Lack of Power / explosive strength

Hockey – Shot at goal from top of D

C1 – Explosive strength Attacking skill 1 – Shot at goal from top of the D:

This skill involves perfect timing, confidence in execution and above all power. This is where I feel I am weakest. In many cases I feel it is due to fatigue and the build-up of lactic acid in the relevant muscles. However the main cause of lack of explosive power is my shortage of upper body strength, especially in my arms. As I do not train constantly and on specific areas of my body, in this case arms, like Rob Moore does, I haven’t built up a lot of muscle in the arms. Explosive power is the rate at which force can be generated by the muscles and exerted. This means the power of my shot is duly affected by my lack of explosive power. It is clear that Rob Moore has done significant weight training and explosive power training throughout a specific fitness regime, whereas I have not organised a regime specific to my fitness requirements. I haven’t done any excessive arm weight training and therefore the strength in my arms is at an adequate level, but with room for improvement/strengthening. Motor units and muscle fibres also have an impact on the explosive strength in my arms. The number of fast twitch fibres will be unknown to me unless a sample is taken and therefore this is slightly irrelevant. However the number of fast twitch fibres will determine how explosive each muscle contraction would be during a hit. In one muscle neurone there may be up to 300 to 800 fast twitch fibres, both oxidated and glycotic. Fast twitch fibres contract more powerfully because they have more myosin filaments. These thicker filaments mean the muscle has more mass and explosive strength. Fast twitch fibres also have a developed sarcoplasmic reticulum which means it releases and removes calcium ions quicker, for faster contractions. This is determined by genetics, but also training. Long, endurance and aerobic training results in type 2b turning to type 2a fibres, explaining the loss of speed in endurance athletes; however high intensity anaerobic training increases the size and the number of fast twitch fibres. This could explain the lack of fast twitch (explosive) fibres in my arms, which in turn results in less strength in the shot. I do not do high intensity weight training for my arms and therefore haven’t developed higher numbers of fast twitch fibres. Motor units however, alter type/strength of contraction. Following the “all or nothing” law that a motor neurone doesn’t activate a single fibre or even a select few, it has to contract all of them. The number of muscle fibres in each motor unit is dependent on the level of control required by that muscle. For example, an eye lid will have fewer fibres (5) to allow a gentle controlled contraction. In larger muscles that require strength over control, may consist of up to 1000 muscle fibres. This links in to special summation; the response of a motor unit follows the “all or nothing” law, but the strength of the response of the whole muscle is determined by the number of motor units involved. For a stronger contraction the brain employs more motor units.

C2 – Explosive strength Attacking skill 1 – Shot at goal from top of the D: Plyometrics.

To increase my explosive strength in my arms there are a number of exercises and training method I could use. I am going to focus on one specifically; it is plyometrics. Plyometrics works on the principal of eccentric contraction on the downwards phase and concentric contraction of muscles immediately after/during the upwards phase. It involves bounding and jumping exercises. Plyometrics is designed to produce fast, explosive movements; it also improves the performance of the nervous system. During plyometric movements the muscle is loaded with weight, contracted in rapid sequence, testing the strength and elasticity of the muscle and surrounding tissue. Because most of the power will come from the arms I will focus on this; by improving the explosive strength in my arms I can achieve faster more “explosive” contractions, making the shot more powerful. Here are some plyometric exercises I will do.

Running with wrist weights

Running with wrist weights conditions the muscles in the upper body to be able to move with large exertion and speed with resistance, building explosive power. When the weights are removed, the muscles will be able to propel the arms with greater speed and force, increasing levels of upward motion.

Press-ups and Hand clap

Press-ups with a hand clap in between are an especially vigorous way to condition the arms and chest. The pre-stretch takes place as the hands arrive back on the ground and the chest sinks toward the ground, followed quickly by the explosive upwards action. As with many plyometric exercises, to get the best training effect keep the time in contact with the ground to a minimum. A weight disc or weight vest can be worn for progression and overload. This will increase the force with which I can use my arms to create lift, when I drive them upwards.

Medicine ball

Another means of increasing upper body strength and power is to lie on the ground facing upwards. A partner then drops a medicine ball down towards your chest; you then catch the ball and immediately throw it back. Alternatively you can do this alone, throwing and catching yourself. However this can be potentially dangerous with no one to help in the case of an accident. To allow progression and overload, the weight of the medicine ball used can be increased, and the frequency of drops and returns can also be raised.

Incline push-ups

•Place the box to elevate the athlete's feet above their shoulders when in a press up position

Facing the floor in a press up position, put your feet on the box and your hands between the mats, push off the ground and land with one hand on each mat. You then push off the mats with both hands and back to the starting position. Keep the hand contact time on the mats as short as possible.

How much

3 sets of 10 repetitions a set, 5 minute recovery between each set, Quality of the push ups will be far more important than the number of push-ups.

These exercises will all develop my explosive strength in my upper body, which means each contraction when I strike the ball is more explosive and powerful, resulting in a harder strike at goal and hopefully more chance of scoring.

Rugby – Rucking

C1- Rucking

Lack of power in lower body (legs and core)

As I am an openside flanker, I am required to be first to the breakdown in attack and defence on most occasions. A high level of aerobic fitness is required to make it to the contact area/breakdown. However, once there a short explosive movement is necessary to be effective. I am not able to clear opposition from the ruck as effectively as McCaw, partly due to technique failing as I tire. But the main cause for this is my lack of power and strength. To be destructive at the breakdown I need to have strong leg drive, a strong core to keep myself stable and good level of upper body strength to twist opposition out of the way. There are a variety of techniques which can be used for clearing out opposition, however I am going to focus on the most common style of aiming to get below the opposition player, ( between them and the ball) and drive straight through maintaining on my feet by engaging my core. This power will be generated from my legs, as it is a short sharp motion of high intensity fast twitch muscle fibres will be used because they contract with greater speed. Furthermore, they produce more force as more myosin filaments are present which are thicker. They have a more developed sarcoplasmic reticulum, meaning they release and remove calcium ions quicker to enable faster contractions. Finally, in comparison to slow twitch fibres they contain different myosin ATPase, which releases energy more quickly. However they do fatigue quickly, therefore only suitable for short bursts, such as clearing out at a ruck.

C2- Plyometric Training

To improve strength and power I will use plyometrics training, it is designed to produce fast, powerful and explosive movements which engage the stretch reflex (a protective mechanism preventing the overstretch of muscle fibres). The movements used are; bounding, jumping or hoping. Within each of the movements muscle groups work eccentrically before the overstretching is detected by specialised receptors called muscle spindles, which send a nerve impulse to the spinal chord which results in a powerful concentric contraction. As I develop the power generated through my legs, I will see the benefits the next time I am in a rucking situation. Within my training regime I would set up a routine/program including plyometric exercises which involve different muscle groups. I would specifically target my leg muscles, which I use for driving back the opposition. Three exercises that are easy to complete but very effective are; jumping squats, jumping lunges, and squat thrusts. All three of these movements can directly benefit my performance as they replicate the movement and muscles used in rucking.

The plyometric movement involves three stages; I will use a squat as the example to explain each phase:

The first phase is the eccentric contraction, where the elastic energy is generated and stored. It is a controlled movement, slower than the concentric contraction. For example the downward phase in a squat.

The second phase is the short hesitation period between the eccentric contraction and the start of the concentric contraction. This period is known as the ‘amortisation phase’. The quicker this phase happens the less time you pause for, the more powerful the muscle contraction will be. This is where the muscle spindles detect the overstretching of muscle fibres and prevents you going any further to prevent injury. This stage occurs at the bottom of the squat, prior to the acceleration upwards.

The third phase is the concentric contraction; it is the fastest stage of the movement, where the power is applied. For example, in a jumping squat, accelerating up just after the amortisation phase.

[](http://www.google.co.uk/url?sa=i&rct=j&q=plyometric+training&source=images&cd=&cad=rja&docid=oDnunwckQXwJ_M&tbnid=wQ2v3be7boC26M:&ved=&url=http://hubpages.com/hub/7_Minute_Plyometric_Workout_-_Squat_Jumps&ei=j1V-UemdGuSe7Ab72YC4Dw&psig=AFQjCNEKPJKi4zIMBIJCuwvR8ECz4O-zhg&ust=1367320335829271)I would incorporate plyometric training into my workout plan, to specifically develop my power and acceleration alongside general strength. I would do it once a week as it is a hard workout and requires several days to fully recover and allow me to improve other aspects of my fitness too.

An example of a plyometric session may look like this:

* 10 x jumping squats- paying particular focus on the slow downward motion before a fast acceleration. This will replicate the driving phase, as I clear out the opposition. The squat also incorporates my back muscles and core, which play an important role in stabilising the movement.
* [](http://www.google.co.uk/url?sa=i&rct=j&q=plyometric+training&source=images&cd=&cad=rja&docid=4AHBVmwngv_OjM&tbnid=pyop6j6SLGGdMM:&ved=&url=http://catcore.blogspot.com/2012/03/plyometric-training.html&ei=j1V-UemdGuSe7Ab72YC4Dw&psig=AFQjCNEKPJKi4zIMBIJCuwvR8ECz4O-zhg&ust=1367320335829271)10 x jumping lunges- Once again, the acceleration upwards will develop my fast twitch fibres to be more reactive in a match. The alternation of legs requires me to ensure I get high enough off the ground by exploding upwards, at the same time, similarly to squats my core will help to keep my balanced and develop my abdominal muscles simultaneously. The initial drive after the eccentric downward phase demonstrates a similar amount of force required for the immediate contact area in a ruck.
* 10 x squat thrusts- This exercise replicates how low you need to get in a ruck in order to be successful. When I do squat thrusts, I make sure that I keep my head in a neutral position, looking straight ahead to prevent myself from falling forwards, I try to transfer that into a competitive situation because if I come off my feet I would give away a penalty.

I would repeat this circuit 3 times, with a one minute break in between each circuit. Therefore, it will keep more body working anaerobically whilst performing the movements. Within my plyometric session I would also do other exercises for my other body; clap press ups, walking press ups. And further exercises that I could bring in to work my legs would be box jumps, and silent squats to work the same muscles as the exercises I have mentioned above. All of these leg exercises will benefit my individual performance in a game, but also aid the overall team performance and opportunity to attack if I win more turnovers as a result of plyometrics training.

Downhill Biking – Bunny hopping

**C1 Bunny hoping – Lack of power**

Being able to lift a downhill bike (which typically weighs around 18kg's) completely off the floor with enough trajectory to land on a high ridge line or clear a large rock is by accounts easy. Especially due to the fact the rider is likely to be fatigued on the lower parts of a track, making bunny hoping even harder. A rider must be able to carry out a fast and powerful movement to be able to bunny hop effectively and this made even harder by the weight of the bike. Therefore, a rider must be powerful in order to carry out a bunny hop effectively on a downhill bike. A lack of power would mean they may not be able to clear a large rock and may end up crashing. It is my lack of power which results in my ability to bunny hop large obstacles to lessen as a get further down the track, and is also the result of me being completely unable to clear certain obstacles of significant height such as very large rocks or high lines that are 50cm's or higher.

Power is strength multiplied by speed and is the most important component of bunny hoping. Regardless of a rider’s technique, strength and speed is needed in order for that rider to reach a certain height. Suspension can be used to aid bunny hoping to a certain extent. However, this would only be the case if a rider was increase the rebound in their fork and shock. This may aid them when bunny hoping but would be a hindrance on the rest of the track, as a high rebound can make a section feel more rough than it actually is. Therefore it is important for a rider to improve their power.

Skeletal muscle is made of bundles of muscle fibres. These fibres are bound together by connective tissue and contain blood vessels and nerves. Within these fibres the main process of muscular contraction takes place, called the sliding filament theory. Myofibrils within the muscle fibres contain sarcomeres. Each sarcomere is divided by the next one by the Z line. These sarcomeres contain two protein filaments, the actin filaments and the myosin filaments. The sarcomeres shorten due to the myosin filaments pulling the actin filaments inwards. The process of muscular contraction starts when a nerve impulse is sent to the sarcoplasmic reticulum; this initiates the release of calcium ions (Ca+).

1) In the presence of high concentrations of Ca+, the Ca+ binds to Troponin, changing its shape and so moving Tropomyosin from the active site of the Actin. The Myosin filaments can now attach to the Actin, forming a cross-bridge.

2) The breakdown of ATP releases [**energy**](http://www.teachpe.com/physiology/energy_systems.php) which enables the Myosin to pull the Actin filaments inwards and so shortening the muscle. This occurs along the entire length of every myofibril in the muscle cell.

3) The Myosin detaches from the Actin and the cross-bridge is broken when an ATP molecule binds to the Myosin head. When the ATP is then broken down the Myosin head can again attach to an Actin binding site further along the Actin filament and repeat the 'power stroke'. This repeated pulling of the Actin over the myosin is often known as the ratchet mechanism.

4) This process of muscular contraction can last for as long as there are adequate enough ATP and Ca+ stores. Once the impulse stops the Ca+ is pumped back to the Sarcoplasmic Reticulum and the Actin returns to its resting position causing the muscle to lengthen and relax.

This process occurs every time we contract our muscles. When bunny hoping we are required to carry out these contractions quickly and powerfully. Being able to move more powerfully and quickly could be affected by the proportion of fast and slow twitch fibres we have in our muscles. Fast and slow twitch fibres are both useful for different types of exercise. Fast twitch fibres are best suited for short, intense bursts of effort whereas slow twitch fibres are best suited for slow, endurance based exercises. A higher proportion of fast twitch fibres would be beneficial for bunny hoping, which requires short and powerful bursts of effort. Fast twitch fibres produce their ATP from anaerobic pathways and therefore the intensity of the effort does not last long. They have a larger diameter than slow twitch fibres due to there being more myosin filaments in them, and the myosin is also thicker than in slow twitch fibres. Because of the type of myosin present and its arrangement in the myofibrils, the fast twitch fibres able to produce more force than slow twitch fibres. This is helped by having a more complex arrangement of the sarcoplasmic reticulum, meaning that calcium ions are able to be released more quickly and returned to storage more quickly than slow twitch fibres. Due to the anaerobic nature of fast twitch fibres, they also have larger stores of phosphocreatine present. Fast twitch fibres are therefore more suited to the strains placed on an athlete when bunny hoping, and therefore the athlete should include exercises in there training which produce faster twitch fibres.

**C2 Bunny hoping – Plyometric training**

Bunny hoping a bike with speed and accuracy when already fatigued requires a high amount of power. By improving my power, will able to bunny hop higher and more effectively. This will enable me to jump to higher lines or clear larger rocks that were previously blocking a faster line. This could therefore lead to me gaining valuable time and improving my results. My chosen corrective measure will be plyometrics.

Plyometrics is a type of training designed to produce fast and powerful movements. These exercises are specialised and high intensity which specifically improves power. This training technique involves explosive muscular contractions which engage the muscles stretch reflex. The stretch reflex is where the target muscle is stretched before it contracts so that it contracts with greater force. For example when an athlete bends down and jumps they will stay down for as short a period as possible in order for the muscle stretch to engage before it is fully contracted. This stretch reflex protects our muscles from over stretching. When the muscles start to overstretch, specialised receptors called muscle spindles detect this and send a nerve impulse which travels to the spinal cord and results in the immediate contraction of the muscle being over stretched.

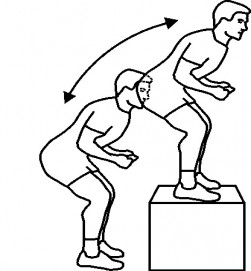
Plyometric exercises involve an initial rapid eccentric movement, followed by a powerful concentric movement. By doing this the muscle contracts more explosively and rapidly. When I use plyometrics in my training I will make sure to use a range of different exercises targeted at different muscle groups.

Plyometric movements have three phases:

The first phase is the eccentric muscle action where the muscle lengthens. This is where the elastic energy is stored. This is also known as the pre stretch phase, as this occurs before the muscles actually stretch.

The second phase is the time in between the eccentric action and the start of the concentric muscle action. This period is where the muscle changes from stretching to contracting and is known as the amortisation phase. The shorter this phase is, the more powerful the muscle contraction will be.

The final stage is the actual muscle contraction and is the movement that the athlete wants to develop. And is the period in which the muscle becomes strengthened.

[](http://www.google.co.uk/url?sa=i&rct=j&q=plyometric%20training%20box%20jumping&source=images&cd=&cad=rja&docid=k_Tqr91vwQVkMM&tbnid=nRctIwzw3shjDM:&ved=0CAUQjRw&url=http://www.protraineronline.com/exercise/box-jump/&ei=BYh2UYiuLoKKhQeM-4AQ&psig=AFQjCNHKhMQkPNTVcbxl_AixQhri3WcmqA&ust=1366808918021386)A good plyometric exercise for lower body strength is drop jumping. This exercise involves the athlete dropping (not jumping) to the ground from a raised platform or box, and then immediately jumping up. The drop down gives the pre-stretch to the leg muscles (eccentric phase) and the vigorous drive upwards the secondary concentric contraction phase. The exercise will be more effective the shorter the time the feet are in contact with the ground. When carrying out this exercise I will make sure to make my ground contact time as short as possible. I should also keep my legs stiff on landing and maximise the flexion of the knees and hip upon landing. I would also need to maximise the height of my jump and keep it as high as possible for my level of power. This will be in order to make sure that I am always progressing and developing strength.

Judo – O Goshi

**C1 O Goshi - Power in the lower legs and core:**

Power is defined as the rapid application of muscular force and it is also a combination of strength and speed. Explosive power is important when executing O Goshi especially as lower body power is essential once in the squat position for this throw, as the main source of energy and power comes from the lower body specifically the quadriceps, gastrocnemius and the hamstrings. Large amounts of explosive power is also required in the execution phase of the throw in the action of straightening the legs at speed in order to gain maximum momentum which is utilised to throw Uke over the hips. This power is created by the eccentric contraction in the downwards phase of the squat and this movement occurs at the hip, knee and ankle. This action also requires large amounts of power to achieve maximum exertion when concentrically contracting the muscles in order to pick Uke up and throw them over my hips. However when I execute this throw I lack the explosive power needed in my lower body and therefore I cannot create the right amount of momentum to throw Uke over, also having little power in my legs means that I cannot contract the muscles rapidly and therefore I tend to tire easily.

Motor units are made up of a single motor neurone and all the muscle fibres. Each motor unit either contains all slow twitch fibres or all fast twitch fibres. Slow twitch fibres are recruited first to cause movements, however they are only useful for aerobic activities and become fatigued, they also stimulate less muscle fibres and produce a weaker contraction therefore fast twitch motor units are recruited. When these are recruited the muscle fibres produce a greater and more powerful contraction as they recruit more motor units than slow twitch fibres. Therefore fast twitch fibres are more important to develop in training as they cause a more powerful muscular contraction. Fast twitch motor units also create more powerful muscular contractions in larger powerful movements as they contain motor units that activate more muscle fibres in order to complete the movement. The recruitment of all the muscle fibres during contraction improves the strength of contraction within a motor unit as the muscle fibres either all contract or do not contract; this is known as the all or nothing law, demonstrating that there is no such thing as a partial muscle contraction. Therefore the lack of lower body power that I experience may be due to being unable to recruit as many fast twitch motor units meaning that my maximum power could not be achieved. Moreover, when the motor unit is activated the muscle fibres activated contract maximally therefore causing the muscle to rapidly contract and exert more power in contraction, meaning that I can throw Uke over much faster and with a lot more force in order to score Ippon. Furthermore, spatial summation is needed to activate all motor units in order to achieve a greater force of contraction. This is achieved by the brain recruiting more motor units, as well as increasing the number and size involved in the muscle contraction. By increasing the number and size of muscle fibres involved in the strength of the concentric contraction becomes stronger, causing the muscle to contract maximally which allows for a more powerful contraction when lifting the opponent up from the squat position.

Additionally the number of fast twitch motor units develop more force than slow twitch motor units with type 2b being able to exert much more force than type 2a fast twitch fibres, however the number of each type of muscle fibres both fast and slow twitch are genetically determined and therefore cannot be modified. Although, plyometric training can help to improve and change the number of type 2a fast twitch muscle fibres I have to type b fast twitch muscles fibres will enable me to produce more powerful muscular contractions, in order to produce more power during the execution phase of O Goshi.

The lack of power in my lower body is because I do not train everyday alike Ashley and therefore I have not developed a large amount of type 2b fast twitch muscle fibres which are important to generate rapid muscular contraction. There are two types of fast twitch fibres: fast oxidative glycolytic (type 2a) and fast glycolytic (type 2b). Type 2b fast twitch fibres produce a very rapid muscular contraction but due to the amounts of ATP which they require for this contraction they fatigue very quickly. Whereas type 2a muscle fibres produce a rapid contraction, however the contraction is considerably slower than the fast glycolytic fibres. Therefore I would need to use power training to increase the number of fast glycolytic fibres that are within the legs in order to improve explosive power. Athletes like Ashley would possess a high proportion of fast glycolytic muscle fibres due to power training; this would therefore produce a more rapid muscular contraction when straightening the legs.

Increasing the number of fast glycolytic fibres would be beneficial to improve power in the lower body as these are recruited for short bursts of intense activity. Although judo is mainly about endurance and uses the aerobic energy system, producing powerful throw requires short bursts of anaerobic activity therefore this would be beneficial to contract the muscles within the legs quickly in order to complete the throw with enough generated momentum to throw the opponent over. Furthermore, these muscle fibres have a fast contractile speed and can produce more force as they have more myosin (thick protein filaments) which are themselves thicker than normal. This is beneficial during the sliding filament theory as having more myosin filaments which are thicker means that actin can be pulled along further to create the muscular contraction. As well as this having a more developed sarcoplasmic reticulum allows for rapid contractile speed as the calcium ions stored here are released quicker therefore causing the muscle contraction to be quicker. They also contain a different myosin ATPase which releases energy rapidly therefore speeding up the power stroke causing the muscle contraction to occur quicker. Therefore improving the number of fast twitch fibres that are in the lower body will allow me to complete O Goshi successfully as I would be able concentrically contract my muscles faster in the upwards phase of the squat in order to flick my opponent over my hips. However using fast twitch fibres does have its disadvantages as they fatigue very quickly.

The amount of fast twitch fibres are genetically determined therefore Ashely may have a natural advantage over myself or will have increased type 2b fast twitch muscle fibres due to specialised training that is aimed specifically at improving explosive power within the legs. Whereas I have not undertaken any specific training to improve the amount of type 2b fast twitch muscle fibres that are in the legs and therefore I will always have a disadvantage compared to the elite performance due to the fact that I do not have the facilities or coaching available to undergo this type of training to improve my explosive power to improve contractile strength.

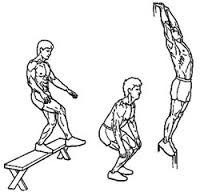
**C2 Corrective measure – Plyometrics:**

Plyometrics is a type of training that is designed to specifically to improve power as it involves bounding, jumping and hopping exercises to make muscle groups work eccentrically before a powerful concentric contraction. This type of training will therefore be beneficial to the skill of O Goshi as I need to improve the power in my legs in order to contract my muscles eccentrically when getting into the squat position and then to contract my muscles concentrically by straightening my legs to throw my opponent over.

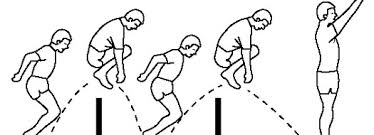
Plyometric training is designed to produce fast, powerful movements and this is achieved through completing exercises involving high intensity, explosive muscular contractions which engage the stretch reflex. This mechanism is vital to ensure that injury is not sustained as overstretching of a muscle can lead to tears in the muscle fibres and reduced flexibility as the muscle becomes tighter. The stretch reflex works as a protective mechanism that prohibits over stretching of muscle fibres it therefore increases the activity in the muscle as specialised receptors called muscle spindles are activated in the muscle undergoing the stretch or eccentric muscle action. When these become activated they supply information about that change in length of muscle and rate in which it changes length, this then gets sent to the spinal cord which results in the immediate contraction of the muscles being over stretched, allowing for a much more forceful contraction. Therefore producing the stretch reflex in the lower body muscles can help to produce a greater force of contraction which is beneficial as producing greater force of contraction means that the contraction of muscles becomes quicker and stronger.

However this type of training is only beneficial if the eccentric contraction is immediately followed by a concentric contraction otherwise the energy produced is lost as heat rather than being used. Therefore the force of the muscles contraction must be produced in the shortest time possible this is the underlying mechanism of plyometric training programmes and is called the stretch shortening cycle. This occurs in three stages. The first phase is the pre-stretch or eccentric muscle action, when elastic energy is generated and stored, for example the downwards phase of the squat. The second phase is the short time between the end of the pre-stretch and the start of the concentric muscle action; this brief period where you change from stretching to contracting the muscle and is known as the amortisation phase. This occurs when the squat position is achieved and is prior to the acceleration phase. The shorter this phase the more powerful the subsequent muscle contraction will be this involves the acceleration from the squat position to the straightening of the legs. Finally the muscle contraction occurs. Ultimately these stages allow for a more explosive muscular contraction. By utilising this cycle, movements become more powerful and explosive and the component of speed can also be worked in order to help rapid contraction of the leg muscles when straightening them from the squat position. Plyometric training therefore will develop the maximum force of the lower body muscles during rapid eccentric contraction. This type of contraction is where the muscle lengthens as it develops tension whereas the concentric contraction that follows is where the muscles shorten. Therefore working on both types of contraction through explosive plyometric training will aid me to squat down and straighten my legs quicker as well as producing more power and force to lift my opponent off of the floor.

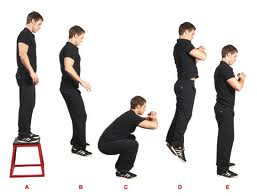
When producing a plyometric programme to work on the lower body, exercises such as drop jumping, bounding and hurdling will be beneficial as they allow different muscles in the legs to be worked rather than repeated strain being placed on one muscle. Also each station of the circuit would have a time limit to complete the exercise instead of completing reps as this would motivate me to work as hard as possible for the time allocated. By adding a time limit to an exercise recovery time would also need to be included to rest the muscles after repetitive exercise. Completing this circuit three times once a week would help to improve power, however there is also the opportunity to increase the intensity of exercises and the frequency as the week’s progress training once a week would not be enough to significantly improve power.

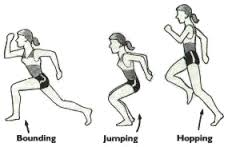
Drop jumping involves dropping down and not jumping to the ground from a raised platform or box the immediately jumping up. By dropping and not jumping to the floor completes the first stage of the stretch shortening cycle as this gives the pre stretch to the leg muscles therefore contracting them eccentrically whereas the immediate jump upwards completes the concentric contraction in the second phase of the cycle. Furthermore, the training becomes more effective if my movement is quick meaning that the shorter the time I am on the ground the more effective the exercise becomes. Also drop jumping is a relatively high impact form of plyometric training and would normally be introduced after the athlete had become accustomed to lower impact alternatives, such as two-footed jumping on the spot therefore I would have to gradually progress up to this exercise to ensure that I do not occur any injuries.

As well as completing this exercise bounding would improve my lower body power as it involves performing oversized strides in a running action. To complete this I would jog into the start of the exercise to make sure that all the muscles are warm before completing explosive exercises then I push off with my left foot and then bring my right foot forward making sure my knees are bent and toes are pointed. During the push I reach forward with my let arm then when the left leg extends back and remains extended for the duration of the push-off also holding this extended stride for a brief time and then landing on my right foot. When the left leg drives back through trough to forward bent position, then I reach my right arm forward, and the right leg extends backwards. Making these strides as long as possible and landing on the sole of the foot, allows energy to be stored by the elastic components of the leg muscles, and immediately take off again. Moreover keeping the feet on the ground for the shortest amount of time and anticipating the landing in order to move off quickly can also help to improve power in my lower body. Also bounding up stairs is a useful way to work on both the vertical and horizontal aspects of the running action. As well as this doing multiple jumps over a series of obstacles like hurdles would also be valuable to improve my power in my lower body.

Hurdling involves setting up 6 to 8 hurdles in a row with plenty of space in between them and by jumping forward over the barriers with your feet together this helps to improve power as it involves a quick explosive eccentric contraction followed by a concentric contraction. Also when jumping over the hurdles keeping the body vertical and tucking both knees into the chest allows you to jump high over the obstacle. Moreover improving power when landing on balls of the feet, allowing energy to be stored by the elastic components of the leg muscles, and to immediately take off again.

Overall plyometrics training with these exercises can improve my performance of O Goshi especially as it requires leg power to complete the throw successfully. Also research has shown that a relatively small amount of training is required to improve performance therefore the quick gain of power will be beneficial when competing and practicing this throw. The adaptations to the body from undertaking plyometric training will not only include a more powerful contraction but gaining a faster myosin ATP-ase and a more developed sarcoplasmic reticulum will enable the sliding filament theory to act faster as the calcium ions will diffuse out quicker as well as the myosin ATP- ase being able to produce energy quicker in order for the power stroke to occur. Ultimately the muscle contraction will occur at lot quicker than usual, therefore allowing for a more powerful muscular contraction.







Climbing – Egyptian

**Egyptian - Steve McClure, British Indoor Champion in 2000, known for his sport climbing.**

**C1: Lack of Power in Leg Muscles**

Climbers are sometimes required to bounce out of egyptians, in a similar manner to a dyno, in order to reach the next hold as the drop knee or egyptian position can be a relatively low stance. A common place to use egyptians is on overhung climbs where dynamic moves and fast climbing and powerful muscle contractions are often required anyway. I find this bounce movement a challenge and can never bounce out as much as Steve due to the lack of power in my legs in comparison.

It may be the case that Steve’s naturally occurring fast twitch fibre percentage in his legs is greater than mine, meaning I have a greater percentage of less-useful slow twitch fibres here. Due to Steve’s training regime being far more sophisticated and of greater intensity and frequency than mine for his powerful bouldering and sport climbing, he is likely to have converted many of his fast oxidative glycotic fibres (type 2a) to fast glycotic fibres (type 2b). Whilst I most likely have more type 2a fibres than Steve, meaning better fatigue resistance and more mitochondria for greater aerobic capacity, the power strokes in fast 2b fibres is greater and their anaerobic capacity is higher, allowing for more powerful contractions.

His powerful climbing technique may also be a result of him genetically having a greater percentage of fast twitch fibres than me. Fast twitch fibres have stronger power strokes and greater anaerobic capacity as well as faster working myosin ATPase to help more efficiently break down adenosine triphosphate.

Fast twitch fibres also have more developed sarcoplasmic reticulums. The sarcoplasmic reticulum is a network of tubes that are over the surface of myofibrils within muscles. At rest the sarcoplasmic reticulum stores a large amount of calcium ions. As Steve likely has a more developed sarcoplasmic reticulum within his muscles, he has the ability to store more Ca+ ions and make the calcium faster moving which increases the speed of contraction. Speed x strength = power, so with a more developed sarcoplasmic reticulum Steve has greater power than me. Steve’s high-intensity training regime for powerful bouldering and sport climbing most likely involves high intensity anaerobic training which causes muscular hypertrophy, increased myosin filament sizes (allowing for more powerful power strokes) and greater muscle mass in comparison to me as I do not undergo training of this magnitude.

**C2: Plyometrics**

Plyometrics is a form of power training that aims to allow for fast, strong contractions of explosive maximal strength. It does this through isotonic contractions using jumping, bounding and hopping movements to enhance power stroke strength. Plyometrics trains fast twitch muscle fibres and, much like most power training, helps convert type fast twitch type 2a (fast oxidative glycotic fibres) to type 2b (fast glycotic fibres). Plyometrics can be very dangerous as it can easily cause pulling muscles due to the over-stretching fibres, and in serious incidents lead to significant tears. Plyometrics can be incredibly fatiguing and so should not be performed <48 hours before of an event. Due to risk of injury it is important I am well prepared with powerful and balanced lower body muscles of the correct posture before commencing plyometric training. Spreading the plyometric sessions out is also important to ensure under compensation does not occur (e.g. no sessions within 48 hours of each other) and muscle fatigue does not interfere with my rock climbing training.

Adequate warm ups, cool downs, stretching sessions and a managed diet (involving a balanced intake of nutrients such as fibre and protein as well as possible glycogen loading) are required to reduce the negative effects of high intensity exercise experienced during plyometrics, such as muscle glycogen store depletion, delayed onset of muscle soreness, muscle fatigue, over-stretching and other injuries.

Each repetition of a plyometric movement begins with an eccentric contraction where muscle fibres are elongated. Muscle spindles within the muscle fibres detect the stretch that occurs during the eccentric contraction and eventually trigger the stretch reflex. The stretch reflex is an automatic reflex that causes motor units to contract in order to prevent any damage from occurring due to over-stretching of muscle fibres. This is then immediately followed by a powerful concentric contraction as the final stage of a single plyometric repetition.

With more powerful power strokes and larger amounts of fast-twitch 2b (fast glycotic) fibres my legs will be able to exert more force when twisting, standing up-right or performing a dyno out of the egyptian stance. The motor programmes from plyometrics of eccentrically then concentrically contracting my leg and hip muscles is transferable and can be used for a more explosive push out of an egyptian. This is not currently a movement I perform as my current habit is to not drop my body and eccentrically contract my leg muscles first.

Below are several plyometric exercises which I will use to focus predominantly on developing lower-body power.

*Low-medium intensity:*

Tuck Jumps

-Begin in standing position

-Jump vertically on the spot, tucking both knees into my chest

-Land on the balls of my feet

-Repeat process with as little time between takeoff and landing as possible

-1-3 sets at a time

-5-10 repetitions per set

-Allow for full recovery between each set

*Medium-high Intensity:*

Bunny Hops

-Feet shoulder width apart

-Lower into a squat position and quickly as far forward as possible, keeping legs under body at all times (not in front or behind)

-Land on balls of my feet

-Use arms to help swing

-Minimum ground contact time possible - spring effect is desired

-1-3 sets at a time

-5-10 repetitions per set

-Allow for full recovery between each set

*Climbing Specific:*

-Use indoor route with egyptian-permitting footholds, chest-height hand jug when in egyptian and large hand jugs repeated above

-Best done on slightly overhung route for safety

-Sport or top-rope rope system

-Start in egyptian stance, holding onto chest-height jug

-Squat down then immediately dyno upwards to the large jug

-Intensity mainly determined by distance to jug (higher jugs can be grabbed)

-Lower intensity: jug to dyno to 180cm from footholds

-High intensity: jug to dyno to 220cm from footholds

-1-3 sets at a time

-3-6 repetitions per set

-Allow for full recovery between each set

Rugby – Jumping to catch a high ball

**C1- Lack of power in muscles of the legs**

One of the reasons why my success rate under the high ball is not as high as Mils is that am I unable to get the height required off the floor in the jump to get above the opposition players also trying to compete for the ball. It is vital to jump off the floor in one explosive movement to get the most efficient but powerful jump.

One reason why Mils gets more height in the jump may be due to the types of muscle fibres he has in his legs. The types of fibres depends on both training and genetic factors; Mils has a higher amount of fast glycotic fibres (type IIb) in his legs compared to myself having more slow twitch fibres(type I). Slow twitch fibres have a greater aerobic capacity than fast twitch so my leg muscles are suited for aerobic activity (which could help last the duration of the game without fatiguing) more than Mils’ are; however fast glycotic fibres are more useful for anaerobic activity when short, explosive movements are required, such as the jump. Fast glycolytic fibres in comparison with slow twitch fibres contract with greater force and speed; this is because fast twitch fibres have thicker myosin filaments which are capable of producing more force. Muscle contractions work by myosin fibres pulling the actin fibres together in a movement called the ‘powerstroke’, this decreases the width of the Z lines of the sarcomere making the muscle contract and become shorter. Type IIb fibres produce a faster and more powerful powerstroke than type I meaning the fibres contract quicker; this means he can get off the floor faster and gather more height at the peak of the jump. Fast twitch fibres also have a more developed sarcoplasmic reticulum which releases and removes calcium ions (Ca+) quickly as well as a more developed myosin ATP-ase. Calcium ions are the nutrient which initiates the start of a muscle contraction; an electrical impulse is sent through transverse tubules to the sarcoplasmic reticulum which contain vast amounts of calcium ions, the impulse triggers the release of the Ca+ ions from the sarcoplasmic reticulum; this can then bind to troponin found on the actin fibres causing it to change shape which in turn removes tropomyosin from the actin binding site for myosin, the powerstroke can then occur. Having a highly developed sarcoplasmic reticulum means that more Ca+ ions are released quicker allowing for faster muscle contractions. As the calcium ions are released quicker, there are more ions are more present to pass through the myosin ATP-ase; fast glycotic fibres contain different forms of myosin ATP-ase which will increase the speed of muscle contractions, this is because the adenosine triphosphate breaks down in a more efficient manner.

Increasing the amount of fast glycolytic fibres in my legs by training will increase the speed and strength of my muscle contractions, it will also increase the efficiency of which my muscle fibres work; both of these factors give me a better chance of gaining more height on my jumps so I can catch the ball with greater success.

**C2- Improving the lack of Power in Leg Muscles using plyometric training**

I will use plyometric training to improve my leg strength and jumping ability; this will allow me to gain extra height on the jump and win more balls. Plyometric training uses bounding, hopping and jumping movements with the aim to increase power and explosive speed which will ultimately increase my jumping ability.

Plyometric training consists of firstly an eccentric contraction during the downwards phase of the movement where the muscles lengthen. Plyometric training involves high intensity explosive muscular contractions in this phase that engages the stretch reflex; this is stretching the muscle before it contracts so it contracts with greater force. The stretch reflex stops any overstretching and is a protective mechanism; it also increases the activity and elastic energy in the muscle undergoing the eccentric contraction, allowing it to act more powerfully. Specialised receptors called the muscle spindles found in the muscle detect any tendency of over stretching. When these are activated, a sensory neurone activates a motor neurone sent down the spinal cord resulting in the immediate contraction of the overstretched muscle. The overall result is a powerful braking effect and the potential for a powerful concentric muscle action. Following the eccentric movement, there is a concentric contraction during the upwards phase. If the concentric muscle contraction does not occur immediately after the pre-stretch all the potential energy and elasticity is lost. Whilst doing this, fast oxidative glycolytic (type IIa) fibres are recruited into fast glycolytic (type IIb) muscle fibres in the leg muscles in the long term. These result in faster muscle contractions as the ATP is split quicker and at a faster contraction velocity than fast oxidative glycolytic.

All plyometric movements involve three phases the first being the pre-stretch or eccentric muscle contraction when the elastic energy is generated and stored. Secondly is the amortisation which is the small gap between the end of the pre stretch and the start of the final phase; the shorter the phase the more powerful and subsequent muscle contraction will be. The final concentric phase results in the use of the energy stored in the muscle.

The key rule for plyometric training is to tailor the training specifically to the sport and action; since I am trying to improve the power of the muscles in my legs I will focus on lower body exercises especially targeting my hamstrings, quadriceps and gluteals. Here is a plan of what one of the plyometric sessions could include to target the main muscles in the lower body. I will build up the intensity of the exercises so my muscles can warm up first.

Squat Jumps- Low Intensity

* Standing jumps to be completed stood on the spot
* Stand with legs just past shoulder width apart
* Initiate the jump by lowering lower body to lowest position
* Jump up powerfully and extend legs straight and arms up at the peak of the jump
* Land back on balls of feet and flex legs at the same time to reduce the amount of lag from landing to the next jump
* Repeat for 6-12 jumps
* 3 sets

Double footed jumps over hurdles- Medium Intensity

* Standing jumps over hurdle at height of 30-90 cm
* Start with legs shoulder width apart
* Initiate jump by squatting down and jumping over hurdle with feet together using a double arm swing
* Upon landing, immediately jump over next hurdle
* Each set consists of 3x 3 hurdles
* 3-4 sets

Drop Jumps- High Intensity

* Start by standing on box 50-110 cm high
* Drop down from the box (do not jump), land on mid foot
* When legs touch the floor jump immediately back up to the box
* Keep legs stiff on landing and reduce the flexion at the knee and hip joint
* Aim for shortest amount of contact time on the floor
* 6x jumps for 1 set
* 2-3 sets

Before I start my plyometric training I need to make sure I am fully prepared, this would start with wearing the correct equipment; soft cushioning shoes are needed, this is because less strain will be placed on the tendons around the muscles which will decrease the chance of injury. The choice of ground underfoot should not be hard unforgiving surfaces like concrete because once again the stress placed on the tendons and muscles may increase the chance of injury. By using soft surfaces such as grass or carpet it will allow me to prolong my training because my muscles won’t fatigue as quickly as if I was using hard surfaces; training on grass will also help during the game because it is the same surface. Competent warm ups and cool downs are possibly the most important part of the preparation as well as a healthy diet. Active stretching will increase blood flow to the working muscles, more oxygen will travel towards the muscles providing more energy and will reduce the risk of injury. Cool downs from the previous plyometric session will help aid recovery; recovery will happen faster by eating protein rich foods, replacing electrolytes lost in sweat and eating carbohydrates with a range of glycaemic values replenishing the energy lost. Plyometric training is a very strenuous activity and involves the muscles working hard, because of this they can tear quite easily; there should be at least a 48 hour gap between plyometric sessions to allow sufficient time for recovery. High intensity exercises and drop jumps in particular place stress on the muscles and joints, in conjunction with plyometric training I will also incorporate weight training as it is important to strengthen the muscles which stabilise the joint to apply the forces required.

The gains in power that are created during plyometric training will vastly improve the height I can vertically jump. The higher and faster I can jump means I have greater chance of jumping higher than my opponent and regaining possession after a high kick as well as giving me greater hang time as the opposing players cannot challenge and tackle me whilst in the air. Catching a higher percentage of balls will improve mine and the teams confidence throughout the game and will force the opposition to change their tactics and give myself more attacking opportunities.

Volleyball – Blocking

**C1- My weakness is lack of power in legs.**

When carry out blocking, the action is very repetitive and strenuous. Often over time I begin to tire as I constantly have to be aware of where the ball is being played to, is it going to come through the middle or outside? When I have identified where the ball is being played through it is my job to make sure I get into the correct position. Therefore, if I was playing at position four and the block was coming through the middle (position three) I would need to use the correct footwork, followed by a squatting action to aid the power of the vertical jump into block. As the match progresses I often tire quickly due to my component of fitness, power being significantly weaker than the rest. Power is strength and speed combined. Having a lack of power causes my block to become weaker because my jump becomes poorer. This prevents me from getting up high to block the ball which means often my block is unsuccessful because my surface area is not big enough.

Power is produced my speed and strength combined. The definition of speed is the ‘ability to move quickly across the ground or move limbs rapidly to grab or throw.’ Speed is generated by the rate at which the sarcoplasmic reticulum and myosin ATPase work within our muscle fibres. The sarcoplasmic reticulum forms the system of channels that spread out over the myofibrils and acts as a store of calcium ions that when released, start a muscle contraction.

The other factor which power is produced by comes from strength. The definition of strength is the *‘*the ability to carry out work against a resistance*.’* and when exploring strength the main focus is on my fast twitch fibres. There are three types of strength: static which is the ability to hold or carry a large weight, dynamic strength which is overcoming a force, multiple times or for multiple reps and finally explosive strength which is the speed of the contraction and can overcome a force at great speed. However, explosive strength is my main focus when looking at fast twitch fibres. Fast twitch fibres work best and have been adapted for short, intense bursts of effort. They have a larger diameter than slow twitch fibres because there are many more myosin filaments and the myosin is thicker. As a result of this fast-twitch fibres are able to produce more force than slow-twitch fibres as they have more muscle fibres per unit.

All the motor neurones which lead to skeletal muscles have branches, each of which ends with a muscle fibre. Where the motor neurone meets a muscle fibre, this is known as the neuromuscular junction. Nerve impulses traveling down a single motor neurone will activate a contraction in all of the muscle fibres within that motor unit. This minimum unit of contraction is called a motor neurone. A motor unit is a motor neurone and all of its muscle fibres. Each muscle fibre within a motor unit will contract or it will not, it will never only contract partially. This is known as the all or nothing law.

Although the response of a motor unit is all or nothing, the strength of the response of the entire muscle is determined by the number of motor units which are activated. This is known as spatial summation.

**C2- Improving my component of fitness, Power.**

To improvemy levels of power in order to help me carry out a successful block without tiring easily throughout the match, I could carry out a plyometric circuit. This is a type of training which is designed to improve power. Plyometric exercises involve bounding, jumping or hopping to make muscle groups work eccentrically before a powerful concentric contraction. This training type is designed to produce fast, powerful movements. It involves high intensity, explosive muscular contractions which engage the stretch reflex. This is a protective mechanism that prohibits over stretching of muscle fibres. Any tendency to over stretch is detected by specialised receptors in muscles called muscle spindles. When these are suddenly activated, a nerve impulse is sent to the spinal chord which results in the immediate contraction of the muscles being over stretched. There are two types of isotonic muscle contractions, eccentric and concentric. Eccentric contractions occur when the muscle lengthens as it develops tension. These contractions occur during a downwards movement, because the muscle controls descent against the force of gravity. When the muscles shorten while contracting, this involves concentric contractions which occur during upward movements. A plyometric contraction involves an initial rapid eccentric movement, followed by an explosive concentric contraction which will contract more forcefully and more rapidly, for example squatting down to get power for my jump followed by an immediate vertical jump (blocking).

This works as a form of power training because, when a quick stretch is detected in the muscles, an involuntary, protective stretch reflex occurs to prevent over stretching and injury. The stretch reflex increases the activity in the muscle undergoing the stretch or eccentric muscle action, allowing it to act much more forcefully. The result is a powerful braking effect and the potential for a powerful concentric muscle action. If the concentric muscle action does not occur immediately after the pre-stretch, the potential energy produced by the stretch reflex response is lost.

All plyometric movements involve three phases: the first phase is the pre-stretch or eccentric muscle action, when elastic energy is generated and stored, the second phase is the short time between the end of the pre-stretch and the start of the concentric muscle action; this brief period where you change from stretching to contracting the muscle and is known as the amortisation phase. The shorter this phase the more powerful the subsequent muscle contraction will be. The final phase is the actual muscle contraction. This sequence of three phases is called the stretch- shortening cycle. By utilising the stretch-shorting cycle, movements can be made more powerful and explosive. Plyometric training is simply a set of drills designed to stimulate the stretch reflex and corresponding additional forceful contraction over and over again.

When selecting my own plyometric exercises to help me improve my power, I need to focus on my lower body as that is where I need the power to come from in order for me not to tire after the repetitive action of the block. The power comes from my legs, so in order for me to improve this, I need to work on them.

I would create a short circuit involving three stages which I would carry out twice. Each station would be 1 minute long, with a 30 second rest between them, where I would constantly walk to reduce the onset of muscle soreness.

I could do drop jumping. This exercise involves me dropping (not jumping) to the ground from a raised platform or box, and then immediately jumping up. The drop down gives the pre-stretch to the leg muscles (eccentric phase) and the vigorous drive upwards the secondary concentric contraction phase. The exercise will be more effective the shorter the time the feet are in contact with the ground. The loading in this exercise is governed by the height of the drop that should be in the region of 30 to 110 cm. The two key factors in drop jumping are a minimal contact time with the ground and the height achieved in the drive upwards. When planning this exercise I need to start off jumping from a height of 30cm and slowly increase this over time, as my lower body becomes accustomed to this. On landing I need to stay on the balls of my feet. If my heels come into contact with the ground then the drop height needs to be reduced. I will start at a drop height of 30cm and I can then increase the drop height by 5cm over time.

Another exercise I will do to improve the power in my lower body is a squat followed by a verticle jump and then the final exercise could be a box/bench jump. This is where you jump from the ground to the bench and then back down again. You repeat this action until the allotted time is up.

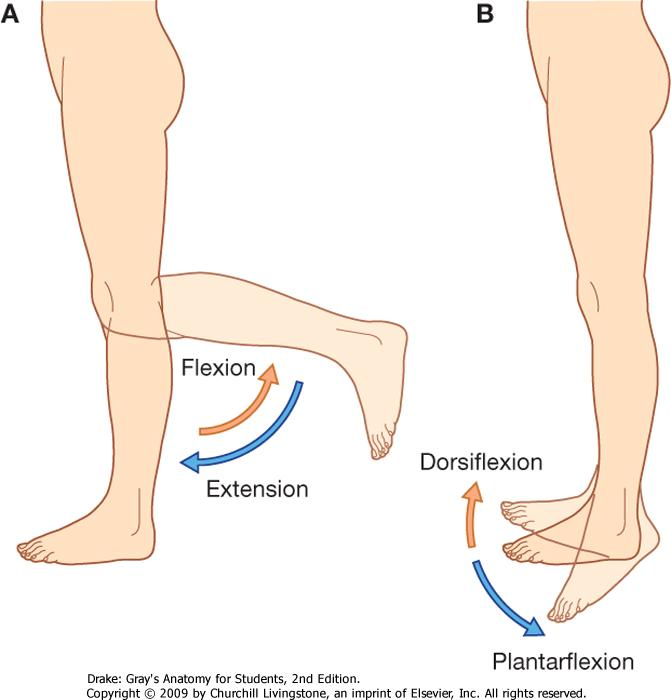
I would do a plyometric circuit once a week to allow time for my muscles to recover and prevent injury as after a plyometric circuit you should feel sore.

Improving my power will have a major impact on the overall performance of my block as I will be able to jump higher. The strength comes from my legs and improving this component will mean I will be able to withstand the repetition of the skill and the constant jumping therefore I will be able to jump high enough for longer and meet the needs of my team.

Athletics – High jump

**C1 High Jump – Power (Legs Muscles)**

Power is defined as the maximum exertion of strength within a short burst movement. High jump requires large amounts of power (predominantly during the take off phase) to be able to perform at a high standard. This requires large amounts of fast twitch fibres in the specific muscle groups in the legs that are required to contract rapidly to create a powerful jump upwards, achieving ultimate height. This will require fast twitch motor units to contract rapidly achieving a much greater height. The benefits of fast twitch fibres include that they have a developed sarcoplasmic reticulum meaning it can release calcium ions rapidly, speeding up contraction time. They also have a high motor unit strength meaning that greater force can be achieved much more quickly, creating a powerful leap. This is a weakness within my performance as without power in my legs I am unable to achieve the same height as an elite performer would even if I had developed a perfect technique. My performance is very reliant upon power.

Power is created during take off through a high knee drive, a powerful plantar flexion and flexion followed by extension around the knee joint. My quadriceps, gluteals, gastrocnemius, hamstring and hip flexors all accompany each other to drive my body off the ground. This will require large amounts of power to achieve maximum height and drive from the ground.

During take off my hips should drop during the penultimate step causing flexion around the knee joint, contracting eccentrically first to create optimal conditions to contact concentrically during the drive upwards. A muscle that is eccentrically stretched before a concentric contraction will contract more forcefully. Without dropping my hips I would not be able to generate the same amount of power as I would by just contracting concentrically and without power my technique suffers. This could also be due to me being unable to recruit as many fast twitch motor units meaning that my maximum power could not be achieved.

A powerful plantar flexion is very important, as this is the last part of my body to leave to track meaning that this can generate the largest amount of power. This is predominantly powered by the gastrocnemius and will probably use all of the motor units available in this area (Spatial summation) meaning that I will find it hard to improve without the development of more fast twitch motor units or by changing my slow twitch fibres into fast twitch fibres, creating a more powerful jump. This is aided by all other movement to drive upwards such as the knee drive, movement around the knee joint and power arm drive. This also requires great amount of flexibility.

Power is requires achieving a successful knee drive, which help achieve maximum height. This achieved by contracting my quadriceps and hip flexors to perform this. To accelerate my ascension a powerful arm drive is essential. As this not only assists in achieving greater height but also determines the speed and strength at which the legs move. Both speed and strength are required to perform a highly powerful jump.

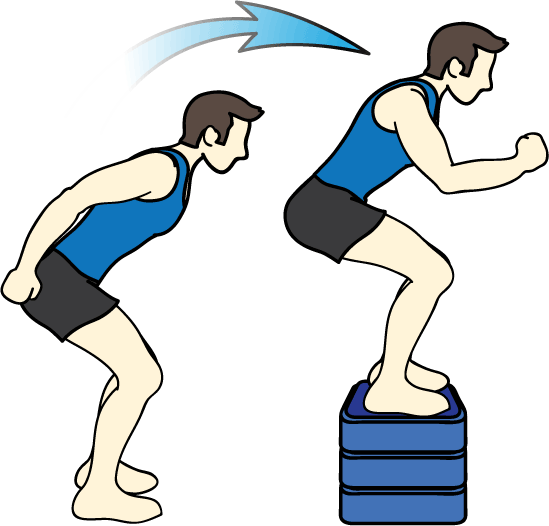
Power is vital for improving my personal best and is a major weakness within my technique. This must therefore, be improved through training and predominantly in the form of Plyometrics.

**C2 Power Training - Plyometrics**

To increase my power during high jump I will use Plyometric training. This is a form of power training and usually is done through bounding, jumping and hopping exercises. All of these involve contracting eccentrically before contracting concentrically and this is completed in 3 stages. Firstly an eccentric contraction during the downward movement followed by a short phase in which the contraction changes from eccentric to concentric, then finally the concentric contraction that is the actual training of the muscle. This creates an explosive muscular contraction, which engages the stretch reflex to prevent overstretching of the muscle.

Lower Body Plyometrics

***Box Jumps***

Box jumps involve jumping on and off a plyobox. It teaches your body how to quickly produce and reduce force. This will develop the muscle fibre into becoming a fast twitch muscle fibre and will allow more motor units to contract at a rapid rate. This will also develop more motor units, allowing me to recruit more when needed, under the law of spatial summation. The idea is to jump up and down as quickly as I can while maintaining my posture and avoiding injuries.

This involves explosive movements at a fairly high intensity. It maintains your posture and balance as you move and improves reflexes, reaction as well as muscular endurance, stamina and power.

You stand with your legs about shoulder width-apart with a plyobox around 60 to 90 centimetres high in front of you. Bend your legs (eccentrically) and jump onto the box (Concentrically), landing gently on the balls of your feet with your legs bent. You then immediately jump back to the ground and land in the same leg position you started. You would repeat this 10 to 15 times with 3 to 4 sets. I am already accustomed to this kind of training and if continued will increase my explosive strength required to achieve optimal height.

I have chosen this exercise as it is simple to do and does not require any specialist equipment. This is also directly transferable to high jump, making it and effective way of developing a greater jump. I would tend to see benefits within a few weeks as well if I perform this 2 to 3 times a week, as it will be required to withstand the added force from falling.

***Bounding and Hurdling***

This is important for the run up phase of my jump and it involves building power to be used in a forward motion meaning that this is an excellent exercise for me to do as it will training the exact muscles I will need during performance. This is a Plyometrics training which involves over sized strides are used to increase the time spent in the air. Two-legged bounds reduce to impact to be endured, but due to being conditioned to this kind of training I can increase the intensity by using one-legged bounding, or hopping. This works by the muscle contracting eccentrically to cushion the ‘bound’ on the downwards movement, followed by contracting concentrically to force my body back off the ground and into the over sized stride. This will allow me to increase the force of which I have available to be during my run up and jump, as it will develop more motor units creating a greater power, increasing height achieved. Bounding upstairs is a useful way to work on both the vertical and horizontal aspects of the running action. Mutiple jumps over a series of obstacles like hurdles are valuable drills for athletes training for jumping events.

Many other lower body Plyometric exercises with intensity level includes standing based jumps (tuck jumps), jumps from standing (Standing long jump), eccentric drops (Drop jumping).

Upper Body Plyometrics

I require upper body power to maximise the height I can achieve by driving my arm upwards while maintain powerful leg contractions and a good technique. However this is not required to the same state as it is with my legs due to it being mainly used for support.

***Medicine Ball***

This is a high intensity exercise, which involves my basic conditioning to allow this to be used by me. I would lie on the ground and a partner will drop the medicine ball down towards my chest and I’ll catch the ball (Pre-stretch and contracts eccentrically) and then immediately throws it back (The actual training of the muscles and contracting concentrically). To allow progression and overload, the weight of the medicine ball can be increased, as can the frequency of the drops.

Benefits of Plyometrics include:

-Improved height achieved from jump

-Development of fast twitch fibres

-Greater motor units being produced

-Development of sarcoplasmic reticulum allowing calcium ions to be released quicker, speeding up contraction times

-Improved technique

-More powerful contractions, generating greater forces

Kayaking – Forwards paddling

**C1: Lack of Power in Gluteals, Abdominal and Shoulder Muscles.**

Kayakers constantly need fast powerful muscle contractions to allow quick, strong forwards paddle strokes. These have stronger, faster working ATPase and greater anaerobic capacity along with a more developed sarcoplasmic reticulum than slow twitch fibres do. This makes them perfect for the short burst of forwards paddling Sutton has to do when entering or leaving a feature.

A muscle contraction occurs when myosin and actin filaments slide across each other. The myosin filaments pull the actin filaments in. This shortens the muscles and the result is a muscle contraction. This needs to happen very quickly when paddling into a feature or along fast moving, turbulent water. To begin the muscle contraction, a nerve impulse arrives at the neuromuscular junction. At rest tropomyosin (a protein) covers the actin binding site as it winds around the actin filament; this prevents the myosin head from attaching to the actin binding site. The sarcoplasmic reticulum (a network of channels that spread over the surface of the myofibril) stores calcium ion. To initiate a muscle contraction an electrical nerve impulse travels into a myofibril via the transverse tubules and triggers the release of calcium ions from the sarcoplasmic reticulum. The calcium ions then bind to the troponin (a globular protein that binds to the actin) causing it to change shape. This causes tropomyosin to move, exposing the actin binding site for the myosin. This allows the myosin head to bind to the actin filament activating myosin ATPase (an enzyme). This enzyme causes ATP to break down and results in the release of energy. The release of energy allows the myosin head to pull along the actin filament; known as the power stroke. The myosin detaches and reattaches further along pulling along the actin filament like a ratchet mechanism. This can only last as long as there are ATP and calcium ion stores. Once the impulses have stopped, calcium is pumped back into the sarcoplasmic reticulum and the actin returns to its resting position. This process is known as the sliding filament theory.

Fast twitch muscles fibres are advantageous for kayakers for many reasons. They have a well-developed sarcoplasmic reticulum which is able to store and release calcium ions more efficiently. This increase the speed of the contraction allowing Sutton to undergo more and with a higher power strokes in a shorter period of time. The sarcoplasmic reticulum is a network of tubes that cover the surface of myofibrils within muscles. At rest the sarcoplasmic reticulum stores vast quantities of calcium ions. Sutton has more developed sarcoplasmic reticulum than I do; this allows him to store more calcium ions than I am able to. This then causes them to be released more readily resulting in him performing a much faster, stronger contraction. Having the faster stronger contraction allows him to apply more power with each stroke, increasing his speed through the water and consequently allowing him to have greater control of the boat. Fast twitch fibres also have stronger myosin filaments. A thicker myosin filament gives a stronger contraction allowing Sam Sutton to apply more power when he is paddling. Another advantage of fast twitch fibres is that it can activate more motor units per fibre. This increases the speed and strength of the contraction.

The amount of fast or slow twitch fibres I have is genetically determined at birth; however the type of fast twitch muscle fibre is susceptible to change through training. Sam Sutton has a continuous training programme which is very intense and can dedicate a lot of time to. This may cause some of his slower fast twitch fibres (type 2a (fast oxidative glycotic fibres) to convert into type IIb fast twitch fibres (fast glycotic fibres). These allow stronger and faster contraction due to their more advanced features such as thinker myosin filaments. High intensity of anaerobic training increases the size of fast twitch (hypertrophy) alongside the number of fast twitch fibres (hyperplasia). This is valuable as it increase his performance when it comes to features or fast moving water which he would need to paddle through. (As when paddling you either need to go slower or faster than the moving water to maintain control). This requires high anaerobic fitness, so the increase in fast twitch muscles would have a large benefit towards his performance.

A motor unit consists of a motor neurone and all the fibres that are supplied by that motor neurone. A motor unit is unable to activate a single muscle fibre, but can only activate the whole group of muscle fibres. This is called the “all or nothing law”. All the muscle fibres in one unit are of the same fibre type (i.e. all fast twitch type II). The number of muscle fibres supplied by a neurone in that motor neurone is determined by the degree of control required by the muscles. The response of a motor unit applies the ‘all or nothing’ law. However the strength of the response varies and this is called spatial simulation. The strength of the response for the whole muscle is determined by the number of motor units involved. Sutton would need lots of motor units to respond to allow for a large contraction creating lots of power. This would allow him to apply more force to each stroke, consequently being more powerful and allowing him to travel through the water at a greater speed.

**C2: Plyometrics.**

Plyometrics is a type of training which is designed to produce fast powerful movements. It is a sequence of contracting and relaxing your muscles in fast succession therefore improving the force and speed of the muscle contractions providing the higher explosive power needed when paddling turbulent water or helping maintain the line towards the feature. It involves jumping, bounding and hopping. This causes the muscle groups to undergo and eccentric contraction before a powerful concentric contraction. Plyometrics involves an eccentric muscular contraction which engages the stretch reflex. The stretch reflex is a protective mechanism which prevents the muscle from over stretching the muscle fibres and it’s detected by muscle spindles. Muscle that is eccentrically stretched before a concentric contraction produces more power as it contracts more forcefully and rapidly (eccentric followed by an explosive concentric contraction). The shorter the amortisation phase, the better and more forceful the contraction. Undergoing plyometrics will help me to enhance my power stroke strength by converting the fast twitch type IIa (fast oxidative glycotic fibres) into type IIb (fast glycotic fibres). This is done by recruiting fast twitch motor unit and enhancing them; changing type 2a into type 2b.

There are several advantages of fast twitch fibres such as having a more developed sarcoplasmic reticulum which allows faster muscle contractions, thicker myosin filaments which gives a stronger muscle contraction. There would also be more muscle units per muscle fibre again, giving a stronger contraction. Myosin ATPase becomes more developed, helping produce a faster contraction.

Plyometric can be very dangerous as if performed without a warm up or I don’t have adequate strength in that muscle area to begin with. Weak muscles around the area I am attempting to train produces the potential to cause significant injury through tearing of muscles, over-stretching or pulling of muscles or connective tissue and the development of weak scar tissue. It is therefore very important to undergo strength training prior to starting plyometrics.

To begin, I should start by using simple, not as challenging routines to help build up the muscle tissue in the area I choose to work out. Starting with one to three sets of six to 10 repetitions of one upper-body exercise such as a medicine ball chest pass and one lower body exercise such as a double-leg hop on two non-consecutive days per week. This can then be built upon and expanded to maybe three or four times a week, eventually, I will have built up enough muscle and have the strength in the muscle to undergo a more challenging routine.

Not only would plyometrics improve my explosive power within my muscles, but it would also help protect my joints (the muscle tissue) helping reduce the risk of injury, particularly the common one amongst kayaker, dislocation of the shoulder joint.

Athletics – 100m Acceleration phase

**C1 100m, 15-60m acceleration phase**

The main weakness in my 100m acceleration phase is power. Power in this instance is the maximum exertion of strength within a short burst movement. Power is repeatedly necessary throughout the 100m but it is even more crucial at this point in the race as acceleration is totally reliant on power.

The power is required to drive my trail leg off from the ground behind me and drive it through to a high knee position in front of me, it is then implied again as the leg is driven down to the ground and forces the ground past underneath me. Without this my leg movements can still be quick but they will be unable to propel me forwards to accelerate at a rate fast enough to remain at the front of the race. This will mean other competitors will accelerate past me, making me have to continually try to catch up. Focussing on catching up instead of on my personal race means that my technique will suffer, making it even less likely for me to be able to win the race, which will then result in anxiety at poor performance and could even lead to learned helplessness. This would mean that in future my acceleration phase will be even slower because I do not believe that I am able to accelerate fast enough to be in with a chance.

Power is essential for my arm drives as they need to drive forcefully and quickly back and forth from behind me, then forwards to a point where the hand is level with my head. This movement needs to be as powerful as possible as the force and speed of the arm drives dictates the speed and strength achievable by the legs, which is the most vital element of a sprint, especially in the acceleration phase, where the speed and power of the stride, not the length is the most important.

Powerful plantar flexion is also crucial because it drives the body forwards from the last point of contact on the track which aids the acceleration with the aid of a powerful contraction of the rest of the leg which is channelled down through it.

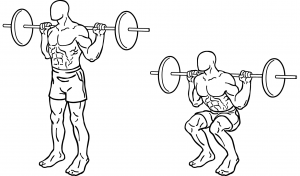
So my lack of power is the most detrimental weakness to my performance even though there are other contributing factors, and so must be addressed.

**C2 100m, 15-60m acceleration phase**

Weight Training

To improve my power in the acceleration phase of the 100m I am going to use weight training to build muscle mass and increase power in both my arms and legs.

The exercises I will use are as follows:

* **Incline Bench Press:** Preparation, I will lie supine on an incline bench at approximately 30-40 degrees, this will engage my chest and shoulders. I will then plant my feet, grasp the bar with a grip slightly wider than shoulder width and dismount barbell from rack over my upper chest using wide oblique overhand grip.   
  Execution, Then I will slowly lower the barbell down to the top of my chest as far as possible without touching my body. I pause, and then slowly raise the bar back to the starting position. Ensuring I do not lock my elbows out, as this risks injury.
* **Squats:** Preparation,ISquat down to place my shoulders under the bar. I will then place my feet shoulder width apart directly under my shoulders. I extend my knees and hips until my legs are straight.  
  Execution, lower the bar by bending my knees forward slightly while allowing my hips to bend back behind, keeping my back straight and knees pointed same direction as feet. I then descend until my thighs are just past parallel to floor. I then lift the bar up by extending my knees and hips until my legs are fully straight.
* **Seated Calf Press:** Preparation, I will sit on the seat and place the balls of my feet on platform. Grasp handles to sides and extend hips and knees. Place toes and balls of feet on lower portion of platform with heels and arches extending off.Execution, I push the sled by extending my ankles as far as possible and straightening whole leg by extending my knees but not locking them. I return by bending ankles until calves are stretched.
* **Dumbell Raises:** Preparation, I select and position two dumbbells to my sides with palms facing inwards, arms straight.  
  Execution, With my elbows to my sides, I alternately raise one dumbbell and rotate my forearm until it is vertical and my palm faces my shoulder. I then rotate my forearms back and lower my arms back to the original position and then I repeat the motion with the opposite arm. I then continue to alternate between sides.

These exercises will increase the power in my arms, which will facilitate rapid leg movement. The increased power in my legs will increase my acceleration dramatically, allowing me so achieve my top speed ahead of my opponents, giving me excellent position from which to enter the speed maintenance phase able to cruise to the finish.

Athletics – long jump take off

**C1 Long jump take-off**

Explosive strength

The weakness that most affects my long jump’s take off is my explosive strength. This is the limiting factor upon both the height and distance that I can achieve, the two factors that decide the trajectory of my jump. This will mean that my jump’s distance is reliant upon two factors which are let down by my lack in explosive strength.

Explosive strength is the rate at which force can be generated by the muscles and exerted. This means that my low levels of explosive strength make the movements required to lift me off the ground and propel me to a distance great enough for the long jump is not as effective as they are not powerful enough in the time I have to make them.

My take-off leg requires high levels of explosive strength to overcome gravity and propel me into the air and forward from the board. However, in the time it takes for my leg to eccentrically contract on hitting the board and then to concentrically contract with the required force in the short time my foot is in contact with the board it has not applied its full force, the contraction time being only 50-250 millisecondsᶧ. If my take off leg cannot provide enough explosive strength then I will not be able to create the lift needed for my momentum to carry me forwards and great distance. This results in me placing low in competitions and losing motivation to continue.

The same also goes for my take-off leg, once it has driven off from the board it is needed to drive up and through in a similar way to the free leg, and then to forcefully extend up and out at right angles from the body and maintain this position to allow stable flight and a safe landing. Without the explosive power to pull the leg through under the body and out fast and forcefully enough from the body, the flight becomes destabilised and I would begin to fall to the left, my body leaning over to the side. This would lead to a landing which was too heavily on the left hand side, which would make it impossible for me to snap my legs back and pass the point at which my feet impacted. This will reduce the distance I have achieved by at least a leg length if not more.

If my arms are not able to cycle in a full circle around my shoulder explosively, and my legs still follow the correct drive and shoot then I will over balance backwards which will result in my landing in a position as though I were lying down, with my back bearing some of the impact of the landing, this would put me at significant risk of injury. This will also drastically reduce the distance of my jump in falling back, as I would lose at least a metre and a half, I being about 185cm tall or more.

When my feet hit the ground, my lack in explosive strength in my arms means that I cannot swing them through explosively enough to generate the force necessary to drive my body past my feet and maximise the distance I achieve. This lack in explosive strength means that instead of my body passing my feet it will impact the sand behind them which limits the distance I can achieve. This will also increase the likelihood of me falling back and reducing the distance of my jump even further.

ᶧAagaard P, Simonsen E. Increased rate of force development and neural drive. ‘Journal of Applied Physiology’. 93: 1318-1326, 2002.

Long Jump Take Off – C2

To increase my explosive strength in the Long jump take-off I will use plyometric training. This works on the principal of eccentric contraction on the downwards phase and concentric contraction of muscles immediately after during the upwards phase. Plyometrics is a type of exercise training designed to produce fast, powerful movements, and improve the functions of the nervous system, generally for the purpose of improving performance in sports. Plyometric exercises may also be referred to as explosive exercises. Plyometric movements, in which a muscle is loaded and then contracted in rapid sequence, use the strength, elasticity and innervation of muscle and surrounding tissues. Plyometrics is used to increase the speed or force of muscular contractions, providing explosiveness for a variety of sport-specific activities, in this instance, the long jump take-off.

**LEGS**

***Drop Jumping***

This exercise involves dropping (not jumping) to the ground from a raised platform or box, and then immediately jumping up. The drop down gives the pre-stretch to the leg muscles (eccentric phase) and the vigorous drive upwards the secondary concentric contraction phase. The exercise is more effective the shorter the time the feet are in contact with the ground. The loading in this exercise is dictated by the height of the drop, which should be in the region of 0.7 to 1.10 meters. Drop jumping is a relatively high impact form of plyometric training and would normally be introduced after the athlete had become accustomed to lower impact alternatives, such as two-footed jumping on the spot. But as I have already become accustomed to these in my training, this level of plyometric training is applicable. This will increase the explosive strength in my legs required for a take-off of maximal lift and drive forward through the air.

***Bounding and hurdling***

Bounding is a form of plyometric training, where oversized strides are used in the running action and extra time is spent in the air. Two-legged bounds reduce the impact to be endured, but to increase the intensity one legged bounding, or hopping, can be used. Bounding upstairs is a useful way to work on both the vertical and horizontal aspects of the running action. Multiple jumps over a series of obstacles such as hurdles are valuable drills for sprinting.

Lower body plyometric exercises with intensity level:

* Standing based jumps performed on the spot (low intensity) - Tuck Jumps, Star Jumps
* Jumps from standing (low-medium intensity) - Standing long jump, Standing hop, Standing jump for height
* Multiple jumps from standing (medium intensity) - bounds, bunny hops, double footed jumps over low hurdle, double footed jumps up steps
* Depth jumping (high-very high intensity) - jumps down and up off box (40 to 100cm), bounding up hill, progression and overload can be obtained by increasing the height or adding a weight vest.
* Eccentric drop and hold drills (high-very high intensity) - hop and hold, bound/hop/bound/hop over 30 metres, stopping and holding on each landing before springing into the next move, drop and hold from a height greater than one metre.

***Medicine Ball:***

The medicine ball can also be used to condition the legs. The athlete lies face down on the floor, a partner or coach then rolls the medicine ball down the back of the thighs towards the feet, when the athlete feels the medicine ball about to reach their ankles they flick their lower leg sharply up, returning the medicine ball to the hands of the partner or coach. To allow progression and overload, the weight of the medicine ball used can be increased, and the frequency of flicks can also be raised.

**ARMS**

***Press ups & Hand clap***

Press-ups with a hand clap in between is an especially vigorous way to condition the arms and chest. The pre-stretch takes place as the hands arrive back on the ground and the chest sinks, and this is followed quickly by the explosive upwards action. As with many plyometric exercises, to get the best training effect keep the time in contact with the ground to a minimum. A weight disc or weight vest can be worn for progression and overload. This will increase the force with which I can use my arms to create lift, when I drive them upwards.

***Running with wrist weights***

Running with wrist weights conditions the muscles in the upper body to be able to move with large exertion and speed with resistance, building explosive power. When the weights are removed, the muscles will be able to propel the arms with greater speed and force, increasing levels of upward motion.

***Medicine Ball:***

Another means of increasing upper body strength and power is to lie on the ground facing upwards. A partner then drops a medicine ball down towards your chest; you then catch the ball and immediately throw it back. To allow progression and overload, the weight of the medicine ball used can be increased, and the frequency of drops and returns can also be raised.

***Incline Push up depth jump***

•The two mats are placed shoulder width apart

•Place the box to elevate the athlete's feet above their shoulders when in a press up position

Face the floor in a press up position with your feet on the box and your hands between the mats, push off from the ground and land with one hand on each mat. You then push off the mats with both hands and back to the starting position. Keep the hand contact time on the mats as short as possible.

*How much*3 sets of 10 repetitions a set, 5 minute recovery between each set, Quality of the push ups is far more important than quantity.

All of these exercises will increase my explosive strength which will mean each of the separate parts of my take-off will be more powerful and therefore they will all collate to give a massive improvement to the distance I can achieve in my jump.

Football Goalkeeper – Getting back to feet for second save

**C1 – Cause of lack of explosive power in Quadriceps, Gastrocnemius and Hamstrings**

Explosive power is the rapid contraction of muscle fibre units to produce maximum generation of force. The reason for the lack of explosive power within my quadriceps, gastrocnemius and hamstrings are because of the type of training which has been available to me and which I have undertaken. Joe hart trains every day to make his game as good as it can possibly be. He uses specific types of training to gain the optimum explosive power from his legs. Because of this prolonged specific training Joe will have developed type 2a and type 2b muscle fibres within his legs. Type 2b muscles fibres are also known as fast glycolytic fibres and produce a very rapid muscular contraction but due to the amounts of ATP which they require for this contraction then they fatigue very rapidly. Type 2a muscle fibres are also known as fast oxidative glycolytic fibres produce a rapid contraction but not as rapid as type 2b they also fatigue quickly but not as quickly as type 2b. The number of each of these types of muscle fibres is predetermined genetically but some can be changed from type 2a to type 2b with training. He will have done weight training specifically devised to increase the explosive power within his legs and would have done this regularly for a prolonged period of time which would have helped the development of some of these fibres. I have not had the facilities and the expertise which Joe has had available and I may not have as many type 2a and b fibres as what Joe has genetically. Due to more of my muscle fibres being type 1 then I am unable to get enough explosive power from my legs quick enough to save the penalty. Muscle fibres make up motor units; each muscle fibre within a motor unit either contracts or doesn’t contract. This is known as the ‘all or nothing law’ also known as spatial summation. Each motor unit is made up of either all slow twitch fibres or all fast twitch fibres there are no mixed motor units. Within a slow twitch motor unit there are anything between 10 and 180 muscle fibres, within a fast twitch motor unit there is anything from 300 to 800 muscle fibres. This is why when a slow twitch unit stimulates its fibres it produces a weaker contraction, due to less muscle fibres being contracted, when a fast twitch unit is contracted then a lot more muscle fibres are contracting producing a greater contraction and hence a more powerful one. The increased number of slow twitch units I think I have within my quadriceps is the reason for my lack of power and speed when it comes to me diving to reach the corners of the goal, resulting in me not reaching the ball at the optimum point in its flight.

**C2 – Improving explosive power within the legs (Quadriceps, Hamstrings and Gastrocnemius) - Plyometric Training**

Plyometric training is a form of training designed to increase the power in a muscle or muscles, in this case the quadriceps, hamstrings and gastrocnemius’. Plyometric training involves powerful muscular contractions in response to a fast stretching of the muscles. The stretching of the muscles before the explosive contraction is often called ‘loading’. The quicker and greater the load then the more powerful the subsequent contraction is. This is due to the ‘loading’ activating the stretch reflex which produces a more powerful contraction than it normally would. The activating of the stretch reflex will help my game hugely as it causes a greater contraction than would normally be produced meaning I will be able to reach the corner of the goal or dive and meet the ball it the best possible point in its flight. There is three phases to plyometrics:

1. The first phase is known as the pre-stretch phase or eccentric muscle action, this is when the elastic energy is generated within the muscles and stored.
2. The second phase is the short time between the ending of the pre-stretch phase and the beginning of the concentric muscle action. This period is known as the amortisation phase. It is when you change from stretching the muscle to contracting it. The shorter the time of this phase the more powerful the contraction will be.
3. The final phase is the actual contraction of the muscle. This would be the movement which the performer wants to improve e.g. the throw or jump.

I would do this by jumping off a high object for example a high box about 3-4 feet off the ground as I landed I would create the ‘loading’ effect on the muscles. I would then immediately jump up onto box which was lower for example a box which is only about 2 feet off the ground. Then I would jump off the smaller box onto a taller box, again about 4-5 feet off the ground.

3-4 ft

3-4 ft

2 ft

Other exercises which can be put alongside this exercise within a training programme are:

* ***Speed Squats*** – keeping my back straight I would squat down until there was a 90o angle at the knee joint and my quads are parallel to the ground. Then with my quadriceps contracting isotonically I would push back up making my legs straight. Whilst doing this I would keep my back straight and arms out in front of me.
* ***Lunges*** – Whilst keeping my back straight I will take a big stride out in front of myself making a 90o angle at the knee joint pushing my weight over my toes. I will then power off my front leg back into an upright position, I will change my leading leg and repeat the movement.
* ***Lateral Cone Hops***  - Standing on one side of a cone or bench I will jump over the cone or bench bringing my knees up to my chest, as I land I will immediately spring back up again bringing my knees up to my chest. My feet should spend split seconds on the floor.
* ***Squat Jumps*** – From a standing position with my arms out in front of me I will squat down making a 90o angle at the knee joint with my quadriceps parallel to the ground. I will then jump up off the ground using my arms to get as high as possible, once I land I will go back down into the squat position and then repeat the jumping movement.

**Plyometric Workout**

2 – Lunges 20 Reps

1 – Speed Squats 20 Reps

3 – Plyometric Box Training

5 Reps

4 - Lateral Cone Hops

20 Reps

5 – Squat Jumps

20 Reps

I would do 3 sets of this circuit; I would do it three times a week. I would expect to see improvements in my games within 4-5 weeks. After these 4-5 weeks I would increase the number of reps.

After 1 or 2 months of this training I think I would start to see a huge improvement on my ability to save the penalties which are placed in the corners. This will help my team as well because when a goalkeeper saves a penalty the whole team get a confidence boost and can start to play better.

Football Goalkeeper – throwing for a counter attack

**C1 – Cause of lack of power – Lack of flexibility in shoulder joint**

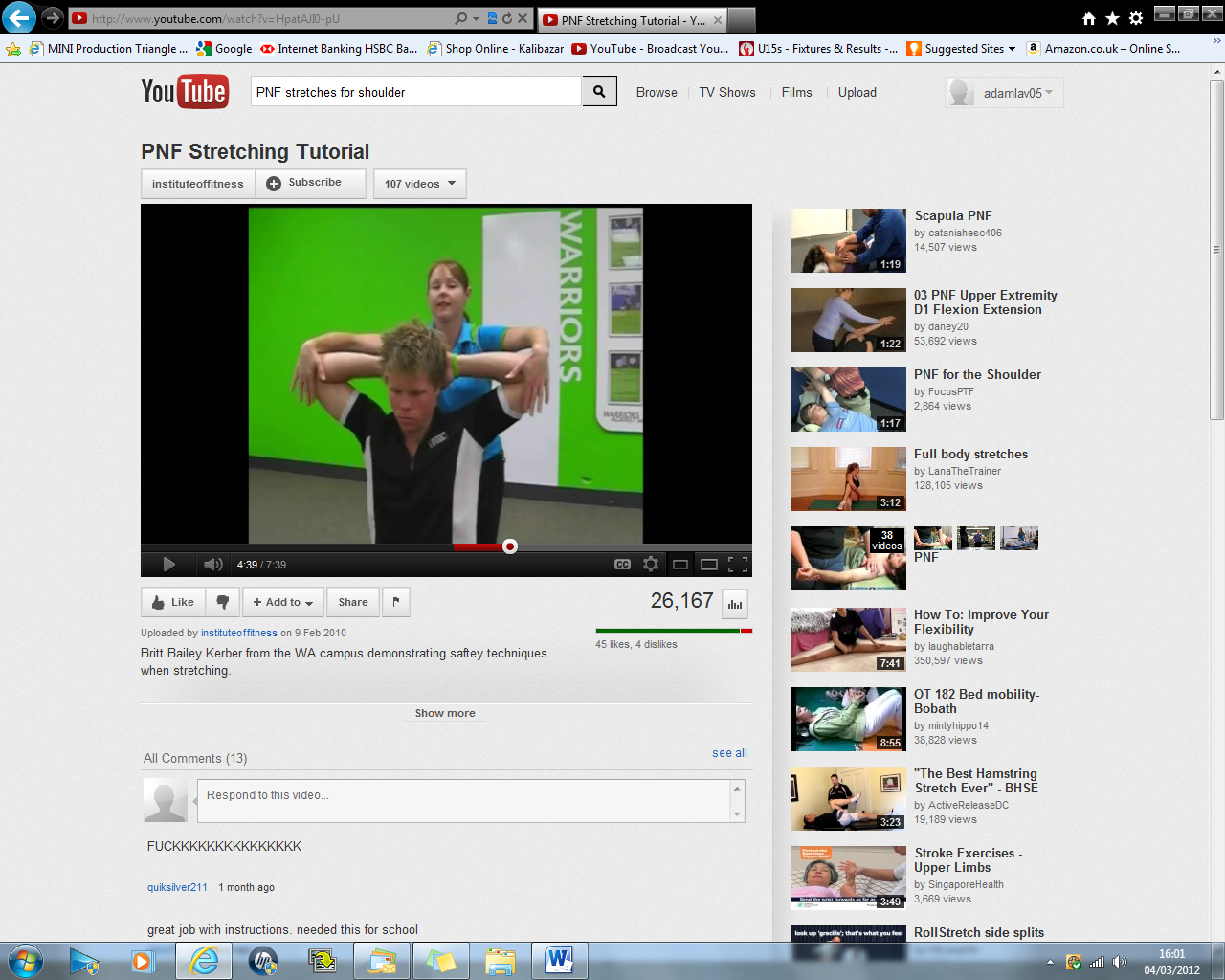
Being able to create power from my body movements and not just from using my muscles is essential if I want to make a throw as effective and as efficient as possible. So being able to pull my arm back as far as possible behind me would help my game.

Due to the lack of flexibility of my muscles around my shoulder joint predominantly the latissimus dorsi, pectoralis major and the deltoids. These have developed over the years of me playing sport and are strong muscles but due to the type of training I have received they have never been able to reach their full potential in relation to flexibility. This is because the coaches I have had at the level I play at and the allotted time for training I have been unable to use techniques to improve the flexibility of these muscles. This has resulted in me not being able to gain the extra momentum from the full extension of my arm. Where I have dislocated my shoulder last year it has contributed to this lack of flexibility as well as the muscles around it were torn and stretched. When they repaired their selves the muscles were shortened which has caused the muscles to be even less flexible. This has resulted in the shoulder joint becoming very inflexible and not being able to rotate to its full extent. The dislocation has also affected me psychologically as I don’t trust my shoulder joint and the muscles around it to hold the shoulder joint in place when extending the arm and when throwing the ball.

**C2 – Corrective measure for lack of flexibility in shoulder joint – PNF Stretching**

Flexibility is a vital component of fitness and almost all coaches see stretching as the best way of increasing flexibility. With increased flexibility comes an increased range of movement which is available to joints, increasing my throwing performance.

PNF stretching is the most effective way of increasing flexibility. PNF stands for proprioceptive neuromuscular facilitation. PNF stretches can be done passively (no associated muscular contraction) or actively (voluntary muscle contraction). There are several types of PNF stretching but they all have one collective aim; they help the body’s muscular inhibition. The most used style of PNF used by professional performers is the contract-relax, antagonist-contract (CRAC) technique, which uses isometric contractions as its foundation. Isometric contractions are contractions which involve no movement. Isometric contractions are done before a passive stretch help to accomplish autogenic inhibition which is where the muscles slowly relax. Muscles spindles are located within the muscle cells; they are highly specialised receptors which protect the muscle from injury. They detect how far and how much a muscle is being stretched and when activated they produce the stretch reflex. This reflex causes the muscle which is being stretched to contract; this avoids overstretching of the joint. Another sensor located within the muscles is the Golgi tendon organ (GTO), this senses how much tension is being exerted on the tendon. The GTO differs from the muscle spindles as when it is stimulated it relaxes the muscle, this is called autogenic inhibition.

PNF stretching is best performed with a partner, it is important to warm up for at least 10 minutes and ensure the partner stays focussed as it can cause serious injury. One of the stretches which I will use will stretch the pectorals; if they are more flexible then my arm will be able to reach further behind me. The stretch starts by me sitting on the floor with a straight back and with my fingers interlocked at the base of my skull. My partner will kneel down behind me with their knee in my back. My partner will place their palms of their hands on my elbow joint (as shown in the picture). My partner will then pull back my arms until I tell them that they are at their limit, once the muscles are at their limit my partner will hold the stretch for 10 seconds allowing the muscle spindles to relax. Once the 10 seconds are up I will push against my partners hands for 5 seconds. I will then relax but my partner will maintain the pressure on my arms for 6 seconds, the pectorals will relax and extend slightly. After I have repeated this action two more times I will relax and my partner will help my arms slowly back down to my sides. I will do this twice a week when my fixtures allow me to as 48 hours should be left between PNF sessions. It will have to be a flexible programme as guidelines to PNF says that it shouldn’t be performed the day before or on the day of a performance. After several weeks of doing PNF stretching I hope to have much more flexibility within my shoulder joint and be able to throw the ball much further and with more power and accuracy.