Fitness and Injury Screen for Adolescent Skiers

Aiglon College

2015-2016

Introduction

The purpose of this pack is to provide instructions and guidance in the delivery of a performance and injury prevention programme to be delivered by coaches within the sporting curriculum.
This pack supports a specific training course the attendance on which should be considered essential before attempting to apply the tests described herein.

The tests as described have been selected according to the following criteria:

- Assesses overall stability and function of the musculoskeletal system to best judge its propensity to injury.
- All tests are easily performed and replicable between practitioners.
- Requires minimal equipment and can be carried out in a normal sports hall.

All data should be stored securely on a suitable database (an Excel version is provided with this pack). It might be easier to collect the information using a paper based system which is then attached to a clipboard and collected by each individual throughout the process

Initially it is important to collect simple anthropometric data:

- Gender
- Age
- Height
- Weight

The group assessments can be carried out en-masse with individuals recording their own scores. The individual tests should ordinarily be carried out by 1 coach per-person with the full protocol taking 40 minutes to complete.

Upon completion participants are encouraged to engage in a 10 minute cool down such as 5 minutes on a bike or gentle rowing and some static relax positions.

Equipment required (individual set-ups as described in main text)

- Measuring scales and tape measure/height measure.
- Marking tape
- Benches
- Cones
- Water bottle.

Overview

Testing phase	Timings	Specifics
Phase 1 – Anthropometric Data Collection	20 minutes Group Session	
Phase 2 – Warm up	20 minutes Group Session	Warm up
Phase 3 – Physical Bench marking	20 minutes	Plank
		L-hang
		5 step hop
		Box jump
		Water bottle bear crawl
		Blind Single Leg Stand
Phase 4 – Physiological measurements	20 minutes	Standing SLR
		Sitting reach
		Beighton score
		Knee flexion
Phase 5 – Special Tests	20 minutes	Single Knee dip
		Knee joint integrity
		Fabere's Tests
		Thomas Test
		Ober's Test
		Latissimus test

Phase 1 – Anthropometric data collection

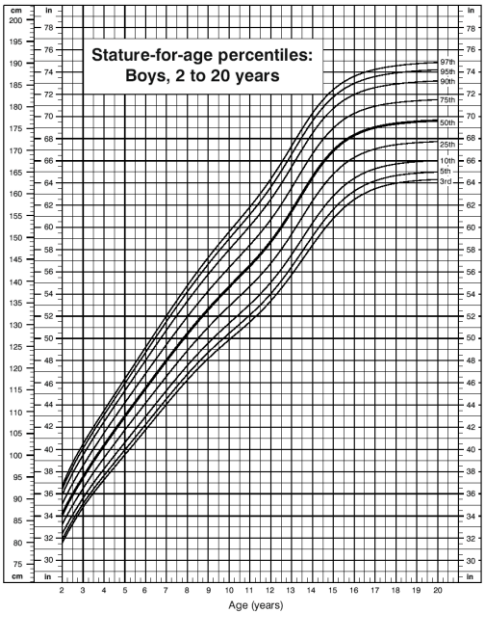
Age and gender are essential to allow comparison to statistical norms.

Height and weight: these can be taken as a once yearly measurement but are not, on their own particularly revealing but can provide us with some statistical norms from which to compare other measurements.

Using Growth Charts

Most parents are familiar with them but they are not sensitive enough to be of use in the short term and should only be introduced to your athletes under the age of 10 years who you think may be with you for some years. On the whole they will only show a change in growth in the long term and after it has happened. Looking out for significant slow-downs in growth is important but probably beyond the remit of a coach. As a coach you need to be able to identify a growth spurt. This is when the growth plates in a child's body are most vulnerable to damage and they should reign in their training. The most effective way to do this is to have a wall mounted measure and use it weekly. A significant jump in their height should mean the start of a growth spurt and therefore the commencement of a maintenance and mileage programme.

These measurements can also be used to calculate BMI (body mass index – a standard measurement of health. However BMI for children is not as straightforward so a specialist BMI calculator of children should be used (http://www.weightconcern.org.uk/node/9).
The risk for skiers is not becoming overweight but *underweight* and this should be carefully monitored. Correct coaching and providing good role models are important.



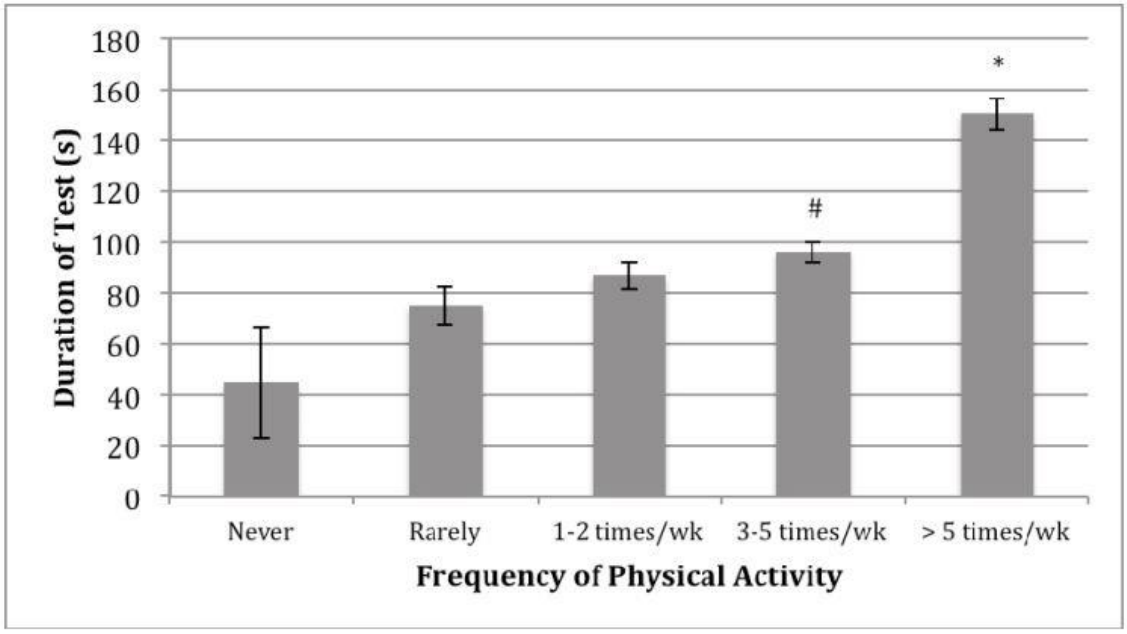
Phase 2 – Warm up

Prior to testing the participant should be adequately prepared by warming up and mobilising all joints for at least 10 minutes. 5 minutes of static stretching should also be included prior to the tests as some will require taking the joints to end of range.

Phase 3 – Physical Benchmarking

Plank

The length of time a person can hold a plank correlates directly to their exercise levels:



It is a simple test and can be carries out en-masse.

The Plank

5-hop test

Apparatus: Tape measure, meter stick, masking tape

Component tested: Stability; power

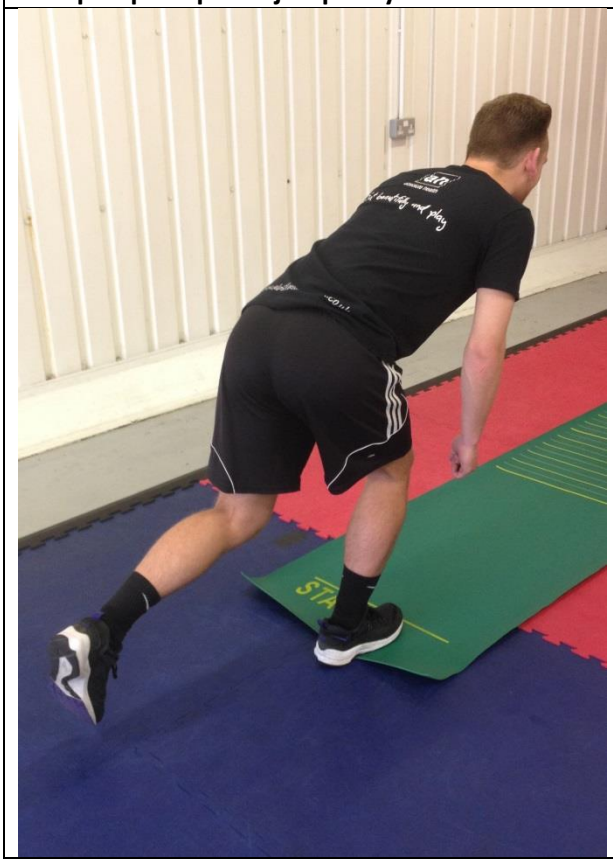
This test is conducted by measuring out a distance of approximately 15 meters (this is sufficient distance for most athletes…some will exceed this).

The athlete gets 2 attempts at each test for each leg:

The athlete starts with both toes behind the line, standing on the both legs. The athlete then hops on the right leg performing 5 consecutive hops on one leg. The athlete must land on the right leg following the 5th jump with the foot firmly planted in position for measurement (the athlete may touch down the other foot to gain balance.)

Measurement is taken from behind the heel. Repeat for the left foot. Athlete gets 2 attempts on each side. The jumps must be in a straight line and performed in a continuous motion.

5 step hop. A special jump may can be used



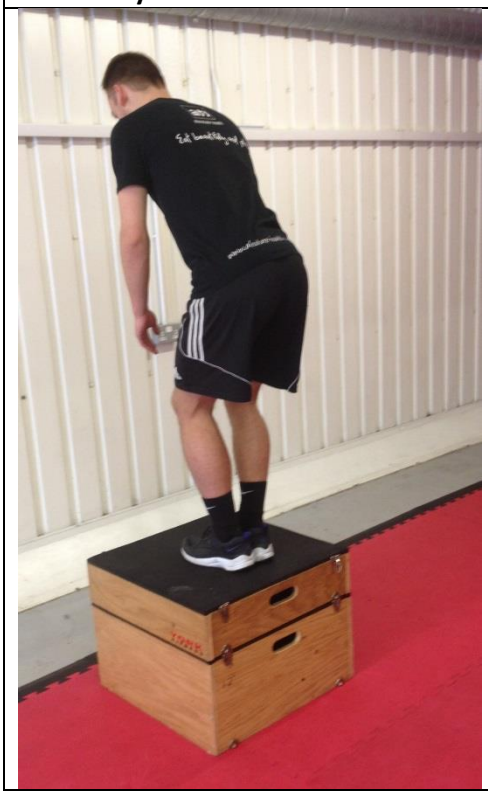
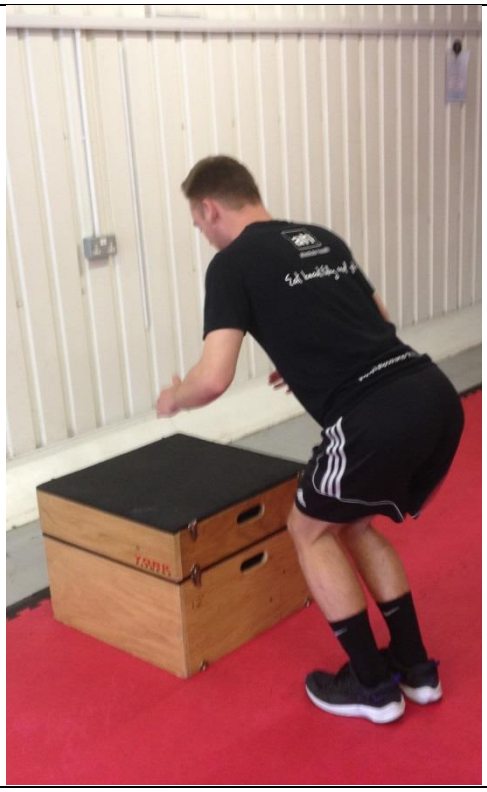
Box Jump

Apparatus: Standard step aerobics box with 6 raisers each side; 4 spotters; gym floor (no mats) and should provide adequate grip.

Component tested: Anaerobic lactic endurance

This test is conducted using a box 16" in height and 14" in depth (a step box fits these dimensions and provides better safety during the test if the athlete falls on the box.) Spotters are recommended for safety in case the athlete falls during the test (this is quite common). 2 spotters steady the box on each side, 2 spotters cover the athlete as they perform the test. The aim is for the athlete to complete as many jumps on and off the box as possible in 90 sec's.

Note, both feet must take off and land at the same time – only these efforts should be counted. The test administrator records number of repetitions completed in 90 seconds.

Ensure you encourage the participant to land in the middle of the box. Use the 40 cm box for under 14 year olds.	
	

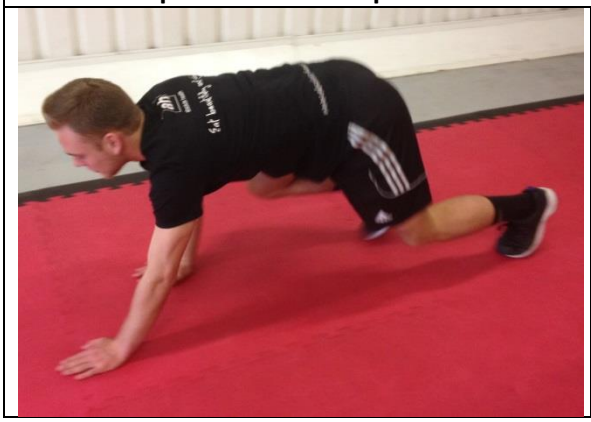
Water Bottle Bear Crawl

This test measures the ability to maintain dynamic control at the shoulder, trunk and hips, whilst completing forward and reverse crawling patterns.
To ensure validity is maintained across assessments a filled water bottle should be rested on top of the athletes' lumbar spine (low back) in a horizontal, across body position (as pictured).
The water bottle serves as constant feedback to the athlete that crawling reps must be completed with a neutral spine and good pelvic positioning. If a neutral 'sound' posture is lost the water bottle will drop to floor indicating distance travelled (marked at the hands) and the limit of the athletes dynamic control and capacity.

How to conduct the Bear Crawl evaluation:
First measure a 10m straight line marked with a single cone at the start and end points.

- Begin by setting up on all fours with hands behind the start cone, have a friend place a full 2 Litre sized bottle across the low back region and crawl 10m to the next cone by simultaneously lifting opposing hand and foot, reach forward and place down on the floor ahead of the body, continue this motion with opposite hand and foot repeatedly.
- When both hands arrive at the end cone crawl in reverse until both feet reach the 10m start cone, and repeat.
- Dragging or sliding of hands and feet are not allowed.
- Crawling is performed continuously until the water bottle drops to the floor, or the athlete cannot complete further distance.

Athletes under the age of 14yrs should complete this evaluation over the same distance without a water bottle on their back. A score is obtained by measuring crawling distance until either loss of form or fatigue occurs.
After practicing crawling technique a couple of times, the athlete is permitted 2 attempts to log a total score with a 30minute rest period permitted between attempts.
Total distance covered in forwards and backwards directions is summed as the 'total score' this should be logged in metres (m) and taken from where the hands finish

Allow a couple of minutes of practice first. Use a water bottle only with over 14 year olds.	
	

Blind Single Leg Stand

This is a test of stability, balance and proprioception.
There are normative values for all age ranges and it is felt that a 10 year old child should have acquired a comparable level of balance as that of an adult.

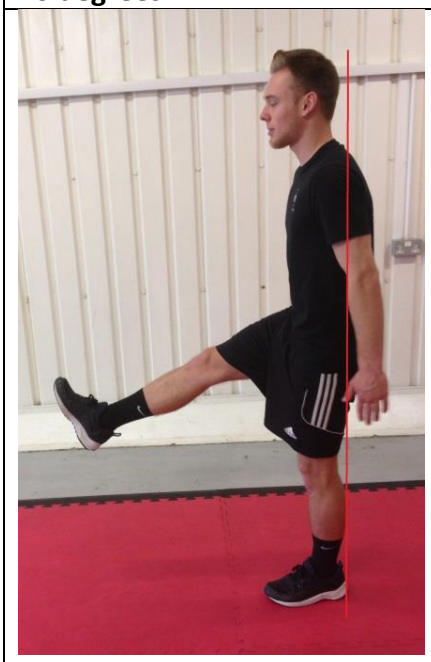
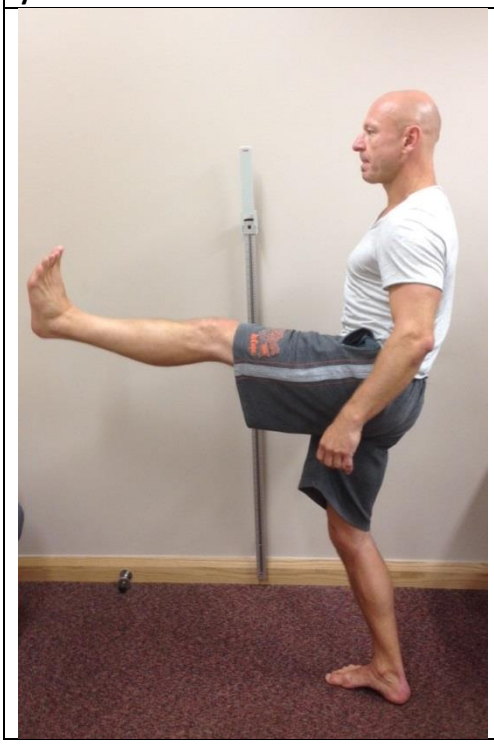
A fit healthy 18 yr old should manage between 15 seconds and 1 minute.

Blind single leg stand

Phase 4 – Physiological measurements

Standing Straight Leg Raise (SSLR)

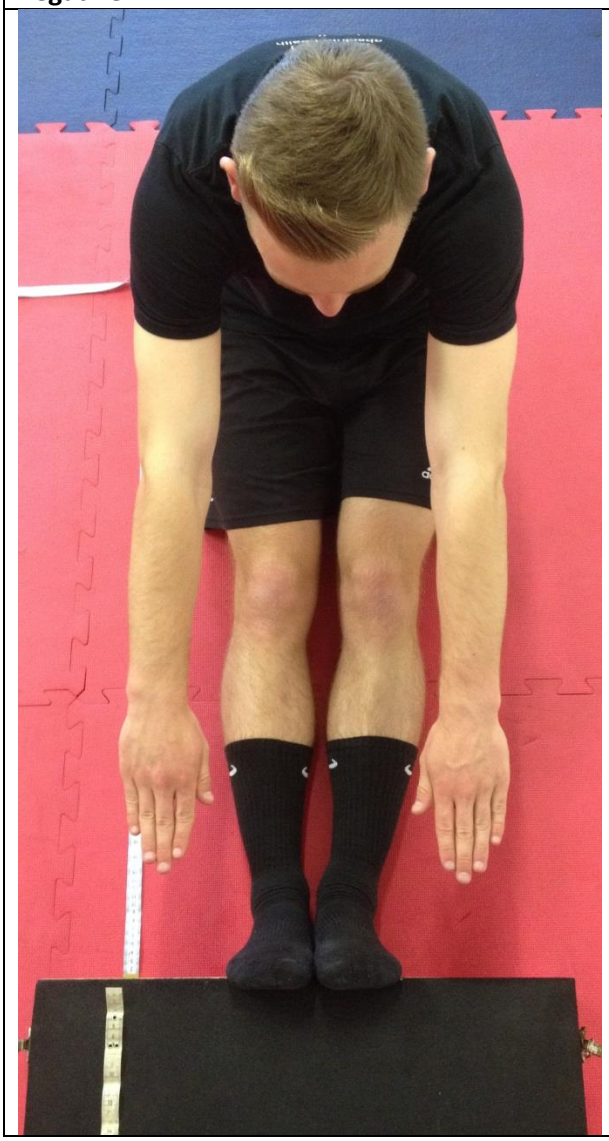
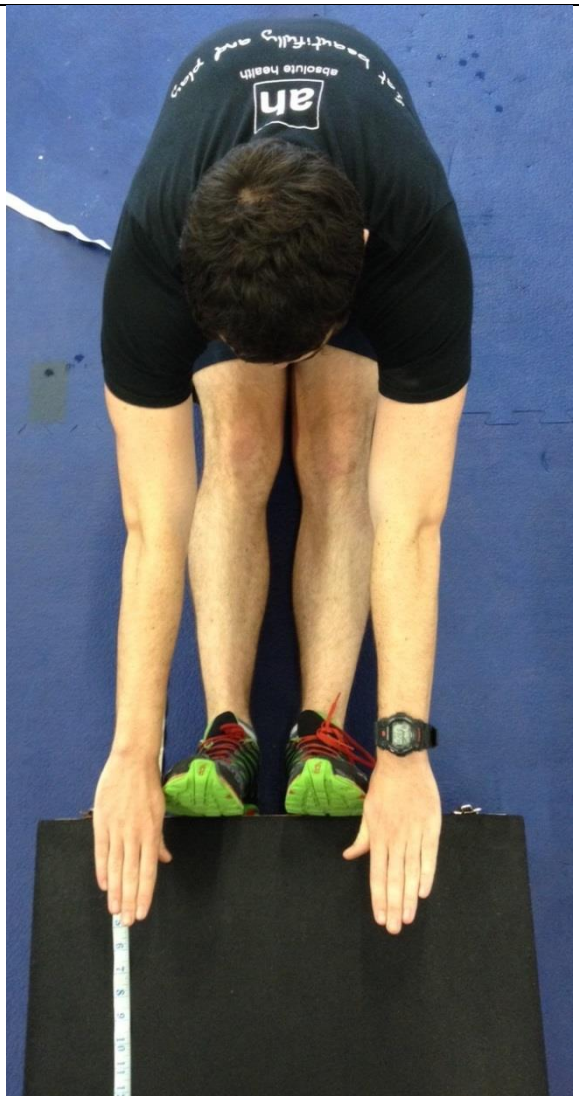
This is an excellent test of strength, control, core strength, stability, hamstring length and balance

Normal upright posture – approx 70 degrees.	**Tight hamstrings force Harrison backwards when asked to lift higher with no discernable improvement in the lift**
	
Mark has excellent control, stability and strngth as well as flexibility – a martial artistist and 58 years old.	**Here we can see Steven has poor core strength causing his trunk to collapse**
	

Sitting Reach

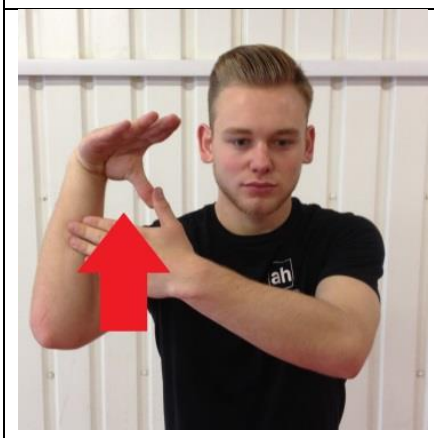
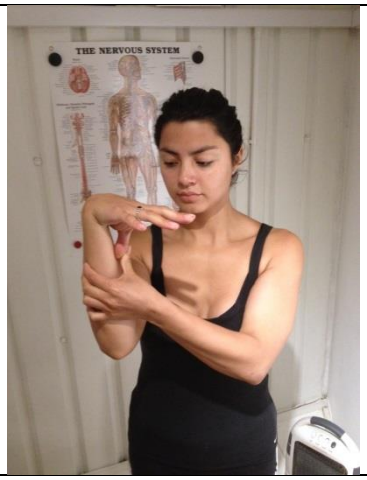
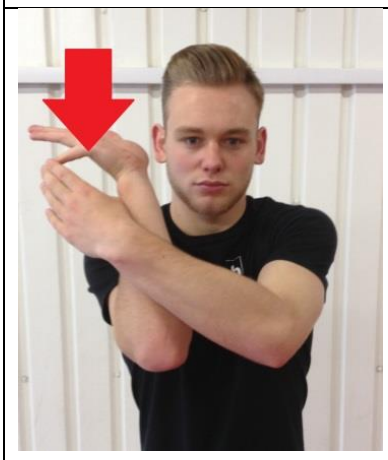
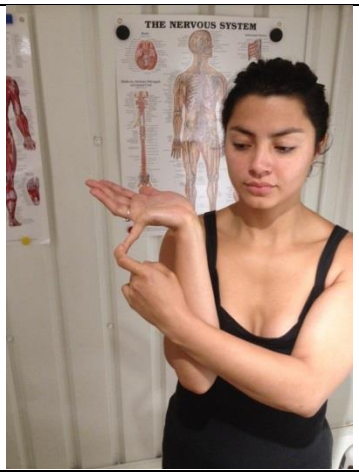
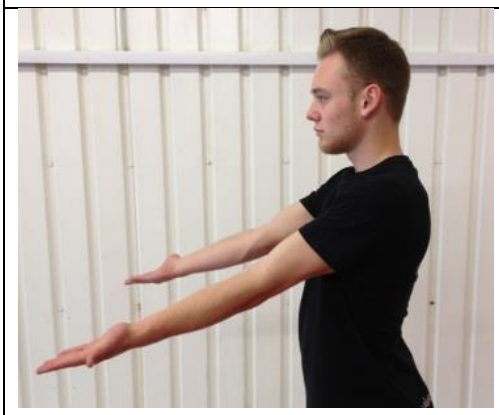
The sit and reach test is a common measure of flexibility, and specifically measures the flexibility of the lower back and hamstring muscles. This test is important as because tightness in this area is implicated in lumbar lordosis, forward pelvic tilt and lower back pain. This test was first described by Wells and Dillon (1952) and is now widely used as a general test of flexibility.

The test as described below is a 'modified version' and does not take into account variables between athletes which is not an issue as we are not comparing athletes with each other.

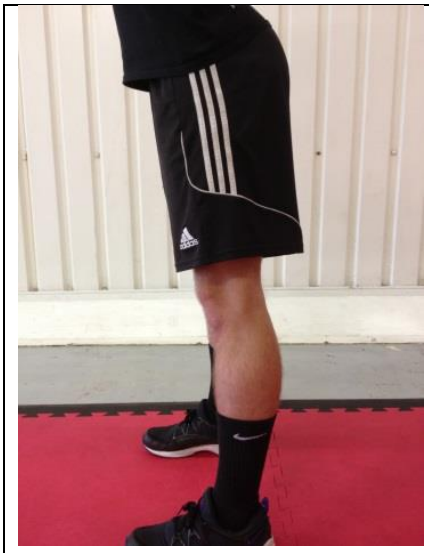
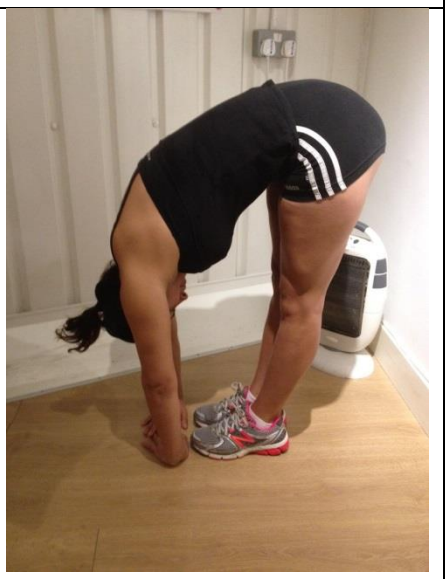
Sitting reach – with the feet against a box and tape measures pre-placed,	
Note the two tape measures to score positive or negative – this footballer is, unsurprisingly negative	**Here we can see Steve has a positive score of 5 cms (despite wearing his trainers)**
	

Beighton Score: or hypermobility score out of 9.

The Beighton score is a test for hypermobility and uses 9 signs, 4 which are repeated left to right and the 5th is bilateral.

2 examples of relative joint laxity – low and high		
	**Score 1 point for each thumb that touches the wrist easily in this position.** **←Harrison scores zero** **Natali scores 2→**	
	**1 more point for each pinky that can be bent to 90 degrees easily** **←Harrison zero** **Natali also zero, but close→**	
	**Do the elbows hyperextend?** **←Harrison 0** **Christina 2 →**	

Beighton Score – 2

	**1 point for each knee that hyperextends** **🡐 0 for Harrison**	
	**And finally 1 point for being able to press your hands on the floor with your knees locked out.** **🡐 Harrison 0** **Natali 1 🡒** **(worth noting here that Natali's knees and elbows do not hyperextend)**	

Knee Flexion

This is a simple measure of the ability of an athlete to fully flex their knees. With a sport like skiing it is possible to develop very tight and therefore ineffective quadriceps.
Also any developing knee problems can be hidden by a corresponding tightness of muscles and loss of range.

The measure should be from the heel of a bare foot held at 90° to the closest point on the buttock.

The heel should sink easily into the buttock	**Here we can see Steve's quads are very tight**
	

Phase 5 – Special Tests

These are a series of simple, easily replicable tests which can be incorporated into an injury screen safely. No end of range testing or excessive force is used and done properly can help the coach analyse all the data more carefully.

Scoring the tests should be done simply and allows for repeated analysis by the coaching team and doesn't allow for mis-interpretation of the data.

- ✓ - the test is performed perfectly – no follow up required
- X – there is instability or imbalance and should be addressed in their training
- (p+) Pain positive outcome – refer to medical team

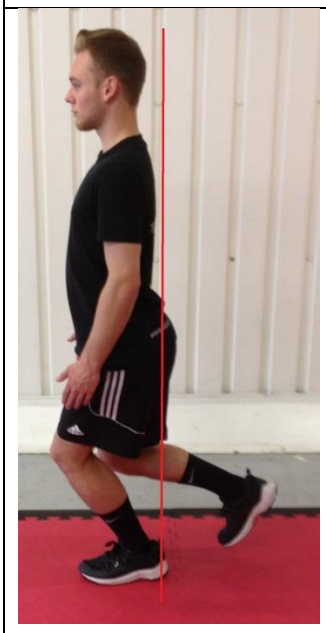
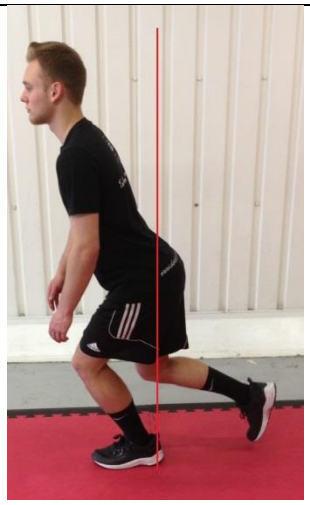
Importantly these tests can be mis-interpreted so this is not a 'right/wrong' outcome, merely further evidence to contribute to an overall analysis. Should any of the tests show a pain positive outcome the candidate should be referred for further testing to the medical team.

Single knee dip

This is a test of hip stability. Things to look for during the test that suggest hip instability include:

- A dropping of the hip
- Leaning over the planted foot
- The knee on the planted foot moving inwards
- The other knee being pulled outwards

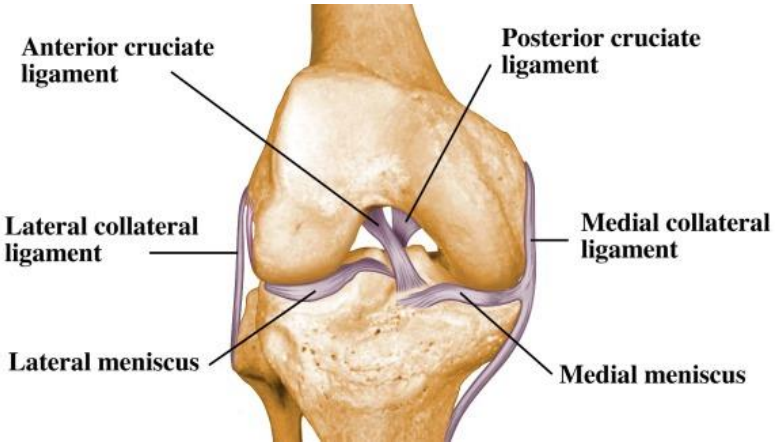
All of these would be considered a positive result

Fig 12: Single Knee dip			
			
Here Harrison is struggling to maintain an upright stance with a marked lower back curve	**This is how he 'normally' moved when asked to do the test. Note that the lower back arch is still present**	**From the front Harrison demonstartes has good hip stability but his core does collapse a little with the effort**	**Aaron, however has obvious instability as his knee crosses his midline when dipping. He does demonstrate excellent core stability however**

Knee integrity testing

The structures we can test for in the knees are the ligaments:

- ACL
- PCL
- LCL
- MCL



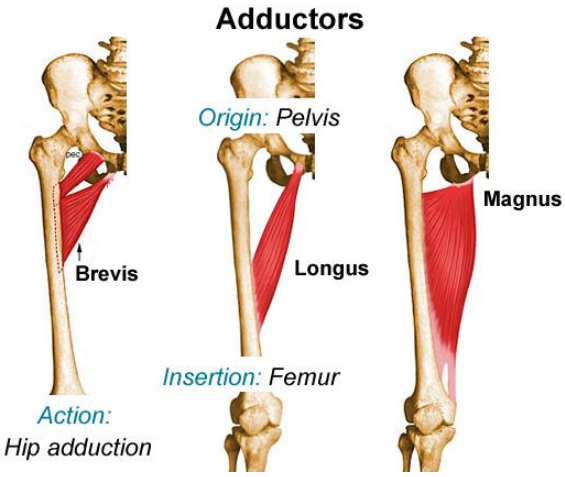
These ligaments provide most of the passive stability at the knee along with the meniscus which is two shallow cups of cartilidge which form the lower joint surface.

To test we need to apply force across the ligaments – NOT TO BE ATTEMPTED ON AN ATHLETE WHO TESTS POSITIVE FOR HYPERMOBILITY AT THE KNEES. Refer to a physiotherapist.

	**With both hands behind the knee bent at 90° with the thumbs on the 'eyes' of the knee.and the foot fixed by the leg gently pull the knee towards you. Any pain should immediately be referred to the physio.** **No noticeable movement or problems mean further vigour can be used to repeat the test whilst being careful not to increase the force.**
	**Here the lower leg is being puched into the joint.**

Fabere's test

This is a test of the tightness of the adductor (or groin) muscles although the shape of the pelvis, hip and hip joint can influence the result so positive outcomes should be checked.



There is also the adductor minimus (at the very top (above) and often blends with magnus, pectineus and gracilis.

The role of the adductors is to pull the knees together (adduct), assist with flexion of the thigh and they also tip the pelvis forward. They are also a very strong stabiliser of the legs, hips & knees in all actions. The size of the adductor is comparable to the individual quads and hamstrings so it can be seen that care of these muscles is as important.

Fabere's Test	
	
Above you can see Danny's knee is dropping level with a clear horizonal lower leg	**Here, Harrison has very tight adductors with the knee being held very high when relaxed.**

Thomas Test

This tests the relative tightness of the hip flexors and the quads and their relationship.

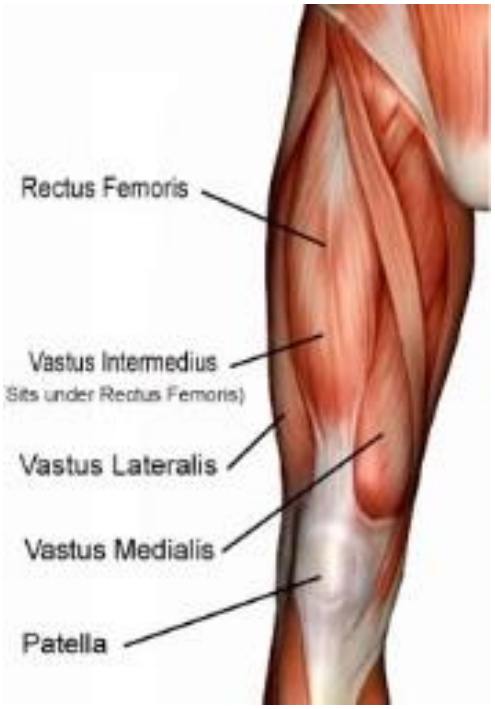
The hip flexors consist of the psoas muscle and the iliacus – together often called the iliopsoas.
They flex the leg at the hip.

There are two psoas muscles; major and minor but they are tested together.
The psoas is important as it attaches from the spine.
Tight psosas is a frequent cause of lower back pain.

The muscle is generally tight in people who spend time sitting i.e. drivers and office workers.

There are four quads:

- Rectus femoris
- Vastus medialis
- Vastus lateralis
- Vastus intermedius

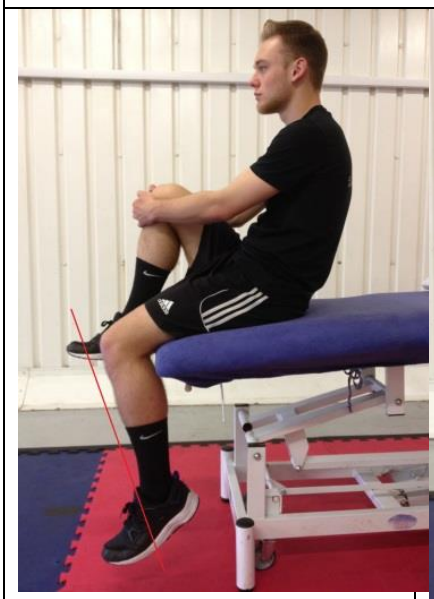


The vastus medialis can in some cases have a pronounced lower section with muscle fibres running in a different direction. This is known as the VMO, vastus medialis oblique. It is not always present, is easy to lose but is the same muscle.

All the quad musles act together to straighten the knee from bent and control the knee when bending.

Importantly the rectus femoris ALSO flexes the leg at the hip.

Thomas test

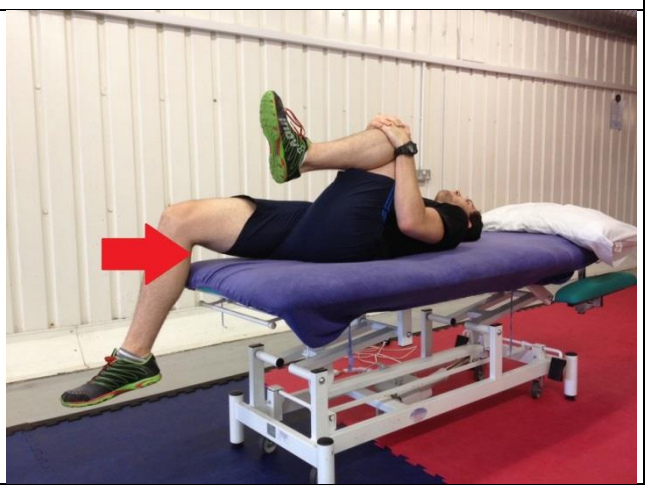


In the start position we can see that Harrison's knee is bent comfortably at 90°

As Harrison lies back his quad is pulled from the top and it forces his knee to extend – this would indicate a tighet rec fem (and probably the other quads).
Here there is no significant gap under his knee so his hip flexors are not likely to be tight.

In the example to the right we can see that during the intial part of the test the thigh lifts up whereas the knee remains bent at (a little above) 90° which suggests more of a psoas tightness
➔

However if we push Harrison's lower leg to bend his knee his knee lifts which confirms that it is a quad tightness issue.
🡐



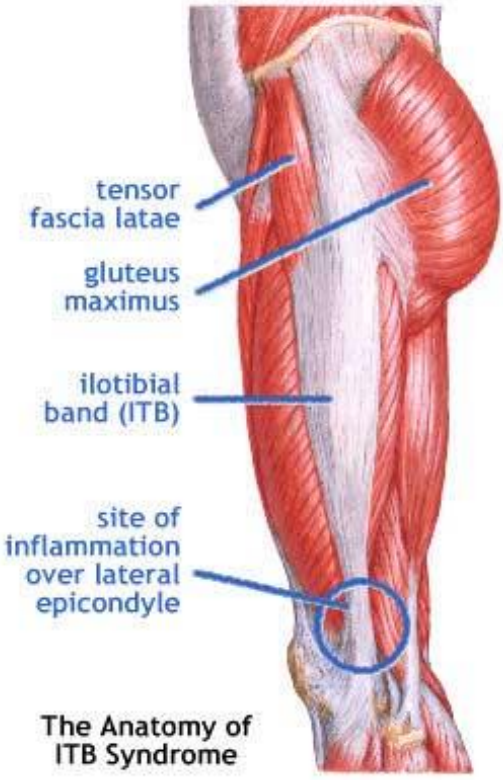
Ober's Test

The Ober's Test is a test of the lateral tension of the structure in the leg including the:

- Glutes (minimus, medius, maximus)
- TFL (Tensia Fascia Lata)
- ITB (Iliotibial Band)

A positive result for ITB syndrome is limited movement towards the midline and pain
A positive result should be checked by a physiotherapist as it can be influenced by hip and pelvis anatomy and spinal structures.

From a coaches perspective you are looking to assess for tight structures on the outside of the hip to inform changes to the training programme.



The Anatomy of ITB Syndrome

Ober's Test	
	
Danny's leg drops well below the table – a good outcome	**Harrison's leg remains adducted but no pain is felt – tight ITB/TFL**

Latissimus Dorsi Test

Latissimus dorsi tightness; this can be done in lying or against a wall. An increase in the arch of the back suggests tightness.

This is an easy way to test for tight lats but not as reliable

Here Steve can be easily seen as having tight lats as my hand and arm go a long way behind his back. This test is more reliable