Relationship between instep kick ball velocity and kicking leg isokinetic strength of adult soccer players

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Introduction

The key performance objective of the instep kick is to achieve maximal distance as accurately as possible. The velocity of the kicking foot at the point of contact with a ball has been shown to be an important determinant of ball speed and distance in soccer. Optimal muscle strength and balance of the knee flexor and extensor musculature has been found to influence the velocity of the kicking foot in football codes (Young & Rath, 2011).

Practitioners utilise isokinetic dynamometers to interpret the relationships between strength and performance measures such as kicking and muscle imbalances (Cronin & Hansen, 2005). No study has investigated the relationship between the instep-kick ball velocity and the isokinetic strength of the kicking leg in New Zealand adult soccer players.

The purpose of this study was to examine the relationship between instep-kick ball velocity and isokinetic strength of the kicking leg in New Zealand adult soccer players.

Methods

Participants:

Ten (10) adult male soccer players, currently participating in the Waikato Premier Division Soccer League, completed the requirements of the study (see characteristics in Table 1).

Table 1. Participant characteristics

	Mean±SD
Age (years)	21.7±2.2
Height (cm)	173.6±5.3
Mass (kg)	71.1±7.9

Procedures:

Participants performed a 5 minute warm-up on a Monarch cycle ergometer at 50 watts followed by a standardized dynamic stretching routine.

Test order:

All test were performed in the following order:

1. Ball velocity assessment
2. Isokinetic strength assessment.

Protocols for these assessment are outlined in their respective sections

Analyses:

Statistical analyses were performed using Microsoft Excel. Pearson's correlations (r) were employed to determine the relationship between instep-kick ball velocity and isokinetic strength of the kicking leg. The level of significance was set at $P<0.05$.

Ball Velocity Assessment

Ball velocity was assessed on an outdoor synthetic surface using a Stalker Radar gun (ATS II Radar, Applied concept, USA) three (3) minutes following the completion of the warm-up. Participants were required to perform an instep kick, as hard as possible without focussing on accuracy, from a 3-4 step approach at an angle of 45° (Andersen & Dörge, 2011). All kicks were taken towards the net surrounding the artificial surface from a standardised spot situated 5m away. After 3 warm-up kicks, participants performed three maximal instep kicks from which the highest linear velocity was recorded for further analysis. See figure 1 for setup.

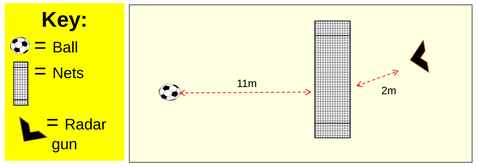
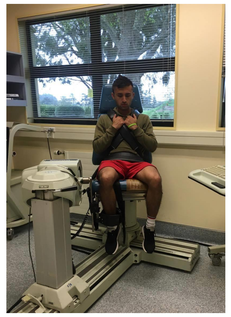


Figure 1: Setup schematic for instep kick

Isokinetic Strength Assessment



Knee flexion

Knee extension

Dominant kicking leg unilateral isokinetic concentric knee flexor and extensor strength was measured via an isokinetic dynamometer (Kin-Com 125AP, Chattanooga group Inc., USA). Two (2) familiarisation sets of 5 repetitions were performed by the participant at 180° $.s^{-1}$ angular velocity at 70-80% effort for sufficient familiarisation.

Following the familiarisation protocol 3 maximal effort repetitions were performed at 180° $.s^{-1}$ and recorded for further analysis.

Participants were allowed a 1-minute rest in between the sets.

During the test, participants were given verbal encouragement.

Results

Table 2. Relationship between ball velocity and leg strength measures (n= 10)

	Mean	SD	r- value	Inference
Ball velocity (m/s)	36.9	2.4		
Peak hamstrings torque (Nm)	91.3	15.2	0.70	Very large
Peak quadriceps torque (Nm)	141.8	18.4	-0.05	Trivial
Hamstring to quadriceps ratio	0.65	0.09	0.93	Nearly perfect

- A very large relationship (r = 0.70) existed between hamstring strength and ball velocity.
- A nearly perfect correlation (r = 0.93) existed between hamstrings to quadriceps peak torque ratio and ball velocity.
- A trivial correlation (r = -0.05) existed between quadriceps strength and ball velocity.

Discussion

Results from this study supports the hypothesis that soccer players with greater muscular strength will generate greater ball velocity.

The hamstring muscles are highly active during the movement and this was reflected in the results, which showed a very large correlation (r = 0.70) between hamstring strength and ball velocity. The comparison of knee extensors and flexors strength between elite soccer players and club level players showed that elite soccer players produce higher peak torques in the isokinetic tests (Rahnama, Lees & Bambaecciehi, 2005).

Interestingly, the study also found that hamstrings to quadriceps torque ratio has nearly perfect correlation (r = 0.93) with ball velocity during instep kick. It implies that soccer players that possess higher H:Q achieve higher ball velocity. Studies have also identified that players who acquire ratios below 0.60 are more likely to suffer from muscular strains. When compared to the elite soccer players, H:Q value was comparatively higher amongst the club level players (0.55 < 0.65) (Rahnama, Lees & Bambaecciehi, 2005).

Take Home Message

- Soccer players should primarily focus on strengthening the hamstring muscles during exercise sessions as this may transfer to an increase in ball velocity during a kick.
- Furthermore, soccer players with higher hamstring to quadriceps peak torque ratios also tend to perform a kick at greater velocity and may be less prone to muscular injuries.

References

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