COMPRESSION SHORTS AND SPORTS PERFORMANCE: HELP OR HINDRANCE

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RUNNING HEAD:
Athlete use of Compression Shorts

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Abstract

Objective: This study examined the impact of using an elasticized compression short on performance measures and proprioception at the hip.

Methods: Thirteen healthy subjects completed two testing sessions, once wearing the *Coreshorts*™ compression shorts, and once without. Active range of motion, joint angle replication, power, agility, speed, and aerobic endurance were measured, while subjective information pertaining to short fit was collected.

Results: The use of the prophylactic brace did not limit performance on any measure except active range of motion during hip flexion. Subjective data revealed 93.3% of subjects felt the shorts were supportive, although proper fit was an issue.

Conclusions: Results drawn from research on ankles, knees, and shoulders do not hold true for all hip test conditions. Continued research is necessary to determine the efficacy of hip bracing within an injured population and their potential prophylactic benefit for active individuals.

Keywords

Hip bracing, Proprioception, Speed, Power, Aerobic capacity

INTRODUCTION

Groin injury can be a debilitating experience for athletes competing in sports that require quick acceleration and sudden directional changes. Groin pain is common to a broad range of injuries occurring in the abdominal, hip, pelvic, or thigh areas (15, 24), although is most frequently associated with muscle strain (2, 14, 36). While approximately 5% of the active population seen for clinical treatments report groin pain, groin injury accounts for a disproportionately large amount of lost competition time in athletes (3).

Those who suffer a groin injury are considered to be at increased risk of recurrence, while subsequent injuries are typically more severe and require longer rehabilitation than the original injury (3, 25). These injuries often occur in multidirectional sports with sudden high velocity or high force contractions and de-accelerations. For example, of the groin/abdominal injuries reported in the NHL, 76% were groin injuries, with 68-82% involving the adductor muscle group. The risk of injury was found to increase with years of play in the NHL, with a significant rate of re-injury (17-23%). Most of the groin injuries were attributed to internal causes, with 91% of the injuries not involving contact. Of possible causes studied, there were no associations found between injury and peak isometric adductor torque, abductor flexibility or skate blade hollow, while off-season training decreased risk. (14, 15)

In an attempt to reduce sport injuries, many athletes are turning to prophylactic and functional braces for protection, support, compression, restriction of movement, immobilization, and proprioceptive enhancement (44). While the effectiveness of a brace varies depending on brace design, use, and the athlete's inherent joint stability, braces have been found to be comparable or superior to athletic tape in restricting range of motion (ROM) and providing support (38, 42). However, Verhagen et al. (42) caution that restricted ROM does not necessarily increase protection. The influence of bracing on performance has been a point of contention for many competitive athletes. While braces have been frequently used during the acute care of injuries, they are becoming more popular in injury prevention.

The use of compression shorts in injury prevention and rehabilitation has become popular over the last decade with the commercialization of compression type athletic wear. While light compression (via lycra or spandex) has not been found to hinder performance (22, 23), garments offering more compression have not been well studied. This study examined issues of performance and proprioception at the hip with the use of elasticized compression shorts offering considerably more compression and resistance to movement. Specifically, this study examined measures of active range of motion, balance, agility, proprioception, endurance, and power of healthy young adults during trials both wearing and not wearing compression shorts.

METHODS

Using a randomized cross-over study design, this study examined the performance of active young adults while wearing a compression short (*Coreshorts*™) designed to offer elastic and compressive support to the anatomical structures of the hip (see figure 1).

Subjects

Ten male and three female (mean = 25.69 years) subjects participated in the present study. All subjects were apparently healthy, active young adults recruited from a university population. Subjects were screened for size in order to ensure they could use the brace prototype. Written informed consent was obtained prior to all testing, while subjects were medically screened for apparent health disorder or unresolved musculo-skeletal injury. Ethical approval for the study was obtained from the university research ethics committee.

Procedures

All subjects completed the test battery twice, once while wearing *Coreshorts*™, and once without. A randomized crossover design was used with seven subjects performing with and without the shorts on each trial. Active range of motion (AROM) measurements were performed using a Leighton flexometer placed on the subject's anterior or lateral thigh. Supine hip flexion, prone hip hyperextension, and standing hip abduction were each measured twice. A standing measure of joint angle replication was performed with the hip flexed, abducted, and then hyperextended to 30 degrees. The subject was actively moved to the target angle and cued to remember that position. The subject then attempted to replicate the target joint angle twice (similar to Barrack (4)).

Balance was assessed using a stork stance while the subject had their eyes closed. One timed trial was allowed. The Canadian Physical Activity, Fitness and Lifestyle Appraisal (13) vertical jump protocol was used to assess leg power, with each subject completing two trials. The T-Test was used to assess agility with one timed trial (33, 42). One trial of a timed 20-meter dash was conducted to test speed, while the 20-meter multi-stage shuttle run was performed to assess aerobic capacity (26, 27).

Subjects who completed the test battery while wearing the *Coreshorts*™ were asked to complete a subjective evaluation of the device. The subjects were asked to indicate their level of agreement for six statements regarding comfort, fit, support, hindering or enhancing performance, and whether they would wear *Coreshorts*™ during sporting activities. Each statement was ranked on a five-point scale from strongly disagree (1) to strongly agree (5). Subjects were given space to specify which sport they play and were also encouraged to write any additional comments on the questionnaire.

Data Analysis

The largest angle produced during each of the AROM movements was used for analysis. Similarly, the best of two trials was used for the power measurement. The value from the two joint replication trials which was closest to the target joint angle was used for assessment. This value was represented as absolute error in degrees. All other tests used the value obtained during the single trial. A comparison of means between the braced and unbraced condition for each test was performed using an analysis of variance (ANOVA). The percentage of subjects responding to each statement of the subjective evaluation in the same way was calculated.

RESULTS

Testing results (mean, standard deviation) are summarized in Table 1 for the ten male and three female subjects completing both experimental conditions. No statistical differences ($p<0.05$) between the braced and non-braced conditions were found except for AROM during hip flexion ($p=0.016$).

Responses to the six statements of the subjective evaluation indicate that subjects did not find the shorts to hinder performance. To the statement "I feel the shorts are comfortable" 46.15% disagreed, 30.77% neither agreed nor disagreed and 23.08% agreed; 61.53% of subjects disagreed or strongly disagreed to the statement "I feel the shorts fit properly", with 23.07% who either agreed or strongly agreed; 93.31% of the subjects agreed or strongly agreed with the statement "I feel the shorts are supportive", with only 7.69% responding neutrally and no disagreement. Results for the statements "I feel the shorts hindered my test results" and "I feel the shorts would enhance my performance" were identical. There were no strongly agree or strongly disagree responses for either statement, while 61.54% had a neutral response. Slightly more subjects agreed (23.08%) than disagreed (15.38%) with the statements. Finally, when asked "I would wear these shorts during sporting activities" 30.76% either disagreed or strongly disagreed, while slightly more (38.46%) agreed or strongly agreed.

DISCUSSION

Results from previous studies examining the efficacy of joint bracing vary depending on the joint, testing procedure, and brace selection, although it is generally agreed that braces have little adverse effect on most activities, other than vertical jump (8, 9, 28). Because these studies were not conducted with hip braces it was necessary for this pilot work to examine the effect of hip bracing on performance in a healthy population before proceeding to injured individuals. While long-term brace use has been found to have no effect on muscle firing (12), reduced EMG activity has been recorded during brace use (31, 43). The research of Osternig and Robertson (31) indicates there may be a change in neuromuscular control of the lower extremity, due to a significant change in ROM for braced subjects during running. Whether EMG activity and neuromuscular control changes are related is unclear. Subjective evaluations of brace use are generally positive, with subjects feeling more confident, less pain due to delayed-onset muscle soreness (DOMS), and reporting that the brace enhanced test performance (7, 21, 24).

Subjective evaluations of the compression shorts used in the present study are similar to those reported previously for neoprene compression sleeves (7, 21, 24). The *Coreshorts*™ prototype used in the present study were designed to offer multi-directional support, offering increased resistance to excessive motion at the hip joint in each plane of motion. Subjective evaluations suggest that the majority of subjects (93.31%) felt the shorts were supportive. When asked if the brace hindered their test results, and if the brace would enhance their performance the results were identical. These statements appear contradictory, however, additional comments provided by the subjects and the responses to the statement about comfort (46.15% disagreement) clarify this discrepancy. Only one size of the *Coreshorts*™ prototype was utilized for this study. While all subjects were able to fit into the brace, the comments on the questionnaire centered around sizing changes which would enhance comfort and result in performance enhancement. Therefore, when responding to statements about the current test the subjects felt supported, however, discomfort made them feel hindered. When responding to the statement "I feel the shorts would enhance my performance", an addendum for proper fit was often included. While the subjects recognized a benefit to the use of the brace, sizing changes were necessary. Specific suggestions for changes to sizing included separate thigh and waist measurements, or the addition of a lacing or strap system to achieve a more customized fit.

The only significant performance difference between the braced and unbraced condition was found in AROM during hip flexion. While there were no differences in AROM during hyperextension and abduction of the thigh this may indicate a restriction in ROM only with large changes in joint angle, which may be beneficial in preventing injury while allowing functional movement. The increasing resistance offered by the elastic brace material when it is lengthened applies a progressive force to limit movement into an individual's end range of motion. This may prevent injury in itself, and/or work by aiding thigh deceleration during such movements as the follow-through of a soccer kick.

It has been hypothesized that the resistance provided by a brace will fatigue muscles more quickly, resulting in an increased risk of injury as proprioceptive control is decreased. Previous research has found a decrease in an individual's ability to distinguish different movement speeds, replicate joint angles, or detect thresholds of movement after fatigue (10, 32, 40), while many others have not found any significant decrease in test measurement (17, 40). While differing protocols, joints and targeted mechanoreceptors make comparisons difficult, the present results (finding similar aerobic capacity during compression short and non-compression short trials) do not support the notion that compression shorts contribute to fatigue in repetitive movement. The present results support previous work that found no significant differences in post-exercise lactate levels in individuals wearing elastic tights (5), and reports of increased venous blood flow during compression garment use (30). These results are supported more recently by Kraemer et al. (23), who found no improvement in single maximal jump powers, but found compression shorts to help maintain higher jumping power during repetitive vertical jumps.

Proprioception allows an individual to know where body segments are in space, direction and speed of movement, and amount of force applied through information received from mechanoreceptors located in the skin, muscles, tendons, ligaments and joint capsules (7). Each mechanoreceptor is found in a different location and responds in a unique way to specific stimuli. Researchers know that factors such as aging, joint effusion, and anaesthesia have a negative impact on an individual's proprioceptive ability (34); however, the specific contribution of each proprioceptor to the total control mechanism is not certain (17). An individual's inherent proprioceptive capability appears to be an important component in the effectiveness of any intervention. Several studies have found that individuals with poor inherent stability or proprioception derive the greatest benefit from an external support (7, 9, 34). Initial research into proprioception concentrated on the role of capsular receptors that were believed to be a major contributor to stability (17, 40); however, the focus has recently shifted to the response of muscle spindles (17, 41).

There is growing evidence that movement of skin overlying stretching muscle triggers cutaneous receptors to send important joint position information to the brain (29, 39). Skin stretch has been found to be a very important source of proprioceptive information (11). If compression enhanced this effect it might also yield increased sensitivity, supporting the use of bracing material around the joints. The compressive quality of elastic braces is thought to make the stimuli of underlying muscle movement more prominent, thereby enhancing activation of these cutaneous receptors (9, 39).

Activation of cutaneous tactile mechanoreceptors or electrical stimulation of mechanoreceptive afferents have been shown to reduce presynaptic inhibition in both the leg (19) and the arm (1). Since proprioception is affected by input from muscle spindle afferents this would have the net effect of increasing proprioceptive sensitivity. While it is quite reasonable to suggest that compression shorts strongly activate cutaneous mechanoreceptors around the hip, similar improvements in proprioceptive sensitivity may result from their use (although there is no direct evidence to support this). Due to the number and complexity of different receptors active in proprioception, it is not surprising that current results are equivocal. Differing test protocols and the specific movement and receptor placement patterns of each joint make research challenging. While some researchers have found no beneficial effect of bracing on proprioception (6, 20, 35), many others have found a significant improvement (18, 34, 38).

With no significant difference between joint angle replication during the braced and unbraced conditions, the present results do not support enhanced proprioception at the hip during periods of compression. However, the use of apparently healthy, active individuals in the current study may account for the lack of significance as their proprioceptive abilities were not hindered by injury. Birmingham et al. (7), Callaghan (9), and Perlau, Frank and Fick (34) suggest that there is an inverse relationship between inherent proprioceptive ability and benefit from brace use. Therefore, individuals with poor inherent proprioceptive ability would derive the greatest benefit from a brace. Further research with injured subjects would be necessary to confirm this association.

PRACTICAL APPLICATIONS

The purpose of this study was to examine potential benefits and disadvantages of wearing compression shorts during sporting activities. Using information from research on other joints, it was hypothesized that the use of compression shorts may hinder speed, agility and aerobic capacity, while enhancing proprioception. However, our results could not support either hypothesis. The use of an elastic compression shorts did not appear to impact performance, and may be useful for injury prevention and during recovery from injury.

Our results were consistent with that of others who suggest bracing does not significantly limit performance (9, 22, 23, 28). While the research by Burks et al. (8) found that sprint and vertical jump were negatively affected, the results from the current study do not support this conclusion. This discrepancy is likely due to the use of a hip brace in the current study, as opposed to Burks' use of ankle bracing. Limitations to performance as a result of bracing may be more marked when bracing distal joints of the lower extremity.

REFERENCES

1. AIMONETTI, J.M., VEDEL, J.P., SCHMIED, A., AND PAGNI, S. Mechanical cutaneous stimulation alters Ia presynaptic inhibition in human wrist extensor muscles: a single motor unit study. J.Physiol (Lond) 522 Pt 1: 137-145. 2000.

2. AMARAL, J.F. Thoracoabdominal injuries in the athlete. Clin. Sports Med. 16:739-753. 1997. **SIRC article number: 456525**

3. ANDERSON, K, STRICKLAND, S.M., AND WARREN, R. Hip and groin injuries in athletes. Am. J. Sports Med. 29:521-532. 2001. **SIRC article number: S-805056**

4. BARRACK, R.L., SKINNER, H.B., AND BUCKLEY, S.L. Proprioception in the anterior cruciate deficient knee. Am. J. Sports Med. 17: 1-6, 1989. **SIRC article number: 231456**

5. BERRY, M.J., BAILEY, S.P., SIMPKINS, L.S., AND TeWINKLE, J.A. The effects of elastic tights on the post-exercise response. Can. J. Sport. Sci. 15:244-248, 1990. **SIRC article number: 267119**

6. BEYNNON, B.D., RYDER, S.H., KONRADSEN, L., JOHNSON, R.J., JOHNSON, K., AND RENSTROM, P.A. The effect of anterior cruciate ligament trauma and bracing on

knee proprioception. Am. J. Sports Med. 27:150-155. 1999.

SIRC article number:S-60950

7. BIRMINGHAM, T.B., KRAMER, J.F., INGLIS, J.T., MOONEY, C.A., MURRAY, L.J., FOWLER, AND P.J., KIRKLEY, S. Effect of a neoprene sleeve on knee joint position sense during sitting open kinetic chain and supine closed kinetic chain tests. Am. J. Sports Med. 26:562-566. 1998. **SIRC article number: 481198**

8. BURKS, R.T., BEAN, B.G., MARCUS, R., AND BARKER, H.B. Analysis of athletic performance with prophylactic ankle devices. Am. J. Sports Med. 19:104-106. 1991. **SIRC article number: 273570**

9. CALLAGHAN, M.J. Role of ankle taping and bracing in the athlete. Br. J. Sports Med. 31:102-108. 1997. **SIRC article number: 420302**

10. CARPENTER, J.E., BLASIER, R.B., AND PELLIZZON, G.G. The effects of muscle fatigue on shoulder joint position sense. Am. J. Sports Med. 26:262-265. 1998. **SIRC article number: 462936**

11. COLLINS, D.F., AND PROCHAZKA, A. Movement illusions evoked by ensemble cutaneous input from the dorsum of the human hand. J Physiol (Lond) 496 (Pt 3): 857-871. 1996.

12. CORDOVA, J.L., CARDONA, C.V., INGERSOLL, C.D., AND SANDREY, M.A. Long-term ankle brace use does not affect peroneus longus muscle latency during sudden inversion in normal subjects. J. Athl. Training. 35:407-411. 2000.

13. CSEP. The Canadian Physical Activity, Fitness & Lifestyle Appraisal. Ottawa, ON: Canadian Society for Exercise Physiology, 1996.

14. EMERY, C.A., AND MEEUWISSE, W.H. Risk factors for groin injuries in hockey. Med. Sci. Sports Exerc. 33:1423-1433. 2001. **SIRC article number: S-790844**

15. EMERY, C.A., MEEUWISSE, W.H., AND POWELL, J.W. Groin and abdominal strain injuries in the National Hockey League. Clin. J. Sport Med. 9:151-156. 1999.
SIRC article number: S-126718

16. ESTWANIK, J.J., SLOANE, B., AND ROSENBERG, M.A. Groin strain and other possible causes of groin pain. Phys. Sportsmed. 18:54-62. 1990.
SIRC article number: 249709

17. GURNEY, B., MILANI, J., AND PEDERSEN, M.E. (2000). Role of fatigue on proprioception of the ankle. J. Exerc. Phys. [On-line serial]. 3(1). Available: http://www.css.edu/users/tboone2/asep/fldr/fldr.htm. **SIRC article number: S-676733**

18. HIGGINS, M.J., AND PERRIN, D.H. Comparison of weight-bearing and non-weight-bearing conditions on knee joint reposition sense. J. Sport Rehab. 6:327-334. 1997. **SIRC article number: 456082**

19. ILES, J.F. Evidence for cutaneous and corticospinal modulation of presynaptic inhibition of Ia afferents from the human lower limb. J Physiol (Lond) 491 (Pt 1): 197-207. 1996

20. JORDEN, R.A. (2000). Influence of ankle orthoses on ankle joint motion and postural stability before and after exercise [Abstract]. *Microform Publications, University of Oregon. [Electronic]* **SIRC article number: S-673292**

21. KRAEMER, W.J., BUSH, J.A., WICKHAM, R.B., DENEGAR, C.R., GOMEZ, A.L., GOTSHALK, L.A., DUNCAN, N.D., VOLEK, J.S., PUTUKIAN, M., AND SEBASTIANELLI, W.J. Influence of compression therapy on symptoms following soft tissue injury from maximal eccentric exercise. J. Orth. Sports Phys. Therapy. 31:282-290. 2001. **SIRC article number: S-782625**

22. KRAEMER, W.J., BUSH, J.A., TRIPLETT-McBRIDE, N.T., KOZIRIS, L.P., MANGINO, L.C., FRY, A.C., McBRIDE, J.M., JOHNSTON, J., VOLEK, J.S., YOUNG, C.A., GOMEZ, A.L., AND NEWTON, R.U. Compression garments: Influence on muscle fatigue. J. Strength Cond. Res. 12:211-215. 1998. **SIRC article number: S-19029**

23. KRAEMER, W.J., BUSH, J.A., BAUER, J.A., TRIPLETT-McBRIDE, N.T., PAXTON, N.J., CLEMSON, A., KOZIRIS, L.P., MANGINO, L.C., FRY, A.C., AND NEWTON, R.U. Influence of compression garments on vertical jump performance in NCAA division I volleyball players. J. Strength Cond. Res. 10:180-183. 1996. **SIRC article number: 402950**

24. KUSTER, M.S., GROB, K., KUSTER, M., WOOD, G.A., AND GACHTER, A. The benefits of wearing a compression sleeve after ACL reconstruction. Med. Sci. Sports Exerc. 31:368-371. 1999. **SIRC article number: S-41577**

25. LACROIX, V.J. A complete approach to groin pain. Phys. Sportsmed. 28(1):66-86. 2000. **SIRC article number: S-159074**

26. LEGER, L.A., AND GADOURY, C. Validity of the 20m shuttle run test with 1 min stages to predict VO_2max in adults. Can. J. Sports Sci. 14:21-26. 1989. **SIRC article number: 234784**

27. LEGER, L.A., MERCIER, D., GADOURY, C., AND LAMBERT, J. The multistage 20 metre shuttle run test for aerobic fitness. J. Sports Sci. 6:93-101. 1987. **SIRC article number: 230123**

28. LOCKE, A., SITLER, M., ALAND, C., AND KIMURA, I. Long-term use of a softshell

prophylactic ankle stabilizer on speed, agility, and vertical jump performance. J. Sport Rehab. 6: 235-245. 1997. **SIRC article number: 456739**

29. MOBERG, E. The role of cutaneous afferents in position sense, kinaesthesia, and motor function of the hand. Brain. 106:1-19. 1983.

30. O'DONNELL, T.F., ROSENTHAL, D.A., CALLOW, A.D. AND LEDIG, B.L. Effect of elastic compression on venous hemodynamics in postphlebitic limbs. J. Am. Med. Assoc. 242:2766-2768, 1979.

31. OSTERNIG, L.R. AND ROBERTSON, R.N. Effects of prophylactic knee bracing on lower extremity joint position and muscle activation during running. Am. J. Sports Med. 21:733-737. 1993. **SIRC article number: 327662**

32. PEDERSEN, J., LOENN, J., HELLSTROEM, F., DJUPSJOEBACKA, M., AND JOHANSSON, H. Localized muscle fatigue decreases the acuity of the movement sense in the human shoulder. Med. Sci. Sports Exerc. 31:1047-1052. 1999.
SIRC article number: S-61632

33. PAUOLE, K., MADOLE, K., GARHAMMER, J., LACOURSE, M., AND ROZENEK, R. Reliability and validity of the t-test as a measure of agility, leg power, and leg speed in college-aged men and women. J. Strength Cond. Res. 14:443-450. 2000.

SIRC article number: S-666612

34. PERLAU, R., FRANK, C., AND FICK, G. The effect of elastic bandages on human knee proprioception in the uninjured population. Am. J. Sports Med. 23:251-255. 1995. **SIRC article number: 373730**

35. REFSHAUGE, K.M., KILBREATH, S.L., AND RAYMOND, J. The effect of recurrent ankle inversion sprain and taping on proprioception at the ankle. Med. Sci. Sports Exerc. 32:10-15. 2000. **SIRC article number: S-163181**

36. RUANE, J.J., AND ROSSI, T.A. When groin pain is more than 'just a strain': navigating a broad differential. Phys. Sportsmed. 26(4):78-103. 1998. **SIRC article number: 458157**

37. SEMENICK, D.M. Testing protocols and procedures. In: Essentials of Strength Training and Conditioning: National Strength and Conditioning Association. T.R. Baechle, ed. Champaign, IL: Human Kinetics, 1994. pp.258-273.

38. SHAPIRO, M.S., KABO, J.M., MITCHELL, P.W., LOREN, G., AND TSENTER, M. Ankle sprain prophylaxis: An analysis of the stabilizing effects of braces and tape. Am. J. Sports Med. 22:78-82. 1994.

39. SIMONEAU, G.G., DEGNER, R.M., KRAMPER, C.A., AND KITTLESON, K.H.

Changes in ankle joint proprioception resulting from strips of athletic tape applied over the skin. J. Athletic Training. 32:141-147. 1997. **SIRC article number: 417399**

40. SKINNER, H.B., WYATT, M.P., HODGDON, J.A., CONARD, D.W., AND BARRACK, R.L. Effect of fatigue on joint position sense of the knee. J. Orthopaedic Res. 4:112-118. 1986.

41. STENDER, B.L., AND DROWATZKY, J.N. Joint position sense in subjects with total hip replacements: The possible role of muscle afferents. Clinical Kinesiology. 48:10-14. 1994. **SIRC article number: 348082**

42. VERHAGEN, E.A.L.M., VAN DER BEEK, A.J., AND VAN MECHELEN W. The effect of tape, braces and shoes on ankle range of motion. Sports Med. 31:667-677. 2001. **SIRC article number: S-786133**

43. WARREN, L.P., APPLING, S., OLADEHIN, A., AND GRIFFIN, J. Effect of soft lumbar support belt on abdominal oblique muscle activity in nonimpaired adults during squat lifting. Orthop. Sports Phys. Therapy. 31:316-323. 2001. **SIRC article number: S-782629**

44. WICHMANN, S., AND MARTIN, D.R. Bracing for activity. Phys. Sportsmed. 24(9):88-94. 1996. **SIRC article number: 402802**

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TABLE 1: Mean, standard deviation (SD), and significance for each test condition.

Test	No *Coreshorts*™ Mean	No *Coreshorts*™ SD	*Coreshorts*™ Mean	*Coreshorts*™ SD	Sig.
AROM (degrees)					
Flexion (N=13)	98.25	8.86	88.50	8.80	0.016
Hyperextension (N=13)	37.67	10.60	38.67	6.48	0.799
Abduction (N=13)	64.83	13.88	69.25	23.71	0.745
Joint Angle Replication (degrees)					
Flexion (N=13)	2.58	3.09	2.33	2.81	0.755
Hyperextension (N=13)	1.75	2.25	2.33	2.88	0.219
Abduction (N=13)	1.42	2.00	2.08	2.73	0.572
Balance (seconds)					
Stork Stance (N=13)	24.22	28.39	24.21	18.78	0.896
Power (meters)					
Vertical Jump (N=13)	0.46	0.09	0.46	0.11	0.850
Agility (seconds)*					

Test	Mean	SD	Mean	SD	Sig.
T-Test (N=12)	11.81	1.07	11.68	1.17	0.993
Speed (seconds)					
20 meter Dash (N=13)	3.46	0.39	3.43	0.36	0.885
Aerobic Capacity (ml/kg/min)					
20 meter Shuttle Run (N=13)	49.64	8.34	49.88	8.70	0.719

All tests F [1,24], $P < .05$

* F [1,22], $P < .05$

FIGURE 1: Photograph of the Coreshorts™ prototype and the elastic arrangement.