Strength Training

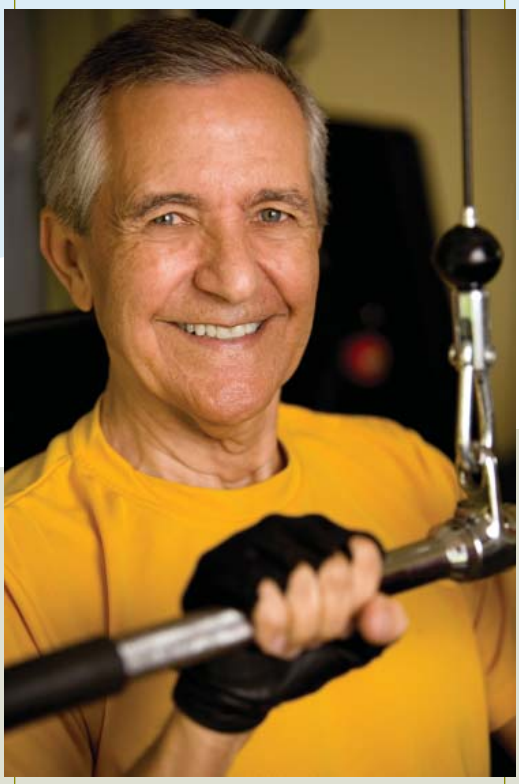
Strength training is the use of resistance to muscular contraction to build the strength, anaerobic endurance and size of skeletal muscles. There are many different methods of strength training, the most common being the use of gravity or elastic/hydraulic forces to oppose muscle contraction. See Wikipedia's resistance training article for information about elastic/hydraulic training, but note that the terms "strength training," "resistance training" and "weight training" are often used interchangeably. When properly performed, strength training can provide significant functional benefits and improvement in overall health and well-being including increased bone, muscle, tendon and ligament strength and toughness, improved joint function, reduced potential for injury, increased bone density, a temporary increase in metabolism, improved cardiac function and elevated good cholesterol. Training commonly uses the technique of progressively increasing the force output of the muscle through incremental increases of weight, elastic tension or other resistance, and uses a variety of exercises and types of equipment to target specific muscle groups. Strength training is primarily an anaerobic activity, although some proponents have adapted it to provide the benefits of aerobic exercise through circuit training.

Strength training differs from bodybuilding, weightlifting, powerlifting and strongman, which are sports rather than forms of exercise, although training for them is inherently interconnected with strength training, as is also the case with throwing sports such as shotput and discus, and Highland games. Many other sports often use strength training as part of their training regimen, notably football, hockey and track and field, but also baseball, downhill skiing, bobsleigh, lacrosse, swimming, rowing and others.

Types of Strength Training

Weight training

Weight and resistance training are popular methods of strength training that use gravity (through weight stacks, plates or dumbbells) or elastic/hydraulic resistance respectively to oppose muscle contraction.



Each method provides a different challenge to the muscle relating to the position where the resistance to muscle contraction peaks. Weight training provides the majority of the resistance at the initiating joint angle when the movement begins, when the muscle must overcome the inertia of the weight's mass (however, if repetitions are performed extremely slowly, inertia is never overcome and resistance remains constant). In contrast, elastic resistance provides the greatest opposition to contraction at the end of the movement when the material experiences the greatest tension while hydraulic resistance varies depending on the speed of the submerged limb, with greater resistance at higher speeds. In addition to the equipment used, joint angles can alter the force output of the muscles due to leverage and the relative overlap of actin and myosin contractile proteins.[3]

Resistance training

Resistance training is a form of strength training in which each effort is performed against a specific opposing force generated by resistance (i.e. resistance to being pushed, squeezed, stretched or bent). Exercises are isotonic if a body part is moving against the force. Exercises are isometric if a body part is holding still against the force. Resistance exercise is used to develop the strength and size of skeletal muscles. Properly performed, resistance training can provide significant functional benefits and improvement in overall health and well-being.

The goal of resistance training, according to the American Sports Medicine Institute (ASMI), is to "gradually and progressively overload the musculoskeletal system so it gets stronger." Research shows that regular resistance training will strengthen and tone muscles and increase bone mass.

Isometric training

Isometric exercise, or "isometrics", is a type of strength training in which the joint angle and muscle length do not change during contraction. Isometric exercises are opposed by a force equal to the force output of the muscle and there is no net movement.

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This mainly strengthens the muscle at the specific joint angle at which the isometric exercise occurs, with some increases in strength at joint angles up to 20° in either direction depending on the joint trained.[4] In comparison, isotonic exercises strengthen the muscle throughout the entire range of motion of the exercise used.

Integrated training

Integrated training is a comprehensive training approach that strives to improve all components necessary to allow an athlete to achieve optimum performance. These components include: 1. Integrated Flexibility Training; 2. Core Stabilization; 3. Balance Training; 4. Reactive Training; 5. Integrated Speed Training; 6. Integrated Resistance Training; and 7. Nutrition and Sports Supplementation.

Assessment of the kinetic chain and correction of kinetic chain dysfunctions allows for optimum strength development. Integrated Training Principles include: Integrated Training Paradigm, Integrated Training Continuum, Multiplanar Training, Training with Optimum Posture, Training with Optimum Muscle Balance, Training for Optimum Muscle Function, Training the Complete Muscle Contraction Spectrum, and Training the Velocity Contraction Spectrum. The National Academy of Sports Medicine has developed integrated training in order to provide science-based and is used by Olympic, Professional, College, and Amateur athletes.

Basic Principles

The basic principles of strength training involve a manipulation of the number of repetitions (reps), sets, tempo, exercises and force to cause desired changes in strength, endurance, size or shape by overloading of a group of muscles. The specific combinations of reps, sets, exercises, resistance and force depend on the purpose of the individual performing the exercise: sets with fewer reps can be performed using more force, but have a reduced impact on endurance.

Strength training also requires the use of 'good form', performing the movements with the appropriate muscle group(s), and not transferring the weight to different body parts in order to move greater weight/resistance (called 'cheating'). Failure to use good form during a training set can result in injury or an inability to meet training goals - since the desired muscle group is not challenged sufficiently, the threshold of overload is never reached and the muscle does not gain in strength.

The benefits of strength training include increased muscle, tendon and ligament strength, bone density, flexibility, tone, metabolic rate and postural support.

Realization of Training Goals

According to popular theory:

- Sets of one to five repetitions primarily develop strength, with less impact on muscle size and none on endurance.
- Sets of six to twelve repetitions develop a balance of strength, muscle size and endurance.
- Sets of thirteen to twenty repetitions develop endurance, with some increases to muscle size and limited impact on strength.[5]
- Sets of more than twenty repetitions are considered to be focused on aerobic exercise. They do still use the anaerobic system, but usually at a rate through which it can consistently remove the lactic acid generated from it.

Individuals typically perform one to six sets per exercise, and one to three exercises per muscle group, with short breaks between each set - the specific combinations of reps, exercises, sets and break duration depends on the goals of the individual program. The duration of these breaks determines which energy system the body utilizes. Performing a series of exercises with little or no rest between them, referred to as "circuit training", will draw energy mostly from the aerobic energy system. Brief bursts of exercise, separated by breaks, are fueled by anaerobic systems, which use either phosphagens or glycolysis.

For developing endurance, gradual increases in volume and gradual decreases in intensity is the most effective program.[6]

It has been shown that for beginners, multiple-set training offers minimal benefits over single-set training with respect to either strength gain or muscle mass increase, but for the experienced athlete multiple-set systems are required for optimal progress.[5][7][8] However, one study shows that for leg muscles, three sets are more effective than one set.[9]

Beginning weight-trainers are in the process of training the neurological aspects of strength, the ability of the brain to generate a rate of neuronal action potentials that will produce a muscular contraction that is close to the maximum of the muscle's potential.

Variable	Training goal			
	Strength	Power	Hypertrophy	Endurance
Load (% of 1RM)	80-100	70-100	60-80	40-60
Reps per set	1-5	1-5	8-15	25-60
Sets per exercise	4-7	3-5	4-8	2-4
Rest between sets (mins)	2-6	2-6	2-5	1-2
Duration (seconds per set)	5-10	4-8	20-60	80-150
Speed per rep (% of max)	60-100	90-100	60-90	60-80
Training sessions per week	3-6	3-6	5-7	8-14

Table reproduced from Siff, 2003[10]

Weights for each exercise should be chosen so that the desired number of repetitions can just be achieved.

Progressive Overload

In one common method, weight training uses the principle of progressive overload, in which the muscles are overloaded by attempting to lift at least as much weight as they are capable of. They respond by growing larger and stronger.[11] This procedure is repeated with progressively heavier weights as the practitioner gains strength and endurance.

However, performing exercises at the absolute limit of one's strength (known as one rep max lifts) is considered too risky for all but the most experienced practitioners. Moreover, most individuals wish to develop a combination of strength, endurance and muscle size. One repetition sets are not well suited to these aims. Practitioners therefore

lift lighter (sub-maximal) weights, with more repetitions, to fatigue the muscle and all fibres within that muscle as required by the progressive overload principle.

Commonly, each exercise is continued to the point of momentary muscular failure. Contrary to widespread belief, this is not the point at which the individual thinks they cannot complete any more repetitions, but rather the first repetition that fails due to inadequate muscular strength. Training to failure is a controversial topic with some advocating training to failure on all sets while others believe that this will lead to overtraining, and suggest training to failure only on the last set of an exercise.[12] Some practitioners recommend finishing a set of repetitions just before the point of failure; e.g. if you can do a maximum of 12 reps with a given weight, only perform 11. Adrenaline and other hormones may promote additional intensity by stimulating the body to lift additional weight (as well as the neuro-muscular stimulations that happen when in "fight-or-flight" mode, as the body activates more muscle fibres), so getting "psyched up" before a workout can increase the maximum weight lifted.

Weight training can be a very effective form of strength training because exercises can be chosen, and weights precisely adjusted, to safely exhaust each individual muscle group after the specific numbers of sets and repetitions that have been found to be the most effective for the individual. Other strength training exercises lack the flexibility and precision that weights offer.

Split Training

Split training involves working no more than two or three muscle groups or body parts per day, instead spreading the training of specific body parts throughout a training cycle of several days. It is commonly used by more advanced practitioners due to the logistics involved in training all muscle groups maximally. Training all the muscles in the body individually through their full range of motion in a single day is generally not considered possible due to caloric and time constraints. Split training involves fully exhausting individual muscle groups during a workout, then allowing several days for the muscle to fully recover. Muscles are worked roughly twice per week and allowed roughly 72 hours to recover. Recovery of certain muscle groups is usually achieved on days while training other groups. I.e. a 7 day week can consist of a practitioner training trapezious, side shoulders and upper shoulders to exhaustion on one day, the following day the arms to exhaustion, the day after that the rear, front shoulders and back, the day after that the chest. In this way all mentioned muscle groups are allowed the necessary recovery. [13]

Intensity, Volume, and Frequency

Three important variables of strength training are intensity, volume and frequency. Intensity refers to the amount of work required to achieve the activity, and is proportional to the mass of the weights being lifted. Volume refers to the number of muscles worked, exercises, sets and reps during a single session. Frequency refers to how many training sessions are performed per week.

These variables are important because they are all mutually conflicting, as the muscle only has so much strength and endurance, and takes time to recover due to microtrauma. Increasing one by any significant amount necessitates the decrease of the other two, eg. increasing weight means a reduction of reps, and will require more recovery time and therefore fewer workouts per week. Trying to push too much intensity, volume and frequency will result in overtraining, and eventually lead to injury and other health issues such as chronic soreness and general lethargy, illness or even acute trauma such as avulsion fractures. A high-medium-low formula can be used to avoid overtraining, with either intensity, volume, or frequency being high, one of the others being medium, and the other being low. One example of this training strategy can be found in the following chart:

Type	Low	Med	High
Intensity (% of 1RM)	10-40%	50-70%	80-100%
Volume(per muscle)	1 exercise	2 exercises	3+ exercises
Sets	1 set	2-3 sets	4+ sets
Reps	20+ reps	8-15 reps	1-6 reps
Session Frequency	1 p/w	2-3 p/w	4+ p/w

A common training strategy is to set the volume and frequency the same each week (eg. training 3 times per week, with 2 sets of 12 reps each workout), and steadily increase the intensity (weight) on a weekly basis. However, to maximize progress to specific goals, individual programs may require different manipulations, such as decreasing the weight, and increase volume or frequency.[14]

Making program alterations on a daily basis (daily undulating periodization) seems to be more efficient in eliciting strength gains than doing so every 4 weeks (linear periodization),[15] but for beginners there are no differences between different periodization models.[16]

Periodization

Periodization is the modulating of volume and intensity over time, to both stimulate gains and allow recovery. Commonly, volume is decreased during a training cycle while intensity is increased. In this template, a lifter would begin a training cycle with a higher rep range than he will finish with. For example, a lifter might begin a training program performing sets with 8 reps. Throughout the course of his/her training program, the lifter will slowly increase the weight while slowly decreasing the reps. This is enough time for the neuromuscular system to adapt and become more efficient.

For this example, the lifter has a 1 rep max of 225 lb:

Week	Set 1	Set 2	Set 3	Set 4	Set 5	Volume Lbs.	Peak Intensity(Last Set)	% of 1 Rep Max(Last Set)
1	95 lb x 8reps	100 lb x 8reps	110 lb x 8reps	115 lb x 8reps	120 lb x 8reps	4,320	73%	52.5%
2	105 lb x 8reps	110 lb x 7reps	115 lb x 7reps	125 lb x 7reps	130 lb x 7reps	4,200	79%	57.75%
3	110 lb x 7reps	120 lb x 7reps	125 lb x 6reps	135 lb x 6reps	140 lb x 6reps	4,010	84%	63%
4	125 lb x 6reps	130 lb x 6reps	140 lb x 6reps	145 lb x 5reps	155 lb x 5reps	3,870	88%	68.25%
5	130 lb x 5reps	140 lb x 5reps	150 lb x 5reps	155 lb x 5reps	165 lb x 4reps	3,535	94%	73.5%
6	140 lb x 4reps	150 lb x 4reps	160 lb x 4reps	165 lb x 4reps	175 lb x 4reps	3,160	99%	79%

This is an example of Periodization where the volume decreases while the

intensity and weight increases.

Benefits

The benefits of weight training include greater muscular strength, improved muscle tone and appearance, increased endurance, enhanced bone density, and improved cardiovascular fitness.

Many people take up weight training to improve their physical attractiveness. Most men can develop substantial muscles; most women lack the testosterone to do this, but they can develop a firm, "toned" (see below) physique, and they can increase their strength by the same proportion as that achieved by men (but usually from a significantly lower starting point). Ultimately an individual's genetics dictate the response to weight training stimuli to some extent.

The body's basal metabolic rate increases with increases in muscle mass, which promotes long-term fat loss and helps dieters avoid yo-yo dieting.[17] Moreover, intense workouts elevate the metabolism for several hours following the workout, which also promotes fat loss.[18] Weight training also provides functional benefits. Stronger muscles improve posture, provide better support for joints, and reduce the risk of injury from everyday activities. Older people who take up weight training can prevent some of the loss of muscle tissue that normally accompanies aging—and even regain some functional strength—and by doing so become less frail. They may be able to avoid some types of physical disability. Weight-bearing exercise also helps to prevent osteoporosis. The benefits of weight training for older people have been confirmed by studies of people who began engaging in it even in their 80s and 90s.

Strength training is the key to maintaining good flexibility. It takes your body parts through a full range of motion and if you use the right technique, you will be able to develop strength throughout an entire range of movement. The ability of the body to resist the stresses that can result from an injury can be increased by obtaining a greater amount of strength. That is true in the athletic world and it has its advantages in performing everyday activities, such as lifting or carrying objects. Strength contributes to the overall efficiency of the human body. Starting a strength training program, means you have started a new lifestyle because strength is reversible. It will decline if you do not continue to obtain a strength stimulus throughout your entire life.[19]

Stronger muscles improve performance in a variety of sports. Sport-specific training routines are used by many competitors. These often specify that the speed of muscle contraction during weight training should be the same as that of the particular sport.

Though weight training can stimulate the cardiovascular system, many exercise physiologists, based on their observation of maximal oxygen uptake, argue that aerobics training is a better cardiovascular stimulus. Central catheter monitoring during resistance training reveals increased cardiac output, suggesting that strength training shows potential for cardiovascular exercise. However, a 2007 meta-analysis found that, though aerobic training is an effective therapy for heart failure patients, combined aerobic and strength training is ineffective.[20]

One side-effect of any intense exercise is increased levels of dopamine, serotonin and norepinephrine, which can help to improve mood and counter feelings of depression [21].

Nutrition

It is widely accepted that strength training must be matched by changes in diet in order to be effective. Adequate protein is generally believed to be required for building skeletal muscle with popular sources advising weight trainers to consume a high protein diet with from 1.4 to 3.3 g of protein per kg of body weight per day (0.6 to 1.5 g per pound).[22][23] Protein that is neither needed for cell growth and repair nor consumed for energy is converted by the liver into fat, which is then stored in the body. Some people believe that a high protein diet entails risk of kidney damage, but studies have shown that kidney problems only occur in people with previous kidney disease. Nonetheless, the deamination process creates urea, which places low, but consistent, strain on the nephrons. Failure to properly hydrate can result in an exaggeration of this effect. [24] [25] An adequate supply of carbohydrates (5-7g per kg) is also needed as a source of energy and for the body to restore glycogen levels in muscles. [26]

A light, balanced meal prior to the workout (usually one to two hours beforehand) ensures that adequate energy and amino acids are available for the intense bout of exercise. Water is consumed throughout the course of the workout to prevent poor performance due to dehydration.[27] A protein shake is often consumed immediately[28] following the workout, because both protein uptake and protein usage are increased at this time.[29] Glucose (or another simple sugar) is often consumed as well since this quickly replenishes any glycogen lost during the exercise period. To maximise muscle protein anabolism, recovery drink should contain glucose (dextrose), protein (usually whey) hydrosylate containing mainly dipeptides and tripeptides, and leucine. [30] Some weight trainers also take ergogenic aids such as creatine or steroids to aid muscle growth. However, the effectiveness of some products is disputed and others are potentially harmful.

Sex Differences in Mass Gains

Due to the androgenic hormonal differences between males and females, the latter are generally unable to develop large muscles regardless of the training program used.[31] Normally the most that can be achieved is a look similar to that of a fitness model. Muscle is denser than fat, so someone who builds muscle while keeping the same body weight will occupy less volume; if two people weigh the same but have different lean body mass percentages, the one with more muscle will appear thinner.[32]

The results obtained by female bodybuilders are extremely atypical: they are self-selected for their genetic ability to build muscle, perform enormous amounts of exercise, their musculature is exaggerated by very low body fat, and like many male bodybuilders their results may be enhanced by anabolic steroids.[33] Unless a woman dedicates her life to bodybuilding, she will not achieve the same results as a professional male bodybuilder. In addition, though bodybuilding uses the same principles as strength training, it is with a goal of gaining muscle bulk. Strength trainers with different goals and programs will not gain the same mass as a male professional bodybuilder.

Muscle Toning

Some weight trainers perform light, high-repetition exercises in an attempt to "tone" their muscles without increasing their size. The use of the word "tone" in this sense is inaccurate. Muscle tone correctly refers to the constant, low-frequency contractions that occur in all muscles, even at "rest", to prepare them for future activity.

What muscle builders refer to as a toned physique is one that combines reasonable muscular size with moderate levels of body fat, qualities that may result from a combination of diet and exercise. High-repetition exercises indeed do cause hypertrophy of both slow-twitch and high-twitch muscle fibers, contributing to overall increased muscle bulk.

Dieting has effect on muscle hypertrophy of any type of muscle fiber. It may however decrease the thickness of the subcutaneous fat between muscle and skin, through an overall reduction in body fat, thus making muscle striations more visible.

Weight Loss

An exercise like sit-ups or abdominal crunches uses a much smaller volume of muscle than whole-body aerobic exercise[38] and is therefore less efficient at burning calories than an exercise like jogging. Instead, high weight/low rep exercises can be used to maintain or increase the body's muscle mass while dieting. This helps to prevent the metabolic slowdown that otherwise often limits the effect of dieting and causes post-diet weight gain.[39]This too depends on the type of strength training utilized. Because weight training generally is used for bulking, this bulking method will more than not likely increase weight because of the diet involved. However, when resistance or circuit training is used, because it is not geared towards bulking, women tend to lose weight more quickly. Lean muscle requires calories to maintain itself at rest, which will help reduce fat through the Basal Metabolic Rate.

Safety

Strength training is a safe form of exercise when the movements are slow, controlled, and carefully defined. However, as with any form of exercise, improper execution and the failure to take appropriate precautions can result in injury.

Methods and Equipment

A number of strength training methods exist, each with its own goals, equipment and results. Apart from weight training, they include isometric exercise, plyometrics, Pilates or Super Slow.

Exercise equipment used for strength training includes weight machines, resistance bands, Swiss balls or Wobble boards, Indian clubs or weighted clothing.

Aerobic Exercise Versus Anaerobic Exercise

Strength training exercise is primarily anaerobic.[40] Even while training at a lower intensity (training loads of ~20-RM), anaerobic glycolysis is still the major source of power, although aerobic metabolism makes a small contribution.[41] Weight training is commonly perceived as anaerobic exercise, because one of the more common goals is to increase strength by lifting heavy weights. Other goals such as rehabilitation, weight loss, body shaping, and bodybuilding often use lower weights, adding aerobic character to the exercise.

Except in the extremes, a muscle will fire fibers of both the aerobic or anaerobic types on any given exercise, in varying ratio depending on the load on the intensity of the contraction.[8] This is known as the energy system continuum. At higher loads, the muscle will recruit all muscle fibers possible, both anaerobic ("fast-twitch") and aerobic ("slow-twitch"), in order to generate the most force. However, at maximum load, the anaerobic processes contract so forcefully that the aerobic fibers are completely shut out, and all work is done by the anaerobic processes. Because the anaerobic muscle fiber uses its fuel faster than the blood and intracellular restorative cycles can resupply it, the maximum number of repetitions is limited.[42] In the aerobic regime, the blood and intracellular processes can maintain a supply of fuel and oxygen, and continual repetition of the motion will not cause the muscle to fail.

Circuit weight training is a form of exercise that uses a number of weight training exercise sets separated by short intervals. The cardiovascular effort to recover from each set serves a function similar to an aerobic exercise, but this is not the same as saying that a weight training set is itself an aerobic process.

Exercises for Specific Muscle Groups

Weight trainers commonly divide the body's individual muscles into ten major muscle groups. These do not include the hip, neck and forearm muscles, which are rarely trained in isolation. The most common exercises for these muscle groups are listed below. (Videos of these and other exercises are available at exrx.net and from the University of Wisconsin.) The sequence shown below is one possible way to order the exercises. The large muscles of the lower body are normally trained before the smaller muscles of the upper body, because these first exercises require more mental and physical energy. The core muscles of the torso are

trained before the shoulder and arm muscles that assist them. Exercises often alternate between "pushing" and "pulling" movements to allow their specific supporting muscles time to recover. The stabilizing muscles in the waist should be trained last.

Strength training exercises	
Quadriceps (front of legs)	Squat (compound) • Leg press (compound) • Lunge (compound) • Leg raise (compound) • Leg extension (isolation)
Hamstrings (back of legs)	Deadlift (compound) • Leg curl (isolation)
Calves	Calf raise (isolation)
Pectorals (chest)	Bench press (compound) • Dip (compound) • Fly (isolation) • Pec dec (isolation) • Press up (compound) • Pullover (isolation)
Lats and trapezius (upper back)	Bent-over row (compound) • Chin-up (compound) • Pulldown (compound) • Pullup (compound) • Shoulder shrug (isolation)
Deltoids (shoulders)	Front raise (isolation) • Handstand push-up (compound) • Lateral raise (isolation) • Military press (compound) • Shoulder press (compound) • Upright row (compound) • Rear delt raise (isolation)
Triceps (back of arms)	Dip (compound) • Pushdown (isolation) • Triceps extension (isolation)
Biceps (front of arms)	Biceps curl (isolation)
Abdomen and obliques (belly)	Crunch (isolation) • Sit-up (isolation) • Leg raise (compound) • (any rotational movement will engage the obliques)
Lower back	Back extension (isolation) • Deadlift (compound) • Good-morning (compound)

Set Structure

Drop sets

Drop sets do not end at the point of momentary muscular failure, but continue with progressively lighter weights.

Pyramid sets

In a pyramid the weight is first increased, and then decreased over a series of sets. A full pyramid typically includes five sets of approximately 12, 10, 8, 10 and 12 reps. The first two sets are performed with light to medium weights to warm up the muscles. The middle set is the work set, and uses the heaviest weight possible. The last two sets are drop sets, and further fatigue the muscle with progressively lighter weights. This technique provides a combination of volume and intensity, and is therefore popular with bodybuilders. However, the full pyramid may be too much for a beginner to handle, so it is only recommended for experienced trainers.

Burnouts

Burnouts combine pyramids and drop sets, working up to higher weights with low reps and then back down to lower weights and high reps.

Diminishing set

The diminishing set method is where a weight is chosen that can be lifted for 20 reps in one set, and then 70 repetitions are performed in as few sets as possible.[43]

Rest-pause (heavy singles)

Rest-pause heavy singles are performed at or near 1RM, with ten to twenty seconds of rest between each lift.[44] The lift is repeated six to eight times. It is generally recommended to use this method infrequently.

Combined Sets

Supersets

Supersets combine two or more exercises with similar motions to maximize the amount of work of an individual muscle or group of muscles. The exercises are performed with no rest period between the exercises. An example would be doing bench press, which predominantly works the pectoralis and triceps muscles, and then moving to an exercise that works just the triceps such as the triceps extension or the pushdown.

Push-pull supersets

Push-pull supersets are similar to regular supersets, but exercises are chosen which work opposing muscle groups. This is especially popular when applied to arm exercises, for example by combining biceps curls with the triceps pushdown. Other examples include the shoulder press and lat pulldown combination, and the bench press and wide grip row combination.

Pre-exhaustion

Pre-exhaustion combines an isolation exercise with a compound exercise for the same muscle group. The isolation exercise first exhausts the muscle group, and then the compound exercise uses the muscle group's supporting muscles to push it further than would otherwise be possible. For example, the triceps muscles normally help the pectorals perform their function. But in the "bench press" the weaker triceps often fails first, which limits the impact on the pectorals. By preceding the bench press with the pec fly, the pectorals can be pre-exhausted so that both muscles fail at the same time, and both benefit equally from the exercise.

Breakdowns

Breakdowns were developed by Fred Hatfield and Mike Quinn to work the different types of muscle fibers for maximum stimulation. Three different exercises that work the same muscle group are selected, and used for a superset. The first exercise uses a heavy weight (~85% of 1 rep max) for around five reps, the second a medium weight (~70% of 1 rep max) for around twelve reps, and finally the third exercise is performed with a light weight (~50% of 1 rep max) for twenty to thirty reps, or even lighter (~40% of 1 rep max) for forty or more reps. (Going to failure is discouraged.) The entire superset is performed three times.[45]

Beyond Failure

Forced reps

Forced reps occur after momentary muscular failure. An assistant provides just enough help to get the weight trainer past the sticking point of the exercise, and allow further repetitions to be completed. Weight trainers often do this when they are spotting their exercise partner. With some exercises forced reps can be done without a training partner. For example, with one-arm biceps curls the other arm can be used to assist the arm that is being trained.

Cheat reps

Cheating is a deliberate compromise of form to maximize reps. Cheating has the advantage that it can be done without a training partner, but compromises safety.

Rest-pause (post-failure)

After a normal set of 6-8 reps (to failure), the weight is re-racked and the trainer takes 10-15 deep breaths, and then performs one more repetition. This process can be repeated for two further repetitions. The twenty-rep squat is another, similar approach, in that it follows a 12-15 rep set of squats with individual rest-pause reps, up to a total of 20

reps.[46]

Negative reps

Negatives are performed with much heavier weights. Assistants lift the weight, and then the weight trainer attempts to resist its downward progress through an eccentric contraction. Alternatively, an individual can use an exercise machine for negatives by lifting the weight with both arms or legs, and then lowering it with only one. Or they can simply lower weights more slowly than they lift them: for example, by taking two seconds to lift each weight and four seconds to lower it.

Partial reps

Partial reps, as the name implies, involves movement through only part of the normal path of an exercise. Partial reps can be performed with heavier weights. Usually, only the easiest part of the repetition is attempted.

Burns

Burns involve mixing partial reps into a set of full range reps in order to increase intensity. The partials can be performed at any part of the exercise movement, depending on what works best for the particular exercise.[47] Also, the partials can either be added after the end of a set or in some alternating fashion with the full range reps.[48] For example, after performing a set of biceps curls to failure, an individual would cheat the bar back to the most contracted position, and then perform several partial reps.

Other Techniques

Progressive movement training

Progressive movement training attempts to gradually increase the range of motion throughout a training cycle. The lifter will start with a much heavier weight than they could handle in the full range of motion, only moving through the last 3-5" of the movement. Throughout the training cycle, the lifter will gradually increase the range of motion until the joint moves through the full range of the exercise. This is a style that was made popular by Paul Anderson.

Super slow

Super slow repetitions are performed with lighter weights. The lifting and lowering phases of each repetition take 10 seconds or more.

Timed rests

By strictly controlling the rest periods between reps and sets a trainer can reduce their level of blood oxygenation, which helps to increase the stress on the muscles.

Wrist straps

Wrist straps (lifting straps) are sometimes used to assist in gripping very heavy weights. They are particularly useful for the deadlift. Some lifters avoid using wrist straps in order to develop their grip strength, just as some go further by using thick bars. Wrist straps can allow a lifter initially to use more weight than they might be able to handle safely for an entire set, as unlike simply holding a weight, if it is dropped then the lifter must descend with it or be pulled down. Straps place stress on the bones of the wrist which can be potentially harmful if excessive.

Bibliography

Many of the most useful books about weight training contain the word "bodybuilding" in the title, but they should not be overlooked just for this reason. Weight trainers who are not interested in bodybuilding can ignore the material devoted to contest preparation, and still obtain much valuable information.

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