Resistance Training Program Design

General Training Principles

- **Specificity**
  - **Anatomical**: If you want better shoulder muscle function, use must train THOSE muscles
  - **Functional**: If you want better muscle size/strength/power/endurance in the shoulders, you must design a program for muscle size/strength/power/endurance, respectively

Readings:
- NSCA text: Chapter 15 pp 347 – 385

Overload
- You must **stress** your neuromuscular system greater than what it is used to
  - Load (i.e. lbs lifted), speed, # sets, frequency/wk, rest (min between sets, days between workouts)
- **Progression in overload**
  - Appropriate increases (frequency and size) in training stress as the body adapts
Program Design Variables (NSCA text)

1. Initial consultation and fitness evaluation
2. Choice of exercises
3. Frequency
4. Order of exercises
5. Load (weight)
6. Volume
7. Rest periods
8. Variation
9. Progression

Program Design Variables

1. Initial consultation and fitness evaluation
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3. Frequency
4. Order of exercises
5. Load (weight)
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9. Progression

Initial consultation and fitness evaluation

- Goals?
- Exercise history?
- Experience with resistance training?
- Injuries?
- Illnesses?
  - (diabetes?, high BP? etc.)
Initial consultation and fitness evaluation

Initial consultation: resistance training status

<table>
<thead>
<tr>
<th>Table 15.1</th>
<th>A Method to Classify Resistance Training Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1: Similar to normal, following a moderate program</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
<td>&gt; 12</td>
</tr>
<tr>
<td>No</td>
<td>3 months</td>
</tr>
<tr>
<td>Yes</td>
<td>2-5</td>
</tr>
<tr>
<td>No</td>
<td>1-5 months</td>
</tr>
<tr>
<td>Yes</td>
<td>1-3</td>
</tr>
<tr>
<td>No</td>
<td>Low</td>
</tr>
<tr>
<td>Yes</td>
<td>2-3</td>
</tr>
</tbody>
</table>

Fitness Evaluation

- 1-RM strength assessment for a variety of resistance exercises is standard
  - Two 1-RM techniques covered in KIN 306
  - Compare to norms or criterion standards (KIN 306)
- Assessment of other muscular function (power & endurance), &/or “functional movement screen” not typically done outside of athlete assessment (& not done in KIN 416)

Set goals

- Muscular Endurance
  - Performance of many reps at submaximal loads
- Muscular Hypertrophy
  - Muscle size
- Muscular Strength
  - Ability to lift heavy loads
- Muscular Power
  - Ability to move moderate to heavy loads at high speeds
  - not mentioned as training goal in NSCA chpt 15
  - discussed in KIN 410
Initial consultation and fitness evaluation

- Set goals
  - Do not use the term “TONE”.
  - e.g. “He is really well toned”
  - “toned” is a nonspecific, misused term.
  - The accurate physiological use of the term “Muscle Tone” refers to a basal level of muscle activation, even when relaxation is attempted

Program Design Variables

1. Initial consultation and fitness evaluation
2. Choice of exercises
3. Frequency
4. Order of exercises
5. Load (weight)
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Initial consultation and fitness evaluation

- Set goals
  - Many people refer to lifting weights as “Strength Training” (even though they are not really doing a program designed to effectively develop “strength”)
  - Use the term “RESISTANCE TRAINING”, encompasses:
    - Different training goals (strength, size, endurance, power)
    - Different loading modalities (free or machine weights, body weight, medicine balls, etc.)
Choice of exercises
Select based on:
- Equipment available
- Time available (# exercises possible, time to learn new exercises)
- Client’s experience (no to high skill) to do exercise properly
- Specific body parts to be trained

Choice of exercises - definitions
- “Core” versus “Assistance” exercises
  What does the term “CORE” mean

Choice of exercises - definitions
- Core Exercise: (NSCA text)
  - “typically more effective at helping a client reach their exercise goals”
  - A multijoint exercise (2 or more primary joints move)
  - Recruits one or more large muscle group(s) or area(s)
    - e.g., chest, shoulder, upper back, hip/thighs
  - Involves synergistic help of one or more smaller muscle groups
    - e.g., biceps, triceps, abs, calves, forearms, lower back

Choice of exercises - definitions
- Core exercise examples: (NSCA text)
  - Bench Press
    - Shoulder + elbow joints
    - Pecs
    - Anterior deltid & triceps brachii
  - Squat
    - Hip + knee + ankle joints
    - Gluts + quads
    - plantar flexors
  - Another example?
Choice of exercises - definitions

- **Structural Core Exercise**: (NSCA text)
  - Core exercise that places load on the spine
  - Requires torso muscles to maintain erect or near-erect posture during exercise
    - e.g., Shoulder press, back squat
  - Another example?

Choice of exercises - definitions

- **Power (explosive) Structural Exercise**: (NSCA text)
  - Structural core exercise that is performed very quickly
    - e.g., power clean, snatch
  - Note: other exercises can be performed powerfully, that are not structural core exercises

Choice of exercises - definitions

- **Assistance Exercise**: (NSCA text)
  - A single primary joint exercise
  - Recruits a small muscle group or only one large muscle group or area
    - e.g., biceps curl, dumbbell fly

Choice of exercises - definitions

- **What does the term “CORE” mean**
Choice of exercises - definitions

Web site definition

So now we can answer the question of “what is the core?” Proximal stiffness occurs between the ball and socket joints (i.e., the hips and shoulders). It involves all of the muscles in the torso. They function primarily to stop motion and they should be trained this way. The core also involves the muscles that cross the ball and socket joints that have distal connections, such as psoas, the gluteals, latissimus, pectoralis, etc.

Choice of exercises - definitions

Stecyk definition

In general, the core includes the lumbosacral region, hips, abdomen, and back. Since there is no universal definition of what muscles make up the core, and that the core may function as part of the kinetic chain, we have broadly defined core by region and have not identified specific core muscles. We believe identification of specific isolated muscles is a misnomer when discussing the application of integrated core exercises. We leave the determination of specific core musculature up to your interpretation of the literature and your practical experience.

Core stability is defined in many ways. Due to its practical emphasis we use the definition of core provided by Dr. Rick Widler and colleagues at the Lexington Clinic Sports Medicine Center in Lexington, Kentucky. “Core stability is defined as the ability to control the position and motion of the trunk over the pelvis to allow optimum production, transfer and control of force and motion to the terminal segment in integrated athletic activities” (1).

Choice of exercises - definitions

McGill definition

What does the term “CORE” mean

So now we can answer the question of “what is the core?” Proximal stiffness occurs between the ball and socket joints (i.e., the hips and shoulders). It involves all of the muscles in the torso. They function primarily to stop motion and they should be trained this way. The core also involves the muscles that cross the ball and socket joints that have distal connections, such as psoas, the gluteals, latissimus, pectoralis, etc.

Choice of exercises - definitions


Choice of exercises - definitions

What does the term “CORE” mean?

In 416 we use the term “Core Exercise” (& Assistance Exercise) as defined in NSCA text.

We also will have a lab to learn about “Trunk & Pelvis “Core” Exercises”

Choice of exercises - definitions

- Open Kinetic Chain Exercise
  - Distal aspect of the extremity is free in space
    - Straight leg raise, hamstring curl, knee extension, etc.

Choice of exercises - definitions

- Closed Kinetic Chain Exercise
  - Distal aspect of the extremity is fixed to an object that is either stationary or moving
    - Leg press, squat, lunge, step-ups, etc.

Choice of exercises - definitions

- Open & Closed Kinetic Chain Exercise terms are widely & commonly used to define leg exercises, particularly related to joint rehabilitation

For healthy exercisers:
DO NOT use open and closed exercises as a basis for deciding good versus bad exercises. It does not work.
Choice of exercises – guidelines
“Functional training”??

<table>
<thead>
<tr>
<th>Isolated exercises, free or machine</th>
<th>Biceps curls, triceps extensions, knee extensions, hamstring curls</th>
<th>Very poor training. The body does not work this way in producing real life movements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercises involve ONLY patterns and loads used in performance</td>
<td>Boxing arm thrust, golf swing, soccer kick, swim stroke</td>
<td>Very poor Training</td>
</tr>
</tbody>
</table>

Choice of exercises – guidelines
“Functional training” Mike Boyle

To better understand the concept of functional training, ask yourself a few simple questions.

1. How many sports are played sitting down? As far as I can tell, only a few sports, such as rowing, are performed from a seated position. If we accept this premise, we can see that training muscles from a seated position would not be functional for most sports.

2. How many sports are played in a rigid environment where stability is provided by outside sources? The answer would appear to be none. Most sports are contested on fields or courts. The stability is provided by the athlete, not by some outside source. Reasoning again would tell us that most machine-based training systems are not by definition functional because the load is stabilized for the lifter by the machine.

3. How many sports skills are performed by one joint acting in isolation? Again, the answer is zero. Functional training attempts to focus on multi-joint movement as much as possible. Multi-joint movements which integrate muscle groups into movement patterns are very functional.

Choice of exercises – McGill's recommendations of exercises to avoid, for low back health

- “...generating twisting torque while twisting away from neutral, appears to be problematic. Now consider the torso twisting machines found in various fitness and training facilities. ... here is a machine that will lead to troubles in many athletes.” (pg 103 3rd ed)
  - “…the kinematic act of twisting [against no load = one end of force vs velocity curve] or generating the kinetic variable of twisting torque while not twisting [isometric against load = opposite end of force vs velocity curve] seems less dangerous than epidemiological surveys suggest” (pg 102 3rd ed)
Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

- “…we do not recommend the spine twisting machines” (pg 70 3rd ed)

Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

- Back extension machines that take spine to full flexion (pg 70 3rd ed)

- Low back health requires extensor endurance NOT strength (pg 233 3rd ed)

Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

MACLEAN’S
The man who wants to kill crunches
A Canadian professor of spine biomechanics rails about the dangers of the ubiquitous sit-up.

The professor of spine biomechanics at the University of Waterloo knows a thing or two about damaging spines. In fact, McGill proudly shows off a machine that probably created more disc herniations than any other in the world.

Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

Neutral (=good) versus Flexed (=bad) lumbar spine

(McGill 3rd ed pg 75)
Choice of exercises
McGill's recommendations of exercises to avoid, for low back health

“...the spine must not bend when under load” (pg 301 3rd ed)

Choice of exercises - definitions
McGill definition

So now we can answer the question of “what is the core?” Proximal stiffness occurs between the ball and socket joints (i.e., the hips and shoulders). It involves all of the muscles in the torso. They function primarily to stop motion and they should be trained this way. The core also involves the muscles that cross the ball and socket joints that have distal connections, such as psoas, the gluteals, latissimus, pectoralis, etc.

Choice of exercises
To train the core...

- #5. If only I had trained my core for three-dimensional stability...
- Swimming is all about slicing through the water with as little drag as possible. A floppy midsection that snakes from side to side with every stroke not only leaks a ton of energy but also creates serious drag. Unfortunately, ask most swim coaches, and they’ll tell you the way to a strong core is a few hundred crunches, V-ups, and Russian twists daily. These movements are minimally sports-specific, however, as the only time flexion occurs in swimming is during the flip-turn. And even then, several muscles in addition to the abdominals help generate the movement.
- To create the rigid, canoe-like core that’s truly needed for swimming (and all sports, really), core stability work is the key. Anti-extension, anti-rotation, and anti-lateral flexion exercises, plus rotational medicine ball work.

Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

“The spine should be held in a neutral position during the lift of the weight, the spine does not flex or extend under the load.

e.g., rowing movements

Figure 7.3 This principle is extended to training. For example, in the rowing exercise, the back is spread through technique selection. Allowing the spine to flex, considered to be poor technique (left panel), is risky. The back can be spread by minimizing a back position that does not flex (right panel).
Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

“... the spine must not bend when under load” (pg 301 3rd ed)

The spine should be held in a neutral position during the lift of the weight, the spine does not flex or extend under the load.

e.g., flexion movements

Resistance Training Program Design
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Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

“the spine must not bend when under load” (pg 301 3rd ed)
e.g., squat = hip flexion/extension NOT lumbar flexion/extension (pg 314 3rd ed)

Gustav Zander’s Abdominal Machine 1890’s

Resistance Training Program Design
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Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

‘the spine must not bend when under load’ (pg 301 3rd ed)
e.g., squat = hip flexion NOT lumbar flexion

‘the spine must not bend when under load’ (pg 301 3rd ed)

Resistance Training Program Design
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Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

Athletes should avoid end range of motion during exertion (pg 140 3rd ed)
e.g., golf swing = “high rotational velocity forces passive tissues to experience impulse loading when they act to create a mechanical stop to motion”

Figure 10.6 For people who are not “body aware” and are unable to adopt a neutral or a flexed spine on command, we suggest rehearsing the spine-neutral position and hip (not lumbar) flexion while doing squat motions before exertion.
Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

“Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

“This is not justifiable for any patient and is a poor method for athletes as well!” (pg 99 3rd ed)

Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

Trunk flexion exercises:

- “… hanging with the arms on an overhead bar and flexing the hips to raise the legs…generates well over 100 Nm of abdominal torque to a spine that is often flexed due to faulty technique.” (McGill 3rd ed pg 95)
  - Use side bridge for similar muscle activation with lower spine loads

Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

Sitting:

- “… the sitting posture required of many machines results in increased bending loading to the back – for example many seated leg press machines force the lumbar spine into flexion with the application of combined shear and compression. … I would very rarely recommend this approach, except in some very particular cases” (McGill 3rd ed pg 43)

Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health

Sitting:

- “There are many other examples of machines that require consideration for optimizing performance and safety: … Any machine that requires a sitting posture.” (McGill 3rd ed pg 43)
  - “Certainly, athletes who resistance train in a seated position would be well advised to question their rationale” (McGill 3rd ed pg 94)
Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health:

Sitting:

“… no single, ideal sitting posture exists; rather they recommend a variable posture to minimize the risk of tissue overload.”

(McGill 3rd ed pg 94)

Choice of exercises – McGill’s recommendations of exercises to avoid, for low back health:

Avoid the high shearing forces

good-bye to good-mornings

Program Design Variables

1. Initial consultation and fitness evaluation
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9. Progression

Frequency

# of workouts/week  Determined by:

- Client’s training status (1-3 days between training the same muscle group)

<table>
<thead>
<tr>
<th>Training status</th>
<th>Frequency guidelines (sessions per week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>2-3</td>
</tr>
<tr>
<td>Intermediate</td>
<td>3-4</td>
</tr>
<tr>
<td>Advanced</td>
<td>4-7</td>
</tr>
</tbody>
</table>

- Other exercise & physical activities
- Client’s schedule, health, other life demands, etc.
Frequency

**Beginner clients** can train (2-)3 days/wk
- Whole body workouts
- One Exercise per muscle group
- At least 48 hrs rest/recovery between workouts
- Exercise of a specific body part occurs (2-)3 x/week

**Intermediate or advanced clients** can train 4+ days/wk AND have rest days between training the same muscle group by:

**Split routines:**
- Different muscle groups are trained on different days

**Split routine examples:**
- **Upper body Mon & Thurs** (More upper body exercises than in beginner whole body workout)
- **Lower Body Tues & Fri** (More lower body exercises than in beginner whole body workout)
- At least 72 hrs rest/recovery between same body part
- Note that exercise of a specific body part only occurs 2x/week

**Split routine examples:**
- **Selected combo 1 upper & lower body**
- **Selected combo 2 upper & lower body**
- **Selected combo 3 upper & lower body**
  - 3 days workout, one day rest, repeat, repeat, repeat....
  - At least 96 hrs rest/recovery between same exercise
  - Note that same exercise only occurs approx 2x/week
Frequency: Rest/Recovery days

To Facilitate Recovery on “Rest Days”
Consider:
- “Active recovery” = low intensity cardiovascular activity

On all days, to support recovery, think about:
- Sleep
- Nutrition
- Hydration

Program Design Variables
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Order of exercises

Sequence of exercises within a single workout

Arrange order so that fatigue caused by one exercise has the least possible impact on the capacity to perform the subsequent exercises

Consider and combine the following:
- Core vs. Assistance exercise
- Muscle area in body
- Nature of the movement (push/pull)

Order of exercises

- Core vs. Assistance exercise
  1. Power exercises first
     - These require the greatest motor skill & focus, & are typically core multijoint exercises using large muscles
  2. Core exercises second
     - These are multijoint, large muscles
  3. Assistance exercises third
     - These are small muscles and/or single joint movements
Order of exercises

- Muscle area in body
  TRY:
  - Alternating upper and lower body
    - e.g., lat pull downs then leg extensions then shoulder press then Lunges, etc.

Order of exercises

- Muscle area in body
  TRY:
  - Alternating “Push” & “Pull”
    - E.g., bench press then seated rows
      - But this does not reduce fatigue between exercises as well (as alternating upper & lower) because antagonists are always active as stabilizers. E.g., once you fatigue your pecs & triceps you will not do a rowing pull as strongly

Program Design Variables

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Load

**Weight to lift for a given exercise**

Two methods to set load:
1. % of 1-RM
2. Repetition Maximum (RM)

(% of body weight technique not discussed)
Load

Basic Definitions:

**Repetition = rep = a single movement cycle against a resistance** (e.g., flexion + extension cycle of a bicep curl, a throw of a medicine ball)

**Set = a group of repetitions performed consecutively** (typically with rest period between sets)

---

**Load**

Repetition Maximum (RM) method to set load
(overview more details later):

- **RM = Most weight client can lift for a specified number of repetitions**
  - e.g., The most weight a client can bicep curl 6x is 35 lbs
  - the biceps curl 6RM is 35 lbs

---

%1-RM method to set load (overview more details later):

1. Determine client’s maximum strength for the exercise
   - = max weight that can be lifted once with proper technique
   - = 1-repetition maximum, (1-RM)
2. Set training load based on training goals as % of 1-RM

---

As load decreases you can do more reps

BUT: table is guideline only, not mathematical or physiological rule because many factors affect the relationship

- Training status
  - More trained = more reps possible at given % 1-RM
  - Applies to single set
  - Subsequent sets lower reps due to fatigue
- Table largely based only bench press, back squat, power clean
  - Application to other exercises?
  - More reps possible on a machine vs. free weight version of same exercise
  - # reps for assistance exercise may be lower

---

Percent of the 1RM and Repetitions Allowed (%1RM-Repetition Relationship)

<table>
<thead>
<tr>
<th>%1RM</th>
<th>Number of repetitions allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>95</td>
<td>2</td>
</tr>
<tr>
<td>90</td>
<td>3</td>
</tr>
<tr>
<td>85</td>
<td>4</td>
</tr>
<tr>
<td>80</td>
<td>5</td>
</tr>
<tr>
<td>75</td>
<td>6</td>
</tr>
<tr>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>65</td>
<td>8</td>
</tr>
<tr>
<td>60</td>
<td>9</td>
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<td>55</td>
<td>10</td>
</tr>
<tr>
<td>50</td>
<td>11</td>
</tr>
<tr>
<td>45</td>
<td>12</td>
</tr>
<tr>
<td>40</td>
<td>15</td>
</tr>
</tbody>
</table>
Load: %1-RM based methods

How to determine client’s 1-RM strength for an exercise?
Method #1: Progressively increase load to find max load client can lift 1x

Rarely done, particularly in personal training settings, because it is not to be done:
1. If training status or general health is low
2. If technique is low
   - e.g., a well trained person starting a new lift but lacking technique
3. If safety and physical risk of max load is high, even for highly trained person (1-RM load is huge!)
   - e.g., lunge balance safety and spinal compression with extreme load

Continues next slide....

Essentials of Strength Training and Conditioning text (3rd ed, pg 395) states:
- 1RM testing is reserved for resistance trained athletes who are who are classified as intermediate or advanced, and who have technique experience in the lift being tested
- Is for core exercises
- Is NOT for core exercises that require stabilization by smaller muscle groups (e.g., in test of upper back muscles in bent over row, lower back muscles may fatigue)
Load: %1-RM based methods

Method #2: Use submaximal loads to predict the max load client can lift 1x

Method discussed in Strength Testing Unit of KIN 306
- Determine heaviest load client can lift 10x
- Use chart* to estimate 1-RM load
  - Use <4 trials to avoid fatigue

*Table 15.4 pg 373, NSCA Personal Training text

Assigning Training Load

Based on the client’s training goal

<table>
<thead>
<tr>
<th>Training goal</th>
<th>Load (%1RM)</th>
<th>Goal repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength</td>
<td>≥85</td>
<td>≥6</td>
</tr>
<tr>
<td>Hypertrophy</td>
<td>63-85</td>
<td>6-12</td>
</tr>
<tr>
<td>Muscular endurance</td>
<td>≥57</td>
<td>≤12</td>
</tr>
</tbody>
</table>

*These RM loading assignments for muscular strength training apply only to core exercises; assistance exercises should be limited to loads not heavier than an 8RM (6).

Assigning Training Load

%1-RM method example

Client wants to increase strength of bench press
Estimated 1-RM for bench press = 40 lbs
Intermediate client will train 85%1RM for strength
Load to train at: = .85(40) = 34 = 35 lbs

Assigning Training Load

%1-RM method example continued

Previously calculated: Intermediate client wants to increase strength of bench press, Load to train at = 35 lbs

TRY the weight, there should be a limit of ≤ 6 reps (for core exercise), or weight is too light
(remember the %1-RM & Reps relationship is approximate)
Load: RM based method (you don't need to know what the max capacity is)

First: Decide how many reps you want the client to perform when exercising (e.g., 6 reps)

Then: the trainer tries increasing loads to find the maximum load the client can lift the desired # of times

Assigning Training Load

RM method example

Client wants to increase strength of bench press

Weight should selected that can be lifted a maximum of 6x (<4 trials)

<table>
<thead>
<tr>
<th>Trial</th>
<th>Weight used</th>
<th>Max # times lifted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>6</td>
</tr>
</tbody>
</table>

Load to train at: = 35 lbs

Notes for use:
1. Use min # trials (<4) possible to avoid fatigue
2. Assistance exercises should use 8RM loads or lighter (to avoid high load stresses on single joints and small muscle groups) (this means you don’t use heavier loads that can only be lifted 1-7x)
3. Untrained clients should use 8RM loads or lighter (this means you don’t use heavier loads that can only be lifted 1-7x)
Assigning Training Load: Further considerations
Two methods to set training load:
1. % of 1-RM
2. Repetition Maximum (RM)

Which is best

Assigning Training Load: example...
In subsequent sets as fatigue occurs you may do fewer reps with same load
You want the reps to stay in the appropriate range for your training goal
SO…You may need to decrease weight to keep # reps appropriate for your training goal

REMEMBER: The max # reps possible, not the %1RM, determines the training result of the exercise!

Assigning Training Load: Further considerations
Two methods to set training load, Which is best % of 1-RM
1RM calculation good for evaluating training progress
1RM calculation good for motivation
% of 1RM ALONE is a poor way to set training load (must be combined with count of maximum reps)
%1-RM methods dominate in basic to intermediate resistance training literature
Repetition Maximum (RM)
Allows training load to be directly determined to put client in the appropriate # reps zone for training goal (no calculations, estimates or errors)
Many people don’t understand it or know about it
Seen used more commonly in more advanced training programs
Program Design Variables

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Volume

- repetition-volume: total # reps in a training session
  - \( = \text{# reps/set \times \# sets} \)

- load-volume: total amount of weight lifted in a training session
  - \( = \text{# reps/set \times \# sets \times weight/rep} \)

Volume

Load-Volume depends on \# reps, weight lifted, \# sets

But \# reps & weight lifted, are largely determined by training goal (strength, size, endurance)

So volume is largely determined by \# sets
**Volume**

*Volume* is largely determined by *# sets*

**Beginners:** One set is sufficient training stimulus until client is able to perform multiple sets.

---

**Program Design Variables**

1. Initial consultation and fitness evaluation
2. Choice of exercises
3. Frequency
4. Order of exercises
5. Load (weight)
6. Volume
7. **Rest periods**
8. Variation
9. Progression

---

**Rest periods**

*Time* between multiple sets of same exercise, or different exercises for the same muscle group, within the same session.

<table>
<thead>
<tr>
<th>Training goal</th>
<th>Rest period length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength</td>
<td>2-5 minutes</td>
</tr>
<tr>
<td>Hypertrophy</td>
<td>30 seconds - 1.5 minutes</td>
</tr>
<tr>
<td>Muscular endurance</td>
<td>≤30 seconds</td>
</tr>
</tbody>
</table>

Untrained clients need up to 2x amount of rest listed.

---

**Types of Sets** (affects “Exercise Order”, “Volume” & “Rest” variables)

- **Straight set**
  - Standard set and rest pattern described previously

**Techniques for advanced clients**

- **Compound set** *(NSCA text)*
  - 2 exercise sets in a sequence work the same muscle group
    - E.g., bench press & dumbbell flys
Types of Sets (affects “Exercise Order”, “Volume” & “Rest” variables)

Techniques for advanced clients
- **Super sets** (NSCA text)
  - 2 exercise sets in a sequence stress *antagonistic* muscle groups
    - E.g., bench press then seated rows
- **Circuit training** (NSCA text)
  - Exercise sets are performed with minimal rest periods

Variation

TO:
- Lower risk of overtraining
- Lower risk of injuries
- Relieve boredom
- Maintain training intensity
- Stimulate muscle groups in different ways
- KEEP IMPROVEMENT HAPPENING
Variation
BY:
- Changing program variables discussed above to change the physical (and mental) stimuli
  1. Choice of exercises
  2. Frequency
  3. Order of exercises
  4. Load (weight)
  5. Volume
  6. Rest periods
- Variety within workout
- Variety across workouts

Pyramid Training (within workout variation)
increase load & decrease reps across sets

Set 1: 75% 1RM, 10 reps
Set 2: 80% 1RM, 8 reps
Set 3: 85% 1RM, 6 reps

Variation
Heavy & Light days (across workout variation)

Heavy day: First day in week you do an exercise, use load calculated as shown previously

Light day: Second day in week you do an exercise, use 80% load calculated as shown previously, same # reps

These are not “lazy” or wimp” days, these are critical to program design (see next two examples)
Variation

Heavy & Light days example:

Faster, Better, Stronger, Heiden, Testa, Musolf, pgs 3-4, 54

From: 10 rules to follow to get in better shape

Program Design Variables

1. Initial consultation and fitness evaluation
2. Choice of exercises
3. Frequency
4. Order of exercises
5. Load (weight)
6. Volume
7. Rest periods
8. Variation
9. Progression

Progression

- Client will plateau in gains if progression in training stimulus is not provided when needed
- Can increase training stimulus by:
  1. Increasing freq/week
  2. Increasing # exercises
  3. Increasing # sets
  4. Increasing speed of movement
  5. Increasing load
  6. Decrease rest period
  7. More difficult versions of exercise

Progression of load

- 2-for-2 rule:
  - if the client can perform two or more repetitions over his or her assigned repetition goal in the last set in two consecutive workouts for a given exercise, weight should be added to that exercise for the next training session

Rest and recovery are a fundamental part of an exercise program. The idea is to fatigue your body to a certain point, then give it a day or more of easy work so your body can experience what we call supercompensation—the anatomical and physiological changes that occur when you adapt to overload.
Progression of load

- How big should the increase be:

**TABLE 15.10**

<table>
<thead>
<tr>
<th>Resistance training status</th>
<th>Body area</th>
<th>Type of exercise</th>
<th>Absolute increase (add weight)</th>
<th>Relative increase (add a percent of the previous load)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>Upper body</td>
<td>Core</td>
<td>2.5-3 pounds (1.2 kilograms)</td>
<td>2.5%</td>
</tr>
<tr>
<td></td>
<td>Upper body</td>
<td>Assistance</td>
<td>1.25-2.5 pounds (0.6-1 kilograms)</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>Lower body</td>
<td>Core</td>
<td>10-15 pounds (6.5 kilograms)</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>Lower body</td>
<td>Assistance</td>
<td>5-10 pounds (2.5 kilograms)</td>
<td>5%</td>
</tr>
<tr>
<td>Intermediate or advanced</td>
<td>Upper body</td>
<td>Core</td>
<td>5-10 pounds (2.5 kilograms)</td>
<td>2.5-5%</td>
</tr>
<tr>
<td></td>
<td>Upper body</td>
<td>Assistance</td>
<td>0-5 pounds (0.4-1 kilograms)</td>
<td>5-10%</td>
</tr>
<tr>
<td></td>
<td>Lower body</td>
<td>Core</td>
<td>10-15 pounds (6.5 kilograms)</td>
<td>5-10%</td>
</tr>
<tr>
<td></td>
<td>Lower body</td>
<td>Assistance</td>
<td>5-10 pounds (2-7 kilograms)</td>
<td>5-10%</td>
</tr>
</tbody>
</table>

*Although these load increases are appropriate for training programs with volumes at approximately three sets of 3 to 10 repetitions, they should be regarded only as guidelines.

Resistance Training Program Design

Progression of More difficult versions of exercise

- Change your position (to fire different motor units) change hand/foot width & angles, body position/angle
- Change the type of resistance (machine, cable, free)
- Go from bilateral to unilateral
- Add a realistic balance challenge
- Do more compound movements

Resistance Training Program Design

**Machine bench press**

<table>
<thead>
<tr>
<th>Progression</th>
<th>Progression</th>
<th>Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Resistance Training Program Design

**Leg press**

<table>
<thead>
<tr>
<th>Progression</th>
<th>Progression</th>
<th>Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Resistance Training Program Design
Progression

- Progression, and training, will **not**, and should **not** be planned or envisioned as a staircase

- **Periodization**, discussed later in “Athlete Training” (but applicable to non-athletes as well) will discuss planned lighter weeks (extensions of the “light days” discussed previously in this unit).

---


**Adults (aged 18-64):** Should do muscle strengthening exercises involving major muscle groups 2 or more days/wk

- Weight training, resistance bands, body weight calisthenics, heavy gardening, etc.
- Perform to point where it would be difficult to do another repetition
- One set 8-12 reps is effective, 2-3 sets may be more effective
- Progressive increase of load is needed

How does this match with NSCA guidelines for strength development?

---

Comparison of NSCA text guidelines to other sources. **How to train to produce hypertrophy?**

NSCA view

<table>
<thead>
<tr>
<th>Training goal</th>
<th>Load (%1RM)</th>
<th>Goal repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength</td>
<td>≥85</td>
<td>≥6</td>
</tr>
<tr>
<td>Hypertrophy</td>
<td>67-85</td>
<td>6-12</td>
</tr>
<tr>
<td>Muscular endurance</td>
<td>≥7</td>
<td>≥12</td>
</tr>
</tbody>
</table>

*These RM loading assignments for muscular strength training apply only to core exercises; assistance exercises should be limited to loads not heavier than an eRMI (6).

**NSCA view and Repetition Assignments Based on the Training Goal**

<table>
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<tr>
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<td>≥12</td>
</tr>
</tbody>
</table>

How does this match with NSCA guidelines for hypertrophy development?

---

**How to train to produce hypertrophy?**

Current research suggests that maximum gains in muscle hypertrophy are achieved by training regimens that produce significant metabolic stress while maintaining a moderate degree of muscle tension. A hypertrophy-oriented program should employ a repetition range of 6-12 reps per set with rest intervals of 66-90 seconds between sets. Exercises should be varied in a multijoint, multijoint fashion to ensure maximal stimulation of all muscle fibers. Multiple sets should be employed in the context of a split training routine to broaden the anabolic milieu. At least some of the sets should be carried out in the point of eccentric muscular failure; perhaps alternating microcycles of sets to failure with those not performed to failure to maximize the potential for overtraining. Concentric repetitions should be performed at fast to moderate speeds (1-3 seconds) while eccentric repetitions should be performed at slightly slower speeds (3-4 seconds). Training should be periodic and so that the hypertrophy phase sustains in a brief period of higher-volume overreaching followed by a taper to allow for optimal supercompensation of muscle tissue.

*How does this match with NSCA guidelines for hypertrophy development?*
...an individual's movement practice (i.e., conditioning) should be about movement quality and variability as much as about cultivating strength and conditioning. Mindless prescription of physical activity (i.e., 30-60 minutes of aerobic exercises; 3 sets of 10 of machine-based resistance exercise) prioritizes strength and conditioning capacity over movement capability and variability, hoping that by blindly improving one's quantity of routine movements the quality of movement will also improve. Don't get me wrong, in moderation, more movement is better than less movement. However, too much of the same movements can create similar problems as too little movement.

Concepts from Vern Gambetta:
The goal of conditioning is to develop the ability to deliver:
- The right force
- At the right time
- At the right place
- Under control
- Safely

"We want adaptable athletes, not adapted athletes"

1. Stay on top of your soft tissue work and mobility drills.
2. Do a small amount of pre-training plyos.
3. Emphasize full-body exercises that teach transfer of force from the lower body to the upper body.
4. Emphasize ground-to-standing transitions.
5. Get strong in single-leg.
6. Use core exercises that force you to resist both extension and rotation.
7. Train outside the sagittal plane.
8. Chuck medicine balls!
9. Be fast on your concentric.

"We want adaptable athletes, not adapted athletes"