THE ROLE OF THE MID-TORSO IN SPEED DEVELOPMENT

The mid-torso is made up of 4 major muscle groups:

1. Rectus Abdominus
   Origin  Base of sternum and bottom ribs
   Insertion  Pubis bone (as part of the pelvis)
   ACTION:  Vertebral Flexion

2. External Oblique
   Origin  Last 3 ribs
   Insertion  Linea alba, pubic crest.
   ACTION:  Vertebral Flexion
             Lateral Flexion
             Opposite side Rotation
             Increased intra-abdominal pressure
             Lumbosacral stabilization

3. Internal Oblique
   Origin  Iliac crest and inguinal ligament.
   Insertion  Linea alba, pubic crest and last 3 ribs.
   ACTION:  Vertebral Flexion
             Lateral Flexion
             Same side Rotation
             Increased intra-abdominal pressure
             Lumbosacral stabilization

4. Transverse Abdominus
   Origin  Inguinal ligament, cartilages of last 6 ribs, iliac crest.
   Insertion  Linea alba, pubic crest.
   ACTION:  Compresses abdominal contents
             Increases intra-abdominal pressure

THE FUNCTION OF THE MID-TORSO IN SPORT ACTIVITIES.

Most sports encompass relatively large movements of the trunk. Since the trunk segment has a large mass, great demands are exerted on the trunk musculature, particularly if the trunk movements are to be performed with high accelerations. Also the trunk has a critical role in the maintenance of stability and balance when performing movements with the extremities.

Sporting activities requiring running or jumping place pressure on the lumbo-pelvic region (that includes the 4th and 5th lumbar vertebra), the pelvis and the hips as this region becomes the hub of weight bearing. The superior forces (from torso, head and arms) meet the inferior forces transmitted from the ground through the lower extremity. No part of the body is more vulnerable to tissue strains and sprains. This point is the centre of all body movements and efficient movements (as required in sprinting) can only occur through the maintaining of an anatomically correct body position, (Which occurs through appropriate tension being produced by the Abdominal muscle groups, erector spinae (making up the mid-torso region) and the gluteus maximus. (Porterfield 1985)
A study by Comerford et al (1991) analysed the mid-torso muscle groups to see which group had the greatest impact on lumbo-pelvic stabilisation. Results indicated that Oblique muscle groups were the most important for this stabilisation (especially from pelvic rotation forces) as found in high speed sprint movements.

To assist in sprint acceleration, powerful arm drive will allow for a more rapid and powerful leg extension. The limitation with this technique is that large rotational forces can be placed upon the mid-torso musculature. If there is inadequate stability in this region, rotation of the pelvis will occur to counteract shoulder rotation resulting in poor technique and inefficient force application, therefore a slower athlete will be the result. At an elite level, upper body strength is emphasised in sprint athletes but with a concurrent development of the mid-torso strength to allow efficient usage of this additional strength during high-speed sprinting movements.

The naturally occurring wide pelvis of the mature female also leads to the above problem and mid-torso strength is absolutely vital if the coach wishes to maximise efficient technique at maximal speed in his/her female sprint athletes. Hip rotation is required to maximise stride length, but if excessive then poor technique will result and if combined with a poor pelvic tilt, then major inefficiencies will result leading to either poor performance, injuries or both.

Apart from resistance to rotational forces, there must be support of the pelvis to minimise excessive anterior pelvic tilt. An excessive anterior tilt indicates poorly toned mid-torso musculature and this can increase the lordotic curve (lower back arch) in the lumbar region. This can increase the strain on the facet joints in the vertebral column and can result in the Ilio-psoas going into spasm to protect the lower core from injury. Also increased pressure on the neural plexus from the lumbar region can result in nerve irritation (Eg. Sciatic nerve) which can then affect the optimal functioning of lower limb musculature that can have deleterious effects if maximal effort work (Eg. 100% sprinting) is performed (Such as Hamstring strains).

Excessive anterior tilt of the pelvis can limit hip range of motion leading to excessive hip extension and limited hip flexion. This technical position limits stride length and increases ground contact time (which is undesirable for increases in speed performance) due to the athlete’s centre of gravity being lower than required for maximal sprinting speed.

The demands of sprinting require the abdominals to function in away that leads to optimal torsional stabilisation during explosive contractile sequences matching the needs of performing up to 5 strides per seconds (such as that which occurs in an elite sprint race). During sprinting at this rate, the lower limb velocity can reach 80km/h, therefore the stresses placed upon the pelvic stabilisers are extreme and can only be accommodated for with extremely well developed abdominal (including oblique) musculature. (Francis 1992)

3. WAYS OF DEVELOPING THE MID-TORSO REGION.

The development of a strong mid-torso should be the goal of all speed/power athletes and the preferred procedures for maximising strength in this region is by the common situp. Kinesiologically the situp and its many variations are the ideal exercises to develop the vertebral flexor and rotational muscles (namely the rectus abdominus RA, external oblique EO and internal oblique IO).

The mid-torso musculature consists of postural muscles with a high percentage of slow twitch muscle fibres. Their function is to be able to hold contractions for long periods to maximise trunk stability. (Nordel and Frankel 1989, p104) To best condition this region, variations on the situp can be used. To maximise abdominal development and minimise stress placed upon the lower back, exercises should be performed slowly (1-4 seconds per repetition) whilst working on all muscle groups in the mid-torso region. These exercises should also be performed through a range of motion that minimises lower back strain, and maximal control is required. When compared to the stress placed upon the lumbar region when standing (assume this is measured as 100%), the full situp (even with knees bent and feet flat on the floor) creates a stress equal to 200%. This load can be decreased if the situp is only partial (first 30° from floor) and lessened even more if a reverse situp is performed (pelvis lifted off the floor). The reverse curl has been shown to increase the activation on the EO and IO as well as the RA. (Nordin & Frankel 1989, p202) A modification to maximise load and minimise stress upon the lumbar region is to perform a partial crunch as well as a reverse situp concurrently and hold each
maximal contraction for 4 seconds. This minimises the use of assistant muscle groups and quickly fatigues the musculature targeted in only 5-15 repetitions. Situps performed fast and or with the feet supported have;

1. The relative contribution of the hip flexors increasing while the relative contribution of the abdominal muscles decreasing. (Sevier 1969)

2. Increased stress placed upon the lumbar region of the spine.

3. Decreased load on the abdominal musculature due to increased momentum from the upper body.

The major limitation of the situp is the functional application of mid-torso strength transferable from a situp routine to the pelvic stabilisation required under the stresses of a sprint or any high speed movement performance. Personal observation of a variety of athletes has highlighted that even the development of very strong mid-torso regions from situps and squat type activities do not automatically transfer to the pelvic and mid-torso positions required to maximise sprinting performance. Many athletes are strong enough through their mid-torso region but have not developed correct motor patterns to be able to stabilise the body whilst having rapid upper and lower limb movements. (Eg. arm and leg movements in sprinting). To develop the specific strength qualities or transfer mid-torso strength to the required strength positions can be achieved both in a weight room and on the field/court/track situation.

**4. WEIGHT ROOM MID-TORSO TRAINING.**

The best adaptation in the mid-torso musculature results from slow isotonic training in combination with isometric training in a range of non-specific and sprinting specific body positions.

Once the athlete can perform acceptable slow isotonic (with movement) mid-torso exercises, more sprint specific positioning can be introduced that requires the athlete to place their hips in the correct pelvic position (posterior pelvic tilt) and have them perform rapid limb movements whilst minimising pelvic movement.

Some of the abdominal exercises that have been useful in development of a stable mid-torso are as follows:

**1. Abdominal hollowing**

To perform abdominal hollowing the athlete can be either in a supine position or standing. The technique is to contract the abdominals "INWARDS" as hard as possible whilst maintaining normal rib cage positioning. This can be assisted by placing a finger into the belly button and try to push the abdominal wall inwards whilst maximally contracting. The athlete should continue to breath as normally as possible throughout the exercise, each contraction can be held for up to 60 seconds.

**2. Isometric prone**

To perform an Isometric Prone exercise the athlete begins on elbows and knees and then takes the knees off the ground whilst trying to maximally contract the abdominal musculature upwards. If any stress is felt on the lower back, this is an indication that the abdominal wall is not being totally contracted allowing the psoas musculature to help in the stability process (which in turn places great stress upon the lower back as the psoas attaches from the 12^{th} Thoracic vertebra to the 5^{th} Lumbar vertebra.

**3. Single leg raise with lumbar support**

To perform a single leg raise with lumbar support, the athlete places his/ her tips of their fingers under the lower back and maximally contracts the back against the fingers. Then one leg at a time is
slowly lowered (up to 10 seconds per leg) whilst maintaining a constant pressure on the fingers. As soon as the pressure decreases, this indicates that the abdominal musculature is beginning to fail and the hip flexors have been activated. At this point if the pressure can not be regained, the athlete either finishes that repetition or brings the leg slowly back to the starting position until lower back pressure can be regained and then continues the repetition.

These are still "PASSIVE" isometric exercises (done slowly) that once a high competency is reached can be followed by "ACTIVE" isometric exercises that are highly sprint specific. Examples of these exercises are;

1. Rapid hip Extension/ hip Flexion

The athlete places themselves in a correct sprint position and with either a cable, theraband or specific flexion/extension machine (eg Keiser air pressured), they can perform repeated flexion/extension movements at speed with resistance whilst attempting to maintain a correct pelvic position.

2. Modified Russian Twist with/ without arm swing

The athlete lays supine on a back extension machine and leans back until they attain the correct body position. From here they can then perform dynamic arm actions whilst again trying to hold their pelvis stable.

ON TRACK/FIELD/COURT MID-TORSO TRAINING.

The weight room training is purely a precursor to what must be achieved in the "on field" situation. This is where true application of the strength gain can be both assessed and true transfer can be completed.

This goal can be achieved in 2 ways;

1. The correct body positioning can be further applied by several "running drills" that are aimed at correct running form (which usually means correct body posture through the mid-torso). The "A", modified single leg "A", "B", Heel flick and High knee drills are all aimed at increasing the tilting and rotational stresses that are placed upon the mid-torso musculature. These drills can be done slowly at first and progressively sped up as the athlete's ability to hold the correct position improves. The modified single leg ‘A’ places high levels of stress upon the mid-torso region to hold the pelvis in place whilst the athletes perform very explosive hip flexion and extension movements in a single leg form.

   The most specific transfer to sprinting is to have the athlete sprint whilst concentrating on the positioning drilled previously. Sprints should be less than maximal at first progressing only as the athlete is able to maintain the correct running position. As soon as pelvic stability decreases, the drill should be stopped.

   External resistance to increase learning can be in the form of a towing device that the athletes place around their mid-torso and the pressure on this region through each repetition reinforces the control required and increases the level of control as the athlete is having to work harder to maintain good body position under this increased resistance.

   In summary, the mid-torso is the link between the upper and lower body and must allow the transfer of strength movements and allow powerful movements of both the upper and lower body to complement each other. The way to achieve this is to develop torso strength through traditional (situps) but ensure functional strength (by more specific mid-torso training methods) is being attained throughout the athlete's training year.

REFERENCES


Sevier, B.A. 1969. Comparative electromyographic analysis of three abdominal muscle (rectus abdominis, internal oblique and external oblique), while running an performing sit-ups. University of 0 Eugene, Ore, 1971,3 fishes.