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Comparing the Effects of Diathermy and Dynamic Stretching on Hip Flexor Flexibility and Postural Control

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Context: Dynamic stretching has become a universally accepted practice used to increase flexibility, reduce muscle injury, and improve performance. In addition to stretching, deep heating modalities such as pulsed shortwave diathermy have been used to increase range of motion through deep heating. The premise for this study was to see if combining a dynamic stretching routine with a diathermy treatment would improve range of motion (ROM) and postural control. **Purpose:** The purpose of this repeated measures study was to assess the effectiveness of both pulsed shortwave diathermy and dynamic stretching on hip flexor range of motion and postural control. **Participants:** Three males and six females between the ages of 18 and 30 completed the study. All of these participants were moderately active and had not sustained an injury to their dominant leg six months prior to the study. **Methods:** Each participant completed all four trials (diathermy alone, dynamic stretching alone, diathermy, and dynamic stretching combined, and a control trial) over the course of a month. Active hip extension and the Y-Star Excursion Balance Test (Y-SEBT) were complete before and after each trial. **Results:** The 2x4 (time by trial) repeated measures ANOVA revealed no statistical significance for hip extension and Y-SEBT ($p=0.817$ and $p= 0.367$ respectively). **Conclusion:** This research intended to determine diathermy's outcomes on increasing ROM and postural control in the hip flexors and how these effects could be enhanced by a dynamic stretching routine. All of the participants regardless of trial improved however, this was due to a practicing effect. Therefore the results of this study were found to be inconclusive for all trials performed.

Introduction

Playing at a high level of competition places many physical demands on the body. Throughout an athletes' life, they are taught to take care of their body in order to perform at their best. Athletes' condition, practice, stretch, and lift to optimize their performance. The idea of gaining flexibility to help prevent injury and enhance performance has been preached throughout any athletes' career.[1]

Stretching has become a universally accepted practice used to increase flexibility, reduce muscle injury, and improve performance. Many athletes stretch as a means to warm up before practice and games. The popularity of this practice is in part due to the main causes of musculoskeletal injuries, which include lack of range of motion and muscle stiffness.[2] The current literature remains inconclusive regarding the effects both static and dynamic stretching have on injury reduction. Some recent research has shown positive results with a sport-specific dynamic stretching routine and light cardiovascular warm-up in regards to improved performance.[3]However, the influence that dynamic stretching has on postural control and function remains to be seen.

In addition to stretching, additional modalities, such as pulsed shortwave diathermy have been used to increase collagen extensibility, therefore increasing range of motion (ROM). Pulsed shortwave diathermy is commonly used for treating pain, muscle stiffness, and prolonged inflammation.[4] Diathermy's thermal effects can be achieved within the tissue at deeper levels as compared with other heating modalities, such as ultrasound. The physiological effects pulsed shortwave diathermy has on the target tissue include increasing collagen extensibility, increasing blood flow, and relaxation of the muscle.[4] When the goal is to increase tissue temperature, deep vigorous heating on the targeted tissue is utilized.

The premise for this study was to see if combining a dynamic stretching routine with pulsed shortwave diathermy would improve ROM and postural control. Past research has produced conclusive results regarding the effects of diathermy and its correlation with increased range of motion in the hamstring muscle of subjects with severe tightness.[5] The goal of this research was to assess the effectiveness of diathermy and dynamic stretching on hip flexor range of motion, with the hope that this research would guide future clinical decision-making regarding

hip flexor strains.

Methods

Design

A repeated measure design was used whereby all participants completed four trials over the course of a month. Each trial day, participants were assigned to a randomly selected treatment. A 48-hour window in-between each trial was ensured to avoid carryover of treatment effects. The dominant leg of each participant was used in all trials.

Participants

Ten students attending The University of Montana volunteered to participate in this study. Three males and seven females between the ages of 18 and 30 were studied. All of the participants were moderately active in addition to their activities of daily living. Moderately active was defined as exercising three or more times a week. Prior to this study, all participants were screened verbally for a lower extremity injury. Any participant that reported an injury within the past six months was disqualified from the study. Participants were instructed to refrain from activity 12 hours prior to their trials. In addition, lower extremity stretching was not allowed for the period of the study.

Instruments

Pulsed Shortwave Diathermy

The Intelect Shortwave Diathermy machine was used for the treatments in this study. Each participant used the same parameters, 400 microseconds, 800 pulses per second for 20 minutes to induce vigorous heating, raising the tissue temperature 3-4 degrees Celsius above baseline.[4] A monode drum was set-up one inch below the anterior superior iliac spine to target the hip flexor muscle group. One person (B.D.) conducted all diathermy treatments to ensure consistency in treatments. [3] If the heat was uncomfortable for the participant, the intensity was adjusted accordingly, down to dose three.

Goniometer

A 12" goniometer (Whitehall Manufacturing in City of Industry, CA) was used to obtain the range of motion measurement in this study. Active hip extension was measured with the participant lying prone. The axis of the goniometer was placed on the greater trochanter of the femur on the participant's dominate leg.[6] The stationary arm was placed parallel on the trunk, and the movement arm was placed on the thigh in line with the lateral femoral condyle.[6] Goniometer measurements were taken while the participant performed active range of motion into hip extension using the dominant leg. Three measurements were taken and an average was calculated for every trial.

Stretching

Five dynamic stretches were used in the study. For the first stretch, the participant performed forward and backward leg swings. To perform this stretch, the participant held onto a wall and swung their dominant leg forward and backward for thirty seconds. [7] The second stretch the participants performed were open and close the gate.[7] The participant performed the open the gate stretch by pulling his or her knee up to the chest and then out away from the body. This stretch was done the length of twenty yards. After open the gate was performed, the participant was then asked to perform close the gate. Close the gate was done in a similar way, however the participant's' hip started in an abducted externally rotated position and was pulled toward his or her body.[7] This stretch was also done the length of twenty yards. The next dynamic stretch was quadriceps hold and touch the floor.[7] The participant performed this stretch by holding there dominant foot to their buttocks and reached to the ground with their opposite hand. This stretch was performed for twenty yards, taking a step in between each hold. The last stretch was a twenty-yard back pedal.[7] The participant was asked to get down in a squat position and then reached back with each leg.

Star Excursion Balance Test

In order to examine the effectiveness of dynamic stretching and diathermy, the Y- Star Excursion Balance Test (Y-SEBT) was used as a functional assessment. The Y-SEBT is used clinically to assess dynamic postural control. Postural control tests are used most often to evaluate the chance that an injury could occur, the discrepancy that can appear after an injury,

and the progress a person is making following an injury. The measure of how far a participant can reach without losing their base of support in the middle of the star is how the postural control component is measured.[8] The Y-SEBT has a high inter-rater reliability (0.97-1.0) as well as good indications of dynamic postural control. It is easy to use and most importantly cost effective for researchers.[8]

During the Y-SEBT, the participants are asked to stand on their dominant leg in the center of a pre-made mat. They were asked to reach with their non-dominant leg as far as they could along the star pattern. Reaching towards three different angles of the star including anterior, posteromedial, and posterolateral. The participant was asked to non-weight bear with the non-dominant leg during this test.[8]A mark was placed where the participant would touch down at each angle. Concluding each trial, a measurement from the center of the star out to each mark was taken. Three trials were completed, and the measurements from each trial were averaged.

Procedures

Each participant's height and weight was obtained prior to beginning research. An initial base line measurement of active hip extension was taken prior to each research day. One person took all goniometer measurements to minimize measurement error and to increase reliability. A baseline Y-SEBT test was also obtained prior to each research day. Three measurements were obtained and averaged. Prior to the beginning of the data collection, the participants were randomly selected to a perform one of the four trials. The four trials consisted of: dynamic stretching alone, diathermy alone, a combination of stretching and diathermy, and a control trial. After the participant received diathermy and stretched, we took their measurements for range of motion and the Y-SEBT within ten minutes.

Ultrasound

Participants who came in for diathermy alone were first instructed to lie prone on the treatment table, for goniometry measurements. Daily baseline measurements of active hip extension ROM were recorded. The Y-SEBT was also performed to provide daily baseline postural control measurements. The participant would then lie supine on a treatment table. A towel was placed over the participant's hip and the monode drum was placed over the towel, one-inch below the ASIS. The parameters for the diathermy treatment are listed previously.

Immediately following the treatment, active hip extension ROM measurements were taken and recorded. Then, the participant performed the Y-SEBT and the results were recorded.

Dynamic Stretching

Participants who came in for only a dynamic stretching treatment were instructed to lie prone on the table. A daily baseline of active hip extension ROM was recorded, as well as a daily baseline to assess postural control (Y-SEBT). The participant completed all five stretches, following parameters listed above. Immediately following the treatment, another active hip extension ROM measurement was recorded. Then, the participant performed the Y-SEBT. The results were recorded.

Diathermy and Dynamic Stretching

Participant who came in for diathermy and dynamic stretch were instructed to lie prone on the table. A daily baseline of active hip extension ROM was recorded, as well as a daily baseline to assess postural control (Y-SEBT). The participant would then lie supine on a treatment table. A towel was placed over the participant's hip and the monode drum of the diathermy was placed over the towel, one-inch below the ASIS. The parameters for the diathermy treatment are listed above. The participant then completed the five dynamic stretches, using the parameters listed above. Immediately following the treatments, another active hip extension ROM measurement was recorded. Then the participant performed the Y-SEBT. The results were recorded.

Control

Participant who came in for diathermy and dynamic stretch were instructed to lie prone on the table. A daily baseline of active hip extension ROM was recorded, as well as a daily baseline to assess postural control (Y-SEBT). The participant was then instructed to sit for about 20 minutes, and received no treatment. Before the participant left, another active hip extension ROM measurement was recorded. Then the participant performed the Y-SEBT and the results were recorded.

<u>Data Analysis</u>

Descriptive statistics were calculated for each subject's age, height, weight, Y-SEBT and

hip flexor ROM. A 2 x 4 repeated measures (time x condition) ANOVA was used to evaluate significance where alpha was set *a priori* at 0.05. If significant interactions were found, pairwise comparisons were run using a Bonferonni adjustment. Microsoft Excel 2013 and IBM SPSS version 22 were used to analyze the data.

Results

The 2 X 4 repeated measures ANOVA revealed no statistical significance for hip extension and Y-SEBT ($p=0.817$and $p=0.367$ respectively). The mean scores for combo, stretch, diathermy, and control for hip ROM pre and post trials are shown in Figure 1.All groups, stretching alone, diathermy alone, combination, and control increased according to the graph, however this was due to a main effect for time ($p=0.001$). Figure 2 shows the mean scores for combo, stretch, diathermy, and control for Y-SEBT composite scores. The composite score used the anterior, posterolateral, and posteromedial scores from the Y-SEBT. [8] Once again, all treatments increased but this was due to a main effect for time ($p=0.003$). Overall, the increases seen in all trials were due to a practiced effect of the active hip extension and the Y-SEBT.

Discussion

Many clinicians use diathermy as a therapeutic modality to heat tissues, and promote healing. Diathermy is also used to improve ROM by increasing collagen extensibility within the desired tissue. This research intended to determine diathermy's effects on increasing ROM and postural control in the hip flexors and how these effects could be enhanced by a dynamic stretching routine. The results of this study were found to be inconclusive for all four trials performed. What follows is a discussion regarding first the stretching trial, second the diathermy trial, and finally the combination trial.

It is believed by many that a dynamic stretching routine will increase ROM but the results from this research showed no statistical significance that stretching improved hip extension. There were increases in both active hip extension and Y-SEBT measurements however these were not clinically significant; these increases were due to a main effect for time. A randomized control trial, however, found increases in hip extension following a passive and active stretching routine, which was conducted over the course of three and six-week trials.[9] This study may have produced different results because of the length of time allotted to conduct research, allowing the benefits of stretching to be seen. There is evidence to suggest that

engaging in dynamic stretching for a short duration will not negatively effect performance, but engaging in a stretching routine for a longer duration could in fact enhance performance.[3] Other modalities have been used alongside stretching to facilitate improvements in ROM pre-event.

Diathermy when used to vigorously heat tissue has been shown to improve ROM. The results showed an increase in goniometry measurements, and Y-SEBT scores. This was once again due to main effect for time, which is the learning effect of performing the motion multiple times over the course of the trials. Putting the participant's hip flexors in a stretched position was utilized to improve the effects of the diathermy treatment and lengthen the stretching window. This stretching window is a phase during vigorous heating where the muscles can achieve their greatest extensibility. It is suggested that joint mobilizations and stretching are done immediately following a diathermy treatment; to ensure that the stretching window is still open.[3] Despite these extra efforts the outcome showed no statistical evidence that diathermy effectively increased hip flexor ROM. The effects diathermy had on postural control also remains to be seen because of the lack of clinical significance found in the Y-SEBT data.

The focus of this study was to see if the combination of these modalities, stretching and diathermy would prove a different outcome. If this study could've been performed over a longer period of time there may have been some clinically significant numbers from the combination trial or the stretching trial. In addition, if a more superficial muscle group was to be studied there may have also been more noteworthy results.

Limitations

The first limitation to our research was the small sample size. Participants volunteered to partake in this study, however one of the female participants was released due to an unforeseen contraindication. In addition, many of the participants were young and healthy individuals, limiting the diversity within this research. There was also no means to measure the rise in tissue temperature following diathermy, to ensure that the muscle group was rising to the desired tissue temperature.

Rest times were also not enforced in our stretching trials and during the Y-SEBT trials. During the Y-SEBT trials rest time between each test was based on participant comfort and was not designated. This could've affected how far the subjects could reach because they may have been fatigued when completing their second and third tests. A rest time was also not enforced between each active hip extension measurement.

When collecting numbers for hip extension the participants were instructed to lie prone, but some participants did not fully lie down but stayed up on their elbows. This could've decreased their hip extension. The participants were reminded to keep their hips on the table, however some of the participants lifted their hips when performing the motion. Overall, hip extension was measured as consistently as possible but errors may have occurred.

Lastly, participants supposed to refrain from exercise 12 hours prior to trials. The majority followed this stipulation, but we had no way of confirming compliance. The effects of working out could've decreased hip extension and their Y-SEBT scores due to soreness of muscles. Working out could've also had the opposite effect and increased hip extension, if the participants were stretching their lower extremity during their workouts.

Future Research

If further research were to be conducted, a larger sample size would be desirable. This would give a more diverse group of participants. Ideally, this research would be best conducted with an athletic population, people currently participating in a competitive sport. Research would also have to be carried out over a longer period of time. This would enable the results to be more conclusive, giving a better idea of specific trends. Lastly, using different diathermy parameters on different subjects could give a better idea on what specific parameters deep heat the hip-flexors best to achieve the desired goal.

Conclusion

This study aimed to produce conclusive results regarding the effects of dynamic stretching and diathermy on postural control and function. This study produced inconclusive results in all four trials, dynamic stretching alone, diathermy alone, combination of the two modalities, and control trial. Further research needs to be completed in order to better assess the effects of diathermy and dynamic stretch as they relate to ROM, postural control, and overall function.

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Tables and Figures

Table 1. Goniometry Data

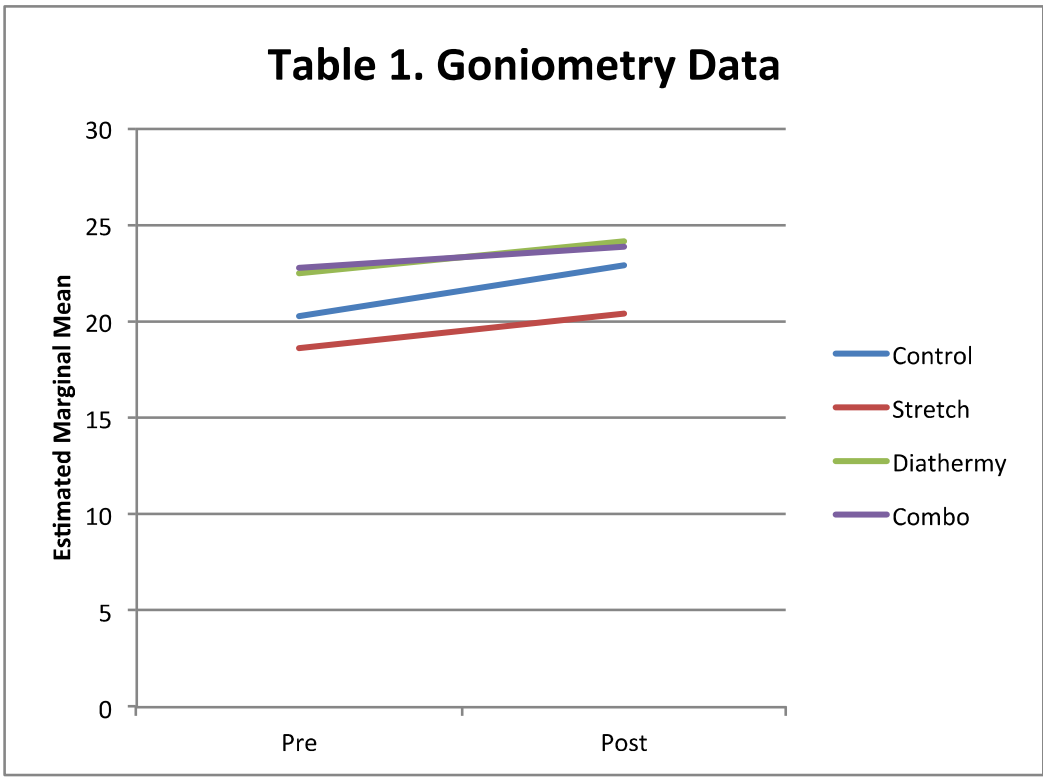

Table 2. Composite Y-SEBT Data