# INCREASES IN JOINT RANGE OF MOTION WITH THE BODYWALLTM SYSTEM

**Patria A. Hume, Simon Pearson, and Chris Whatman**
**New Zealand Institute of Sport and Recreation Research, Division of Sport and Recreation, Auckland University of Technology, New Zealand**

Flexibility has important implications in terms of sporting performance, health and fitness, and general movement function. The BodywallTM is a new training tool developed to help improve joint range of motion. This study aimed to determine the effectiveness of the BodywallTM system in improving joint range of motion. Forty-five subjects from the general active population were assigned to one of three groups (BodywallTM stretching; control stretching; no stretching) and measured for joint range of motion before and after a six-week intervention period. The two stretching groups both produced significant increases in joint range of motion, with the BodywallTM group showing greater improvement. No changes in range of motion were seen in the non-stretching group.

**KEY WORDS:** range of motion, BodywallTM, stretch.

**INTRODUCTION:** The range of motion (ROM) around a joint (Prentice, 1983) can be referred to as either static or dynamic flexibility. Static flexibility is the degree to which a joint can be passively moved to its end point of range of motion and dynamic flexibility is the joints ease of movement through its ROM (Blum & Beaudoin, 2000). Angular measurements of limits of joints motion are usually used to determine static flexibility, whereas dynamic flexibility is examined by measures of muscle stiffness (Knudson, 1999). Muscle stiffness is defined as the force required to produce a given change in length (Shrier & Gossal, 2000).
Improving flexibility is an important goal in the training and rehabilitation of athletes, as increases in flexibility are thought to help prevent injuries (Muir, Chesworth, & Vandervoort, 1999) and to enhance performance (Godges, MacRae, & Engelke, 1993). Flexibility is also an important aspect of clinical rehabilitation. The most common and easiest method of improving flexibility is through stretching exercises including static, passive, ballistic, and proprioceptive neuromuscular facilitation (PNF) techniques. Increases in ROM have been reported following both chronic (Draper, Miner, Knight, & Ricard, 2002) and acute stretching (Godges et al., 1993; McNair & Stanley, 1996) in a variety of joints. The indication from previous studies has been that static stretching and PNF stretching are the most effective in terms of increasing joint ROM, with any difference between these two methods being inconclusive (Condon & Hutton, 1986; Gribble, Guskiewicz, Prentice, & Shields, 1999). For our study static stretching was chosen over PNF due to the relative simplicity of the static stretching method, and because the majority of the target subject group (active, general population) were likely to have previously experienced static stretching, but possibly not PNF. Previous studies also indicated that the greatest changes in ROM were gained when stretches were held for 15-30 seconds (Bandy, Irion, & Briggler, 1997; Feland, Myrer, Schulthies, Fellingham, & Measom, 2001; Madding, Wong, Hallum, & Medeiros, 1987; Mohr, Pink, Elsner, & Kvitne, 1998) and were repeated three to five times (Taylor, Brooks, & Ryan, 1997).
The BodywallTM stretching system is a novel tool for increasing joint range of motion. Users wear gloves and slip-on shoes covered in velcro-like grips made from 3M Nulock to attach their hands and feet to a wall and floor construction which is also covered in Velcro-like material (see Figure 1). The purpose of our study was to investigate the effects of BodywallTM stretching on lower limb joint range of motion after a six-week stretching intervention period.

**METHODS:** Forty-five subjects were recruited from the general population and randomly assigned into three groups: (1) experimental, (2) stretching control, (3) pure control. All subjects had their ROM measured immediately before and after completing a six-week intervention period. For the experimental group, the intervention period consisted of supervised stretching sessions three times per week using the BodywallTM to perform a series of stretches covering most of the major joints in the body. Stretches were performed as a 20-second static stretch repeated three times, with each repetition interspersed with a brief

period during which no stretch was applied. The stretching control group completed essentially the same intervention period as the experimental, except that the stretches were performed without the aid of the BodywallTM. The pure control group had no stretching intervention, simply maintaining their normal activity levels for the six-week period.
Flexibility measures assessed ROM for gastrocnemius, hip flexors, knee extensors, hamstrings, shoulder extension, and shoulder abduction. Digital video footage was captured of each subject performing three repetitions of each ROM measure. Markers were taped over the greater trochanter, femoral lateral epicondyle, lateral malleolus, lateral aspect of the 5th metatarsal head, and the acromion process. Using images taken from the video footage the relevant joint angles were measured for each of the repetitions using Silicon Coach video analysis software.
**Analysis:** Means and standard deviations were calculated from the three trials for all ROM measurements (pre- and post-intervention). Change scores and 95% confidence intervals for the size of the change in ROM from pre- to post-intervention were calculated.

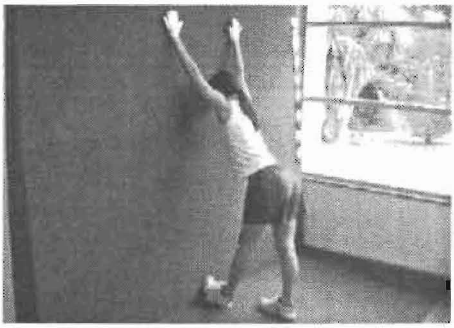

Figure 1: A sample stretch using the BodywallTM .

**RESULTS AND DISCUSSION:** Descriptive characteristics of the 45 participants are exhibited in Table 1. The three groups were closely matched in terms of age, weight, height, and the average amount of exercise performed in a week. Groups were also matched for gender, with both the experimental and stretching control groups consisting of nine females and six males, while the pure control group consisted of eight females and seven males. One of the most important areas in terms of group matching for a stretching intervention study is pre-intervention joint ROM. As this study involved a number of range of motion measures we were not able to match groups directly from individuals range of motion results, however, as the largest source of variation in flexibility was gender, matching groups for gender should have acted as a fairly effective control.

**Table 1 Descriptive characteristics for 45 participants.**

| | Experimental (n = 15) | Stretch control (n = 15) | Pure control (n = 15) | ENTIRE GROUP (n = 45) |
|---|---|---|---|---|
| Age (years) | 25.2±8.0 | 26.7±6.7 | 26.7±4.3 | 26.2±6.4 |
| Weight (kg) | 65.8±9.9 | 67.9±12.3 | 72.5±8.5 | 68.3±11.0 |
| Height (cm) | 170.9±7.0 | 171.9±7.9 | 175.1±9.9 | 172.6±8.3 |
| Exercise (hrs/wk) | 5.9±3.6 | 6.5±3.8 | 6.1±3.5 | 6.1±3.6 |

Results presented as mean SD. No significant differences between any of the groups (p<0.05).

Results (see Table 2) show that for the group stretching with the BodywallTM significant improvements were seen from baseline for the gastrocnemius (5.9 ), hip flexors (4.2 ), and hamstring measures (8.3 ), in addition to a substantial improvement in shoulder abduction ROM (4.6 ). In comparison, the stretching control group exhibited a significant improvement in hip flexor ROM (4.1 ), with substantial improvements also seen in the hamstrings (3.4 ) and shoulder abduction (3.7 ) measures. Based on reliability assessment the measurement error for the ROM measures used in this study was 3-4° {Hume, 2003 #83}, meaning that any change over this amount could be confidently interpreted as an actual change. It is worth noting that in all measures, except for shoulder extension, the BodywallTM stretching group improved more than the stretching control group, with the difference in the hamstrings and gastrocnemius measures being statistically significant. No real changes were seen in the pure control group, with all differences falling within the range of what could be considered normal systematic measurement error based on the results of the pre-study reliability testing.

**Table 2 Average changes in joint range of motion (95% confidence limit) following the six-week stretching intervention period.**

| Measure | Experimental | Stretching control | Pure control |
|---|---|---|---|
| Gastrocnemius | 5.9° (3.2-8.6)*+ | 2.7° (1.1-4.3) | 1.6° (-0.6-3.7) |
| Hip flexors | 4.2° (2.8-5.6)* | 4.1° (2.7-5.5)* | -0.3° (-1.8-1.0) |
| Quadriceps | 1.8° (-2.1-5.6) | 0.6° (-2.8-4.0) | 1.5° (-0.9-3.9) |
| Hamstrings | 8.3° (5.8-10.8)*+ | 3.4° (0.7-6.1) | 0.8° (-1.7-3.2) |
| Shoulder extension | 1.6° (-0.1-3.2) | 2.5° (-0.3-5.4) | 0.9° (-0.5-2.4) |
| Shoulder abduction | 4.6° (1.7-7.5) | 3.7° (1.8-5.6) | 1.5° (-1.0-3.9) |

* = significant ($p<0.05$) greater improvement from baseline.
+ = significant ($p<0.05$) greater improvement than stretching control.

Our study did not allow us to determine the mechanisms behind the greater improvements when stretching with the BodywallTM than when performing standard static stretches. Potential mechanisms are an increased contribution from body weight to the stretch as well as a reduction in antagonistic muscle action whilst performing the stretch. The greater freedom of position selection may also play a role in improving the effectiveness of a stretch, in particular with stretches such as the elevated leg hamstring stretch in which the foot can be placed at variable heights in order to facilitate the stretch. However, it cannot be discounted that the greater improvements exhibited by the BodywallTM stretching group were the result of some sort of novelty effect, with the subjects using the BodywallTM being more rigorous with their stretching due to the use of a new and potentially more interesting piece of equipment, in contrast to the control stretching to which they will have already been exposed.

**CONCLUSION:** The BodywallTM system was effective in improving joint range of motion following a six-week stretching program. The results show stretching with the BodywallTM to be generally more effective than unassisted static stretching, however, the mechanistic causes for this difference could not be determined from the measures in this study.

REFERENCES:

Bandy, W.D., Irion, J.M., & Briggler, M. (1997). The effect of time and frequency of static stretching on flexibility of the hamstring muscles. Physical Therapy, 77(10), 1090-1096.
Blum, J.W., & Beaudoin, C.M. (2000). Does flexibility affect sport injury and performance? Parks and Recreation, 35(10), 40-47.
Condon, S.M., & Hutton, R.S. (1986). Soleus muscle electromyographic activity and ankle dorsiflexion range of motion during four stretching procedures. Physical Therapy, 24-30.
Draper, D.O., Miner, L., Knight, K.L., & Ricard, M.D. (2002). The carry-over effects of diathermy and stretching in developing hamstring flexibility. Journal of Athletic Training, 37(1), 37-42.
Feland, J.B., Myrer, J.W., Schulthies, S.S., Fellingham, G.W., & Measom, G.W. (2001). The effect of duration of stretching of the hamstring muscle group for increasing range of motion in people aged 65 years or older. Physical Therapy, 81(5), 1110-1117.
Godges, J.J., MacRae, P.G., & Engelke, K.A. (1993). Effects of exercise on hip range of motion, trunk muscle performance, and gait economy. Physical Therapy, 73(7), 468-477.
Gribble, P.A., Guskiewicz, K.M., Prentice, W.E., & Shields, E.W. (1999). Effects of static and hold-relax

stretching on hamstring range of motion using the flexibility LE1000. Journal of Sport Rehabilitation, 8, 195-208.
Knudson, D. (1999). Stretching during warm-up: Do we have enough evidence? Journal of Physical Education, Recreation and Dance, 70(7), 24-27.
Madding, S.W., Wong, J.G., Hallum, A., & Medeiros, J.M. (1987). Effect of duration of passive stretch on hip abduction range of motion. The Journal of Orthopaedic and Sports Physical Therapy, 8(8), 409-416.
McNair, P.J., & Stanley, S.N. (1996). Effect of passive stretching and jogging on the series elastic muscle stiffness and range of motion of the ankle joint. British Journal of Sports Medicine, 30, 313-318.
Mohr, K.J., Pink, M.M., Elsner, C., & Kvitne, R.S. (1998). Electromyographic investigation of stretching: The effect of warm-up. Clinical Journal of Sport Medicine, 8(3), 215-220.
Muir, I.W., Chesworth, B.M., & Vandervoort, A.A. (1999). Effect of a calf-stretching exercise on the resistive torque during passive ankle dorsiflexion in healthy subjects. Journal of Orthopaedic and Sports Physical Therapy, 29(2), 106-115.
Prentice, W.E. (1983). A comparison of static stretching and PNF stretching for improving hip joint flexibility. Athletic Training, 56-59.
Shrier, I., & Gossal, K. (2000). Myths and truths of stretching. The Physician and Sportsmedicine, 28(8), 57-63.
Taylor, D.C., Brooks, D.E., & Ryan, J.B. (1997). Viscoelastic characteristics of muscle: passive stretching versus muscular contraction. Medicine and Science in Sports and Exercise, 29(12), 1619-1624.