The efficacy of a short-term strength-agility complex training protocol on strength, power and agility measures in female soccer players.

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Purpose

Agility is the ability to quickly decelerate, change direction and accelerate and is clearly important across sport, especially in team sports (Brugheli et al., 2008). For example football players can make up to 700 changes of direction in a match (Bloomfield et al., 2007) with 150-250 at high intensity (Bangsbo et al., 2006). As agility involves the rapid execution of complex motor skills it requires multidirectional technique, straight sprinting speed and leg muscle qualities alongside perceptual and decision-making abilities for successful execution (Young et al 2002). Although speed and agility are related they should be considered independent qualities that may require specific procedures to be successfully trained (Little and Williams, 2005). Thus, perhaps due to its multifaceted nature, the most effective ways to develop agility remain unclear.

One training method that can positively affect agility is plyometrics. Plyometrics utilises the stretch shortening cycle of a muscle which involves the storage of elastic energy across the tendon during a pre-load stretch followed by an explosive release of the energy (Mohamed and Mohamad, 2014) and can take the form of jumping, bounding and change of direction actions. Agility performance has been positively linked to reactive strength (Young et al., 2002) and therefore ground reaction time. Plyometric training has been repeatedly shown to enhance agility performance (e.g Váczi et al., 2013). The effectiveness of plyometric training has led to innovative coaches experimenting with methods that combine strength and plyometric work, commonly known as complex training.

Complex training aims to utilise post-activation potentiation, where a heavy resistance primes the rate of force development (Lorenz, 2011) for biomechanically similar movements and in theory enhances the subsequent explosive action. Complex training typically involves strength-sprint and strength-jump complexes and such training has been found to improve sprint and jump performance but not agility (e.g. Alves et al., 2010); which is surprising given the effect of plyometrics on agility. Subsequently these results appear to highlight the importance of training specificity and that strength-agility complexes may be most relevant when aiming to improve agility. However as yet the effects of strength-agility complex training are unknown. Therefore the aim of this study was to investigate the efficacy of a strength-agility complex training protocol on strength, power and agility in female soccer players.

Methods

This study adopted a single case research AB design (A represented baseline conditions, B represented the introduction of an intervention) with the group acting as their own control (Kratochwill et al, 2010). Six female soccer players (age, 20 ± 4 years; height, 1.63 ± 0.02m; weight, 60.35 ± 6.95kg), who could be considered as advanced novices (Rippetoe and Kilgore, 2006), performed complex training twice a week for 4 weeks. The complex training involved performing 3 deadlifts (at 85% of 1RM as recommended by Carter and Greenwood, 2014) followed by 1 minute rest and then completing a modified 5-0-5 agility sprint. The deadlift was chosen as it primarily involves the musculature of the gluteals, hamstrings and quadriceps to produce hip and knee extension simultaneously (Hales, 2010) that is similar to the mechanics involved in sprinting and explosive turning (e.g. Beardsley and Contreras, 2014). The 5-0-5 was modified by shortening the run up to 5m given space confinements. Each complex was performed 6 times with 2 minutes rest between sets. 1RM deadlift strength, relative strength (% of body mass), power (squat and countermovement jump) and agility (modified 5-0-5) were tested pre and post intervention. Paired sample t-tests were used to determine significant changes ($p < 0.05$), with Cohen's D used to establish effect size.

Results

Significant improvements in 1RM strength (Pre, 72 ± 10.81kg; Post, 77.17 ± 10.30kg; p = 0.0001; d = 0.5; Figure 1), relative strength (Pre, 119 ± 11%; Post, 128 ± 12%; p = 0.0004; d = 0.03; Figure 2), and left foot agility time were found (Pre, 2.58 ± 0.07s; Post, 2.54 ± 0.04s; p = 0.04; d = 0.7; Figure 3). No changes in jump performance (Figure 4) or right foot agility were noted (Figure 3), although there was a significant difference between left and right foot agility post-training (Left, 2.54 ± 0.04s; Right, 2.60 ± 0.08s; p = 0.04; d = 1.0; Figure 3) but not pre-training.

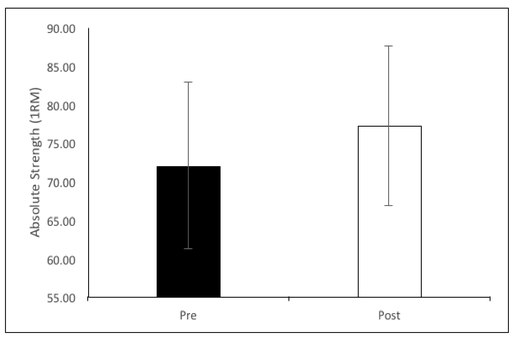

Figure 1: Pre and Post 1RM Deadlift Strength

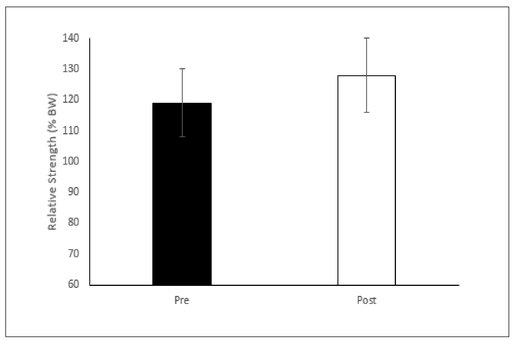

Figure 2: Pre and Post Relative 1RM Deadlift Strength

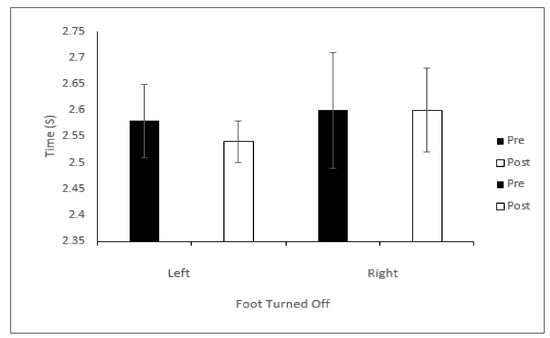

Figure 3: Pre and Post Modified 5-0-5 Agility Speed

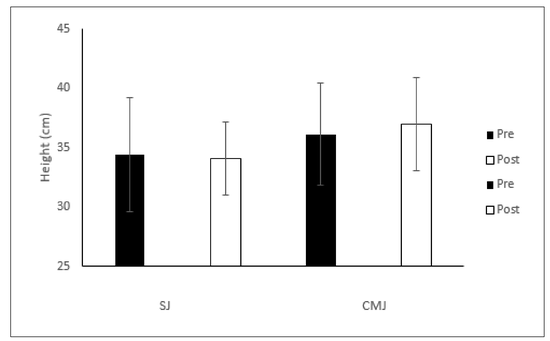

Figure 4: Pre and Post Squat and Countermovement Jump Heights

Conclusions

The improvements in agility in the left leg may have been due to unique imbalances developed through repetitive kicking (Rahnama et al., 2005). As all players were right-footed, the left leg may have developed superior neuromuscular qualities whilst acting predominantly as the supporting leg during kicking. The strength improvements were likely due to neural adaptations because of the protocol applied and were perhaps aided by motor learning transference to strength expression (Selvanayagam et al., 2011).

Short-term strength-agility complex training can simultaneously develop strength and agility qualities in female soccer players and therefore may be a viable training strategy to develop multiple aspects of fitness in team sport athletes with prolonged training, perhaps inducing further performance gains. The addition of unilateral strength and power tests and strength exercises that improve horizontal force production, should also be investigated due to the issue of leg dominance and the importance of specificity in agility training.

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