Review of resisted sled towing for sprint training

Sprinting consists of three phases: acceleration phase, transition phase and a maximal velocity phase (Cronin & Hansen, 2006). Acceleration is a major component in making a successful performance in many different sports and it can also be seen as potentially pivotal in determining the outcome of a sports game. Therefore training for acceleration is an essential component of many athletes' strength and conditioning programme (Kraemer et al. 2000).

When choosing methods to improve sprinting certain parameters need to be considered. The acceleration phase includes a longer stance time, increased trunk and knee flexion and greater propulsive forces (Kraemer et al. 2000). The muscular structure of the lower leg needs to have the necessary capacity to contribute to the acceleration performance and this is done through specific strength training activities. When an athlete improves strength, it produces greater force and decreased ground contact time which increases stride frequency (Spinks et al. 2007). Various training modalities including sprint loading improve the elastic energy during the support sage of the sprint cycle, increasing stride length.

Resisted sprint training is a basic conditioning method used by coaches to lengthen running stride (Makarur et al. 2013). It is carried out by adding an external load to the athlete, such as pulling a tyre, a loaded sled, running up hill or using parachutes. Hunter et al. (2005) observed that running velocity and increasing strength are greatly increased by resisted sprint training due to the increased strength and power of the leg extensor muscles in the acceleration phase.

This critical review will analyse previous studies and their findings when using resisted sprint training using weighted sleds on athletes.

Lockie (2003) and Letzelter et al. (1995) stated that towing causes acute changes in sprint kinematics of acceleration phase. Certain loads may be more appropriate for sprints performed from a block start compared to a standing start. Mero and Komi (1990) found mean contact time of foot to floor in the acceleration phase after a block start to range from 0. 15s to 0. 22s. This coincides with Spinks et al. (2007) findings of decreased contact time of first step of acceleration phase in the resisted sprint group of 11. 8% and recording 0. 15s to 0. 19s contact time.

Spinks et al. (2007) also found that the biggest increase in overall velocity was achieved in the 0-5m interval. Rimmer and Sleivert (2000) found that carrying out 8 weeks of sprint and plyometric training improves the velocity over the first 10m of the sprint. However Kafer et al. (1993) studied resisted sled training and found that there was a significant improvement of 0. 35 seconds (P <0. 001) over 20m and 60m when compared to assisted sprint training. They concluded that resisted sled towing improvements were due to increased resistance, increasing force production developing and maintaining velocity. This would increase the load on the strength shortening cycle, increasing muscle stiffness and vertical force at each ground coupling point.

Harridge et al. (1998) found that resisted sled towing can alter myosin heavy chain expression of muscle fibres. Increases in speed occur due to a shift in fibre type distribution and speed of shortening cycle which might contribute to increased power generation. 8. 4% significant increases were found on resisted sprint trained athletes when compared to a control group (Spinks et al. 2007). If power output of knee extensors are increased, improved ground contact time results in greater propulsive acceleration efforts. However Maclean () disproved this as he found that after testing this hypothesis across 6 weeks of training increase in muscle performance occurred without any significant change in myosin heavy chain or fibre type distribution.

Letzelter et al. (1995) after studying 16 female sprint performances found that performance was decreased by 8% and 22% respectively for the loads of 2. 5 kg and 10 kg. Results showed that this was predominantly due to the reduced stride length in athletes. Decreases in stride length by 5. 3% and 13. 5%, stride frequency 2. 4% with 2. 5 kg load and 6. 2% with a 10 kg load. Across all loads were found to be an increased stance time to lean and hip flexion angle. Lockie et al. (2003) reported similar findings when testing 20 males' field sport athletes. Athletes performed 15m sprints using no resistance, 12. 6% or 32. 2% of body mass load. These were chosen as previous findings show a decrease in 10/20% of max velocity. Decrease in stride length of 10% +24% were documented. Stride frequency was only found to decrease by 6% in each load. In agreement with Leztler et al. (1995).

Makurak et al. (2013) found running stride length increased in their resisted sled training group when compared to the standard training group. Findings were also supported by Delecluse (1997). Increasing stride length is said to be the result of performing fuller extension at the knee found by the increased knee angle at toe off. This change could be directly due to the strength between hip and knee extensors.

Bhowmick and Bhattacharyya (1988) suggest the horizontal acceleration of the arm swing increases stride length and during ground contact time the vertical element enhances the leg drive. Ropret et al. (1988) tested adding load to the athlete's arms however no significant reduction in initial acceleration over 30 m was found. Lockie et al. (2003) state that 32. 2% body mass was better for the development of upper body action. As the load increases shoulder range of motion increases. However Spinks et al. (2007) in terms of their study of upper-body kinematics found that it had little impact on acceleration performance.

The critical analysis of various studies showed that results were contradictory. More investigations into optimal load, changes in strength shortening cycle and training distances should be undertaken to find ideal training focus.

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