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Effectiveness of Electrical Stimulation in Treating Upper Extremity Pain for Older Adult Clients Residing in a Skilled Nursing Facility

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Effectiveness of Electrical Stimulation in Treating Upper Extremity Pain for Older Adult Clients Residing in a Skilled Nursing Facility

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Certification

We hereby certify that this Capstone project, submitted by Cody West, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the project requirement for the Doctor of Occupational Therapy degree.

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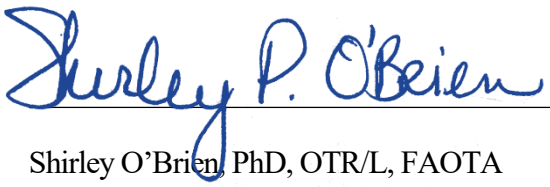

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Executive Summary

Background: It is estimated that 55% of older adults who reside in skilled nursing facilities (SNFs) have chronic pain that affects their daily function. However, limited research has been conducted on the effectiveness of electrical stimulation (e-stim) in treating upper extremity (UE) pain for the older adult population specifically.

Purpose: The purpose of this study was to examine whether electrical stimulation can decrease UE pain in clients age 65+ residing in a SNF. A sub-question in the study was whether e-stim can improve UE functional performance in older adult clients.

Theoretical Framework: There are two guiding theoretical frameworks for this pilot study, the biomechanical and rehabilitative frames of reference.

Methods. This study was a quasi-experimental design in the form of pretest-posttest design. Each participant was administered two pre-tests, Visual Pain Scale (VPS) and Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH), the electrical stimulation treatment for at least eight visits, then the post-tests.

Results. The results of this study found that e-stim shows promise in decreasing UE pain and improving UE function for older adult clients 65+ years old residing in a SNF. There was a low sample size at the conclusion of the study, therefore, more data needs to be collected in order to determine if the results are statistically significant. All participants in this study indicated decreased pain and improved UE function based on the post-test outcome measures that were used. On the Visual Pain Scale, eight out of ten participants indicated a change in score from pre- to post-test. The change in the VPS score was considered clinically significant, with greater than a 2-point difference. On the Quick Disabilities of the Arm, Shoulder, and Hand, half of the participants (5) indicated a change in score from pre- to post-test. that was considered clinically significant with greater than a 15-point difference.

Conclusions: The results of this pilot study look promising for the use of e-stim to decrease UE pain and improve UE function for older adults 65+ residing in a SNF. The study will continue to collect data until there are sufficient participants to perform paired-sample *t*-tests to determine statistical significance of pretest/posttest scores for both the VPS and QuickDASH.

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I would like to say thank you to the therapists and the clinical sites that assisted with data collection for this study. I know that the workload and time constraints of working as a therapist is very demanding and I appreciate your time and efforts in helping me collect the data I needed for this study.

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CERTIFICATION OF AUTHORSHIP

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Certification of Authorship: I hereby certify that I am the author of this document and that any assistance I received in its preparation is fully acknowledged and disclosed in the document. I have also cited all sources from which I obtained data, ideas, or words that are copied directly or paraphrased in the document. Sources are properly credited according to accepted standards for professional publications. I also certify that this paper was prepared by me for this purpose.

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Section One: Nature of the Problem and Problem Identification

It is estimated that 55% of older adults who reside in skilled nursing facilities (SNFs) have chronic pain that affects their daily function (National Institutes of Health [NIH], 2014). Many studies have been conducted concerning the effectiveness of electrical stimulation (e-stim) in treating upper extremity (UE) pain and function. These studies have shown positive effects in age cohorts apart from the older adult population (Marquez-Chin et al., 2017; Teashell et al., 2012). Studies that show positive outcomes for e-stim in treating UE pain in older adult clients and, even more specifically, older adult clients that reside in SNFs, are limited in the literature. Research is needed to determine the effectiveness of e-stim in treating UE pain for the older adult population residing in SNFs. Examining the use of e-stim and how it decreases UE pain to support improved UE functional performance can bridge the gap that exists in the literature regarding treatment of UE pain in the older adult population. This research may aid in combating the high prevalence of reported chronic pain within the older adult population.

Abbreviated Literature Review

Multiple studies have been conducted regarding the effectiveness of e-stim in UE pain and function, but studies that focus on the older adult population are significantly limited. An example of the gap that exists within this literature is shown in a study conducted by Page et al. (2012). The aim of their study was to compare the efficacy of 30-, 60-, and 120-minute repetitive task-specific practice (RTP) sessions incorporating the use of an electrical stimulation neuroprosthesis on affected UE movement. The participants were recruited from an outpatient hospital and included thirty-two participants with a mean age of 57. Results show that participants who received 120-minutes of the provided electrical stimulation neuroprosthesis exhibited an increase in scores on all outcome measures. Outcome measures included the UE section of the Fugl-Meyer Assessment of Sensorimotor Impairment, the Arm Motor Ability Test,

the Action Research Arm Test, and Box and Block assessment 1 week before and 1 week after intervention. This study illustrates an example of research that has been conducted demonstrating the effectiveness of e-stim in UE function. However, the mean age for this study is younger than 65+ years old and the setting is not targeted specifically on older adult clients who reside in SNFs.

Another article demonstrating the gap in the literature was a systematic review with meta-analysis conducted by Howlett et al. (2015). The aim of their review was to investigate the effectiveness of functional electrical stimulation (FES) in improving activity and whether FES is more effective than conventional training alone. The findings from the systematic review revealed that use of FES intervention showed improved performance when compared with both no intervention and conventional training alone. The researchers included eighteen studies in their review. Of the eighteen studies included in the review, only four of them included participants that were 65+ years old and none of them focused on participants that were exclusively 65+ years old. This further emphasizes the gap in the literature given that this study was a systematic review of the existing literature. The findings reported only minimal studies that included this study's target population and no studies that were exclusively focused on this study's target population.

Given the literature that has been mentioned, as well as other studies that have been reviewed within the full literature review for this study, the results and conclusions of the majority of studies show decreased UE pain and improvement in UE function when using e-stim as an intervention. The current literature does indicate the effectiveness of e-stim, however, most studies do not include this study's target population or focusing solely on the practice setting of a SNF. To reiterate, there is a reported high prevalence (55%) of chronic pain for the older adult population (NIH, 2014). Due to the literature gap that exists, research that is conducted regarding

an intervention of proven effectiveness that targets UE pain and function for older adult clients who reside in SNFs is important both for clinicians and clients. This study can assist with closing the literature gap and contribute to evidence-based practice and the body of knowledge regarding the effectiveness of e-stim interventions in treating UE pain with the older adult population.

Problem Statement

The problem being addressed in this study is the effectiveness of e-stim in the treatment of UE pain and UE function for older adult clients who reside in a SNF.

Purpose Statement

The purpose of this study was to examine whether e-stim can decrease UE pain in older adult clients residing in a SNF. A sub-question in the study was whether e-stim can improve UE functional performance in older adult clients. A second sub-question was is there a relationship between the use of e-stim in decreasing UE pain and improving UE functional performance for older adult clients residing in a SNF.

Project Objectives

The objectives for this project were as follows:

- To analyze de-identified data collected, by modality certified therapists apart from the research team, at SNFs on older adult clients who experience UE pain.
- To determine if the use of e-stim decreases UE pain in older adult clients who reside in SNFs as self-reported on the Quick Disabilities of the Arm, Hand, and Shoulder (QuickDASH) and Visual Pain Scale (VPS) assessments.
- To determine if there is a relationship between the use of e-stim in decreasing UE pain and improving UE functional performance for older adult clients who reside in SNFs.

Theoretical Framework

The theoretical frameworks that helped shape and inform this research design and

proposal are the biomechanical frame of reference (FOR) and the rehabilitative FOR. Occupational therapists (OTs) use the biomechanical FOR for clients with limited range of motion (ROM), strength, and endurance. The biomechanical FOR has four assumptions (Pawar, 2017). The first assumption is the belief that purposeful activities can be used to treat loss of ROM, strength, and endurance. The second assumption is the belief that after ROM, strength, and endurance are regained, the client regains function. The third assumption is the principle of rest and stress. First, the body must rest to heal itself, then the peripheral structure must be stressed to regain range, strength, and endurance. The fourth assumption is the belief that the biomechanical FOR is best suited for clients with an intact central nervous system. Patients may have limited range, strength, and endurance, but have the ability to perform smooth, isolated movements (Pawar, 2017). Although pain is not directly stated as a deficit area in the biomechanical FOR, it correlates to this FOR because pain can reduce movement which results in decreased ROM, strength, and endurance which then leads to decreased functional performance.

The rehabilitative FOR considers rehabilitation as the process of facilitating clients in fulfilling daily activities. This FOR is used with clients whose underlying impairments are unlikely to remediate and the impairments are considered to be permanent (Gillen, 2014). The theoretical basis of this FOR is that the client must focus on their remaining abilities despite their disabilities to attain their highest level of function (Gillen, 2014). This FOR includes concepts of adaptation, compensation, and environmental modifications. Adaptation involves adapting an activity, usually with varying types of adaptive equipment, to allow the client to engage in a task at their highest level of independence (National Rehabilitation University Hospital [NRH], 2022). Adaptive equipment and durable medical equipment include, but is not limited to, tub transfer benches, sock aids, dressing sticks, and sliding boards (NRH, 2022). Compensation involves modifying how a task is completed to allow for client independence. Compensation

includes hemi-dressing techniques, fatigue management strategies, and energy conservation techniques (NRH, 2022). Environmental modifications are used to alter one's various environments to make them as safe, independent, and functional as possible (Facilitate OT, 2022). Environmental modifications include rails, grab bars, wheelchair ramps, and non-slip treatments/surfaces (Facilitate OT, 2022). The ultimate goal for the rehabilitative FOR is to maximize independence despite the presence of persistent impairments (Gillen, 2014).

The pain experienced by the older adult population is most often chronic and is caused by a chronic condition. Because of this, the pain/condition experienced may not always be expected to remediate and so pain management is important in conjunction with rehabilitative interventions to allow the client ample opportunity to effectively use the adaptation, compensation, and environmental modification strategies in their daily life. Therefore, it is important to research the effectiveness of interventions that can reduce pain for this population to maximize independence and allow for attainment of the highest level of function.

A third FOR known as the Occupational Performance Model (Australia) was also initially considered for this study. This model proposes that individuals fulfill their occupational performance roles by engaging in routines, tasks and activities, in the domains of self-maintenance, productivity, leisure and rest, in the process responding to internal and/or external demands of the environment (Chapparo & Ranka, 1997). Specifically, this study had considered focusing on the internal environment portion of this model. The internal environment considers the condition and component within the individual that influences occupational performance (Chapparo & Ranka, 1997). The rehabilitative FOR was chosen over this model because it focused on achieving the client's highest level of function for chronic conditions (including chronic conditions that cause pain) that are not expected to remediate. The rehabilitative FOR also pulled in aspects of occupation-based treatments such as adaptation/adaptive equipment,

compensatory strategies, and environmental modifications that are relevant to this study's population. It was felt that the rehabilitative FOR was more relevant to what the study's objectives were focusing on. In future research, models and FORs, such as the Occupational Performance Model (Australia), can be more closely considered in order to ensure that occupation-based theory is better represented and linked to use of e-stim for UE pain and function with the older population.

Significance of the Study

The overall significance of this study is that it will produce results that can inform healthcare practice, outcomes, and delivery. The research questions and the purpose of this study were written in a manner that focused on production of results that enhance the ability of practitioners to provide a common intervention (e-stim) that targets a common deficit (pain) for the older adult population. Producing results about the effectiveness of e-stim when targeting UE pain informs everyday practice for clinicians who utilize this intervention for this deficit. The results of this study will provide pertinent clinical information about the effectiveness of e-stim and allow guidance for clinicians to provide evidence-based practice and best practice for their older adult clients who reside in a SNF.

This study is also significant for consideration of client outcomes. In terms of outcomes, the results of this study can improve client outcomes for clinicians by potentially decreasing their client's UE pain and improving UE function, thus improving their performance with daily occupational tasks. When these components improve, SNFs could then begin to see improvements in outcomes on common SNF assessments such as the Minimum Data Set (MDS). The MDS is a comprehensive, standardized assessment of each client's functional capabilities and health needs (Center for Medicare and Medicaid Services [CMS], 2020). Assessments are conducted by trained clinicians on all clients at admission and discharge, in addition to other

time intervals such as quarterly, annually, and when residents experience a significant change in status (CMS, 2020). Therefore, when looking at common SNF assessments, the results of this study impact healthcare outcomes. Research data on the effectiveness of an intervention that canbe used to improve SNF client's performance with daily tasks could assist with improving their outcome scores on relevant, common SNF assessments, such as the MDS.

Lastly, this study has significance in healthcare delivery to older adults. Given the purpose of this study, the results will impact and inform practice for clinicians. Clinicians having access to readily available research results in their practice area assists with providing evidence-based practice. This research will obtain results in using e-stim to treat clients with UE pain in skilled nursing facilities and so, in turn, this research holds significance to the healthcare delivery for the older adult population.

Summary

In summary, the overall intent of this research study will be to determine the effectiveness of e-stim in treating UE pain and UE function for older adult clients who reside in SNFs. In doing so, the study will produce results that inform best practice for clinicians working with older adults in SNFs. Apart from the purpose statement and project objectives, the overarching goal will be to produce a research study that can be used in evidence-based practice to improve engagement in occupations for older adult clients. Given the high prevalence of reported chronic pain within this population, the results of this study will hold weight and relevance in current practice for clinicians and their clients.

Section Two: Literature Review

Introduction

A comprehensive literature review was conducted using subcategories related to the overall purpose of this research study. The databases used for the literature review included: CINAHL Complete, CINAHL with Full Text, Academic Search Ultimate, MEDLINE, Psycinfo, and ScienceDirect. The subcategories included the following: occupational therapy and skilled nursing facilities, rehabilitation with skilled nursing facility clients, upper extremity conditions in older adult clients, upper extremity pain in older adult clients, modality descriptions and how e-stim works with therapy clients, treating upper extremity pain using electrical stimulation in general, treating pain using electrical stimulation with older adult clients, and OT and PT training and certification to use modalities in treatment. Each subcategory is included in the body of literature review in the next section.

Occupational Therapy in Skilled Nursing Facilities

When looking at OT practice in SNFs, one of the most prominent points is to acknowledge the growing percentage of the older adult population in the United States (US). By 2030 older adults (aged 65+ years old) will account for 20% of the total population (Bureau of Labor Statistics, 2020). Currently 5% of older adults live in SNFs. Of these, about 50% of SNF residents are 85 years old or older, 35% are between the ages of 75 and 84, and 15% are between 65 and 74 years of age (Neufeld, 2017). Statistics such as these greatly impact OTs who work with older adult clients in the US. The workforce of OTs will need to be prepared to adequately treat this increasing population in the very near future. There are currently around 15,600 SNFs in the United States (Center for Disease Control and Prevention [CDC], 2022). As of 2020, there are around 11,300 OTs that work in SNFs in the United States (CDC, 2022). As the growth in the older adult population continues, the number of OTs that work in the SNF setting with this

population will need to be able to meet the demands of growing caseloads and client needs. Beyond having the available workforce needed to treat the growing client population in SNF, OTs also need to be prepared and skilled in providing the most effective and evidence-based interventions for this population.

Previous studies have focused on OT treatment interventions of older clients in SNF settings. Occupation-centered practice is the gold standard treatment within an OT plan of care, which is emphasized in many OT educational programs (Jewell at al., 2016). However, OTs who practice in SNFs often do not focus on occupation during their treatments. This indicates a gap between theoretical frameworks and interventions being taught in professional schools and what is actually occurring in practice in SNFs (Jewell et al., 2016). Because of this, studies point to the fact that OTs have an opportunity and a potential role to serve as a catalyst for changing the culture of treating SNF clients (Jewell et al., 2016). By OTs committing to make a concerted effort to be occupation-based in treatments with SNF clients, older adults can benefit by being able to participate more fully in their daily occupations. Centering therapy around occupational activities ensures that older adults are receiving quality and effective OT services (Jewell et al., 2016). Implementing this culture change for OTs treating older adult clients in SNFs begins with advocacy on an individual level by practitioners challenging themselves and others to provide more occupation-centered care (Rafeedie et al., 2018). When this happens, the care provided to SNF clients can lead to changes that benefit clients, facilities, and payment systems as well as contribute to career satisfaction of OT practitioners (Rafeedie et al., 2018). Occupational therapy can and should serve as a catalyst for culture change in SNFs by providing meaningful interventions and opportunities that support engagement and health. Overall, the literature points out that OT within the SNF practice area is somewhat lacking in providing occupation-based practice. Despite students graduating from OT programs that showcase and highlight occupation-

based practice, many OTs in this setting fallback on therapeutic exercise and non-occupation-based activities due to time/productivity restraints and healthcare policies influence on reimbursement (Jewell et al., 2016; Rafeedie et al., 2018). As the SNF client population continues to rise, OTs need to make a strong commitment to implementing more occupation-based practice and improving the overall daily functioning of SNF clients.

Rehabilitation within Skilled Nursing Facility Clients

Due to healthcare policies driving reimbursement becoming unmanageable and, in some instances unethical, reimbursement policies have recently changed regarding rehabilitation with older adult clients who reside in SNFs (Prusynski et al., 2017). Exponential increases in rehabilitation intensity in SNFs motivated recent changes in Medicare reimbursement policies, which removed financial incentives for providing more treatment minutes across all therapy disciplines (Prusynski et al., 2017). Yet, there is concern that SNFs will reduce therapy provision and clients will experience worse outcomes. In fact, there is low-level evidence that indicates higher intensity therapy is associated with improvements in function (Prusynski et al., 2017). When looking at the rehabilitation of SNF clients, one study noted higher intensity therapy in SNFs leads to higher community discharge rates and shorter length of stay, but does not necessarily result in improved function (Prusynski et al., 2017). Continued studies in this area will be important as new healthcare policies and Medicare guidelines greatly impact the amount and duration of therapy services that SNF clients receive throughout their rehabilitation process.

Rehabilitation for SNF clients often involves both OT and physical therapy (PT) treatment and two separate plans of care for each therapy discipline. Studies have shown that role blurring can occur between OT and PT services and service delivery within the SNF practice setting (Marangoni et al., 2020). In many ways, the literature remains unclear as to what the distinct roles of PT and OT are in the rehabilitation setting (Marangoni et al., 2020).

Doctor of Physical Therapy students noted a division of therapeutic interventions of the upper and lower extremities during their clinical rotations in 94.2 % of SNFs (Marangoni et al., 2020). Review of the therapy treatments in SNF settings has indicated that OT is primarily responsible for the examination and treatment of UE pathologies, while PT is responsible for the examination and treatment of lower extremity pathologies almost exclusively (Marangoni et al., 2020). This suggests that the responsibility for UE care is provided by OT, while lower extremity care is provided by PT in both SNF and long-term care facilities. The reason for this division remains unclear (Marangoni et al., 2020).

OT's working with the UE has become part of the norm in SNFs regarding the rehabilitation process for older adult clients (Marangoni et al., 2020). It is important information for OTs who practice in this setting. There is a reiteration that OTs need to treat the "whole person", use an occupation-based approach, and remain holistic in treatment efforts (Marangoni et al., 2020). However, it also indicates that OTs, who work with client's on improving occupational functioning, and so focus on treatment of the UE is often more relevant to OT goals and plan of care (Marangoni et al., 2020). Because of this, it is important for OTs to have more in-depth and specialized knowledge of the UE anatomy and UE assessment/interventions when rehabilitating older adult clients who reside in SNFs (Marangoni et al., 2020).

Although the overall discussion of OTs practicing in SNFs focuses primarily on culture change and implementing more occupation-centered care, the rehabilitation process for OTs working with older adults emphasizes a focus on treating UE conditions. Therefore, it is important that OTs working in SNFs are knowledgeable of and have access to evidence-based interventions that target UE pain to improve UE function for SNF clients. Improved function leads to improved functional performance and allows therapists to implement a wider array of occupation-based interventions. Decreasing UE pain can lead to improved function, which leads

to increased opportunity to implement occupation-based practice, thus assisting with the culture change needed for OTs practicing in SNFs.

Upper Extremity Conditions in Older Adult Clients

Chronic diseases, such as stroke and osteoarthritis are rising in our older adult population (Baptista et al., 2018). The impact of a stroke is unique for every individual and may result in complex neurological deficits in sensory, motor, cognitive or emotional function, including pain (Williams & Murray, 2013). With the rising aging population, the incidence of stroke is also predicted to rise. Experiencing a stroke is a major event for individuals, as there may be a sudden and dramatic change in physical, emotional or cognitive capabilities, including a new onset of pain (Williams & Murray, 2013; Baptista et al., 2018).

Chronic conditions often lead to loss of hand function due to decreased strength and development of hand and wrist pain (Baptista et al., 2018). A study by Baptista et al. (2018) examined the functional outcomes of an occupation-based educational program for older adults with hand and wrist pain. A pre-test/post-test design was utilized to understand changes in occupational performance, hand function, pain, grip and pinch strength, and dexterity. Each treatment session addressed functional activities, symptom management, and exercises. All participants reported improvements in function, and significant improvements in post-test scores. Reported levels of pain significantly decreased from pre- to post-test (Baptista et al., 2018).

Several participants expressed benefit in incorporating modalities, such as e-stim, to manage hand pain (Baptista et al., 2018). Results of this study demonstrates how effective OT strategies and interventions can be used to improve UE pain for older adults caused by common chronic UE conditions.

Another common UE condition that causes UE pain within the older adult population is osteoarthritis. This diagnosis can often cause neck and shoulder pain (NSP). For this study, NSP was defined as the presence of muscle tension, stiffness, pressure, or dull pain in areas between the neck and the arch of the scapula. NSP is very common in the general population (Machino et al., 2021). NSP has a prevalence ranging from 16% to 75% and contributes to musculoskeletal disability that influences an individual's physical, social, and psychological well-being (Machino et al., 2021). When NSP is present in healthy middle-aged and older adults, there is a direct correlation to poor health-related quality of life and diminished physical and mental health (Machino et al., 2021). Therefore, interventions to assist with improving NSP may improve physical health for middle-aged and older adults (Machino et al., 2021).

Upper Extremity Pain in Older Adult Clients

The presence and management of pain is an area of concern for older adult clients, especially persistent pain caused by chronic conditions. It is currently reported that 25.3 million adults in the United States suffer from persistent daily pain (Watson et al., 2021). Persistent pain due to chronic musculoskeletal disorders is the leading cause of disability among older adults, surpassing heart disease, stroke, and lung disease (Watson et al., 2021). It is estimated that over 60% of the 46.2 million American adults over the age of 65 report having persistent pain (Watson et al., 2021). Pain experienced by older adult clients is most commonly chronic pain, regardless of location or condition (Watson et al., 2021). Chronic pain is a complex condition to assess and treat (Thakral et al., 2018). Older age is associated with several highly prevalent comorbid pain conditions including both musculoskeletal and neurological conditions (Thakral et al., 2018). The impact of pain in older adults goes beyond physiological risks to include impaired cognitive function, depression, sleep disturbance, diminished socialization, increased healthcare use and costs, and impaired functional abilities (Thakral et al., 2018).

The prevalence of pain, including UE pain, in older adults living in SNFs is as high as 80% in developed countries, which includes a component of pain known as persistent pain quality (Auxier et al., 2019; Thakral et al., 2018). Persistent pain quality is defined as reporting pain descriptors within the following categories: sensory, cognitive/affective, or neuropathic (Thakral et al., 2018). When these persistent pain qualities are present in older adults they are 2-2.5 times more likely to experience widespread pain (Thakral et al., 2018). More specifically, UE pain and loss of function is caused by the high prevalence of musculoskeletal disorders (MSKDs). MSKDs include osteoarthritis, which can occur in multiple joint articulations of the UE. It affects hundreds of millions of people around the world and is the most common cause of disabilities in older adults (Kechichian et al., 2022). For the older adult population, it is important to address the severity of chronic pain, as this is the type of pain commonly experienced by older adult clients (Auxier et al., 2019; Thakral et al., 2018).

Treating Upper Extremity Pain in Older Adult Clients

Moving beyond looking at the prevalence of pain, the next concern is then looking at effective methods to treat pain in older adults. Assessing the effectiveness of multimodal interventions including exercise rehabilitation for older adults and client education is important in effectively treating UE pain for older adults (Kechichian et al., 2022). Non-pharmacological interventions including interventions such as e-stim and UE exercise rehabilitation appear to be more effective to reduce UE pain and disabilities and to improve functional performance in older adults, compared with usual medical care or no treatment (Kechichian et al., 2022; Watson, et al., 2021). For older adults, surgery and pharmacological interventions have inherent risks due to age and comorbidities (Watson et al., 2021). Many previous studies that have looked at non-pharmacological treatments for pain have excluded individuals who are 65+ years old (Watson et al., 2021). Given the risks involved in treating pain in older adults by

pharmacological and surgical means, it is important to conduct studies and include participants over the age of 65 in studies that focus on non-pharmacological treatments and interventions for pain (Watson et al., 2021). One example is patient education, including teaching older adults about pain and pain management (Watson et al., 2021; Kechichian et al., 2022). Another example of a non-pharmacological approach would include the focused intervention of this study, e-stim. This section of the literature review has focused on UE conditions and pain experienced by older adult clients. The literature review will now discuss how the use of e-stim works when treating therapy clients and the available literature that has demonstrated the effectiveness of e-stim in treating pain, first in general and then within the older adult population specifically.

Modality Descriptions and How E-stim works with Therapy Clients

Physical agent modalities are interventions that are systematically applied and used in various forms of force or energy to modify specific client factors when neurological, musculoskeletal, or skin conditions are present that may limit occupational performance (Bracciano, 2021). In occupational therapy intervention, physical agents which include thermal and electromagnetic, are used in preparation for or concurrently with purposeful and occupation-based activities (Bracciano, 2021). Thermal agents provide a change in tissue temperature, heating or cooling tissue, and include hot packs, cold packs, and ultrasound (US), which have a thermal and mechanical effect (Bracciano, 2021). Electromagnetic agents use magnetic/electrical fields and move through the air without need for a specific conductor or medium through which to focus the energy (Bracciano, 2021).

Physical agent modalities can be described by depth of penetration and mechanism of action. Superficial thermal agents, such as hot or cold packs, penetrate 1-2 cm, whereas deep thermal agents penetrate from 2-5 cm (Bracciano, 2021). US has either a deep or superficial effect depending on parameters set and has either a thermal or nonthermal, mechanical (healing)

effect, leading to different bio physiological impact (Bracciano, 2021). Superficial thermal agents also include hydrotherapy/whirlpool, cryotherapy, fluidotherapy, hot packs, paraffin, and infrared heating. Deep thermal agents include electrical stimulation, therapeutic US, phonophoresis, and diathermy (Bracciano, 2021). Electrotherapeutic agents include neuromuscular electrical stimulation (NMES), functional electrical stimulation (FES), transcutaneous electrical nerve stimulation (TENS), high-voltage galvanic stimulation (HVGS), electrical stimulation for tissue repair (ESTR), and iontophoresis (Bracciano, 2021). Electromagnetic agents also include low-level laser (light) therapy (LLLT) that has a therapeutic effect for tissue healing and pain modulation for both acute and chronic pain (Bracciano, 2021).

This study will primarily examine electrical stimulation (e-stim) as a modality to lessen pain in the UE to prepare a client for engagement in occupation. E-stim is an electrotherapeutic agent and is used to treat pain (Bracciano, 2021). During e-stim treatment, electrodes are placed on the client's skin on or around the area experiencing pain (Bracciano, 2021). Electrodes must be placed securely to maintain conductivity. Electrodes can be positioned parallel, crossed, front/back, bracketed, or criss-crossed over the area of pain (Bracciano, 2021). The electrodes are then connected to lead wires (Bracciano, 2021). The lead wires deliver low-level modulated alternating currents to the body to stimulate sensory nerves or a physiological response to modulate the perception of pain (Bracciano, 2021). The frequency, intensity, and type of current being delivered to the electrodes is controlled by the therapist delivering the treatment and is dictated by client feedback (Bracciano, 2021). There are two common e-stim currents used to treat pain. One is interferential current (IFC). IFC utilizes two channels simultaneously , which consist of four electrodes placed in a vector pattern,with different frequencies and parameters. This allows deeper tissue penetration to facilitate pain reduction. IFC is used for treatment of large areas and deeper tissues (Bracciano, 2021). The second e-stim current is an alternating

current (AC). The AC current is characterized by periodic changes in the polarity of the electrical current flow (Bracciano, 2021). The current is uninterrupted and bidirectional, without any true positive or negative pole (Bracciano, 2021). The pre-mod current is similar in its benefits and use to the IFC current. The main difference between the two is how the current is delivered to the muscle tissue (Prohealthcare, 2022). With premod current, a single channel is used to mix the frequencies prior to delivery of the current through the electrode of the body (using two electrodes rather than four). This is beneficial when treating areas of the body that have less space available for electrode placement. This makes it the perfect choice to use on smaller muscle groups and joints such as the elbow, wrist, ankle, foot, and hands (Prohealthcare, 2022).

Treating Upper Extremity Pain using E-Stim in General

Methods of e-stim used in occupational therapy to decrease pain include, e-stim (IFC and AC), NMES, and FES**.** The use of NMES has proven to be effective in treating pain in a wide variety of healthcare disciplines (Smith et al., 2021). This includes shoulder pain caused by varying diagnoses including post-stroke pain and sports related injuries (Smith et al., 2021; Hochsprung et al., 2017). Approximately 20% of clients have shoulder pain immediately after a stroke (Hochsprung et al., 2017). Prognosis with post-stroke pain is better when pain is addressed in an early stage (Hochsprung et al., 2017). A conservative treatment based on gentle mobilizations, alone or combined with e-stim, and proper shoulder positioning and handling, is often used in the clinical setting to prevent spasticity, shoulder subluxation, and pain (Hochsprung et al., 2017) The use of NMES and taping to supplement strengthening and stretching programs has shown to facilitate decreased UE pain in clients with these UE diagnoses in younger populations <65+ years old (Smith et al., 2021; Hochsprung et al., 2017). Furthermore, the use of NMES and e-stim are commonly recommended for treating UE pain, due to their multiple physiological effects such as increasing muscle strength, improving circulation, promoting wound

healing, and inhibiting pain fibers (Zhou et al., 2018).

Upper extremity impairment is one of the main diagnoses that causes functional disability (Karakus et al., 2013). Specifically, hand-wrist function and UE pain post-stroke have been found to cause decreased independence and functional impairments (Karakus et al., 2013; Karaamet et al., 2019). Functional Electrical Stimulation (FES) is another common form of e-stim that is utilized to treat UE conditions that cause pain and impaired function. FES is an e-stim technique used to provide voluntary muscle contraction during a functional task (Karaahmet et al., 2019). FES has been used in individuals poststroke to improve strength, UE function/pain, and to prevent shoulder subluxation (Auchstaetter et al., 2016; Karaahmet et al., 2019; Karakus et al., 2013). Moreover, FES is associated with neuroplasticity poststroke and can contribute to neural recovery (Auchstaetter et al., 2016). FES has shown to improve UE pain and function when compared to standard rehabilitation therapy for shoulder pain relief in patients with acute–subacute stroke (Karaahmet et al., 2019; Karakus et al., 2013). Therefore, combining an e-stim treatment such as FES with a standard rehabilitation program can alleviate shoulder pain, improve function, and may prevent development of shoulder subluxation over time (Karaahmet et al., 2019; Karakus et al., 2013). This demonstrates the improved effectiveness in treating UE pain and function using a common form of e-stim when compared to conventional therapy methods alone.

The literature discussed here produced results that show the effectiveness of e-stim in decreasing UE pain and improving UE function. However, the studies were conducted exclusively on younger age cohorts and did not focus on older adult clients residing in SNF specifically. This section indicates the effectiveness of e-stim as an intervention in treating UE pain while simultaneously demonstrating the gap that exists in the literature in using e-stim in the older population.

Treating Pain using E-Stim with Older Adult Clients

The literature review for this study revealed that the research involving use of e-stim to treat UE pain for older adult clients is limited. Due to this, the subcategory was broadened to include "pain" in a more general sense rather than specifically "UE pain." Among older adults, low back pain (LBP) is common, costly, and disabling (Pugliese et al., 2019). NMES along with trunk muscle training (TMT) has been found to be effective in reducing LBP, but studies among older adults have been limited (Pugliese et al., 2019). A case study by Pugliese et al. (2019) involved an 83-year-old female with left-sided chronic LBP to participate in a randomized controlled trial of supervised TMT and NMES treatments to the paraspinal muscles two times per week for 12 weeks. At the end of the intervention, the participant reported reduced LBP and LBP-related disability with improved scoring on all outcome measures indicating improved LBP and overall function (Pugliese et al., 2019). This case study demonstrates a positive short-term treatment response to TMT supplemented with NMES to the paraspinal muscles in an older adult with chronic LBP. Outcomes of this study show how e-stim can be effective in treating pain in older adult clients. Although e-stim was not utilized as a stand-alone treatment, the use of e-stim assisted with a positive outcome for improved pain.

A study by Karlsen et al. (2020) focused on the use of NMES functions to preserve leg mean mass in older adult clients. This study aimed to examine changes in lean mass during hospitalization in older adult patients and the effect of muscle activation by NMES (Karlsen et al., 2020). During this study, participants received daily stimulation through NMES of the knee extensors, whereas the other leg served as a control leg (Karlsen et al., 2020). A moderate decline in leg lean mass during a hospital stay in the control leg of older adult clients occurred, whereas leg lean mass was preserved with daily stimulation using NMES (Karlsen et al., 2020). Although this study does not address pain specifically, it was able to show a positive outcome

with the utilization of e-stim in treating the older adult population. Also, the condition being targeted in this study was muscle atrophy which can lead to increased pain and decreased function.

Transcutaneous electrical nerve stimulation (TENS) is a portable/milder form of e-stim and has several advantages as it is a non-addictive, non-invasive means of analgesia that is simple to use, portable, and can give continuous analgesia for a variety of conditions (Wright, 2012; Martimbianco et al., 2019). Conventional TENS tends to have a quick onset of analgesia but loses its effect rapidly when the stimulation is turned off. The analgesic effect of low-frequency TENS takes longer to achieve but the pain relief produced by the endogenous opioids can last anywhere from five minutes to 18 hours. Some patient's pain levels do not return to pre-stimulation levels even after 24 hours (Wright, 2012). A systematic review evaluating the effectiveness of TENS in chronic pain found there was a positive analgesic outcome in favor of active TENS treatments (Wright, 2012). Results found that TENS is useful to consider as an additional method of pain management, as it has no side-effects and therefore has a good benefit potential when compared to the risk (Wright, 2012). This article provides support in the use of TENS, a common form of e-stim, in treating chronic pain conditions for older adult clients.

OT and PT Training and Certification to use Modalities in Treatment

OT's need to be certified and receive extra training post education to be able to use electrical stimulation and other physical agent modalities with clients. For OTs, getting certified in modalities is on a state-by-state basis. Some states require credentialing for OTs beyond the basic licensure process in order to use modalities (American Occupational Therapy Association [AOTA], 2022). However, each state has unique regulations and certification processes. OTs who wish to become certified to use modalities in treatment must refer to their state's occupational therapy practice board for guidance (Lyon, 2022). There are several organizations that offer

certification courses, but time and cost vary. Many states do not consider modalities application to be an entry-level skill, so it is important to determine whether modalites are covered within your state's occupational therapy license or if you need an additional certification (AOTA, 2022; Lyon, 2022).

This study took place in Kentucky. When looking specifically at OTs practicing in Kentucky, OTs are required to undergo a minimum of 36 hours of training or instruction, four hours of which must be dedicated to hands-on laboratory time (Kentucky Board of Licensure for Occupational Therapy [KBLOT], 2022). Training and instruction must be earned by direct personal participation in courses, workshops, or seminars, as well as five modality treatments supervised by an OT who already holds a modality certification (KBLOT, 2022). The five supervised treatments must include one session for each of the following areas: iontophoresis, ultrasound, electrical stimulation. The remaining sessions may cover any modality treatment (KBLOT, 2022). Supervised treatment sessions may be completed in a laboratory portion of an instructional course, provided that the instructor meets the requirements for a modality supervisor and that all of the requirements of this administrative regulation have been met (KBLOT, 2022).

The modality certification process for PTs is different from OTs. Physical therapy educational institutions are accredited through the Commission on Accreditation in Physical Therapy Education (CAPTE) (Commission on Accreditation in Physical Therapy Education [CAPTE], 2020). CAPTE ensures that PT curriculum standards include learning outcomes and coursework where PT students gain knowledge and experience in the use of modalities throughout their education (CAPTE, 2020). This includes that students demonstrate the ability to safely perform therapeutic interventions appropriate to practice setting within a PT plan of care with constant monitoring and feedback (CAPTE, 2020). This is achieved for modalities by

having PT students apply and correctly utilize physical agent modalities throughout the curriculum (CAPTE, 2020). Because this is integrated into the coursework, PT students who attend CAPTE accredited universities and colleges graduate with the ability to begin using modalities in treatment with their clients at entry-level (CAPTE, 2020).

Conclusion

Overall, the literature review revealed that a gap does exist in the literature regarding the effectiveness of e-stim in treating pain, specifically UE pain for older adult clients who reside in SNFs. The literature included under the subheading "Treating Pain using E-stim with Older Adult Clients" were not conducted on client's residing in SNF, nor did they focus specifically on pain in the UE. The subcategory had to be generalized to "pain" rather than "UE pain" to locate existing literature. The current literature points to OT's role in SNF and in the rehabilitation process for older adult clients. Occupational therapists working in SNFs need to utilize occupation-based practice and continue to improve their knowledge and skills in treating clients with UE conditions and pain. The gap that exists in the literature regarding the effectiveness of treating pain for this population is concerning. If this population is experiencing pain, their UE function diminishes resulting in inability to engage in valued occupations. As research does exist that shows positive outcomes in treating UE pain and function using e-stim for other age cohorts and populations, more research needs to be conducted that focuses on the effectiveness of decreasing UE pain and improving UE function utilizing e-stim for the older adult population, and more specifically with older adults residing in SNFs.

Section Three: Methods

Project Design

This capstone study was a quasi-experimental design in the form of pretest-posttest measurements. Each participant completed the pre-tests, the e-stim treatment for "x" number of visits was administered for UE pain, and then the post-tests were completed one time at the end of the e-stim treatments (Creswell & Creswell, 2018). This research design was well suited for this study because the goal was to determine the effectiveness of a specific treatment.

Setting

The setting where this study took place was at two different SNFs in the central Kentucky area. The first clinical site where data collection occurred was in the Northern Kentucky area. There are two OTs at this facility and both are modality certified. The second was in the Southeast Kentucky area. There were also two OTs at this facility and both are modality certified. Both facilities had under 100 beds. Clients seen at both facilities are mostly older adults with varying diagnoses including hip fracture/replacement, osteoarthritis, knee replacements, shoulder replacements, UE fractures/contractures, stroke, dementia, and cardiorespiratory disease. These settings were chosen based on the focus of the study, the inclusion criteria, and access to de-identified data. The settings offered convenience as therapists employed at the sites were already licensed to administer e-stim. This setting was ideal given that the minimum optimal sample size for this type of study is 30 subjects (Taylor, 2017). Using SNFs as the setting maximized the chances of obtaining a minimum optimal sample size of individuals that met inclusion criteria.

Inclusion/Exclusion Criteria

The participants for this study needed to meet specific inclusion criteria to participate. Participants were individuals who were 65+ years old, resided in a SNF, and had UE pain that

limited occupational functioning in their daily life. Participants needed to be cognitively intact or minimally cognitively impaired to complete the outcome measures (pre and post). Minimally cognitively impaired was defined as being able to reliably complete the Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH) (Appendix C) and the Visual Pain Scale (VPS) (Appendix D) with assistance as needed. The participants also needed to be cognitively intact or minimally cognitively impaired in order to give therapists feedback during e-stim treatments (i.e. when intensity was at an optimal level). The exclusion criteria included individuals who were younger than 65+ years old, did not reside in a SNF, did not have UE pain that limited daily function, or who were moderately or severely cognitively impaired.

The recruitment procedure of participants for this study used a screen/screening process that the SNF currently utilizes. The screen is titled “Modality Should I?” (Signature Healthcare, 2018) screen (Appendix E) and it is used to determine if e-stim treatment is indicated for the client's plan of care. This screening process is carried out routinely at the facility in the Northern Kentucky area. The facility in the Southeast Kentucky area uses an electronic screening form that is similar to the “Modality Should I?” form that was used for this study. This was optimal to recruit participants who met inclusion criteria because it screens the client for all areas that are needed to be included in the study (age, SNF status, UE pain, and cognitive status).

Data Collection Methods

This study used a quasi-experimental pretest-posttest design. Because of this, the data collection was reliant upon change in outcome measure scores based on the utilization of the specific intervention of e-stim. Additionally, this study used a nonprobability sampling method in the form of purposive sampling. This sampling method is the deliberate selection of individuals based on certain predetermined criteria (Taylor, 2017). This sampling method was used because the inclusion criteria required a specific sample of participants. Because of this, nonprobability

sampling was the most practical choice for this study.

Data collection within this research study will be discussed next. Firstly, participants were selected using the screening form/methods. The target number of participants was at least 30 because this is the minimum sample size for experimental design (Creswell & Creswell, 2018). The final number was not exact, but the goal will be to obtain 30 participants by continuing with the study in the future. The number of participants at the conclusion of the pilot study was 10. Because of the low sample size, the initial data was analyzed using descriptive statistics with the plan to continue the study until at least 30 participants are achieved. Voluntary participation was ensured via an oral script (Appendix A). The script included content regarding the following: purpose of the study, a statement that participation is voluntary, expected duration, and the procedures to be followed during the study. Participants then completed the pre-test for both outcome measures.

At this point, recording de-identified data from provided e-stim treatments for the participants began. Recorded de-identified data regarding e-stim function included settings and parameters that are meant to target pain. These functions included IFC and pre-mod currents. Throughout the treatment portion of the study, all therapists who administered e-stim recorded and documented de-identified, relevant data on an excel spreadsheet (Appendix B). The data collected included the following: assigned client number, UE diagnosis, e-stim function used (pre-mod, IFC), number of visits, and pre-/post-test scores on the QuickDASH and VPS outcome measures. Post-test data for both outcome measures was only collected at the conclusion of the treatment process.

Data Analysis

Data analysis occurred through analyzing the descriptive statistics from the study's initial data. The data that was analyzed included the pre-/post-test scores for both the VPS and the

QuickDASH outcome measures. The differences in all pre-/post-test scores were calculated and then the mean, median, and mode scores for the difference in scores were calculated. The highest and lowest differences in scores were calculated and all differences in scores were analyzed to see if any changes in scores were clinically significant according to the outcome measures. The changes in scores were also analyzed in comparison to the number of visits that the participant received. The plan for future data analysis will be to collect more data and then use paired-sample *t*-tests to determine statistical significance of the data.

Instruments

The outcome measures that were used for this study were the QuickDASH assessment (Appendix C) and the VPS (Appendix D). Disability of the UE is often measured using the DASH assessment, which is a client questionnaire assessment addressing disability and symptoms of a UE condition using a scale ranging from one(no disability) to five (most severe disability) (Institute for Work and Health, 2006). The DASH assessment was created as an outcome measure for UE disorders with the UE as a functional unit. It is a reliable and valid instrument for patients with diverse UE disorders and conditions affecting the arm, wrist, and hand (Ydreborg et al., 2015).

It is important to mention that the QuickDASH assessment (Appendix C) is an abbreviated version of the full DASH assessment (Institute for Work and Health, 2006). Although both have reliability and validity in research, the QuickDASH was chosen because it obtained all relevant information needed regarding UE performance with functional tasks, was already commonly used at the clinical site(s) where the study occurred, and was less time consuming for the therapists that assisted with recording the deidentified data. The QuickDASH was also utilized because it assesses client performance with UE functional tasks rather than focusing only on pain intensity, as with the VPS. The QuickDASH assessment

asks the client to self-report 11 functional tasks using the same likert scale as the full DASH assessment, with a "1" meaning no difficulty and a "5" meaning unable to perform the task (Smith-Forbes et al., 2018; Institute for Work and Health, 2006). The functional tasks the client is asked about include, but are not limited to, opening a tight or new jar, doing heavy household tasks, carrying a shopping bag or briefcase, washing your back, and cutting with a knife (Smith-Forbes et al., 2018; Institute for Work and Health, 2006). These tasks are considered to be ADL/IADL tasks by occupational therapists (AOTA, 2022) and provide the therapist with data on these specific occupation-based tasks that the client may be having difficulty with due to their UE disability (Smith-Forbes et al, 2018; AOTA, 2022).

The QuickDASH is widely used in UE rehabilitation. The QuickDASH has additional sub-sections including work and sports subcomponents, however, data was not collected for these subcomponents as they did not apply to the target population of this study. There is strong evidence to support the reliability and validity of this outcome measure in UE rehabilitation (Smith-Forbes et al., 2018).

Visual Pain Scales have been used in studies of older adult clients and have proven to be a useful outcome measure for assessing pain for this population (Naber et al., 2020). A study by Naber, et al. (2020) used the Short-Form McGill Pain Questionnaire as a research instrument to assess pain in older adults. This assessment includes a Visual Analog Scale where the individual's level of pain is rated from 0-10, with zero representing no pain and 10 representing worst possible pain. There is a strong body of evidence that supports the validity and reliability of using the Short-Form McGill Pain Questionnaire and Visual Analog/Pain Scales in clinical studies with a variety of conditions (Naber et al., 2020). Psychometric evaluation of pain intensity scales suggests that variations of the numeric rating scales, such as the faces pain scales, and visual analogue scale are appropriate for use with older adults (Herr & Garrand,

2001). A prerequisite for selecting an appropriate pain measurement scale for older adults involves determining the individual's ability to read, hear, and understand the directions for accurately completing the assessment (Herr & Garand, 2001). Many older adults may not exhibit cognitive impairment but will present with adaptations for sensory losses such as hearing aids and corrective lenses. For older adults with these needs, as well as other concerns such as reading issues, clinicians may need to provide the VPS to meet the older person's capabilities (Herr & Garand, 2001).

The VPS was chosen for this study because it offers accommodation for these specific needs for older adults. Although inclusion criteria required that participants had no cognitive impairment or no more than a minimal cognitive impairment, older adults could still have difficulty understanding the numeric pain scale instrument and what is being asked of them. This can be from multiple issues including visual deficits, illiteracy issues, and the novelty of the instrument itself. The use of the VPS offered different choices and visuals to appeal to different types of understanding for individuals and allowed a greater opportunity for accurate self-reported pain on the scale.

Both the QuickDASH and the VPS outcome measures were ideal to collect the pre- and post-test data because they assessed all areas that were relevant to this study. This included assessment of UE pain and function and the impact that UE pain had on an individual's ability to perform common UE functional tasks. Because of the proven reliability and validity of the QuickDASH and the VPS assessments, as well as the relevance to the study's purpose, these instruments were used for the outcome measures of this study.

The time and number of visits for e-stim treatment for chronic pain is 10-30 minutes up to 3-5 times a week (Bracciano, 2021; Enriched Healthcare, 2022). The number of visits needed varies depending on the client's needs, but SNF clients are typically on a therapy caseload for

3-4 weeks, ranging from 3-5 days a week of treatment during that 3-4 week time frame (Marie, 2019). Given these common ranges for both how often e-stim is typically provided and the average length of stay on a therapy caseload for SNF clients, the typical number of visits for e-stim treatment for SNF clients is 9-10 e-stim treatments (Bracciano, 2021; Enriched Healthcare, 2022; Marie, 2019). This is justification as to why the data collected required the participant receive at least eight e-stim treatments during the treatment portion of the study.

Ethical Considerations

Ethical concerns could have potentially occurred during this study. It was important to consider that all participants received the benefits of the study. Because the study was a quasi-experimental design, it was important to ensure that data was collected so that other clients, not just the participants of the study, benefit from future treatment (Creswell & Creswell, 2018). The end result was that future clients could benefit from the results that are produced from the study regarding the effectiveness (whether effective or not effective) of e-stim treatment for UE pain/function. During the data acquisition and management phase (specifically, data storage), it needed to be ensured that any data collected was properly protected and stored. In addition, under the Health Insurance Portability and Accountability Act (HIPAA), individuals who collected personal health information (PHI) for research purposes were required to store all PHI according to acceptable standards. Data was to be stored in locked cabinets or offices and electronic files were password protected to manage data storage (Taylor, 2017). The concern of data storage was a potential ethical issue because data storage relied on various practicing therapists to keep data accurate and safe at their respective sites.

The deidentified data that was collected included the following: client number, UE diagnosis, e-stim function used during the client's treatment, pretest/posttest scores on both outcome measures, and number of visits the client received. All data being collected was being

done so in a manner that adhered to confidentiality requirements to ensure client privacy and HIPAA compliance.

Section Four: Results and Discussion

Results

For the quantitative results of this study in each data set below, each client was assigned a number by the treating therapist. Table 1 describes the client's UE diagnosis, type of e-stim function the client received, and the number of e-stim visits the client received. Table 2 discusses the client's pre-test score, post-test score, and difference in pre/post-test scores for the VPS outcome measure. Table 3 discusses the client's pre-test score, post-test score, and difference in pre/post-test scores for the QuickDASH outcome measure.

Client UE diagnosis and Number of Visits

The assigned client number, UE diagnosis, type of e-stim used, and the number of e-stim visits the client received can be seen in Table 1. The assigned client number was random and was at the discretion of the therapist that was collecting data for that participant. The client was assigned a random number in order to maintain confidentiality and so the data remained de-identified. Of the ten participants that data was collected on for this pilot study, seven of them had an UE diagnosis of shoulder osteoarthritis (OA). Other diagnoses affecting the shoulder included a shoulder fracture at the greater tuberosity and a rotator cuff tear. The only diagnosis that data was collected on that did not occur at the shoulder was a wrist fracture. The type of e-stim the client received consisted of two specific e-stim functions, either IFC or pre-mod. The choice of the type of e-stim the client received was at the discretion of the therapist providing the e-stim treatment. Of the ten participants, nine of them received the IFC e-stim function. The only participant that received the pre-mod estim function was the participant with a wrist fracture. The number of e-stim visits the participants received varied from eight to fifteen visits with the majority of the participants receiving eight to nine e-stim visits.

Table 1: Client UE Diagnosis and Number of Visits

Client number	Client UE diagnosis	Type of e-stim received	Number of visits
1	Shoulder osteoarthritis (OA)	IFC	8
3	Shoulder OA	IFC	15
4	Shoulder OA	IFC	9
5	Shoulder OA	IFC	9
788	Shoulder OA	IFC	9
809	Shoulder OA	IFC	8
921	Shoulder OA	IFC	10
2	Shoulder fracture	IFC	8
150	Rotator cuff tear	IFC	8
947	Wrist fracture	Pre-mod	8

Pre-Test and Post-Test Scores for Visual Pain Scale

The pre-test and post-test scores for the Visual Pain Scale outcome measure and differences in VPS scores from pre- to post-test can be seen in Table 2. The VPS is an assessment that measures pain intensity on a numeric scale of 0-10 (Appendix D). A lower VPS score indicates that the client is experiencing less pain. The highest difference in scores occurred for a participant with shoulder OA with a difference of 10 from pre- to post-test.The lowest difference in scores occurred for a participant with a rotator cuff tear with a difference of one from pre- to post-test. The mean score for the difference in scores for the VPS was 5.7. The median score was 6 and the mode was 6.

Table 2: Pre-Test and Post-Test Scores for Visual Pain Scale

Client number	Pre-test score	Post-test score	Difference
1	8	0	8
3	8	1	7
4	10	0	10
5	9	0	9
788	7	5	2
809	6	3	3
921	6	2	4
2	10	2	8
150	4	3	1
947	6	1	5

Pre-Test and Post-Test Scores for QuickDASH Assessment

The pre-test and post-test scores for the QuickDASH outcome measure and differences in the QuickDASH scores from pre to post-test can be seen in Table 3. The QuickDASH assessment uses a five point likert scale and asks the client to self-report on there ability to perform various UE functional tasks such as cutting with a knife and opening a jar (Appendix C). QuickDASH scores range from 0-100. A lower QuickDASH score indicates UE improvement and less UE disability the client is experiencing. The highest difference in scores occurred for a participant with shoulder OA with a difference of 68.19 from pre- to post-test. The lowest difference in scores occurred for a different participant also with shoulder OA with a difference of five from pre- to post-test. The mean score for the differences in scores for the QDASH was

28.8. The median score was 23.05 and the mode was 8.

Table 3: Pre-Test and Post-Test Scores for QuickDASH Assessment

Client Number	Pre-Test Score	Post-Test Score	Difference
1	77.27	36.36	43.91
3	86	50	36
4	100	31.81	68.19
5	84.09	22.72	61.37
788	43	38	5
809	33	21	12
921	33	25	8
2	100	65.9	34.1
150	34	23	11
947	41	33	8

Differences in Pre-Test and Post-Test Outcome Measures and Number of Visits

The differences in pre/post-test scores for the VPS and QuickDASH outcome measures compared to the number of visits the client received can be seen in Table 4. At the conclusion of this pilot study, scores varied regardless of how many visits the participants received. The study needs more data to be collected and analyzed to be more conclusive if the number of visits has clinical implications for decreased pain and improved UE functional performance. So far the initial data appears promising with the indication that decreased pain and improved function does correlate to number of visits because all participants indicated decreased UE pain and improved UE function for both outcome measures and all participants received at least eight e-stim treatments.

Table 4: Differences in Pre-Test and Post-Test Outcome Measures and Number of Visits

Client Number	Difference in VPS Scores	Difference in QDASH Scores	Number of Visits
1	8	43.91	8
3	7	36	15
4	10	68.19	9
5	9	61.37	9
788	2	5	9
809	3	12	8
921	4	8	10
2	8	34.1	8
150	1	11	8
947	8	8	8

Discussion

The most prominent finding from the results of this pilot study was that the differences in the pre-test scores and post-test scores for both outcome measures showed that all participants had decreased reported UE pain and improved UE function after e-stim treatment intervention. When looking at assessing chronic pain using the VPS numeric scale of 0-10, a difference of two or more points on the pain scale indicates a change in score that is considered to be clinically significant (Michner et al., 2011; Farrar et al., 200; Zhou et al., 2018). All ten participants of this pilot study reported decreased UE pain measured by the VPS. Over half of the participants (eight participants) had a change in score that was clinically significant with greater than a two-point difference from pre- to post-test. This shows that the majority of the participants had a clinically significant reduction in pain with e-stim treatment to the UE when using the VPS as an outcome measure of pain intensity.

The research looking specifically at e-stim to treat UE pain for this specific population is very limited in the current literature. When referencing the literature review that was conducted

for this study, the amount of research that focused on e-stim to treat UE pain for older adults who reside in SNFs was so limited that UE pain had to be broadened to focus on pain in general.

Use of E-stim to Treat Shoulder Pain

The majority of the diagnoses for this pilot study involved chronic pain occurring at the shoulder joint. Studies exist in the current literature that demonstrate the effectiveness of e-stim to treat hemiplegic shoulder pain (HSP) post-stroke due to decreased mobility and shoulder subluxation. E-stim has been used to effectively treat UE pain due to HSP. Although participants in this study did not show HSP, e-stim did reduce the client's' perception of shoulder pain due to other shoulder diagnoses.

Use of IFC E-stim to Treat Chronic Pain

IFC e-stim has shown to have positive effects when treating chronic pain. When using IFC to treat chronic pain, it has been shown to be effective in providing positive, immediate analgesic for chronic pain (Diaz et al., 2021; Wright 2012). The Diaz et al study used a numeric pain scale as an outcome measure and their study demonstrated a reduction in chronic pain with statistical significance with a p-value of <.5 (Diaz et al., 2021).

Use of e-stim to improve UE Function

When looking at assessing UE function using the QuickDASH assessment, a difference of fiftenn or more points indicates a change in score that is considered to be clinically significant (Smith-Forbes et al., 2018). Half of the participants of this pilot study (five participants) reported improved UE function that was clinically significant according to the QuickDash with greater than a fifteen-point difference from pre- to post-test. This indicates that the use of e-stim to treat UE pain shows promise in improving UE function for older adult SNF clients when they have received at least 8 e-stim treatments.

The results of this study are not clearly related to occupational performance and

occupational therapy as a unique profession. Completion of the full DASH assessment or potentially adding another outcome measure that is more occupation-based than the QuickDASH such as the Canadian Occupational Performance Measure (COPM) would have strengthened this study. The COPM has been studied in UE rehabilitation focusing on construct validity in relation to common UE assessments including the DASH and the Michigan Hand Outcomes Questionnaire (MHQ) (van de Ven-Stevens et al., 2015). Results show that the COPM has construct validity in relation to the DASH and MHQ outcome measures when evaluating individuals with UE conditions (van de Ven-Stevens et al., 2013). Therefore, the use of the COPM in future research would be a relevant occupation-based assessment to pair with the QuickDASH to gain further insights into the correlation between how using e-stim to treat UE pain results in improved occupational performance.

The use of e-stim to treat pain by OTs needs to be differentiated from PTs utilizing e-stim to treat pain. Treatment in the SNF setting has shown that OT is primarily responsible for the examination and treatment of UE pathologies (Marangoni et al., 2020). There is a reiteration that OTs need to use an occupation-based approach to remain true to the profession, however, OTs tend to focus on the rehabilitation of the UE in this setting due to UE function being more relevant to OT's plan of care (Marangoni et al., 2020). In order to differentiate an OT e-stim treatment from a PT treatment, the OT would follow-up the e-stim treatment and focus on an occupation-based intervention (Marangoni et al., 2020). This could include an ADL/IADL task that requires UE functional performance such as upper body dressing, washing back, or cutting with a knife (AOTA, 2022). For future research, in order to further investigate the relationship between e-stim decreasing UE pain and improving UE function, the e-stim treatment session could be followed up with a functional ADL/IADL task to more fully assess if occupational performance improved.

Limitations

The limitations for this study included that there was a low sample size. When this pilot study concluded, data was collected on ten participants. This was not at the minimum number of 30 participants needed to conduct paired sample *t*-tests to look for statistical significance in the data. Another limitation was the varying years of experience for the therapists that were providing the e-stim treatments and assisting with data collection. Some of the therapists had been practicing for 20+ years and some were more recent graduates. The number of years was considered a potential limitation as the amount of experience could have impacted the therapist's comfort level and knowledge on providing e-stim treatment to the participant. A final limitation was that this pilot study took place in a similar regional/cultural location in the central Kentucky area which could have led to a lack of diversity in participants.

Implications for OT Practice

The initial results of this pilot study indicate providing e-stim to treat UE pain for this population is promising as an adjunct intervention. Because there is a gap in the literature and very limited research that has been conducted on this topic, the results of this pilot study is of interest to OT's practicing with the older adult population. The results of this study provide support for practitioners who use e-stim to treat UE pain for older adult SNF clients. The results of this study indicate that e-stim (IFC or pre-mod functions) appears promising in reducing UE pain for this population when they receive 8+ e-stim treatments. Once more data is collected so that statistical significance can be determined, the results could benefit OT practitioners who utilize this common intervention with this specific population. The results of this study will also assist with ensuring that our older adult population who reside in SNFs are receiving interventions to treat their UE pain that have been determined to be an effective intervention for treating UE pain and improving occupational functioning.

Future Research

It is important to reiterate that the research looking specifically at e-stim to treat UE pain for the older adult residing in a skilled nursing facility is very limited in the literature. Therefore, it is important to continue this study. The plan for this study moving forward will be to continue with data collection using the clinical sites that are already established with the hopes of adding additional clinical sites to assist with increasing data collection. Once data has been collected on at least 30 participants, paired sample *t*-tests will be used to determine statistical significance using a p-value of <.05.

This research project was presented to fellow colleagues, committee members, and peers. At the conclusion of the presentation, all attendees were given the opportunity to pose questions. Many of the questions and comments focused on the future research of this study. One of the questions that occurred that could assist with guiding future research regarded conducting a regression analysis on the data collected. This will be considered for future research on this study to determine which variables of the study have the most significant impact and looking more closely as to whether pain has a correlation to actual improved occupational performance.

Conclusion

The initial results from this pilot study look promising. All of the participants' differences in pre-test-/post-test scores for decreasing UE pain and improving UE function improved following at least eight e-stim treatments. Furthermore, over half of the post-test scores on the VPS and half of the post-test scores on the QuickDASH were considered to be a clinically significant change in scores from the pre-tests. When more data is collected, if this trend continues, there is a good possibility e-stim could show a statistical significance in treating UE pain for this population. This would indicate an overall benefit to using e-stim to decrease UE pain and improve UE function for older adults residing in SNFs.

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Appendix A: Oral Script for Voluntary Participation

Read the following script to the study participant and have the participant initial and date the script prior to including the participant in the study:

"Thank you for agreeing to be in this research study. Agreeing to this study is your choice. You may quit at any time. As part of therapy, you will receive gentle electrical tingles to make your arm pain feel better. The electrical tingles can rarely cause your skin to turn red for a short time. Your therapist will watch this closely for safety. You will complete two short forms at the beginning and at the end of the 8-week study. These forms will tell how well you are using your arm and how much pain you have in your arm. You can ask for help to complete the two short forms. The results on the short forms may be used in a research study without names or identifying information".

Participant's Initials: _____ Date: _____

Witness Signature: _____ Date: _____

Appendix B: Spreadsheet for Data Collection

Client Number	UE Diagnosis	E-stim Function Used (IFC, Pre-mod)	Pre-test QuickDASH	Pre-test Visual Pain Scale	Post-test QuickDash	Post-test Visual Pain Scale	# of Visits

Appendix C: QuickDASH Assessment

QuickDASH

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Do heavy household chores (e.g., wash walls, floors).	1	2	3	4	5
3. Carry a shopping bag or briefcase.	1	2	3	4	5
4. Wash your back.	1	2	3	4	5
5. Use a knife to cut food.	1	2	3	4	5
6. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
7. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
8. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	1	2	3	4	5

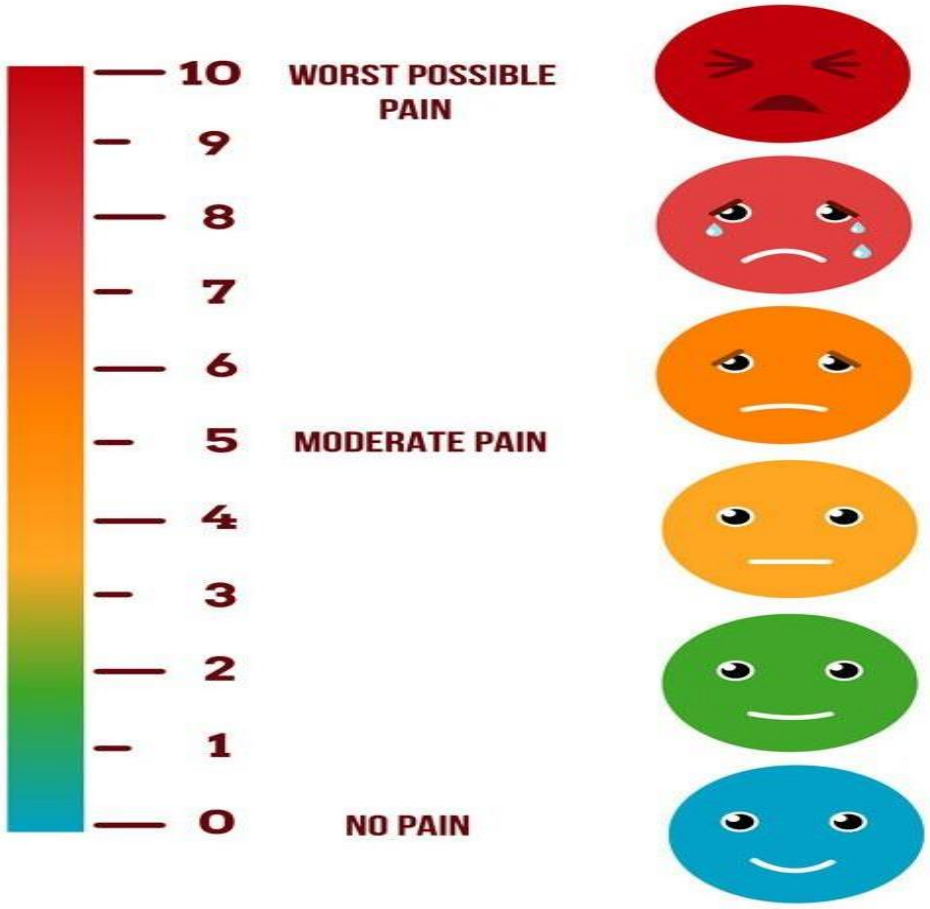
Please rate the severity of the following symptoms in the last week. *(circle number)*	NONE	MILD	MODERATE	SEVERE	EXTREME
9. Arm, shoulder or hand pain.	1	2	3	4	5
10. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
11. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

QuickDASH DISABILITY/SYMPTOM SCORE = $\left(\left[\frac{\text{sum of n responses}}{n}\right] - 1\right) \times 25$, where n is equal to the number of completed responses.

A QuickDASH score may <u>not</u> be calculated if there is greater than 1 missing item.

Appendix D: Visual Pain Scale



Appendix E: "Modality Should I?" Screening Form

MODALITIES, SHOULD I?

Patient Name: _____ **Date of Eval:** ___/___/___ **Therapist:** _____
Medical Diagnoses: _____ **Treatment Dx:** _____ **Physician:** _____

Check the box next to ALL indications present in your patient, including duplicates across the 3 modalities

ULTRASOUND
☐ Musculoskeletal pain from muscle spasm
☐ Inflammation (acute, sub-acute, and chronic)
☐ Soft tissue tightness
☐ Edema reduction through increased blood flow
☐ Wound healing
☐ Scar tissue remodeling

SHORTWAVE DIATHERMY
☐ Musculoskeletal pain from muscle spasm
☐ Inflammation (acute, sub-acute, and chronic)
☐ Soft tissue tightness
☐ Edema reduction through increased blood flow
☐ Wound healing
☐ Acute soft tissue trauma

ELECTRICAL STIMULATION
☐ Nerve Stimulation
☐ Increase ROM, Decrease tone
☐ Re-educate muscles
☐ Pain relief
☐ Acute- gate theory
☐ Chronic- release endogenous opiates
☐ Tissue stimulation
☐ Increase local circulation
☐ Decrease Edema
☐ Muscle Stimulation
☐ Prevent disuse atrophy
☐ Electrical Orthosis
☐ Strengthening - fast twitch fib

Check the box next to ALL contraindications present in your patient, including duplicates across the 3 modalities

DO NOT SONATE OVER:
☐ Implanted electronic devices
☐ Pregnancy/external reproductive organs
☐ Heart, carotid sinus
☐ Tumors
☐ Eyes, ears, genitalia
☐ Infection – in proximity
☐ Active epiphyseal growth plates
☐ Unprotected spinal cord/laminectomy
☐ Thrombophlebitis - DVT
☐ Circulatory insufficiencies (no thermal)
☐ Artificial joints with plastic/cement
☐ Acute bleed/hemorrhage
☐ Skin exposed to radiation therapy
☐ Deficits in sensation (no thermal)
☐ Unknown etiologies

DO NOT USE SWD IF PRESENT:
☐ Electronic devices – anywhere in/on body
☐ Pregnancy/menstruation; hemophilia; fever
DO NOT SWD OVER:
☐ Surface/implanted metal in treatment area
☐ Eyes, ears, cranium, anterior neck, genitalia
☐ Unknown etiologies
☐ Active epiphyseal growth plates
☐ Infection; Malignancies
☐ Sensory impairment (heat)
☐ Malignancies
☐ Acute inflammation (no continuous mode)
☐ Obesity, if using capacitive (pads) setup
☐ Acute hemorrhage/bleed
☐ Impaired circulation – DVT, venous insuff.
(Precaution) Tattoos (in continuous mode)

DO NOT USE E-STIM IF PRESENT:
☐ Implanted device – in/on body can't turn off
☐ Pregnancy
DO NOT E-STIM OVER:
☐ Active infection; history/active osteomyelitis
☐ Eyes/ears, carotid sinus, heart
☐ Tumors
☐ Genitalia, mucosal membranes
☐ Unknown etiologies; AROM contraindicated
☐ Circulatory insufficiencies; thrombosis
☐ Superficial metal
☐ Transcerebrally, transcranially
(Precaution) Seizure disorder
(Precaution) Significantly impaired cognition
(Precaution) Around the neck
(Precaution) Diminished sensation

Modalities Ordered: (Freq. x Duration, location)
US: ___x___, _____
SWD: ___x___, _____
E-stim: ___ x ___, _____

No Modalities Indicated – Why?:
1. Contraindication (specify which):_____
2. Pt. refused (specify reason): _____
3. Not approved by MD (specify reason): _____

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