Effects of Spinal Reflex Analysis and Attachment Point Therapy on Range of Motion and Power in College Athletes

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Introduction: The purpose of this pilot study was to determine the degree to which Spinal Reflex Analysis™ (SRA) assessment and Attachment Point Therapy™ (APT) treatment protocols affect range of motion (ROM) and power in trained athletes. **Methods**: Collegiate athletes were assessed with SRA and then treated with APT for one to six sessions. Measurements of hip flexion, pelvic girdle extension, knee flexion, and vertical jump were taken before and after each session. The data was then assessed for effects after one session, five to six sessions, and six weeks post therapy. The sample size is smaller for the categories of multiple sessions and six week post therapy as some of the subjects in the study did not attend all scheduled sessions. Thus, t*he baseline measurement was adjusted in each case so that baseline statistics represented only those students available for that part of the test.*

Results: After one session, there was an average increase in ROM of 2.1 % in knee flexion from 137.6° ± 9.1 to 140.4° ± 7.0, 7.1% in hip flexion from 73.3° ± 14.2 to 78.5° ± 13.4, and 29.4% in pelvic girdle extension from 22.7° ± 7.5 to 29.4° ± 7.7. After five or six sessions there is an increase of 5.6% in knee flexion from 140.4° ± 8.4 to 148.5° ± 8.6, 22.4% in hip flexion from 74.1° ± 12.2 to 90.7° ± 17.7, and 65.7% in pelvic girdle extension from 22.9° ± 7.3 to 38.0° ± 13.3. Six weeks after the final session, the change was greater still with an increase of 6.6% in knee flexion from 139.2° ± 11.0 to 148.3° ± 7.3, 30.3% in hip flexion from 69.2° ± 21.7 to 90.1° ± 17.0, and 67.4% in pelvic girdle extension from 22.5° ± 7.6 to 37.7° ± 7.8 . There was no statistical difference in baseline scores and post treatment scores for the vertical jump test except for the six week post treatment category where an average increase of 11.3% is evident from the baseline average of 24.2 inches to the final average of 27.0 inches.

Conclusions: Data clearly shows an improvement in ROM in all categories tested. There does not appear to be sufficient evidence to support an improvement in power as measured by vertical jump until six weeks post treatment. Subjective comments ranged from no noticeable affect, to a sense of greater perceived flexibility, improved performance on repeated heavy lifting and repeated all out running, improved overall recovery, and less muscle ache and pain after workouts. Further research needs to be done to determine the effects on athletes in different sports, female athletes, and athletes of different ages. Research into the effect on explosive power at different intervals of time post treatment would also be valuable.

The term "spinal reflex" is used to describe a monosynaptic or simple peripheral reflex where stretch receptors initiate a single motor response to stimuli via a cord mediated reflex arc [1] (example: the patellar tendon reflex). A complex spinal reflex, i.e., the spondylogenic reflex, specifically originates from the axial spine. It is a multisynaptic reflex and it produces an intricate pattern of muscle-fiber contractions throughout the pelvis, torso, and cervical-occipital regions.

In the late 1970's and early 1980's, European researcher M. Sutter defined this polysynaptic reflex as Spondylogenic Reflex Syndrome (SRS).[2] According to Dvorak, Dvorak, Sutter based his discovery on experiments in which volunteer subjects were injected with a noxious compound into the facet capsule of each successive vertebrae and then assessed for resulting soft tissue (muscle) contractures using EMG recordings.[3] With this method, Sutter was able to show evidence that irritation of the facet articulation resulted in a reflexive contraction of isolated muscle-fibers in multiple muscles (between four and seventeen depending on the specific level of the spine). L. Jarrell found that the SRS can grossly impair neuromusculoskeletal function and induce neuromusculoskeletal pain and nerve compression syndromes. The SRS is further defined by Jarrell as an "axial spinal reflex" (ASR) to differentially state that the primary stimulus for the reflex not only originates in the facet articulations of the axial spine (as opposed to peripheral deep tendon reflexes), it is also indicative of dynamic axial facet instability propagated by multiple biomechanical and environmental factors. This segmental axial instability drives the SRS and can be subtle and illusive, is often illustrated on radiographic plain film studies as flexion or extension facet instability, and is often mistaken in joint palpation as a fixated articulation. The symptom profile ranges from minimal axial and peripheral ROM and biomechanical alterations to complex scleratomal, radicular, and arthritic pain patterns.[4] Additional acute and chronic soft tissue dysfunction is evidenced as myofascial pain and trigger point development [5], cumulative injury disorder (CID) [6], and pathological soft tissue changes in muscle and tendons.[7]

Over the past ten years, Jarrell expanded on Sutter's empirical data and a clinical understanding of the effects of the SRS to develop a system of diagnostics and treatment protocols called Spinal Reflex Analysis (SRA). This system identifies the level of the spine at which the ASR is actively originating. In a clinical setting, SRA uses soft tissue palpation, algometry, infrared thermography, and/or diagnostic ultrasound to identify the involved segment. SRA based spinal manipulation and/or soft tissue therapy and strengthening is utilized in this system to reduce ASR activity, resulting pain, and aberrant biomechanics.[8]

Utilizing A. C. Guyton's reference to the "lengthening reflex" elicited by affecting the golgi-tendon organ,[9] Jarrell and Culver developed SRA based Attachment Point Therapy™ (APT). This protocol definitively reduces the reflexive contracture of muscle produced by the ASR. Treatment is administered to the specific pattern of muscle-fiber contractions inherent to the identified spinal segment. Clinical findings indicate that as the hypertonic status of the involved muscle-fibers is reduced, a global reduction in the hypertonicity of the muscle occurs. The cumulative relaxation in the hypertonic muscles induced by the ASR leads to a decrease in associated tonal imbalances throughout the body, reduced attachment tendonosis, multi-articular decompression, improved pliability of muscle and ligament structures, and net increases in ROM, power, and coordination. Large increases in the range of motion in post-operative and post-injury patients have been noted with the application of SRA based APT and SRA based spinal manipulation (CMT). This pilot study was designed to determine if the tonic changes in muscles produced by this protocol in a clinical setting are also observed in a non-injured athletic grouping. A secondary interest was whether the SRA/APT protocols would elicit an increase in power output.

Methods:

Participants: Seventeen male student athletes from a small southwestern U.S. college volunteered to participate in the study. No incentive was offered for participation. Of the seventeen students that originally signed up for the study, eight completed at least five of the six therapy sessions. A total of seven subjects were available for follow up testing six weeks after the final session and all seven of those subjects attended at least four of the six SRA sessions. Testers included the researchers (Jarrell, Culver, Osorno) who performed the therapy, and student athletic trainers who assisted in data acquisition.

Design: Each athlete was assigned to six therapy and measuring sessions. The students were measured in the two areas of conditioning, ROM and power, both before and after each session. Vertical jump was chosen as a test of explosive power. Six weeks after the end of the therapy phase, the athletes were measured again to see if the changes were maintained. ROM measurements showing flexibility included hip flexion, pelvic girdle extension, and knee flexion. The initial measurements taken prior to the first session were used as a baseline for statistical analysis. The statistical significance of the outcomes were analyzed with paired sample t-tests by comparing the baseline measurement to the post-treatment measurement after one session, five or six sessions, and for the six week post-treatment scores.

Materials: Testers used a standard goniometer from Baseline (White Plains, NY) to measure ROM and a Vertec jump and reach measuring pole from Sports Imports, (Columbus, OH) to measure vertical jump. A Boss portable massage table from Oakworks, (Freedom, PA) was utilized for measuring and treating the athletes. Statistical software from SPSS (Chicago, IL) was used to calculate statistics.

Procedures: Each session began with the researcher and tester measuring the subjects' pre-treatment ROM and vertical jump. The subject was then administered SRA /APT, and post-tested to observe any change in score. The length of each session was 15 minutes including pre/post measurements and therapy. Student athletic trainers used the goniometer to measure ROM with the subject lying on a table and the researcher passively stretching the subject to the tolerable end range of motion of the articulation for each of the three different measures. Knee flexion was measured with the subjects in the prone position, and the researcher applying pressure at the ankle toward the pelvis. When measuring pelvic girdle extension, subjects were measured in the prone position with a stabilizing force on the posterior superior iliac spine. However, the pelvis was allowed to move slightly at the sacroiliac joint in order to observe the effect on the mobility along the anterior line of the pelvis to further assess psoas muscle tonicity. Subjects were measured supine to assess hip flexion with a stabilizing force along the anterior-superior iliac spine of the pelvis. Vertical jump, demonstrating power, was measured by having the subject strike the highest flag they could reach over two successive jumps. SRA/APT was conducted per SRA protocol by the researchers with the subject lying prone on the treatment table.

Subjects were treated and measured twice weekly over a four-week period with week three allocated as a scheduled holiday for a total of three weeks of treatment. A follow-up test was conducted six weeks post therapy to determine if the effects were retained. ROM change scores were computed by averaging the ROM of the right and left leg to get one score per session for each athlete. The results were then tabulated using t-tests in the following grouping arrangements: effect after one session, effect after five or six sessions, and effect at six weeks after the final treatment.

Results

The results are shown in the tables A through D. If the student made fewer than six sessions the score for the greatest number of sessions attended was given. The baseline measurement was adjusted in each case so that baseline statistics represented only those students available for that part of the test. The results show a statistically significant increase in range of motion after any amount of treatment.

After one session, there is an average increase of 2.1 % in knee flexion (Table A) from 137.6° ± 9.1 to 140.4° ± 7.0, t=2.626, 7.1% in hip flexion (Table B) from 73.3° ± 14.2 to 78.5° ± 13.4, t = 2.246; and 29.4% in pelvic girdle extension (Table C) from 22.7° ± 7.5 to 29.4° ± 7.7, t = 3.841. After five or six sessions the change shows an increase of 5.6% in knee flexion from 140.4° ± 8.4 to 148.5° ± 8.6, t = 4.608; 22.4% in hip flexion from 74.1° ± 12.2 to 90.7° ± 17.7, t = 4.185; and in 65.7% in pelvic girdle extension from 22.9° ± 7.3 to 38.0° ± 13.3, t = 5.226. Six weeks after the final session, the change was greater still with an increase of 6.6% in knee flexion from 139.2° ± 11.0 to 148.3° ± 7.3, t = 4.904; 30.3% in hip flexion from 69.2° ± 21.7 to 90.1° ± 17.0, t = 3.274; and 67.4% in pelvic girdle extension from 22.5° ± 7.6 to 37.7° ± 7.8, t = 5.694. In the vertical jump (Table D), there was no statistical difference in baseline scores and post treatment scores until the sixth week post treatment measurement with an average increase of 11.3% in vertical jump from with 24.2 ± 4.9 inches to 27.0 ± 4.9 inches, t = 5.966 observed.

Discussion

It is important to note that the protocol for SRA/APT therapy administered in this study includes the following parameters in therapeutic application: 1. to muscle-fibers that attach directly to the spine or the pelvic girdle only, 2. to specific fibers within given muscles as defined by that sessions' assessed ASR, 3. to differing segmental levels according to that sessions findings, 4. to asymmetrical (right to left) muscles as identified through the ASR pattern. Therefore, the bilateral increase in ROM in extremities and pelvic articular structures observed during therapy, and seen in the raw data, is not a direct result of treatment of the specific muscles affecting the joint measured, or the effect of a global therapeutic massage on a given set of muscles. These changes in ROM appear to be a function of the overall effect of SRA on reducing neural disregulation leading to pathological muscle tonus. This suggests that large portions of the neuromuscular system affecting tone and coordination are being mediated by the ASR process.

The data tables consistently illustrate that the more therapeutic sessions received, the greater the effect on ROM. Furthermore, the average gain in ROM tested, which is critical to many sports activities, was not only maintained after 6 weeks, but continued to increase in all categories. It is intriguing that marked gains occurred across all measurements and thus warrants further investigation. Knee flexion shows an average increase of 10.4°. This large of an increase is likely to be a result of tonic reduction in the m. quadriceps musculature, allowing for greater lengthening of the same, with subsequent increased joint mobility through reduced compression loading. The same premise applies to the increase in pelvic extension through a direct reduction in the m. iliopsoas hypertonicity, and increases in hip flexion as a result of reduced m. hamstring group activity.

The results in the vertical jump were not as robust during the treatment phase. The results showed a small but measurable increase after five or six sessions, although the change was not large enough to be statistically significant. Six weeks after the last treatment, the vertical jump shows an average increase of 2.7 ± 1.3 inches. The increase in explosive power as measured by vertical jump six weeks after the treatment phase suggests a development of coordination and strength over time in response to retention of reduced ASR status. There is a high probability that the acute or chronically shortened muscle fibers induced by the ASR become effective histological limiters to associated muscle fibers in both length and fatigue free contractile function. It is believed by Jarrell, et al. that the ASR shortened fibers (primary ASR fibers) in a given muscle belly would require adjacent muscle fibers to brake for rapid and/or maximum lengthening in order to reduce risk of tear, and/or limit maximum contractile output due to primary fiber metabolic fatigue. In essence, neurologically mediated ASR primary fibers would become the limiting factor in the contractile process, and thus determine net qualitative and quantitative output. Reducing the influence of the ASR may liberate significant gains in ROM and power as seen in this study. This premise requires additional research to determine the specific functional and physiological findings governing the above statistical outcomes.

Additional research can be restructured to overcome certain problems the encountered during the course of this study. Potential variables during data collection included limitations in testing equipment and consistency in technical application of ROM measurement procedures. The effects of these variables on the study would have been of greater concern had the statistical gains and the confidence interval not been as large. A double blind study with randomized control groups that crossover is in development, and standardized measuring equipment has been acquired to achieve greater control over these potential variables in future studies.

The study was successful in showing the effect of SRA based APT as a means of improving measurable aspects of athletic performance. It would be valuable to test vertical jump at different time intervals post therapy to find out what time interval develops the greatest improvement in overall power. Professional cyclists and ultra-endurance runners have shown very positive preliminary results in the same measurable categories. The same subjective findings of greater endurance, improved post performance recovery, increased range of motion and decreased pain levels reported by the subjects of the study, are consistently reported by these athletes. Research proposals are in process for athletes of different sports, genders, and ages.

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SRA/ APT Study Findings

Table A: Statistical Analysis of the Change in Knee Flexion ROM in Degrees utilizing Spinal Reflex Analysis™ Based Attachment Point Therapy™

Number of sessions	N	Mean (SD)	95% CI	t value	ρ value
One Session	17	2.9° ± 4.5°	.6° to 5.2°	2.626	.018
Five to Six Sessions	8	7.8° ± 4.8°	3.8° to 11.8°	4.608	.002
Six Week Post-Treatments	6	9.2° ± 4.6	4.3° to 14.0°	4.904	.004

Table B: Statistical Analysis of the Change in Hip Flexion Range of Motion in Degrees utilizing Spinal Reflex Analysis™ Based Attachment Point Therapy™

Number of sessions	N	Mean (SD)	95% CI	t value	ρ value
One Session	17	5.2° ± 9.5°	.3° to 10.1°	2.246	.039
Five to Six Sessions	8	16.6° ± 11.2°	7.2° to 26.0°	4.185	.004
Six Week Post-Treatments	6	20.9° ± 15.6	4.5° to 37.3°	3.274	.022

Table C: Statistical Analysis of the Change in Pelvic Girdle Extension Range of Motion in Degrees utilizing Spinal Reflex Analysis™ Based Attachment Point Therapy™

Number of sessions	N	Mean (SD)	95% CI	t value	ρ value
One Session	17	6.6° ± 7.2°	3.0° to 10.4°	3.841	.001
Five to Six Sessions	8	15.1° ±8.2°	8.2° to 21.9°	5.226	.001
Six Week Post-Treatments	6	15.2° ± 6.5	8.3° to 22.0°	5.694	.002

Table D: Statistical Analysis of the Change in Vertical Jump in Inches utilizing Spinal Reflex Analysis™ Based Attachment Point Therapy™

Number of sessions	N	Inches	95% CI	t value	ρ value
One Session	17	0.0 ± 1.5	-.85 to 8.5	.000	1.000
Five to Six Sessions	8	.06 ± 1.3	-1.1 to 1.2	0.131	.899
Six Week Post-Treatments	7	2.8 ± 1.1	1.6 to 3.9	5.966	.002