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Training for Muscle Hypertrophy in an Athletic Population:

A Summary of Expert Consensus

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I currently have, or I have had in the past 2 years an affiliation or financial interest with Tonal Corporation around this presentation, including:

- Consulting
- Stockholder or stock options
- Research funding

Resistance Training Recommendations to Maximize Muscle Hypertrophy in an Athletic Population: Position Stand of the IUSCA

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ABSTRACT

Hypertrophy can be operationally defined as an increase in the axial cross-sectional area of a muscle fiber or whole muscle, and is due to increases in the size of pre-existing muscle fibers. Hypertrophy is a desired outcome in many sports. For some athletes, muscular bulk and, conceivably, the accompanying increase in strength/power, are desirable attributes for optimal performance. Moreover, bodybuilders and other physique athletes are judged in part on their muscular size, with placings predicated on the overall magnitude of lean mass. In some cases, even relatively small improvements in hypertrophy might be the difference between winning and losing in competition for these athletes. This position stand of leading experts in the field synthesizes the current body of research to provide guidelines for maximizing skeletal muscle hypertrophy in an athletic population. The recommendations represent a consensus of a consortium of experts in the field, based on the best available current evidence. Specific sections of the paper are devoted to elucidating the constructs of hypertrophy, reconciliation of acute vs long-term evidence, and the relationship between strength and hypertrophy to provide context to our recommendations.

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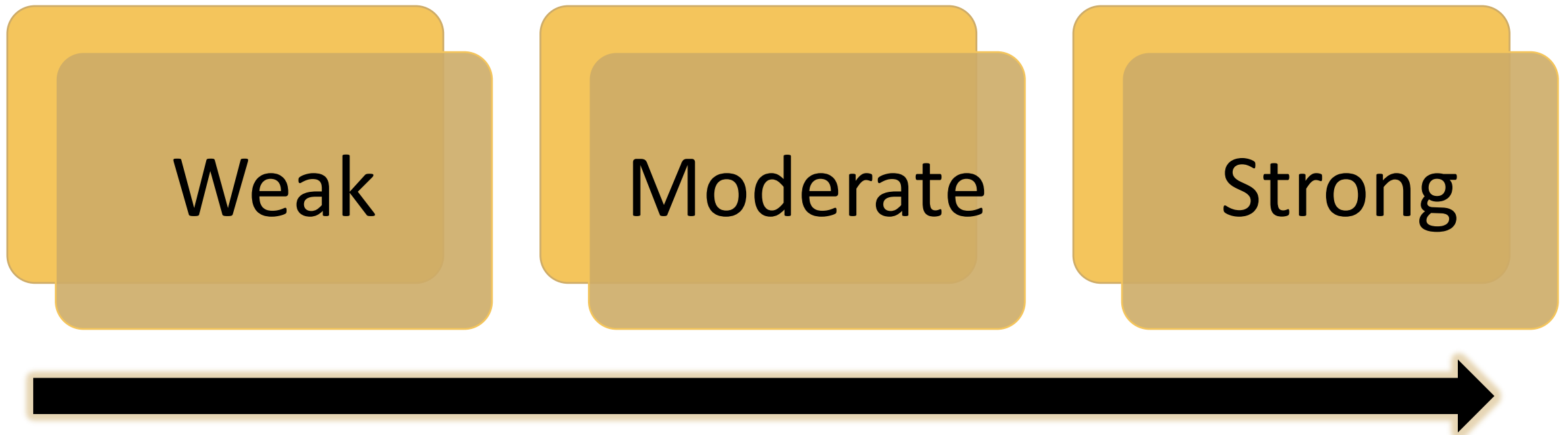
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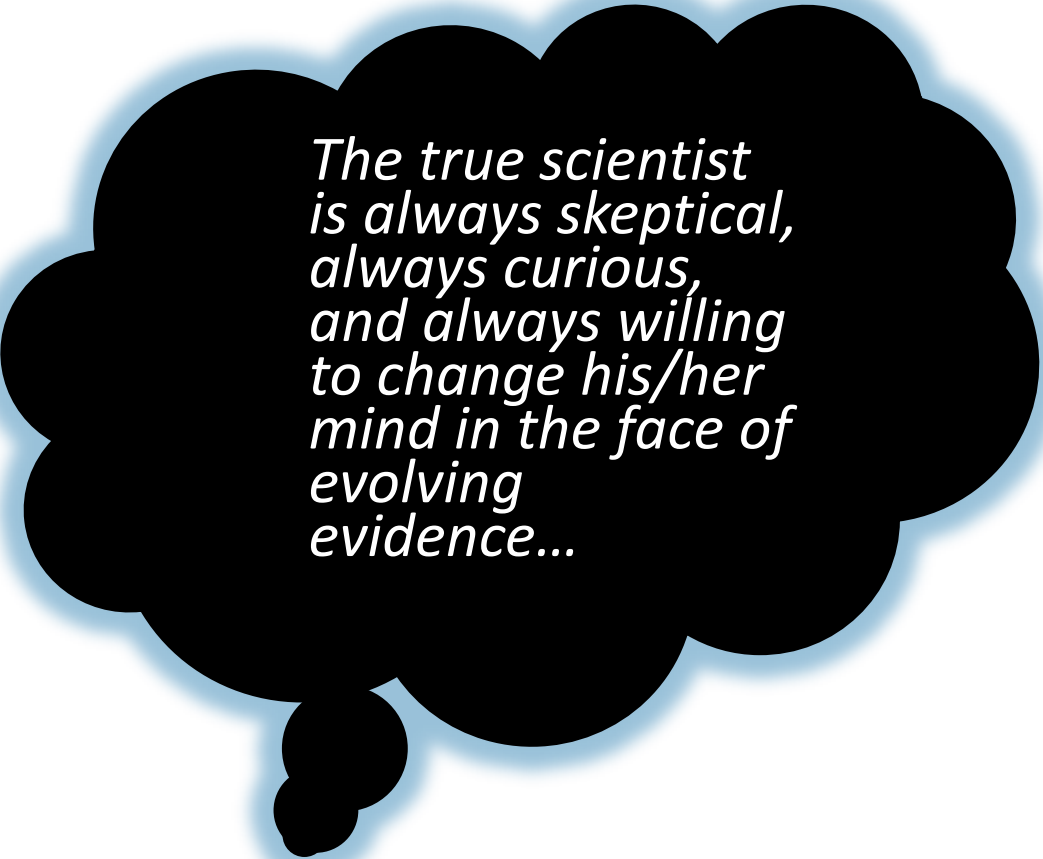
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Strength of Evidence Exists on a Continuum



Evidence-Based Fitness



*The true scientist
is always skeptical,
always curious,
and always willing
to change his/her
mind in the face of
evolving
evidence...*

Hypertrophy: Operational Definition



An increase in the axial cross-sectional area of a muscle fiber or whole muscle due to increases in the size of pre-existing muscle fibers and not to an increase in fiber number (i.e. hyperplasia).



Several contributory processes including:

- ✓ *Shifts in muscle net protein balance favoring new net protein accretion*
- ✓ *Satellite cell content and activation*

Hypertrophy in Sports

- Desired outcome for many athletes
 - In certain sports muscular bulk and the accompanying increase in strength/power beneficial for optimal performance.
 - Bodybuilders and other physique athletes are judged in part on their muscular size, with placings predicated on the overall magnitude of lean mass.
- In some cases, even relatively small improvements in hypertrophy might be the difference between winning and losing in competition

Manipulation of Variables: Load

- Athletes can achieve comparable muscle hypertrophy across a wide spectrum of loading zones.
- There may be a practical benefit to prioritizing the use of moderate loads for the majority of sets in a hypertrophy-oriented training program.
- Preliminary evidence suggests a potential hypertrophic benefit to employing a combination of loading ranges. Can be accomplished through a variety of approaches including:
 - Varying repetition ranges within a session from set to set
 - Implementing periodization strategies with specific 'blocks' devoted to training across different loading schemes

Manipulation of Variables: Volume

- A dose of approximately 10 sets per muscle per week would seem to be a general minimum prescription to optimize hypertrophy
 - Some individuals may demonstrate a substantial hypertrophic response on somewhat lower volumes.
- Evidence indicates potential hypertrophic benefits to higher volumes, which may be of particular relevance to underdeveloped muscle groups.
- There may be a benefit to periodizing volume to increase systematically over a training cycle.
- It may be prudent to limit incremental increases in the number of sets for a given muscle group to 20% of an athlete's previous volume during a given training cycle (~4 weeks) and then readjust accordingly.

Manipulation of Variables: Frequency

- Significant hypertrophy can be achieved when training a muscle group as infrequently as once per week in lower- to moderate volume protocols
 - Does not seem to be a hypertrophic benefit to greater weekly per-muscle training frequencies provided set volume is equated.
- May be advantageous to spread out volume over more frequent sessions when performing higher volume programs.
 - General recommendation: Cap per-session volume at ~10 sets per muscle and increase weekly frequency to distribute additional volume if/when applicable.

Manipulation of Variables: Rest Periods

- As a general rule, rest periods should last at least 2 minutes for multi-joint exercises.
- Shorter rest periods (60-90 secs) can be employed for single-joint and certain machine-based exercises.
- Longer rest intervals are likely needed when sets are performed to muscular failure

Manipulation of Variables: Exercise Selection

- Hypertrophy-oriented RT programs should include a variety of exercises that work muscles in different planes and angles of pull to ensure complete stimulation of the musculature
- Programming should employ a combination of multi- and single-joint exercises to maximize whole muscle development.
 - Where applicable, focus on employing exercises that work muscles at long lengths.
- Free-weight exercises with complex movement patterns should be performed regularly to reinforce motor skills; less complex exercises can be rotated more liberally for variety.
- Attention must be given to applied anatomical and biomechanical considerations so that exercise selection is not simply a collection of diverse exercises, but rather a cohesive, integrated strategy designed to target the entire musculature.

Manipulation of Variables: Set End-Point

- Novice lifters can achieve robust gains in muscle mass without training at a close proximity to failure; need to increase intensity of effort appears to become increasingly important as one becomes well-trained.
- Highly trained lifters may benefit from taking some sets to momentary muscular failure.
 - Should be employed somewhat conservatively (limit to the last set of a given exercise).
- Confining use of failure training primarily to single-joint movements and machine-based exercises may help to manage the stimulus-fatigue ratio and thus reduce potential negative consequences on recuperation.
- Older athletes should employ failure training more sparingly to allow for adequate recovery.
- Periodizing failure training may be a viable option
 - Very high levels of effort are employed liberally prior to a peaking phase, and then followed by a tapering phase involving reduced levels of effort

Advanced Training Techniques

- The present body of literature does not empirically support the use of advanced training methods for enhancing hypertrophic adaptations.
- Eccentric overload has most evidentiary support and thus may be selectively implemented as a novel stimulus.
- Other advanced methods (drop-set, pre-exhaustion, and superset training) lack evidence for a beneficial hypertrophic effect but do not show detrimental effects.
 - Drop-set and superset training might provide a more time-efficient approach to increasing muscle hypertrophy compared to traditional training
 - Pre-exhaustion training may present health and safety benefits over a training career; fatiguing a target muscle with a single joint movement might serve to decrease the necessary load for the ensuing multi-joint movement and thus reduce the subsequent forces around anatomical joints.

Concurrent Training

- Current evidence does not seem to support a concurrent training ‘interference’ effect for hypertrophy at least within the relatively moderate volumes studied
 - Assuming that training volumes are not overly excessive, trainees can likely engage in aerobic/endurance type (‘cardio’) training alongside their RT without detriment to their adaptive response.
- Given the relative uncertainty of evidence on the topic, it would seem prudent to schedule aerobic and resistance bouts at least several hours apart or, perhaps even better, perform them on separate days to minimize any potential detrimental effects on hypertrophy.
 - If this is infeasible, then best to perform RT prior to cardio

Planning/Periodization

- There is no clear consensus whether or how training for hypertrophy should be periodized.
- Sound logical basis to employ some form of planning/periodization for hypertrophy training.
- The specific organization for manipulating variables can be achieved in many different ways
 - There is no universal "best" method for planning; specific to the given athlete and his/her sport

Resistance Training Recommendations to Maximize Muscle Hypertrophy in an Athletic Population: Position Stand of the IUSCA

Load

The magnitude of resistance employed during training



- Athletes can achieve comparable muscle hypertrophy across a wide spectrum of loading zones.
- There may be a practical benefit to prioritizing the use of moderate loads in hypertrophy-oriented training (40-80% 1RM), given that it is more time-efficient than lighter loads (<40% 1RM) and less taxing on the joints and neuromuscular system than very heavy loads (>80% 1RM).

Volume

The total amount of work performed in a session



- A dose of approximately 10 sets per muscle per week would seem to be a general minimum prescription to optimize hypertrophy, although some individuals may demonstrate a substantial hypertrophic response on somewhat lower volumes.
- Evidence indicates potential hypertrophic benefits to higher volumes, which may be of particular relevance to underdeveloped muscle groups.

Frequency

The number of training sessions performed over a given period of time



- Significant hypertrophy can be achieved when training a muscle group as infrequently as 1x/week in lower-to-moderate volume protocols (~≤10 sets per muscle per week); there does not seem to be a hypertrophic benefit to greater weekly per-muscle training frequencies provided set volume is equated.
- Consider spreading out volume over more frequent sessions when performing higher volume programs; a general recommendation would be to cap per-session volume at ~10 sets and, when applicable,

Rest

The period of time taken between sets of the same exercise, or between different exercises in a given session

- General recommendation: at least 2 minutes between sets for multi-joint exercises.
- Shorter (60 to 90 seconds) okay for single-joint and machine exercises.



*%1RM, = % of one-repetition maximum;
Muscle hypertrophy = muscle growth*

Exercise Selection

Inclusion of specific exercises in a training program (consider modality, working joints, planes of movement, & angles of pull)

- Variety of exercises working muscles in different planes and angles of pull to ensure complete stimulation of musculature.
- Free-weight exercises for motor skill development; more liberal use of less complex exercises.
- Cohesive, integrated strategy designed to target entire musculature.



Set End Point

The proximity to momentary failure during a repetition without deviation from the prescribed form of the exercise

- Novice lifters can go close to failure. As training age increases, intensity of effort needs to increase as well.
- In highly trained lifters, achieving momentary muscular failure may benefit, but should be used sparingly.
- Failure exercises may be best for single-joint and machine-based exercises to help manage stimulus-fatigue ratio.
- Older athletes should employ failure more sparingly to ensure adequate recovery.



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Thank You for Coming!



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