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MANUAL MODALITY

The effects of the Bowen technique on hamstring flexibility over time: A randomised controlled trial

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Summary The hamstring muscles are regularly implicated in recurrent injuries, movement dysfunction and low back pain. Links between limited flexibility and development of neuromusculoskeletal symptoms are frequently reported. The Bowen Technique is used to treat many conditions including lack of flexibility. The study set out to investigate the effect of the Bowen Technique on hamstring flexibility over time.

An assessor-blind, prospective, randomised controlled trial was performed on 120 asymptomatic volunteers. Participants were randomly allocated into a control group or Bowen group. Three flexibility measurements occurred over one week, using an active knee extension test. The intervention group received a single Bowen treatment. A repeated measures univariate analysis of variance, across both groups for the three time periods, revealed significant within-subject and between-subject differences for the Bowen group. Continuing increases in flexibility levels were observed over one week. No significant change over time was noted for the control group.

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Introduction

The hamstring muscles are commonly linked with movement dysfunction at the lumbar spine, pelvis and lower limbs, and have been coupled with low back pain and gait abnormality (Mok et al., 2004; Orchard et al., 2004; Vleeming and Stoeckart, 2007). Hamstring strains are regularly cited as a sport-related injury (Dadebo et al., 2005; Hoskins and Pollard, 2005), with high risk of recurrence and lengthy recovery times (Gabbe et al., 2005; Sole et al., 2008). Development of pathology and movement dysfunction have been attributed to many intrinsic and extrinsic factors (Alter, 2004). Such factors include: flexibility, strength, stability, timing, endurance, previous injuries, psychosocial aspects, equipment and environmental conditions. Limited flexibility has often been associated with neuromusculoskeletal symptoms (Spernoga et al., 2001; Witvrouw et al., 2004), providing a continual drive to investigate more effective treatment options.

The Bowen technique

The Bowen technique is named after Tom Bowen (1916–1982), who created a form of bodywork in Geelong, Australia. Described as a soft tissue remedial therapy, the therapist uses fingers or thumbs to apply pain-free, gentle rolling moves over muscle, ligament, tendon and other connective tissues in specific parts of the body (Baker, 2009). Each treatment programme is personalised and determined following assessment. Reports following treatment have included improvements in; pain, range of motion (ROM), oedema, heart rate, respiration, injury rates and functional recovery (Whittaker et al., 1997; Kinnear and Baker, 1999; Carter, 2002; Esson and Godfrey, 2002; Rattray, 2002; Rattray and Godfrey, 2002; Baker, 2008; Godfrey, 2008; James, 2008). Despite a growing body of evidence, there is a paucity of quantitative research to support such claims.

Literature review

The topic of flexibility is frequently debated in the literature. The need for the human body to alter flexibility variables to optimise muscular performance and prevent injury remains undisputed (Nigg et al., 2000; Witvrouw et al., 2004). The complex nature of these multi-tissue events to allow changes in length-tension relationships also remains unchallenged. Yet, the importance of interactions between the so-called 'active' components, (musculotendinous unit and nervous system), and 'passive' components (connective tissues) remains unclear, and has prevented consensus over a single definition of flexibility (Shrier, 1999; Alter, 2004; Dadebo et al., 2005). As a result, the many definitions that do exist have tended to focus on the following themes (Alter, 2004): the motion available actively and passively (Halvorson, 1989; Saal, 1987), the fluidity or freedom to move without pain (Kisner and Colby, 2007), the speed and purpose of movement (Galley and Forster, 1987) and, the extensibility of soft tissues rather than joint ROM (Halbertsma et al., 1996). To date, there is no quantification of what 'normal' or desirable levels of flexibility are. For the purposes of the present study, Kisner and Colby's (2007, p. 66) definition was accepted: '*Flexibility is the ability to move a single joint or series of joints smoothly and easily through an unrestricted, pain-free ROM. Muscle length in conjunction with joint integrity and the extensibility of periarticular soft tissues determine flexibility*'.

Flexibility: 'active' and 'passive' components

The components that affect flexibility have tended to fall into two categories: 'active' and 'passive'. In previous years, the focus has been on the 'active' musculotendinous unit (MTU) and neural structures, with regard to ROM, performance, timing and injury, rather than on the connective tissues, which have been considered more of a 'passive' contributor to changes in ROM (Alter, 2004). The role played by the many types of connective tissue in the control, mechanics and support of movement is the subject of much research and debate (Guimberteau, 2005; Findley and Schleip, 2007, www.fasciacongress.org/2009).

Fascia (loose areolar tissue), the most abundant connective tissue, that surrounds and supports all tissues, has been classified into 'superficial' and 'deep' layers (Hedley, 2005a–c). The integral nature of its relationship with the skin begs the question that any form of manual therapy, or penetration beneath the skin, must have an effect upon these layers, even if the intention is to target the deeper structures linked to viscera, muscle and bone. Langevin et al. (2002) examined the involvement of fascia during acupuncture, using high frequency ultrasound on rat abdominal tissue. The study concluded that the winding of fascia around the needle was indeed the mechanism responsible for the needle grasp effect, rather than contraction of muscle. Furthermore, the cellular and molecular effects of the mechanical signals through this interface have been shown to be widespread, varying from cell contraction to signal transduction to gene expression (Langevin et al., 2002). Fascia has been reported to have the following functions: (1) it provides a 3D framework for all tissues promoting alignment and stability (DeRosa and Porterfield, 2007), (2) it can respond to change in tension levels by transmission of signals to other interfaces (Langevin, 2006; Stecco et al., 2009), termed 'mechanotransduction', and (3) it provides the necessary lubricant between tissue interfaces to enable movement (Alter, 2004). Research by Hinz and Gabbiani (2007), Schleip et al. (2006, 2007), Petroll (2008) and Thomasek et al. (2002) have reported a fourth function, that fascia is capable of generating its own mechanical tension through the contraction of smooth muscle cells within its matrix. Researchers were able to produce in-vivo fascial contractions, measuring sufficient mechanical tension to potentially influence the dynamics of the human musculoskeletal system (Schleip et al., 2007).

Treatment for limited flexibility

For decades, stretching, with or without warm-up, has been the most advocated conventional treatment for improving or maintaining flexibility levels (Murphy, 1991; Shrier, 1999). Pre-exercise stretching has been reported to help reduce risk of injury and improve muscle performance (Safran et al., 1989; Best, 1995). Contrasting reports have also stated that static stretching may increase the risk of injury through desensitisation of the stretch reflex (Shyne and Dominguez, 1982; Saal, 1987; Murphy, 1991; Gleim and McHugh, 1997) with subsequent reduction in muscle strength and torque. Dynamic stretching has also been reported to improve muscle efficiency and reduce injury by using specific functional movement sequences as a training tool (Tollison, 2009). Yet studies into dynamic stretching have demonstrated both increase and decrease in post stretch ROM (Alter, 2004; O'Sullivan et al., 2009). Due to a multitude of opposing findings and a lack of recent, homogeneous research or reviews since Weldon & Hill's study in 2003, it is difficult to draw definitive conclusions on the topic of stretching.

The Bowen technique is also implicated where movement range is restricted (Kinnear and Baker, 1999; Carter, 2002; Baker, 2005) reporting post-treatment changes in ROM in the absence of stretching, joint mobilisation, or warm-up procedures (Kinnear and Baker, 1999; Carter, 2002; Baker, 2005). Therefore, the aim of the present study was to investigate the effect of the Bowen Technique on hamstring flexibility over time.

Method

Design

A prospective, assessor-blind, randomised controlled trial investigated the effects of the Bowen technique on hamstring flexibility. Data were collected over one week using a repeated measures design.

Sample

One hundred and twenty asymptomatic non-professional athletes, were recruited following advertisements in sports centres in Warwickshire. A sample size calculation was based on previous work by Feland and Marin (2004), who recorded hamstring flexibility changes using an experimental and control group. Based on their between-subject standard deviation of 6.58 degrees (experimental condition), a power analysis for the current study calculated that a total of 100 subjects (50 per group) would enable a difference in hamstring flexibility (as measured by knee ROM) of 6.5 degrees (effect size 0.63) to be detected at a 5% significance level with 80% power (Altman, 1982). Accounting for an attrition rate of 20% (Altman, 1991; Cohen, 1992), the number of subjects required was 63 per group. A third-party randomisation method was selected, where treatment allocation excluded the author, practitioner and assessor, and was entrusted to an independent individual. Microsoft Excel's Analysis Tool Package™ was used to randomly allocate 120 subjects into two equal sample sizes (Bowen and Control). In this way, the process of randomisation was unbiased and concealed (Bland and Altman, 1994). Subjects were included provided they partook in a minimum of one 30-min cardiovascular, strengthening or flexibility conditioning programme per week and were aged between 18 and 50 years. A deficit of at least 15 degrees from full knee extension was required at baseline, determined after randomisation. Individuals were excluded if current or previous symptoms or pathology were reported in the lower limbs, pelvis or the lumbar spine. Those who performed sport at a professional or semi-professional level were also excluded.

Ethical considerations

The Research Ethics Committee at Coventry University granted ethical approval for the study. Participants received a detailed information sheet, verbal explanation of the study intentions and a consent form. All concerned were aware of the right to withdraw from the study at any time.

Reliability

An intra-tester reliability study was performed, due to the removal and replacement of the electrogoniometer on each participant's leg. Ten subjects lay supine on a plinth. Markers and use of equipment proceeded as per the data collection section. Subject's placed the dominant leg in a random level of knee flexion, remaining supported and unmoved in this position. With the measured angle concealed, the equipment was removed, recalibrated and replaced. The results were tested for stability using an Intraclass Correlation Coefficient (2,1) (Sim and Wright, 2000, p. 335) revealing that intra-tester equipment replacement was reliable ($r = 0.99$). This result has also been confirmed by Rothstein et al. (1983) and Gogia et al. (1987) where $r = 0.91–0.99$ during tests. The reliability of the active knee extension test has been confirmed by Gajdosik and Lusin (1983).

Interventions

Each subject, wearing loose shorts, had three flexibility measurements taken from the hamstring muscles of the dominant leg over seven days. Dominance was defined as the preferred leg to kick a football. The independent assessor, blind to group allocation and interventions received, performed all measurements, but was not involved in either intervention procedure. Measurements were collected at baseline, post-intervention and at a one-week follow-up. An active knee extension (AKE) test was chosen following a report that dynamic flexibility measurements are the most valid indicators of functional MTU activity (Hunter and Spriggs, 2000), with movement restricted at the lumbar spine and pelvis. A Bowen treatment lasted a mean of 20 minutes. Retesting of the control group therefore occurred 20 minutes after baseline. Between measurements, the control group rested in supine. The final flexibility measurement was collected one week later, within one hour of the original measurement time, to minimise the effects of diurnal variations. An accredited Bowen practitioner, with 17 years of experience, performed the same treatment routine on all subjects in the Bowen group. Each subject received a single treatment of the following documented Bowen treatment techniques, as shown in Baker (2005), receiving bilateral

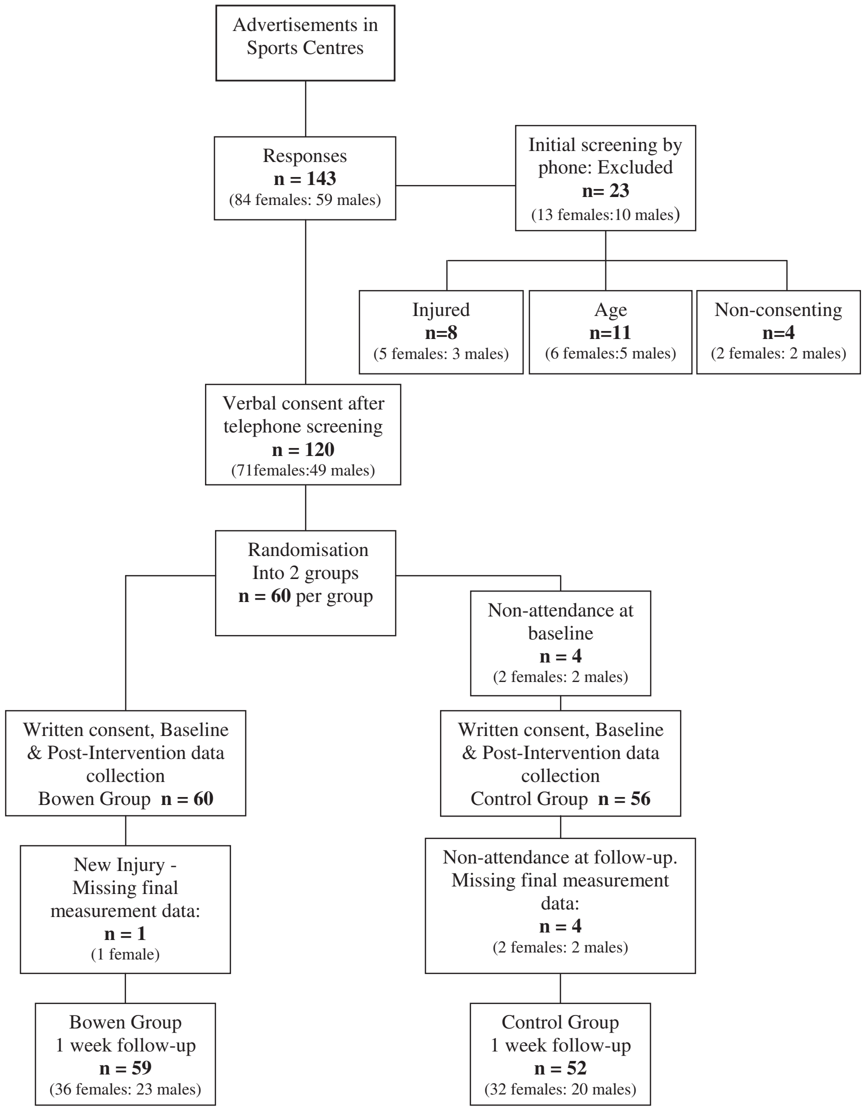

Fig. 1 Flow chart of participant recruitment and allocation.

rolling moves over; segments of the erector spinae from the lumbar towards the cervical spine, latissimus dorsi, the gluteals, the hamstring muscles proximally and distally, tensor fasciae latae (TFL) and a medial hip adductor move. Techniques correspond to Bowen techniques pages 1—3, hamstring technique and medical adductor move as part of the pelvic technique (Baker, 2005).

Post-intervention

Subjects were asked to continue their normal weekly exercise or activity routine. Participants were encouraged to maintain the permanent pen marks on the skin until the final measurement.

Data collection procedures

Each subject lay supine, with the head in neutral on a single pillow. Using the dominant leg, a permanent ink pen marked a point 2 cm superior to the lateral femoral condyle in line with the greater trochanter, and also over the midpoint of the head of the fibula in line with the lateral malleolus. Each edge nearest to the spring on a Biometrics™ flexible electrogonimeter (model no: SG150, serial no: B16421703, Gwent, UK) was placed directly over the skin marks, using non-allergic, double-sided skin tape. The electrogoniometer was attached to a Biometrics angle display unit (model no. ADU301, serial no. M01048/5198, Gwent, UK). The pelvis was secured across the iliac crests using a non-slip adjustable nylon strap with the pelvis in posterior tilt. The non-dominant limb was also secured across the thigh with an additional strap. The fulcrum of a 30 cm goniometer was placed over the greater trochanter and the arms were lined up along the mid-axillary and the lateral femoral condylar lines respectively, placing the hip in 90 degrees of active flexion. A removable wooden bench acted as a reference point and was secured by a non-slip strap to prevent movement. The foot and ankle rested in neutral, following reports of statistically significant differences in straight-leg-raise measurements with the foot in dorsiflexion (Gajdosik et al., 1985). The participant extended their dominant leg, once, until the first feeling of mild tension or pulling was felt in the back of the thigh. Participants were informed that the technique should be free of pain and discomfort and to avoid the induction of a stretch reflex (clonus) (Fig. 3) by over extending. All participants received the same verbal instructions. The knee maintained contact with the bench throughout the procedure. The independent assessor also ensured that any pressure from the extending limb did not move the bench. A single AKE movement was recorded, per measurement, rather than a mean of several measurements to avoid changes due to repeated mobilisations (Atha and Wheatley, 1976). During the final flexibility measurement all marked points were rechecked against the original bony landmarks to optimise accuracy of equipment replacement.

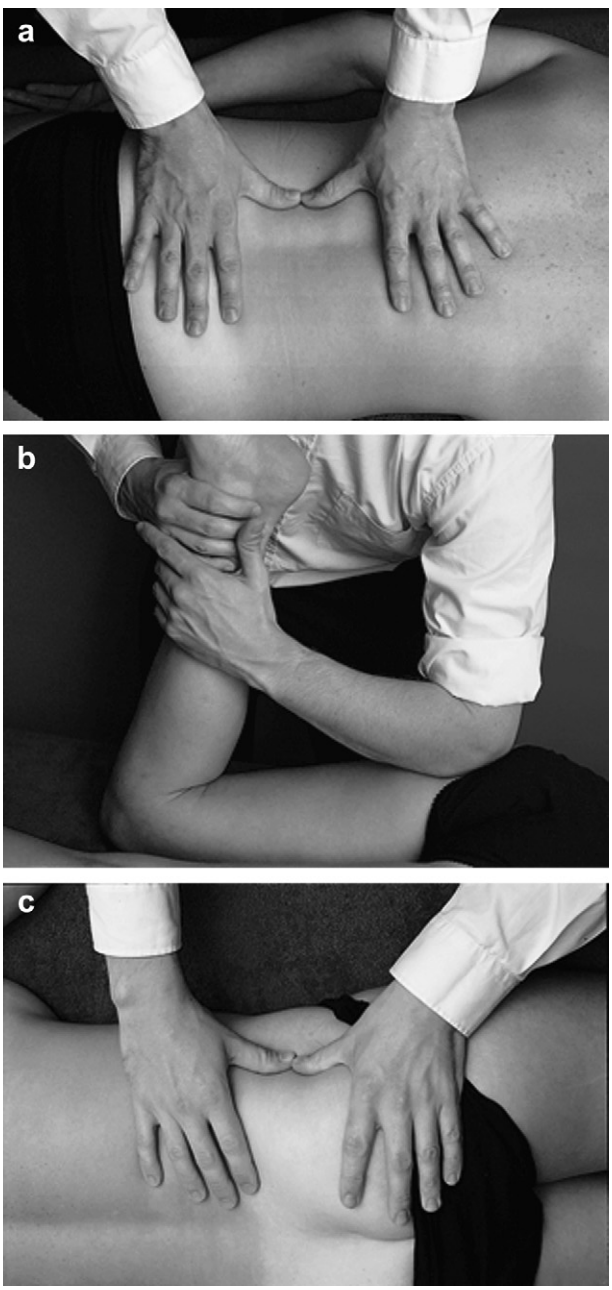

Fig. 2 (a—c) Photographs of a selection of Bowen treatment techniques.

Data analysis

The outcome measure for this study was hamstring flexibility, determined by AKE, and recorded as the angle of knee flexion (i.e. lack of full extension, measured in degrees). Testing of the null hypothesis was performed using descriptive(Fig. 2) and inferential statistical analyses (Tables 1—3). Descriptive analyses included measures of central tendency and variation (mean, standard deviation, min—max and confidence intervals) and were further illustrated using box-plots and profile plots of the two groups over the three time periods. All statistical analyses were conducted using SPSS (2006, version 15). A general linear model repeated measures univariate analysis was utilised, with group (Bowen Technique vs Control) and time (baseline, post-intervention and one week follow-up), as factors for analysis, at a significance level of 5%. Multiple-imputation analyses (nine imputations) were performed on the nine incomplete data sets to evaluate the impact of missing data.

Results

Descriptive analysis

Table 1 illustrates the anthropometric characteristics of the participants, taken at baseline. Table 2 shows the measurements of hamstring flexibility for both groups across the three time periods and these are also illustrated in Figs. 4 and 5.

A repeated measures univariate analysis of variance (using a General Linear Model) was conducted to compare and contrast within and between-subject differences in hamstring flexibility across the two groups, and across the three time periods (see Table 3).

Within-subject significant differences were revealed within the Bowen group in the baseline to post-intervention period ($p = 0.0005$), and in the baseline to follow-up time period ($p = 0.0005$), but not in the post-intervention to follow-up time period ($p = 0.36$). Between-subject significant differences were also observed in the Bowen group, across time and across groups in the baseline to post-intervention and baseline to follow-up phases ($p = 0.008$ and $p = 0.0005$ respectively). Results showed a pattern of increasing flexibility levels over one week for the Bowen

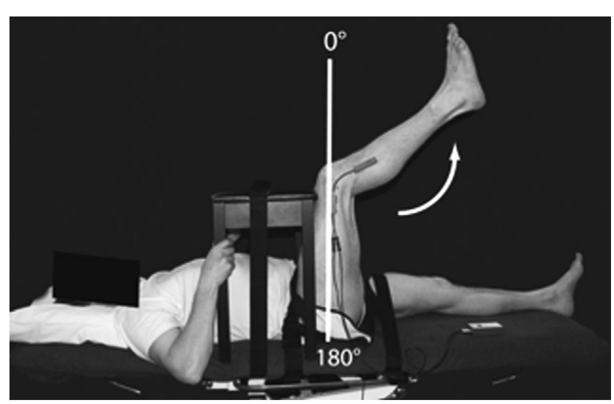

Fig. 3 Photograph of the AKE test.

Table 1 Demographic characteristics of participants after randomisation (*4 missing data sets at baseline due to attrition — the gender of these 4 sets has been imputed)

Characteristics	Intervention group ($n = 60$)		Control group ($n = 56$)	
Gender	62% Female (m/f = 23/37)		61% Female (m/f = 22/34)	
	Mean & SD	Min—Max	Mean & SD	Min—Max
Age (years)	35.2 (9.7)	18—50	33.2 (10.2)	20—50
Height (meters)	1.7 (10.0)	1.5—1.9	1.7 (9.0)	1.5—2.0
Weight (kilograms)	73 (12.9)	50—100	69 (11.2)	51—98

group. There was no significant change across time for the control group either within or between subjects ($p = 0.70$, $p = 0.14$ and $p = 0.051$ respectively, see Table 3).

Multiple-imputation analyses (nine imputations) were performed to evaluate the impact on the results of the nine missing or incomplete data sets on the results, due to attrition or injury. The following variables were imputed; baseline and post-intervention ROMs, gender, age, height and weight. Although the imputed values did result in a change in the p value of the Bowen baseline to post-intervention results (from $p = 0.008$ to $p = 0.0005$, after imputation), these changes did not affect the overall results from the initial analyses (Table 3).

Discussion

A single treatment of the Bowen technique demonstrated immediate significant increases in the flexibility of the hamstring muscles in asymptomatic subjects, both within-subjects ($p = 0.0005$) and between-subjects ($p = 0.008$), maintaining improvements for one week without further treatment ($p = 0.0005$, mean increase of 9.73°). Evidence of previous research showing continual increases in hamstring flexibility over one week, following a single treatment, was not found.

Comparative studies

In 1999, Kinnear and Baker investigated the effect of the Bowen Technique on ROM at the shoulder in 100 patients with shoulder dysfunction and pain. Following a course of three Bowen treatments, shoulder ROM demonstrated significant improvements ($p < 0.05$, mean increase in ROM of 23°) when compared with a placebo group. Whilst these results present evidence to support changes in participants with pathology, Kinnear and Baker's (1999) study did not measure changes over time or use statistical tests to evaluate changes in pain. In 2002, Carter also performed a quantitative study of the effect of five Bowen treatments on 20 patients with "Frozen Shoulder". Reports of improved shoulder mobility and associated function were observed, with 70% of subjects gaining a return in movement equal to their non-affected side. Lack of detail pertaining to methodology, data collection and statistical analysis limits interpretation of this paper.

Hopper et al. (2005) examined the effect of two massage techniques on hamstring muscle length in competitive female hockey players reporting increased hamstring flexibility levels ($p = 0.01$) in both massage groups. These improvements were not maintained after 24 h and used passive flexibility tests without an independent control group.

Spernoga et al. (2001) and de Weijer et al. (2003) also performed single-application stretch programmes on asymptomatic subjects and observed maintained improvements in flexibility for six minutes and twenty-four hours, respectively. Feland and Marin (2004) measured hamstring extensibility in three experimental groups with varying intensity of isometric hamstring contractions against a control group. All contract-relax groups showed significant increases compared with the control. However, there was no significant difference in hamstring flexibility levels between the CR groups, and changes over time were not evaluated. Smith et al (2008) also reported significant increases in hamstring length using two groups of varying length contraction using Muscle Energy Technique (MET). Increases in hamstring flexibility were evident immediately post-test ($p < 0.005$: mean increase of 8.24°), with improvements

Table 2 Hamstring flexibility (as measured by degrees of knee flexion) for Control and Bowen groups across the three time periods.

Group		Time period		
		Baseline ($n = 116$)	Post-intervention ($n = 116$)	One week follow-up ($n = 111$)
Control	Mean	28.46	28.50	27.23
	Standard deviation	9.44	9.61	10.22
	Min—max	15, 46	13, 47	4, 49
	CI's	25.8, 31.1	25.5, 31.1	24.9, 30.0
Bowen	Mean	29.41	21.68	19.39
	Standard deviation	9.46	10.84	8.85
	Min—max	15, 50	0, 43	2, 39
	CI's	26.9, 31.7	19.0, 24.3	17.0, 21.8

Table 3 Differences in Hamstring flexibility (in degrees of knee flexion) within and between control and Bowen groups (across three time periods).

Group		Time period		
		Baseline to post-intervention ($n = 116$)	Post-intervention to follow-up ($n = 116$)	Baseline to follow-up ($n = 111$)
Within Control Group, $n = 56$	Mean	0.02	1.13	1.23
	SD	4.18	4.33	3.92
	CI	−1.7, 1.82	−0.68, 2.94	0.49, 2.95
	P values	0.70	0.14	0.051
Within Bowen Group, $n = 60$	Mean	7.73	2.29	9.73
	SD	8.07	8.06	7.73
	CI	6.04, 9.42	0.59, 3.99	8.41, 11.63
	P values	0.0005*	0.36	0.0005*
Between Control & Bowen groups, $n = 116$	Mean	7.47 (7.91)	1.58 (0.90)	9.73 (8.75)
	SE	1.18 (0.49)	1.19 (0.50)	1.14 (0.48)
(In brackets: Imputed data for $n = 120$ (1200 imputations)	CI	−9.81, −5.13 (−8.88, −6.93)	−3.93, 0.77 (−1.89, 0.08)	−11.34, 6.83 (−9.69, 7.81)
	P values	0.008* (0.0005*)	0.186 (0.072)	0.0005* (0.0005*)

*Statistically significant result and bracketed figures indicate the results of multiple-imputation analyses.

being shown one week later ($p < 0.04$: mean increase of 2.49° from baseline). A control group was not included for comparison, and detail is lacking relating to how a 40% knee flexion isometric contraction was established reliably by each participant. The present Bowen study differs from Smith and Fryer (2008) MET study, because the mean flexibility levels in the Bowen intervention group continued to increase throughout the three recordings over 7 days (mean increase over 1 week = 9.73°).

Study limitations

The hamstrings were the only muscles to be assessed in the current study, but the technique involved treating the paraspinal muscles, latissimus dorsi, gluteals, TFL, hip adductors as well as the hamstrings. Measurements taken can only account for changes in flexibility of the hamstring muscles and did not evaluate movement control characteristics or injury statistics. Therefore, increases in flexibility cannot be correlated with changes in stability, efficiency or strength. The Bowen techniques performed during this RCT also required identical treatment routines with controlled variables, to enable comparison. This differs from usual clinical practice, where a personalised programme of treatment is determined following assessment, and may result in a variety of possible technique combinations or regions treated. It is unknown if the results would have differed if this approach had been adopted. It is also difficult to speculate whether real-life treatment outcomes may have shown further improvements, where individuals often have co-morbid conditions, thereby adding additional variables. The authors accept that tight

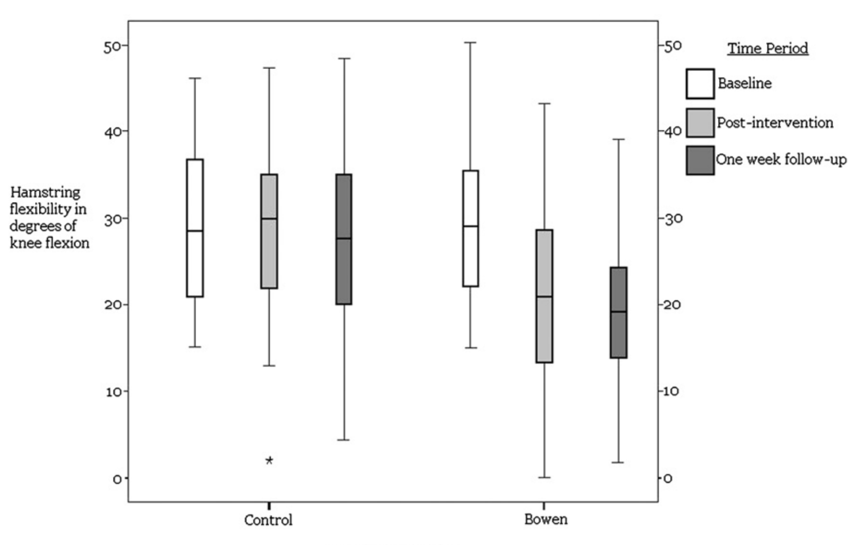

Fig. 4 Box-plots of Hamstring flexibility and Intervention Group (*represents an extreme case).

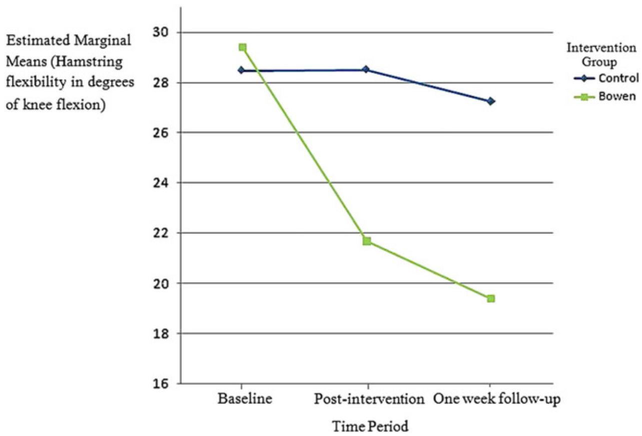

Fig. 5 Profile plots illustrating the changes in estimated marginal means of hamstring flexibility against time for each group.

control of variables may not reflect everyday events and outcomes, yet is necessary to perform an RCT.

A further weakness of the current study relates to a flawed randomisation process. Subjects were randomised into two groups after the phone-call screening phase (see Fig. 1), yet before the final inclusion criterion had been assessed. Baseline hamstring flexibility measurements were the final inclusion criterion, and required a minimum flexibility deficit of at least 15 degrees from full AKE. Following assessment, it was found that all subjects did meet this criterion, therefore no participants were excluded at baseline. However, because of this randomisation process, 4 subjects did not attend between phone-call screening and baseline measurement, resulting in a 3.2% attrition rate prior to data collection. Incomplete data from these 4 subjects ($n = 4$), in addition to the five incomplete data sets due to non-attendance at the follow-up phase ($n = 4$), plus 1 new injury ($n = 1$), resulted in a need for multi-imputation analyses to assess the impact of the nine incomplete data sets. Following imputation, the results showed that there were no changes from the initial analyses.

Clinical implications

Explanations for the changes observed with the Bowen technique have not been well researched. The superficial pressure applied during the technique, yet lack of joint loading, weight bearing, warm-up or stretching, invalidates changes attributable to tissue creep through loading or plastic deformation of tissues. Furthermore, the use of a single repetition AKE test minimised the effect of tissue lengthening due to repetitive tissue mobilisation from the measurement procedure itself. Many of the studies previously discussed have localised interventions specifically to the hamstring muscles. The present Bowen study provided manual stimulation to multiple regions including; the cervical, thoracic and lumbar spine, pelvic attachments; latissimus dorsi, hamstrings, gluteals, hip adductors and TFL. The anatomical linkage through the presence of inter and intramuscular fascial 'slings' and compartments has enabled a deeper, more integrated approach to understanding how manual stimulation or mechanical tension may be transmitted from one region to another (Langevin, 2006; DeRosa and Porterfield, 2007).

> *Muscles are linked to each other through fascial and ligamentous connections...the force of muscle contraction is potentially passed via specialized connective tissues to the skeletal structures and lumbopelvic articulations* (DeRosa and Porterfield, 2007, p. 48)

This view is also supported through cadaveric work by Stecco et al. (2009) who confirmed the '*anatomical continuity*' of integrated attachments between muscles and superficial and deep fascia through specific fascial expansions. Each of 15 cadavers demonstrated a similar pattern of tissue connectivity, being arranged according to directions of movement. These observations, despite being limited through absence of an intact sensorimotor system, also confirm the basis for Myers' (2001) work, in the demonstration of *Myofascial Trains* and Hedley's (2005, vols. 1–3) work on *Integral Anatomy*. All three authors have inferred that these anatomical trains are directly involved in the organisation of movement and transmission of muscular force (Myers, 2001; Hedley, 2005a, b, c; Stecco et al., 2009). The studies cited above contribute towards a more integrated understanding of the occurrence of pain at some distance from its origin, through Travell and Simons' (1992) work on *Myofascial Trigger Points*.

In addition, the role played by the nervous system, both locally and centrally, to control changes in soft tissue length and tension has advanced considerably (Comerford and Mottram, 2001a, b; Nigg, 2001; Langevin et al., 2002). Lee et al. (1999, p. 632) state that the motor and sensory system connections allow reflex fine-tuning by '*facilitating the control of limb stiffness*'. This suggests that changes in stability, or stiffness and tone may have occurred, not only within the MTU, but also within the 'passive' constituents, (the viscoelastic connective tissues), through alteration of reflex pathways (Solomonow et al., 1998; Schleip et al., 2006). The superficial Bowen moves that were applied to each participant in the Bowen intervention group, occurred along the posterior layer of the thoracolumbar fascia (as described by DeRosa and Porterfield, 2007), and included manual stimulation of the fascial linkage of the latissimus dorsi to the gluteus maximus. This was followed by stimulation of the hamstring and adductor muscles, with proven anatomical continuity through to the gluteus maximus and into the lumbopelvic slings (DeRosa and Porterfield, 2007). In other words, the Bowen treatment received, provided a planned direction of manual stimulation throughout the extensors of the spine, trunk and lower limbs. It is therefore suggested, based on the growing body of literature relating to myofascial continuity (Myers, 2001; Hedley, 2005, vols. 1–3; Langevin, 2006; Schleip et al., 2006, 2007; Stecco et al., 2009; Vleeming and Stoeckart, 2007), combined with literature on neural modulation, that these are the most plausible explanations for the changes observed within the present study.

Summary and conclusion

A unanimous view exists that the body needs the ability to alter flexibility variables to optimise task performance, ROM, timing, stability and therefore prevention of injury. Flexibility is a phenomenon consisting of complex, multi-tissue interactions that permit length-tension changes. As a result of the findings of the present study, it can be concluded that a single treatment of the Bowen Technique significantly increases the flexibility of the hamstring muscles in asymptomatic individuals and maintains this level of increase for one week, demonstrating continuing improvements. Further research is required into the effects of the Bowen Technique on injury statistics, motor control characteristics and into the mechanisms that detect and respond to manual therapy in healthy and pathological tissues.

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