Effect of a Positional Release Therapy Technique on Hamstring Flexibility

Trevor B. Birmingham, Julie Kramer, Jim Lumsden, Kathy D. Obright, John F. Kramer

ABSTRACT

Purpose: To investigate the effect of a positional release therapy (PRT) technique proposed to increase hamstring flexibility.

Methods: Using a crossover design with random assignment, 33 subjects (mean age 24 years) who had decreased hamstring flexibility (mean deficit in knee extension 24°), but no history of major trauma or underlying pathology, received either a true or a sham PRT technique applied to the hamstrings of the right and left limbs. Hamstring flexibility was assessed before and after each technique by measuring the popliteal angle during maximal active knee extension performed in sitting. A blinded evaluator measured popliteal angles on digital photographs using a standard protractor.

Results: There were no statistically significant differences between the true and sham treatment techniques in the change in popliteal angle for the right (mean difference 0.1°; 95% CI: –1.5–1.6°) and left (mean difference 0.2°; 95% CI: –1.5–1.9°) limbs.

Conclusion: These findings suggest that the PRT technique evaluated is not effective in otherwise healthy subjects with decreased hamstring flexibility. Future studies should evaluate the effect of PRT techniques in subjects with a clear history of trauma or defined pathology.

Key Words: flexibility, hamstring, positional release therapy, randomized controlled trial, strain-counterstrain

RÉSUMÉ

Objectif: Investiguer l'effet d'une technique thérapeutique proposée de relâchement positionnel (TTRP) pour augmenter la flexibilité des muscles ischio-jambiers.

Méthodologie: En utilisant un plan avec permutation et répartition aléatoire, 33 sujets (âge moyen de 24 ans) dont la flexibilité des muscles ischio-jambiers était réduite (déficit moyen de l'extension du genou 24°), mais qui n'avaient pas d'antécédents de traumatisme majeur ou de pathologie sous-jacente, ont reçu une TTRP réelle ou fictive appliquée aux muscles ischio-jambiers des membres droit et gauche. La flexibilité des muscles ischio-jambiers a été évaluée avant et après chaque séance en mesurant l'angle poplité durant l'extension active maximale du genou effectuée en position assise. Un évaluateur qui travaillait à l'insu a mesuré les angles poplités sur des photographies numériques au moyen d'un rapporteur standard.

Résultats: On n'a noté aucune différence statistiquement significative entre les techniques de traitement réelles et fictives en ce qui concerne la modification de l'angle poplité pour le membre droit (différence moyenne 0.1°; IC à 95%: –1.5–1.6°) et le membre gauche (différence moyenne 0.2°; IC à 95%: –1.5–1.9°).

Conclusion: Ces observations indiquent que la TTRP évaluée n'est pas efficace chez les sujets autrement en bonne santé présentant une flexibilité réduite des muscles ischio-jambiers. Des études futures devraient évaluer l'effet de la TTRP chez des sujets ayant des antécédents de traumatisme ou une pathologie définie.

Mots clés: effort-contre-effort, étude randomisée et contrôlée, flexibilité, muscle ischio-jambier, thérapie de relâchement positionnel

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Muscle flexibility can be defined as the ability of a muscle to lengthen, allowing a joint to move through its range of motion.[1] Both the Canadian Physiotherapy Association and the American Physical Therapy Association include improvement of muscle length and joint range of motion within their musculoskeletal physical therapy practice patterns.[2,3] Because of the potential impact of decreased hamstring flexibility on posture, muscle performance, and injuries, improving hamstring flexibility is not only of clinical importance but has also been the goal of a number of clinical studies.[4-17] Numerous interventions for decreased hamstring flexibility have been investigated, including static[4-7,10-12] and dynamic[5] stretching, proprioceptive neuromuscular facilitation,[13] the neural slump position,[15] and application of heat and cold.[14]

Positional release therapy (PRT), originally termed strain counterstrain, is an osteopathic manual therapy technique proposed to increase muscle flexibility by placing the muscle in a shortened position to promote muscle relaxation, in contrast to placing the muscle in a lengthened or stretched position.[18-23] The technique involves positioning the restricted joints and muscles in the direction opposite to that of stretch or strain (ie, the "position of ease or comfort") for a period of at least 90 seconds. PRT has been suggested for use in the treatment of "any tissue implicated in the pathophysiology of somatic joint dysfunction."[20]

Although specific courses in PRT are available, no formalized training is required to perform these techniques, which are described in a number of texts.[20-22] Described as a gentle, passive technique, PRT has been proposed for resolving dysfunction in chronic, subacute, and acute conditions. Additionally, there are no client age restrictions for the use of these techniques.

The neurophysiologic rationale underlying PRT is based on the premise that alterations in afferent neurons affect somatic joint dysfunction.[20-22] Restricted movement is theorized to be due to hyperactivity of the myotatic reflex arc, which is caused by excessive gamma gain.[20-22] Some PRT proponents have suggested that a muscle becomes hyperactive or hypertonic with repetitive use or after trauma to protect itself from injury.[20-22] By positioning the patient's muscles in the position of ease (comfort) for a short period of time (approximately 90 seconds), Giammatteo and Weiselfish-Giammatteo theorized that the gamma gain decreases, thereby allowing the hyperactive reflex arc to return to its original state and range of motion to increase.[21]

In spite of its popularity as a manual therapy technique, we are unaware of any published studies evaluating the effectiveness of PRT techniques. Therefore, the overall purpose of the present study was to investigate the effect of a PRT technique designed to increase hamstring flexibility. The specific objective was to compare the change in active knee extension following a true or a sham PRT technique.

METHODS

Subjects

Seventeen male and 16 female subjects participated in the study (Table 1). To be eligible, subjects had to lack at least 10° of active knee extension in each of their lower limbs (full knee extension was defined as 180°). The mean deficit in knee extension (average of both limbs) before treatment was 24° (95% CI: 21-27°). None of the subjects reported any current knee, hip, lumbar spine, or sacroiliac impairments or previous major trauma to these joints. Furthermore, there were no reports of skin disease or peripheral vascular disease, major neurologic conditions (such as cerebral vascular accident), or pain with active or passive hip, knee, or back movements. No subject had enough knowledge of PRT techniques to enable them to differentiate between the true and the sham conditions used in the present study. Ethics approval was obtained from the institution's review board for health sciences research involving human subjects, and all subjects provided written informed consent prior to testing.

Procedures

We used a crossover design with random assignment that enabled each limb to be treated with each of the two treatment techniques. There was a washout period of 1 week between treatment sessions. At the first treatment session, one lower limb was treated with the true PRT technique and the other limb was treated with a sham PRT technique. At the second treatment session, 1 week later, the technique performed on each limb was reversed. The order of technique and limb was randomly allocated during the first visit, after determination of eligibility. Treatments and testing were performed in adjoining, but separate, rooms. One investigator (the treating therapist) provided all treatments, and a different investigator (the testing therapist) completed all hamstring flexibility (popliteal angle) testing. The testing therapist and the subjects were blinded to the treatment technique being performed.

We operationally defined an improvement in hamstring flexibility as an increase in active knee extension, quantified as a change in popliteal angle. The popliteal angle was assessed immediately before and after each technique, using an active knee extension test to measure

Table 1 Subject Characteristics (mean ± SD)

Characteristic	*Males (n = 17)*	*Females (n = 16)*	*Group (N = 33)*
Age (yr)	24 ± 4	24 ± 2	24 ± 2
Mass (kg)	74 ± 12	60 ± 6	67 ± 12
Height (m)	1.79 ± 0.05	1.66 ± 0.02	1.72 ± 0.09

hamstring flexibility.[4,6,14,15] For each test, the testing therapist recorded maximal active knee extension using a digital camera (Nikon E990 V1.0, Nikon Corp., Tokyo, Japan) and subsequently measured the popliteal angle on a photograph (22 × 28 cm) using a standard protractor. DePino and colleagues reported an intraclass correlation coefficient (ICC)(2,1) of 0.96 to describe the reliability of goniometric measures obtained using a similar method, repeated on two occasions by a single rater.[6] We are unaware of any reliability studies evaluating the present method.

Subjects were tested and treated while wearing gym shorts and in their bare feet. Testing began by aligning the tripod-mounted digital camera on marked points on the floor to ensure that the camera was maintained at the same distance (142 cm) from the subject. The camera was kept level, determined using a bubble level, and the long axis of the camera lens was positioned perpendicular to the subject's sagittal plane. Subjects were seated on an isokinetic dynamometer chair (Kin-Com 500H, Chattecx Corp., Chattanooga, TN) with the test limb initially resting at approximately 90° of knee flexion (Figure 1). They were then asked to raise their shorts on the test side so that circular red dots (0.75 cm diameter) could be placed on the skin over the greater trochanters, lateral femoral epicondyles, and lateral malleoli by the testing therapist. A piece of low-density open cell foam (10 × 20 cm) was placed under the thigh on the test side to produce a horizontal orientation of the long axis of the thigh (greater trochanter to lateral femoral epicondyle). The back of the dynamometer chair was then placed against the subject's back, and a lap belt was applied and tightened maximally to stabilize the pelvis. The subject's thigh was then stabilized using a padded thigh belt. A cylindric piece of dense closed cell foam was placed between the subject's lumbar spine and the chair back to help maintain a consistent amount of lumbar lordosis. The angle of the hip was then verified to be 90° using a fixed metal goniometer.

A wooden right angle triangle was placed in the photograph's frame along with a wipe board, which identified the photograph's order in the sequence. The subject and camera positions were then checked, and the subject was asked to straighten the knee to maximal active knee extension (see Figure 1). The subject's limb was maintained in the extended position for about 5 seconds, and a picture was then taken with the digital camera. The subject then relaxed the limb and returned it to the starting position. Identical knee extension and picture sequences were then repeated twice more at 30-second intervals, producing three pictures. After the baseline pictures were recorded (pretreatment angles), the subject was unstrapped and was asked to go into the adjacent room approximately 5 m away to receive the assigned treatment technique from the treating therapist. Once the treatment was complete, another set of three pictures was taken using the previously described procedure (post-treatment angles). The testing equipment was then repositioned to test the opposite limb, and the entire sequence of pre- and post-treatment testing was repeated for the opposite limb using the other treatment technique.

Treatments

After entering the treatment room, subjects positioned themselves supine lying on a standard wooden plinth. All

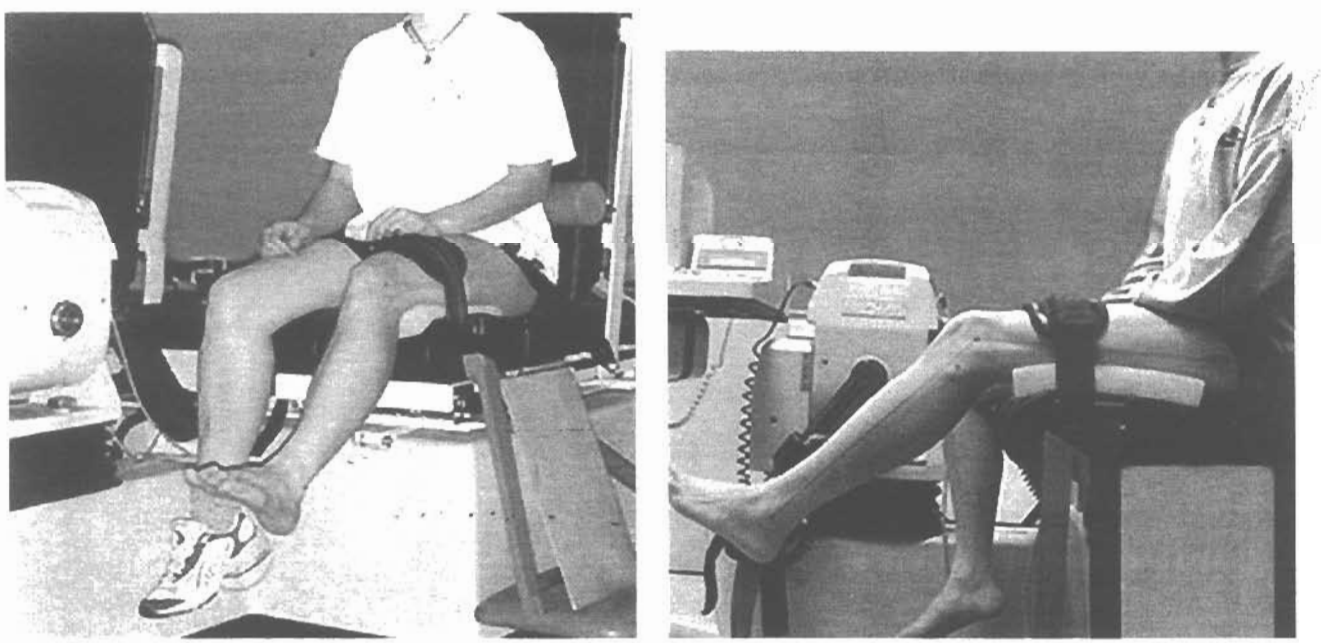

Figure 1 Subjects completing the active knee extension test.

subjects attained full knee extension in this position, confirming that the hamstrings, rather than an inert knee joint structure, caused the limitation in knee extension observed in sitting. The windows of the treatment room were covered with white paper, and the door was closed to blind the testing therapist to the treatment being performed. The subjects were not told which treatment they would be receiving. They were simply asked to relax and were told that their limb would be placed in a position for 90 seconds by the treating therapist.

PRT Technique

The subject's limb was passively moved into the assigned true PRT treatment position as described by D'Ambrogio and Roth.[20] This particular technique was chosen because of its clear description with step-by-step instructions and accompanying illustration, the suggested ease of performing the technique, and our frequent clinical observation of decreased hamstring flexibility. The subject's thigh was extended and abducted off the edge of the plinth slightly, and then the knee was flexed passively to 40°, measured using a preset goniometer that was aligned using the markers on the limb. The limb was then slightly adducted (varus force), and the tibia was internally rotated (Figure 2). This position was held for exactly 90 seconds and was measured using a standard watch timer, and then the limb was returned to the resting position. Following this true treatment technique, the subject walked to the isokinetic dynamometer chair in the testing room to have the treated limb retested.

Sham Technique

The sham PRT technique involved lifting the subject's limb passively into a straight leg raise position until the lower limb musculature was just off the plinth surface (approximately 10° of hip flexion). The treating therapist lifted the limb, using hand positions under the thigh and ankle, and maintained this position for 90 seconds (see Figure 2). Following this sham treatment technique, the subject walked to the isokinetic dynamometer chair in the testing room to have the treated limb retested.

Photographic Analysis

Using *Adobe Photoshop 5.0 Limited Edition* (Adobe Systems Limited, San Jose, CA), the brightness levels were automatically adjusted, the picture size was adjusted to 15.24 × 20.32 cm, and the picture was enlarged to a magnification of 66.7%. The line tool was then used to connect the landmark dots between the greater trochanter and the lateral femoral epicondyle and between the lateral femoral condyle and the lateral malleolus. The picture was then saved under a different file name and was printed in black and white on standard 22 × 28 cm paper. The testing therapist then used a standard protractor to measure the popliteal angle of each picture to the nearest degree and recorded the value on the picture and in the subject's file.

Data Analysis

The change in hamstring flexibility was determined by measuring the pre- and post-treatment popliteal angles. The dependent variable was the change in the popliteal angle, calculated as the mean of three angles observed post-treatment minus the mean of three angles observed pre-treatment. Change scores for the true and sham PRT techniques were compared using a nondirectional paired *t*-test for the right and left limbs. The .05 level was used to denote statistical significance.

The test–retest reliability of the testing procedure was also evaluated using the sham pre- and post-treatment popliteal angles (mean of three repetitions) for the left

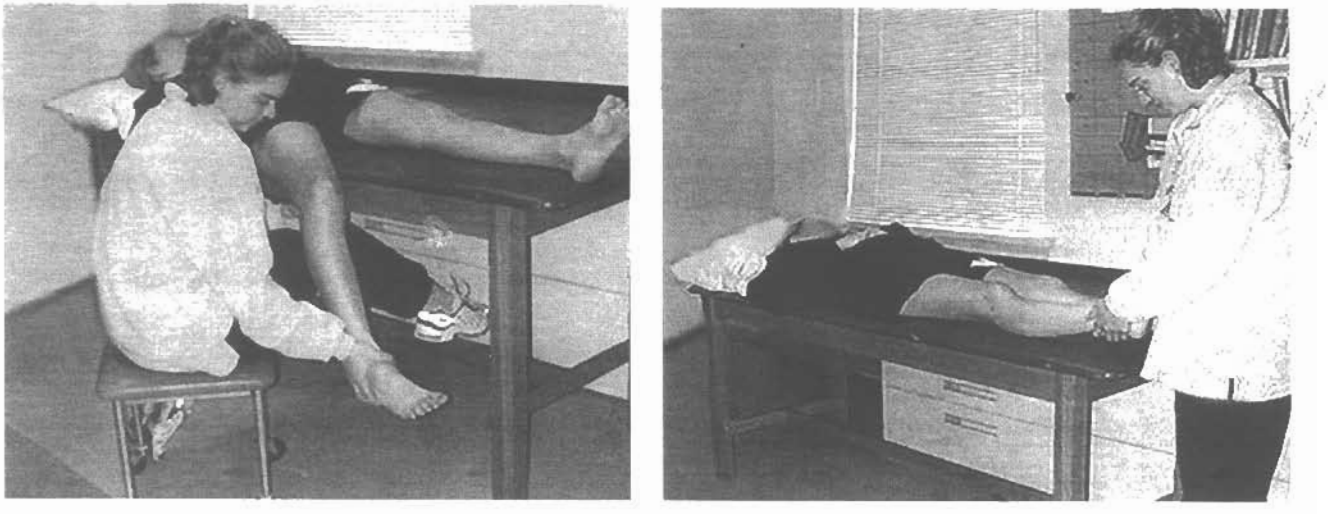

Figure 2 Testing therapist administering the true (left) and sham (right) treatment techniques.

Table 2 Mean (95% CI) for Pretreatment, Post-treatment, and Change in Popliteal Angles for Sham and True PRT Techniques on the Right and Left Limbs (in degrees)

Technique	*Pretreatment*	*Post-treatment*	*Change**
Right sham	156.7 (153.4–160.0)	157.2 (153.8–160.6)	0.5 (−0.8–1.8)
Right true	156.1 (152.5–159.8)	156.6 (153.3–159.8)	0.4 (−0.4–1.2)
Left sham	155.2 (152.1–158.4)	156.4 (153.1–159.7)	1.2 (−0.1–2.4)
Left true	155.9 (152.1–159.8)	156.9 (153.3–160.5)	1.0 (−0.2–2.1)

PRT = positional release therapy.

*Change = post-treatment minus pretreatment popliteal angle.

and right limbs. ICCs (3,1) were calculated to assess the relative reliability of repeated measurements obtained from the same rater.[24] All analyses were performed using the *Statistical Package for the Social Sciences (SPSS for Windows, Release 10,* SPSS Inc, Chicago, IL).

RESULTS

The pretreatment, post-treatment, and change in popliteal angles for the true and sham PRT techniques are displayed in Table 2. The mean difference in change scores between the two techniques was 0.1° (95% CI: −1.5–1.6°) for the right limb and 0.2° (95% CI: −1.5–1.9°) for the left limb. No statistically significant differences were observed between true and sham PRT techniques for the right (t = 0.11, df = 32, p = .92) and left (t = 0.74, df = 32, p = .81) limbs.

Test–retest reliability of the testing method was excellent. ICCs were 0.97 (95% CI: 0.94–0.99) and 0.95 (95% CI: 0.91–0.98) for the right and left limbs, respectively.

DISCUSSION

Our results indicated that the PRT technique was not effective in improving hamstring flexibility. The observed changes in popliteal angles following both the PRT and sham treatments were very small, and the post-treatment values were not significantly different from pretreatment values (95% CIs for the change included the value 0; Table 2). Based on a comparison of means in a paired situation, a two-sided α set at 0.05, the present sample size of 33, and the standard deviation of the measured change scores (±4°), a post hoc analysis indicated that this study had 80% power to detect a significant difference between pre- and post-treatment scores as small as 2°.[25] Therefore, we are confident that if any true differences existed, they were very small and not likely to be clinically important.

To be consistent with previous studies that have reported positive results for other interventions,[1–7,10–15] we evaluated subjects who had decreased knee extension but without a history of knee pathology or major trauma. To be included in these studies, subjects had to have a finger-to-ground distance of greater than 0 when bending forward to touch the floor[10–12] or at least a 15°,[15] 20°,[6,7,13] or 30°[4,5] deficit in active knee extension. Although we used a slightly less stringent operational definition of decreased hamstring flexibility than in some of these studies, the observed deficit in our subjects before treatment was similar (mean deficit 24°, 95% CI: 21–27°). For example, Taylor and colleagues reported that a single static hamstring stretch held for 1 minute during one treatment session significantly increased range of motion by an average of 16% in healthy subjects (n = 24) who had a mean deficit in active knee extension of 26°.[14]

The strengths of the present study include its design and high degree of experimental control. Because the design enabled within-subject comparisons of the true and sham interventions in both limbs, it provided increased statistical power and controlled for potential effects of treatment order and limb dominance. Both the subject and the tester were blinded to the treatments, and the treatments were administered by a different therapist in accordance with standardized instructions.[20] Treatment sessions were scheduled to be 1 week apart to limit potential carry-over effects and were performed at approximately the same time of day. During testing, all subjects were given identical instructions when asked to straighten their leg to maximize consistency in subject effort, and the reliability of the measurement technique was excellent. Finally, the subjects were screened to increase the likelihood that they had sufficiently decreased knee extension to allow for a possible treatment effect.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Although control over experimental conditions is particularly important for initial investigations of new or unproven interventions, the ability to generalize findings beyond the experimental situation is also important.[26] For example, proponents of PRT suggest that some individuals may require "fine tuning" of the treatment position, based on palpation of tender points, and may require treatment times greater than 90 seconds.[20] Providing therapists with the opportunity to alter the PRT treatment technique on an individual patient basis, apply the technique for prolonged periods of time and over multiple treatment sessions, or combine different treatment strategies may yield different findings. Similarly, D'Ambrogio and Roth suggested that PRT is more effective and can decrease pain in patients who have clear, traumatic

mechanisms of injury.[20] Therefore, future investigations involving patients with pain following traumatic injuries should be conducted.

PRT is proposed to affect both the medial and lateral hamstrings (ie, both are put into a shortened position). However, the technique used in the present study required that internal rotation of the tibia should be added to achieve the optimal treatment position for the medial hamstrings, whereas either internal or external rotation of the tibia may be optimal for the lateral hamstrings.[20] Therefore, it is possible that the technique used was less effective for subjects who might have had decreased flexibility confined to the lateral hamstrings and required the addition of external rather than internal rotation of the tibia to achieve the optimal treatment position.

CONCLUSION

These findings suggest that the PRT technique to increase knee extension is not effective in healthy subjects who have decreased hamstring flexibility. Future studies should evaluate the effect of PRT techniques in subjects with a clear history of knee or hamstring trauma or other defined musculoskeletal pathology.

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