SINGLE-LEG AND DOUBLE-LEG TRAINING IMPLICATIONS FOR BASKETBALL

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Basketball players engage in strength and conditioning with the goals of maintaining their health and ability to meet the demands of the sport (e.g., running, cutting, changing of direction, jumping, etc.), reducing the risk of injury, and improving performance. However, appropriate manipulation of strength and conditioning programming variables is necessary in order to optimize the potential athletic adaptations. Specifically, exercise choice is a modifiable variable with great influence on the resulting adaptations and subsequent sport performance (6). For this reason, debate exists over whether bilateral or unilateral training is best for eliciting the desired response (1). Bilateral exercises require contraction of contralateral limbs (e.g., bilateral back squat as seen in Figure 1), while unilateral exercises require contraction of one limb individually (e.g., rear foot elevated split squat as seen in Figure 2). Some argue that bilateral training is best given the potential for greater absolute force and velocity generation (2). Whereas others argue that unilateral training is more sport-specific (i.e., running, cutting, and jumping are performed unilaterally), thus making it the superior option. Additionally, it has been argued that the existence of a bilateral force deficit (BLFD), the phenomenon of decreased bilateral force production compared to the sum of unilateral contractions, justifies a unilateral training preference (2). However, the available evidence suggests that the BLFD should have little to no influence on exercise selection (3). It may be wise to select bilateral and unilateral exercises based on how each influences performance. The purpose of this article is to compare single-leg and double-leg training options and provide considerations and potential implications for training basketball athletes.

COMPARING SINGLE-LEG AND DOUBLE-LEG TRAINING

Research comparing unilateral (single leg) and bilateral (double leg) training provides insight into how each training approach influences athletic attributes (e.g. strength, power, etc.) (1,2,3,4,5,7,8,9,10). A brief review of the literature comparing bilateral and unilateral lower body training allows for conclusions to made on the effects of single-leg and double-leg training and thus practical implications can be drawn to guide strength and conditioning programming for basketball athletes.

Rube and Secher investigated the effects of five weeks of single-leg and double-leg training on leg strength and fatigue (7). In agreement with the principle of specificity, this study found that single-leg and double-leg training increased strength and decreased fatigue, with no differences between single-leg and double-leg results (7). Interestingly, despite the fact that both legs were trained, single-leg training did not decrease fatigue during double-leg repeated maximal voluntary contractions, and double-leg training did not decrease fatigue during single-leg repeated maximal voluntary contractions (7). These results suggest that improvements in strength are similar between bilateral and unilateral training, while endurance capacity requires specific bilateral and unilateral training, with minimal crossover effect (i.e., unilateral training does not decrease bilateral fatigue and vice versa). Although endurance appears to exhibit training-specific adaptations without a crossover effect, strength and hypertrophy adaptations are not exclusive to the training type (4,5,7,8).

Recently, Botton et al. compared the neuromuscular adaptations of the knee extensors to unilateral and bilateral training in recreationally trained woman (5). Subjects trained for 12 weeks performing unilateral or bilateral leg extensions two times per week on non-consecutive days. Both unilateral and bilateral training groups similarly increased unilateral and bilateral knee extension one-repetition maximum (1RM), as well as unilateral and bilateral peak isometric knee extension torque (5). However, the unilateral training group had greater increases in unilateral 1RM than bilateral 1RM, while the bilateral training group had similar increases in bilateral and unilateral 1RM (5). Additionally, the unilateral training group demonstrated greater isometric peak torque increases compared to the bilateral training group, and only the unilateral training group increased muscle electrical activity. No difference in muscle thickness increases existed between training groups. These results suggest that dynamic strength increases and morphological changes are similar between unilateral and bilateral training, while unilateral training appears to potentiate unilateral strength gains as well electrical activity.

While unilateral and bilateral training can increase both unilateral and bilateral strength, the reported greater increases in unilateral 1RM by the unilateral training group is in agreement with other research. For example, Hakkinen et al. reported an average increase of 19% in bilateral 1RM in the bilateral training group versus an average increase of 13% in bilateral 1RM in the unilateral training group (10). Conversely, an average of 17% and 14% 1RM increase for right and left leg was reported for the unilateral training group, while the bilateral training group had average unilateral 1RM increases of 10% and 11% for the right and left legs, respectively. The same researchers reported non-significant differences in hypertrophy of the quadriceps suggesting hypertrophic effects to be similar between unilateral and bilateral training. Thus, unilateral and bilateral training appear to affect muscle size adaptations similarly, while the magnitude of strength increases seems to be specific to the training type.

In addition to the importance of endurance, strength, and hypertrophy qualities for basketball players, power is perhaps the most desired athletic attribute. McCurdy et al. studied the effects of eight weeks of unilateral or bilateral training on measures of strength and power in untrained men and women (8). Strength was assessed with a 5RM unilateral and bilateral squat test while power was assessed with a unilateral and bilateral vertical jump, as well as the Magaria-Kalamen stair climb test. The researchers reported similar improvements in all tests between the two training groups, with the exception of unilateral vertical jumping performance and relative power, which improved more in the unilateral training group (8). This would indicate that alternate-leg bounding power is equally improved with unilateral and bilateral training, but unilateral power is best improved by unilateral training. Given that alternate-leg bounding improvements do not appear to be training type specific, sprinting and agility qualities may be equally improved by unilateral and bilateral training.

Sprinting and changing of direction are two common tasks required in basketball. In what may be the most practical study comparing unilateral and bilateral training to date, researchers compared the effects of unilateral and bilateral squat training on strength, agility, and sprint performance (4). In this study, 18 rugby players performed rear foot elevated split squats (RFESS) or bilateral back squats twice weekly for five weeks using progressive relative 1RM loads. Subjects were pre- and post-tested for RFESS, back squat, pro-agility, 10-m, and 40-m sprint with results showing equal improvements between unilateral and bilateral training groups in the RFESS, back squat, and 40-m sprint (4). No improvement was seen in the 10-m sprint. These are compelling results demonstrating similar efficacy of unilateral and bilateral training for improving strength, sprint, and change of direction speed.

While the aforementioned data provides insight into unilateral and bilateral training muscle performance adaptations, these studies are limited by short training durations (<8 weeks) and pre- and post-test methods that do not allow for a time course distinction between training adaptations. Makaruk et al. performed a study to distinguish between the effects of unilateral and bilateral plyometric training on muscle performance over the course of training and detraining periods (9). In a group of physically active women, the researchers tested the unilateral and bilateral countermovement vertical jump, a 10-s Wingate test, and a five-jump alternate-leg bound pre-training, mid-training (after week 6), post-training (after week 12), and after four weeks of detraining. Interestingly, the unilateral training group improved in all tests by mid-training but had no further improvements from mid- to post-training, and had substantial decreases during detraining (9). The bilateral training group improved in only the Wingate test and bilateral countermovement jump from pre-training to mid-training (9). However, in contrast to the unilateral training group, the bilateral training group continued improvements from mid-training to post-training in all tests and did not regress from post-training to detraining.

These results indicate that although unilateral and bilateral training can be effective at improving lower body power and jumping ability, the improvements from unilateral training may be more immediate (e.g., 6 weeks) than improvements from bilateral training yet do not continue after initial increases. Conversely, power and jumping increases from bilateral training may take longer (e.g., 12 weeks) than unilateral training, but the adaptations appear to equate over time and last longer (9). These results have important implications for program design when training basketball athletes. Specifically, unilateral plyometric training appears beneficial for rapidly improving performance (e.g., pre-season, competition peaking), while bilateral plyometric training appears to allow for adaptations to maintain through periods of little to no training (e.g., in-season training, injury recovery). Importantly, the results do not suggest that each training type should be performed exclusively, but rather best practice likely warrants the inclusion of both unilateral and bilateral training to take advantage of the unique time course adaptations. Unfortunately, this study did not include strength training so it is unknown whether unilateral and bilateral resistance training follows similar time dependent adaptations as plyometric training.

CONCLUSION

Strength and conditioning participation is meant to allow basketball players to maintain their health, elicit desired muscle adaptations (e.g., endurance, strength, hypertrophy, power), and ultimately improve their ability to meet the demands of their sport (e.g., running, jumping, changing direction). Given the influence of exercise selection on training and performance outcomes, debate exists over whether unilateral or bilateral training is best for developing basketball players. The scientific literature comparing unilateral and bilateral training indicates that both types of training should be used to optimize performance. Endurance capacity (i.e., ability to resist fatigue) improvements appear to be type specific (e.g., unilateral training is required for unilateral endurance and vice versa). While strength and power increases are not exclusive to training type, the magnitude of improvement appears to be dependent on the type of training performed. Increases in muscle size, sprinting performance, and agility are similar between training types. Lastly, considerations must be given to the time dependent response of each training type; unilateral training appears to elicit rapid adaptations while bilateral training may take a bit longer to improve performance but the adaptations appear more resistant to detraining regression. The data taken together indicates that both unilateral and bilateral training should be incorporated into a comprehensive strength and conditioning program to develop basketball players optimally.

FIGURE 1.
BILATERAL BACK SQUAT

FIGURE 2.
UNILATERAL REAR FOOT ELEVATED SPLIT SQUAT

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