Hypertrophy Fundamentals

I. Introduction

- What is skeletal muscle hypertrophy?

At a cellular level, each individual muscle fiber within a muscle fascicle increases its cross-sectional area by expanding the sarcoplasm and adding contractile units to the muscle cell. In other words, the gel within the cell expands, and sarcomeres are added to the larger cell space in parallel (i.e., sardines in a can) or in series (i.e., links in a chain). When every individual muscle fiber expands, the muscle fascicle that bundles the fibers expands, and the entire muscle belly grows (Taber, 2019).

- What causes skeletal muscle hypertrophy?

In short, muscle protein synthesis (MPS) and muscle protein breakdown (MPB) are constantly in flux within the muscle cell, and there are phases throughout the day when MPS outpaces MPB (e.g., following a session of lifting), and vice versa (e.g., following an overnight fast). When resistance training (RT) is performed, it increases the rate and duration of MPS, so that MPS will be greater than MPB for an extended period of time. This effect is amplified when amino acid consumption is combined with RT. If MPS > MPB for days, weeks, and months, muscle hypertrophy occurs. There are several proposed mechanisms by which RT stimulates an increase in MPS, which include increased metabolic stress, local hypoxia, cellular swelling, muscle damage, ribosomal biogenesis, myonuclear accretion, and mechanical tension. All of these contribute to muscle hypertrophy, but mechanical tension (i.e., forces applied to the sarcolemma) is likely the strongest stimulus (Wackerhage, 2019).

- Why does skeletal muscle hypertrophy matter?

There are several cardiovascular and metabolic health benefits associated with increasing lean mass that include increased resting metabolic rate, increased cellular hydration, decreased visceral fat mass, decreased fasting glucose, decreased blood pressure, decreased inflammation, improved insulin sensitivity, and improved blood-lipid panels. Together, these positive effects help explain why RT has been associated with decreased risk for mortality and sudden cardiac episodes (Codella, 2018; McLeod, 2019; Westcott, 2012). This implies that hypertrophy training is essential for every client.

II. How many sets should you perform?

There are several ways to quantify RT volume (i.e., how much work is performed during a training session) including total volume load (sets x reps x load), repetition volume (sets x reps), and sets per exercise. The latter option is arguably the easiest way to monitor training volume, and it has been researched the most in the RT literature. Considering one training session, research consistently suggests that multiple-set training is more effective than single-set training, and there is a dose-response relationship between set volume and hypertrophy (Krieger, 2010). When extrapolated over the course of a week, there is also a consistent dose-response relationship between weekly set volume for a muscle group and the subsequent hypertrophy of that muscle group

(Schoenfeld, 2017). Weekly set volume for a muscle group can be increased by performing more sets of a particular exercise (e.g., leg press) or by adding another exercise that targets the same muscle group (e.g., leg press and belt squat). For best practice, the current evidence suggests that a lifter should perform 3-4 sets of an exercise during one session and/or complete 12-20 weekly sets for each major muscle group. Above all, consider how many weekly sets your client is currently doing for a muscle group, and increase their volume by ~10% each week until they are no longer responding to the stimulus, or they feel extraordinarily fatigued (i.e., non-functional overreaching). Like other training variables, set volume should be systematically increased and decreased throughout a training cycle.

III. How many days per week should you train?

In the context of RT, frequency (i.e., how many days per week you train) refers specifically to how many days per week you dedicate to each major muscle group. For example, if you train 4 days/week while using an upper/lower split, you are training your upper- and lower-body muscles at a frequency of 2-days/week. Interestingly, when weekly training volume is matched, hypertrophy is similar regardless of how many days per week the lifter trains (1-4 days/week) (Schoenfeld, 2019). This means that volume is the key variable for hypertrophy, and frequency should be seen as a tool to modulate volume during a training cycle. Consider the following example- If you planned to perform 12 sets of leg press this week, you have several options for training frequency:

- 1 day/week = 12 sets on Mon
- 2 days/week = 6 sets on Mon, 6 sets on Thurs
- 3 days/week = 4 sets on Mon, 4 sets on Wed, 4 sets on Fri

According to the meta-analysis by Schoenfeld et al. (2019), hypertrophy in the quadriceps should be similar between these conditions, but we must be pragmatic with our exercise programming. For instance, it is unlikely that a client would like to perform 12 sets for one exercise on one training day. Also, if you increased training frequency from 1 day/week to 3 days/week, weekly set volume for leg press will naturally increase (e.g., from 12 to 15), which may be a stronger stimulus for hypertrophy. For best practice, arrange your training to target each major muscle group 2-3 days/week. If a client can only train 1 day/week, it is important to hit a high set volume during this training session.

IV. How heavy should the external load be?

Although it is commonly referred to as “intensity,” external load is arguably a more accurate representation of how heavy the weights are during RT sessions. Intensity/external load is commonly expressed relative to a one-repetition maximum (1-RM) (e.g., , if a lifter’s 1-RM is 100 pounds, then 75% 1-RM is 75 pounds) or as a repetition maximum (RM) (e.g., if a lifter can lift 75 pounds for 10 reps, their 10-RM is 75 pounds). With this in mind, the traditional “hypertrophy training zone” touted by the National Strength and Conditioning Association is ~6-12 repetitions at ~67-85% of 1-

RM. By their estimation, this is the ideal blend of mechanical and metabolic stress that leads to a perfect hormonal milieu for increasing MPS and stimulating long-term hypertrophy. However, a plethora of recent research has demonstrated that hypertrophy actually occurs outside of this range with loads as heavy as 90% 1-RM (3-5 reps) and as light as 30% 1-RM (30-35 reps) (Schoenfeld, 2021). Some have even reported hypertrophy with 95-100% of 1-RM (1-2 reps) and <20% of 1-RM (40+ reps) (Schoenfeld, 2021). For best practice, the effective hypertrophy range is ~3-35 reps per set, which corresponds with a relative intensity of 30-90% of 1-RM. This means that light, moderate, and heavy loads can be used to stimulate hypertrophy, as long as sets are performed *close to failure* (discussed later).

V. How fast or slow should repetitions be?

Although it is sometimes an overlooked training variable, repetition tempo (i.e., how fast or slow the lifter completes a full range of motion) is important to consider for hypertrophy. Repetition tempos are typically divided into their eccentric and concentric phases so that a 3-second tempo might be written as a 2:1 second tempo in which the lifter lowers the weight for 2 seconds (eccentric) and raises the weight for 1 second (concentric). Similarly, a 6-second tempo could be written as a 4:2 second tempo or a 5:1 second tempo. Assuming that effort is high, and sets are performed *close to failure,* a recent meta-analysis concluded that hypertrophy occurs at a range of 0.5-8 seconds (Schoenfeld, 2015). This means that fast, normal, and slow tempos are effective for hypertrophy. Another review paper showed evidence that when very-light weights and/or body weight are used for resistance, repetition tempos can be as slow as ~15-90 seconds (Lyons, 2020). Here are some practical application points:

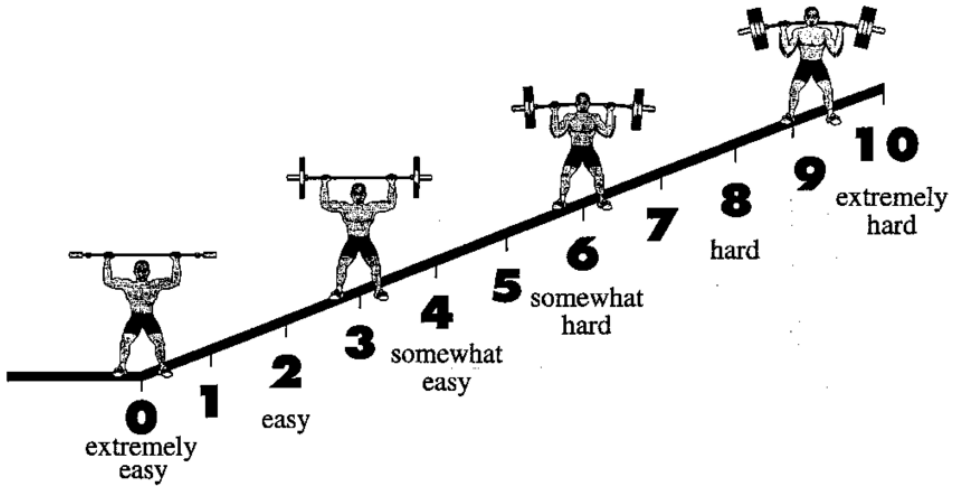
- Keep things simple. The most commonly used repetition tempos in the RT literature are 1:1 sec, 2:1 sec, and 4:2 sec, and each of them are effective. Try rotating them on a daily, weekly, or monthly basis as you would any other training variable.
- Change the tempo as a form of overload. Instead of changing the set volume or increasing/decreasing external load, have your client keep the external load the same (e.g., 60 lbs.) but perform slower repetitions (e.g., 4:2 sec instead of 2:1 sec).
- Consider the primary training goal. For example, if your primary desired outcome is hypertrophy, it may be prudent to perform a block of training with slower tempos such as 4:2 sec or 5:1 sec. However, if power and strength are desired outcomes, faster repetition tempos might be more effective, especially during the concentric phase of motion.

VI. Should you train to failure or not?

Training to failure, or not, is a hot topic of debate in the hypertrophy research. A recent meta-analysis reported that hypertrophy is similar between failure and non-failure training, although it may be necessary for highly-trained lifters to perform their sets

closer to failure (Grgic, 2021). It is important to consider how "failure" is defined. For example, momentary muscular failure, also known as concentric muscular failure, implies that the lifter performed the set to complete exhaustion and could not finish the final repetition. Think of this as being a 10 out of 10 effort on a 1-10 RPE scale (below). In contrast, "volitional interruption" describes a condition in which the lifter feels fatigued, but they terminate the set before complete exhaustion occurs. Think of this as a 7-9 out of 10 effort meaning that effort was high, but momentary muscular failure did not occur. Of note, a recent study by Santanielo et al. (2021) concluded that hypertrophy was similar between momentary muscular failure and volitional interruption conditions, which means that "10 out of 10 efforts" are not necessary for hypertrophy. Here are some key practical application points:

- Use both in the same session. If you have 4 sets of seated row planned, perform the first 3 sets to volitional interruption and the final set to momentary muscular failure.
- Consider the exercise being trained. It is safer and more practical to perform failure sets on RT machines and for single-joint, auxiliary lifts at the end of a training session. In other words, do not perform sets of barbell back squat to complete failure.
- Training status is important. Inexperienced, untrained lifters require significantly less effort than experienced, trained lifters to stimulate hypertrophy.
- Apply failure and non-failure training in a flexible manner. In other words, allow your client's current mood, fatigue, and soreness dictate how much effort they put into each set.



VII. Bonus: How long should rest intervals be between sets?

The original hypertrophy research recommended shorter rest intervals between sets (30-60 sec) in order to spike supposedly anabolic hormones such as insulin growth factor 1, growth hormone, and testosterone (Wackerhage, 2019). However, prevailing research has demonstrated that the transient increase in these hormones are not associated with post-

RT MPS and subsequent hypertrophy (West, 2009), and the concentration of these hormones is similar when short (30 sec) or long (210 sec) rest intervals are used (Fink, 2017). In addition to these facts, a recent study by Schoenfeld et al. (2016) demonstrated that superior hypertrophy was achieved following training with 3-minute rest intervals compared to 1-minute rest intervals. In a follow-up study, the same research team again reported that 3 minutes > 1 minute for hypertrophy, which stemmed from higher volume load performed by the 3-minute rest interval group (Longo, 2020). Frankly, longer rest intervals result in lower fatigue and higher quality of set as measured by greater repetitions completed, average velocity of repetition, and volume load for the entire session. Thus, for hypertrophy training, it is recommended that 2-3 minute rest intervals are afforded between sets, and some clients may even require longer. With that in mind, the fitness professional should be creative with their programming to maximize the time spent between sets that target the same muscle group:

- Reciprocal super sets
    - Goblet squat + hamstring curl + rest
- Total-body super sets
    - Goblet squat + inverted row + rest
- Corrective exercise super sets
    - Dumbbell bench press + thoracic rotation + rest
- Total-body tri sets
    - Goblet squat + inverted row + push up + rest

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10 Advanced Hypertrophy Techniques

1. **Longer Eccentric Contractions**

   - **What is it:** Because eccentric contractions elicit greater mechanical tension and muscle damage compared to concentric contractions, some have theorized that repetitions with longer, slower eccentric phases may lead to more hypertrophy than repetitions with shorter, faster eccentric phases. For example, a fast-repetition tempo may involve lowering a weight for one second and lifting the weight for one second (1:1 sec). In contrast, a repetition with a slower-eccentric phase would involve lowering a weight for four seconds and lifting the weight for one second (4:1 sec).

   - **Study reviewed:** Kojic et al., 2021
     - ***Methods:*** 20 untrained, college-aged subjects were randomly assigned to training with 1:1 or 4:1 second tempos (as described above). Both groups trained biceps preacher curl two days/week for 7 weeks, completed 3-4 sets at 60-70% 1-RM, used 120-second rest intervals, and all sets were performed to failure.
     - ***Hypertrophy results:*** Muscle thickness of the biceps brachii, as measured by B-mode ultrasound, significantly increased for the 1:1 sec (+3.24 mm) and 4:1 sec (+3.57 mm) groups with no differences between them.
     - ***Conclusion statement:*** When external load is matched and sets are performed to failure, it seems that eccentric duration does not have a significant effect on muscular hypertrophy.

   - **Practical advice:** Because effort and load have a stronger effect on hypertrophy than the duration of eccentric contractions, fitness professionals should use several variations of repetition tempos to keep the program effective and interesting. Like other popular training variables, such as intensity and volume, eccentric duration can be undulated on a daily, weekly, or monthly basis based on training goals and client's preference.

2. **Accentuated Eccentric Training**
   - **What is it:** Because muscles are ~25-50% stronger while contracting eccentrically, some have proposed that RT exercises should be adapted so that lifters can use heavier loads during the eccentric phase and lighter loads during the concentric phase of the same exercise. For example, this can be accomplished with weight releases, which are essentially weight stacks attached to a barbell that detach when the lifter transitions from eccentric to concentric phase. Alternatively, there are flywheel pulley systems in which a disc spins and conserves energy during the concentric phase of movement, which is released during the eccentric phase of movement (i.e., more force is applied to the muscle during the eccentric phase).

- **Study reviewed:** Lundberg et al., 2019
    - **Methods:** 16 young, healthy subjects had their legs randomly assigned to perform sets of knee-extension with traditional, weight-stack machines or a flywheel, accentuated eccentric phase machine. Training took place 2-3 days/week for 8 weeks and they performed 4 sets to failure on each leg.
    - **Hypertrophy results:** Muscle thickness was measured at the proximal, distal, and middle portions of all four quadriceps muscles. Both groups significantly increased at every site measured with no differences detected between groups.
    - **Conclusion:** Both training styles are effective at stimulating muscle hypertrophy. However, flywheel training involved significantly fewer repetitions per set (7 vs. 10), meaning that comparable results were delivered with less training volume and duration.

- **Practical advice:** Although this style of training is effective, the equipment may be expensive and/or difficult to access. For those training athletes, accentuated eccentric training may confer benefits to human performance that extend beyond skeletal muscle hypertrophy (e.g., deceleration capability for injury prevention). However, for those training general population clients, it is worth noting that hypertrophy can be stimulated with traditional training techniques.

3. Slow, Tonic Contractions

- **What is it:** This type of lifting tempo involves lowering a weight for 3 seconds and raising a weight for 3 seconds with ZERO pause between consecutive repetitions. Those who tout this style of training believe that by keeping the muscle under constant tension, the lifter will elicit greater hypertrophy by imposing greater metabolic and hypoxic stress on the muscle.

- **Study reviewed: Tanimoto et al., 2008**
    - ***Methods:*** 36 young, healthy subjects without RT experience were randomly assigned to non-exercise control, slow + tonic training (3:3:0 sec; 55-60% 1-RM), or fast + heavy training (1:1:1 sec; 80-90% 1-RM). The training groups lifted two days/week for 13 weeks and performed total-body RT with the following five exercises: vertical squat, chest press, abdominal crunch, back extension, and lat pull down. By design, the slow + tonic group did not relax between their repetitions in order to keep constant tension on the muscles.
    - ***Hypertrophy results:*** Sum of muscle thickness at the chest, biceps, triceps, abdomen, scapula, quadriceps, and hamstring, which was measured by B-mode ultrasound, significantly increased for the slow + tonic (+6.8%) and fast + heavy (+9.1%) groups with no differences between them.
    - ***Conclusion statement:*** Both training programs were effective for hypertrophy, so a well-rounded RT plan could include both styles within it. Alternatively, because some lifters may not be able to use heavy loads (80-

90% 1-RM), this study suggests that they can use lighter loads (55-60% 1-RM) with slower contractions.

- **Practice advice:** Because some lifters may not be able to use heavy loads (80-90% 1-RM), this study suggests that they can stimulate hypertrophy with lighter loads (55-60% 1-RM) lifted with slower, tonic contractions (3:3:0 sec). Alternatively, the 3:3:0 sec tempo can be used to increase the difficulty of body weight RT and/or to have a lifter concentrate harder on their form while they learn a new motor pattern.

4. Cluster Sets

- **What is it:** Simply, a cluster set involves using an intra-set rest interval while lifting with moderate/heavy external loads (2-8RM). By doing so, the lifter will experience less fatigue during the set while performing more forceful, powerful repetitions. For example, while using a 6-RM on a bench press, the lifter could perform two different version of a cluster set:
    - #1 = Perform first 3 reps - rest for 30 sec - perform final 3 reps
    - #2 = Perform first 2 reps - rest for 15 sec - perform middle 2 reps - rest for 15 sec - perform final 2 reps.

- **Study reviewed:** Davies et al., 2021
  This was a meta-analysis that combined the results from 29 studies that compared cluster-set to traditional-set RT. Data indicated that both styles of RT had positive effects on endurance, strength, power, and hypertrophy and there were no significant differences between styles. Therefore, both should be included at various phases during a RT program, especially when a lifter wants to finish their sessions with significantly less fatigue.

- **Practical advice:** Use cluster sets for clients who do not tolerate muscular fatigue well (e.g., elderly clients) or for populations who are looking to increase hypertrophy and strength with less fatigue and exhaustion (e.g., athletes). This style of training should be reserved for multiple-joint exercises that serve as the main lifts during a RT session such as back squat, dead lift, bench press, push press, etc.

5. Drop Sets

- **What is it:** When doing this style of training, a lifter completes a set of 6-10 repetitions to failure, immediately reduces the external load by 20-30%, and performs another set to failure. Most drop sets include 2-4 “drops” as described in the previous sentence. This style of training is attractive because it allows a lifter to perform high repetition volume in a short amount of time, which represents an opportunity to train for hypertrophy in a time-efficient manner.

- **Study reviewed:** Ozaki et al., 2018
    - ***Methods:*** Nine untrained subjects had each of their arms randomly assigned to high-load training (3 sets with 80% 1-RM), low-load training (3 sets with 30% 1-RM), or drop-set training (1 set with 80-65-50-40-30% 1-RM). All groups performed unilateral dumbbell curls 2-3 days/week for 8 weeks and all sets were performed to concentric muscular failure.
    - ***Hypertrophy results:*** Elbow flexor cross-sectional area, as measured by magnetic resonance imaging, increased after high-load (+2.5 cm^2), low-load (2.6 cm^2), and drop-set (+2.4 cm^2) training with no difference between groups. Interestingly, the drop-set sessions only lasted ~2 minutes compared to ~7-11 minutes for the other groups.
    - ***Conclusion:*** Drop-set training is just as effective as traditional high-load and low-load training, and is accomplished in a time-efficient manner.

- **Practical advice:** Use drop sets as a part of a hypertrophy training session, particularly for single-joint, machine-based exercises that are performed at the end of a session. Do not use drop sets on multiple-joint, free-weight exercises such as back squat or bench press.

6. Reciprocal super sets

- **What is it:** To reduce time in the gym, lifters can perform their exercises in pairs that target different and/or opposing muscle groups. For example, a lifter could perform 8-10 repetitions of a seated row, take a minimal rest interval (5-15 seconds), and then perform 10-12 repetitions of a push up. In another example, a lifter could perform consecutive sets of 6-8 repetitions for belt squat and hamstring curl with minimal rest between them. This style of training leads to greater cardiorespiratory stress and reduces training time by 50-60%.

- **Study reviewed:** Fink et al., 2020
    - ***Methods:*** 23 young athletes were randomly assigned to traditional or super-set training. Both groups performed bicep curl and triceps extension with elastic bands 3 days/week for 8 weeks.
    - ***Hypertrophy results:*** Muscle thickness, as measured by B-mode ultrasound, increased for the biceps brachii (+12.9-13.3%) and triceps (+4.8-9.5%) for both groups with no significant difference between groups.
    - ***Conclusion:*** There is not a unique hypertrophic advantage to super-set training, but this style of training serves as a time-efficient strategy to achieve adaptations in muscle mass.

- **Practical advice:** By performing exercises in pairs, and limiting the rest between consecutive exercises, you can reduce your client's training time by 50-60%. This will allow you to increase work capacity and muscular hypertrophy in a time-efficient

manner. You can apply reciprocal super-sets to upper-body, lower-body, and total-body training.

7. **Pre-exhaustion sets**

- **What is it:** There are several forms of pre-exhaustion training, but the most popular form involves fatiguing a synergist muscle (e.g., triceps extension) to allow the agonist muscle (e.g., pectoralis major) to work harder during a subsequent exercise (e.g., bench press). However, this style of pre-exhaustion training often leads to reduced training volume during the primary exercise (e.g., bench press), which causes inferior adaptation of the muscle of interest (e.g., pectoralis major). Because of this, it may be more effective to simply perform compound sets, which are essentially super sets that target the same muscle group.

- **Study reviewed:** Trindade et al., 2019
    - ***Methods:*** 24 untrained, middle-aged subjects were randomly assigned to traditional RT (3 sets of leg press with 75% 1-RM) or pre-exhaustion RT (3 sets of leg press with 75% 1-RM immediately after a pre-exhaustion set of knee-extension to failure). Both groups trained two days/week for nine weeks.
    - ***Hypertrophy results:*** Both groups significantly increased their total-body lean mass, thigh lean mass, and muscle thickness for their quadriceps and gluteus maximus with no significant differences between groups.
    - ***Conclusion:*** Both training styles were equally effective despite the extra time commitment of performing the pre-exhaustion set of knee-extension.

- **Practical advice:** To protect RT volume for the main lift, agonist-agonist super sets should be performed in lieu of pre-exhaustion sets. It is most practical to perform a multiple-joint lift (e.g., dumbbell push press) followed by a single-joint lift (e.g., lateral raise) for the same muscle group. This is a logical way to increase training volume for a particular muscle group.

8. **Partial range of motion**

- **What is it:** Partial range of motion (ROM) training, also known as "partials", focuses on training the middle ROM of an exercise and is thought to elicit significant muscular tension by allowing the lifter to perform RT at a higher load compared to lifting with the full ROM and thus aid in the development of muscular strength and hypertrophy. The slower movement speeds associated with partials may elicit substantial time under tension that promotes large accumulations of local metabolites that may also contribute to increases in muscular strength and hypertrophy.

- **Study reviewed:** Goto et al., 2019
    - ***Methods:*** 44 resistance-trained males were randomly assigned to perform supine elbow extensions (i.e., skull crushers) through a full-ROM or a partial-

ROM, where only the middle ROM was covered. Both groups performed 3 sets of 8 repetitions and trained 3 days/week for 8 weeks.
    - ***Hypertrophy results:*** Both groups significantly increased their triceps thickness from baseline, but hypertrophy was slightly greater in the partial-ROM group compared to full-ROM. The researchers also reported that metabolic stress and local hypoxia was greater during the partial-ROM sessions, which may explain why they had superior results.
    - ***Conclusion:*** Partial-ROM training may be effective for hypertrophy, but it should not be used to replace full-ROM training, especially for those who have mobility, speed, and power goals.

- **Practical advice:** Consider partial-ROM training a tool in the practitioner's toolbox to include as a part of a hypertrophy training session. For instance, it may be best to save this style of training at the very end of the workout during the auxiliary, single-joint work such as during a triceps extension or biceps curl. Alternatively, partial-ROM training can be used in concert with full-ROM training to make body-weight exercises more difficult and stimulating. Some have also reported that partial-ROM training is effective when it is applied to the specific ROM where a lifter typically gets "stuck" when attempting a full-ROM repetition (i.e., the sticking point).

9. Linear and reverse pyramid training

- **What is it:** Instead of using the same external load and relative intensity for every set (e.g., 3 sets of 10 at 75% 1-RM), pyramid training involves increasing or decreasing the load as sets progress. During a linear pyramid plan, the lightest set is performed first, and load is increased in subsequent sets (e.g., 3 sets at 75-80-85% 1-RM). The opposite is true during a reverse pyramid plan, as the heaviest set is performed first, and load is decreased in subsequent sets (e.g., 3 sets at 85-80-75% 1-RM). Generally speaking, the research in this area is scarce, but these styles of training can serve as a way to break up the monotony of training with the same external load for every set of a given exercise.

- **Study reviewed: Razmjou et al., 2010**
    - ***Methods:*** 34 young, untrained women were randomly assigned to linear pyramid training, reverse pyramid training, or non-exercise control. The exercising groups performed total-body RT 3 days/week for 6 weeks and used the following exercises: biceps curl, triceps extension, leg extension, leg curl, and leg press.
    - ***Results:*** The authors did not report data for muscle mass or hypertrophy, but both groups significantly increased their 10-RM for each of the six exercises mentioned above. Besides the biceps curl, where greater increases were seen in the reverse pyramid group, there were no differences between groups.
    - ***Conclusion:*** Both pyramid styles are effective for increasing muscular strength and should be used in a client's program based on convenience and

preference. Research is needed to determine the effect of pyramid training on hypertrophy.

- **Practical advice:** For lesser-trained clients, apply linear and reverse pyramid with moderate external loads such as 8-15 RM (~60-80% 1-RM). As they become more experienced, increase the number of sets (e.g., 3 to 4) and start to implement heavier loads such as 2-6 RM (~85-95% 1-RM). When structuring a session of RT, linear and reverse pyramid set/rep schemes should be reserved for multiple-joint power and structural lifts such as dumbbell cleans, back squat, or push press.

10. Rotated-exercise program

- **What is it:** Although it may be considered a secondary variable, performing a variety of exercises for the same muscle group has recently become a hot topic in RT research. For example, in a fixed-exercise routine, a lifter would perform the same exercise for the same muscle group for every training session (e.g., seated cable row would be the only horizontal pulling exercise). In contrast, during a rotated-exercise routine (i.e., varied), the lifter would perform a variety of exercises for the same muscle group (e.g., seated cable row, bent-over barbell row, and single-arm dumbbell row would be used in a cyclical fashion). Indeed, to increase hypertrophy and strength, it is not necessary to change the exercise on a daily or weekly basis, but providing variety may help your client adhere to their program better.

- **Study reviewed:** Baz-Valle et al. 2019
    - **Methods:** 19 resistance-trained men were randomly assigned to a fixed-exercise routine or rotated-exercise routine, which was performed 4 days/week for 8 weeks following an upper/lower split. Those in the fixed-exercise group used the same upper- and lower-body routines throughout the study while those in the fixed-exercise routine had their exercises randomly selected by an iPhone app at the beginning of each session.
    - **Hypertrophy results:** Quadriceps hypertrophy, which was measured by B-mode ultrasound, significantly increased for both groups with no differences between them. Similar results were reported for upper- and lower-body strength.
    - **Conclusion:** Physical fitness outcomes were similar between groups, but subjective measurements of motivation were higher in the rotated exercise group. Although exercises should never be chosen at random (e.g., via a phone app), presenting a little bit of variety may help adherence.

- **Practical advice:** Personal trainers should teach their clients as many variations of a movement pattern as possible (e.g., front squat, back squat, split squat, goblet squat, belt squat, etc.), and eventually progress the program where the client is able to pick their favorite version for a given day, week, or month. Alternatively, you can keep the

primary exercises consistent for longer periods of time (e.g., perform goblet squat for 4-6 weeks straight) while presenting variety during the auxiliary, single-joint exercises (e.g., teach/perform several versions of a hamstring curl or glute bridge).

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