Pontifex Physiotherapy:
Strength & Power Philosophies

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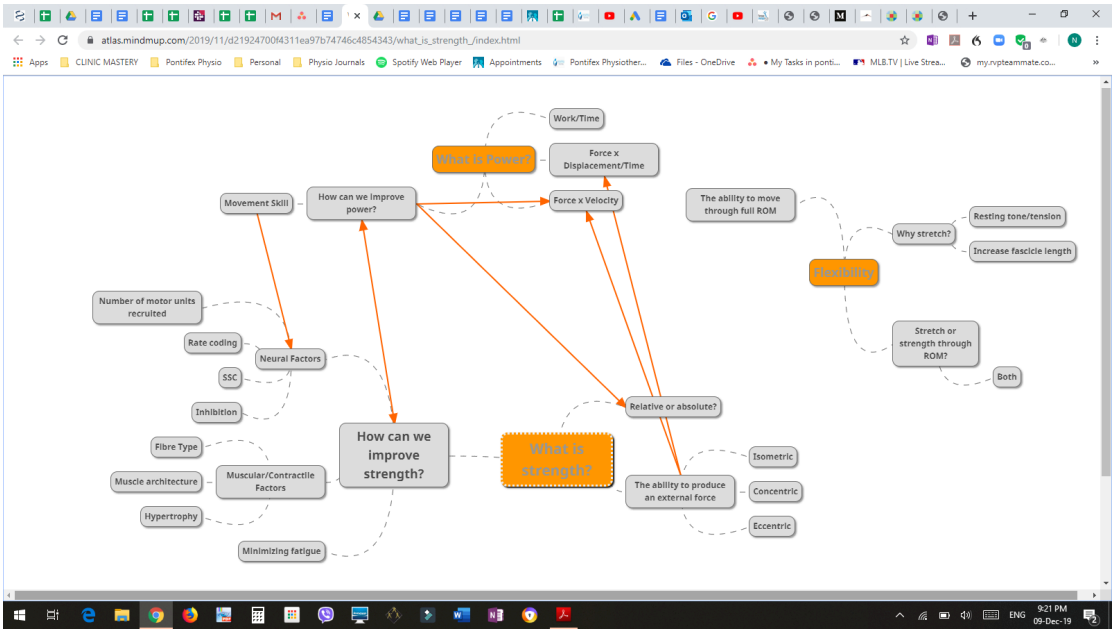

Strength: Do you Need More?
How Much is too Much?
Does it help daily life?
How does it help Performance?

Do you need more?

- ***Strength* is the most important training factor;**
- It is the underlying factor in technique, efficiency, power etc. Strength is defined as the ability to produce an external FORCE (Stone, 2007). This is especially important in collision sports, collision is a force to tolerate.
- Three types of strength:
  - Isometric: force (strength) without movement
  - Concentric: force (strength) with movement
  - Eccentric: force (strength) that controls or decelerates movement

Does it help daily life?

- **YES.**
- This is why people get hurt. Their body cannot tolerate the forces that act on it during everyday life. Whether that is sport or work, if you're tissues are not strong enough, ***they will break.***

How does it help performance?

- For athletes, eccentric strength or the forces required to slow down is the most important aspect of strength related to sports injuries. For example, most hamstring strains happen as the leg is slowing down from going forwards and about to start going backward. ACL injuries usually happen when trying to change direction, which is a slowing of movement one way and beginning to move another. In throwers, shoulder & elbow injuries happen because the body can't slow down the force generated to throw the ball.
- It is also important to consider absolute strength (amount of force generated regardless of body mass) and relative strength (amount of force generated relative to lean body mass) (Bompa & Haff, 2009).

Strength is a coordination of the neuromuscular system (Cormie, 2011). This is why some people seem "naturally strong".

- Strength is a complex skill, but it can be learned and improved by training muscular or contractile elements:
    - Fibre type e.g. Type II fibres have greater relationship to force generating capacity.
    - Hypertrophy or size of muscle fibres-bigger muscles can produce more force. If you can produce more force, you can learn to tolerate more force.
    - Muscle architecture e.g. angle of pennation-some muscles and/or contractions don't occur at an angle of advantage & therefore large forces can't be produced. This can be the reason for a sports injury.
    - You can also improve strength by training neural Factors:
        - Motor unit recruitment-the more motor units you recruit, the more force you can produce. *But wait! What's a motor unit? Simply put, it's made up of muscle fibres and the particular nerve that makes them go.*
        - Rate coding-how fast do your motor units produce contractions? This is usually done from smallest to largest, because it's less tiring that way.
        - Synchronization-the timing of contractions relative to need. This is a skill, therefore can be improved.
        - Stretch shortening cycle-the use of ground reaction forces to produce higher forces than you are capable of.
        - **Inhibition**-a reduction in the above elements. **This is common in the presence of pain/injury: if your brain**

senses a risk by the continued use of a muscle or group of muscles, it will try to stop you & protect you from risk.

How do we develop strength & how much is too much?

- Do we lift heavy all the time?
  - No. The greatest gains in strength are seen when training at 75-85% of 1RM or approx. 4-6 reps (Peterson, 2005). But to make gains, you need to vary the combinations you use for this because of all the factors listed above.
- Do we train to failure?
  - No. Fatigue reduces the ability to execute the neural factors listed above. Therefore, ***not training to failure*** produces superior gains in strength (Peterson, 2005). You should aim for your last rep to look the same as your first and to have 1-2 reps "left in the tank".
- What is optimal program structure?
  - **This is individual dependent.**
    - You need to find someone who will properly assess & identify your specific needs such as those listed above.
    - You also need someone who understands the specific demands of your sport.
    - You also need someone who understands your injury history and can build a program to strengthen your weaknesses AND condition you to your sport. This is where a physiotherapist with a proper understanding of strength & conditioning principles can be extremely valuable.
- A few examples of programming:
  - Consider the mixed methods & High/Low approaches.
  - You can improve strength by developing the above qualities that you have assessed as needing improvement in your individual.
    - E.g. making muscles bigger will improve strength.
    - Getting better at the skill of a lift e.g. bench press will make you stronger-Think back to the earlier discussion about the neural aspects of strength
    - Focusing on moving a weight faster will increase strength-stay tuned for the next post on power for more info on this.
    - Increasing the amount of force produced will increase strength.
    - Stretch shortening cycle or plyometric training can increase strength.
    - Eccentric or isometric training can increase strength.

Strength Vs Power? What is the difference and what should I be concentrating On?

- An example to consider: Are you limited in how fast a muscle can contract? Biochemically?
- Therefore once you reach max speed, the only way to influence power is force-or strength

- ***What is Power?*** (Cross et al., 2015)
    - In terms of pure physics, power is defined as:
        - The rate the work (movement) is performed or the product of the force (strength) and how fast it is produced (velocity)
        - Power = Work/Time = Force x Displacement/Time = Force x Velocity
    - Simply put in the real world, power is the product of the force (strength) and how fast you can produce it.
    - Power can be improved by improving one (or both) of the above elements.
        - For example: increasing your squat from 100kg to 150kg, can allow you to produce more force.
        - So instead of your power being: 100x1.5meters per second =150.
        - You would now be: 150x1.5m/s = 225

Make sense?

However,

- A weak person (small amount of force) who moves quickly (velocity) isn't powerful, they're fast (speed).
- A strong person (high force) who moves slowly isn't powerful either because power is BOTH force and velocity dependent.
    - But, a strong individual will produce more power under load (Cormie, 2011).

Enough physics, what about sport? What should I be concentrating on?

- Correct, we should also consider the skill of the movement e.g. sprinting, pitching, hitting. This is where your skills coach, S&C coach & physio should all work together & all understand your sport. Think back to the previous post about the neural aspects of strength (LINK).
- Having the physical qualities only means someone is capable of high power. We need to help them learn how to express this power in the field
    - *As an aside, this is often why people "fail rehab" and why an experienced physio with an in depth understanding of these principles should be part of your team.*

- However, this doesn't mean we should simulate sports in the gym. During rehab/training, we should develop qualities e.g. force, power and then have a phase for "conversion" or ideally, this happens during sport training (Plisk, 2000).
- In order to fully develop your power, you need to figure out which part of the equation you're deficient in. Are you strong (high force) but slow? Are you weak, but fast? Could you improve both aspects? In this scenario, an experienced strength coach is imperative to help you walk the fine line between both qualities.

Stretching: What is it? *What does it do to the muscles? What is the best way to stretch? Do we need to do it?*

What is Stretching or flexibility?

- The ability to move a joint through its complete range of motion (McNeal, 2006).
- Affected by joint structure e.g. ball & socket joint and the elasticity or plasticity of connective tissue (Simmel, Nickels, & Liedl, 2014).

What does it do to muscles?

- Theories as to what stretching does have mostly centered on the lengthening of fascicles-based on the evidence that they shorten during contraction. Hamstring research in particular has shown that fascicles can in fact be lengthened (at least with strength work) (Opar, Williams, Timmins, Dear, & Shield, 2013).
- ***BUT,* the urge to stretch comes from tension or resting tone in a muscle,** usually the result of the amount of contractions a muscle group has done during previous exercise or having been held in a static position for an extended period of time e.g. sitting at a desk (Simmel et al., 2014).
- Stretching is just one of the means by which flexibility can be changed (McNeal, 2006). Therefore, you might not be aiming to increase the length of muscles, but rather get them back to their normal length. In that case, other dynamic methods of recovery/treatment e.g. foam rolling, trigger balls, heat or massage may be more useful to reduce neural tension, without necessarily changing muscle length This is thought to be the effect of foam rolling, rather than a true lengthening of the tissue (Myers, 2013).
- You may also need to consider other options to reduce tension such as spa, sauna, breathing/relaxation methods.

What is the best way to stretch?

- Most stretching interventions e.g. static, ballistic & proprioceptive can increase static joint flexibility, but have little to no effect on dynamic flexibility (Weerapong, 2004). Static joint flexibility is not as important as dynamic flexibility-the ability to get into the positions necessary for your sport.
- Dynamic flexibility can however, be influenced by strength & power training. (MAKE THIS A LINK TO OTHER POSTS) Moving through the full range of motion of a joint, with extra load or speed, will also provide a stretch on the muscles.
- If we train like this, we can change the length/tension relationship of a muscle by using load to lengthen the muscle or take it to the end of its length.

Do you need stretch? Will it help you?

- Dynamic stretching and tools such as foam rolling can improve flexibility instantly (with a combo of both producing the greatest gains), but the effects last no more than 10 minutes (Smith, Pridgeon, & Hall, 2018).
- Research is still mixed on whether stretching reduces performance, particularly in high-powered activities such as sprinting. This is thought to be due to taking the tissue outside its optimal length tension relationship to produce force.
- A consensus on ideal dosing does not exist, but 3 times per week for 4 weeks ***(or 12 sessions)*** seems to be a common range needed to improve fascicle length, with stretches being held for 30 seconds, with 30 seconds rest and repeated twice more (Leslie, 2017).
- In our opinion YES. A combination of static, dynamic and flexibility tools should be used to either a) increase flexibility and allow better tolerance of the positions needed to excel in the athletes sport or b) get back to baseline flexibility following training/competition in order to allow the person to achieve ideal movement position during load and reduce the risk of negatively affecting length/tension relationships, therefore increasing the risk of injury.

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