THE SCIENCE OF MUSCLE GROWTH

INSIGHTS FROM THE LAST 50-60 YEARS OF RESEARCH

BY

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Muscle growth, or hypertrophy, has been a central topic in exercise science for decades. Over the past 50-60 years, extensive research has provided us with valuable insights into the mechanisms, strategies, and principles that maximize muscle growth. This eBook compiles these findings into actionable guidelines, supported by scientific evidence, to help you optimize your training and nutrition for better muscle development.

Principle 1: Training Close to Failure

One of the most critical principles for muscle growth is training close to failure. The concept of "true failure" refers to the point at which you cannot complete another repetition with good form, even if your life depended on it. Research indicates that training 1-2 repetitions shy of this point is ideal for maximizing muscle hypertrophy.

Studies have consistently shown that training close to failure increases muscle activation, leading to greater muscle fiber recruitment, which is essential for growth (Grgic et al., 2018).

Principle 2: The Non-Negotiable Rule of Progressive Overload

Progressive overload is the cornerstone of any effective muscle-building program. This principle involves gradually increasing the weight, volume, or intensity of your workouts over time to continue challenging your muscles. Without progressive overload, your muscles will adapt to the workload, leading to a plateau in growth. The research strongly supports the need for progressive overload to sustain long-term muscle hypertrophy (Schoenfeld et al., 2017).

Principle 3: Optimal Training Volume

To maximize muscle growth, most individuals should aim for 12-20 hard sets per muscle group per week. However, this is a general guideline, and there are outliers who may require more or less volume. Stronger body parts that grow quickly often need closer to 12 sets per week, while lagging parts might benefit from higher volumes, up to 20 sets.

Research has demonstrated that training volume is a significant predictor of muscle hypertrophy, with higher volumes generally leading to greater growth (Schoenfeld et al., 2016).

Principle 4: Garbage Technique = Garbage Results

Before optimizing volume or intensity, it is essential to perfect your exercise technique. Poor technique not only limits the effectiveness of your workouts but also increases the risk of injury. Studies emphasize the importance of proper form to fully engage the target muscle groups and prevent compensatory movements (Kibler et al., 2013).

Principle 5: Frequency and Distribution of Training Volume

You can only do about 6-8 hard sets per muscle group per session. So doing 4-5 exercises for a muscle group and 15-20 sets on the same day (aka bro split) is a huge waste of time. You will get a lot more out of your sessions by spreading them over 2-3 sessions (Schoenfeld, 2016).

Principle 6: The Versatility of Rep Ranges

Muscle growth can occur across a wide variety of rep ranges, from 5 to 30 repetitions per set. Research shows that both low (5-8) and high (20-30) rep ranges can stimulate hypertrophy, as long as the sets are performed close to failure (Morton et al., 2016).

Principle 7: Exercise Selection and Muscle Lengths

Effective exercise selection involves choosing movements that train muscles through their entire range of motion, including the lengthened, mid, and shortened positions. This approach ensures comprehensive development of muscle fibers, leading to more balanced growth (Wernbom et al., 2007).

Principle 8: Recovery: Muscles vs. Connective Tissues

Muscles recover quickly, often within 24-48 hours, while connective tissues like tendons and ligaments take longer to heal. Periodizing your training with varied rep ranges can help balance muscle growth with connective tissue recovery, reducing the risk of overuse injuries (Schoenfeld, 2011).

Principle 9: The Myth of Muscle Confusion

The concept of muscle confusion, or frequently changing workout routines to "shock" the muscles, is largely unsupported by research. Instead, consistency and gradual progression in a well-structured program are key to sustained muscle growth (Schoenfeld, 2011).

Principle 10: Caloric Surplus Gives You Better Odds for Muscle Growth

Building muscle requires energy, and while it's possible to gain muscle at maintenance or in a small deficit, a caloric surplus offers the best odds. Studies have shown that a moderate surplus enhances muscle protein synthesis, leading to greater muscle gains (Stronska et al., 2020).

Principle 11: Optimal Protein Intake to Maximize Muscle Growth

Optimal protein intake for muscle growth ranges from 1.6 to 2.2 grams per kilogram of body weight. Higher amounts, up to 3.3 g/kg, have been shown to reduce fat accumulation during a caloric surplus, making it beneficial for lean gains (Morton et al., 2018).

Principle 12: Avoid Intense Cardio Right After Weight Training

It's advisable to keep high-intensity cardio sessions 6-8 hours apart from resistance training to avoid interference with muscle growth. Low-intensity activities like walking do not have the same negative impact and can be done close to or even during resistance training days (Cadore et al., 2012).

Principle 13: Avoid Antioxidants Close to Workouts

Large doses of antioxidants taken close to workouts can blunt the beneficial effects of exercise on muscle growth by reducing the signaling needed for muscle repair and growth (Paulsen et al., 2014).

Principle 14: Testosterone Boosters Are Categorically Useless

Most muscle-building supplements and testosterone boosters are ineffective in healthy individuals. However, creatine is a well-researched exception, consistently shown to increase strength and muscle mass over the long term (Kreider, 2003).

Principle 15: There Is No Magic Macro Ratio

When it comes to optimizing muscle growth, the specific ratio of macronutrients—carbohydrates, fats, and proteins—is often

debated. However, research suggests that there is no one-size-fits-all "magic" macronutrient ratio that guarantees the best results. The key is to ensure that total caloric intake and protein levels are sufficient, as these are the primary drivers of muscle growth. Once these are in place, the specific balance between carbohydrates and fats becomes largely a matter of personal preference and can be adjusted based on individual needs and goals.

For instance, studies have shown that increasing saturated fat intake may help improve testosterone levels, which can be beneficial for those experiencing low libido (Volek et al., 2001). On the other hand, a diet higher in carbohydrates can be beneficial for those dealing with high stress levels or poor sleep, as carbohydrates can increase serotonin production, which may improve sleep quality and reduce stress (Jenkins et al., 2014).

Principle 16: The Impact of Stress on Muscle Growth

Both mental and physical stress can significantly impair muscle growth. Stress triggers the release of cortisol, a catabolic hormone that can break down muscle tissue and inhibit protein synthesis. Chronic stress can also disrupt sleep patterns, reduce training performance, and negatively affect recovery, all of which are crucial for muscle development (Sousa et al., 2017). Managing stress through techniques like meditation, adequate sleep, and proper nutrition is essential for maximizing muscle gains.

Principle 17: Caffeine Is Your Friend

Caffeine is a well-established ergogenic aid that can enhance physical performance by increasing the levels of adrenaline and dopamine in the body. This stimulation can lead to improved muscular power output, greater endurance, and a heightened ability to train intensely. Research has consistently shown that

caffeine consumption before workouts can lead to better performance and, consequently, greater muscle growth over time (Grgic et al., 2019).

Principle 18: Creatine and Long-Term Strength Gains

Creatine is one of the most researched supplements in the world, with numerous studies supporting its efficacy in improving strength, power, and muscle mass over the long term. Creatine works by increasing the availability of phosphocreatine in the muscles, which enhances the ability to perform high-intensity exercise and promotes greater gains in strength and muscle size (Kreider et al., 2017).

Learn more about Creatine:
https://youtu.be/61BU4csH0g8?si=RW8iPmoEC0NcYZms

Principle 19: Best Time to Train

Research suggests that training in the afternoon to evening may be slightly better for strength gains and muscle growth. This is likely due to the body's natural circadian rhythms, which result in higher body temperature and improved neuromuscular efficiency later in the day. However, the evidence is not conclusive, and the benefits are relatively small (Chtourou & Souissi, 2012). More important than the time of day is consistency; training at a time that fits your schedule and allows for regular workouts is more crucial than the slight advantage of afternoon training.

Learn more about training time:
https://youtu.be/vSBpYH4tsQo?si=_LE_63sgUA4H7ynF

Principle 20: Don’t Train Fasted (Empty Stomach)

Fasted training, or exercising on an empty stomach, is often touted as a way to increase fat burning. However, research consistently shows that fasted weight training is inferior to training after consuming a meal. Eating before training provides the necessary fuel for intense workouts, leading to better performance and muscle growth (Schoenfeld et al., 2014). For those practicing intermittent fasting, it's advisable to schedule training sessions after breaking the fast and having at least one meal.

Principle 21: The Anabolic Window: Longer Than 30 Minutes

The concept of an "anabolic window"—a short period post-workout when nutrient intake is crucial for muscle growth—has been extended by recent research. Studies indicate that the anabolic window can last much longer than the traditionally believed 30 minutes, often extending up to 24-48 hours, and even 72 hours in beginners (Aragon & Schoenfeld, 2013). This means there's no need to rush to consume a protein shake immediately after training.

Principle 22: Sleep: The Underrated Factor in Muscle Building

Sleep is a critical yet often overlooked factor in muscle building. During sleep, the body undergoes processes essential for recovery and growth, including the release of growth hormone and the repair of muscle tissue. Research shows that inadequate sleep can severely impair muscle recovery, reduce muscle mass, and even lead to muscle loss over time (Reilly & Edwards, 2007). Ensuring 7-9 hours of quality sleep per night is crucial for anyone serious about muscle growth.

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