PRE-SEASON HAMSTRING/QUADRICEPS RELATIONSHIP RECORDED ON PROFESSIONAL SOCCER PLAYERS

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The purpose of this study was to investigate the dominant and nondominant leg hamstring/quadriceps relationship at three different speeds of movement using professional soccer players who were beginning their pre-season training. Each subject was tested on bilateral concentric knee flexion/extension using a Cybex NORM isokinetic dynamometer at speeds of 60, 180, and 300 °/s. Data were analyzed using descriptive statistics and a repeated measures analysis of variance ($p < .05$). The results of the study indicated significant differences between dominant and non-dominant legs. The nondominant leg recorded greater H/Q values than the dominant leg which could indicate less quadriceps strength or greater hamstring strength in this leg.

KEY WORDS: isokinetic, percentage of peak torque

INTRODUCTION: Many studies have looked at the strength of athletes from a variety of perspectives (Aagaard, Simonsen, Magnusson, Larsson & Dyhre-Poulsen, 1998; Hahn, Foldspang & Ingemann-Hansen, 1999; Ostenberg, Roos, Ekdahl & Roos, 1998; Wisloff, Helgerud & Hoff, 1998; Worrell & Perrin, 1992). Some of the populations evaluated are athletic while others are non-athletic samples of convenience. Regardless of the sample there seems to be some disparity as to the best measure to evaluate strength. To assess strength, there are studies which have used isokinetic machines, others used one repetition maximum, and yet others used a variety of performance tests such as vertical jump, one-leg raise, one-leg hop for distance, etc. Subjects have ranged from injured to non-injured, and have been evaluated during different phases of the season's training (Agre and Baxter, 1987; Bennell, Wajswelner, Lew, Schall-Riaucour, Leslie, Plant & Cirone, 1998; Osbenberg *et al*., 1998; Wisloff, Helgerud & Hoff, 1998). The purpose of this study was to investigate the dominant and non-dominant leg hamstring/quadriceps (H/Q) relationship at three different speeds of movement (60, 180 and 300°/s) using professional soccer players who were beginning their pre-season training.

METHODS: Eight male professional soccer players volunteered to participate in the study and signed informed consents. Each participant warmed up on a stationary bicycle before their testing session. Once the subject felt sufficiently warmed up, they were tested using a Cybex NORM isokinetic dynamometer. All tests were conducted using the manufacturer's gravity correction equation. Concentric knee flexion and extension were assessed on both the dominant and non-dominant legs with the order of limb testing being alternated for each successive participant. The tests were conducted with five repetitions at 60°/s, 10 repetitions at 180°/s, and 15 repetitions at 300°/s. The number of repetitions were increased as the speed increased to ensure that subjects had adjusted to speed of the machine to get stable peak torque values (Cybex NORM Manual, 1996). The dominant and non-dominant leg H/Q values were compared across speeds using repeated measures analysis of variance ($p < .05$).

RESULTS AND DISCUSSION: The means and standard deviations of the dominant and non-dominant H/Q ratios for each speed are found in Table 1. The dominant leg H/Q values were very similar at each speed. The dominant leg H/Q ratios are comparable to those reported by Guaratini, Bertollo & Mesquita (2000), who reported values of 50%, 58%, and 75% at 60°/s, 180°/s, 300°/s respectively. However, the non-dominant leg H/Q ratios varied considerably when moving from 60°/s to 180°/s, but decreased somewhat from 180°/s to 300°/s. These non-dominant leg H/Q ratios differ greatly from the values reported by Guarantini *et al*. (2000), who reported values of 50%, 58% and 76% at 60°/s, 180°/s, 300°/s respectively. The results of the repeated measures ANOVA indicated there were significant differences between dominant and non-dominant legs. This contradicts the findings of Ostenberg *et al*., (1998) and Guaratini *et al*. (2000), who found no significant differences between dominant and non-dominant legs.

Table 1 Mean Values of H/Q Relationship

	60°/s	180°/s	300°/s
Dominant H/Q	60.36 ± 10.97	60.85 ± 11.07	64.07 ± 14.20
Non-dominant H/Q	66.90 ± 9.33	86.53 ± 15.52	82.16 ± 25.64

N = 8

In Figure 1, it is quite evident that the dominant leg had a more stable H/Q relationship than did the non-dominant leg. Although the interaction between speed and leg was not significant (p = .11), a trend was evident. It has previously been reported that increases in speed reduce the amount of quadriceps torque more than the reduction of hamstring torque, thus increasing the magnitude of the H/Q ratio at greater speeds (Perrin, 1993; Guarantini *et al*. 2000). The data reported from this study certainly indicated such a pattern when looking at the non-dominant leg values. However, this only accounts for the 60-180°/s, while a reverse trend could be argued for 180-300°/s. However Guarantini *et al.* (2000) did not find significant differences in the dominant versus nondominant leg across speeds when assessing non-athletes.

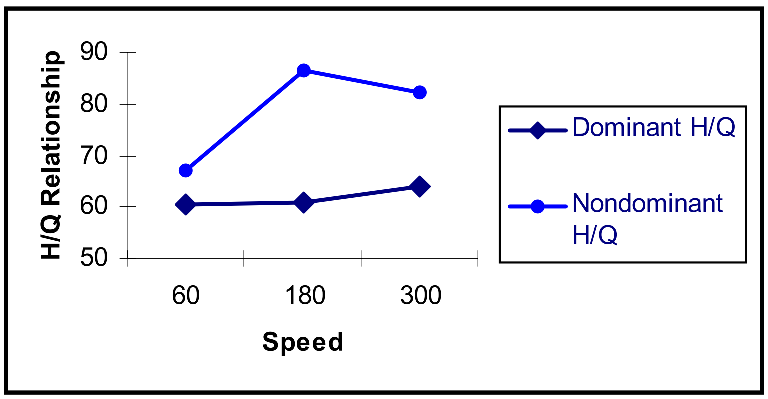

Figure 1 - Mean values of H/Q relationship at three test speeds (degrees).

One suggestion for finding leg dominance differences in this study, is that the dominant leg is the favored kicking leg, which is likely to have a stronger quadriceps muscle group. The non-dominant leg would then be used more often for the plant leg and for postural control rather than the task of kicking. Thus, the quadriceps could be weaker, even if functioning correctly for performance, while the hamstring is as strong as the hamstring of the dominant leg, which could account for the higher non-dominant H/Q ratios.

The participants in this study were undergoing intense pre-season training at the time of testing. In addition to real relative strength differences in the hamstrings and quadriceps between dominant and non-dominant legs, findings may have been influenced by a result of a lack of familiarity with the testing device or long practices prior to being tested. Further research should examine the following issues: 1) testing the participants when totally rested or after they have experienced some sort of light exercise during the day; 2) testing the differences in using athletes versus non-athletes for testing, and; 3) testing the same participants several times under different conditions.

CONCLUSION: A significant difference was found between the dominant and non-dominant legs in H/Q ratios. The non-dominant leg recorded greater H/Q ratios than the dominant leg which could indicate less quardriceps strength or greater hamstring strength in this leg. Further research should investigate differences which may be present between dominant and non-dominant legs and use a variety of populations.

REFERENCES:

Aagaard, P., Simonsen, E., Magnusson, S., Larsson, B. & Dyhre-Poulsen, P. (1998). A new concept for isokinetic hamstring:quadriceps muscle strength ratio*. Medicine and Science in Sports and Exercise*, **26**, 231-237.

Agre, J., & Baxter, T. (1987). Musculoskeletal profile of male collegiate soccer players. *Archives of Medicine and Rehabilitation*, **68**, 147-150.

Bennell, K., Wajswelner, H., Lew, P., Schall-Riaucour, A., Leslie, S., Plant, D. & Cirone, J. (1998). Isokinetic strength testing does not predict hamstring injury in Australian Rules footballers. *British Journal of Sports Medicine*, **32,** 309-314.

Guaratini, M., Bertollo, F. & Mesquita, R. (2000). Reliability and precision of the hamstring/quadriceps relationship. In Y. Hong & D. Johns (Eds*). Proceedings of XVIII International Symposium of Biomechanics in Sports* (646-649) Hong Kong.

Hahn, T., Foldspang, A. & Ingemann-Hansen, T. (1999). Dynamic strength of the quadriceps muscle and sports activity. *British Journal of Sports Medicine*, **33**, 117-120.

Ostenberg, A., Roos, E., Ekdahl, C. & Roos, H. (1998). Isokinetic knee extensor strength and functional performance in healthy female soccer players*. Scandanavian Journal of Medicine and Science in Sports*, **8**, 257-264.

Perrin, D. (1993). *Isokinetic Exercise and Assessment*. Champaign, IL: Human Kinetics.

Wisloff, U., Helgerus, J. & Hoff, J. (1998). Strength and endurance of elite soccer players. *Medicine and Science in Sports and Exercise*, **30**, 462-467.

Worrell, T. & Perrin, D. (1992). Hamstring muscle injury: the influence of strength, flexibility, warm-up, and fatigue. *Journal of Orthopaedic and Sports Physical Therapy,* **16**, 12-18.