Poor flexibility

Hockey – Attacking short corner / drag flick

C1 –Lack of flexibility – Poor rotation of body Attacking Skill 2 – attacking short corner, drag flick:

As I mentioned in the B1 section of the execution phase, I struggle to get low enough to make a powerful and accurate drag flick. This lack of flexibility prevents me from rotating my body and flicking the ball with enough momentum to challenge the goalkeeper. The lack of movement around my joints prevents me from getting low to the ground and initialising the movement required to perform the flick powerfully and accurately. The flexibility is mainly required in the knee joints, my upper body will be bent over but the main way I get lower to the ground is by bending my knees. However I will need to maintain that position throughout the skill. Due to lack of flexibility getting there and staying there is strenuous. The knee is one of the largest and most complex joints in the body; it comes under a lot of pressure and pounding, especially in a fast paced running game. I do not look after me knee joints as well as I could and this can lead to them being subject to injury, degeneration and ultimately inflexibility. This has led to me physically not being able to get as low as is needed to perform a drag flick. As a consequence of this my rotation and speed of rotation is poor. This means I am unable to generate the correct amount of power. My angular velocity is relatively slow; this means my rate of movement during the rotation is slower. This also relates well to angular acceleration, which is the rate of change in velocity. This means from my starting point when I receive the ball to where I end up after releasing the ball, the change of pace that occurs between those two points. Moment of inertia is also a factor that describes why my drag flick is weak. Moment of inertia is the resistance of ‘a body’ to change its state when rotating; because I can’t get low enough this means moment of inertia is larger as there is more resistance when I start to rotate. To work out moment of inertia I must do a calculation: Mass x Distance from the axis of rotation (fulcrum). The resistance arm or the mass of the object trying to be moved acts as inertial force – it resists being moved. The ball will never change its mass…

C2 - Lack of flexibility – Poor rotation of body Attacking Skill 2 – attacking short corner, drag flick: PNF and Effective body positions.

My first corrective measure addresses the issue of lack of flexibility. One of the main reason I don’t get low enough and prevent ease of rotation if inflexibility in my joints. PNF or proprioceptive neuromuscular facilitation is a form of stretching as a means of increasing flexibility. However this cannot be used as a short term warm up, but a long term regime set out to gradually increase flexibility. Reducing inflexibility will improve my performance because of the greater range of motion available to my joints. PNF uses alternating contraction and relaxation movements for flexibility; there are both passive and active stretches. Passive involves no associated muscular contractions and active is voluntary muscle contractions. The most effective and widely used PNF technique is the ‘CRAC’ technique. This is contract-relax, antagonist-contract technique; it uses isometric muscle contractions as a basis. In order to make the isometric contractions effective a passive stretch must be done immediately after, this will achieve autogenic inhibition. This is where the muscles gradually relax instead of quickly snapping back into position and potentially causing injury. Muscle spindles aid this gradual relaxation by detecting how a muscle is being stretched and activate the stretch reflex; the reflex action prevents over-stretching by contracting the muscle. A good example is a hamstring stretch; if I were lying on my back performing this stretch, and have the stretch pushed to the limit or my range of movement, my leg would start to jump/twitch. This is where the muscle spindles have been activated and tell the hamstring to contract in order to prevent injury. Another aid that prevents over stretching is the Golgi tendon organ (GTO). If activated it doesn’t contract the muscle but relaxes it instead. The GTO detects how much tension there is on the tendon and reacts accordingly. Autogenic inhibition is reflex relaxation that occurs in the same muscle as the GTO is found.

Some precautions to performing PNF are as follows. One is that it shouldn’t be done before or immediately before a competition or performance; a 48 hour window should be left between stretches and performance. I must remember it’s a long term process and shouldn’t perform more than one stretch on the same muscle group in one session.

Rugby – Kicking

C1- Kicking

Lack of Flexibility

In order to perform a successful kick with good distance and accuracy, I need to be flexible; (have a good range of motion at the joint). For kicking I need to have flexible quadriceps and hip flexors for the drawback phase and flexible hamstrings for the drive phase. The further I am able to drawback my leg, the larger force I can exert on the ball. Furthermore, the drive phase is equally important to guide the ball, and exert the final force through the ball to help with momentum. Therefore, the higher I am able to get my leg on the drive phase the further the kick will go and more accurate it will be. Also, if I am more flexible, I will be able to accelerate through the motion with less risk of injuring myself.

Although I have a reasonable amount of flexibility in my legs, my hamstring flexibility needs to improve in order to have a greater follow through. The flexibility in my quadriceps and hip flexors is more sufficient, there is still room for improvement but I am going to focus on my hamstrings as I feel they would benefit me more for this skill. As a result of my lack of flexibility in my hamstrings it can cause me too hold back on a kick, in order prevent injury. This has negative effect on the teams’ position on the field, which shouldn’t be caused by my flaw, therefore needs to be improved. On the other hand if do push it too far, I cause damage to that muscle, which can be prevented with the appropriate training and stretching.

C2 PNF stretching (Proprioceptive Neuromuscular Facilitation)

To improve flexibility I need to begin to incorporate PNF stretching in to my training program. It also improves muscular strength. It is a session on its own and needs to be completed properly to be effective and remove the risk of injury. PNF results in DOMS (delayed onset of muscle soreness) up to a few days after, however in the long run it is extremely successful in improving flexibility. Before using PNF, a thorough warm up must be completed. This helps to increase the body's core temperature while also increasing the body's muscle temperature. This is essential to ensure the maximum benefit is gained from your stretching, but more importantly to prevent injury. The process of PNF stretching involves passive stretching with the help of a partner. They hold the body part and manoeuvre it to stretch the muscle. For kicking, your hamstrings are the main muscle used; therefore they need to be flexible. To explain the process I will describe how to stretch my right hamstring.

With my partner I would lie on the ground with my back flat and my left leg straight on the floor. My right leg would be elevated straight and my partner would support it by resting it on the front of their shoulder whilst kneeling on the ground. They will begin to push my right leg back until the muscle begins to tighten, and cannot move any further. This prevention is caused by the stretch reflex kicking in. The muscle spindles, which are sensory receptors, detect the change in the length of the tissue. They send signals through sensory neurons to the spinal cord, and interneurons, they then direct the signal to motor neurons causing a contraction. The Golgi tendon senses the muscle tension when a muscle is contracted, sending signals to the brain about how much force is being exerted and where. It almost acts as a safety element, to prevent overstretching. At this moment, my partner slightly lowers my leg to reduce the strength of the contraction. This is followed by me contracting the groups of muscles in my legs for five seconds by pushing against my partners shoulder. The stretch is then held for a further five seconds as I relax the muscle. After this, my partner gradually pushes my leg further towards me until the stretch reflex kicks in again and the process is repeated. This pattern continues until no more movement can occur safely and my partner gradually lowers my leg to the ground. To stretch the calf muscle, my partner would pull down the top of my foot to feel the stretch in the lower part of my leg.

This will have a positive effect on my performance as I will be able to follow through further allowing me to have greater control and accuracy of the kick. It will lead to me being able to kick further down field and be more confident with aiming to place the ball nearer the touch line. Therefore, giving my own team better field position to compete from.

Judo - Kesa Gatame

**C1 Kesa Gatame – Flexibility:**

Flexibility is the ability of a limb or part of the body to show a wide range of movement and this is an important component of fitness in all sporting activities. It is also linked to the range of motion around a joint and reflects the joint structure, the length of the related muscles and the limiting effect of the joints ligaments. Usually it is assumed that higher levels of flexibility can be found in women and that it is more important in activates such as gymnastics, however flexibility is also important in other sports like Judo as having increased flexibility specifically at the hip joint means that I would not have any restricted range of movement therefore aiding performance. It would allow me to produce the correct T shape position in the recovery of this hold down. However I would need to undergo PNF stretching in order to improve flexibility as my hip joints do currently have a restricted range of movement as I do not stretch every day.

There are a number of factors that limit flexibility. The type of joint can limit flexibility for example the shoulder joint is a ball and socket joint and therefore has a greater range of movement and more potential for flexibility than the knee which is a hinge joint which provides the body with stability. Even though the hip is a ball and socket joint, it has a much deeper socket than the shoulder as this has to support my body weight therefore it naturally limits the range of movement and flexibility at this joint. The strength of the surrounding muscles can also affect levels of flexibility. If the agonist muscle has a good level of strength then this can restrict movement as it creates a more stable joint which naturally limits flexibility. As I already have a good amount of strength in the quadriceps and the hamstrings this may explain why I have a limited amount of movement at the hip joint when completing this hold down. The elasticity of the ligaments and tendons surrounding the joint can aid flexibility as the more elastic these tissues are the more movement they will allow at the joint. Whereas the elasticity of the of the skin and the amount of adipose tissue decreases flexibility as the skin is not completely elastic reducing flexibility at some joints when completing large movements. The resting length of muscles can also be limiting causing the joint to become less flexible as the muscles have a short resting length meaning that the muscles become tightened. Other factors that can limit flexibility include the temperature of the joints, as they become more flexible if both the joint and the surrounding muscles are warmed up, placing the importance on warming up before starting the stretching exercises. Flexibility decreases as we get older meaning that we generally lose flexibility and mobility due to soft tissues becoming less elastic.

There are four different types of stretching that could help me to improve flexibility and these include: active, passive, static, and ballistic stretching. Active stretching involves holding a stretched position by contraction of the agonist muscles; this helps to increase muscular strength in the agonist muscles rather than specifically working on improving the range of movement at the hip joint therefore this would only be beneficial in improving strength of in the body. Passive stretching involves holding a stretched position by something other than the agonist muscles, however this would only be useful during a cool down and reducing post exercise muscle soreness therefore this type of stretching would not improve my flexibility in order to produce the correct body position during the recovery phase. Static stretching or stretching to the limit and then isometrically contracting the muscles would be much more effective to improve flexibility in my legs so that I can produce the T shape position that this hold down requires. This type of stretching is directly linked to PNF and would therefore be the most beneficial to utilise, as research has shown this is the most effective way to increase flexibility. It also requires less energy to complete and causing much less damage to the connective tissues at the hip joint therefore preventing muscle soreness. Finally Ballistic stretching would not be effective in improving flexibility as this is considered as dangerous as it does not allow the stretched muscles to adjust to the position causes the muscle to become tighter as a result of bouncing into the stretched position, therefore this method has the potential for injury.

Having a good level of flexibility acts as a contributing factor to make this hold down effective, therefore having a lack of flexibility at the hip joint means that I do not execute the hold down as effectively as I could because my legs are not in the correct position which causes less weight to be placed onto the opponent therefore affecting my position as I do not make the opponent uncomfortable in the hold down to reduce the chance of countering. Also having a good level of flexibility would allow for the right application of muscular contraction for power or speed when attempting to produce movement that copies a perfect model. However because my flexibility is limited I would need to training specifically to increase the elasticity of my lower body muscles by completing PNF stretching, in order to produce the correct T shape position with legs during the recovery phase of Kesa Gatame alike my perfect model Sally Conway. She can create this position because she has a wide range of movement at hip joints, whereas I do not meaning I need to improve my flexibility at the hip joint not only to improve my performance but higher levels of flexibility would also be beneficial as this would help to avoid soft tissue injuries such as muscle pulls, ligaments and tendon strains and tears. Additionally, improving flexibility at the hip joint will not only improve my overall performance of Kesa Gatame and reduce the change of soft tissue injuries it will also be beneficial to general health as having a high level of flexibility is essential to maintaining a good level of general mobility and avoiding injuries whilst doing everyday activities. Other benefits of improved flexibility include helping in the generation of faster and more powerful muscular contractions.

Training programmes include sessions on improving flexibility and mobility, because muscles which are not regularly stretched are at risk of becoming shorter and less elastic inhibiting performance further. This therefore reduces the range of movement at the hips, increasing the risk of injury from tears and pulls. However regular stretching helps improve general mobility reduces tension and stiffness and helps to prevent back pain which would be beneficial in all elements of Judo.

**C2 Corrective measure for Flexibility – PNF Stretching**

Having improved flexibility would be extremely beneficial in the recovery phase of Kesa Gatame as I need to improve my body position particularly my leg placement in order to maintain stability throughout the hold down, and to reduce the chance of being held down myself. Proprioceptive neuromuscular facilitation can help me to improve my flexibility (the range of motion at the joints) specifically at the hip joint as it is one of the most effective forms of flexibility training.

To improve my flexibility at the hip joint and therefore improve the elasticity of the hamstrings and gluteals in order to produce the T shape with my legs I could use the CRAC technique. This involves alternating contraction and relaxation movements in a sequence such as contract – relax –antagonist – contracting again, this will help to increase the range of movement at the hip joint as well as the elasticity of the surrounding muscles, tendons and ligaments. Also this technique uses isometric contractions (where no movement takes place) which facilitate the body’s muscular inhibition. As well as this training can also be performed both passively (no associated muscular contraction) and actively (voluntary muscle contraction) in order to improve flexibility so that I can perform the T shape body position when placing my legs during the hold down.

When completing Proprioceptive neuromuscular facilitation passively the isometric muscular contraction occurs before the stretch so that autogenetic inhibition can be achieved, and this is where the muscles gradually relax causing them to lengthen. Specialised receptors known as muscle spindles can also help to produce autogenetic inhibition as they are activate in order to protect the muscle cells from injury. This receptors sense how far and fast a muscle is being stretched and when they are activated they produce the stretch reflex, it is this action that causes the muscles to contract isometrically to prevent overstretching and injury occurring. Additionally the Golgi tendon organ senses how much tension is being placed on the tendon, however when this is activated it relaxes the muscle as autogenetic inhibition is a reflex action that occurs at the same muscle where the Golgi tendon organ is stimulated. This action help to improve flexibility and prevent long term injury as overstretching does not occur and instead the isometric contraction improves elasticity in the muscles.

PNF stretching is best performed with a partner, but it is important that they remain focused so that overstretching does not occur. It is also important to warm up for at least five to ten minutes with light aerobic exercise which increases the body temperature causing an increase in elasticity of muscles. This should then be followed by dynamic stretching before proceeding with specific stretches for the hamstrings and hip flexors in order to improve flexibility at the hip joint. To stretch out the hamstrings I would need to lie flat on the floor with one leg flat on the floor and the other extended in the air, a partner would then push on the extended leg to a point where it becomes uncomfortable, and this passive stretch is then held for 10 to 15 seconds. After this I would isometrically contract the hamstrings by pushing my leg against my partner’s hand in order for the muscle spindles to activate and prevent overstretching from occurring. My partner would then apply more force to the extended leg and hold this position for another 10 seconds so that autogenetic inhibition is achieved, as the Goldgi tendon organ then activates causing an increased flexibility in the muscle. After the contraction has been completed I would then have to relax the muscles by holding the passive stretch for 10 seconds, this should help to improve short term flexibility as I would be able to move the extended leg further than before as I will have greater elasticity in both the hamstrings and hip flexors due to the autogenic inhibition.

However, Proprioceptive neuromuscular facilitation should not just be used as part of a warm up and should be used as a long term programme to increase flexibility. Increasing my flexibility will reduce the risk of injury but ultimately it will improve my performance of Kesa Gatame as it will give me a greater range of motion at the joints. Other adaptations will include the soft tissues that surround the hip joint will gain an increased resting length, this will also affect the muscle spindles as they will become used to the increased length of muscles causing them to reduce the stimulus that enables the stretch reflex. These adaptations will allow me to produce the correct leg position in order to hold the opponent down to score Ippon.

Climbing - Flagging

**Flagging - Rich Cliffman, local rock climbing guide and indoor climbing wall assistant.**

**C1: Lack of flexibility in the hip joint**

Flexibility is the range of motion around a joint. Due to the nature of climbing routes that requires flagging, such as overhangs or fine balancing positions where my body position is fairly obscure, flexibility in the hip joint is a major limiting factor. Flexibility is often limited by two factors: body structure and muscle fibre suppleness. For my scenario the structure of my hip allows for far more flexibility than the suppleness of my muscles allow. The muscles causing this limitation are the hip flexors; more specifically the Iliotibial and the Iliotibial band. These are powerful muscles located within the hip, under other flesh and muscle, and are attached to the hip and the spine at the top with their insertion on the femur. Common movements in my climbing routine cause inflexibility or tightening of these muscles, specifically when lunging my body downwards and hanging off holds with straight arms. During hip flexion movements the iliopsoas can hyperextend the spine whilst using the hip flexors. Risk of injury, let alone inability to perform the perfect flag, is increased with abdominal weakness. My inflexibility in the hip joint is most evident when climbing on overhanging routes where having a hip perpendicular to the wall, lay backing and flagging are crucial. As my body is hanging low, in order to flag effectively my flagging hip, especially when flagging behind my body, has to be extended upwards and slightly twisted. This is when my limiting flexibility is evident.

All the factors affecting flexibility are joint structure, properties of ligaments, tendons, muscles, skin, any tissue injury, fat, age, gender, movements involved in activity and body temperature. My muscle properties are the main effector for inflexibility here.

There are five main types of stretching:

*Active***:** Holding stretch using agonist muscles, no external force. Good for increasing agonist strength but not too effective for increasing flexibility.

*Passive***:** Stretching using an external force, such as the floor, not the agonist muscle. Good to increase flexibility and prevent the delayed onset of muscle soreness.

*Ballistic***:** Movement to bounce in and out of stretch. This is dangerous and not very effective as it induces the stretch reflex due to the muscle spindles detecting overstretching and in turn shortens the muscle by contracting it to protect the fibres.

*Static*: Static stretching involves isometric contractions where no limbs are moving. Research shows this is the most efficient form of increasing flexibility; a good example of an effective static stretching method is Proprioceptive Neuromuscular Facilitation (or PNF).

*Dynamic***:** Involves isotonic contractions and moving limbs whilst stretching, e.g. lunges.

These types of stretching can be applied to both the execution of a skill and the act of flexibility training.

**C2: Proprioceptive Neuromuscular Facilitation**

All the factors affecting flexibility are joint structure, properties of ligaments, tendons, muscles, skin, any tissue injury, fat, age, gender, movements involved in activity and body temperature. I aim to mainly affect the pliability of the muscle fibres and avoid affecting other body parts as stretching tendons for example can cause serious near-permanent damage.

Here is a summary of the different types of stretching:

There are five main types of stretching:

*Active***:** Holding stretch using agonist muscles, no external force. Good for increasing agonist strength but not too effective for increasing flexibility.

*Passive***:** Stretching using an external force, such as the floor, not the agonist muscle. Good to increase flexibility and prevent the delayed onset of muscle soreness.

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*Dynamic***:** Involves isotonic contractions and moving limbs whilst stretching, e.g. lunges.

Proprioceptive neuromuscular facilitation (or PNF) is the most effective form of stretching for increasing flexibility. It is best done with a professional partner such as my fitness coach who knows how to perform PNF as proprioceptive neuromuscular facilitation can be dangerous and cause serious injury such as over-hyperextension of the hip joint, specifically the iliopsoas muscles, which may lead to tearing or stress on tendons and ligaments. PNF often causes muscle fatigue significant enough to impair me from performing safely or at my normal standard for the next 48 hours. For this reason, it should be done only following a warm up, consume a training session of its own (e.g. not be used as a ‘cool down’) and should not be performed within a 48 hour period before another PNF session or performance event.

Proprioceptive neuromuscular facilitation is a passive, static stretch that facilitates the body’s muscular inhibition. The method of PNF I intend to practice is known as the contract-relax method.

This method involves stretching the participants muscle to its limit when the stretch reflex kicks in. At this point the participant should isometrically contract against this force and hold for ~15 seconds. The stretch reflex is triggered when muscle spindles, sensitive receptors within the muscle cells of the muscle’s tendon are elongated to a certain extent. The local motor units contract to prevent any damage due to overstretching from being done. This protects muscle fibres and other soft-tissue damage, such as tearing from occurring. The golgi tendon organ inside the proprioceptors eventually stop the stretch reflex in an act called autogenic inhibition where the golgi tendon organ is stimulated after the body realises no harm is being done. After the isometric contraction the participant relaxes for 2-3 seconds. A passive stretch is then performed and held for ~15 seconds - the participant will notice an immediate effect on their range of movement already. At this stage the participant now relaxes for ~15 seconds before the process repeats about two-five times.

Autogenic inhibition is most easily achieved when an isometric contractions occurs immediately before a passive stretch, hence why I am using the contract-relax method of PNF.

Below is a PNF exercise, specific to the muscles I will use (the Iliotibial band which causes hip adduction) which uses a passive force, gravity, and another person, namely the test administrator.

*Preparation*

Lie on mat or bench on side with lower leg bent 90° at hip. Test administrator grasps upper leg above or below ankle and places hip in neutral position (no flexion nor hyperextension) and knee at 90°

*Execution*

The upper leg can be allowed to naturally lowered, or be pushed downwards toward the mat or bench for the isometric contraction. Have the test administrator pull the upper leg at the top of the foot to create an acute angle at the knee, thus relying on the tightening of the quadriceps to pull the iliotibial muscles. Hold for ~15 seconds isometrically against the administrator, relax for 2-3 seconds then passively stretch for ~15 seconds.

In summary, proprioceptive neuromuscular sessions will help increase flexibility when adducting my hip, specifically stretching the Iliotibial band. With increased flexibility, flagging, in particular outside flags where my leg is twisted round the back of my other leg, will be more effective as I will be able to put my leg weight further over one side to help balance the weight distribution over the foot hold I am using as opposed to strenuously leaning off one side.

Here is an example of the stretch being performed passively without a test administrator

 

Rugby – rucking

**C1- Lack of flexibility in hip and knee joints**

The most common way to win turnovers at the ruck during a rugby game is using the jackling method; this involves being in a low squat position over the opposition whilst stopping the opposition from being able to correctly present the ball to their side of play. Flexibility is the most important part of the jackle; currently due the lack of flexibility I possess, I am not able to get into the low position required to be able to consistently win turnover ball.

Flexibility is the range of movement around a joint. The two main joints that are involved in the jackle are the hip joint and the knee joints; this is where most of the flexion occurs. There are two groups of muscles which control the flexion and extension of the knee; these are the quadriceps and the hamstrings. The quadriceps consists of four separate muscles which converge into one tendon, the quadriceps are mainly involved in extension but also control the flexion in weight bearing positions, like the squat, and similar to the low body position required to jackle. Although all four muscles work together the three larger muscles tend to pull the knee laterally, the fourth and smallest muscle therefore counteracts this pull and stabilises the knee joint. The second main group of muscles is the hamstrings; the hamstrings consist of three muscles which originate from the pelvis to the knee. These muscles pass down the back of the leg and are involved in flexion at the knee; they are also used for extending at the hip. Since there are many muscles that are involved in the flexion and extension of the knee it is important to have the range of flexibility in all muscles.

The other area of poor flexibility is at my hip joint. To maintain the correct posture during the jackle, my back must be bent to at least to the half forward bend (*diagram 12*) and preferably all the way to the full forward bend. The main muscles involved in this movement and therefore in need of improving flexibility are the gluteals, hamstrings and the lower back.

*Diagram 12: Half forward bend*

*Diagram 13: Anatomy of hamstrings*

The posterior muscles which are the biceps femoris, semitendinosus and semimembranosus are often grouped together as the ‘hamstrings’, they span the hip and knee joints. As well as extension at the hip they perform flexion at the knee joints. The ‘hamstrings’ are involved in multiple movements, the extensors of the hip joint draw the trunk upright when raised from a stooping position, useful for departing from the ruck if the referee calls “hands away”. Any action which carries the line of body weight in front of the transverse axis of the hip joint (e.g. forward bending at the hips) are supported by a strong contraction of the hamstrings. Due to this knowledge, it is vital that both muscles have improved flexibility in order to maximise the advantages of each (*diagram 12*).

The muscles of the gluteal region (*diagram 14*) consist of the glutei, maximus and medius et.minimis which are extensors and also abductors at the hip joint. The main muscle is the maximus; structurally this is a broad thick quadrilateral muscle. When standing, the muscle is inactive and remains so in forward swaying, however, when raising the trunk, it becomes active when partnered with the hamstrings. The medius and the minimus are involved in maintaining posture and supporting the body when weight bearing on one side; this is important to be strong and flexible in a ruck because I may be pushed off one leg by an opposition player so need to maintain a strong posture on one leg. Although each muscle is important in completing a different action it is important to get a full stretch on all parts of it to maintain a balanced posture and maximise the use of each muscle.

*Diagram 14: Anatomy of gluteals*

Finally the deep muscles in the back, especially the lower back, are crucial for overall flexibility in the hip and hamstring region. The erector spinae and its sub-muscles form a large muscular mass, which varies in size and composition throughout the vertebral column. This muscle acts as an extensor of the vertebral column and plays a key role in the downwards phase in the forward bend and maintaining the upright posture. The majority of flexion movements are controlled by the erector spinae however during full flexion they are relaxed and posture is maintained by tension in the ligaments of the spine.

To improve the flexibility of my knee joints and my hip joint, stretching and flexibility training must be incorporated into my training programme. There are 5 main types of stretching;

1. Active Stretching- holding a stretched position by contraction of own agonist muscles; increases flexibility and strengthens agonistic muscles.
2. Passive Stretching- a stretch position held by something other than agonist muscles; great as a cool down and preventing DOMS (delayed onset of muscle soreness).
3. Static Stretching- stretch to the limit and then isometrically contract stretched muscles; better than active and passive for flexibility and strength. PNF (proprioceptive neuromuscular facilitation) is a common technique used.
4. Ballistic Stretching- uses bouncing movements in and out of stretched positions; very dangerous and not recommended.
5. Dynamic Stretching- involves isotonic contractions and moving limbs whilst stretching; great for muscle strength.

All of the stretches above have their advantages and disadvantages except ballistic which is not recommended and can cause injury. Research has shown that a type of static called proprioceptive neuromuscular facilitation (PNF) is the best technique to use. Using PNF the regions explained above will vastly improve my chances of getting into a lower posture to win turnover ball more effectively.

**C2- Proprioceptive Neuromuscular Facilitation (PNF)**

For my corrective measure for the lack of flexibility at my hip and knee joints I will use PNF stretching. By doing these stretches/ exercises the elasticity in the muscles will increase so I will able to get myself into lower positions in the ruck, therefore increasing the chance of winning turnover ball.

PNF is a type of static stretching because the muscles are contracted isometrically. The aim of the training is to increase flexibility of the targeted muscles and increase the range of movement around the hip joint. Before PNF is performed I must have completed a thorough warm up to get the blood flowing into the working muscles or after a game where my muscles have previously been warmed up; if I went straight into PNF before any warm-up then there is a great chance my muscles will tear as they are cold and aren’t ready for stretching. Proprioceptive neuromuscular facilitation is not a warm-up, in respect of this it should not be used as one. A couple of PNF techniques are practised today; the most practical style is the contract-relax-antagonist-contract (CRAC) technique. During PNF, isometric muscle contractions are completed immediately before a passive stretch help to achieve autogenic inhibition, where the muscles gradually relax. This continues until the stretch reflex is activated; muscle spindles are highly specialised receptors, located within the muscle cells, which protect the muscle from injury; they sense how far and how fast a muscle is being stretched and, when activated, produce this stretch reflex. This reflex action causes the muscle to contract and prevents over stretching of the joint; however, once the muscles and the brain have realised that the stretch is not causing injury the Golgi tendon organ is stimulated causing the muscle to relax. This contract-relax process is repeated until the muscle cannot stretch further, usually 3-5 times.

PNF allows for the joint to be stretched further than other methods such as active and passive stretching; this is because my body has time to react to the stretching and realise that there is not harm towards my body, due to the Golgi tendon organ. Active and passive stretching doesn’t allow for the muscle spindles and Golgi tendon organ to be fully activated and stresses overcome, therefore, my joints are not stretched for the required time and the technique doesn’t improve my flexibility. PNF also focuses deeper into the muscle because the joint is isolated, resulting in just that muscle and joint being stretched. Passive stretching for example uses muscles held by something other than the agonist muscle so other muscles are working in tandem with each other to stretch, not solely the targeted agonist muscle, meaning the stretch isn’t as effective as PNF would be.

As described earlier the three muscle groups that I am concerned with each have different properties; but, PNF can be used to increase the flexibility of my hamstring, gluteals and quadriceps. Gluteals and hamstring PNF will be performed whilst laying on my back and quadriceps PNF on my front. To make PNF easier it is best performed with a partner; the partner must remain attentive and listen to my commands as only I know how my muscles feel. Here are the three different muscle groups each going through the PNF process:

*Diagram 15: Hamstring PNF*

Hamstring PNF (*Diagram 15*): my partner will extend my leg and rest it on his/her shoulder, making sure that the knee joint is stable to avoid injury of the joint. Ensuring my leg is solely being bent at the hip, to utilise the hamstring, they can start the process. My partner will slowly lean forward until my muscles can no long stretch and the stretch reflex is activated; they will then hold my leg stationary for 10-15 seconds, after this I will contract my leg isometrically against the helpers shoulder for a count of 8 seconds. At the end of a 30 second rest after the contraction my Golgi tendon organ will kick in allowing my partner to lean forward again and stretch my hamstring. Repeating this process 3-5 times will fully stretch my hamstrings.

*Diagram 16: Gluteal PNF*

Gluteal PNF (*Diagram 16*): even though the gluteals are directly above the hamstrings, the structure and size of both muscles vary. Hamstrings are a very short muscle so usually take the full load of the stretch before the gluteals can be activated, if I was to maintain the straight leg hold. To activate the gluteals, my partner will make sure my leg is bent at the knee, by doing this; the hamstring is not engaged fully allowing my leg to be closer to my hip, nearer to my gluteal muscles. Furthermore, by rotating my leg to the opposite side my gluteals are activated further, adding to the stretch. The PNF technique follows the same pattern; my partner will slowly apply force to my leg until the stretch reflex is engaged, and hold my leg stationary for 10 seconds. After this I will contract my leg isometrically, opposing their force for a count of 8 seconds. At the end of the 30 second pause my Golgi tendon organ will kick in allowing my partner to lean forward again and stretch my gluteals. This process is repeated 3-5 times.

Quadriceps PNF (*Diagram 17*): this differs from hamstring and gluteal PNF as I am laying on my front. As the quadriceps is a long muscle they already have good flexibility compared to hamstrings which are shorter. My partner will place his leg across my gluteus maximus to stop any extension at the hip; then with one hand hold my ankle and with the other lift my hamstring off the floor to activate the deeper stretch. The partner will bring my ankle to above my backside and hold for 10 seconds when the stretch reflex is engaged. An 8 second isometric contraction against the resistance of my partner’ arms will be followed by a 30 second rest, until the Golgi apparatus realises that there is no harm. 3-5 more contractions will result in the quadriceps being fully stretched.

*Diagram 17: Quadriceps PNF*

As PNF is a training technique in itself, it involves intense strain and tension on my body; due to this routines must not be redone within a 24hour period of a previous session or on the morning of a competition. Another guideline is not to perform exercise on more than one muscle group per session as this can also cause injury and reduce the effectiveness of the PNF on each muscle. Proprioceptive neuromuscular facilitation will greatly improve my flexibility in the joints that are vital to getting in a low body position that a good jackle demands. It is best if it is used after training or after a skills session where my muscles will be pre stretched and warm allowing for greater flexibility gains. If my flexibility increases and I win more turnover ball my team will end up with greater possession which can be used to score points and win more games, as well as placing doubt into the opposition’s minds that they cannot maintain possession of the ball. Not only will it help in the side tackle situation but it will also in other general aspects of game play.

Athletics – High jump

**C1 High Jump – Flexibility (Legs and back)**

Flexibility is defined as “the range of movement around a joint.” It is an important aspect for performing an effective skill and technique or action as well as a contributory factor for speed and power. This range of movement depends upon many factors, which include muscle bulk, the surrounding tissue, the structure of the joint, skin and muscle length. Muscle length however is the only one we can modify as humans (Stretching). If the lengths of the muscles in my legs are short then I will have poor flexibility meaning that I cannot stretch as far as an elite performer, meaning the lever I have to achieve higher heights is not long enough to accelerate my ascension further. A lack of flexibility in my back and abdominals prevents me from arching back further leading to me losing several centimeters.

Flexibility will also help for everyday mobility as well as decreasing my chances or injury. This all therefore means that it is an important aspect for me to maintain and improve to increase the heights I can currently achieve. As it stands, this is probably my worst weakness and is limiting my performance the most.

Flexibility is important during the flight and the arch of the back to clear the bar. Without flexibility I will have the inability to arch my back effectively during flight. This leads to my gluteals dropping, resulting in the high jump bar being knocked off and achieving a no jump. This also leads to me landing in an incorrect and awkward position that can result in an increased probability of injury.

After I have taken off after plant I require flexibility to drive my knee upwards to assist the leap. If I lack flexibility then I am unable to drive that knee above 90 degrees. This is due to my gluteals not being able to stretch any further (Due to short muscle length), limiting how high I can drive my knee. This results in the knee dropping further into the jump, which can lead to the development of a poor technique that makes it more difficult to rotate my body as well as achieving maximum height.

Poor ankle flexibility is a huge weakness for me as with a small plantar flexion I am unable to maintain contact with the ground for a large period of time. This means that I am unable to build an upward momentum due to the small ground contact time, which limits that height I can achieve. This also means that I have to become more reliant upon my drive knee to maintain the small amount will drastically decrease my trajectory in comparison to what I could achieve. This will therefore have a knock on effect on my technique as it limits the short period of time in which I have to drive my knee, rotate my body and arch my back ready for landing.

I also require flexibility in my arms to achieve a full circle around my shoulder. If I am unable to do this then I may become unbalance during the curved part of my run up, causing me to drop my shoulder away from the bar. This will result in a poor take off, possibly causing injury and a loss of momentum that could lead to me landing on the bar and achieving a no jump. This could lead to me losing a large amount of height, which could lead to me consistently performing poorly in competitions that could lead me to becoming unmotivated.

All these factors lead to me performing poorly so therefore it is important for me to improve my flexibility otherwise my performance may hit a plateau resulting in this being one of my largest weaknesses.

**C2 High Jump – Improving flexibility**

Proprioceptive Neuromuscular Facilitation

Increasing the elasticity of the muscles is how I can improve my flexibility, therefore increasing the range of movement around the joints. I can achieve this through Proprioceptive Neuromuscular Facilitation (PNF).

Proprioceptive Neuromuscular Facilitation involves using alternating contraction and relaxation movements to increase flexibility. Firstly an isometric contraction is performed and this is followed immediately by a passive stretch until muscle spindles cause the muscle to prevent overstretching (This is the stretch reflex). This then stimulates the golgi tendon organ, which causes the muscle to relax. The muscle is then actively isometrically contracted and the process repeats but the muscle will be stretched slightly further after the relaxation of the muscle. This is easiest to perform with a partner even though I would be able to perform this alone.

Isometric contractions followed by a passive stretch help to facilitate the body’s muscles inhibition causing then to gradually relax. This therefore increases the elasticity of the muscles increase flexibility. This will help to achieve greater heights during my performance due to a larger amount of movement causing a much large amount of force to be generated and at my disposal. This will cause a greater knee drive, a much powerful take off leg as I will be able to extend me knee joints concentrically much faster creating greater height. I will have a better ankle flexibility allowing me to stay in contact with the ground for a longer period of time, giving me an opportunity to generate much more force than if I was already airborne. This is related to ‘Newton’s 2nd Law’ suggesting that if I apply a greater force then I will accelerate faster meaning I would achieve a greater height. Impulse suggests that if I have a longer time in contact with the ground to gather momentum, then I will have a greater positive impulse resulting in a much quicker acceleration creating a more powerful leap.

PNF stretching requires a long aerobic warm up to reduce the chances of injury during PNF. This is because PNF is a training session within itself and also requires around 48 hours of recovery time after the ‘set’. This should never be done on the morning of a competition, as it will lead to fatiguing and possibly injury.

Drills

I can improve all my flexibility through performing a series of drills. A drill is defined as a “Disciplined, repetitious exercise as a means of teaching and perfecting a skill or procedure”. This will be important for the arch of my back, as this is much harder to improve through PNF due to the increased probability of injury.

**Bridge Drill:**

To increase the arch of my jump, it is important to improve and maintain my flexibility. Yoga is not only effective for back flexibility, but it also is a cross-training exercise. I’d lie face down on the ground and with my chest up off the ground, straightening your arms. While lifting my upper body off the ground I’d concentrate on pushing my hips into the ground.

On a mat I would lie on my back and place my hands behind my head close to my ears. I would have my palms laying flat with my fingers pointing toward your feet. I’d push up to create a bridge in my spine. As I get stronger at maintaining a bridge up, I will practice pushing my body off the ground in the bridge position. As I attempt to push myself off the ground I’d press my back into a deeper arch by quickly reaching for my ankles and releasing. Performing this drill in the pit for safety.

I chose this drill as it is easy to do and doesn’t require any other equipment making it much cheaper as well as being very effective in improving my arch and overall technique. This could add several centimetres onto my personal best as well as me starting to see improvements within a couple of months if I complete this exercise a few times a week.

**Hurdle Step Over’s**

This drill is done to improve flexibility in my hamstrings allowing me to lift my legs higher during the recovery phase (on the way down to the mat), decreasing the chances of me knocking the bar off with my feet.

This drill consists of setting up 5 to 6 hurdles all in a line, leaving a gap of around 50cm between each hurdle. They should stand at a height just below hip level. I will stand side on to the first hurdle flexing the leg closest to the hurdle up directly in front of me (stretching the hamstring) up to just above 90 degrees. Then this leg will then travel over the hurdle and flex to allow plant on the opposite side of the hurdle at which I begun. This allows me to extend my outside leg around the edge of the hurdle, while rotating my body 180 degrees, (Facing opposite direction) meaning my leg to being hyperextended behind me. Then bringing that leg (without planting) up in front of me (Extended) to a 90 degree angle and planting on the opposite side of the hurdle (Repeating the first action). I will then progress down the hurdle like this.

This is a good drill to use as it not only stretches my hamstring leading to a greater flexibility during take off and during the drive knee, but also during rotation of the body and swinging my leg up to 90 degrees helps to improve take off technique ultimately helping with my technique during the jump. I should do this at the beginning of every training session to start to see improvement within my jump.

All these exercises will allow me to develop miniscule skills to help develop my technique overall and achieve a much greater jump. The improved flexibility will give me a greater range of movements meaning that I can reach greater heights as well as perform a better arch to allow extra centimetres to be added.

Kayaking – Stern rudder

**C1: Lack of Flexibility.**

Flexibility is the range of motion around a joint. When paddling and needing to perform a stern rudder, I need flexibility in the hip and shoulder joints. This is because I need to rotate my torsos; needing a combined flexibility of the hips and shoulders and strength in my core muscles. Having a lack of flexibility is problematic as I need to have a wide range of movement in my shoulders and hips to perform the stroke to its highest potential. If I don’t I have a much higher risk of becoming injured as well as performing a weaker stroke.

There are several types of stretching and ways to increase your flexibility.

The first of the four is active stretching. This involves holding a stretch position with your own agonist muscle. This not only improves flexibility but also improves strength of the agonist muscle. This would be an important type of stretching to help improve performance within kayaking as the performer needs both strength and flexibility in all muscles.

Passive stretching is another form of stretching used by many just after a warm up as general stretches. This is when the performer stretches their muscle against something else other than the agonist muscle. This is a very good form of stretch when cooling down as it helps reduce post exercise muscle soreness. This is an important use of stretching for kayakers as it allows the performer to easily stretch their most used muscles such as their deltoids, trapezius and teres minor and major muscles.

Static stretching, also known as PNF stretching is when you stretch your muscle to the limit then isometrically contract the stretched muscle. This is very effective for strength and flexibility which is essential in kayaking. The strength within kayaking is needed to allow the athlete to perform their strokes to the best of their ability, allowing them to apply considerable power when needed and be able to continue to apply that power at different points down the river. Flexibility is needed to allow the performer to perform strokes that involve difficult body positions without injury. It is also has uses for simple strokes. Allowing you to stretch further or reach higher, again allowing maximum power to be placed into the strokes. For the stern rudder, the need for flexibility is vital as it requires the performer to reach for the stroke. The need to rotate their trunk and reach with their forwards arm allows the stroke to be performed at its best.

Ballistic stretching is the final type of stretching. It is where the performer uses movement to bounce in and out of a stretch position. This is considered to be very dangerous as it doesn’t allow the muscles to adjust to the stretch position. As a result it triggers the stretch reflex and causes the muscle to tighten or even snap!

When Brown begins to paddle, he always makes sure he warms up, this is because he does not want an uneven muscle balance and also so he does not pull any muscles or injure himself in any other way when performing. This is something I sometimes fail to do. A lot of the time, I am unable to control my excitement to get on to the water and if I do not remember to warm up, or I am not told to, I don’t, this sometimes results in me injuring myself as when I get onto the water, I push myself as hard as I can. I do this as I want to improve. However, sometimes the lack of a warm up hinders my performance as I feel stiff and unprepared. Stretching is part of a regular warm up Brown does and it allows him to be able to take bigger risks with his paddling and not have the fear of pulling or overstretching a muscle as he would have warmed up, not preventing, but minimizing the risk.

**C2: PNF (Proprioceptive Neuromuscular Facilitation)**

Proprioceptive Neuromuscular Facilitation is done by altering between contracting and relaxing the muscles to increase flexibility. It attempts to facilitate the body’s muscular inhibition. This is a more rapid way of gaining flexibility over other forms of stretching. It is also the most effective for increasing flexibility.

To perform PNF, the performer undergoes a passive stretch, pushing the body until the muscle reaches the stretch reflex (this detected by the muscle spindles in order to prevent overstretching). Reaching the stretch reflex and holding the limb in that position causes the Golgi tendon organ to become stimulated and causes the muscles to relax. The performer then in the stretch position, isometrically contracts their muscle; holding the position for up to 10 seconds. This is then repeated. It is best to be done with a professional partner such as a fitness coach or personal trainer as it can be very dangerous and does require some form of experience to administer correctly.

PNF training is potentially dangerous and requires a long aerobic warm up, is easiest to do with a partner, should not be done on morning of competition and requires 48hrs rest between sessions.

The main objective of PNF Stretching is to increase flexibility and to promote neuromuscular response through stimulating proprioceptors helping to, not only improve the flexibility of the muscle but also it has a slight effect on the strength of the muscle too; increased strength at the limits of my range of motion.

PNF is a valuable part of many athletes training programmes as although increasing overall performance through flexibility, it is also an effective rehabilitation method. It also reduces the risk of future injury as it lowers the risk of joint and muscle injury during a training session or work out. However, performing PNF itself carriers a rather high risk. Injurys such as over hyperextension; this would lead to more strain on tendons and muscles surrounding the injured area, resulting in recovery time and less time participating in sport.

Athletics – long jump flight and landing

**C1 Long jump flight and landing.**

The main weakness affecting my long jump flight and landing performance is the limited range of movement around my joints, my flexibility.

My limited flexibility affects my performance because my technique relies on the cyclical motion of my arms and legs. If this motion is impeded, the forwards rotation acting upon me as I am in the air will rotate my body forwards and I will lose control and land leaning too far forwards which will decrease the length of my jump, as I will be unable to shoot my legs forwards to gain the distance I need to perform well. It could also result in injury as over-rotation could cause me to land on my front, shoulders or head, all of which could result in injury serious enough to prevent me from competing in the rest of the competition or the near future, such as a sprain, dislocation or concussion.

Inflexibility will also have a detrimental effect upon each phase of my long jump flight and landing as well as an overall effect.

After I have taken off, my free leg needs to drive powerfully up as high as possible to create lift, if however, due to a lack in range of motion it cannot drive up very high, the lift generated will be severely diminished and the decreased height achieve will drastically decrease the trajectory of my jump, severely diminishing the distance I can achieve.

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 extend up and out at right angles from the body and maintain this position to allow stable flight and a safe landing. Without the flexibility to pull the leg through under the body and out to a ninety degree angle from the body then the flight is 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 flexible enough to cycle in a full circle around my shoulder, 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 will drastically reduce the distance of my jump as by falling back I would lose at least a metre and a half, I being about 185cm tall or more.

All of these factors will lead to either a reduced performance or injury and so is the biggest weakness in my performance.

**C2 Long jump flight and landing**

Proprioceptive neuromuscular facilitation (PNF)

To combat my inflexibility I have decided to use PNF stretching. Proprioceptive neuromuscular facilitation uses alternating contraction and relaxation movements for flexibility. PNF stretching is one of the most effective forms of flexibility training for increasing the range of motion of a joint. PNF techniques can be both passive (no associated muscular contraction) and active (voluntary muscular contraction). While there are several variations of PNF stretching, they all have one thing in common: they facilitate or help the body’s muscular inhibition. This is the reason why PNF stretching is superior to other forms of flexibility training.

The PNF style I am going to use is the contract-relax, antagonist-contract (CRAC) technique, which uses isometric muscle contractions as its basis.

Isometric muscle contractions completed immediately before a passive stretch to help to achieve autogenic inhibition, where the muscles gradually relax. Muscle spindles are highly specialised receptors, located within muscle cells, which protect the muscle from injury. They sense how far and how fast a muscle is being stretched and, when activated, produce the stretch reflex. This reflex action (see image) causes the muscle to contract, preventing overstretching of the joint. For example if you are lying on your back performing a hamstring stretch, and take the stretch to the limit of your range of movement, your leg starts to jump and twitch. At this point the muscle spindles have been activated and are telling the muscle to contract to prevent any further stretching.

Also located within the muscle’s tendon is another sensor called the Golgi tendon organ (GTO). This organ senses how much tension there is being placed on the tendon. However, the GTO differs from the muscle spindle in that, when activated, it relaxes the muscle. Autogenic inhibition is reflex relaxation that occurs in the same muscle where the Golgi tendon organ is stimulated. Often the isometric contraction is referred to as ‘hold’ and the concentric muscle contraction is referred to as ‘contract’.

PNF stretching is not to be performed as a separate exercise session, I shall therefore do a thorough warm-up consisting of five to ten minutes of light aerobic exercise, for example a jog, and some dynamic stretching.

PNF stretching should be avoided immediately before, or on the morning of, a competition and I will leave forty-eight hours between each PNF session.

I will only perform one exercise per muscle group in a session, but I will do two to five sets of each exercise. Each set will consist of one stretch held for up to thirty seconds after the contracting phase.