BUILDING A BALANCED AND SYMMETRICAL PHYSIQUE—IS REGIONAL HYPERTROPHY POSSIBLE?

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The concept of developing a region of a muscle or muscle group is commonly known as non-uniform or regional muscle hypertrophy. Bodybuilders and physique athletes have been implementing various techniques to attempt to accomplish this for many decades, but what is the scientific truth and basis for regional muscle hypertrophy? This article will provide a brief overview of the literature where regional hypertrophy has been reported and will discuss the basic science and application of regional hypertrophy training. The techniques presented can potentially be used to help clients with specific physique building goals.

EMERGING EVIDENCE OF REGIONAL MUSCLE HYPERTROPHY

Resistance training is well-accepted as the primary driver of hypertrophy of the target muscles. However, recent advances in noninvasive technology (e.g., magnetic resonance imaging, ultrasound) have allowed for a greater understanding of muscular adaptations within each muscle. Some studies suggest that growth of muscle heads of the quadriceps femoris, triceps brachii, and biceps brachii can vary following resistance training (19). Moreover, other studies suggest that anatomical cross-sectional area increases non-uniformly along the length of a muscle following regimented resistance training (1). In other words, the magnitude of exercise-induced muscle growth can vary in the proximal, middle, and distal portion of the muscle belly. For example, regional changes in muscle thickness were reported along the length of the biceps brachii (12% in proximal site versus 4.7% in distal site) following an upper body resistance training program (9). A study using blood flow restricted (BFR) training also reported that hypertrophy was greater in the distal part of the biceps compared to the middle part of the biceps when a dumbbell biceps curl program was performed concentrically only with BFR (the eccentric phase was facilitated by investigators) in one extremity as compared with BFR performed eccentrically only with the other arm (the concentric phase was facilitated by investigators) (18). Moreover, a study implementing a knee extension resistance training program showed more growth in the distal region of the vastus lateralis and rectus femoris, while greater muscle growth was evident in the proximal region of the vastus intermedius and medialis muscles (10).

EXERCISE SELECTION AND REGIONAL MUSCLE HYPERTROPHY

Muscles can be regionally targeted by varying exercise selection and performing exercises in different joint positions. For example, the proximal, middle, and distal regions of the rectus femoris grew significantly during a leg extension training program, while only the middle region of the vastus lateralis grew significantly during a Smith machine squat training program (20). Furthermore, performing various exercises during the week has shown to induce better muscle growth at all sites of the thigh and upper arm (proximal, middle, and distal), while performing the same exercises during all sessions only induced gains in some sites (16). Additionally, multi-joint and single-joint exercises may differentially impact regional hypertrophy. One study compared the effects of barbell bench press and lying barbell triceps press, either in isolation or in combination, on growth of the different heads of the triceps brachii. Greater growth of the triceps brachii lateral head was observed in groups that included the barbell bench press compared to those that only performed the lying barbell triceps press; conversely, greater growth of the long head was observed in groups that included the lying barbell triceps press compared to those that only performed the barbell bench press (3). Lastly, performing exercises in different joint positions may also promote regional hypertrophy. Positioning the toes straight, outward, or inward during the calf raise exercise has recently shown to impact hypertrophy of the heads of the gastrocnemius (12). When the toes were positioned outward, greater increases were observed for muscle thickness of the medial gastrocnemius head; whereas when the toes were positioned inward, greater gains were observed for the lateral gastrocnemius head (12).

EXERCISE RANGE OF MOTION AND REGIONAL MUSCLE HYPERTROPHY

It is also suggested that region-specific muscle growth can result from altering joint range of motion (ROM). Recruitment of specific areas of a muscle can potentially be optimized during a specific portion of an exercise's ROM and emphasizing this part of the ROM may promote regional hypertrophy (11). For example, training with shallow squats (60 degrees of knee flexion) has shown to preferentially induce growth at proximal regions of the thigh compared to other regions; however, training with a full ROM squat (femur parallel to floor) elicited equal growth across all muscle regions (2). Most recently, it was shown that partial ROM training in the initial phase of the knee extension exercise promoted greater muscle cross-sectional area of the rectus femoris and vastus lateralis at 40%, 50%, 60%, and 70% of femur length compared to final phase and full ROM training (13). It does seem that training at long muscle lengths is important for maximizing growth in the distal parts of the muscle. Nevertheless, training through a variety of ROMs has been suggested to be ideal for enhancing overall muscle growth (14).

ADVANCED TECHNIQUES FOR REGIONAL MUSCLE HYPERTROPHY

Non-uniform muscle hypertrophy is also possible with the use of advanced training methods, such as drop sets and eccentrics. Recently, a study reported that using drop-sets during leg extension training induced non-uniform hypertrophy whereby greater increases were observed at the proximal and middle

regions of the rectus femoris compared to the distal region (15). Lastly, a recent review found that the use of eccentric or isokinetic resistance training seems to promote hypertrophy of the most distal part of the muscle (19). Regular use of such advanced training techniques may also help optimize muscle growth across the entire length of muscles.

HOW DOES REGIONAL MUSCLE HYPERTROPHY OCCUR?

The exact mechanism as to how non-uniform hypertrophy occurs is not well understood yet. It has been speculated that region-specific hypertrophy is a consequence of differences in contractile protein synthesis following region-specific activation of a given muscle (17). Adding to this, which motor units are recruited during muscle contraction is primarily determined by Henneman's size principle, which suggests that there is an orderly recruitment of motor units according to their size (7). Recently, however, it has been suggested that the motor units recruited can also change depending on the mechanical properties of specific muscles and regions of muscles via the principle of neuromechanical matching (8). Simply stated, some motor units are recruited over others because they are better able to contribute to the movement due to factors such as internal moment arm length of the muscle. Lastly, some evidence also suggests that certain regions of a muscle have different architectural adaptations, such as pennation angle, which could make specific regions of a muscle grow differently based on the exercise and technique since those regions may be experiencing different mechanical tension (4,19). In short, altering the exercise, angle, range of motion, and technique in which exercises are performed may preferentially recruit different motor units. In turn, different regions of the muscle develop better than others.

PRACTICAL APPLICATIONS

Some evidence suggests that exercise selection, technique, and execution of the movement impacts which areas of the muscle experience the greatest gains in hypertrophy. For maximal muscular development, individuals looking to attain a well-balanced and symmetrical physique are recommended to incorporate several exercises, exercise techniques, ROMs, and angles to activate the full spectrum of muscle fibers within a given muscle. Table 1 below provides some guidance as to how to implement various methods to promote growth of various parts of muscles and muscle groups.

Although variety is important, changing exercises and techniques on a weekly basis is not ideal, as it does not allow for progressive overload to be implemented. As such, variables can be altered periodically between training blocks every 4 – 12 weeks to allow adequate time with the exercise and technique to properly progress. This means that a program that utilizes weekly variety should be followed for several weeks to several months before it is altered with different exercises/techniques for another 4 – 12 week training block unless there is a need to change the program due to factors such as pain associated with the movement.

It should be mentioned that not all studies that have examined regional hypertrophy have demonstrated positive outcomes. For example, a study investigating whether the rest-pause technique elicited different changes in muscle thickness to the proximal, middle, and distal parts of the thigh as compared to traditional resistance training revealed that regional muscle hypertrophy was similar between the conditions (6). The authors did report that the effect sizes tended to favor the rest-pause technique for increases in distal thigh growth, yet the practical meaningfulness remains questionable. While an in-depth discussion of other studies that have shown similar results is beyond the scope of this article, it is important to emphasize that this area of research is relatively new. However, personal trainers should be aware of conflicting studies.

In conclusion, a growing body of evidence supports regional hypertrophy is possible and it may be worthwhile for personal trainers and athletes to consider strategies for promoting regional growth when attempting to maximize muscle hypertrophy and build a balanced and symmetrical physique. More studies in this area are necessary to fully understand the various exercises and techniques that may be utilized to preferentially induce regional hypertrophy. Adding variety to a weekly training program appears to be advantageous as long as the changes to the program are not made so frequently that progressive overload is prohibitive.

TABLE 1. TECHNIQUES FOR REGIONAL HYPERTROPHY OF SELECT MUSCLES

MUSCLE OR MUSCLE GROUP	REGION OF MUSCLE	TECHNIQUE OR EXERCISE SELECTION	REFERENCES
Chest	1. Upper pectoralis major	1. Incline bench press	(5)
Triceps	1. Lateral head triceps	1. Barbell or dumbbell (DB) flat bench press	(3)
	2. Long head triceps	2. Overhead barbell triceps extension	
Biceps	1. Distal biceps	1. DB concentric blood flow restricted training	(18)
Quadriceps	1. Rectus femoris (RF)	1. Leg extensions	(2,15,20)
	2. Vastus lateralis	2. Smith machine squats	
	3. Proximal quadriceps	3. Partial range of motion squat	
	4. Proximal/mid RF	4. Drop sets	
Calves	1. Medial gastrocnemius	1. Calf raises (toes positioned outward)	(12)
	2. Lateral gastrocnemius	2. Calf raises (toes positioned inward)	

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