

# The Effectiveness of a Seven Week Sacro-iliac Joint Mobilization and Stabilization Program on a Low Back Population

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## INTRODUCTION:

Low back pain (LBP) is a 50 billion dollar a year growth industry in our society (Graves, et. al. 1990). The incidence of low back pain continues to escalate in number and in total costs to health care systems. The trend of increased injury and cost continues in spite of large increases in research and funding that is directed at all areas of spine care. (Twomey & Taylor, 1995). Gordon Waddell (Waddell 1987) states that there has been an epidemic of LBP in the western world since 1956. The reason behind this phenomena is unclear; however, it is believed that the increased LBP can be attributed to increasing sedentary lifestyles and sedentary work roles in an information society.

An area of LBP that has attracted increased research is the sacroiliac joint (SIJ) and associated structures. This area is interested in what degree does the sacroiliac joint play in LBP, especially chronic low back pain. Before Mixter and Barr introduced the herniated nucleus pulposus to the medical world the sacroiliac (SI) joint was being theorized as a possible mechanism for pain in the low back (Vleeming, Stoeckart & Snijders, 1992). Fifty years after the initial realization that the lumbar disk is involved in LBP, the model of the herniated lumbar disc mediating all forms of LBP syndromes has been discounted. It seem quite obvious that there are a variety of structures associated with low back pain, these structures can be commonly damaged in vigorous activities or in chronic daily activities. The question remains, to what degree does damage in each structure mitigate chronic LBP?

Ideas related with a possible pain mechanism associated with sacro-iliac joint dysfunctions (SIJD) come from a number of areas: muscle imbalance, muscle or ligamentous sprain/strain, sacral and/or ilial misalignment, and SIJ capsule tears. Problems that occur in delineating pain associated with SIJ dysfunction is that the pain patterns are very similar in nature to symptoms of a herniated lumbar disk, and that there is no uniform criteria to aid in diagnosis of SIJD (van Deursen, et al., 1980). In mimicking lumbar disk injuries the SIJ is overlooked as a possible pain source and discounted entirely. Another problem involved with SIJD is the nature of the activity causing the injury, this activity is usually very similar to the circumstance found in more commonly accepted LBP disorders. Another problem facing the accurate determination of SIJD is that there is no reliable and valid testing procedure to determine the extend of SIJD (Aslett & Williams, 1994). In addition to test determination concerns, there is a non-standardized approach to care for the dysfunction. In most circles the diagnosis is completely overlooked or cast off as a diagnosis of quackery.

Sacroiliitis is considered the most common form of SIJ pain (Bernard & Cassidy, 1992), the exact mechanism causing the inflammation is unclear. Muscle imbalance has also been sighted as a possible cause of pain. This theory maintains that the SI joint itself is unaffected, but the musculature surrounding the SI joint is in some form of dysfunction (Kermond, 1995). This muscular dysfunction could limit the flexibility of the muscles of the low back, and ultimately begin a syndrome of chronic disuse culminating in decreased function and heightened pain. Intense trauma or a shearing blow to the SIJ could cause degeneration of the connective sheath surrounding the SIJ. This potential degeneration of the SIJ capsule has provoked growing interest by radiologists and orthopaedic surgeons. Observation of possible SIJ capsule ruptures are observed by injecting contrast materials into the joint capsule that can provided radiographic evidence of abnormality (Schwarzer, Aprill, and Bogduk, 1995).

The most common form of treatment for any form of LBP is bed rest and analgesics, however there is no documentation that this is an effective treatment regimen. Exercise has been proposed to remedy LBP since Dr. Samuel Gowers (Gowers 1904) advocated an active rehabilitation program for his patients. Exercise as a form of treatment is only now gaining acceptance as an effective method of treatment. Resistance exercises that are specific only to the lower back region are relatively unique, although strength is always considered a positive attribute in warding off LBP. The increased aggressive nature and specific training effects of machine driven rehabilitation is showing strong results by increasing lumbar extensor strength and decreasing patient pain (Risch, et al., 1991).

The treatment protocol that this article describes is unique in comparison to any other rehabilitation process that is described in the literature. The protocol utilizes an extensive evaluation of the SIJ, manual correction of the SI joint, and aggressive resistance exercise that is specific to the lower back. It is the belief of this treatment team that the dysfunction of the SIJ is overlooked as a source of pain, commonly misdiagnosed, and then lumped into treatment with more commonly seen LBP disorders. There is now a resurgence of conventional mainstream care-givers (medical doctors, orthopaedic surgeons, and physical therapists) who are again looking into the SIJ as a possible cause for pain.

#### METHODS:

Workers' compensation subjects presented at an orthopaedic surgeon's practice due to LBP, with specific complaints of pain in the sacroiliac joint areas. Specific complaints were documented by use of pain diagrams (Schwarzer, Aprill & Bogduk, 1995) and a visual analog pain scale. Subjects were examined and had no neurologic signs of lumbar disk abnormality, as well as no prior low back surgeries. After the LBP physical exam subjects were diagnosed with SIJ dysfunction if the following criteria were met.

The diagnosis of SIJ dysfunction was determined by the use of manual testing. The SIJ

manual dynamic tests were: sitting flexion test, March/stork test, standing flexion test, supine long sitting test. The static bi-lateral symmetrical test procedures were: anterior superior iliac spines (ASIS), iliac crests, posterior superior iliac spines (PSIS), symphysis-pubis, and sacral obliquity. If one or more tests in each category was positive and a generalized region of pain in the SIJ area was present, then the patient was considered as SIJD.

#### Manual Dynamic Tests:

The supine long sitting test was performed with patient supine and the examiner placing thumbs under the inferior border of each medial malleolus. The two medial malleoli were brought together for comparison. Then the patient sat with knees extended, and the relative length of the malleoli were reassessed. A positive test resulted when observable change occurred in relative leg length between the two positions.

The standing flexion test was performed with patient standing, knees straight, feet pointing straight ahead. Examiner's thumbs placed on inferior aspect of the left and right PSIS's. Patient bent forward slowly as far as they could. A positive test has occurred when one PSIS has moved cranially more than the other.

The sitting flexion test, patient is sitting on a table. The examiner's thumbs are placed on PSIS's in accordance with the standing flexion test. The patient is then ask to forward bend, if one PSIS becomes superior in relation to the other PSIS a positive test has occurred. The superior PSIS is considered the dysfunctional side. The standing flexion test is the same design as the sitting flexion test except the subject is standing.

The March/stork test, patient is standing in the neutral position. One thumb of the examiner is on the right PSIS and the other thumb is on the dorsal cranial surface of the sacrum in line with the PSIS. The patient flexes at the hip on the examination side. The PSIS will go downward in comparison to the sacrum. If there is no downward motion of the PSIS, then a positive test has occurred.

#### Static Symmetry Tests:

PSIS bilateral test, the two PSIS's were found by placing a thumb under each PSIS. The two heights were compared at a horizontal level. A positive test resulted when the height of one of the PSIS's was uneven.

ASIS bilateral test, the two ASIS's were found by placing a thumb under each ASIS. The two heights were compared for horizontal height. A positive test results when the height of one of the ASIS's is uneven.

The iliac crest test is located on the prone patient by use of lateral aspect of the index finger slightly palpating the tip of the iliac crest. If levels of the index fingers are not even, then a positive test has occurred.

The pubis symphysis is located on the supine subject. Both thumbs are placed on the anterior surface of the pubis. If the pubis surfaces are not at equal heights, then a positive test has occurred.

Sacral obliquity test, different levels of the dorsal sacral surface are observed by palpation. The examiner's thumbs are placed slightly apart, palpating the dorsal surface of each fused segment of the sacrum. If one thumb is more posterior than the other thumb, a positive test has occurred.

#### Rehabilitation:

The rehabilitation process consisted of manual mobilization, basic flexibility stretches, specific lower back resistance training, and progressive resistance exercises (PRE's) for general conditioning. On the first visit to the rehabilitation area the subjects that were identified as SIJD were manually mobilized into symmetric sacral and ilial positions, and then given a home stretching program consisting of basic pelvic stabilization and flexibility stretches. If SIJD was present at the time of evaluation, the following manual mobilization techniques, for the various dysfunctions seen, were used.

Iliac upslip with a posterior rotation of the ilium. The subject will be in a supine position, the leg on the affected side will be externally rotated and fully extended. The leg is held in a SLR position at a 30 to 45 degree angle from the table. The subject is instructed to relax, a gentle but forceful sustained traction is applied to the leg in a series of three pulling motions. The traction should not cause any pain to the subject. If the traction does not produce symmetrical ilial positioning, reproduce the mobilizations.

Iliac upslip with an anterior rotation of the ilium. The subject will be in a prone position, the leg on the affected side will be externally rotated and fully extended. The leg is held at a 30 to 45 degree angle from the table. The subject is instructed to relax, a gentle but forceful sustained traction is applied to the leg in a series of three pulling motions. The traction should not cause any pain to the subject, if the traction does not cause symmetrical ilial positioning, reproduce the mobilization.

Note: It is important to discuss the technique developed in this paper, the correction of iliac "upslips" were always treated prior to any other manual corrections/mobilizations. It is believed that the relationship occurring between the ilium and the sacrum make the ilium the primary correction point, if the sacral mobilizations are to have any long term effects.

If the right ilium is rotated in a posterior position, then the following correction was used. Activate the hip flexors on the right and the hip extensors on the left. With the subject lying on his back with knees bent, the examiner has the patient pull his right knee toward his chest while resisting him above the knee. At the same time patient tries to push left knee downward with the examiner resisting below the knee.

If the left ilium is rotated in a posterior position, then the following correction was used. Activate the hip flexors on the left and the hip extensors on the right. With the subject lying on his back with knees bent, the examiner has the patient pull his left knee toward his chest while resisting him above the knee. At the same time patient tries to push right knee downward with the examiner resisting below the knee.

If the right ilium is rotated in an anterior position, then utilize the following correction. Activate the hips extensors on the right and hip flexors on the left. The subject will lie on his back with his knees bent, the subject pushes his right knee down while the examiner resists him below the knee. At the same time, patient pulls his left knee towards his chest while the examiner resists him above the knee.

If the left ilium is rotated in an anterior position, the same mobilization is used in accordance with the right ilium anterior rotation technique. The only difference being, the use of the opposite limbs in the description above.

If the sacrum is rotated in a posterior position on the right side, the following technique used for correction. The subject is lying on his right side with hips flexed at approximately a 90 degree angle. The examiner places one hand under the subject's right knee and the other hand on the medial side of his right ankle. Patient holds the left leg up (approximately 30-50 degrees) while the examiner pushes the leg down. Resistance should be placed under the knee and on the medial surface of the ankle.

If the sacrum is rotated in a posterior position on the left side the same technique is used, as described above for the right rotated sacrum. The only differences is that the subject will lay on his left side, and the movements are done on the left.

If the right symphysis pubis is superior to the opposite pubis, the following mobilization will produce symmetry. The subject will activate the left rectus abdominis and the right hip adductors. The subject is supine and instructed to pull his left shoulder off the table, while the examiner provides resistance to this movement at the shoulder when 2-4 inches of movement has occurred. The right leg simultaneously adducts, with the examiner providing resistance to the movement above the knee.

The same mobilization, as described in the paragraph above, is performed if the left symphysis pubis is more superior than the right. Except that the movement patterns are performed on the opposite side of the body.

Of note, when performing the various mobilization techniques the movement should be held for 3-5 seconds at a sub-maximal contraction level (60-80% of maximum), and repeated in a series of 3.

After all of the necessary manual mobilizations have been completed, and symmetric alignment has been achieved, mobilization of the pubes will be last (this is referred to as "shot-gunning" the pubes). An audible click, that is not painful, is commonly heard after this movement in the area of the symphysis pubis. In this technique the subject is

supine with his hips flexed at 45 degrees, the subject's feet are positioned almost side by side (in a "butterfly position"). The examiner's elbow is placed at one side of the inner knee and the other hand will lock down on the opposite inner knee. The subject is instructed to drive his knees together at 80-100% of maximal force for 3-5 seconds.

On the second visit to the rehabilitation unit the SIJ was re-evaluated and manually corrected in the manner as stated above, if SIJD was observed. Following the manual correction the patient was then isometrically (IM) tested in an isolated lumbar extension unit (MedX Lumbar Extension Unit, Ocala, Florida). In the strength test the subjects were isometrically tested at their maximal pain-free extension and flexion points. In between these two end points of the range of motion, testing was also conducted at standardized points (Risch, et al., 1991). These standardized points on the MedX lumbar extension machine are 0, 12, 24, 36, 48, 60, 72 degrees of lumbar flexion. The side-on visual description of the MedX isolated lumbar extension unit is seen in Figure 1.

After the initial strength test (visit 2) the subject exercised on 6 progressive resistance exercise (PRE) machines, did free-standing pelvic stabilization and flexibility stretches as part of a home exercise program. The six PRE's performed exercised the quadriceps, hamstrings, latissimus dorsi, shoulder, and abdominal muscle groups (10-15 reps / 1 set per exercise). Excessive lumbar flexion movements were not allowed, long distance walking was not allowed; as well as, no stair climbing exercises. This training regimen continued two times per week until the subject was discharged. Isometric tests were only administered 1 time per month, the other exercise periods with the MedX lumbar extension unit consisted of dynamic lumbar training to volitional failure. The method of training to volitional failure utilizes a progressively heavier weight at exercise that can be lifted dynamically 12-20 times (in 75-120 seconds) until the subject can not continue the training session. If, in the training session prior, 12-20 repetitions were successfully completed, with correct time, the training weight would be raised 5-10%.

#### Pain Scores:

Subjects were asked to score their pain levels at each rehabilitation session. The reading was the average level of pain that the person felt before entering the building for that days' rehabilitation session. The visual analog scale used for the rating of pain was as follows: 0 - no pain, 1-2 occasional pain, 3-4 mild constant pain, 5-6 moderate constant pain, 7-8 unable to do daily activities, 9-10 emergency: needs to see a Doctor.

#### Work Status:

Subjects work status was taken at initial visit and at the discharge from the program. The following rating system accompanied the level of work the subject was at, 0 - no work, 1 - sedentary duty, 2 - light duty, 3 - moderate duty, 4 - full duty. Sedentary duty consisted of lifting 10 pounds at maximum and occasionally lifting and carrying such articles as docket, ledgers, and small tools. Light duty consisted of lifting 20 pounds at maximum with frequent lifting and/or carrying of objects weighing up to 10

pounds. Moderate duty consisted of lifting 50 pounds at maximum and frequent lifting and/or carrying of objects weighing up to 25 pounds. Full duty consisted of the normal 40 hour a week job previously done prior to injury.

#### Discharge from the Program:

Subjects were given a one month prescription for physical therapy (2x week). At the one month mark subjects were reviewed for the following criteria: strength improvement, compliance to program, and pain status. If subjects exhibited a non-physiologic decrease in strength status then the subject was released. If compliance was not at the acceptable level (greater than one miss per week) the subject was released. If the subjects were deemed as possible rehabilitation candidates, the therapy was continued for two more weeks and the review process again occurred at that time. If the patient reported a 0 pain level they were released. The subject could remain in therapy for up to an additional 4 weeks. At the seven week mark patients were reassessed for overall progress and prepared for discharge.

#### Exclusion from the Analysis:

Subjects that were treated for SIJ dysfunction were excluded from this study's results if they fell into the following categories. Subjects that exhibited classical lumbar disk herniation(s) on physical exam or herniations upon imaging studies were not included in this report. Subjects that had any form of lower back surgery were excluded. Subjects that showed three or more Waddell signs (Waddell 1980), indicating non-physiologic complaints, on the physical exam were excluded.

#### RESULTS:

Forty-two females qualified for this analysis in a six month period, from March 1994 to September 1994. The average height was 164.1 cm, average weight was 66.6 kg, and average age was 38.1 years. The average number of months of that LBP had been observed before entering this program was 5.9 months (Table 1.) Analysis of variance (ANOVA) reveals that the average pain score on the visual analog scale significantly decreased ( $p < 0.01$ ), initially at a 6.2 level and then declining to an average of 2.9. ANOVA reveals that work status increased significantly ( $p < 0.01$ ) from an initial visit average work level of 2.6 to a discharge average work level of 3.7. ANOVA reveals that the average IM torque increased significantly ( $p < 0.01$ ) from an initial IM average of 91.4 ft-lbs to a final IM average of 113.2 ft-lbs (+23.8%). ANOVA reveals that IM torque increased significantly ( $p < 0.01$ ) at all standardized test points throughout the pain-free range of motion (ROM) during IM testing (see Table 3, Graph 1). The pain-free ROM did not significantly change during the program. The average number of rehabilitation visits for the female population was 15.4 sessions.

Thirty-seven males qualified for this analysis in a six month period, from March 1994 to September 1994. The average height was 180.3 cm, average weight was 90.4 kg, and average age was 40.1 years. The average number of months of that LBP had been

observed before entering this program was 5.5 months (Chart 1). ANOVA reveals that the average pain score on the visual analog scale significantly ( $p < 0.01$ ) decreased from an initial visit average of 5.5, declining to a discharge average of 2.1 (scale above). ANOVA reveals that work status increased significantly ( $p < 0.01$ ) from an initial visit work level of 3.2 to a work level of 3.7 (scale above) at discharge from the program. ANOVA reveals that the average isometric (IM) torques scores increased significantly ( $p < 0.01$ ) from an initial IM average of 160.1 ft-lbs to a final IM average of 203.6 ft-lbs (+27.2%). ANOVA reveals that the IM torque increased significantly ( $p < 0.01$ ) at all standardized test points throughout the pain-free ROM during IM testing (see Table 2, Graph 2). The pain-free ROM increased significantly ( $p < 0.01$ ) from initial ROM (0-46 degrees) to final ROM (0-50 degrees). The average number of male rehabilitation visits was 14.3 sessions.

#### Male to Female Group Comparisons:

In comparison of male and female populations, ANOVA reveals no significant difference ( $p \geq 0.05$ ) in these categories: group age, number of rehabilitation sessions, initial pain rating, final pain rating, final work status level, length of LBP previous to SIJ protocol entry, and average lumbar IM strength change. Significant differences ( $p < 0.05$ ) occur in average group height and group weight. The male group being greater in height and weight.

#### DISCUSSION:

This data indicates that this SIJ mobilization and isolated lumbar strengthening protocol is effective in reducing pain and increasing functional status. Objective measurements of LBP changes are witnessed by the increasing strength values exhibited on lumbar extension strength testing (Lumbar IM torque), and the increasing levels of subject work status (comparing pre- and post- program work levels). These objective changes also occur with subjective decreases in subject self-reported pain levels, this is occurring in a workers compensation LBP population (average LBP was 5+ months prior to program entry).

In comparison of male and female group characteristics ANOVA reveals that the populations are homogeneous in nature, except for gender based differences. The areas which there are no significant differences between the groups are: group age, number of rehabilitation sessions attended, initial pain rating, final pain rating, length of LBP previous to entry into the program, average percent change (gain) in isometric lumbar strength, and work status level at discharge. The gender based differences seem to occur in group height, group weight, and total lumbar IM torque produced. These differences are to be expected when comparing male and female groups in an occupational medicine population.

This information shows an objective functional restoration of subject strength and work status in chronic LBP within a worker's compensation population. This protocol warrants scrutiny due to its overall effectiveness, method of diagnosis, and unique form

of manual treatment teamed with aggressive isolated lumbar machine driven resistance exercise.

#### Constraints of the Study:

The objective study of the effects of manual mobilization on the SIJ and LBP in general, have yet to be fully examined. The effects of aggressive resistance training on LBP sufferers diagnosed with SIJD has yet to be fully investigated. To our knowledge this is the only study that has had a well defined SIJD group that was mobilized into symmetric SIJ position, and then trained in an isolated lumbar extension device. This is also one of the few studies dealing with the SIJ that has objective evidence (increased strength gain, increased work status level) along with subjective reports of decreased pain when utilizing a specific treatment protocol.

The greatest question that arises in this research team's minds is, what were the individual effects of the isolated strength training versus the effects of the SIJ manual mobilization techniques. At a future date this research team will attempt to define the roles of these two mechanisms to a greater degree with further more controlled studies.

#### CONCLUSION:

This study reveals a very positive result in the areas of self-reported subjective pain decreases in LBP; as well as, objective increases in lumbar strength and increased functional status (work level). This unique combination of manual therapy and aggressive resistance training in a chronic LBP population requires further enthusiastic investigation due to its effectiveness and the efficient treatment period (7 weeks). Two main issues involving this population bear mentioning: subjects were utilizing the workers' compensation system, and had chronic complaints of LBP for greater than 5 months prior to entry into this program. Considering these two important issues in dealing with this study population, the results are remarkable. This evaluation and treatment method for the SIJD is an attempt to treat and delineate a subcategory of LBP that in the past has not been well defined and/or treated.

**Table 1. Male and Female Sacroiliac Joint Rehabilitation Group Population Characteristics**

<b>Males</b>	<b>(N=37)</b>	<b>Females</b>	<b>(N=42)</b>
Age =	40.1 (± 10.1)	Age =	38.1 (± 9.4) yrs
Height =	180.3 (± 9.1)	Height =	164.1 (± 6.9) cm
Weight =	90.4 (± 17.4)	Weight =	66.6 (± 16.2) kg
Number of Months of LBP prior to Program = 5.5 (± 5.3)		Number of Months of LBP prior to Program = 5.9 (± 9.0)	

**Table 2. Male Sacroiliac Joint Rehabilitation Group Strength Results**

Male (N=37)

**MedX Degrees of Lumbar Flexion**

Test Situation	0°	12°	24°	36°	48°	Total Average
Initial Lumbar Isometric Test (ft-lbs)	107.7	142.1	169.5	188.7	218.3	160.1
Final Lumbar Isometric Test (ft-lbs)	148.8**	189.9**	211.7**	242.9**	273.7**	203.6**
Percentage Change at this Test Point	+38.2%	+33.6%	+24.9%	+28.7%	+25.4%	+27.2%

Values are means.

\*\* Significantly greater than the initial test values, accepted at p<0.01.

Table 3. Female Sacroiliac Joint Rehabilitation Group Strength Results

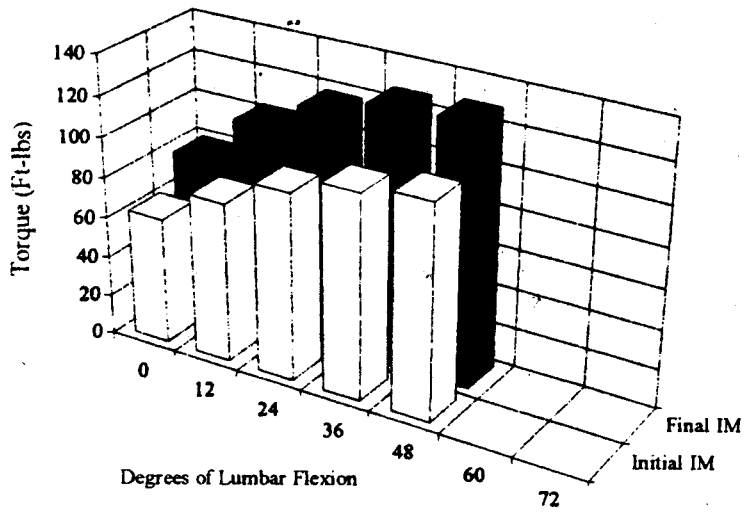
Female (N=42)

Test Situation	MedX Degrees of Lumbar Flexion					Total Average
	0°	12°	24°	36°	48°	
Initial Lumbar Isometric Test (ft-lbs)	59.7	76.4	90.7	100.4	103.8	91.4
Final Lumbar Isometric Test (ft-lbs)	76.5**	101.1**	115.2**	123.1**	126.8**	113.2**
Percentage Change at this Test Point	+28.1%	+32.3%	+27.0%	+22.7%	+22.2%	+23.8

Values are means.

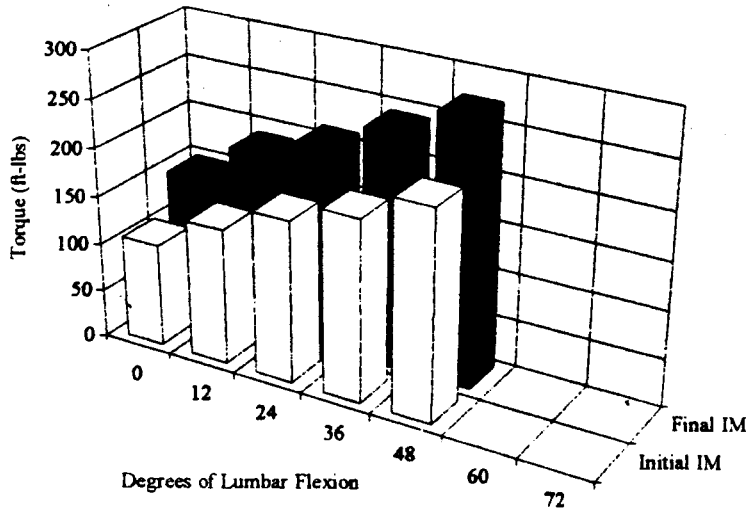
\*\* Significantly greater than the initial test values, accepted at  $p < 0.01$ .

**Graph 1. Female Strength Changes with Sacroiliac Joint Rehabilitation**



*\* All Final test values are significantly greater than the initial values ( $p < 0.01$ )*

**Graph 2. Male Strength Changes with Sacroiliac Joint Rehabilitation**



*\* All Final test values are significantly greater than the initial values ( $p < 0.01$ )*

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