



RU RMT 19 · REMEDIAL EXERCISE & KINESIOLOGY

Exercise & Its Effects

Lecture 3 — Training Principles & Resistance Training

LECTURE 3

Learning Outcomes

By the end of this lecture, learners will be able to:

- Explain the Overload Principle and how progressive, graded load drives physiological adaptation.
- Distinguish the roles of intensity and volume in developing strength, power, and endurance.
- Describe the SAID (Specific Adaptation to Imposed Demands) principle and apply specificity to exercise selection.
- Explain the Reversibility Principle and its implications for detraining and skill retention.
- Define resistance training and outline its functional and health benefits.
- Identify and apply the nine determinant variables of resistance training.
- Interpret strength-training-zone and training-goal parameters (Tables 1.1 and 1.2).
- Differentiate muscle strength, power, and endurance as expressions of muscle performance.



PART ONE · TRAINING PRINCIPLES

The Overload Principle

One of the basic sports fitness and training concepts



TRAINING PRINCIPLES

Overload Principle

- **One of the basic sports fitness / training concepts.**
- In order to improve, people must continually work harder as their bodies adjust to existing workouts.
- This is accomplished by having a load that exceeds the metabolic capacity of the muscle.
- To increase strength = a progressive increase in heavier weights.
- To also increase strength / power, you can:
 - Increase the intensity — resistance / weight.
 - Increase the volume — repetitions / sets / frequency.



Overload: Strength vs. Endurance

Strength (Resistance) Training

- *Also known as Resistance training.*
- The amount of resistance applied is progressively increased.
- Load is graded upward over time as the muscle adapts.
- Drives gains in strength and power.

Endurance Training

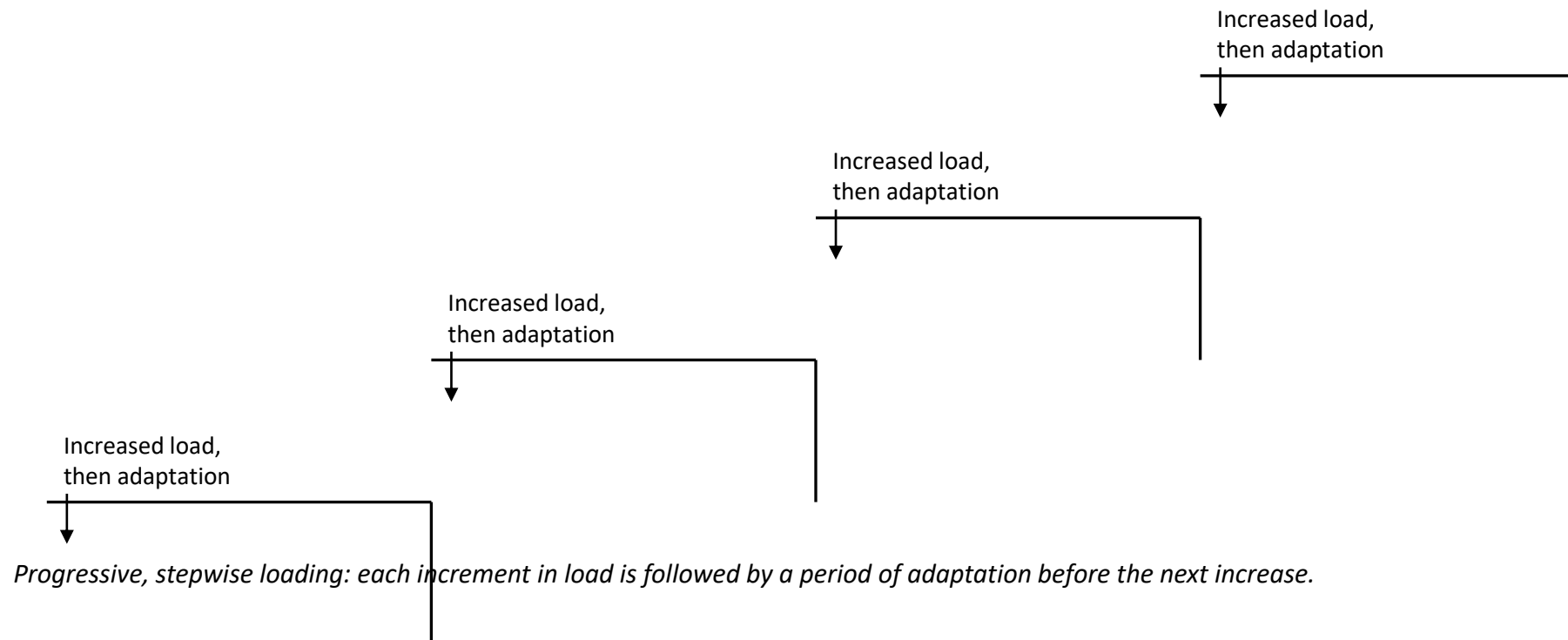
- The time of sustained contraction is progressively increased,
- and / or the number of repetitions is progressively increased.
- Emphasis is on repeated, sustained work rather than maximal load.
- Drives the capacity to resist fatigue over time.



TRAINING PRINCIPLES

Overload Must Be Gradual & Progressive

This must be a gradual and progressive process. Too much overload can lead to injury and fatigue.





TRAINING PRINCIPLES

Applying the Overload Principle

When applying this principle, keep in mind the following:

- Test maximums.
 - Avoid muscular failure — i.e., avoid burnout.
 - Allow ample recovery time.
 - Plan and monitor training loads.
- Track individual progress.
 - Alternate activities.
 - Coordinate all training activities and schedules.



TRAINING PRINCIPLES

Overload Works With Other Principles

The Overload Principle works together with other sport training principles, including:

- SAID — Specific Adaptation to Imposed Demands.
- Reversibility Principle.
- Resistance Training.

These principles are examined in turn through the remainder of this lecture; each shapes how overload is safely and effectively applied.



TRAINING PRINCIPLES

SAID — Specific Adaptation to Imposed Demands

Sometimes called the Specificity Principle.

- **The body will adapt to the specific demands placed upon it.**
- You get what you train for (e.g., Dragon Boat training, Martial Arts training).
- We achieve this through Specificity:
 - Exercises should mimic the function you are trying to improve.
 - e.g., if endurance needs to improve, then the volume should ultimately be geared to that purpose.



TRAINING PRINCIPLES

SAID — Task-Specific Training

- **Task-Specific Training:**

- What you do when you exercise — whether in the gym or at home — should be relevant and appropriate to the desired outcome.
- This is accomplished by focusing on:
 - Movement patterns.
 - Limb position.
 - Velocity of exercise — speed and direction.

Clinical takeaway: prescribed remedial exercise should replicate the movements, positions, and speeds of the client's target activity or activities of daily living.



TRAINING PRINCIPLES

Reversibility Principle

- People lose the beneficial effects of training when they stop working out.
 - *If you don't use it, you lose it.*
 - Occurs when exercise stops or slackens, causing benefits to be lost.
 - Detraining effects can be reversed when training resumes.
- Rest periods are necessary, but extended rest intervals can reduce physical effects.
 - **Most benefits of training are lost in 4–8 weeks.**
 - Sport-specific skills are retained much longer than the physiological effects of training.
 - Once a skill is learned, it is never forgotten — e.g., riding a bicycle.

PART TWO · RESISTANCE TRAINING

Resistance Training

Sometimes called Strength Training



RESISTANCE TRAINING

Resistance Training — Definition

Sometimes called Strength Training.

- **Any exercise that causes a muscle to contract against an external resistance, with the expectation of an increase in strength, tone, mass, and / or endurance.**
- Can provide significant functional benefits and improvement in overall health and well-being.



Resistance Training — Benefits

Functional benefits and improvements in overall health and well-being include:

- | | |
|---|--|
| <ul style="list-style-type: none">• Increased bone, muscle, tendon, and ligament strength and toughness.• Improved joint function.• Reduced potential for injury.• Increased bone density. | <ul style="list-style-type: none">• Increased metabolism.• Increased fitness.• Improved physiological systems. |
|---|--|



RESISTANCE TRAINING

Determinant Variables for Resistance Training

- | | |
|--|---|
| <ul style="list-style-type: none">• Alignment• Stabilization• Intensity• Repetition Maximum (RM)• Strength Training Zone | <ul style="list-style-type: none">• Volume• Frequency• Exercise Program Length• Rest Periods |
|--|---|



DETERMINANTS OF RESISTANCE TRAINING

1 · Alignment

- Determined by muscle fibre direction and the muscle's line of pull.
- **Proper alignment isolates the muscle.**
- Poor alignment results in substitute motions — compensatory patterns caused by stronger neighbouring muscles.
 - *e.g., preacher curls on a bench vs. free weights.*



2 · Stabilization

- Works together with alignment — i.e., “holding the body steady.”
- Helps ensure correct muscle actions by avoiding substitute motions, because those motions may place the muscle or joint in a weakened position.
- *There are two types of stabilization — external and internal (next slide).*



2 · Stabilization — External vs. Internal

External Stabilization

- Use of equipment such as belts and straps.
- Or firmly supporting surfaces such as walls or tables.
- Support is provided from outside the body.

Internal Stabilization

- Isometric contraction of adjacent muscles to stabilize the proximal attachment of the muscle you are training.
- *e.g., why you should have a strong core when doing exercises or sports.*



DETERMINANTS OF RESISTANCE TRAINING

3 · Intensity

- **The amount of weight or resistance a muscle contracts against per repetition.**
- Otherwise known as the Exercise Load.
- As the intensity increases, so do the cardiovascular risks.
 - Therefore it is beneficial to teach rhythmical breathing or proper diaphragmatic breathing to help minimize risks.

Refer to Table 1.1 for further details.



DETERMINANTS OF RESISTANCE TRAINING

4 · Repetition Maximum (RM)

- **RM is the greatest amount of weight (load) a muscle can move, through the available ROM, within a specific number of times.**
 - *e.g., maximum bench press — how much weight in one rep.*
- 1 RM represents one maximal effort at a high intensity.
- 10 RM represents the weight that can be moved 10 times — usually at 75%.

Refer to Table 1.1 for further details.



DETERMINANTS OF RESISTANCE TRAINING

5 · Strength Training Zone

- After RM has been determined, the exercise load used at the beginning of the program is expressed as a percentage of RM.
- Can be as low as 30–40%, or up to 90–100% of RM.

Refer to Table 1.1 for further details.



DETERMINANTS OF RESISTANCE TRAINING

6 ▪ Volume

- The sum of the total number of repetitions (times a specific movement is repeated) and sets (a predetermined number of repetitions grouped together, after a brief rest period).
- There is no optimal number of sets per session, but a general rule is 1–6 sets. Single sets are used primarily in early phases of resistance exercise or in a maintenance program.
- **Inverse relationship between Volume and Intensity — the higher the Intensity, the lower the Volume.**
- Volume is influenced by: frequency of sessions, order of exercises, and rest intervals.

Refer to Table 1.1 for further details.



DETERMINANTS OF RESISTANCE TRAINING

7 • Frequency

- **The number of exercise sessions per day or per week.**
- The greater the Intensity and Volume, the more time is needed between sessions to recover.
- Overtraining is when performance declines due to excessive frequency and inadequate rest, resulting in progressive fatigue.
 - High-intensity, eccentric exercise causes more depletion of muscle energy stores and requires more time to replenish.
 - *e.g., HIIT — High-Intensity, Intense Interval Training.*

Refer to Table 1.1 for further details.



DETERMINANTS OF RESISTANCE TRAINING

8 • Exercise Program Length

- **The total weeks / months of an exercise program.**
- As a general rule:
 - Returning a client to a pre-injury state, or sufficiently maintaining the exercises for a lifetime — only 1–2 months is needed.
 - Making gains in strength — this normally occurs after 2–3 weeks (because of neural adaptations).
 - Hoping for hypertrophy or increased vascularization — 6–12 weeks of resistance training is needed.

Refer to Table 1.1 for further details.



DETERMINANTS OF RESISTANCE TRAINING

9 • Rest Periods

Also called the Rest Interval or Recovery Period.

- Allows for recuperation from the acute effects of exercise due to Intensity and Volume.
- General rules of thumb:
 - Moderate exercise at 8–12 RM needs approx. 30–60 s before the set is repeated.
 - Clients with pathologies, the elderly, and children should do ACTIVE rest (low intensity) for 1–2 minutes between sets.
 - For exercises of moderate intensity, a 48-hour rest interval is recommended.
- **Decreasing rest intervals can lead to: progressive fatigue, overtraining, staleness, deterioration in performance, and decreased motivation.**

Refer to Table 1.2 for further details.



RESISTANCE TRAINING

Table 1.1 — Example of Strength Training Zone

TYPE	HIGH	MEDIUM	LOW
Intensity (% of 1 RM)	80–100%	50–70%	10–40%
Volume (per minute)	1 exercise	2 exercises	3+ exercises
Sets	1	2–3	4+
Reps	1–6	8–15	20+
Frequency	1 per / week	2–3 per / week	4+ per / week

Read across each row to compare High, Medium, and Low training-zone parameters.



RESISTANCE TRAINING

Table 1.2 — Example of Training Goals

TYPE	STRENGTH	POWER	HYPERTROPHY	ENDURANCE	SPEED
Load (% of RM)	90–80	60–45	80–60	60–40	30
Reps	1–6	1–6	6–12	13–60	1–6
Sets	4–7	3–5	4–8	2–4	3–5
Rest between Sets (min)	2–6	2–6	2–5	1–2	2–5
Duration (sec per set)	5–10	4–8	20–60	80–150	20–40
Speed per Rep (% of max)	60–100	90–100	60–90	60–80	100
Training Sessions per Week	3–6	3–6	5–7	8–14	3–6



PART THREE · MUSCLE PERFORMANCE

Muscle Performance

The capacity of a muscle to do work



MUSCLE PERFORMANCE

Muscle Performance · 1 · Strength

- **The ability of contractile tissue to produce tension and a resultant force.**
 - *i.e., lower reps, increased load.*
- Strength increases due to:
 - Neural adaptation — synchronization of motor unit firing and improved ability to recruit motor units.
 - Increased muscle fibre size.
 - Increased metabolic efficiency.
 - Increased body awareness and mechanics.



MUSCLE PERFORMANCE

Muscle Performance · 2 · Power

- **Strength and speed of movement — i.e., $\text{Power} = \text{work} / \text{time}$.**
 - *e.g., plyometric exercises such as clapping push-ups and box jumps.*
- A single burst of high-intensity activity (putting luggage into an overhead compartment) or repeated bursts of less intense muscle activity (climbing stairs).
- Power is enhanced by:
 - Increasing the work a muscle has to perform in a specified period of time.
 - Decreasing the time it takes to perform a specified amount of work.



MUSCLE PERFORMANCE

Muscle Performance · 3 · Endurance

- **The ability of a muscle to contract repeatedly against a load, generate and sustain tension, and resist fatigue over an extended period of time.**
 - *i.e., more reps, decreased load.*

Contrast with strength (lower reps, higher load) and power (strength combined with speed).



LECTURE 3 SUMMARY

Key Takeaways

- Overload: improvement requires progressively loading beyond current metabolic capacity — gradually, to avoid injury and fatigue.
- Intensity builds strength/power; volume and sustained contraction build endurance; the two are inversely related.
- SAID / Specificity: the body adapts to the specific demands imposed — train the movement, position, and velocity of the target task.
- Reversibility: benefits are lost in 4–8 weeks without training, though motor skills persist far longer.
- Resistance training is governed by nine determinant variables — from alignment through rest periods.
- Tables 1.1 and 1.2 translate these variables into practical strength-zone and training-goal parameters.
- Muscle performance is expressed as strength, power, and endurance.

LECTURE 3

References & Verification

- Primary source: Kisner & Colby, Therapeutic Exercise: Foundations and Techniques (K&C) — resistance-training determinants and muscle-performance concepts.
- Course tables adapted for RU RMT 19 (Table 1.1 Strength Training Zone; Table 1.2 Training Goals).
- Continues in Lecture 4: exercise techniques and their clinical application (strengthening, stretching, ROM/mobility, proprioception, and cardiovascular exercise).
- *Instructor note — verify before delivery: confirm all numeric ranges (RM %, sets/reps, rest intervals, program lengths) against the current course textbook edition and the latest CMTCA competency framework prior to distribution.*