Investigation of the Immediate Effects of the Facilitated Oscillatory Release Technique versus the Traditional Posterolateral Glide on Internal Rotation Range of the Asymptomatic Shoulder: A Pilot Study

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ABSTRACT

Background & Purpose: The Facilitated Oscillatory Release Technique (FORT), or "harmonics," may be used in the treatment of shoulder injuries. Little evidence exists to support its use in physical therapy. The purpose of this study is to investigate the immediate effects of the FORT versus posterolateral glides on internal rotation range (IR) of asymptomatic shoulders. **Methods:** Participants were blocked-randomized by gender to the harmonics or posterolateral glides group and received 3 minutes of treatment. Passive IR range of motion (ROM) was measured at baseline and immediately following treatment. A 2-way ANOVA with repeated measures was utilized. **Findings:** The harmonics group had a greater change in mean passive IR (mean difference posterolateral glides=4.90 degrees, harmonics=7.16 degrees). The difference was found to be statistically significant between groups (p=0.025, alpha=0.05). **Clinical Relevance & Conclusion:** The FORT is a useful option to increase PROM of shoulder IR.

Key Words: harmonics, manual therapy, mobilization, oscillation

INTRODUCTION

The Facilitated Oscillatory Release Technique (FORT), also known as "harmonics", is a manual technique relatively uncommon to physical therapy practice in the United States. According to Dr. Eyal Lederman, a leading harmonics expert, the technique is defined as the external application of force to an area of the body to produce natural rhythmic frequencies. It expresses the importance of movement to effect physiologic change. In contrast to end range mobilizations where an external force is imposed upon the joint, harmonics allows the joint to respond within its inherent, natural frequency. Minimal effort is required on the part of the treating therapist to apply this technique in clinical practice secondary to the decreased amount of energy required to sustain motion.[1]

Early induced passive motion is effective in increasing overall range of motion (ROM) for many joints.[2-4] Treatments that combine both passive and dynamic elements, such as the harmonics technique, promote change in joint range of motion through their effect on specific mechanisms (i.e. the stretch reflex of motor neurons).[5] Applications of harmonics includes the treatment of various musculoskeletal injuries to improve circulation and the quality of tissue repair, reduce edema, and improve the rate of recovery.[4,6-12] Passive dynamic stretch techniques based upon harmonics principles have been shown to be effective in incorporating mechanotransduction via oscillations, which produces a length adaptation effect on various tissues and effective long-term changes at end-range.[13-15] Oscillatory release techniques may also play a role in the neurological component of care through their effect on pain receptors and the pain-gate theory, thereby introducing the concept of pain control through movement.[16-19]

Specifically, the harmonics technique may also be utilized in the treatment of shoulder pain and general injury. Shoulder complex injuries are considered one of the most prevalent categories of musculoskeletal conditions, with causes often attributed to restrictions in ROM at the glenohumeral joint.[20] These ROM restrictions are of great clinical significance to the practicing clinician. Decreased internal rotation ROM at the shoulder diminishes inherent stabilizing factors, further increasing the risk of shoulder pathology.[21-22] Deficits in rotational ROM negatively affect the length and quality of contractile tissue comprising the rotator cuff.[23-25] Additionally, glenohumeral internal rotation deficit (GIRD) increases the risk for impingement syndromes or instability type pathologies.

Traditionally, posterior mobilizations and stretching of the posterior capsule have been recommended for both prevention and rehabilitation protocol of the shoulder lacking internal rotation (IR). End range posterior mobilizations for improving restrictions in ROM at the glenohumeral joint are commonly prescribed manual therapy treatments and have been shown to be more effective than mid range or low-grade mobilizations.[26-27] Improving the mobility of the glenohumeral joint in the posterior capsule using angular or non-angular techniques increases internal rotation at the joint and subsequently may reduce risk for sport specific or occupational activity injury.[28] The posterior mobilization of the shoulder joint capsule may also resolve pain caused by various pathologies.[29-31]

The field of physical therapy is constantly evolving, and it is imperative for clinicians to provide the most relevant and evidence based treatments for their patients. While posterolateral glides of the shoulder have been demonstrated to be an effective treatment of choice, little to no evidence exists regarding the effects of the harmonics technique on shoulder ROM nor has the technique been compared to more traditionally accepted methods of treatment. To our knowledge, the efficacy for the clinical application of the harmonics technique has yet to be realized through investigation and research. Therefore, the purpose of this pilot study was to investigate the immediate effects of the FORT/harmonics versus posterolateral glides on IR range of the asymptomatic shoulder. It was hypothesized that the harmonics technique would demonstrate a statistically significant greater increase in passive range of motion (PROM) of shoulder IR over the traditional posterolateral glides.

METHODS

Design

A prospective, blocked randomized, single blind design was utilized incorporating volunteer participants with asymptomatic dominant shoulders in a single session.

Participants

Data collection and participant recruitment was performed entirely by Student Physical Therapists (SPTs) enrolled as full time students in the Angelo State University Doctor of Physical Therapy Program. A convenience sample of student volunteers with asymptomatic dominant shoulders was recruited from the Angelo State University Doctor of Physical Therapy Program over a 4 month period. Inclusion and exclusion criteria can be referenced in Table 1. The Institutional Review Board (IRB) at Angelo State University in San Angelo, Texas approved this study. Health Insurance Portability and Accountability Act (HIPPA) guidelines were adhered to throughout the course of this study, and participant privacy, participant consent, and full participant disclosure was maintained.

Following a thorough informed consent process, each participant underwent screening and a physical examination performed by a 3rd year Student of Physical Therapy with rigorous orthopedic training who had recently completed a primary musculoskeletal practicum. This examination included an assessment of a rotator cuff lag sign, Spurling's A and B tests, Hoffman reflex, and C6, C7, and C8 deep tendon reflexes. A team of 2 Student Physical Therapists also assessed passive IR range of the dominant shoulder to obtain baseline measurements prior to treatment, with responsibilities set and constant throughout the course of the study. Prior to initiation of the study, intra-rater reliability of the pair of examiners was determined to be excellent (ICC=.809) utilizing a cohort of 5 subjects over 2 measuring sessions separated by 24 hours . All measurements were performed with participants in a supine position, with 90 degrees of shoulder abduction and 90 degrees of elbow flexion. One examiner was charged with determining endpoint of true glenohumeral range through palpation of the coracoid process of the scapula, with IR assessed at the moment of coracoid tilt. A second examiner was charged with measurement of the final range with a standard universal goniometer affixed with a bubble inclinometer for consistent alignment of the proximal, fixed arm. This method of assessing passive ROM has been demonstrated to be excellent for ROM of shoulder IR (ICC, 0.85-0.99).[32]

Procedures

Once the participants completed an informed consent, screening, and physical examination (including baseline IR measurements) thereby satisfying all inclusion and exclusion criteria, each was randomly block assigned by gender to a treatment group: Posterolateral Glides or Harmonics. Randomization was performed utilizing Quick Calcs (Graph Pad Software 2015) without the replacement of treatment group variables. Participants then received 3 minutes of treatment per the respective group allocation, performed by a 3rd year Student Physical Therapist with extensive manual training regarding interventions relative to this study. Grade III-IV posterolateral glide mobilizations were performed with the patient in a standard supine position, shoulder abducted to 90 degrees and elbow flexed to 90 degrees. The harmonics technique was applied with the patient in supine with 3 separate planes of shoulder oscillations for 1 minute in each direction: medial to lateral, anterior to posterior, and superior to inferior. Following the 3 minutes of treatment time, the participants' passive IR range was immediately assessed utilizing the same baseline procedure.

Data collectors were blinded to all group allocations and the treating SPT was not given access to results until the study was concluded.

Statistical Analysis

Data was analyzed utilizing SPSS version 21 (IBM, Chicago, IL). 1 subject was excluded as an outlier for analysis due to aberrant clinical findings from suspected soft tissue variability, potentially altering palpation and measurement values. A Shapiro Wilks test was performed to assess normality. Demographic data was assessed for initial group differences using an Independent *t* test for age and baseline IR measurements.

The dependent variable of interest was passive ROM of shoulder IR. The two independent variables were GROUP (harmonics and posterolateral glides) and TIME (baseline and post-treatment). Finally, a 2-way ANOVA with repeated measures on the second factor was examined to test the hypothesis by determining a GROUP x TIME interaction as well as the presence of any significant differences between treatment groups or simply over time.

RESULTS

A total of 44 participants were recruited and screened, with 40 participants satisfying all inclusion and exclusion criteria and included (20 males, 20 females, age range 19-38 years, mean age=24.2 years). Demographics of the two treatment groups can be referenced and compared in Table 2. Of the 4 participants who did not meet all criteria, 3 were excluded for demonstrating dominant shoulder passive internal rotation range greater than 50 degrees. One participant was excluded following a positive Spurling's B test and was referred out for further examination by a physician (Figure 1.)

Both treatment groups consisted of 20 participants, with 7 males and 13 females in each group. One subject in the harmonics treatment group presented as an outlier and was excluded from statistical analysis. Throughout the course of the statistical analysis, alpha was set and held at 0.05. Homogeneity was found between both groups of participants (p-value=0.05). No significant differences regarding baseline IR measurements existed between the 2 groups (p-value= 0.511). No significant differences were found regarding the age of participants (p-value =0.591).

Mean passive IR range baseline (pre-treatment) and post treatment data can be referenced in Table 3. The harmonics treatment group demonstrated a greater change in mean passive IR range from baseline (pre-treatment) to post-treatment. Within group mean differences were calculated, with the posterolateral glides group at 4.90 degrees and the harmonics group at 7.16 degrees. From these within group calculations, it was determined that the between group difference of means was 2.26 degrees in favor of the harmonics intervention. This difference was found to be statistically significant between the two groups ($p=0.025$). A graphical representation displaying changes of mean shoulder IR across time can be found in Figure 2.

DISCUSSION

This is the first study with the purpose to analyze and compare the immediate effects of the harmonics technique versus the traditional posterolateral glide on shoulder passive internal rotation range. Techniques utilizing the concept of oscillation energy have been shown to provide clinically and statistically significant differences in pain intensity and functional status in patients demonstrating symptoms of lateral epicondylitis.[33] Additionally, Codman's pendulum exercises have been widely accepted as an appropriate form of early shoulder joint mobilization via grade I and II distractions and oscillations.[34] A physiological model of manual therapy has been presented to further examine the effects that the harmonics technique may have on local tissue, neurological organization, and psychophysiological organization[35]. Various studies have shown the capability of passive, cyclical motion to influence the repair process following tissue damage[36,37]. Proprioceptive stimulation has also been demonstrated to possess the potential ability to improve neurological organization and reduce overall motor tone. When applied in a clinical setting this technique may also invoke a relaxation response in patients due to its low intensity application within a comfortable ROM over longer periods of time.[1] Due to this existing evidence, it was hypothesized that participants receiving harmonics treatment to the shoulder would demonstrate a greater immediate increase in internal rotation passive ROM as compared to participants receiving the traditional posterolateral glide.

Current results from this study indicate a trend towards agreement with the presented hypothesis. There was a significant difference in overall increase in internal rotation passive ROM immediately following equal treatment times between the groups, with individuals receiving harmonics treatment demonstrating a statistically greater increase in range. The exact mechanism regarding how harmonics enables an increase in joint range is not relatively agreed upon, although it has been postulated that rhythmic peripheral afferent input and functional rhythmic force can reset muscle tone, remove edema, stretch tissue, and reverse the deformation of fibrin in the joint following trauma.[38] This multi-dimensional mechanism may have combined to elicit the differences observed in this study.

Application of the harmonics technique has been suggested to impact various local tissue structures through an array of different mechanisms imposed by the passive cyclical movement. Structures that become active with harmonic technique include muscle spindles, group 1-3 mechanoreceptors, and skin mechanoreceptors[35]. With the afferent recruitment applied by the harmonic motion there is significant proprioceptive stimulation to the central nervous system[39,40]. General joint mobilizations may not have as significant of an immediate effect on joint movement due to the diminished activation of the various types of mechanoreceptors as traditional mobilizations are generally performed along a single axis. Both harmonics and posterior mobilizations of the glenohumeral joint have been shown to have hypoalgesic affects in symptomatic populations.[1]

Although no formal measurement for subjective and qualitative data was utilized in this study, many participants voluntarily provided positive reports regarding their experience with harmonics treatment. Of these reports, commonly used descriptors included the terms "relaxing" and "calming". Relaxation techniques have been shown to be highly beneficial throughout a variety of rehabilitative activities. One study found that relaxation and guided imagery sessions contributed to greater knee strength and less re-injury anxiety in patients following anterior cruciate ligament reconstruction.[41] A systematic review regarding the effective management of temperomandibular disorder found that relaxation training should be a recommended intervention.[42] The general subjective experience of the participants may have contributed to the differences between gains in range between the two separate treatment groups, although the magnitude of this factor as a contributor compared to pure mechanical effects is unknown.

LIMITATIONS

There are several limitations to be noted in this study. As is to be expected of a pilot study, the investigators utilized a small, convenience sample consisting of fellow Student Physical Therapists, many of who were familiar with the concept of mobilization to increase range of motion. This study also only examined the effects of the harmonics technique versus posterolateral glides on the passive internal rotation range of the asymptomatic shoulder. Therefore, these results cannot be generalized to patients with distinct pathologies of the shoulder. Additionally, only the immediate effects of the opposing techniques were examined, making it difficult to determine or predict any possible long-term changes or benefits. Finally, all measurements, data collection, and treatments were performed by 3rd year Students of Physical Therapy. Although each of these students had received rigorous training in musculoskeletal practice and the intra-rater reliability of the those researchers performing measurements was assessed prior to initiation of the study, there is a level of uncertainty present due to overall lack of clinical experience between the researchers.

Secondary to the limited sample demographic, small number of participants, and uncertain generalizability of the study, further investigation to compare the two methods utilizing a larger, symptomatic, and diverse population over a longer span of time would be beneficial. Additionally, areas of future research may focus on the assessment of subjective data in addition to objective data with the use of the harmonics technique in order to provide an in-depth examination into the neuromuscular and psychosocial implications of the technique.

CLINICAL APPLICATIONS

Preliminary data indicates that the FORT, also commonly known as the "harmonics" technique, is an appropriate and useful treatment option for clinicians seeking to increase shoulder internal rotation passive ROM in a single session. Immediate gains in range may assist in improving treatment efficiency in addition to increasing the rate of recovery in patients with decreased shoulder ROM. However, caution should be taken with this technique as very little evidence exists to support its use in clinical practice. While this data is preliminary, our study suggests that the harmonics technique, at minimum, is a comparable treatment option to posterolateral glides for immediate gains in internal shoulder rotation, as well as a beneficial supplementary approach to soft tissue limitations.

CONCLUSION

The harmonics technique is a relatively novel treatment option with very little existing evidence to support its use in physical therapy treatment. Following this pilot study, which analyzed the immediate effects of the harmonics technique versus the commonly utilized posterolateral glide on shoulder passive internal rotation ROM, there is preliminary evidence to suggest that this technique is a more effective technique. Additional research is required to analyze the effects of the harmonics technique on various pathologies and to determine if any long-term or lasting effects exist.

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Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	**Exclusion Criteria**
• Age 18-65 years • Asymptomatic dominant shoulder • Dominant shoulder passive internal rotation range < 50 degrees	• History of shoulder dislocation, fracture, or adhesive capsulitis • History of Cerebral- Spinal injury • History of full thickness rotator cuff tear • Production of upper extremity symptoms with cervical spine examination (Spurling's A and B Test) • History of neurologic or systemic disease affecting the shoulder, or current presentation of neurologic signs and symptoms upon screening • Dominant shoulder passive internal rotation range >50 degrees • Physical Therapy treatment for the shoulder within 6 months prior to start of study • Shoulder pain at time of study

Table 2. Participant Demographics

TREATMENT GROUP	POSTEROLATERAL GLIDES	HARMONICS
Participants (n)	20	20
Males	7	7
Females	13	13
Mean age (years)	23.9	24.5
Age range (years)	21-29	19-38

Table 3. Mean Dominant Shoulder Passive Internal Rotation Range in Degrees

	Baseline (Pre-treatment)	Post-treatment	Within-group Difference	Between-group Difference	p-value
Posterolateral Glides (Control)	36.15	41.05	4.90	--	--
Harmonics (Experimental)	37.21	44.37	7.16	2.26	0.025

Figure 1. Enrollment Flowchart

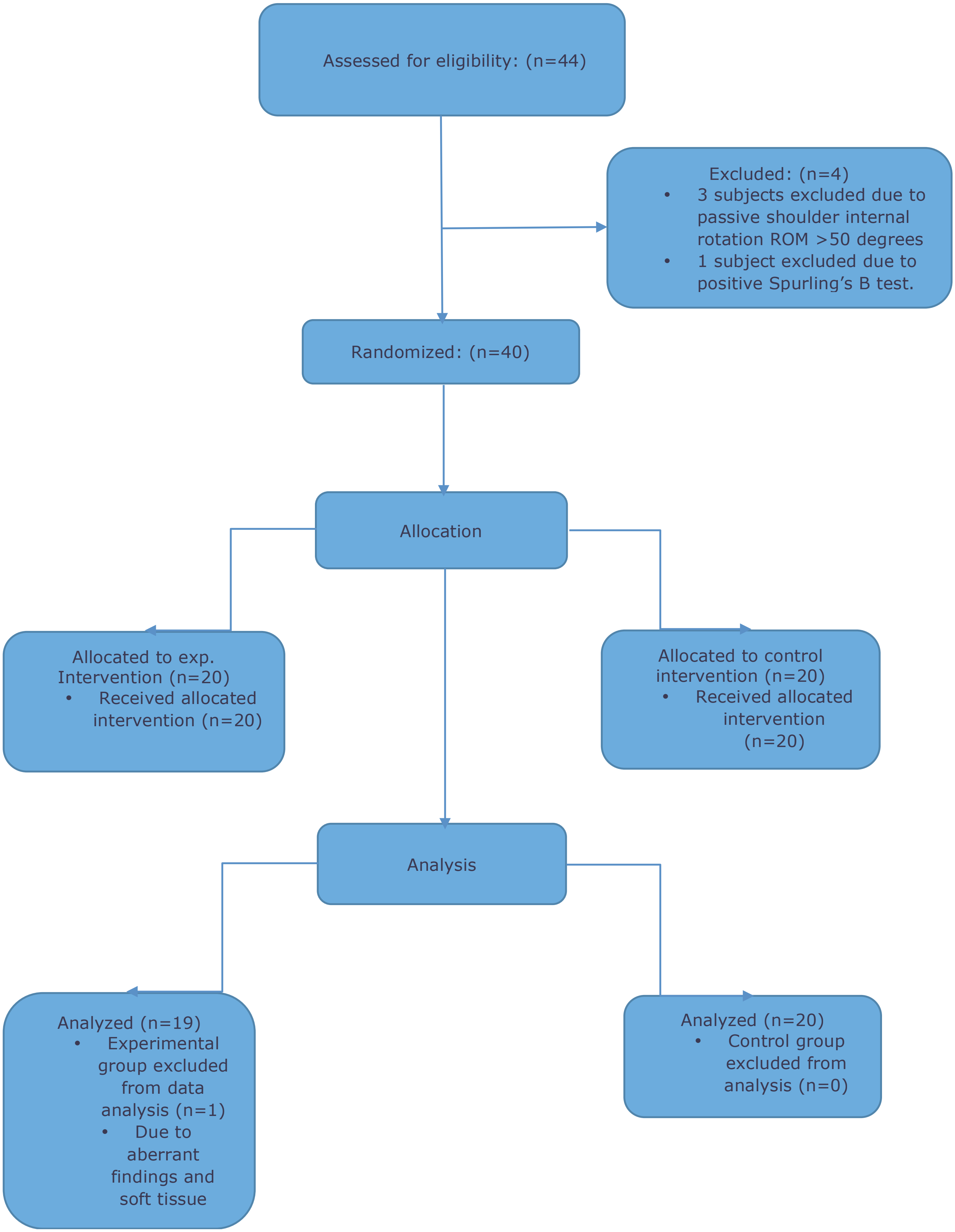

Figure 2. Difference of Mean Shoulder IR Over Time