

LECTURE 11

Resistance Training

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Resistance Training

When designing a client's training programme, there are a few steps that we go through initially when considering what we are going to utilise.

These are...

1. Client goals.
2. Time available to the client.
3. Facilities they have access to.
4. Their training background & experience.
5. Session planning - once you have the above information.

Most of the information will have been gathered during the initial consultation with the client.

The resistance-training aspects of the PT programme-design phase are very variable. You can plan to achieve a lot of different types of goals through appropriate design of this component. Initially we will remind ourselves of how the principles of training are represented in resistance training.

Principles of Training (Resistance)

Individuality

Every client is different...we need to remember this in our programme design. We differ in such things as structure, aspiration, experience, movement capacity, goals, height, weight and age.

When planning, we need to take all these factors into consideration. Let's think back to when we discussed squats. Each client in the picture below may have squats in their programme, but the reps, sets, ROM, rest, equipment, and frequency may differ for each person. Equally they may all differ in technique, and even how we choose to load them - front squat, back squat, goblet squat etc. There is a lot to consider, and we need to always keep the client's individuality at the top of the list when designing their sessions.



Specificity

Specificity is related to the task you want to achieve. So, in considering the relationship with resistance training, specificity is centred around the specific joint actions, muscle groups and load you choose to apply to the client. Let's say you choose to do a squat - this will be an exercise specifically designed to target the muscles of the hips and legs. The progress the client makes is linked to the reps and sets you apply, the rest period and the load.

Progressive

What challenges us today may not provide enough of a challenge next week. This is the principle of overload. We need to consistently increase the stress placed upon the structures of the body in order to continue to progress. Therein lies the challenge for a PT as we cannot simply offer linear increments in resistance to our clients forever.

So we need to have an awareness of rep ranges, load, time under tension (TUT), partial reps, angles, tempo etc in order to offer the overload the client needs over time to progress. But we also need to factor in how the stress will impact the client and the rest they may need in order to recover and progress.

Reversibility

Effectively the principle of reversibility can be summed up by the phrase 'use it or lose it'. All the work you have done in fitness to progress to where you are now can be undone if you embark on an inactive lifestyle. It is important to be aware that fitness cannot be 'stored' and must be worked on and maintained over time.

This isn't to say that you need to always train as hard as you do right now. There will naturally be times when you ease off, and other times when you increase the intensity.

Another thing to consider here is how different types of training can impact each other.

In order to highlight the point, let's take two extreme opposite types of training - long duration running and powerlifting

- The long-distance runner will utilise lots of aerobic respiration, and Type-1 muscle fibre recruitment to complete the task.
- The powerlifter is using primarily the creatine phosphate system, and much greater levels of neural recruitment, utilising Type 2B fibres to lift heavy loads.

If our distance runner stopped running and started lifting heavy weights, their aerobic capacity and cardiovascular efficiency might suffer, and equally our powerlifter would likely lose muscle mass and strength if they consistently embarked on long runs instead of their normal programme.

Recovery

Recovery time is an important principle for you to understand as a concept in fitness. As the exercise intensity increases, the client will require more time to recover. This stands true in terms of both between and within sessions.

For example, if you administer heavy weights to the client for 5 reps, and they cannot perform a sixth, then they will require a lengthy recovery in order to repeat the 5 reps again. Inadequate recovery would lead to a loss in performance.

This concept is also true between sessions. If you are lifting heavy weights on a given exercise then you will require a few days before you repeat the exercise again at the same intensity. This doesn't mean you cannot train on consecutive days, but the exercise selection would need to be different while your muscles recover.

Adaptability

Adaptability is the premise of our ability to overcome stresses in exercise, and to progress. If we programme the exercise variables correctly, we can ensure adaptation to the stimulus. If we provide too great a stress to overcome, the client will not manage it, and equally if we offer too little stimulus, there won't be significant physiological improvements.

The adaptations we can make as a result of sound programming are vast, ranging from the increased efficiency of tissues, to growth of muscles, strength of bones and connective tissues, movement improvements, stability, strength and power, and increased nervous system control.

Managing the Principles

To achieve different outcomes, we need to be able to effectively manage and manipulate the above principles. Let's look at some examples of how these principles are of importance for different objectives.

Muscular Strength

For strength improvements we need to make sure high-load stress is applied to the target muscle. If we are subjecting the muscles to higher loads, we need to give adequate recovery time so that the nervous system has enough resources to complete further sets.

Muscular Hypertrophy

Hypertrophy is a consistent goal of most clients as it denotes muscle growth. The exposure of stress with shorter rest periods will ensure there is enough stress for the muscles to recover and grow providing it is well planned.

Muscular Endurance

Muscular Endurance requires the muscles to be subjected to longer periods of exercise stress. High rep exercises will recruit the muscle fibres that are capable of longer-term contraction at lower levels of force.

Flexibility

To develop flexibility, practice must be consistent. Stretching can and should have its own space within the training programme and must be completed consistently if you are to see the benefits and begin to improve.

Core

Core can be enhanced through the use of specific exercises such as a plank, back raises, wood chops or crunches.

If we have a strong core, we are more likely to have better posture and if we have better posture, the core muscles have more opportunity to work together with the posture to protect the spine.

Motor Skills

Motor skills cover things such as agility, balance and reaction times. In order to develop these skills, we must train clients in an environment that requires the use of them.

For example, if we want to help a client improve their balance, we might introduce unilateral exercises that would challenge a client's balance through using a single leg instead of both.

Variables

There are a number of variables that you can control and manipulate as a trainer to help make your programme as suitable to the client as possible.

These variables include...

- **Sets & reps** - using higher numbers of reps will have a significantly different outcome versus low reps so this should be a key consideration.
- **Recovery** - the amount of recovery time you give clients in between sets and exercises is important. It should also be linked to the number of reps and weight lifted. For example, lower reps with significantly more weight will require greater rest periods.
- **Volume** - the overall volume lifted has a big impact on the outcome of a training programme. It is also a useful tool that you can manipulate. For example, lifting higher reps with a moderate weight could still be a similar overall volume to lower reps for more sets (volume = weight lifted x number of times lifted).
- **Exercise order** - some exercises are more taxing than others. For example, compound lifts such as the bench press - because they require the use of multiple muscle groups. Because of this, commonly you would place the more taxing exercises at the start of the session when the client is fresher.
- **Tempo** - adjusting the tempo at which a certain exercise is performed can increase or decrease the time a muscle is under tension, thus increasing the stress it is exposed to. Tempo should work in relation to the weight lifted. A slower tempo is often better implemented with a lighter weight.
- **Range of motion** - different clients will have different ranges of motion that they are comfortable with. Sometimes utilising more weight in specific parts of the ROM can help to increase the overall range of motion.
- **Frequency** - frequency put simply is the amount of times in a given period (for example a week) that you train the same muscle group. It is one of the main variables in muscle growth and should be a key consideration when looking at workout splits. For example, if a client can only train three times a week, you would use a full body routine more frequently than a body-part split.

Different Types of Training

We will now identify the sets/ reps and rest schemes that are appropriate for each type of training, and the variables you might choose to manipulate, and then look at some strategies that will enhance the results of the training programme design.

Endurance Training



1. Likely a total body routine.
2. Lower weights (relative to client).
3. Higher reps.
4. Moderate sets.
5. Short rest.
6. TUT is high accumulatively

Hypertrophy Training



1. Possibly a split routine (beginners possibly not).
2. Moderate weights (relative to client).
3. Moderate reps.
4. Moderate sets.
5. Moderate rest.
6. TUT is high.

Strength Training



1. Focused on specific movement patterns.
2. High weights (relative to client).
3. Low reps.
4. Moderate sets.
5. Long rest – (dependent on client).
6. Based on nervous system rather than local muscle.

International Guidelines

There are a number of recognised international guidelines that relate to exercise prescription. For this lecture, we will focus on those directed by the ACSM (American College of Sports Medicine).

They state that resistance training is of benefit to everyone, with fat loss, blood pressure normalisation, reduction in heart disease risk, bone mineral density (BMD) improvements, and fitness improvements being among their stated benefits.

- **Types of resistance** - for example bodyweight, resistance bands, free weights or machine weights.
- **Minimum of 2 sessions per week** - you should aim for at least two resistance-based sessions per week on days that are not consecutive.
- **Lower fitness** - those with lower fitness levels should start on machines and move to free weights as they gain more experience. This is because it's more mechanically difficult to use free weights.
- **Rep ranges** - most healthy adults should aim for an 8-12 rep range. For individuals targeting strength training, this would be less and for those who are potentially older or more frail, higher with a lower weight.
- **Exercise volume** - you should aim to include 8-10 exercises into a workout.
- **Hypertrophy**- when targeting muscle growth, beginners should be aiming for a volume of 1-3 sets of 8-12 reps whereas advanced clients would be 3-6 sets of 1-12 reps.
- **Strength** - when trying to generate maximum force, a beginner should again be aiming for 1-3 sets of 8-12 reps whilst an advanced client would be aiming for 2-6 sets of 1-12 reps.
- **Power** - when trying to generate maximum power, you would typically perform 1-3 sets of 3-6 reps. However, this should be reserved for experienced clients.

How These Guidelines Might Differ from Others

Hypertrophy Training

The area for consideration is that of advanced lifters performing 1-8 reps, - a wide range. Hypertrophy can certainly be achieved with lower reps but is also reliant primarily on muscular stress and volume, so the higher reps on this scale are likely to achieve that as well. Utilising a range or different volumes will likely provide good results.

Strength Training

When it comes to strength training, you will gain greater improvements from lower rep ranges with higher loads, whereby the nervous system has to stimulate more motor units, and greater synchronisation. This will demand longer rest periods. The 1-8 rep range is fairly wide, accommodating those coming from hypertrophy and endurance training.

Power Training

Power development utilises the same type of recruitment – high-threshold motor units, and coordinated activation – as strength training, but it achieves it through acceleration and explosive activity rather than through the use of high loads. Performance is important, and each set should only be continued until the point the reps are no longer able to be performed quickly.



The area that is most obviously overlapping in the guidelines here is that of hypertrophy and strength training. The take-home point when it comes to assigning reps, sets and rest for different goals is that there is an overlap from one category to the next. There is no ‘perfect’ number of reps that you perform that makes the body respond in a specific way, only a guideline and a parameter to follow. You should also understand that there are differences when it comes to the term ‘strength’, in the same way that the term ‘fitness’ means different things to different people. In pure terms ‘strength’ is related to maximal force production, whereas it can be related to new exercisers as an interchangeable term for ‘muscular training’.

Endurance

Endurance based training is characterised by the use of low weights and high reps. It is likely to result in mainly Type 1 muscle fibre recruitment, additional calorie expenditure, and muscle mass maintenance (potential muscle growth in new clients). We would likely begin most new clients with an endurance-based programme in order that they gain a level of tissue tolerance, with low demand, and low injury risk. Endurance-based training can also be useful for those returning to training following an inactive period, clients who wish to supplement their cv-based training, and people who may have low-risk health issues (providing the GP has agreed to this route of exercise).

We may also use endurance training protocols for clients who are entering a de-load phase of training, or for higher-performing clients who are potentially engaged in a sports season and want to simply ‘maintain’ at present.

Hypertrophy

Hypertrophy training is designed to enhance muscle size. There are two primary methods that this happens – **sarcomere hypertrophy** and **sarcoplasmic hypertrophy**. Sarcomere is related to additional tissue being formed in the myofibrils, whereas sarcoplasmic hypertrophy relates to a greater intramuscular fluid volume. Either way, muscle growth is as a response to moderate sets and reps, with moderate loads resulting in greater local muscular stress on a range of muscle fibres. This stress results in super-compensation following training, assuming the recovery strategy suits the client (rest and nutrition).

Programming Hypertrophy for Different Level Clients



Hypertrophy programme design is a balance between training stress and recovery. For this reason, we need to manipulate the sets and reps to suit the client. Each client's journey is unique, as we have mentioned, and we need to respect this by ensuring that we don't manipulate too many variables at once. Simply increasing the weights and decreasing the reps, while using the same exercise selection and order, might be enough for the client's initial progression from endurance training. It can be easy to jump too far ahead too soon.

Beginner

If we have a client entering hypertrophy training following endurance-based training, possibly a beginner using this method for the first time, it would make sense to utilise higher-rep ranges, while remaining in the hypertrophy parameters (10-12 reps perhaps). If they are a beginner, we need to also be aware of how much volume we assign to their sessions.

We might use 10-12 reps but remain using a total-body approach.



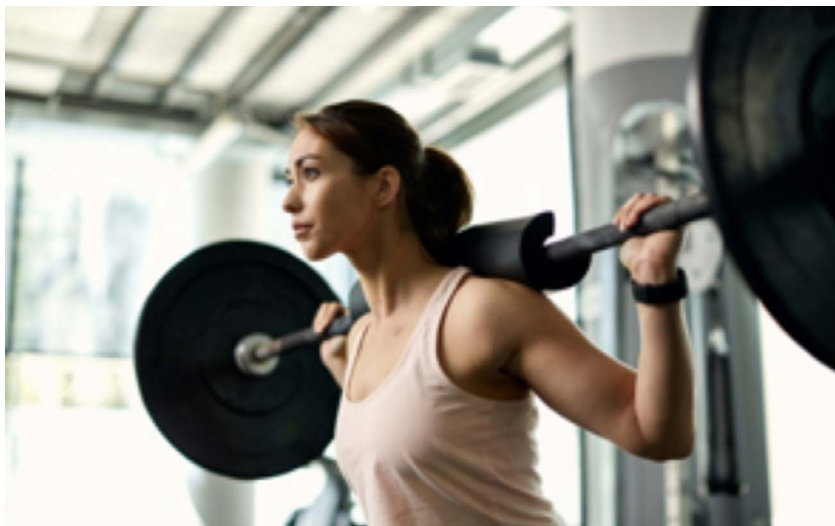
Intermediate



We could progress into using a split routine with a client who is now more comfortable lifting slightly heavier weights for lower reps. We might also increase the weights slightly, and lower the reps. This enables us to increase the total stress the muscles are subjected to, and hopefully enhance the growth they experience. Another option is to adapt the tempo (particularly the eccentric phase) to ensure each rep takes a little longer – another way to increase training stress.

Hypertrophy can also be a good fat loss strategy as the increased stress enhances the EPOC effect of training (excess post-exercise oxygen consumption).

Advanced



An experienced exerciser, or a higher-performer, might choose to utilise the hypertrophy rep ranges and programme design to enhance their performance by alternating between strength and hypertrophy protocols. The hypertrophy would offer a little growth, while the strength training would offer the central nervous system (CNS) the opportunity to mould the new muscle tissue through higher-end recruitment and synchronisation, in order that it is able to be explosive and/or powerful.

As stated above, you may want to consider split routines for certain clients and specific goals, particularly where hypertrophy is the objective.

Below are a couple of examples...

1. Two-way split e.g. upper body / lower body.
2. Three-way split e.g. push / pull / legs.

These aren't the only options for split-routines but give you an idea of how to structure a client's training week so that all major muscle groups are covered to ensure balanced progression.

Strength

Programming for strength is largely based on the nervous system's ability to coordinate and synchronise muscular activation, utilising as much of the muscle tissue that is available for the task. So, in a heavy squat, the muscles in your glutes, quads and hamstrings will be recruited to complete the task. The level of recruitment is based upon the task (load), and the central nervous system's ability to activate a large number of high-threshold motor units near-simultaneously.

Strength training is of course a muscular endeavour. However, it is not a 'local muscular endeavour'. What we mean by this is that lifting heavy weights is more of a 'global', total-body training style. For this reason, it is incredibly demanding of the CNS, reliant on its ability to recruit lots of motor units in rapid succession to support the effort.

With strength training we will likely experience some level of hypertrophy due to the muscle's production of high forces. However, despite the use of heavier weights, strength training isn't as efficient at growing new tissue as traditional hypertrophy training due to the fact the muscles are under stress for shorter periods of time – both during each set, and throughout a full workout. The longer rest periods that are a staple of strength sessions are designed to offer the nervous system full recovery so that it can repeat its recruitment efforts again and again. This lack of accumulating muscular fatigue makes strength training more a task of using what you already have - and using it well.

Beginner

The development of a strength-based programme should be reserved for those that have more training experience, and better muscular conditioning. Beginners and de-conditioned clients shouldn't be subjected to the higher stresses of strength training as there is too much risk attached if they aren't adequately prepared for this type of training.

Intermediate

In those that are in the early stages of transitioning to strength training we can manipulate the FITT principle (frequency, intensity, time & type) in order that the client isn't overwhelmed with the challenge. Decreasing the frequency (days per week) and intensity of sessions (lower the load and slightly increase reps) will help the client to adapt to the increased demands.

Advanced

High-performing clients, such as athletes, will benefit massively from strength training as it effectively ensures a greater level of efficiency in recruiting the high-powered motor units – those that also play a role in speed, power and explosive activity. There are a lot of similarities between a heavy squat, and a jump in terms of movement pattern, dominant muscles, and neural recruitment (more on this later).

Power

Power training shares some similarities with strength training in terms of it being far more about how the nervous system interacts with the muscles and the type of high-level recruitment that high-performance demands of the body. Being able to accelerate a weight is a vital part of developing power, which is characterised by strength at speed.

Programming for power requires a good level of understanding in terms of the ideal protocols. You need to consider the appropriate exercises, as some lend themselves to power training while others don't. You need to consider appropriate loads in order that they can be accelerated (high weight is hard to move fast). And finally, it requires discipline on the PT's part, as well as the client's, to honour the longer rest periods. Beginning the next set too soon after the last will lead to the inability to generate adequate force, and at this point power development suffers.

Beginner

Power training is not really designed for the novice exerciser. There needs to be good level of technical competence, and strong neuromuscular connections.

The final point is a really good one to expand on...

Remember that power training requires speed, and typically without a high level of experience it is hard for the nervous system to actually perform this task. At the same time technique is hard to manage, and monitor, with high-speed exercises, so there needs to be a level of satisfaction on the PT's part that the client's technique is very good.

Intermediate

When a client is beginning power training one of the things for us to consider is that performance is important. We need to remember that this type of training is designed to make someone a better performer of exercise. As such, when a client's technique starts to suffer, and when they are exhausted, it is important we give them rest. Oftentimes we subscribe too much to the 'more is better' philosophy, yet with power training this is not the case. We need to ensure exercise is performed well.

Advanced

Power training can be of massive benefit in a periodised plan for high-performers. It effectively takes the muscle mass the client has and makes it efficient at performing towards its genetic potential. The expression of power, speed and explosiveness feature in many sporting endeavours, so to a degree it is useful for many different people, ranging from elite athletes, through to those that play recreational sport. We just need to ensure our exercise prescription is appropriate for the specific client we are training.

1-10 Rep Max Calculations

We have talked in this lecture about rep ranges and the percentage of a client's 1RM that they should be using (ie the maximum weight for one repetition). But how do we know what a clients 1RM is...? Well, outside of testing their maximal rep max figures – which is simply not possible with some clients and is perhaps not necessary with others – we can use estimations.

Initially we will perform a 10RM test, whereby the client uses progressive loads to reach a figure that they are challenged with for 10 reps. And then we can use one of the tables easily available on the internet, to assign the rough weight they could lift for a given rep-range. For an example of one of these tables, go to the National Strength and Conditioning Association (NSCA).

<https://www.nasca.com>

At this point, we have discussed lots of training parameters and various intensities. We should discuss how to monitor these intensities...

By virtue of resistance training being split into sets of work and recovery it can be difficult to monitor the intensity. Unlike steady-state CV efforts, which often feature curve-based intensity increase and decrease, and can be easily monitored, resistance training can often feature more rest time than work time. On top of this, Heart Rate is not as reliable of a measure when it comes to intensity, as some exercises are really difficult, despite not impacting HR significantly.

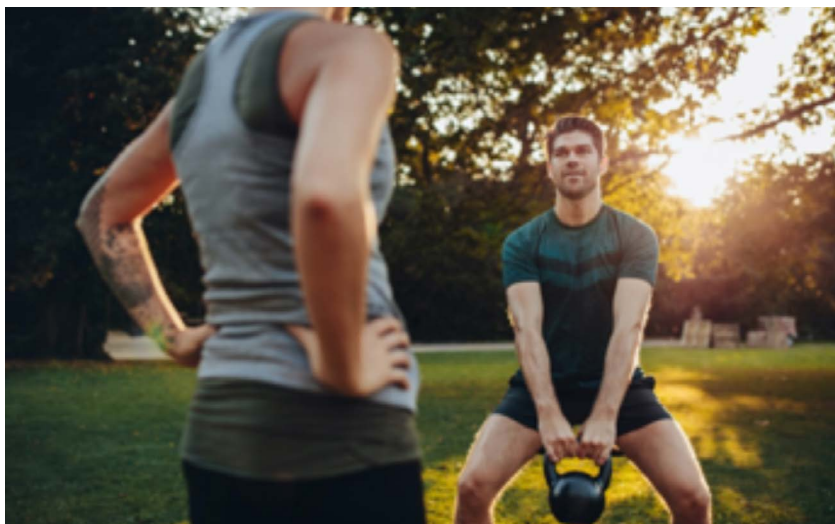
Monitoring Exertion in Resistance Training Sessions

Rate of Perceived Exertion



The original 6-20 scale by Borg could be used in weight training, but this was designed to correlate with heart rate to assess exertion, so the modified 1-10 RPE scale is probably a better choice in resistance training. From this you can easily assess how hard your client feels they are working, and ensure it matches their goals.

Visual Assessment



Looking at the picture above you might think that the exercise has been a real challenge for the client. Using visual assessments as a guide is non-scientific, but can assist you in making sure you have assigned the right intensity to the client. As the difficulty increases, it should become obvious from the client's physical responses.

Conversational Test



Even during weight training it is possible to use the talk test as a guide to the intensity of your client's exercise. It is unlikely as intensity increases, and the reps get lower with higher weights, that the client will have the ability to talk at all. If they are talking during a set, it is likely that the intensity is manageable for them.

When putting a client's programme together we mentioned you want to consider their training experience and background. They might be an experienced exerciser, but not in the type of exercise you are planning for them. This means that their training age in this discipline will be low and you shouldn't overload them too much early on.

If they are a complete beginner needing to work through a progressive phase of preparatory training initially, then you should absolutely do this, rather than feeling that you want to showcase all the skills you have too soon.

With experienced clients you can subject them to higher intensity and be more confident that their overall system is more prepared for this.

There are many different types of resistance available to you, some of which will be available in most gyms, and others that you might want to consider when we discuss training in different environments below. Among the options...

Machines



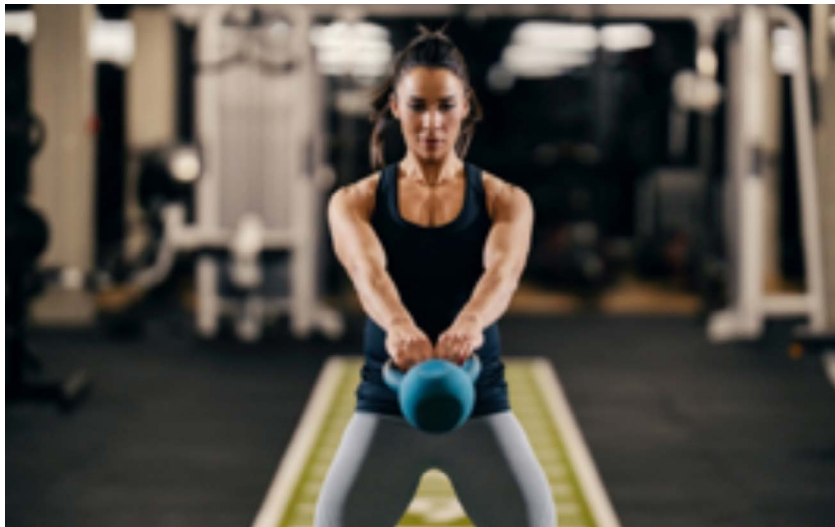
Fixed-path machines offer a fantastic option for training in a gym. They lend themselves well for the targeting of specific muscles or muscle groups, they give excellent stability to novice exercisers and the opportunity to advanced exercisers to overload muscles.

Free Weights



Barbells and dumbbells are a staple of fitness clubs and offer users a wide range of resistance options to train for any goal. They also give exercisers a different type of exercise stimulus than machines do – they demand more from the stabilising muscles in order to perform the exercise effectively.

Small Equipment



Kettlebells, medicine balls, slam balls, resistance bands, training harnesses, suspended movement equipment... the list goes on. Not only are these excellent options for training clients in the gym, but they are also portable, and (relatively) lightweight, meaning they can be used at home.

Bodyweight



Bodyweight training is an area of growing popularity. The ability to utilise your own weight in various angles, to create a range of different resistances and exercise effects is not only useful, but very empowering.

