to lack of evidence on these apparatus on chronic neck pain.

Photobiomodulation therapy (PBMT) is also used by the physical therapists as a treatment modality to decrease pain and improve function of patient by the effect of light on the soft tissues (Chow, Johnson, Lopes-Martins, & Bjordal, 2009).

Recently, one of the innovative used therapeutic modalities is High-Intensity Laser Therapy (HILT). HILT has photochemistry effects that stimulate oxidation of mitochondria and ATP creation by delivering high energy output inside tissues. This therapeutic intervention affecting on the muscles and soft tissues extensibility and increase the blood supply deeper rather the other modalities such as hot packs or massage, also its application is done in a short time of about 10 to 15 minutes according to the required energy, and the goal of treatment (Choi et al., 2017).

Also, ultrasound (US) was widely used by the physical therapists in the treatment of musculoskeletal disorders, it is presented in most the physical therapy clinics, and the use of US is not costly in comparison with HITL. UST is a non-invasive treatment that improves the healing of soft tissue and increases the blood supply, also, its effect reaches the deep tissues up to 5 cm. the impact of UST on neck pain and the patient function is controversial. (Noori et al., 2020) Therefore, the aim of this study is to compare between the effect of HILT and UST on patients with CNP.

1.2 Problem statement

Neck pain is the second musculoskeletal problem causing disability after low back pain with prevalence about (12% - 25%), among female more than male (Henriette, 2020; Jiménez-Trujillo et al., 2019; Sharma, 2017). Many risk factors contribute to increasing CNP occurrence such as the modern lifestyle, anxiety, smoking, sleeping disorders, educational level, working in sitting position, and bad posture during the activity of daily living (ADL) (Cohen, 2015; Damgaard et al., 2013; Genebra et al., 2017). Physical therapy has been used via different modalities to treat the neck pain, it has been proved that physical therapy consists of mobilization, manipulation, advices and exercise can improve posture, increase soft tissue extensibility, decrease muscle spasm, increase blood circulation, and decrease patient's pain which lead to increase the level of patient's function and satisfaction (Roland Valdes Jr. Lori M. Millner, 2019), but the used physical therapy techniques in the treatment of CNP are still limited in introducing a long-term effective treatment. HILT is considered as a new non-

invasive therapeutic physical therapy modality that could be efficient in the treatment of chronic neck pain (Frost, Camarero-Espinosa, & Foster, 2019), but there is a lack of such investigations concerning the use of the HILT for CNP in Palestine. Also, UST is a popular therapeutic intervention that has been applied by physical therapists in Palestine. Still, there is a lack of evidence-based practice protocol, some related studies recommended it for CNP treatment, on the other hand, there is a systemic review that did not recommend the use of UST for chronic pain management (Aiyer et al., 2020). Therefore, investigating the effect of HILT intervention on patients with CNP compared to UST may help in highlighting its importance in treating such patients to prevent further complications and promoting better functional outcomes.

1.3 Study justification "Rational"

The results of this study will be valued for different communities and individuals such as, decision makers in the Palestinian physical therapy clinics to adopt the HILT as a vital part of the fundamental management of chronic neck pain. In addition, Both patients and physical therapists s will benefit from the results of this research; as it may contribute to the evidence based protocol that explored PT work with chronic neck pain patients. Also, the study results will hopefully add a new suggestion to the musculoskeletal international literature.

1.4 Study Objectives

Primary objectives:

- To examine the effect of the HILT on pain severity, cervical mobility, and the functional ability among patients with CNP
- To examine the effect of the UST on pain severity, cervical mobility, and the functional ability among patients with CNP

Secondary objectives:

- To compare between the effect of HILT and UST on pain severity, cervical mobility, and the functional ability among patients with CNP
- To assess the effect of HILT and UST on CNP according to age groups and sex

1.5 Study Hypothesis

- The use of high intensity laser therapy is more effective treatment than UST on pain severity, cervical mobility, and the functional ability among patients with CNP
- A combined treatment of HILT and active exercises on CNP is more effective than UST and exercises on pain severity, cervical mobility, and the functional ability among patients with CNP
- The effect of HILT on CNP may differ according to age and sex
- The effect of UST on CNP may differ according to age and sex

1.6 Terminology

LASER: means Light Amplification from Stimulated Emission of Radiation. Laser is created by specific process within the laser device to cause the controlled emission of radiation in form of light (Physiopedia, laser)

Ultrasound: utilizes sound energy, pressure waves created by the mechanical vibration of particles through a medium (Physiopedia, US)

Chapter Two

Literature Review

2.1 Theoretical Framework

2.2 Similar Studies

2.1 Theoretical Framework

2.1.1 Definition

Neck pain is defined as "an unpleasant sensory or/and emotional experience linked with actual or potential tissue injury" in the neck region, starts from the superior nuchal line continues down close to the scapular spine with or without radiation to the head, trunk, and upper limbs (Bier et al., 2018). Neck pain that persists for 3 months or longer is defined as chronic neck pain (Chung & Jeong, 2018).

2.1.2 Incidence and prevalence

The Global Burden of Disease study which was conducted in 195 countries worldwide ranked neck pain as the fourth musculoskeletal reported problem (Safiri et al., 2020). The prevalence of CNP is exceeding of 30% of population (Cohen, 2015). In addition, the chronic neck pain (CNP) was increased markedly over the past 25 years, and it is described as one of the most prevalent causes of disability among adults patients (Hurwitz, Randhawa, Yu, Côté, & Haldeman, 2018). However, there are no specific reports about chronic neck pain prevalence in Palestine.

2.1.3 Anatomy and Physiology

The cervical region of the spinal column consists of 7 vertebrae, they are extended from C1 (Atlas vertebra) at the base of the skull into the C7 over the thoracic region. The cervical vertebrae are separated by 6 intervertebral discs (IVD), these IVD are smaller than any other IVD in the spine, due to the load-bearing on the cervical is less than other regions (Frost et al., 2019). The main role of cervical vertebrae is to protect the spinal cord which passes through the vertebral canal (Frost et al., 2019). Also, the cervical region carries the weight of the head and provides a wide range of motion (ROM) for the head and neck. The first two cervical vertebrae C1 (Atlas), and C2 (Axis) formed the atlanto-axial joint which is responsible for 50% of cervical and head rotation (Swartz, Floyd, & Cendoma, 2005). The remaining ROM comes from the segmental rotation of the vertebrae $C_3 – C_7$ (Swartz et al., 2005).

The cervical vertebrae serve as origin and insertion for many muscle groups, which give good stability and flexibility to the head and neck at the same time (Muscles of the Neck - TeachMeAnatomy). Figure 2.1 & 2.2 show the major cervical muscles (www.crossfit.com).

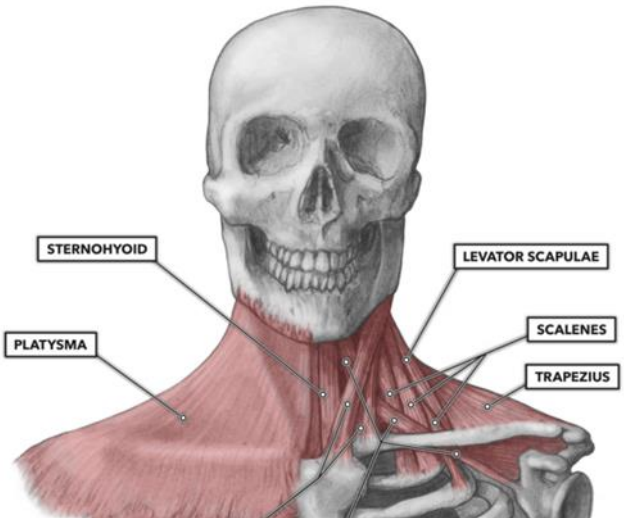


Figure 2- 1 cervical muscles (anterior view)

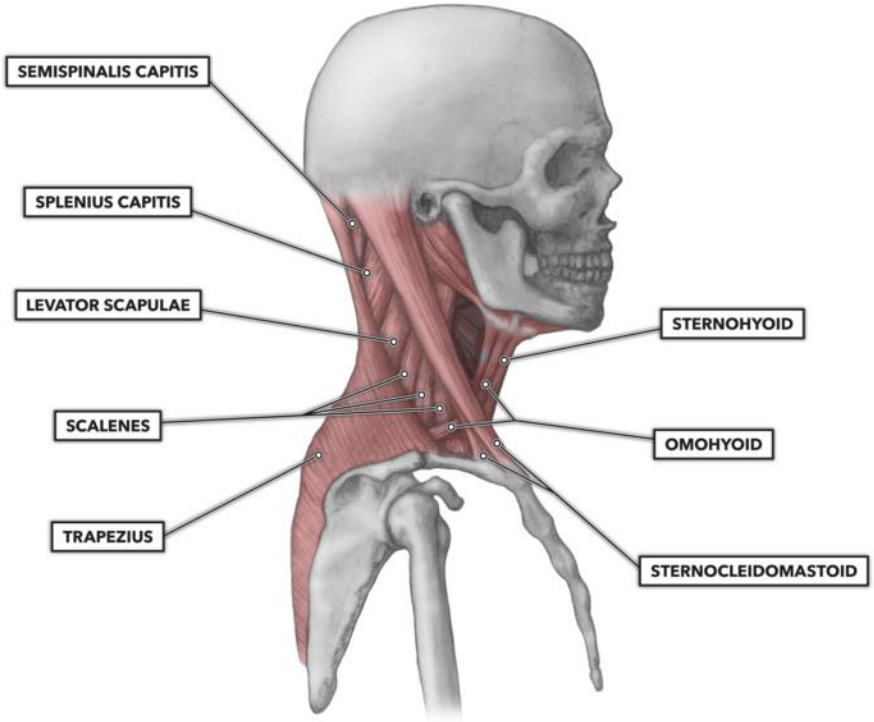


Figure 2-2 Cervical muscles (posterior-lateral view)

2.1.4 Pathophysiology of chronic neck pain (CNP)

The pathophysiology for most disorders of chronic neck pain is not clear, some evidence suggests that the cause of disturbance refers to oxidative metabolism (Rice, McNair, Huysmans, Letzen, & Finan, 2019), and impairment of local neck muscles circulation and embolism due to increased level of pain-generating substance in the neck muscles (Cohen, 2015). Another physiological cause arises from an impairment of the proprioception, post-traumatic injury in the shoulders or neck muscles (Rice et al., 2019). An impaired information from the mechanoreceptors ascending from the injured muscles in the neck region caused sensory and motor dysfunction (pathophysiology for CNP., 2021).

2.1.5 Main causes of chronic neck pain (CNP)

Degenerative changes in the vertebral bodies and facet joint, myofacial dysfunction, muscles injury, muscles weakness, cervical discopathy, sitting and leaning positions, psychological problems, and traffic accidents, all of these reasons may lead to CNP (Bier et al., 2018; Genebra et al., 2017).

2.1.6 Risk factors of CNP

Predisposing risk factors for CNP include: (Henriette, 2020; Jadon, 2016; Jiménez-Trujillo et al., 2019; Mahmoud, Hassan, Abdelmajeed, Moustafa, & Silva, 2019)

- Age >40 years
- Female gender
- Higher BMI
- Patients with low back pain
- History of recurrent neck pain
- regular sports which stress on cervical region like cycling, poor quality of life
- Work, such as working with leaning forward posture
- Smoking
- Low social support

2.1.7 Signs and Symptoms of CNP

1. localized pain in the neck area with or without interference with activities of daily living (Bier et al., 2018).

2. limited active cervical ROM.

3. Headache is a very prevalent painful symptom that affects the patient with CNP (Côté et al., 2019). Cervicogenic headache (CGH), is a sub-type of headache caused by a disorder related to cervical disorders, which affect the quality of life, and functional activity (Rani & Kaur, 2021).

2.1.8 Physical therapy role in CNP management

The knowledge about the actual physical therapy effects on CNP is important to be reflected in the evidence practice by the therapist on their patients. The used physical therapy modalities in the treatment of CNP, like exercise, manual therapy, and electrotherapy. Physical therapy for CNP was found as an effective intervention in terms of easing pain and improving function and quality of life, by different techniques (Damgaard et al., 2013).

A clinical practice guideline for non-specific neck pain set many recommendations depends on the severity of pain, started by hands off therapy by advices plus simple home exercise, followed by mobilization or manipulation plus home exercise. (Bier et al., 2018). Also, in a European clinical practice guideline for neck pain, there were a recommendations for advices, education, manual therapy and therapeutic exercise (Corp et al., 2021). However, HILT and UST weren't mentioned in these guidelines that could be of lack of evidence on these apparatus on chronic neck pain.

2.1.9 Laser therapy

Laser therapy also called photobiomodulation therapy PBMT, or known as phototherapy, is a non-thermal process where light interacts with chromophores leading to photophysical and photochemical reactions in different tissues (Leal-Junior, Lopes-Martins, & Bjordal, 2019). PBMT is a light therapy that uses non-ionizing light sources, such as lasers, light emitting diodes (LEDs), and broadband light, from the visible to the infrared spectrum. (PBMT) or low level laser therapy (LLLT) was used more than 50 years ago when was discovered accidentally by Mester (Zein, Selting, & Hamblin, 2018). Through this time, many studies were conducted

to assess the effect of PBM on human tissues, and to determine the appropriate parameters in terms of the wavelength, energy density, power density, total power, time of application, and tissue absorption. The effect of PBMT increased in the tissues rich with mitochondria such as (brain cells, muscle cells, neural cells, macrophages, monocytes), result in increased ATP synthesis (Dompe et al., 2020). The short wavelength like (600 to 700 nm) tends to treat the superficial tissue, the longer wavelength (780 to 950 nm) has more effect in the treatment of deeper tissues (Leal-Junior et al., 2019). Despite the large numbers of studies about the effect of PBM, still no consensus on special protocol or parameters of the application of this therapeutic technique (Zein et al., 2018).

Recently, HILT is used as a new therapeutic modality in the physical therapy and rehabilitation centers, also called Pulsed neodymium-doped yttrium aluminum garnet (Nd:YAG) laser therapy, Class 4 laser therapy, and high power laser therapy (HPLT). This type of laser has power >500mw reach to 12000 mw or higher. The wavelength of HPLT reach to 1064 nm, by these characters HILT produce high energy, deep penetration up to 8-10 cm in a short time. It has a local and systemic effect on the treated part, it helps reduce pain, stimulate soft tissue repair, and reduce inflammation. According to many studies, HILT was found as a non-invasive and safe equipment to improve pain and functional activities among patients with musculoskeletal disorders (Conforti & Fachinetti, 2013; Dundar, Turkmen, Toktas, Solak, & Ulasli, 2015; Ezzati et al., 2020).

2.1.10 Ultrasound therapy (UST)

Ultrasound is an electro physical agent, routinely used by physical therapists for the treatment of painful musculoskeletal conditions (Papadopoulos & Mani, 2020), it is used for more than 50 years for its thermal and non-thermal effect. UST is affecting the soft tissues by acoustic waves that are produced by stimulating a crystal in the head of the apparatus, the output energy with 1Mhz and 3 Mhz. The power of application varies from 0.1 to 3 W/cm^2 depends on the purpose of the application. The depth of the UST effect range from 2.5 cm in 3 MHz to 5 cm in 1 MHz and depends on the type of soft tissue. The absorption of the applied energy higher in the tissues rich in protein such as muscles, cartilage, and bones (Watson, 2008).

The US beam creates longitudinal waves with zones of compression and rarefaction. UST waves pass through materials, producing oscillations of its particles; these oscillations can transfer the energy by compression and rarefaction of the media (Noori et al., 2020). Similarly, when the US waves pass through the tissues will cause vibrations that produce thermal changes

in the tissues, this thermal effect leads to improve the local blood circulation, vasodilatation, increase collagen production, increase the contractility of skeletal muscles, relieve muscles spasm and decline in pain threshold (Aiyer et al., 2020; Yilmaz, Tarakci, & Tarakci, 2020).

As therapeutic ultrasound has a thermal effect it also has a non-thermal effect that comes from the friction between the acoustic waves and the molecules of the soft tissues, non-thermal mechanisms include: ultrasonic cavitation, gas body activation, mechanical stress or frequency resonance (Liu, Ullah, Concepcion, Dahl, & Thakor, 2020; Papadopoulos & Mani, 2020).

The physiological mechanisms of UST (thermal and non-thermal) are interconnected depending on the sitting of the parameters. In the continuous mode, the delivery of US waves is constant throughout the treatment period. While in the pulsed mode, the delivery of US waves is intermittent. The treatment parameters of US can be adjusted according to the patient pathology (Liu et al., 2020) .

2.2 Similar Studies

Alayat, et.al 2016 conducted a randomized double-blind study to investigate the effect of HILT on chronic neck pain, the researcher randomly assigned the patients into two groups, the first group was treated with HILT plus exercise, while the second group was treated with placebo plus exercise for 6 weeks. They used cervical active range of motion (AROM), pain level intensity according to visual analog scale (VAS), and functional activity measured by neck disability index score (NDI) as outcome measures of this study. Both groups showed statistically significant improvement in cervical AROM, while the HILT plus exercise showed more statistical improvement in NDI and VAS (Alayat, Mohamed, Helal, & Khaled, 2016). Moreover, HILT was compared with placebo laser therapy for CNP caused by trapezius myofascial syndrome, the result supported the use of HILT for this type of cervical disorders, also it concluded no significant differences in improvement based on gender or age (Dundar et al., 2015)

The effectiveness of HILT on musculoskeletal disorders MSD was analyzed by a systemic review and meta-analysis; it included 12 randomized controlled trials (RCTs), the results of 11 RCTs showed that significant improvement of pain and disability within the groups treated by HILT. The improvement of neck pain patients was the highest followed by the patients had low

back pain (Song, Seo, Lee, & Kim, 2018).

Also, in a similar study was conducted by Alayat et. al., a total of 72 male patients took part in this study, with mean age of 32.81 years. Participants were randomly assigned into three groups, the first was treated with HILT (power of 3,000 J) plus exercise, the second was placebo laser plus exercise, and the third was HILT alone (power of 3,000 J). The outcome measures were lumber ROM, VAS scale of pain, and functional disability measured by Roland Disability Questionnaire (RDQ) and Modified Oswestry Disability Questionnaire (MODQ). Finally, the results were in favor of HILT plus exercise group (Alayat, Atya, Ali, & Shosha, 2014).

Laser biostimulation effects on patients with a degenerative intervertebral disc (IVD), was assessed by a retrospective study double blind on 60 patients with lumbar Intervertebral Discs degeneration post discectomy surgery, 30 patients underwent laser stimulation, while 30 patients underwent placebo laser therapy. The results showed a higher number of mucopolysaccharides and young newly formed elastic fibers in laser stimulation group, which means laser therapy is an effective method for degenerative intervertebral discs (Tramontana, Sorge, & Page, 2016). The same effect appears on another degenerative disorder which was knee osteoarthritis. HILT seems to be as an efficient intervention in decreasing pain and disability with patients who had knee osteoarthritis OA, a systemic review assessed the effect of HILT on knee OA by analyzing 6 RCTs, the HILT power in this RCTs ranged from 1250 to 3000 joules in every session (Wyszyńska & Bal-Bocheńska, 2018).On the other hand, LLLT and HILT interventions showed no effect on decreasing pain or improving function on patients with lumbar disc degeneration, in this study the researcher randomly assigned 68 participants into 4 groups, group 1was HILT of 1,064 nm, 60 J/cm^2, 10 minutes (HILT), group 2 was (HILT placebo), group 3 was LLLT of 785 nm, 8 J/cm^2, 8 minutes; and group 4 was LLLT placebo (Taradaj et al., 2018).

Photobiomodulation therapy (PBMT) is a non-pharmacological intervention; PBMT successfully has been proven as an effective intervention for patients with neck pain. A systemic review and meta-analysis were conducted to assess the effect of low-level laser therapy LLLT on neck pain (Chow et al., 2009). The results concluded that LLLT is an effective interventions in treating patients with neck pain, but there was no follow - up program in this study.

Evidence of physical therapy interventions on patients with CNP was assessed by a systematic

review of randomized controlled trials. Included different types of exercise, laser therapy, manual therapy, and electrotherapy. Both exercise and laser interventions showed significant improvement of pain and disability (Damgaard et al., 2013). In addition, active specific exercises for neck pain, such as isometric strength exercise, and stretching exercise leads to decrease chronic neck pain and improve ADL (Dundar et al., 2015).

A systematic review done by Selaiman Noori, et al, 2021 assessed whether continuous ultrasound significantly decreases pain scores than other standard therapy or sham in adult patients with chronic non-specific LBP or neck pain, it includes 10 RCTs that used VAS, ODI, and NDI as outcome measurements. They summarized the results as the following, 3 studies of LBP showed significant pain reduction in both therapeutic and sham groups, three of the four studies on neck pain showed no significant pain reduction with ultrasound in combination with other modalities. Conversely, only one of these RCTs demonstrated that using ultrasound showed statistically significant improvement in pain intensity. Finally, the systemic review didn't recommended UST as main modality to decrease LBP, or CNP, it could be used as a combination with other modalities for better effect (Section, 2020).

A recent similar study that compared HILT to the UST in treating CNP was conducted by Rahele Kenareh, et. al, 2021. Sixty participants (43 females and 17 males) were randomly assigned to either group. In Group A (UST), each patient was treated by a skilled physiotherapist (30 minutes/day -the used frequency was 2 MHz) for 10 sessions over 2 weeks. In Group B (HILT), a skilled physiotherapist treated each patient (9 minutes/day) overall sessions completed two-week period. Power, frequency and dosage of the HILT were set at 10 W, 25 Hz and 15 J/cm2 correspondingly for 3 minutes which was sustained for 6 minutes, 7 W power, and 100 J/cm2 dosage. The outcome measures were used: VAS to assess pain, Neck Disability Index (NDI), Neck Pain and Disability Scale (NPDS), and Bournemouth Questionnaire for Neck Pain (BQN). The results showed significant improvement between pre and post-tests in both groups compared to baseline, with statistically more significant improvement in the HILT group, the results also showed a good improvement of the percentage of headache and work ability in both groups (Kenareh, Mirmohammadi, Khatibi, Shamsi, & Mehrparvar, 2021). However, Andréa Oliver, et, al.2022 in their systematic reviews of RCTs showed that HILT is effective in decreasing musculoskeletal pain in general but failed in the management of headaches (Gomes et al., 2022).

The physical therapist frequently use the UST for LBP or neck pain, a systemic review was conducted to assess its effect on chronic LBP and CNP conclude that; the UST may be used as a part of physical therapy sessions, and it may be had a short term effect, but, it does not recommend the use of UST for LBP or CNP (Noori et al., 2020). Both HILT plus exercise and (UST&TENS) plus exercise were effective in the treatment of patients with cervical disc herniation (Yilmaz et al., 2020). Nevertheless, a comparison of HILT and UST was examined by some studies to assess the effect of these two therapeutic modalities on pain and function, the effect of HILT plus exercise is higher than in UST plus exercise on improving pain and function(Fiore et al., 2011; Tantawy, Abdelbasset, Kamel, Alrawaili, & Alsubaie, 2019).

Cervicogenic headache (CGH) is a type of pain originating from cervical (neck) region. It usually disables patients and restrict them from their usual daily activities including work. Many patients with CNP complain of headache. Overview contains six moderate to high quality of systematic reviews studied the effect of physical therapy on cervicogenic headache, the results indicated that manipulation and mobilization had the most significant effect on headache followed by other conservative treatment such as Massage, UST, and laser therapy (Rani, Kulandaivelan, Bansal, & Pawalia, 2019).

Summary

In conclusion, many related similar studies found that HILT as well as UST were effective modalities in treating a variety of musculoskeletal conditions such as cervical pain, low back pain, and osteoarthritis. On the other hand many similar studies did not find a significant improvement by using these modalities in compare to control groups. Also, there is a lack of studies conducted to compare between HILT and UST in treating chronic neck pain.

Evidence suggests that the HILT & UST are particularly effective in decreasing pain, improving function, and range of motion. However, most of the current evidence compared HILT or UST to placebo only. In this study the researcher aimed to compare the HILT with the UST in treating non-specific chronic neck pain.

Chapter Three

Methods and Materials

3.1 Study design

3.2 Study setting

3.3 Study sample

3.4 Data collection

3.5 Suggested program

3.6 Statistical analysis

3.7 Ethical considerations

Introduction

This chapter targets on presenting the sampling method, sample size, inclusion and exclusion criteria, in addition, the methodology of the research represented in the design, data collection tools and procedure, study intervention, and statistical analysis besides to the ethical considerations of this study.

3.1 Study design

This study is a randomized comparative trial design, single-blinded with two groups; the assessor was blinded to the randomization, and to the intervention of the participants. By this design, the random assignment of the participants does not take place until they have been demonstrated to be eligible, have had the details of the study explained, including possible risks and benefits of the therapeutic alternatives, and have then agreed to participate. This comparative study was conducted to evaluate the effect of HILT versus UST on chronic neck pain patients in Hebron/Palestine. This design was chosen as it is a suitable design to answer questions of effectiveness of one method versus another (Ellenberg, 1984; Kim, Lee, & Kim, 2018)

3.2 Study setting

The study was conducted at Al-Hakeem physical therapy center in Hebron / West bank Palestine. It is a private physical therapy center concerns with the treatment of musculoskeletal and spinal disorders.

3.3 Study sample

3.3.1 Sampling method

At baseline, the sample was convenient; the patients of Al-Hakeem center had the right to participate or to refuse participating in the study. Then, all patients were screened for eligibility in the study by the researcher. Subsequently, the participants were randomly assigned into the intervention group or control group. The researcher used the random stratified sampling method, based on special characteristics to be measured on each unit of the sample, and the sample is further subdivided into subpopulations. For estimating the population means of all characteristics (Haq, Ali, & Varshney, 2020); this done in this research by dividing the population into smaller strata. The strata were established based on the age categories (20 to 35 & 36 to 50) and the gender of the participants. The researcher formed the first female group

strata with age (20 to 35), the second female group strata with age (36 to 50), and also, the first male group strata with age (20 to 35), and the second male group strata with age (36 to 50). These sub-groups were done for both HILT and UST groups, accordingly, we had 8 sub-groups. After that, the researcher used systemic randomization of the participants one by one for the 8 sub-groups. (Appendix 1)

3.3.2 Sample size

The study included 43 patients (males and females) with non-specific chronic neck pain, aged from 20 - 50 years. The number of the participants in this study is nearby to other similar studies, but we did not do it depending on the prevalence of chronic neck pain in Palestine because there is no epidemiological study in Palestine to express the size of this disorder among the population (Genebra et al., 2017; Kenareh et al., 2021). The participants with non-specific chronic neck pain were recruited primarily from Alhakeem clinic's clients, or the patients who are referred by orthopedic or neurological physicians, the diagnosing of the participants depends on the orthopedic physicians who refer the participants with non-specific chronic neck pain to our center, also, upon the Dutch guideline for the physical therapists which classifies the patient according to their signs and symptoms. (Bier et al., 2018)

3.3.3 Inclusion criteria

- Males and females (Age 20 to 50 years).
- Neck pain persisted for more than 3 months.
- Current non-specific neck pain.

3.3.4 Exclusion criteria

The patient will be excluded from the study if they have one of the following criteria :

- Red flags (night pain, involuntary loss of weight, neurological deficit).
- Previous cervical operation, vertebral fracture, disc extrusion, Foraminal stenosis, osteophytes, ankylosing spondylitis, cervical myelopathy, psychological disorders, tumors, and pregnant women.
- Physical therapy treatment continued in the last 3 months, and any other medical intervention or medication for the neck pain.

3.4 Data collection

3.4.1 Tools of data collection

Demographic and clinical characteristics Sheet (Appendix 2).

A demographic and clinical characteristics sheet was used to collect personal data of the patient related to (age, sex, marital status, occupation, BMI, Smoking habits, medical conditions, medications, pain duration, aggravating factors and easing factors). Data collection was done by the researcher and the physical therapist after screening for eligibility.

Clinometer

Cervical range of motion was examined by using the inclinometer application on an Apple iPhone 5 smartphone; which is an application on smartphones that measures the angular range of motion of the joints. This method is valid (v=0.99), and reliable (r=0.99) in comparison with the universal goniometer (Wellmon, Gulick, Paterson, & Gulick, 2016). (Figure 3-1) shows a screenshot of the application, the assessor fixes the phone on the head of the patient and asks him/her to do the required movement; the degree of the ROM appears at the end of the movement on the screen of the phone.

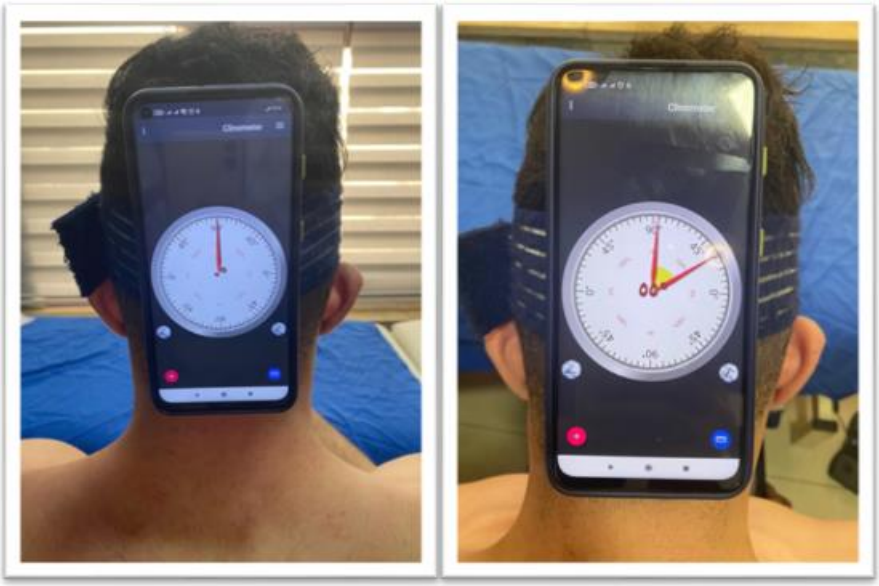


Figure 3- 1 clinometer (ROM of neck flexion)

Visual Analogue Scale VAS

It is a straight horizontal line with a fixed length of 10 cm that is usually used to measure the intensity of pain and symptoms. A numeric rating from left 0 cm (no pain) to right 10 cm (unbearable pain) as shown in (figure 3-2). It is a simple method to determine the severity of pain according to the patient's perception, and easy to see the changes of values later on. The assessor asks the patient to describe his/her level of pain intensity by a number from 0 to 10, the participant sees the graph of the scale and answers about the level of pain according to his/her perception. VAS is a reliable (r = 0.77) and valid (v = 0.51) tool for pain assessment (Aun, Lam, & Collett, 1986; Boonstra, Schiphorst Preuper, Reneman, Posthumus, & Stewart, 2008; Crichton, 2001). (Appendix 3)

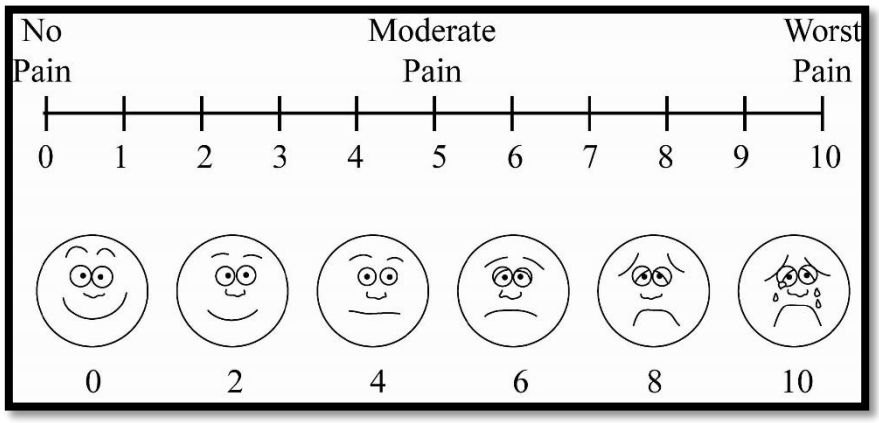


Figure 3-2 visual analog scale

Self-activity assessment by neck disability index (NDI)

The NDI is the most commonly used outcome measure for patients with neck pain, NDI is a questionnaire about the functional status of the participant related to neck pain with 10 items including (pain, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation) (MacDermid et al., 2009). The assessor asks the participant the 10 items of NDI, by clear and unified questions using the Arabic language to answer by the most related choice to his/her functional status. Each item is rated on a scale of 0 to 5, where 0 no pain to 5 the worst pain. The disability categories for NDI are 0-4 point (0–8%) without disability, 5-14 point (10–28%) mild, 15-24 point (30–48%) moderate, 25-34 point (50–68%) serious disability, and 35-50 point (70–100%) complete disability (Cleland, Fritz, Whitman, &

Palmer, 2006). The Intended populations for (NDI) are the patients with chronic neck or upper back pain, musculoskeletal neck pain, whiplash-associated disorders, and cervical radiculopathy and Thoracic Disc Syndrome. The patient will be instructed to answer the question by the most choice that better describes his/her status. (Appendix 4)

NDI is considered as a valid and reliable (r = 0.88) tool to measure neck pain and disabilities in patients with neck pain due to acute or chronic conditions as well as in patients suffering from musculoskeletal dysfunctions, whiplash-associated disorders, and cervical radiculopathy (Young, Dunning, Butts, Mourad, & Cleland, 2019).

3.4.2 Study procedures

All participants were assessed by the same physical therapist two times (pre and post- tests), the first assessment was at the baseline, and the second after 4 weeks of treatment. The patients were allocated randomly into the 2 groups, the first was the intervention group included (23) patients (males and females), were treated with high-intensity laser therapy (HILT) and exercise program; they received 3 sessions weekly in the first two weeks and 2 sessions weekly in the second 2 weeks, the duration of every session is 10 minutes of HILT followed by the exercise program. The second was the control group included (20) patients (males and females), they underwent ultrasound therapy (UST) with the same exercise program. They received 3 sessions weekly in the first two weeks and 2 sessions weekly in the second 2 weeks, the duration of every session is 10 minutes of UST followed by the exercise program. (See figure 3-3)

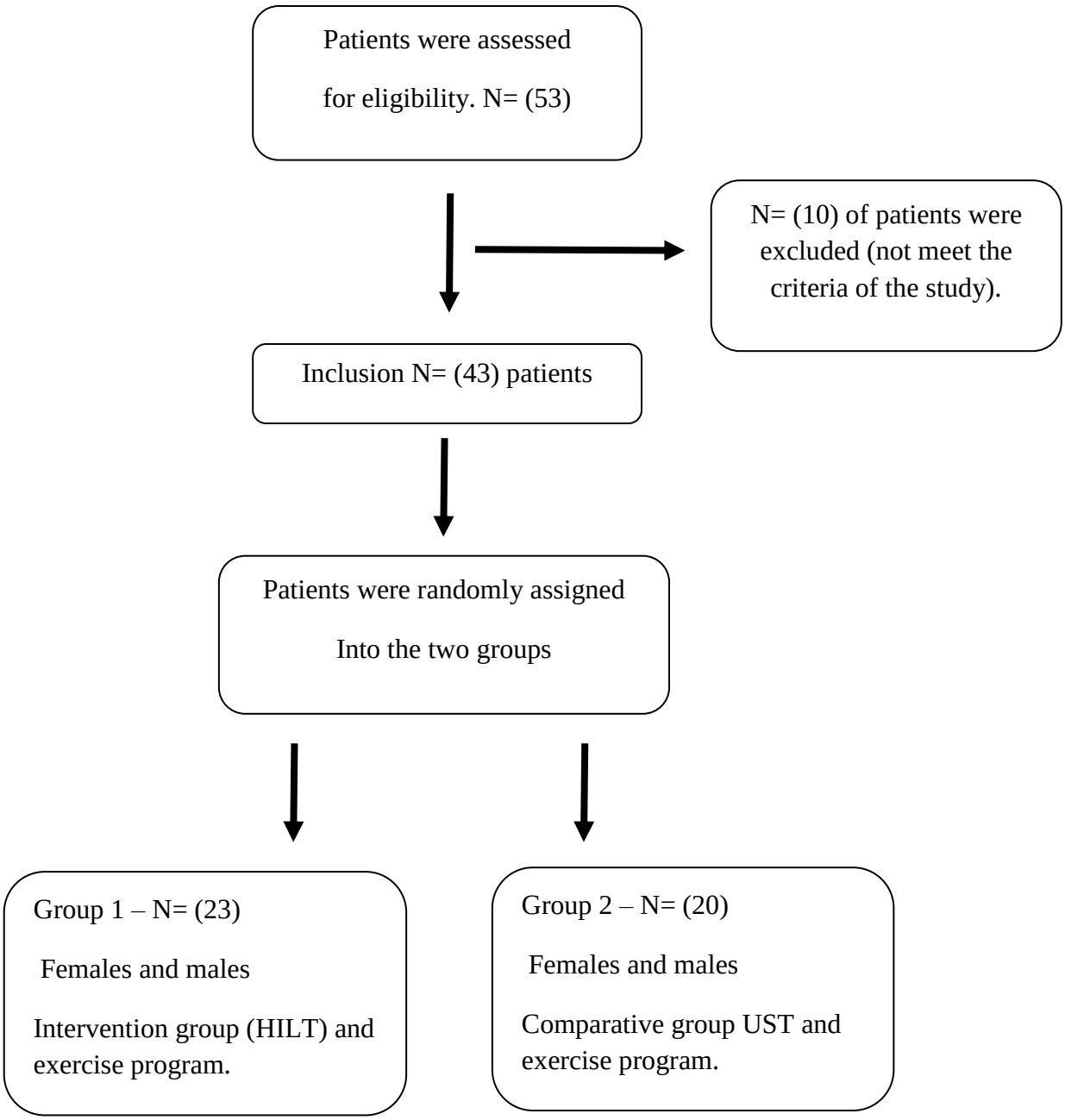


Figure 3-3 flow chart of the participants

3.5 Suggested program

- **The program of the intervention group** consisted of 10 sessions through one month, the participants in this group received HILT with exercises, through 3 sessions weekly for the first 2 weeks and 2 sessions weekly for the third and fourth week. The physical therapist applied HILT by using a device Zimmer Optopro High power laser (high power laser apparatus made in Germany, with wavelength 980 nm and maximum power 7 watts), (figure 3-4).

Figure 3-4 Zimmer opton pro high power laser

- The device was set on pulse mode 1:1, frequency 10Hz, and power of 5 watts as shown in (figure 3-5). The application of HILT was through a combination of static and dynamic techniques, with a head spacer 25mm, the patient received 2000 joule every session on the trigger points, trapezius and cervical para-spinal muscles, the total duration of HILT application was 10 minutes for each session.

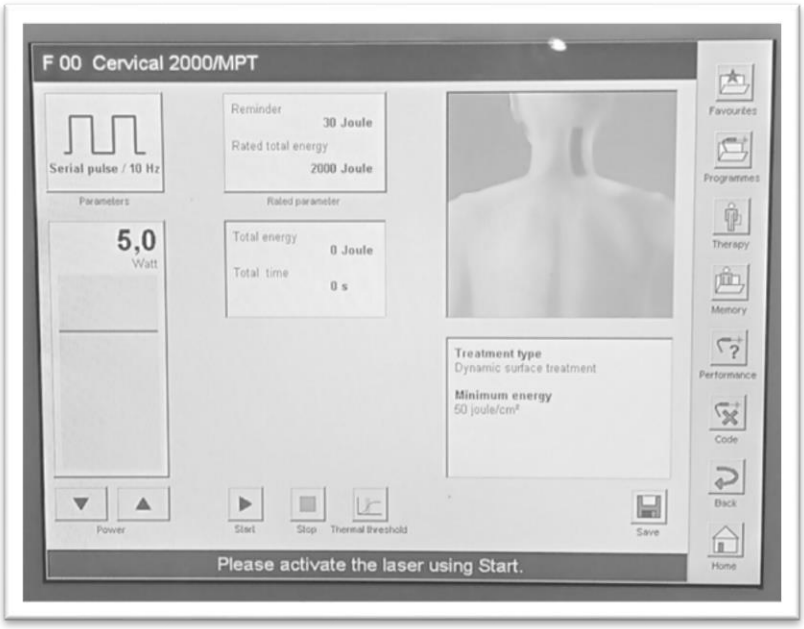


Figure 3-5 the parameters of HILT, the screen of the apparatus

The pattern of application was as the following, in the first stage the therapist did scanning on the para-vertebral and trapezius muscles for 850 joules, the second stage included a static application over 10 trigger points (mid trapezius, transfer process of C_4,C_7,T_2 and T_4), for 30 joules for each point, the duration of static application on every point was 6 seconds, as shown in (figure 3-6), the last stage included scanning for 850 joules same to the first stage area (Alayat et al., 2016; Dundar et al., 2015)

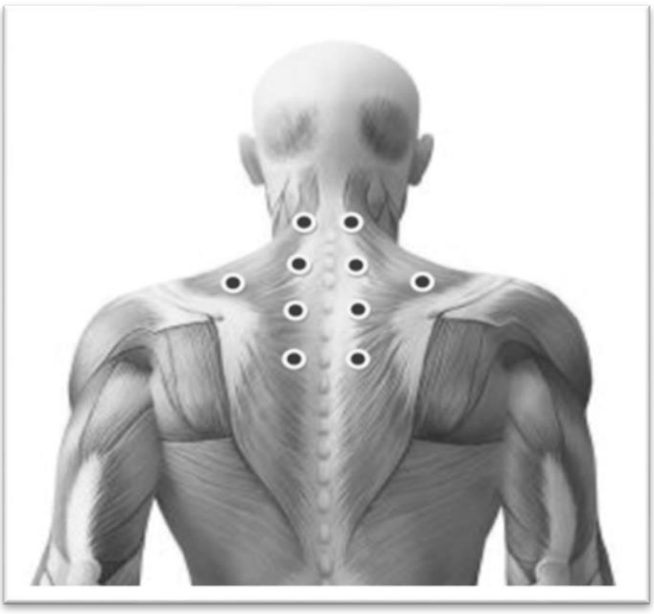


Figure 3-6 the trigger point, on which the Therapist will apply static HILT 30 joule for each point

The patient was placed in a sitting position on a chair, his/her hands on the bed and the head over the hands (figure 3-7) The position of the therapist was sitting behind the patient and wearing protective eyes glasses.

After the intervention, the therapist demonstrates a home exercise program to both groups which include active therapeutic exercises(Bernal-Utrera, González-Gerez, Saavedra-Hernandez, Lérida-Ortega, & Rodríguez-Blanco, 2019), will be applied as described in table 3-1.

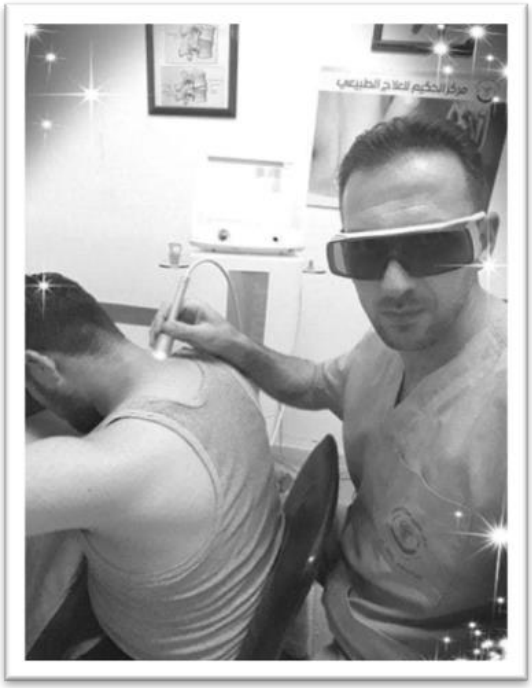
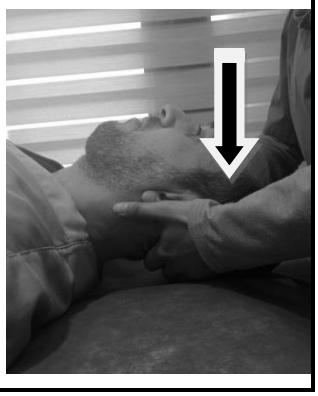


Figure 3-7 position of patient and therapist during application of HILT

Table 3-1 Active cervical exercise program for both HILT and UST group

Exercise program
First week - Isometric cervical extension exercise, the therapist ask the patient to press his/her occiput on the hands of the therapist, hold 5-10 seconds, then relax and do it 10 repetition - In the first week, this exercise will be applied in the center - In the next 3 weeks the patient will do it at the home by press his occiput on a cushion, 3 times a day 

Second week

- In addition to the first exercise.
- The patient actively do isometric chin in exercise against his/her hand for 10 repetitions, hold each time for 5-10 seconds
- Do the exercise 3 times a day at home

Third week

- In addition to the previous 2 exercises.
- The patient do active cervical flexion, extension and rotation exercise, also for 20 repetitions for each exercise
- Do the exercise 3 times a day at home.

Fourth week

- Both shoulders flexion exercise, the patient actively join his/her hands and doing full shoulders flexion to the maximum range, done for 20 repetition and asked to do it 3 times a day.
- Besides the exercises of the previous 3 weeks.

- **The program of the control group** received10 sessions of UST, through 3 sessions weekly for the first 2 weeks and 2 sessions weekly for the third and fourth weeks, the application of UST was done by a device (Primo EMS ultrasound, made in the UK, the device produces ultrasound waves for 1MHz and 3MHz, pulse and continuous, head size 4 cm^2) as shown in (figure10). The application of UST was done by setting the device on 1MHz, 1.5 W/cm^2, and continuous mode for 10 minutes. The position of the patient and the therapist was similar to the intervention group; the patient was in a sitting position and the therapist sit behind, and apply the UST by slow circular movement on the para-vertebral area from C_4 to T_4 on both sides. After UST the therapist teach the patient the same previous active exercise program (table3-1).

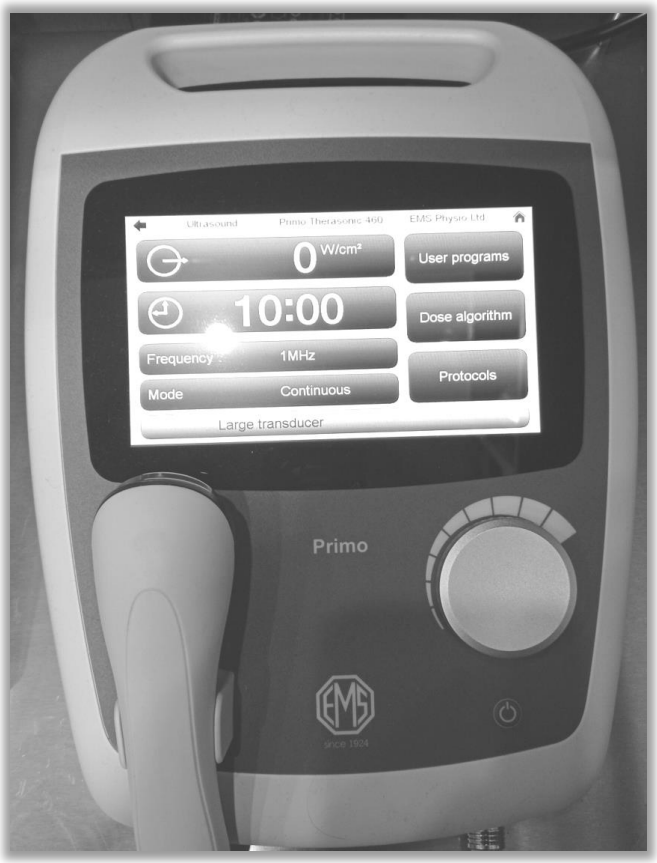


Figure 3-8 Primo EMS ultrasound device

3.6 Statistical analysis

Statistical analysis was performed via the Statistical Package for the Social Sciences (SPSS) package, version 23 (SPSS Inc., Chicago, IL). Descriptive statistics (frequencies, means, and standard deviation) were performed to characterize the sample according to age and sex. Inferential statistics, paired sample and t-test were conducted to determine the differences between pre-tests and post-tests for the two groups. And the Independent sample t-tests were performed to compare between the mean differences of the studied variables in the two groups at post-tests. The researcher used Pearson's correlation to assess the association between the pain severity, cervical mobility, and the functional ability among patients with CNP according to sex and gender. Statistical significance was set at $P < 0.05$.

3.7 Ethical considerations

The study approval was obtained from the MPT committee, and the Research Ethical Committee at Al Quds University (Appendix 5) which is in accordance with the Declaration of Helsinki. The participants were fully informed about the procedures and the study purposes before s/he recruited to the study. Participants had the right to refuse or to withdraw from the study at any time without any restrictions. Written informed consent was signed before randomization. To ensure the patient's confidentiality, all patients' records were processed anonymously.

Chapter Four

Results Presentation, Analysis & Discussion

4.1 Results presentation and analysis

4.2 Results Discussion

4.3 Study Limitation

4.1 Results presentation and analysis

Recruitment and follow-up process

Patients were recruited from Al-Hakeem center, 23 patients underwent high- intensity laser therapy (HILT), while 20 patients underwent ultrasound therapy (UST). Both groups had pre-test at the admission and post-test at the discharge.

4.1.1 Descriptive Statistics of variables

Age of participants

The mean age of the whole participants in the study was **33.40 ± 8.7.** The average ages of the participants in the HILT group was **34.35 ± 8.8**, whereas the average age of the UST was **32.30 ± 8.6** (Figure 4.1). No significant differences were recorded according to age between the two groups P value = .4405.

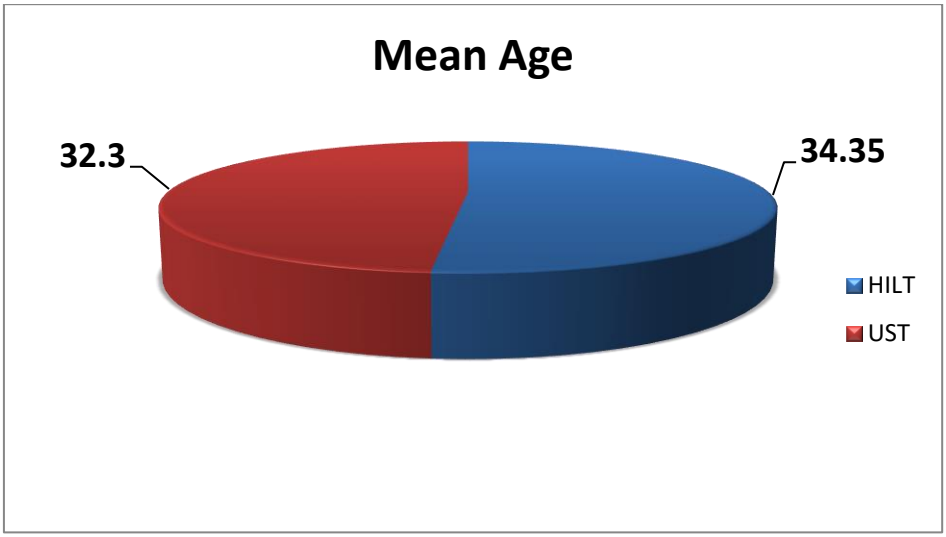


Figure 4-1 Mean Age of the Participants

Gender of participants

The study sample was divided into two groups, HILT group (23) and UST group (20), The HILT group included (**9**), **39.1%** Males and (**14**), **60.9%** Females, also, UST group included (**8**), **40%** Males and (**12**), **60%** Females. Females' percentages were higher in the both group (Figure 4.2)

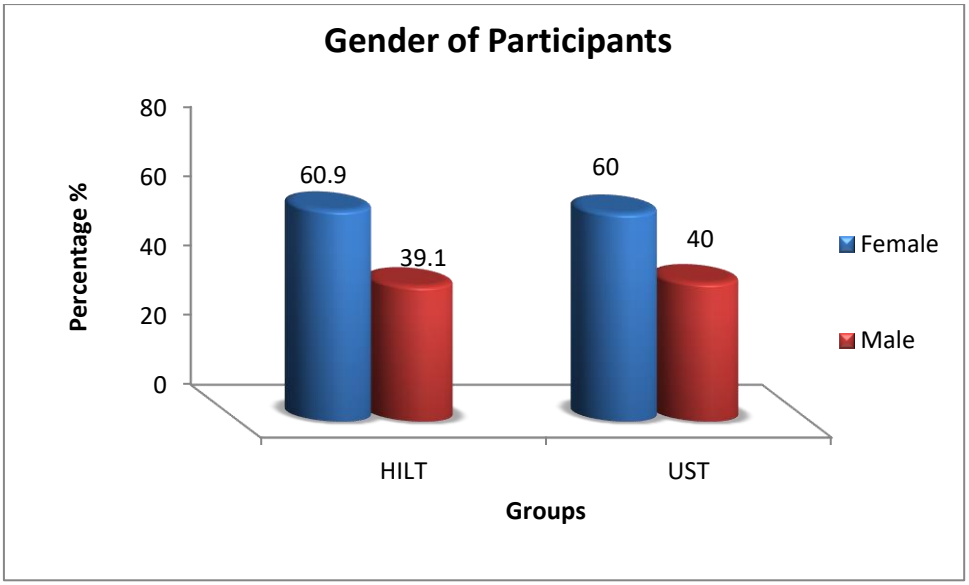


Figure 4-2 Gender of the Participants

BMI of participants.

Body Mass Index (BMI) mean of HILT group was **26.49/SD was 5**, while it was **25.46** in UST group with SD of **5.7**. No significant differences were recorded according to BMI between the two groups P value = .61 >.05.figure 4.3.

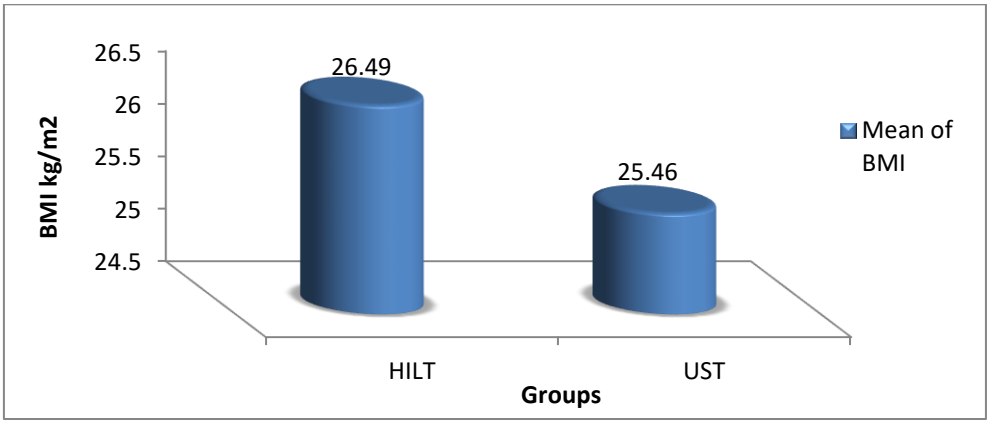


Figure 4- 3 BMI of the Participants

Regarding BMI Categorization of the Participants, in HILT group, the distribution was: **10**(**43.5%**) participants had normal BMI, **8**(**34.8%**) were over- weight, and **5(21.7%**) were obese, while in the UST group, **12**(**60%**) participants had normal weight, **4**(**20%**) were overweight, and **4**(**20%**) were obese Figure 4.4.

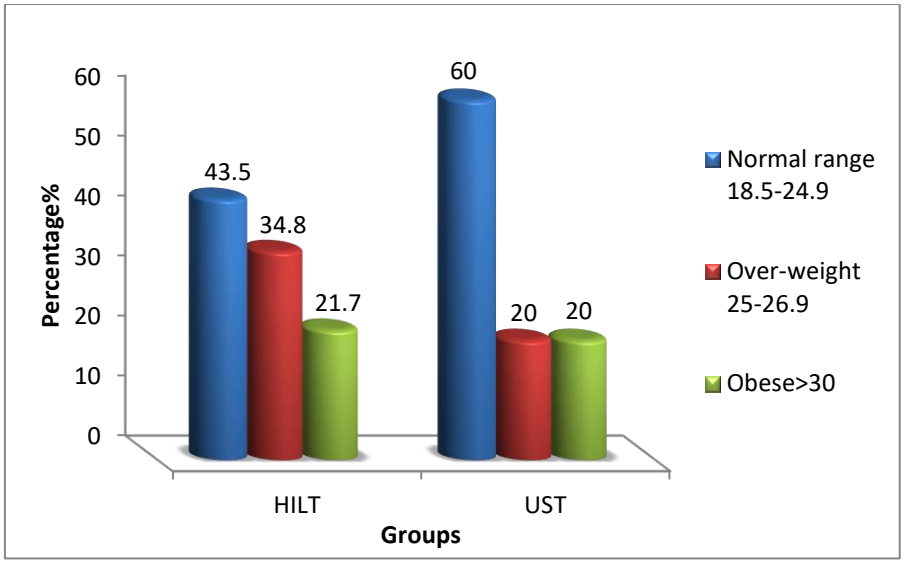


Figure 4- 4 BMI categories of the Participants

Occupation of the participants

Regarding the occupation of the Participants, in HILT group, the distribution was: 6(26.1%) of the participants were officers, 9(39.1%) were housewives, and 8(34.8%) were workers. On the other hand, UST group had, 10(50%) of the participants were officers, 3(15%) were housewives, and 7 (35%) were workers. Figure 4.5.

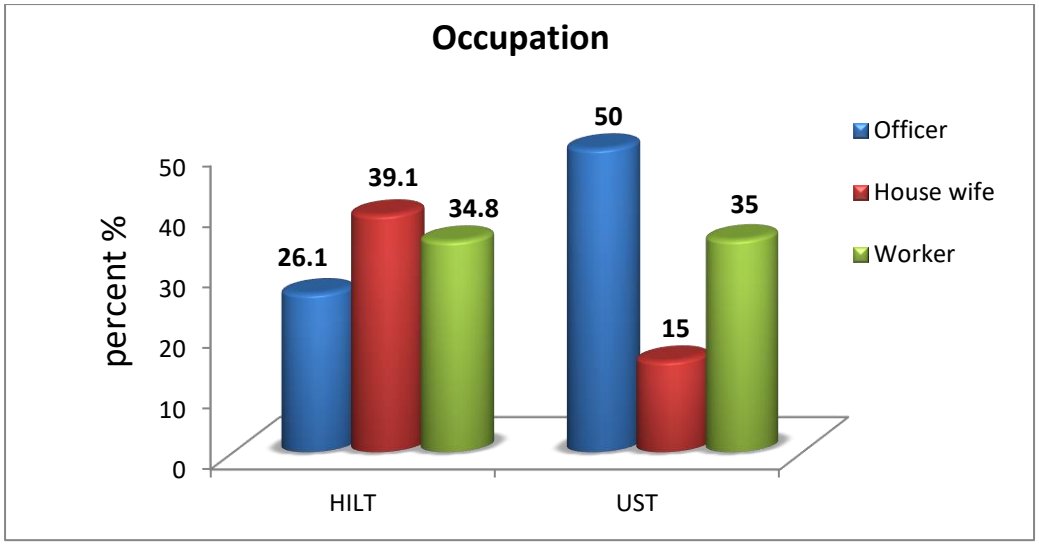


Figure 4- 5 the Participants Occupation

History of Smoking

In the HILT group **8(34.8%)** of the participants were smokers, and **15(65.2%)** were non-smokers, while in the UST group the distribution was **8(40%)** smokers, and **12(60%)** were non-smokers. (Figure 4-6).

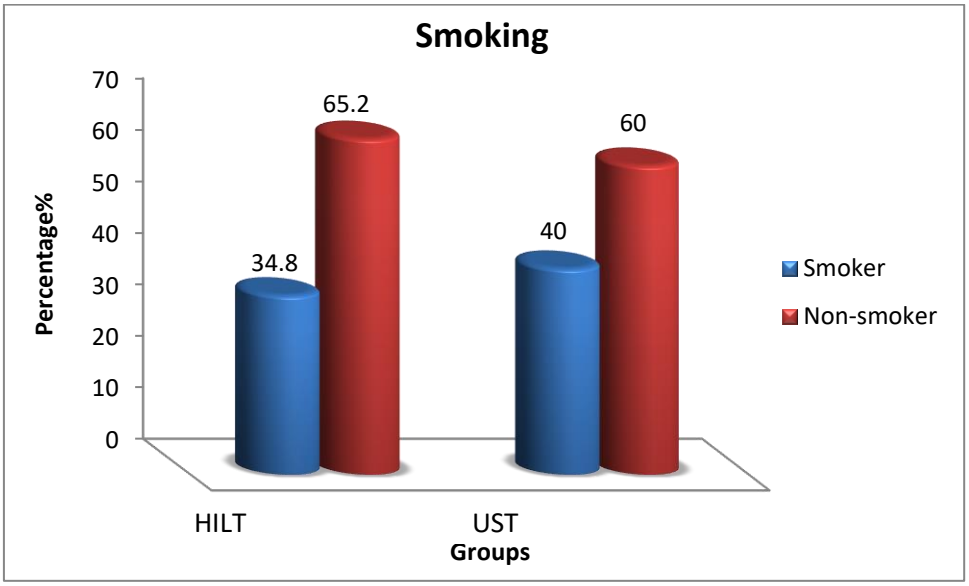


Figure 4- 6 History of smoking

Normality distributed of the parametric data

Normality test of all study variables among the study groups (HILT and UST) was conducted before starting the data analysis. The test of Shapiro-Wilk test was used for this purpose, and the following table (Table 4.1) shows the results of this test:

Table 4-1 the results of Shapiro-Wilk Normality Test

Study variables	Shapiro-Wilk		
	Statistic	df	Sig.
Neck Disability Index percent pre intervention	.970	43	.326
Visual Analogue Scale-Pain Intensity pre intervention	.908	43	.102
Neck Flexion Range of motion pre intervention	.965	43	.202

Neck Extension Range of motion pre intervention	.962	43	.161
Rt Neck Rotation Range of motion pre intervention	.916	43	.34
Lt Neck Rotation Range of motion pre intervention	.959	43	.125
Rt Neck Lateral Flexion Range of motion pre intervention	.935	43	.117
Lt Neck Lateral Flexion Range of motion post intervention	.978	43	.573

The results of the normality test in the table above showed that the study variables of both groups (HILT, UST) were normally distributed since the P-values of the Shapiro test are higher than 0.05, so there was no significant differences in the participants' variables at the pre-test. Shapiro-Wilk Normality Test used for small study samples N>60, the results ensure that the normality condition of study variables were satisfied, and it is allowed to use Parametric statistical methods in this research, since the N=43, and based on the central limit theory, they can be analyzed using parametric tests.

4.1.2 Inferential statistical analysis of the tested variables

First test: Visual Analogue scale VAS

Testing variables in between groups at baseline and post-test for both groups

The results in Table 4.2 shows significant difference in pre-test and post-test of VAS among HILT group, P value was .000; also it shows significant difference in pre and post-test of VAS among UST group, P value was .000. Pain was significantly decreased in both groups.

Table 4- 2 Testing VAS Mean at baseline and post-test of both groups

Test	VAS at baseline ± SD	VAS at discharge ±SD	Difference	df	t-test	Sig.
VAS in HILT	7.30 ±1.39	2.91 ±1.50	4.39	22	12.59	.000
VAS in UST	7.90 ±1.48	3.90 ±2.02	4	19	7.96	.000

Testing VAS in between groups at post-test of both groups

Table 4.3 Shows the mean and SD at post-test of VAS in the HILT and UST. The results shows that there was no significant difference between the HILT and UST groups in pain intensity (VAS) at post-test (P = .082 >0.05),

Table 4- 3 VAS (Post the intervention in 2 groups)

Test	Mean post HILT±SD	Mean post UST±SD	Mean Difference	T test	df	Sig.(2 tailed)
VAS	2.91 ±1.50	3.90 ±2.02	.98	-1.97	34.7	.082

In Visual Analogue Scale (VAS), the HILT group VAS Improves from 7.30 at pre-test to 2.91 at post-test, while UST group improves from 7.90 to 3.90, as showed in Figure 4-7.

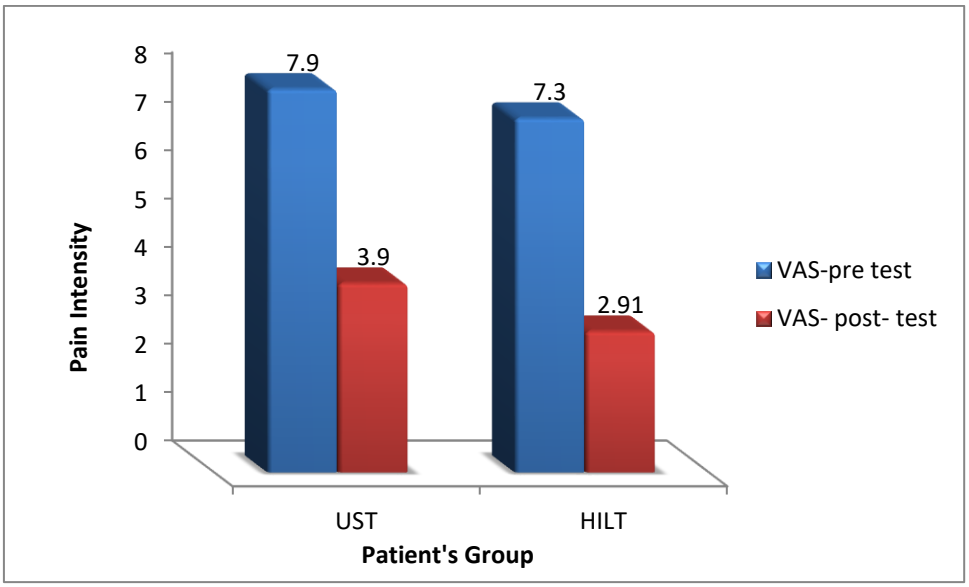


Figure 4- 7. VAS means' differences in both groups pre-test and post-test

Second Test: Neck Disability Index (NDI)

The NDI consists of 10 items including pain, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation(MacDermid et al., 2009). The patient stated his/her most appropriate status related to neck pain.

The following three items (pain, headache and work) show the prognosis of patients' conditions in these items.

Pain intensity

Table 4.4 exhibits pain intensity in both groups pre-test and post-test, it shows that pain intensity decreased in both groups. For example," very severe pain" status decrease in HILT group from 30% to 0% and in UST group from 20% to 0%. Moreover "very mild pain" status increased from 8.7% to 65.2% in HILT group and from 10% to 50% in UST group.

Table 4- 4 The pain intensity in NDI of both groups (pre and post-test)

Patient Group		**Frequency And percent Pre-test N (%)**	**Frequency And percent Post-test N (%)**
HILT	No pain	0 (0)	3(13.0)
	Very mild	2(8.7)	15(65.2)
	Moderate	6(26.1)	3(13.0)
	Fairly sever	6(26.1)	2(8.7)
	Very severe	7(30.4)	0(0)
	The worst imaginable	2(8.7)	0(0)
UST	No pain	0(0)	2(10.0)
	very mild	2(10.0)	10(50.0)
	Moderate	4(20.0)	6(30)
	Fairly sever	7(35.0)	2(10)
	Very severe	4(20.0)	0(0)
	The worst imaginable	3(15.0)	0(0)

Work

Table 4.5 below shows how hard the patient did his/her work before the intervention in both groups. It shows that working became easier in both groups. For example, the status “I can hardly do any work at all "in the NDI scale decreased from 39.1 to 4.3 in HILT group, and from 25% to 0% in UST at post-test. In addition, the status “I can do as much work as I want" in the NDI scale increased from 13% to 39.1% in the HILT group, and increase from 15% to 55% in UST groups at post-test.

Table 4- 5 the work item in NDI of both groups (pre and post-test)

Patient Group		**Frequency And percent Pre-test N (%)**	**Frequency And percent Post-test N (%)**
HILT	I can do as much work as I want to	3 (13.0)	9 (39.1)
	I can only do my usual work, but no more	1 (4.3)	12 (52.2)
	I can do most of my usual work, but no more	8 (34.8)	1 (4.3)
	I cannot do my usual work	2 (8.7)	0 (0)
	I can hardly do any work at all	9 (39.1)	1 (4.3)
UST	I can do as much work as I want to	3 (15.0)	11 (55.0)
	I can do most of my usual work, but no more	12 (60.0)	8 (40.0)
	I can only do my usual work, but no more	0 (0)	1 (5.0)
	I can hardly do any work at all	5 (25.0)	0 (0)

Headache

Table 4.6 shows headache severity among both groups’ pre and post-test, it shows that headache decreased in both groups. For example," I have severe headaches, which come frequently "status disappeared in both groups at post-test; it decreases from 30.4% to 0% in HILT group and from 35% to 0% in UST group. Moreover "I have no headaches at all" item increased from 4.3% to 34.8% in the HILT, and from 20% to 65% in UST groups.

Table 4- 6 The headache in the NDI of both groups (pre and post-test)

Patient group		Frequency and percent Pre-test N (%)	Frequency and percent Post-test N (%)
HILT	I have no headaches at all	1 (4.3)	8 (34.8)
	I have slight headaches, which come infrequently	6 (26.1)	11 (47.8)
	I have moderate headaches, which come infrequently	0 (0)	3 (13.0)
	I have moderate headaches, which come frequently	5 (21.7)	1 (4.3)
	I have severe headaches, which come frequently	7 (30.4)	0 (0)
	I have headaches almost all the time	4 (17.4)	0 (0)
UST	I have no headaches at all	4 (20.0)	13 (65.0)
	I have slight headaches, which come infrequently	3 (15.0)	2 (10.0)
	I have moderate headaches, which come infrequently	1 (5.0)	0 (0)
	I have moderate headaches, which come frequently	3 (15.0)	4 (20.0)
	I have severe headaches, which come frequently	7 (35.0)	0 (0)
	I have headaches almost all the time	2 (10.0)	1 (5.0)

Difference between pre-test and post-test mean of Neck Disability Index (NDI) among both groups

Table 4.7 Display the mean and SD at pre-test and post-test for NDI in the HILT & UST groups. This demonstrates that there was a significant difference between the pre and post- test in NDI of HILT group P value was .000, and there was a significant difference between the pre and post- test in NDI of UST group P value was .000. NDI scores improved in both groups.

Table 4- 7 Testing NDI Mean at pre-test and post-test for both groups

Test	Mean of NDI at baseline ± SD	Mean of NDI at discharge ±SD	Difference	Df	T-test	Sig.
NDI of HILT	45.22 ±13.29	13.65 ± 9.96	31.57	22	10.8	.000
NDI of UST	37.5 ±11.8	12.10 ±8.35	25.40	19	9.85	.000

Difference of mean Neck disability index percentage (NDI) post-tests In HILT and UST groups.

Table 4.8 Showed the mean and SD at post-test for NDI among HILT and UST groups. This exhibits that there was no significant difference between HILT and UST groups at post-test (P = .59 > 0.05).

Table 4- 8 (Post-test of NDI in 2 groups)

Test	Mean posttest HILT± SD	Mean post UST± SD	Mean Difference	t- test	df	Sig.(2 tailed)
NDI	13.65 ±9.96	12.01±8.53	1.55	.56	41	.59

Neck Disability Index (NDI) of the HILT group improved from 45.22 at pre-test to 13.65 at post-test. While, UST group NDI scores improved from 37.5 to 12.10 as figure 4-8 shows.

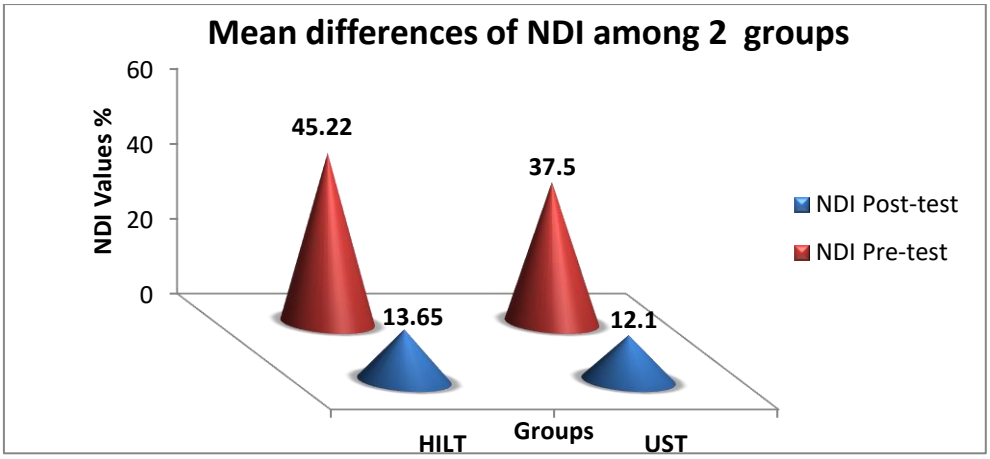


Figure 4- 8 NDI mean differences between both groups at pre-test and post-test

Difference between baseline and post-test mean of Neck ROM among Both groups

Table 4.9 exhibits the mean and SD at baseline and post-test for Neck ROM in the HILT & UST groups. This demonstrates that there was a significant difference between pre-test and post-test in both groups (P= .000 <0.05).

Table 4-9 Testing variables within the both groups between pre-test and post-test

	HILT Group			UST Group		
Testing variables	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	P-value	Pre-intervention Mean ± SD	Post--intervention Mean ± SD	P-value
Neck Flexion ROM	53.22 ± 14.2	62.48 ±8.92	0.000	60.25 ±13.3	67.50 ±12.2	0.000
Neck Extension ROM	58.8 ±16.95	68.22 ±12.1	0.001	53.2 ±16.4	63.9 ±15.8	0.003
RT Neck Rotation	63.8 ±12.85	71.7 ±11.1	0.000	65.7±12.4	73.4 ±9.3	0.001
LT Neck Rotation	66.4 ±12.4	73.7 ±11.8	0.000	64.3 ±14.5	72.5 ±11.1	0.002
RT Neck Lateral – flexion	38.7 ±7.2	47.6 ±8.3	0.000	44.7 ±11.05	54.7 ±14.1	0.001
LT Neck Lateral – flexion	47.3 ±10.9	54.04 ±8.3	0.000	41.7 ±12.1	50.7 ±10.6	0.000

Difference of mean neck range of motion post-tests In HILT and UST groups.

Table 4.1 Showed the mean and SD at post-test for neck ROM among HILT and UST groups. This exhibits that there was no significant difference between HILT and UST groups at post-test (P > 0.05).

Table 4-10 (Post-test of neck ROM in 2 groups).

Tested item	Patient Group	Mean & Std. Deviation	t-test	Sig. (2-tailed)
Neck Flexion Range of motion post intervention	HILT	62.48± 8.9	-1.517	.139
	UST	67.50±12.2		
Neck Extension Range of motion post intervention	HILT	68.22±12.0	.983	.332
	UST	63.95±15.8		
Rt Neck Rotation Range of motion post intervention	HILT	71.17±11.0	-.634	.530
	UST	73.15±9.3		
Lt Neck Rotation Range of motion post intervention	HILT	73.96±11.8	.400	.691
	UST	72.55±11.1		
Rt Neck Lateral Flexion Range of motion post intervention	HILT	47.57±8.2	-1.987	.056
	UST	54.70±14.0		
Lt Neck Lateral Flexion Range of motion post intervention	HILT	54.04±8.2	1.137	.263
	UST	50.70±10.6		

Correlations between Study variables:

Table 4.11 shows that Age was not significantly correlated with any of the dependent variables (VAS, NDI, ROM), as it did not show any statistically significant correlation (p>0.05). Statistical significance for α was set at (P<0.05).

Table 4- 11 Pearson correlation between Age and the dependent variable of the study

Age variable with outcomes.	Pearson- correlations	Sig
Pre-VAS	.125	.42
Post-VAS	.092	.559
Pre- NDI	.23	.084
Post NDI	.084	.591
Pre-flexion	-.224	.148
Post- flexion	-.214	.169
Pre- neck extension	-.194	.213
Post- neck extension	-.145	.353
Pre RT- Neck rotation	-.078	.619
Post RT- Neck rotation	-.142	.37
Pre LT- Neck rotation	-.158	.31
Post LT- Neck rotation	-.30	.046
Pre RT- Neck lateral flexion	-.14	.92
Post RT- Neck lateral flexion	-.112	.47
Pre LT- Neck lateral flexion	-.090	.56
Post LT- Neck lateral flexion	-.122	.47

Bivariate Difference of mean:

Differences according to Gender:

Independent sample t-test done in pre and post (VAS and NDI) among gender, shows that there is no mean differences in the tested item among different gender, p value > .05.

Table 4.12 exhibits there is no statistical significant mean differences between male and female in the pre and post VAS, pre and post NDI p value > 005.

Table 4- 12 Differences of VAS and NDI among Gender

Tested items	Gender	Mean ± SD	T	Df	Mean differences	Sig (2 tailed)
Pre VAS	Male	8.00 ±1.6	1.55	41	.692	.128
	Female	7.31 ±1.32				
Post VAS	Male	2.76 ±1.85	1.83	41	1.005	.075
	Female	3.77 ±1.7				
Pre NDI	Male	40.94 ±10.68	.28	41	1.136	.784
	Female	42.08 ±14.6				
Post NDI	Male	10.82 ±9.4	1.22	41	3.48	.23
	Female	14.31 ±8.9				

Independent sample t-test done in pre and post (VAS and NDI) among Age categories, shows that there was no significant differences in the tested item among different age categories, p value >0.05. Table 4.13 exhibits there is no statistical significant mean differences between different age categories in the pre and post VAS, pre and post NDI p value > 005.

Table 4-13 Differences of VAS and NDI among the two age categories.

Tested items	Gender	Mean ± SD	T	Df	Mean differences	Sig (2 tailed)
Pre VAS	20 years old to 35 years old	7.52±1.53	-.288-	41	-.128-	.775
	36 years old to 50 years old	7.65±1.38				
Post VAS	20 years old to 35 years old	3.30±1.9	0.259	41	-0.146	0.796
	36 years old to 50 years old	3.45±1.7				
Pre NDI	20 years old to 35 years old	39.83±12.2	-0.969	41	-3.874-	.338
	36 years old to 50 years old	43.7±14.01				
Post NDI	20 years old to 34 years old	12.09±9.2	-.642-	41	-1.813	-0.642
	35 years old to 50 years old	13.9± 9.3				

Independent sample t-test done in pre and post (Neck ROM) among Gender, shows that there was no significant mean differences in the tested item among male or female , p value > .05.

Table 4.14 shows that there were no statistical significant mean differences between different gender in the pre and post ROM of the neck as the p value > 005.

Table 4- 14 Differences of Neck ROM among Gender

Neck ROM	Gender Mean ± SD		Sig	
	Male	Females	male	female
Neck Flexion Range of motion post intervention	65.71±10.20	64.23±11.2	.67	.14
Neck Extension Range of motion post intervention	70.12±12.55	63.69±14.4	.13	.74
Rt Neck Rotation Range of motion post intervention	72.71±8.78	71.69±11.24	.08	.73
Lt Neck Rotation Range of motion post intervention	73.71±11.18	73.04±11.8	.08	.68
Rt Neck Lateral Flexion Range of motion post intervention	54.76±1215	48.35±11.013	.6	.056
Lt Neck Lateral Flexion Range of motion post intervention	53.12±9.8	52.08±9.4	.4	.19
Neck Flexion Range of motion pre intervention	55.76±15	56.96±13.7	.8	.08
Neck Extension Range of motion pre intervention	61.65±15.5	52.65±16.5	.087	.68
Rt Neck Rotation Range of motion pre intervention	65.65±12.3	64.04±12.7	.59	.20
Lt Neck Rotation Range of motion pre intervention	66.76±12.3	64.54±14.1	.41	.43
Rt Neck Lateral Flexion Range of motion pre intervention	45.65±8.95	38.81±9.1	.6	.5
Lt Neck Lateral Flexion Range of motion pre intervention	42.82±13.3	45.85±10.6	.45	.3

4.2 Results Discussion

This study was conducted to compare the efficacy of HILT combined with Exercise to UST combined with Exercise in the treatment of patients with CNP. Overall, both modalities effectively decreased VAS, decreased NDI scores, and increased cervical AROM after 10 sessions of the intervention.

The average age of the HILT group was **33.4 years**, while the average age of the UST group was **32.3** years, which was expected as the range of the inclusion criteria was between 20-50 years.

In terms of gender, in the current study, female was the predominance gender in both groups, they constitutes **60%** of the participants in each group, previous studies identified significant associations between the severity of musculoskeletal pain and female gender(Henriette, 2020; Jiménez-Trujillo et al., 2019; Shariat et al., 2018). The reason for this could be directly related to poor posture, as poor posture usually resulted in muscle fatigue and more muscle fibers recruitment over time as a compensatory motion potentially leading to injury to the muscles triggering pain and chronic fatigue(Dangayach, Meena, Chaudhary, & Singh, 2018; Kocur, Wilski, Lewandowski, & Łochyński, 2019). In addition, this result could be possibly related to the frequent physical use of this anatomical region (neck) in doing ADLs more in female than male(Dangayach et al., 2018).

According to participant's weight, BMI mean of HILT group was **26.49**, while BMI mean in UST group was **25.46** , these numbers categorized as "overweight" as reported by the National Collaborating Centre for Primary Care (UK, 2006). Around **56.5%** of HILT group in this study had overweight or obesity, compared to **40%** in the UST group who had overweight or obesity, suggesting that adults with higher BMI could be at risk of CNP. This study findings are similar to a recent systematic review findings, in which BMI considered one of the most important risk factors of having chronic neck pain (Henriette, 2020). A high amount of adipose tissue and decrease lean body mass around the joints and muscles could restrict a person’s movements, thus stressing musculoskeletal tissues resulting in pain and discomfort. This is why ergonomic recommendations have been made in an attempt to improve work capacity (Chowdhury, Zhou, Wan, Reddy, & Zhang, 2021).

Regarding to participants work, the results showed that the participants in the current study divided into 3 main occupations: officers, housewives, and workers. These results were understandable, as these types of occupations need physical efforts more than others (Mahmoud et al., 2019). Similar findings were recorded in a longitudinal study (Marins, Andrade, Peixoto, & Silva, 2020) that conducted to determine risk factors for the development of non-specific neck pain among office workers. The study concluded that both psychosocial (stress, workload) and physical behaviors (postural deviations and extended siting time) play a major role in the development of interfering neck pain among office workers. They argued that increased sitting hours during week, and higher levels of work strain and psychological stress were linked with increased risk of neck pain , and they estimated that extended time of sitting will increase the possibility of having non-specific neck pain by 4% (Marins et al., 2020).

One of the core findings in this study was that there is a significant reduction of pain intensity according to (VAS) scale between pre and posttest in both groups compared to baseline, with no statistically significant in favor to any group. The intensity of pain is decreased by the physiological effect of both modalities which leads to an increase in the blood supply of deep tissues and improves the flexibility of the cervical muscles. This result is similar to Song HJ, et.al.2018 systematic review and meta-analysis that conducted to assess the effect of HILT in treating musculoskeletal disorders (LBP and CNP), analyzed 11 studies, comprising 736 patients, they concluded that HILT is more efficient in decreasing pain and disability than the control group (Song et al., 2018). However, Rahele Kenareh, et.al, 2021 study showed statistical improvements for both group in pain and disability with more improvements in favor of HILT group (Kenareh et al., 2021). In addition, these results consistent with the findings of other studies Tantawy and Fiore on chronic low back pain which showed significant pain reduction of HILT group on VAS scale compared to the UST group (Fiore et al., 2011; Tantawy et al., 2019).

Regarding to Neck Disability Index (NDI) results, there were significant improvements of NDI total scores between pre and posttest in both groups compared to baseline, while, the total score of NDI was higher by **6 degrees** for the favor of HILT group, however this improvement was **not** statistically significant. This significant improvement occurs as a result of both interventions on the cervical muscles and soft tissues, both HILT and UST lead to decrease muscles spasm and increased blood supply in the treated area, which lead to decreased pain intensity and improve the function of the patient. The same improvements were recorded in Umit Dundar, et. al. 2014 (Dundar et al., 2015), and Alayat, et.al 2016 (Alayat et al., 2016)

studies' results in which HILT compared to sham in treating CNP, but NDI scores improved significantly in HILT group. Also, in a study by Rahele Kenareh, et.al, 2021, the results showed that HILT was more effective than UST in improving NDI total scores among CNP patients (Kenareh et al., 2021).

Chronic Neck Pain usually results in problems in work and functional capacity experienced by any person (housewife, office worker, or physical worker, etc.). Moreover, Severe CNP is associated with work performance. For instance, it decreases work ability and increases the number of sick leaves (Hallman, Holtermann, Dencker-Larsen, Jørgensen, & Rasmussen, 2019). Work performance in the current study was an output of the NDI scale in which patients showed a good improvement after the intervention, the status "I can do as much work as I want to" improved in HILT group by 26%, and 40% in UST group, this also similar to the results of Rahele Kenareh, et. al , 2021 (Kenareh et al., 2021).

By return to Headache as a very important output of the NDI scale, our results indicated that the number of patients who reported no headache in the HILT group have improved by **30%,** and by **45%** in the UST group. Findings that are similar to Monika Rani, et, al. 2019 results of overview of many systematic reviews, they concluded that physical therapy interventions usually decrease the cervicogenic headache and relax cervical muscles, in this overview many systematic reviews emphasized on manipulation and mobilization as fast and effective methods to treat headache. However, 2 other systematic reviews support the fact that conservative treatment including UST, Exercises, and laser therapy are effective in treating headache (Rani et al., 2019). However, Gomes AO, et, al. 2022 systematic reviews of RCTs showed that HILT is effective in decrease musculoskeletal pain in general but failed in the management of headache (Gomes et al., 2022).

Another core finding in this study was significant improvement in active Neck ROM between pre and posttest in both groups compared to baseline, with no significant improvement in favor to any group. Restricted range of motion could be as a result of increased pain, muscles spam, or weak muscles (Mahmoud et al., 2019), HILT and UST decrease pain thus could improve ROM (Dundar et al., 2015; Kenareh et al., 2021). Moreover, the therapeutic program of isometric and active range of motion exercises contribute in pain and range of motion improvement which is similar to many studies that concluded the positive effect of isometric cervical exercises or cervical range of motion exercises on improving neck range of motion

and decreasing disability (Ankarborg, 2021; Chung & Jeong, 2018b; Gulsen, 2019; Tsang et al., 2021).

Finally, the results of this study showed no improvement differences in the used outcome measurements according to gender and age. However, female gender is a risk factor of having neck pain more than male (Henriette, 2020; Jiménez-Trujillo et al., 2019; Shariat et al., 2018), there is no significant difference between both gender in response to the intervention, this similar to Dundar et.al results (Dundar et al., 2015). In addition, Aging usually result in progressive changes in the body structure and function that could be clear in neuromuscular system lead to decreased physical performance (Peng et al., 2020), decreased autonomy, and quality of life (Pavan et al., 2020). Nevertheless, in the current study there was no significant difference in results regarding to the age, this could be due to the age homogeneity in the sample.

4.3 Study Limitations and strengths

There were several limitations to the current study that the researchers recommend taking into consideration in any further research:

- Follow-up measures for the results after the wash-out period were not obtained within the scope of this research, for example, to follow up on patients' progression after a definite period, from their discharge to examine the long-term effect of the intervention.
- Sample size, the results of this study could be more representative, if a larger sample size was recruited, but due to the COVID-19 pandemic restrictions, it wasn't easy to recruit more patients.

There were two points of strength in the current study that done by the researcher:

- Due to socio-economic challenges during the Covid-19 pandemic, the researcher tried to facilitate the recruitment of the participants through overcoming some financial challenges with a feasible cost of the sessions.
- The researcher provided the participants with a printed home exercise program, which is illustrated in the Arabic language, which contributed to effective adherence by the participants to complete the therapeutic exercise. (Appendix 7)

Chapter Five

Conclusions and Recommendations

5.1 Conclusions.

5.2 Recommendations.

5.1 Conclusions.

After conducting this study, the researcher concluded the following:

- ✓ HILT and UST combined with the suggested physical therapy home exercises are efficient in reducing pain according to VAS.

- ✓ Both modalities combined with the suggested physical therapy home exercises are effective in improving NDI scores. However, the HILT group recorded a higher score on the NDI scale.

- ✓ Both modalities combined with the suggested physical therapy home exercises are effective in improving neck mobility.

- ✓ Age and gender were not correlated with the severity of pain, function, or neck mobility.

5.2 Recommendations

Based on the findings of the present study, the researcher's recommendations are as followed:

Recommendations for physical therapists:

- Considering the implementation of the HILT or UST plus exercise in treating chronic neck pain.
- Promoting the use of Unified outcome measures at physical therapy departments at national clinics, to be able to compare between the results of this study and potential future studies.

Recommendations for Researchers, Conduction of further studies to investigate:

- The long term effect of these modalities, after wash out period
- The effect of these modalities but on other cases, such as LBP, OA, etc.
- The effect of the suggested protocol on older ages over 50.
- The effects of this intervention on the patients who were excluded from this study such as patients with disc extrusion.

References

(UK, C. for P. H. E. at N., & (UK, N. C. C. for P. C. (2006). *Obesity: The prevention, identification, assessment and management of overweight and obesity in adults and children [Internet]*.

Aiyer, R., Noori, S. A., Chang, K.-V., Jung, B., Rasheed, A., Bansal, N., … Gulati, A. (2020). Therapeutic Ultrasound for Chronic Pain Management in Joints: A Systematic Review. *Pain Medicine*, *21*(7), 1437–1448. https://doi.org/10.1093/pm/pnz102

Alayat, M. S. M., Atya, A. M., Ali, M. M. E., & Shosha, T. M. (2014). Long-term effect of high-intensity laser therapy in the treatment of patients with chronic low back pain: a randomized blinded placebo-controlled trial. *Lasers in Medical Science*, *29*(3), 1065–1073. https://doi.org/10.1007/s10103-013-1472-5

Alayat, M. S. M., Mohamed, A. A., Helal, O. F., & Khaled, O. A. (2016). Efficacy of high-intensity laser therapy in the treatment of chronic neck pain: a randomized double-blind placebo-control trial. *Lasers in Medical Science*, *31*(4), 687–694.

Ankarborg, C. (2021). *PATIENTS WITH CHRONIC LOW BACK OR NECK PAIN – Degree Project in Medicine*.

Aun, C., Lam, Y. M., & Collett, B. (1986). Evaluation of the use of visual analogue scale in Chinese patients. *Pain*, *25*(2), 215–221.

Bernal-Utrera, C., González-Gerez, J. J., Saavedra-Hernandez, M., Lérida-Ortega, M. Á., & Rodríguez-Blanco, C. (2019). Manual therapy versus therapeutic exercise in non-specific chronic neck pain: study protocol for a randomized controlled trial. *Trials*, *20*(1), 487. https://doi.org/10.1186/s13063-019-3598-7

Bier, J. D., Scholten-Peeters, W. G. M., Staal, J. B., Pool, J., van Tulder, M. W., Beekman, E., … Verhagen, A. P. (2018). Clinical Practice Guideline for Physical Therapy Assessment and Treatment in Patients With Nonspecific Neck Pain. *Physical Therapy*, *98*(3), 162–171. https://doi.org/10.1093/ptj/pzx118

Boonstra, A. M., Schiphorst Preuper, H. R., Reneman, M. F., Posthumus, J. B., & Stewart, R. E. (2008). Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. *International Journal of Rehabilitation Research*, *31*(2). Retrieved from

https://journals.lww.com/intjrehabilres/Fulltext/2008/06000/Reliability_and_validity_of_the_visual_analogue.8.aspx

Choi, H.-W., Lee, J., Lee, S., Choi, J., Lee, K., Kim, B.-K., & Kim, G.-J. (2017). Effects of high intensity laser therapy on pain and function of patients with chronic back pain. *Journal of Physical Therapy Science*, *29*(6), 1079–1081. https://doi.org/10.1589/jpts.29.1079

Chow, R. T., Johnson, M. I., Lopes-Martins, R. A. B., & Bjordal, J. M. (2009). Efficacy of low-level laser therapy in the management of neck pain: a systematic review and meta-analysis of randomised placebo or active-treatment controlled trials. *Lancet (London, England)*, *374*(9705), 1897–1908. https://doi.org/10.1016/S0140-6736(09)61522-1

Chowdhury, S. K., Zhou, Y., Wan, B., Reddy, C., & Zhang, X. (2021). Neck Strength and Endurance and Associated Personal and Work-Related Factors. *Human Factors*. https://doi.org/10.1177/0018720820983635

Chung, S., & Jeong, Y. (2018a). Physiotherapy Theory and Practice Effects of the craniocervical flexion and isometric neck exercise compared in patients with chronic neck pain : A randomized controlled trial. *Physiotherapy Theory and Practice*, *00*(00), 1–10. https://doi.org/10.1080/09593985.2018.1430876

Chung, S., & Jeong, Y. G. (2018b). Effects of the craniocervical flexion and isometric neck exercise compared in patients with chronic neck pain: A randomized controlled trial. *Physiotherapy Theory and Practice*, *34*(12), 916–925. https://doi.org/10.1080/09593985.2018.1430876

Cleland, J. A., Fritz, J. M., Whitman, J. M., & Palmer, J. A. (2006). The Reliability and Construct Validity of the Neck Disability Index and Patient Specific Functional Scale in Patients With Cervical Radiculopathy. *Spine*, *31*(5). Retrieved from https://journals.lww.com/spinejournal/Fulltext/2006/03010/The_Reliability_and_Construct_Validity_of_the_Neck.19.aspx

Cohen, S. P. (2015). Epidemiology, diagnosis, and treatment of neck pain. *Mayo Clinic Proceedings*, *90*(2), 284–299. https://doi.org/10.1016/j.mayocp.2014.09.008

Conforti, M., & Fachinetti, G. P. (2013). High power laser therapy treatment compared to simple segmental physical rehabilitation in whiplash injuries (1° and 2° grade of the

Quebec Task Force classification) involving muscles and ligaments. *Muscles, Ligaments and Tendons Journal*, *3*(2), 106–111. https://doi.org/10.11138/mltj/2013.3.2.106

Corp, N., Mansell, G., Stynes, S., Wynne-Jones, G., Morsø, L., Hill, J. C., & van der Windt, D. A. (2021). Evidence-based treatment recommendations for neck and low back pain across Europe: A systematic review of guidelines. *European Journal of Pain*, *25*(2), 275–295.

Côté, P., Yu, H., Shearer, H. M., Randhawa, K., Wong, J. J., Mior, S., … Varatharajan, S. (2019). Non-pharmacological management of persistent headaches associated with neck pain: A clinical practice guideline from the Ontario protocol for traffic injury management (OPTIMa) collaboration. *European Journal of Pain*, *23*(6), 1051–1070.

Crichton, N. (2001). Visual analogue scale (VAS). *J Clin Nurs*, *10*(5), 706.

CrossFit. (n.d.). cervical muscles pictures. Retrieved from CrossFit September 25, 2019 website: https://www.crossfit.com/essentials/lon-cervical-muscles-part-1

Damgaard, P., Bartels, E. M., Ris, I., Christensen, R., & Juul-Kristensen, B. (2013). Evidence of Physiotherapy Interventions for Patients with Chronic Neck Pain: A Systematic Review of Randomised Controlled Trials. *ISRN Pain*, *2013*, 567175. https://doi.org/10.1155/2013/567175

Dangayach, G. S., Meena, M. L., Chaudhary, H., & Singh, A. K. (2018). Ergonomic evaluation of cumulative trauma disorders among female carpet weavers in India: guidelines to an effective sustainability in work system design. *International Journal of Human Factors and Ergonomics*, *5*(2), 129. https://doi.org/10.1504/ijhfe.2018.10013597

Dompe, C., Moncrieff, L., Matys, J., Grzech-Leśniak, K., Kocherova, I., Bryja, A., … Dyszkiewicz-Konwińska, M. (2020). Photobiomodulation—underlying mechanism and clinical applications. *Journal of Clinical Medicine*, *9*(6), 1–17. https://doi.org/10.3390/jcm9061724

Dundar, U., Turkmen, U., Toktas, H., Solak, O., & Ulasli, A. M. (2015). Effect of high-intensity laser therapy in the management of myofascial pain syndrome of the trapezius: a double-blind, placebo-controlled study. *Lasers in Medical Science*, *30*(1), 325–332. https://doi.org/10.1007/s10103-014-1671-8

Ellenberg, S. S. (1984). Randomization designs in comparative clinical trials. *New England*

Journal of Medicine, *310*(21), 1404–1408.

Ezzati, K., Laakso, E.-L., Salari, A., Hasannejad, A., Fekrazad, R., & Aris, A. (2020). The Beneficial Effects of High-Intensity Laser Therapy and Co-Interventions on Musculoskeletal Pain Management: A Systematic Review. *Journal of Lasers in Medical Sciences*, *11*(1), 81–90. https://doi.org/10.15171/jlms.2020.14

Fiore, P., Panza, F., Cassatella, G., Russo, A., Frisardi, V., Solfrizzi, V., … Santamato, A. (2011). Short-term effects of high-intensity laser therapy versus ultrasound therapy in the treatment of low back pain: a randomized controlled trial. *European Journal of Physical and Rehabilitation Medicine*, *47*(3), 367–373.

Frost, B. A., Camarero-Espinosa, S., & Foster, E. J. (2019). Materials for the Spine: Anatomy, Problems, and Solutions. *Materials (Basel, Switzerland)*, *12*(2), 253. https://doi.org/10.3390/ma12020253

Genebra, C. V. D. S., Maciel, N. M., Bento, T. P. F., Simeão, S. F. A. P., & Vitta, A. De. (2017). Prevalence and factors associated with neck pain: a population-based study. *Brazilian Journal of Physical Therapy*, *21*(4), 274–280. https://doi.org/10.1016/j.bjpt.2017.05.005

Gomes, A. O., Martimbianco, A. L. C., Junior, A. B., Horliana, A. C. R. T., da Silva, T., Santos, E. M., … Bussadori, S. K. (2022). Photobiomodulation for the Treatment of Primary Headache: Systematic Review of Randomized Clinical Trials. *Life*, *12*(1), 1–11. https://doi.org/10.3390/life12010098

Gulsen, M. (2019). *European Journal of Physical Education and Sport Science EFFECT OF ISOMETRIC EXERCISES ON PAIN AND DISABILITY IN PATIENTS WITH CHRONIC NECK PAIN*. 59–66. https://doi.org/10.5281/zenodo.3442452

Haładaj, R., Pingot, M., & Topol, M. (2017). The Effectiveness of Cervical Spondylosis Therapy with Saunders Traction Device and High-Intensity Laser Therapy: A Randomized Controlled Trial. *Medical Science Monitor*, *23*, 335–342. https://doi.org/10.12659/MSM.899454

Hallman, D. M., Holtermann, A., Dencker-Larsen, S., Jørgensen, M. B., & Rasmussen, C. D. N. (2019). Are trajectories of neck-shoulder pain associated with sick leave and work ability in workers? A 1-year prospective study. *BMJ Open*, *9*(3), 1–10.

https://doi.org/10.1136/bmjopen-2018-022006

Haq, A., Ali, I., & Varshney, R. (2020). Compromise allocation problem in multivariate stratified sampling with flexible fuzzy goals. *Journal of Statistical Computation and Simulation*, *90*(9), 1557–1569. https://doi.org/10.1080/00949655.2020.1734808

Henriette, J. (2020). Risk factors for neck pain in young adults - a systematic review and meta-analysis. *BMC Musculoskeletal Disorders*, *21*, 366.

Hurwitz, E. L., Randhawa, K., Yu, H., Côté, P., & Haldeman, S. (2018). The Global Spine Care Initiative: a summary of the global burden of low back and neck pain studies. *European Spine Journal*, *27*(6), 796–801.

Jadon, A. (2016). *Pathophysiology of Neck Pain*. Retrieved from https://www.researchgate.net/publication/293820979_Pathophysiology_of_Neck_Pain

Jiménez-Trujillo, I., López-De-Andrés, A., Del Barrio, J. L., Hernández-Barrera, V., Valero-De-Bernabé, M., & Jiménez-García, R. (2019). Gender Differences in the Prevalence and Characteristics of Pain in Spain: Report from a Population-Based Study. *Pain Medicine (United States)*, *20*(12), 2349–2359. https://doi.org/10.1093/pm/pnz004

Kenareh, R., Mirmohammadi, S. J., Khatibi, A., Shamsi, F., & Mehrparvar, A. H. (2021). The Comparison of The Efficacy of Photobiomodulation and Ultrasound in the Treatment of Chronic Non-specific Neck Pain: A Randomized Single-Blind Controlled Trial. *Journal of Lasers in Medical Sciences*, *12*, 1–8. https://doi.org/10.34172/jlms.2021.20

Kim, H. S., Lee, S., & Kim, J. H. (2018). Real-world evidence versus randomized controlled trial: Clinical research based on electronic medical records. *Journal of Korean Medical Science*, *33*(34), 1–7. https://doi.org/10.3346/jkms.2018.33.e213

Kocur, P., Wilski, M., Lewandowski, J., & Łochyński, D. (2019). Female office workers with moderate neck pain have increased anterior positioning of the cervical spine and stiffness of upper trapezius myofascial tissue in sitting posture. *Pm&r*, *11*(5), 476–482.

Leal-Junior, E. C. P., Lopes-Martins, R. Á. B., & Bjordal, J. M. (2019). Clinical and scientific recommendations for the use of photobiomodulation therapy in exercise performance enhancement and post-exercise recovery: current evidence and future directions. *Brazilian Journal of Physical Therapy*, *23*(1), 71–75.

https://doi.org/10.1016/j.bjpt.2018.12.002

Liu, D. D., Ullah, M., Concepcion, W., Dahl, J. J., & Thakor, A. S. (2020). The role of ultrasound in enhancing mesenchymal stromal cell-based therapies. *Stem Cells Translational Medicine*, *9*(8), 850–866. https://doi.org/10.1002/sctm.19-0391

MacDermid, J. C., Walton, D. M., Avery, S., Blanchard, A., Etruw, E., McAlpine, C., & Goldsmith, C. H. (2009). Measurement properties of the neck disability index: a systematic review. *The Journal of Orthopaedic and Sports Physical Therapy*, *39*(5), 400–417. https://doi.org/10.2519/jospt.2009.2930

Mahmoud, N. F., Hassan, K. A., Abdelmajeed, S. F., Moustafa, I. M., & Silva, A. G. (2019). The Relationship Between Forward Head Posture and Neck Pain: a Systematic Review and Meta-Analysis. *Current Reviews in Musculoskeletal Medicine*, *12*(4), 562–577. https://doi.org/10.1007/s12178-019-09594-y

Marins, E. F., Andrade, L. S., Peixoto, M. B., & Silva, M. C. da. (2020). Frequency of musculoskeletal symptoms among police officers: systematic review. *Brazilian Journal Of Pain*, *3*(2), 164–169. https://doi.org/10.5935/2595-0118.20200034

NDI SCALE. (n.d.). Retrieved from https://www5.aaos.org/uploadedFiles/NDI.pdf

Noori, S. A., Rasheed, A., Aiyer, R., Jung, B., Bansal, N., Chang, K.-V., … Gulati, A. (2020). Therapeutic Ultrasound for Pain Management in Chronic Low Back Pain and Chronic Neck Pain: A Systematic Review. *Pain Medicine*, *21*(7), 1482–1493. https://doi.org/10.1093/pm/pny287

Papadopoulos, E. S., & Mani, R. (2020). The Role of Ultrasound Therapy in the Management of Musculoskeletal Soft Tissue Pain. *International Journal of Lower Extremity Wounds*, *19*(4), 350–358. https://doi.org/10.1177/1534734620948343

pathophysiology for CNP. (n.d.). Retrieved from https://s3.amazonaws.com/rdcms-iasp/files/production/public/Content/ContentFolders/GlobalYearAgainstPain2/MusculoskeletalPainFactSheets/NeckPain_Final.pdf

Pavan, P., Monti, E., Bondí, M., Fan, C., Stecco, C., Narici, M., … Marcucci, L. (2020). Alterations of extracellular matrix mechanical properties contribute to age-related functional impairment of human skeletal muscles. *International Journal of Molecular Sciences*, *21*(11), 1–14. https://doi.org/10.3390/ijms21113992

Peng, X., Li, X., Xu, Z., Wang, L., Cai, W., Yang, S., … Cheng, X. (2020). Age-related fatty infiltration of lumbar paraspinal muscles: A normative reference database study in 516 Chinese females. *Quantitative Imaging in Medicine and Surgery*, *10*(8), 1590–1601. https://doi.org/10.21037/QIMS-19-835

Physiopedia- US. (n.d.). us def. Retrieved May 5, 2021, from https://www.physio-pedia.com/Therapeutic_Modalities?utm_source=physiopedia&utm_medium=related_articles&utm_campaign=ongoing_internal

Physiopedia-laser. (n.d.). laser def. Retrieved from https://www.physio-pedia.com/High_Power_Laser_Therapy?utm_source=physiopedia&utm_medium=search&utm_campaign=ongoing_internal

Rani, M., & Kaur, J. (2021). Effectiveness of different physiotherapy interventions in the management of cervicogenic headache: a pilot randomized controlled trial. *Journal of Manual & Manipulative Therapy*, 1–9.

Rani, M., Kulandaivelan, S., Bansal, A., & Pawalia, A. (2019). Physical therapy intervention for cervicogenic headache: an overview of systematic reviews. *European Journal of Physiotherapy*, *21*(4), 217–223. https://doi.org/10.1080/21679169.2018.1523460

Rice, D., McNair, P., Huysmans, E., Letzen, J., & Finan, P. (2019). Best evidence rehabilitation for chronic pain part 5: Osteoarthritis. *Journal of Clinical Medicine*, *8*(11). https://doi.org/10.3390/jcm8111769

Roland Valdes Jr. Lori M. Millner, M. W. L. (2019). 乳鼠心肌提取 HHS Public Access. *Physiology & Behavior*, *176*(3), 139–148.

Safiri, S., Kolahi, A. A., Hoy, D., Buchbinder, R., Mansournia, M. A., Bettampadi, D., … Ferreira, M. L. (2020). Global, regional, and national burden of neck pain in the general population, 1990-2017: Systematic analysis of the Global Burden of Disease Study 2017. *The BMJ*, *368*. https://doi.org/10.1136/bmj.m791

Section, R. M. (2020). *REHABILITATION & REGENERATIVE MEDICINE SECTION Therapeutic Ultrasound for Pain Management in Chronic Low Back Pain and Chronic Neck Pain : A Systematic Review*. *21*(January 2019), 1482–1493. https://doi.org/10.1093/pm/pny287

Shariat, A., Cardoso, J. R., Cleland, J. A., Danaee, M., Ansari, N. N., Kargarfard, M., &

Mohd Tamrin, S. B. (2018). Prevalence rate of neck, shoulder and lower back pain in association with age, body mass index and gender among Malaysian office workers. *Work*, *60*(2), 191–199. https://doi.org/10.3233/WOR-182738

Sharma, G. (2017). Impact Factor : 5 . 2 IJAR. *International Journal of Applied Research*, *3*(7), 749–752.

Song, H. J., Seo, H.-J., Lee, Y., & Kim, S. K. (2018). Effectiveness of high-intensity laser therapy in the treatment of musculoskeletal disorders: A systematic review and meta-analysis of randomized controlled trials. *Medicine*, *97*(51).

Swartz, E. E., Floyd, R. T., & Cendoma, M. (2005). Cervical spine functional anatomy and the biomechanics of injury due to compressive loading. *Journal of Athletic Training*, *40*(3), 155–161.

Tantawy, S. A., Abdelbasset, W. K., Kamel, D. M., Alrawaili, S. M., & Alsubaie, S. F. (2019). Laser photobiomodulation is more effective than ultrasound therapy in patients with chronic nonspecific low back pain: a comparative study. *Lasers in Medical Science*, *34*(4), 793–800. https://doi.org/10.1007/s10103-018-2665-8

Taradaj, J., Rajfur, K., Shay, B., Rajfur, J., Ptaszkowski, K., Walewicz, K., … Rosińczuk, J. (2018). Photobiomodulation using high- or low-level laser irradiations in patients with lumbar disc degenerative changes: disappointing outcomes and remarks. *Clinical Interventions in Aging*, *13*, 1445–1455. https://doi.org/10.2147/CIA.S168094

TeachMeAnatomy, neck. (n.d.). Retrieved from https://teachmeanatomy.info/neck/muscles/

Tramontana, A., Sorge, R., & Page, J. C. M. (2016). Laser biostimulation effects on invertebral disks: histological evidence on intra-observer samples. Retrospective double-blind study. *Laser Therapy*, *25*(4), 285–290.

Tsang, S. M., Chan, K. T., Ho, P. L., Kwok, J. C., Tse, D. H., & Tsoi, H. H. T. (2021). Comparison between velocity-specific exercise and isometric exercise on neck muscle functions and performance: a randomised clinical trial. *BMC Musculoskeletal Disorders*, *22*(1), 1–16. https://doi.org/10.1186/s12891-021-03943-0

Watson, T. (2008). Ultrasound in contemporary physiotherapy practice. *Ultrasonics*, *48*(4), 321–329. https://doi.org/https://doi.org/10.1016/j.ultras.2008.02.004

Wellmon, R. H., Gulick, D. T., Paterson, M. L., & Gulick, C. N. (2016). Validity and

Reliability of 2 Goniometric Mobile Apps: Device, Application, and Examiner Factors. *Journal of Sport Rehabilitation*, *25*(4), 371–379. https://doi.org/10.1123/jsr.2015-0041

Wyszyńska, J., & Bal-Bocheńska, M. (2018). Efficacy of High-Intensity Laser Therapy in Treating Knee Osteoarthritis: A First Systematic Review. *Photomedicine and Laser Surgery*, *36*(7), 343–353. https://doi.org/10.1089/pho.2017.4425

Yilmaz, M., Tarakci, D., & Tarakci, E. (2020). Comparison of high-intensity laser therapy and combination of ultrasound treatment and transcutaneous nerve stimulation on cervical pain associated with cervical disc herniation: A randomized trial. *Complementary Therapies in Medicine*, *49*, 102295. https://doi.org/https://doi.org/10.1016/j.ctim.2019.102295

Young, I. A., Dunning, J., Butts, R., Mourad, F., & Cleland, J. A. (2019). Reliability, construct validity, and responsiveness of the neck disability index and numeric pain rating scale in patients with mechanical neck pain without upper extremity symptoms. *Physiotherapy Theory and Practice*, *35*(12), 1328–1335.

Zein, R., Selting, W., & Hamblin, M. R. (2018). Review of light parameters and photobiomodulation efficacy: dive into complexity. *Journal of Biomedical Optics*, *23*(12), 1–17. https://doi.org/10.1117/1.JBO.23.12.120901

Appendixes

Appendix 1: Randomization

Randomization of the participants to strata depending on age and sex

The researcher randomly allocates the participants systematically one by one to the sub groups, started by the HILT group then to the UST.

HILT group			
Female (20-35)	**Female (36-50)**	**male (20-35)**	**male (36-50)**
Participant 1	Participant 2	Participant 3	Participant 4
UST group			
Female (20-35)	**Female (36-50)**	**male (20-35)**	**male (36-50)**
Participant 5	Participant 6	Participant 7	Participant 8

Appendix 2: data collection sheet

ملف المريض Patient File

سيتم تعبئة الملف وجمع المعلومات قبل البدء بالدراسة و سيتم اعادة تقييم المريض

بعد الانتهاء من البرنامج العلاج

• Name/code ( )		
• Age		
• Sex		
• Marital status		
• Occupation		
• BMI		
• Smoking		
• Medical conditions		
• Medications		
• Pain duration		
• Aggravating factors		
• Easing factors		
• Patient group		
	Pre Test	Post Test
• Pain intensity/VAS		
• NDI		
• Neck flexion ROM		
• Neck extension		
• Rt. Neck rotation ROM		
• Lt. Neck rotation ROM		
• Rt. Neck lateral flexion ROM		
• Lt. Neck lateral flexion ROM		

Appendix 3: outcome measures (VAS)

نموذج تقييم شدة الوجع عند المريض باستخدام (VAS)

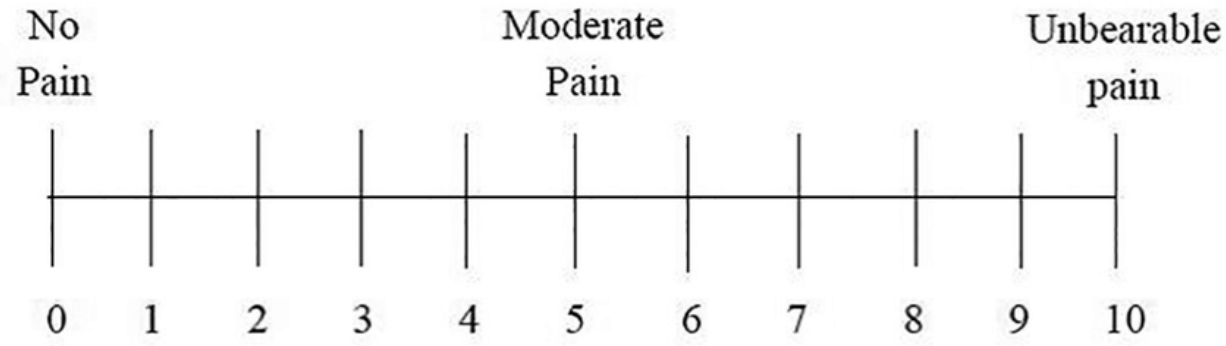
هذا المقياس عبارة عن خط مستقيم متدرج من (0 إلى 10) حيث أن (0 لا يوجد وجع) و (10 وجع شديد لا يحتمل).

يطلب الباحث من المريض وصف شدة الوجع عنده على هذا المقياس ويتم تسجيل النتيجة قبل البرنامج

العلاج ومرة أخرى بعد الانتهاء من البرنامج العلاجي لكل مريض

Name:
Date: / /

0-10 Vas Numeric Pain Distress Scale



THE RESULT	
Pre test	Post test

Appendix 4: outcome measures (NDI)

NECK PAIN DISABILITY INDEX QUESTIONNAIRE

PLEASE READ*: This questionnaire is designed to enable us to understand how much your neck pain has affected your ability to manage your everyday activities. Please answer each section by circling the ONE CHOICE that most applies to you. We realize that you may feel that more than one statement may relate to you, but *PLEASE JUST CIRCLE THE ONE. CHOICE WHICH MOST CLOSELY DESCRIBES YOUR PROBLEM RIGHT NOW.

SECTION 1 - Pain Intensity	***SECTION 6 - Concentration***
A I have no pain at the moment. B The pain is very mild at the moment. C The pain is moderate at the moment. D The pain is fairly severe at the moment. E The pain is very severe at the moment. F The pain is the worst imaginable at the moment.	A I can concentrate fully when I want to with no difficulty. B I can concentrate fully when I want to with slight difficulty. C I have a fair degree of difficulty in concentrating when I want to. D I have a lot of difficulty in concentrating when I want to. E I have a great deal of difficulty in concentrating when I want to. F I cannot concentrate at all.
SECTION 2 -Personal Care (Washing, Dressing, etc.)	***SECTION 7 - Work***
A I can look after myself normally without causing extra pain. B I can look after myself normally, but it causes extra pain. C It is painful to look after myself and I am slow and careful. D I need some help, but manage most of my personal care. E I need help every day in most aspects of self care. F I do not get dressed, I wash with difficulty and stay in bed.	A I can do as much work as I want to. B I can only do my usual work, but no more. C I can do most of my usual work, but no more. D I cannot do my usual work. E I can hardly do any work at all. F I cannot do any work at all.
SECTION 3 - Lifting	***SECTION 8 - Driving***
A I can lift heavy weights without extra pain. B I can lift heavy weights, but it gives extra pain. C Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example, on a table. D Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned. E I can lift very light weights. F I cannot lift or carry anything at all.	A I can drive my car without any neck pain. B I can drive my car as long as I want with slight pain in my neck. C I can drive my car as long as I want with moderate pain in my neck. D I cannot drive my car as long as I want because of moderate pain in my neck. E I can hardly drive at all because of severe pain in my neck. F I cannot drive my car at all.
SECTION 4 - Reading	***SECTION 9 - Sleeping***
A I can read as much as I want to with no pain in my neck. B I can read as much as I want to with slight pain in my neck. C I can read as much as I want to with moderate pain in my neck. D I cannot read as much as I want because of moderate pain in my neck. E I cannot read as much as I want because of severe pain in my neck. F I cannot read at all.	A I have no trouble sleeping. B My sleep is slightly disturbed (less than 1 hour sleepless). C My sleep is mildly disturbed (1-2 hours sleepless). D My sleep is moderately disturbed (2-3 hours sleepless). E My sleep is greatly disturbed (3-5 hours sleepless). F My sleep is completely disturbed (5-7 hours)
SECTION 5 - Headaches	***SECTION 10 - Recreation***
A I have no headaches at all. B I have slight headaches which come infrequently. C I have moderate headaches which come infrequently. D I have moderate headaches which come frequently. E I have severe headaches which come frequently. F I have headaches almost all the time.	A I am able to engage in all of my recreational activities with no neck pain at all. B I am able to engage in all of my recreational activities with some pain in my neck. C I am able to engage in most, but not all of my recreational activities because of pain in my neck. D I am able to engage in a few of my recreational activities because of pain in my neck. E I can hardly do any recreational activities because of pain in my neck. F I cannot do any recreational activities at all.

COMMENTS:_____

_____

_____

NAME: _____ **DATE:** _____ **SCORE:** _____

Appendix 5: ethical approval

Al-Quds University
Jerusalem
Deanship of Scientific Research

بسم الله الرحمن الرحيم

جـــامـــعـــة الـــقـــدس
القدس
عمادة البحث العلمي

Research Ethics Committee
Committee's Decision Letter

Date: March 12, 2021
Ref No: 174/REC/2021

Dear Dr. Hadeel Halaweh, Mr. Adel Zeen Ashour,

Thank you for submitting your application for research ethics approval. After reviewing your application entitled "A Randomized Comparative Study between High-Intensity Laser Therapy and Ultrasound Therapy on Chronic Neck Pain among Adults", the Research Ethics Committee confirms that your application is in accordance with the research ethics guidelines at Al-Quds University.
We would appreciate receiving a copy of your final research report/ publication.
Thank you again and wish you a productive research that serves the best interests of your subjects.

PS: This letter will be valid for two years.

Sincerely,

Suheir Ereqat, PhD
Associate Professor of Molecular Biology
Research Ethics Committee Chair

Cc. Prof. Imad Abu Kishek - President
Cc. Members of the committee
Cc. file

Abu-Dies, Jerusalem P.O.Box 20002
Tel-Fax: #970-02-2791293
research@admin.alquds.edu
أبودبس، القدس ص.ب. 20002
تلفاكس: #970-02-2791293

Appendix 6: inform consent

نموذج موافقة على المشاركة في بحث علمي.

(دراسة مقارنة بين تأثير العلاج الطبيعي باستخدام تقنية الليزر عالي الكثافة والعلاج بالموجات فوق الصوتية على آلام الرقبة المزمنة لدى البالغين)

عزيزي المشارك /المشاركة

توقيعك ادناه على نموذج الموافقه هذا هو بموجب موافقة مكتوبة و موقعة على المشاركة في الدراسة التي يقوم بها الباحث أخصائي العلاج الطبيعي عادل زين الدين عاشور وفريقه بإشراف الدكتوره هديل حلاوة، ضمن برنامج الماجستير في العلاج الطبيعي - جامعة القدس، والذي سيتم البدء بإجرائه في مركز الحكيم للعلاج الفيزيائي في مدينة الخليل مع بداية آذار للعام 2021

لقد قام فريق البحث بشرح مفصل عن أهداف الدراسة حيث أنني سأشارك في دراسة تهدف إلى المقارنة بين نتائج العلاج باستخدام الليزر والعلاج باستخدام الموجات فوق الصوتية على أوجاع الرقبة المزمنة، حيث ان فريق البحث سيقوم بتوزيع المشاركين في الدراسة بشكل عشوائي الى مجموعتين ، المجموعة الاولى ضمن برنامج العلاج بالليزر والمجموعة الثانية ضمن برنامج العلاج بالموجات الفوق صوتية, وبانه تم التأكيد أن كلا البرنامجين مستخدمين بشكل أمن وواسع في مجال العلاج الطبيعي في فلسطين ولا يوجد اية تأثيرات جانبية على المريض, وبأن البرنامج العلاجي يتكون من 10جلسات علاجية خلال 4اسابيع وسيتم تقييم كل مريض قبل البدء بالعلاج وبعد الانتهاء من البرنامج العلاجي, كما ان الاخصائي سيتبع كل وسائل الامان في تطبيق العلاج على كلا المجموعتين ولا يوجد اي مخاطر او آثار جانبية للعلاج.

لقد تم وصف الدراسة البحثية لي شفهيا، وبما فيه المعلومات المدرجة أعلاه، واوافق على المشاركة بهذه الدراسة البحثية, و انه

قد تم شرح حقوقي المتضمنة:

- سرية المعلومات وعدم إطلاع اي شخص عليها و تخزينها في مكان امن لا يصل اليه سوى الباحث
- استخدام المعلومات للاغراض العلمية البحثية فقط
- حرية انسحابي في اي وقت من الدراسة و من دون الحاجة لإبداء الاسباب و دون اية عواقب شخصية او مالية
- حقي في الاطلاع على نتائج البحث النهائية

اسم المشارك الرباعي_____ :

توقيع المشارك/ة:_____

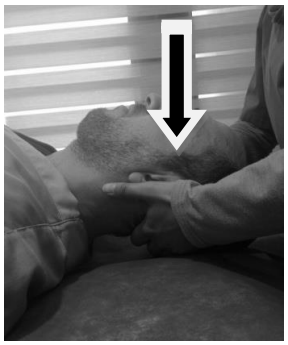
التاريخ_____:_____

شاكرين لكم حسن تعاونكم

Appendix 7: exercise program

Exercise program برنامج التمارين

First week الاسبوع الاول



- **isometric cervical extension exercise, the therapist ask the patient to press his/her occiput on the hands of the therapist, hold 5-10 seconds, then relax and do it 10 repetition**
- **In the first week, this exercise will be applied in the center**
- **in the next 3 weeks the patient will do it at the home by press his occiput on a cushion, 3 times a day**
- **ضغط الرأس على الوسادة 10 مرات والثبات من 5-10 ثواني/ 3مرات يوميا**

Second week الاسبوع الثاني

- **In addition to the first exercise.**
- **The patient actively do isometric chin in exercise against his/her hand for 10 repetitions, hold each time for 5-10 seconds**
- **Do the exercise 3 times a day at home**
- **يوميا ضغط الذقن باتجاه اليدين مع الثبات من 5-10 ثواني بدون حركة/ 3 مرات**

Third week
الاسبوع الثالث
تمارين المدي الحركي لليمين واليسار والاعلى والاسفل 10 حركات في كل اتجاه/ 3 مرات يوميا

- **In addition to the previous 2 exercises.**
- **The patient do active cervical flexion, extension and rotation exercise, also for 20 repetitions for each exercise**
- **Do the exercise 3 times a day at home.**

Fourth week الاسبوع الرابع

- **Both shoulders flexion exercise, the patient actively join his/her hands and doing full shoulders flexion to the maximum range, done for 20 repetition and asked to do it 3 times a day.**
- **Besides the exercises of the previous 3 weeks**
- **رفع الذراعين معا بشكل مستقيم عشر حركات / 3 مرات يوميا**