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PREVENTION & REHABILITATION: SCREENING

Assessing and correcting the middle crossed syndrome

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In the accompanying editorial a novel description of what might be termed the "middle crossed syndrome" is described — akin to Janda's (1979) nomenclature for the muscle imbalance syndromes that he had observed. Janda's descriptions essentially described imbalance in the sagittal plane, while the middle crossed syndrome descriptor refers to imbalance in the transverse plane musculature.

In this practical paper, three screening tests are described that may help to identify this imbalance, and suggestions are made to help with corrective measures.

Gait analysis

Assessing gait can be challenging and often is focused closely on the foot. However, assessment of the trunk in gait can inform the bodyworker and movement therapist of how loads are transferred through the entire kinetic chain — both in an ascending and in a descending fashion.

Since the legs act to amplify motion at the trunk on the swing side, and to transfer ground reaction forces into the trunk on the stance side (Gracovetsky, 1988), any asymmetrical deviation of the umbilicus from central is an indication of imbalance, inefficiency and potential therefore for decreased performance and increased injury risk.

Most commonly it is observed that when standing on the "dominant" leg (ie the kicking leg) the umbilicus will deviate to the left. In other words, the trunk goes into a relative left axial rotation in the transverse plane.

When this is observed, it is of course important to consider all aspects of the kinetic chain that could produce this finding. To combine this assessment with additional screens of the sling systems is therefore prudent, and if a pattern of findings is observed, then the requirement to address the finding increases proportionally.

Two additional tests are described below:

Supine lateral ball roll

The supine lateral ball roll can be used as a simple clinical screening for multi-planar motor control (Figure 1).

Laying supine with his or her back on the Swiss ball, and feet on the ground, the client moves off to one side, keeping the arms parallel to the ground at all times — like the wings of a plane. As the patient moves leftward to the

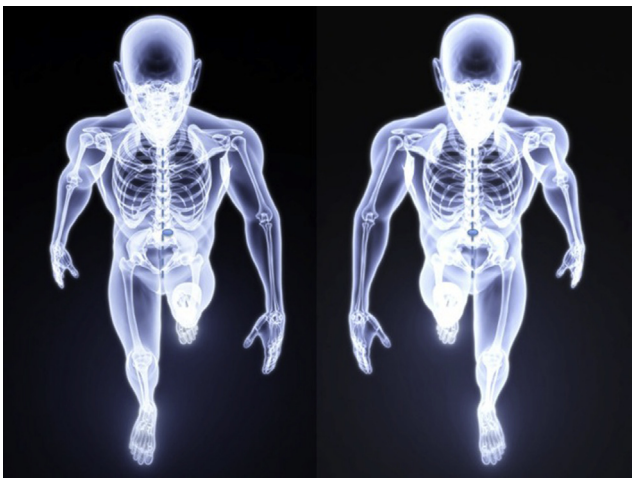

Figure 1 Walking gait. When loading the right leg, a weak or inhibited anterior oblique sling from the right hip to the left shoulder may result in umbilical deviation to the patient's left side.

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Box 1

The traditional model of gait analysis has been to view the human body as a skyscraper whose foundations may be flawed. Hence the solution has been to look at ways to "relay the foundations" through use of orthotic devices. However, this is a very passive model of human function and doesn't take into account the neural and active components of gait mechanics. When such components are considered, it becomes clear that a foot which over-pronates, or under-pronates is not due to an orthotics deficiency (something missing from the foot), but is due to a lack of control through the structures of the foot. The orthotics paradigm arose before the motor control paradigm; and now the concept of motor control is finally making its way down from the trunk to the foot. In addition, it becomes clear when looking at the musculature of the foot that it is poorly suited to controlling the significant loading associated with activities such as running gait, jumping or turning; these activities load the foot with multiples of bodyweight (hundreds of kilograms) so tiny muscles such as lumbricales, interossei, or the flexor hallucis brevis muscles, each with little more flesh than a chicken wing, are hardly likely to be able to control such loads on their own.
And this is why in the design of animal limbs the bulk of muscle mass is always found at the hip, with slightly less in the thigh, less again in the lower leg, and only marginal muscle mass at the foot. This arrangement allows both for larger muscles situated closer to the great mass of the trunk to be engaged, controlling the descent from the swing or flight phase of gait; and also means that, as a lever designed to amplify movement of the trunk, the greater mass of the legs is located proximally, and less distally.

side of the ball, the loading moves toward the left leg and the right shoulder supporting the bodyweight through the ball. This motion therefore loads the posterior oblique sling from left hip to right shoulder; but also the opposing anterior oblique sling from right hip to left shoulder; as gravity attempts to drop the unsupported left shoulder, and less-loaded right hip, backward toward the ground (See Figure 2). This often results in the umbilicus moving to the right (relative to the sternum) (Figure 3, Figure 4).

Interpretation of this finding is that either the left shoulder to right hip anterior oblique sling is weak, inhibited or deconditioned, or the left shoulder right hip posterior oblique sling (gluteus maximus) is weak, inhibited or deconditioned. This can be further evaluated by utilizing the tests described below.

Active straight leg raise (ASLR)

The ASLR was devised and popularized by Diane Lee (1998) to assess for stabilization of the sacroiliac joints. In distinction from the traditional straight leg raise which is a passive test (the practitioner lifting the patient's leg), the ASLR requires the patient to lift the leg and to pay attention to any symptoms that arise, as well as the effort required to lift the leg. The practitioner observes for technique and for range of motion achieved. In the conventional test, the practitioner then mimics the role of several different stability mechanisms while the practitioner and patient pay attention to differences in range of motion, pain, effort to see if any of the interventions alter any of these factors. Frequently it is observed that one or more of these factors changes as a result of the practitioner mimicking one of the stability mechanisms with their hands (Mens et al., 1999). This is indicative of decreased activation of that muscle group and a rehabilitation program is designed based on the outcome.

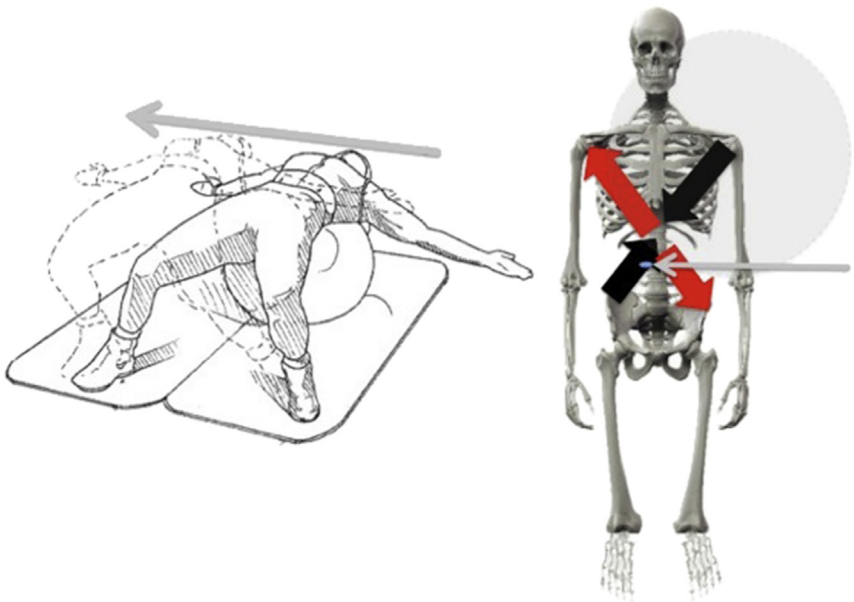

Figure 2 Supine lateral ball roll. As the patient moved out to the right side on the Swiss ball, the right shoulder becomes unsupported and the anterior oblique sling from right shoulder to left hip becomes loaded. If this sling is weak or inhibited (or if the posterior oblique sling from right shoulder to left hip is weak or inhibited) the umbilicus may deviate to the patient's right side (left image© Paul Chek).

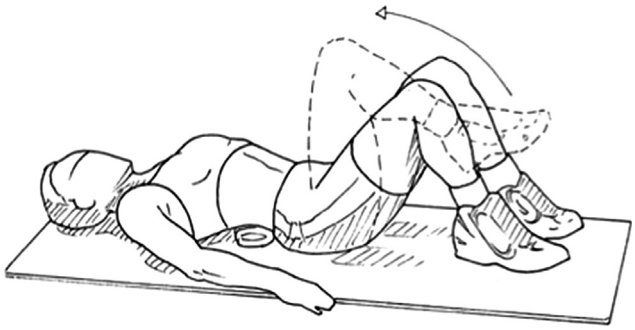

Figure 3 Lower abdominal exercise. If the active straight leg raise identifies a weak or inhibited anterior oblique sling, one way to turn the test into a corrective exercise would be to bend the knees. (image© Paul Chek).

One of those aspects that can be reinforced is the anterior oblique sling — by placing a cupped hand over the coracoid process of, say, the left shoulder, and asking the patient to push their shoulder "up towards the ceiling" to activate their pectoralis minor and anterior oblique sling. Once they have created upward pressure with the shoulder, the patient is asked to lift the contralateral leg — in this example, the right leg, keeping it straight. This is compared to lifting the leg without the hand pressure, and can be repeated several times to allow the patient time to sense which is easier, if it isn't immediately obvious. Someone with a classic middle-crossed syndrome pattern for a right-hander would exhibit no change in strength or effort required when lifting the left leg, but may notice a discernible difference when lifting his or her right leg.

An addition to this test, based on consideration of the middle crossed syndrome, would have the practitioner standing at the head end of the patient, or at the foot end, in order to observe how the umbilicus moves in relation to the leg being lifted. Commonly, for a right-handed, right footed individual, when the left leg is lifted the umbilicus will stay central; but when the right leg is lifted the umbilicus will deviate toward the right. The total movement of the umbilicus is usually between a few millimetres and up to about 2 cm on the weak, inhibited side, and is absent on the strong side.

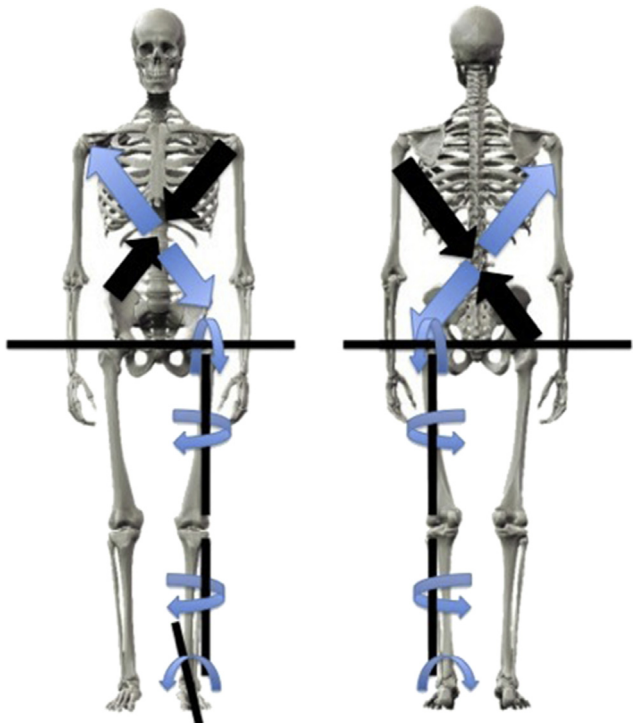

Figure 4 Middle crossed syndrome & lower limb mechanics. The identification of a middle crossed syndrome on one side (in this instance from right shoulder to left hip), is commonly associated with a descending pattern of pronation (medial rotation & adduction at the hip & knee, and pronation at the foot).

"Cheat" mechanisms

It is possible that those with greater levels of kinesthetic intelligence can "cheat" the test through finding compensatory strategies. The most obvious strategy to compensate for a weak or inhibited anterior oblique sling is to activate the posterior oblique sling on the contralateral side by pushing the opposite leg into the ground.

For example, lifting up the right leg results in a requirement to stabilize against this motion. The leverage on the pelvis will attempt to pull it into an anterior tilt and a right axial rotation in the transverse plane. Hence the anterior oblique sling from left shoulder to right hip operates to resist both of these motions. If it doesn't function well, the rectus abdominis may be able to compensate to resist anterior pelvic tilt, and the posterior oblique sling from right shoulder to left hip can also help to resist anterior pelvic tilt (via the right gluteus maximus), but is also well placed to resist right axial rotation of the pelvis. In addition, the foot can press down against the bed making the right shoulder/left hip posterior oblique sling ideally placed to compensate.

A way to assess for this would be to stand at the foot end of the bed and place your hand under the heel. Any additional pressure under the heel as the patient lifts the opposite leg is indicative of use of the posterior oblique sling. While some slight increase in pressure is expected, compare from side to side paying attention to any umbilical deviation as the patient switches from left to right straight leg-raise.

Application

Based on the outcome of these tests it is possible to look for patterns (sometimes the patterns will be mixed with apparent weakness/inhibition through different slings under different movement patterns) and then to create corrective strategies based on the findings.

Often the best corrective strategy is to teach the patient what they are doing incompetently, and how to "pass the test". So, for example, if the right hip or left shoulder drops during movement to the left side on the supine lateral ball roll, the patient can be taught to keep shoulder and hip in

alignment with the rest of the trunk. Sometimes this can be enough to make an effective corrective intervention.

Sometimes, the exercise will need to be made less challenging. For example, if the umbilicus deviates to the right when the patient picks up the right leg in an ASLR, it may be that by, first, raising awareness and, second, decreasing the leverage by flexing the knee, control would be regained of the umbilicus. By performing repetitions of this movement pattern, at a tempo slow enough to create a postural training effect, and biasing the exercise to the weaker side, correction of an imbalance in sling strength or activity could be rapidly corrected. For example, doing a right-right-left format (lifting the right leg twice then, the left leg once, to count as "1 repetition") and then repeating this for, say 10—12 repetitions, can be an effective corrective measure. An important awareness with these kinds of imbalanced programs is that, with a diligent patient, the imbalance can be corrected — and even reversed, creating the opposite imbalance within weeks of giving the exercise; hence regular reassessment is key.

There are many other ways to stimulate activation, strength and conditioning of the sling systems of the body; some more isolated, some more integrated, some more phasic, others more postural. The key is to assess each of them, and to provide effective and relevant interventions based on those findings — and also to regularly reassess after corrective intervention has been applied.

Discussion

These tests can be useful both in treatment of pathologies, but also may be predictive of them. For example, clinical screening may often reveal a middle crossed syndrome, with the weaker slings coming from the left hip to the right hip. The upshot of this tends to be a right leg that rolls inward when loaded. This may be explained partly from the middle crossed syndrome, where the anterior oblique sling and the posterior oblique sling from left shoulder to right hip are weak or inhibited, thereby allowing the innominate on that side to tilt more anterior when loaded. If the pelvis tilts anteriorly (and the gluteus maximus is relatively weak/inhibited) this will encourage more of a medial rotation through the femur, causing adduction and medial rotation at the knee, which stresses the menisci and medial collateral ligament (MCL) in particular.

An impressive but simple palpatory test is to assess the patient as described above, to identify the middle crossed imbalance at the umbilicus, and then to go straight to the MCL of the knee and compare palpation of left and right legs. Almost invariably, the leg associated with the weaker sling (usually the left shoulder to right hip sling in right-dominant individuals) will have a significantly more tender right MCL. In left dominant individuals, with the usual middle-crossed pattern, the left MCL will be overtly more painful to palpate — even when it is otherwise asymptomatic (Fig. 5).

This is a good example for the patient (and practitioner) to become aware that, although symptoms are not yet manifest, the knee and its stabilizing structures are under cumulative stress, which will be compromising tensile strength (see Fig. 2 in the accompanying editorial).

In this way, it is important to realize that injury figures for, say, MCL tears in a given sport are really only the tip of the iceberg, and that a larger prevention program would be prudent. Put another way, an important stabilizing structure (the MCL in this example) can be asymptomatic; yet it is becoming progressively weaker over time, due to the effect of cumulative microtrauma. Since the microtrauma is "micro" it is often not overtly painful until either it is palpated, as in the example just given, or it finally tears. For some key stabilizing structures, such as menisci

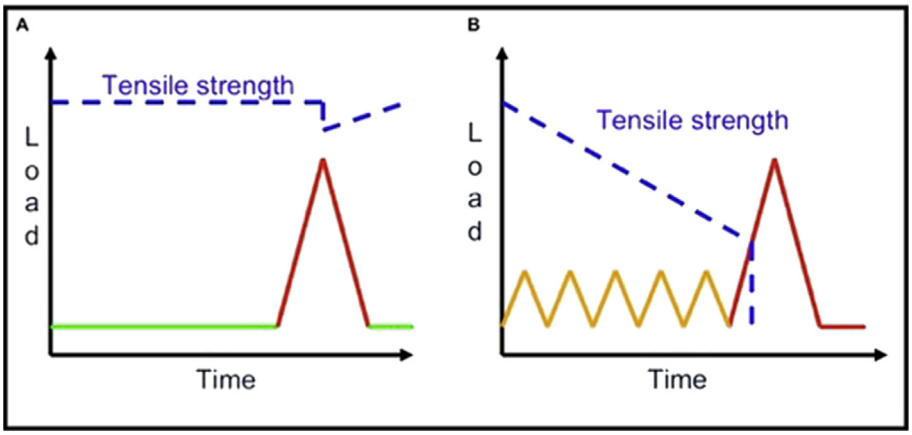

Figure 5 Cumulative microtrauma and tensile strength. Graph A) represents the normal level of loading (solid line) over time. The dashed line represents the tensile strength of a given tissue, for example the medial collateral ligament (MCL). Graph B) represents what happens when there is repetitive aberrant loading (such as medial rotational instability creating an adduction moment at the knee). Across time, this cumulative microtrauma compromises the tensile strength of the tissue under stress (in this example, the MCL). If then at a certain point in time there is a lateral blow to the knee — for example, a football tackle, then the knee in Graph A may suffer some short-term soreness, but the tensile strength of its MCL exceeds the impact load. However, the MCL in Graph B has lost tensile strength across time, so the same lateral blow, with exactly the same loading profile rupture the MCL in this instance.

or the cruciate ligaments, palpation is not possible. Hence our best chance for prevention is to identify faulty movement patterns in advance of more catastrophic effects.

Seeking out patterns of imbalance, such as layered, upper-crossed, lower-crossed or middle-crossed syndrome may prove one of this profession's most effective tools in minimizing injury risk, optimizing function and to realizing potential. To do this, to realize our full expression of potential as a human being, after all, is surely one way to answer the age-old question of what life is all about.

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