THE EFFECTS OF SACROILIAC JOINT DYSFUNCTION ON LOWER BODY POWER

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Abstract

Purpose

The purpose of this investigation is to access the effects of sacroiliac joint dysfunction on the lower body power as tested via the VERTEC© vertical jump test. Dysfunction of the sacroiliac joint due to fixation and/or misalignment has been shown to create musculoskeletal imbalances in the body, thus increasing the biomechanical stresses on various muscles and joints from the feet to the head. Imbalances of the pelvis have shown to cause postural, biomechanical stresses on the spine, resulting in symptomatology ranging from low back pain to chronic muscle spasms and fatigue. Furthermore, from an athletic perspective, dysfunction of the sacroiliac joint can present a detrimental effect on one's ability to generate proper performance via neuromusculoskeletal signaling and execution. These imbalances can lead to less than optimal results in physical performance and/or assessment. Although much research is present on the effects of pelvic imbalances on physical performance, there is a lack of reference data specifically targeting the effects of chiropractic manipulation on the dysfunctional sacroiliac joint and its effects on lower extremity performance, specifically lower body power; therefore, the data collected from this study will be a basis for further investigations correlating dysfunctional sacroiliac joints and lower body performance.

Methods

Twenty-five consenting volunteer participants performed a pre-treatment jump test via the VERTEC© vertical jump test, recording the best of three jump attempts. The patients were then asked to come back later that same day for clinical assessment of dysfunctional sacroiliac joint, treatment via chiropractic manipulation, then reassessed on VERTEC© vertical jump test, again taking the best of three attempts as the participant's 'post-treatment jump.'

Results

Amongst 25 participants, 18 presented with a left sacroiliac joint dysfunction and 7 with a right sacroiliac joint dysfunction. Amongst the 18 left sacroiliac (SI) joint subjects, the average change post-treatment was an increase of 0.17 inches, while an average increase of 0.43 inches was shown among the 8 subjects demonstrating a right SI joint dysfunction. The overall average change in vertical jump values was 0.24 inches increase in vertical jump value after receiving treatment via Reinart© Diversified side posture chiropractic adjustment for all of the participants.

Conclusion

The testing showed only a 56% success rate in the improvement of vertical jump heights amongst the test subjects, thus, at this time, we cannot conclude that the chiropractic adjustment as seen via Reinart© Diversified side posture adjusting improves lower body power as tested via vertical jump testing.

Introduction

Lower body power is a keystone measurement in the evaluation of athletic performance and prowess in nearly every facet of sports. Closed-kinetic-chain lower body muscular strength capacity (especially body mass adjusted strength capacity) is very influential in the performance of powerful, speed-related activities. This evaluation is done through the gold standard of testing for lower body power: the vertical jump test. The vertical jump height has been tested as an indicator of hip and leg power. This test evaluates the energy generated in time through an explosive vertical jump from the static squatting position. The universal measurement of testing the subject's leaping abilities is the Vertec®, a simple yet effect measuring tool which allots several tabs sticking out horizontally from a measuring tower, helping to determine the exact measurement of the subject's vertical jump. Utilizing the Vertec® for the prediction of possible changes in athletic performance with training or for the identification of exceptional athletes has been an important factor for the strength and conditioning practitioner.

Sacroiliac (SI) joint dysfunction and misalignment alter the proper biomechanics of not only a person's gait, but also the ability to perform athletic tasks such as the vertical jump to maximize performance.

Leg-length inequality (LLI) is a topic that seemingly has been exhaustively examined; yet much is left to be understood. SI dysfunction can lead to functional LLI for the patient, in which the side of the pelvis misaligned in a posterior-inferior plane correlates to the leg on the ipsilateral side appearing short in length. This type of short leg is merely a result of misalignment of the pelvis, whereas an anatomical short leg, in which one leg is truly shorter than the other (many times resulting from some type of disturbance to one of the growth plates during the patient's earlier years), impacts proprioception, joint kinematics, biomechanics, and physics, decreasing the ability to generate force, energy, and power.

There exists some controversy about the amount of LLI that has a clinical impact on patients. However, several authors have described multiple effects of LLI on the human body and the musculoskeletal apparatus. LLI can be a predisposing factor for acute and chronic disorders of the sacroiliac joint. In this study, the focus is on functional short legs resulting from SI dysfunction.

In this study, it is hypothesized that a sacroiliac dysfunction can affect dynamic function of the associated musculature. One of the most well-known characteristics of muscle tissue functionality is the force-velocity relationship. This relationship exemplifies the interactions between muscular contraction velocity and magnitude of contraction force, such that a muscle contracts at a speed inversely proportional to the load. A sacroiliac dysfunction will hinder the necessary load transfer of the lower body during movement by inhibiting stabilizing and responsive musculature surrounding the joint. Muscular tension applied by the gluteus maximus to the SI joint and to the sacrotuberous and long dorsal ligaments, contributes to the force closure stability of the SI joint. This force closure is needed to provide stability necessary for power production. The gluteus maximus muscle, due to its attachments to sacrum, iliac bones, and sacrotuberous ligament, plays a significant role in stability of the SI joint. The stabilizing forces applied to the SI joint, therefore, could be compromised with gluteal muscle weakness. In patients with gluteal weakness, shortening of the hamstring muscles, through their common attachments to the ischial tuberosity and sacrotuberous ligament, could compensate for gluteal muscle weakness and contribute to the SI joint stability.

The purpose of this study is to study the effects of sacroiliac dysfunction on the power generated by the lower body as tested through the vertical jump test. Mechanically, in the standing position, the weight of the body in the pelvis induces a force vector through the hip joints and towards the feet. With asymmetry of the leg-lengths, the pelvis, being pushed down on the femoral heads, must rotate or torsion. The innominate movement tends to be posterior on the side of the short leg and anterior contralaterally. This imbalance is hypothesized to have a direct effect on force production. Muscular power and explosive coordinated movement rely on rate of force production, as well as magnitude of force production. Case in point, failure to optimize the basic force producing characteristics of muscle may diminish the developmental potential of muscular power adaptation and expression.

In this study, it is hypothesized that due to the altered joint kinematics resulting from a functional short leg, correcting the misaligned, dynamically-challenged sacroiliac (SI) joint, whether in the posterior-inferior or anterior-superior orientation, will increased the efficiency of the biomechanics of the vertical jump, thus demonstrating an increase in lower body power through the correction of the SI dysfunction.

Methods

Participants

This study was first approved by the Logan College Institutional Review Board. Twenty-five consenting Logan College of Chiropractic students between the ages of 20 to 35 years of age volunteered to participate in this study. Prospective subjects were excluded from the study if any of the following exclusion criteria applied: history of prior major injuries to the lower body (pelvis or lower extremities), major breaks in any location of either leg, any full tears or colossal damage of the ligaments in the knee or ankle, frequent ipsilateral ankle sprains (more than 4 per year) for more than a year at any given time in lifetime, anatomical short leg, and/or pregnant or thought to be preganant (for female candidates). The twenty-five approved participants were comprised of 23 males and 2 females.

Instruments

The vertical jump measurements were collected by the best of three jump attempts on the VERTEC© jump test apparatus. The VERTEC© apparatus consists of a tall aluminum poll with a four corner secure base. The poll has several plastic flags on it, each representing a different increment and vertical distance landmark, starting at 14 inches and going up to 36 inches. The white flags represented ½ inch increments, while the red represented increments of 1 inch. The blue flags were landmarks separated by 4 inches each. The patients were asked to stand next to the VERTEC© with their right arm extended overhead as high as possible to generate a starting point for the jump tests.

Procedures

In the morning session, candidates, required to show up in comfortable clothes and sneakers, signed a consent form as well as an inclusion/exclusion criteria form, which included some questions pertaining to the subjects ability to participate in the study. Following some light 'warm-up' exercises (jumping jacks, running in place) as applicable, the approved participants were then asked to stand next to the VERTEC© vertical jump apparatus with their right arm extended over their head. The participant placed their right hand in the aforementioned position onto the shaft of the VERTEC© poll, then inhaled deeply and held the breath while the examiner pulled the participant's right arm to envoke greater extension as seen on the VERTEC©. This was marked as the proper positioning height for the VERTEC© to collect proper veritical jump data specific for the participant's height and reach. The participant was then asked to jump vertically from a fixed position, both feet flat on the ground. Three attempts were permitted for each subject, and the best of the three heights was recorded as the participant's 'pre-treatment jump.' The subjects were then advised to return in the afternoon for assessment, treatment, and their post-treatment jump attempts.

Upon returning in the afternoon (~4 hours later), the test subjects were evaluated by Dr. Anthony Miller though static and dynamic palpation for the precise dysfunction of their sacroiliac (SI) joint, noted as PI (posterior-inferior) in orientation on the functional restricted side. Following acknowledgement and recording of the dysfunctional sacroiliac (SI) joint, Dr. Miller then treated the aforementioned SI joint with Reinart© Diversified side posture chiropractic adjustment. Test subjects then rose from the adjusting table, walking around for ~1 min prior to getting set-up for their vertical jump test. The procedural steps for proper positioning height of the VERTEC© apparatus for accurate data per the participant's height and reach were repeated as they were done in the morning session. Test subjects again performed the vertical jump from a fixed position, and the best of three attempts was recorded as the participant's 'post-treatment jump.' The pre- and post-treatment jump values were then compared.

Summary of Data

VERTEC© Vertical Jump Values			
Participant	Pre-tx jump (inches)	SI Dysfunction	Post-tx jump (inches)
1	24	PI- Left	25
2	28.5	PI- Right	27
3	25.5	PI- Left	26
4	23	PI- Right	24
5	18	PI- Right	17.5
6	20	PI- Left	20
7	26.5	PI- Left	26.5
8	29.5	PI- Left	29
9	32.5	PI- Left	32.5
10	18.5	PI- Right	19.5
11	25	PI- Left	23.5
12	28.5	PI- Left	28.5
13	23.5	PI- Right	24
14	21	PI- Left	22
15	19	PI- Left	21
16	24.5	PI- Left	23.5
17	27	PI- Left	28
18	27	PI- Left	26.5
19	27	PI- Right	28
20	16.5	PI- Right	17
21	24.5	PI- Left	26
22	20.5	PI- Left	20
23	15	PI- Left	15.5
24	34.5	PI- Left	33.5
25	27	PI- Left	27.5

**PI= posterior inferior: misalignment listing of the dysfunctional sacroiliac joint*

Data separated into Left vs Right SI joint dysfunction:

LEFT SI JOINT dysfunction

Participant	Pre-tx jump (inches)	SI Dysfunction	Post-tx jump (inches)
1	24	PI- Left	25
3	25.5	PI- Left	26
6	20	PI- Left	20
7	26.5	PI- Left	26.5
8	29.5	PI- Left	29
9	32.5	PI- Left	32.5
11	25	PI- Left	23.5
12	28.5	PI- Left	28.5
14	21	PI- Left	22
15	19	PI- Left	21
16	24.5	PI- Left	23.5
17	27	PI- Left	28
18	27	PI- Left	26.5
21	24.5	PI- Left	26
22	20.5	PI- Left	20
23	15	PI- Left	15.5
24	34.5	PI- Left	33.5
25	27	PI- Left	27.5

RIGHT SI JOINT dysfunction

Participant	Pre-tx jump (inches)	SI Dysfunction	Post-tx jump (inches)
2	28.5	PI- Right	27
4	23	PI- Right	24
5	18	PI- Right	17.5
10	18.5	PI- Right	19.5
13	23.5	PI- Right	24
19	27	PI- Right	28
20	16.5	PI- Right	17

Results summary

The data above shows that amongst 25 participants, 18 presented with a left sacroiliac joint dysfunction and 7 with a right sacroiliac joint dysfunction. Amongst the 18 left sacroiliac (SI) joint subjects, nearly half (8) went up in vertical jump values post-treatment via chiropractic adjustment, 6 decreased in jump value after their treatment, and 4 remained at the same value. Furthermore for the left sacroiliac joint subjects, the average amongst those who increased in jump value was 1 inch, while the test subjects who went down in vertical jump value averaged a decrease of 0.83 inches. The overall average change amongst all of the left SI joint dysfunction subjects was an increase of 0.17 inches.

For the remaining 8 participants who were diagnosed with a right SI joint dysfunction, 7 of the total 8 increased in jump value, averaging 0.86 inches after receiving treatment via chiropractic adjustments. When compared with the only subject to decrease in jump value post-treatment, the right SI joint dysfunction group showed a 0.43 inch increase in vertical jump value after receiving their chiropractic manipulation.

In an analysis of all test subjects, the overall average change in vertical jump values was 0.24 inches increase in vertical jump value after receiving treatment via Reinart© Diversified side posture chiropractic adjustment.

Discussion

Strengths and Limitations

The main strengths of this experiment lie in its easy reproducibility and risen awareness of the immediate effects of chiropractic care on athletic performance. The instruments needed for this experiment were limited to only the VERTEC© vertical jump apparatus. The procedure was simple, as pre- and post-treatment jumps were a recording of the best of three jump attempts.

The limitations of this experiment were plentiful, as the main contributor to the limits of the study was the control of variables during the study. Test subjects, although screened via inclusion/exclusion criteria survey, presented a host of other variables, as some subjects chose to perform the jumps barefoot versus in shoes, while others jumped in dress pants and dress shoes. Furthermore, the control of the test subjects' activities between jumps (morning and afternoon sessions) was not monitored, as some participants admitted to have working out during the 4 hr window while others sat at a desk chair and worked on a computer for the same duration. In addition, Dr. Miller's availability for the experiment provided a larger window between jumps for a small group of test subjects, as their treatment and post-treatment testing was performed the following morning rather in the afternoon for one of the testing sessions (participants 5-9). The variability of the testers also provided a window of limitation, as Mr. Rassoul, Mr. Teece, and Mr. Ritchey all took turns measuring the test subjects' reach for proper VERTEC© alignment. In regards to the VERTEC©, stability served as a challenge, for the bolts on the apparatus were worn down and between a test subject's three jump attempts, the poll may have slipped slightly, changing the recorded values.

Future Research Recommendations

The use of a more stable, non-portable VERTEC© veritical jump apparatus would provide a controlled independent variable for future research trials. Furthermore, a more thorough control of the test subjects, from clothing to activity between the pre- and post-treatment jumps, would provide a higher reliability of the resulting data. A specifically designated area for the test subjects to rest and relax together prior to their respective jump tests would provide the experiment with minimized independent variability and increase the reliability of the collected data in the analysis of the sacroiliac dysfunction on lower body power.

An elaboration of sacroiliac dysfunction for further testing, not simple palpation, as well as more diverse listings of dysfunction would allow for a larger pool of analysis of how specific sacroiliac joint dysfunctional patterns affect athletic performance differently. The use of X-ray and other diagnostic tools for nerve, muscle, and joint stress at the lumbosacral and sacroiliac areas would provide a more thorough evaluation of the precise dysfunction plagueing the test subjects and provide the testers and chiropractor a better understanding of the corrective technique to be utilized in the treatment phase of the experiment.

Conclusion

In this study, the effects of chiropractic manipulation via Reinart© Diversified side posture adjusting proved to have 56% success rate in improving the vertical jump capabilities, while 28% of the test subjects actually decreased in performance via the vertical jump test after receiving the treatment for their sacroiliac joint dysfunction (16% did not show any change in performance). Therefore, at this time, we cannot conclude that the chiropractic adjustment as seen via Reinart© Diversified side posture adjusting improves lower body power as tested via vertical jump testing.

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