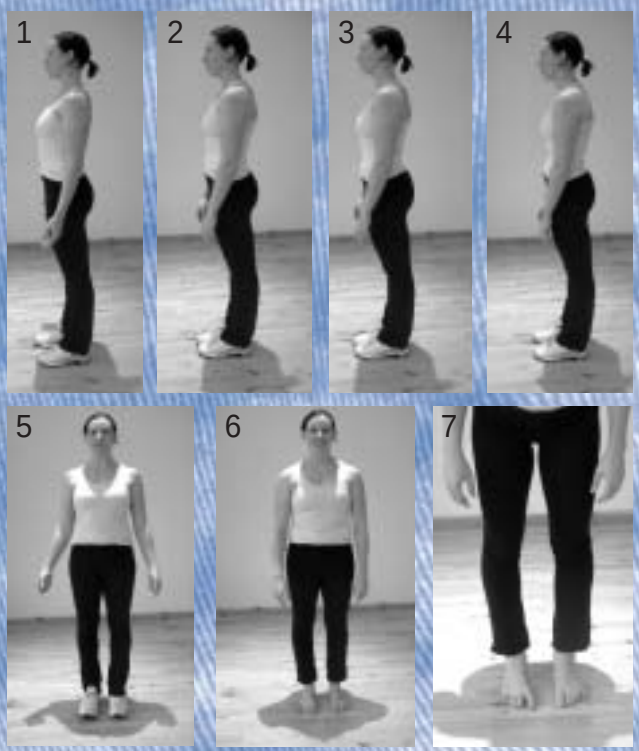
The kinetic chain assessment provides a structural and functional assessment of your client prior to designing their exercise plan, moving one step closer to 'personal' training

kinetic chain assessment

report: Dax Moy



The aim of the Kinetic Chain Assessment (KCA) is to gather baseline data on your client's orthopaedic and neuromuscular status in order for you to develop a corrective exercise strategy prior to progressing through the performance continuum.

The KCA involves a series of both static and dynamic functional profiles including:

- Static Postural Assessments
- Fundamental Movement Assessments
- Lower Extremity Functional Profile
- Range of Motion Assessment
- TVA Strength Assessment
- TVA Activation Assessment
- Lumbo-Pelvic Rhythm Assessment
- Scapulo-Humeral Rhythm Assessment
- Extensor Chain Firing Order Assessment
- Rotational Movement Assessment
- Spinal Extension Assessment

It should be noted that most of the above assessments are not single tests, rather investigations that usually require further confirmatory testing.

Here is a brief overview of some of the assessments that can be performed:

1. static postural assessment

Assessment of static posture forms the start point for any KCA as it is our most easily utilised assessment tool. Performed against a standard plumbline (representing the line of gravity), the client is assessed visually in frontal and saggital planes for evident misalignment from standard or ideal posture.

Although there is much debate about what constitutes this ideal reference (due to what are perceived as individual differences), most experts agree that ideal posture is characterised by the alignment of body segments so that torques and stresses are minimised and minimum energy is expended[1-5].

When viewed from the side using the lateral malleolus (outside of ankle) as the reference, the plumbline should pass through:

- Slightly anterior to centre of the knee
- Greater trochanter of the hip
- Level with the glenohumeral joint (shoulder)
- Through the central mass of the neck
- Through the earlobe

In addition the ASIS and pubic bone should be in vertical alignment [1, 3, 4, 5] indicating neutral lumbo-pelvic alignment.

Unfortunately, deviations from this ideal posture exist in myriad forms and the common classifications are not always as clear-cut as their authors may suggest. However, a useful starting point in understanding postural analysis may include examination of the work of Vladimir Janda, the Czech who came up with the concept of upper and lower cross syndromes based upon predictable patterns of distortion resulting from both facilitated and inhibited musculature[6].

With the upper cross syndrome (UCS), clients present as follows:

This is perhaps the most commonly seen of the postural distortion patterns that you will come across, due to the chronic forward head postures adopted by most office workers at PCs and drivers at the wheel. It is nearly always seen along with its 'sidekick', Lower Cross Syndrome[4].

Studies by the chiropractic community have found that there is a direct relationship between the position of the C3 vertebra and that of the L3 vertebra. In other words, any forward migration of the head and cervical vertebrae will usually be followed by a commensurate anterior migration (rotation) of the lumbar spine and pelvis creating:

Lower Cross Syndrome (LCS)

Tight or Facilitated	Weak or Inhibited
Rectus femoris	Rectus Abdominis
Iliopsoas	Obliques
Erector spinae	Gluteus Maximus
Quadratus lumborum	Gluteus Medius
Tensor fascia latae	Hamstrings
Adductors	
Resulting In	**Common Injuries**
Anterior rotation of pelvis	Low Back Pain
Increased lumbar lordosis	Knee Pain
Hips in flexion	Hamstring strains
Knees may be hyperextended	

Adapted From NASM

Tight or Facilitated	Weak or Inhibited	Resulting In	Common Injuries
Pectorals	Longus Capitis and Colli	Forward head posture	Headaches
Internal rotation of Humerus	Hyoid Musculature	Depressed manubrium of sternum	Rotator cuff impingement
upper trapezius	Serratus Anterior	Anterior migration of shoulder girdle	Thoracic outlet syndrome
Levator Scapulae	Rhomboids	Increased Thoracic Kyphosis	Shoulder instability
Sternocleidomastoid	Lower and Middle Trapezius	Internal rotation of Humerus	
Anterior Scalenes	Posterior rotator cuff		
Suboccipitals			
Teres major			
Anterior deltoid			
Latissimus Dorsi			

Adapted From NASM

Already we have a clear example of the amazing compensatory ability of the kinetic chain to relocate stress but it doesn't stop there! The stress created by the anterior tilt of the pelvis needs to be relocated too. So where does it go? To the legs of course! This can be seen clearly in individuals who exhibit 'knock knees' and 'flat feet' or pronation syndrome:

Tight or Facilitated	Weak or Inhibited
Iliopsoas Adductors Hamstrings Iliotibial band Gastroc-soleus Peroneals	Gluteus maximus Gluteus minimus Vastus medialis Anterior tibialis Posterior tibialis
Resulting In	**Common Injuries**
Increased pronation of feet Internal rotation and/or adduction during functional movements Heel raises from ground	Low back pain Knee pain Plantar fasciitis 'Shin splints'

Adapted From NASM

It is amazing that all of this information can be gleaned from simply taking the time to stop and look at our clients before prescribing exercises, yet how many of us actually do this? It's not too difficult, takes about 90 seconds and gives you a solid base upon which to start your investigations.

Bear in mind however, that a single look at a person at rest will only ever give you part of the picture. In order to understand how postural dysfunction may be affecting someone, we need to get them to move.

fundamental movement assessment

The fundamental movement assessment (FMA) is used to assess how a person's apparent postural distortions affect their ability to move. It examines the kinetic chain for its ability to co-ordinate muscle synergies and produce integrated patterns of movement.

Although not widely used (there is still much dispute as to the accuracy of information gained) the FMA gives movement practitioners a lot of useful information about groups of muscles that may be short or facilitated and those that may be lengthened or weak. This information can then be used to perform muscle- and/or joint-specific tests in order to find corroboration.

The most commonly used movement for the FMA is the squat. Other movements such as the overhead squat lunge, deadlift and gait (walking, running) can also be used and work just as well[7]. The common theme here is that all of these movements are multi-joint and involve all three aspects of the performance paradigm, eccentric deceleration, stabilisation and concentric acceleration[8,9]. To carry out the FMA, simply observe your client during any of the above functional movements and compare their joint movements to the table below:

Abnormal Movement	Tight / Facilitated Muscles	Weak / Inhibited Muscles
Feet flatten	Lateral gastroc / nemius peroneals	Gluteus medius, anterior tibialis posterior tibialis
Feet externally rotate	Soleus, biceps femoris, piriformis	Gluteus medius
Knees adduct	Adductors, iliotibial band	Gluteus medius, gluteus maximus
Knees abduct	Biceps femoris, iliopsoas, piriformis	Glueus maximus, gluteus medius
Increased lordosis	Iliopsoas, rectus femoris, erector spinae, latissimus dorsi	Gluteus maximus, gluteus medius, inner unit musculature
Decreased lordosis	External obliques, rectus abdominis	linner unit
Abdominal protrusion	Iliopsoas	Inner unit

Adapted From NASM

If abnormal movement patterns are detected, such as knee adduction, you can then perform tests to the specific muscles indicated in the chart. If no abnormal movements are found, continue the activity until they

	*The figure on the left shows correct lumbo-pelvic rhythm. As the subject approaches 45 degreees flexion, the pelvis roatates anteriorly and will shortly be followed by spinal flexion.*	*No specific precautions are necessary in this case.*
	*This figure shows incorrect lumbo-pelvic rhythm. The spine is flexing independent of pelvic rotation, indicating a relative tightness of the hamstrings and gluteals in relation to the over-flexible lumbar spine.*	*This subject should be encouraged to maintain a lordosis during exercises that involve spinaol flexion. This will strengthen the lumbar musculature and stretch the hamstrings and glutes.*
	*This figure show incorrect lumbo-pelvic rhythm. The pelvis is rotating prematurely indicating a relative tightness of the lower back in relation to the over-flexible hamstrings.*	*This subject should be encouraged to stretch the lumbar spine prior to lifting exercises that involve forward flexion. A progressive programme of hamstring and glute stength would also be of benefit.*

become apparent (they always do!). This will help you to identify the 'weak link' in a movement chain.

Despite its lack of scientific validation at this point, use of the FMA serves as a pretty good indicator of dysfunctional movements and their causes, although quite a lot of training and practice are necessary in order to make it an accurate assessment.

lumbo-pelvic rhythm assessment

Individuals presenting dysfunctional static posture and chronic pain syndromes frequently exhibit disruption of normal flexion and extension during saggital plane movements. These disruptions create hyper- and hypo-mobile segments disproportionately and often lead to further problems through the cumulative injury cycle[3,10].

During movement at the lumbar, pelvic and hip regions, the ability to disassociate one body segment from that of its neighbour requires both stabiliser strength and mobiliser length. These attributes in their correct proportion allow for a greater range of motion than is capable of the individual component parts[5]. For example, during a toe-touching exercise with straight legs, movement of the pelvis is limited to around 90 degrees, with further range of motion capable only through lumbar flexion. This relationship is known as lumbo-pelvic rhythm (LPR)[11].

Using the above toe-touching exercise as an example, we should see little or no movement at the pelvis until the subject reaches a position at or near 45 degrees. At this point there is a progressive contribution through anterior pelvic rotation and finally spinal flexion allowing the movement to be completed[4].

This assessment is easily performed by simply observing your clients' pelvic movement during forward bending. Alternatively, palpation of ASIS and PSIS may be performed during the movement to better assess the action.

summary

These three tools form an integral part of the kinetic chain assessment. With training and practice they are easy to perform and yield so much useful information that you'll be able to 'fast track' the improvements that your client receives from their exercise programme.

You may think these are more like physiotherapy assessments than fitness assessments and you wouldn't be too far off the mark. The skills being utilised here are all known and used within the fields of physiotherapy, chiropractic and osteopathic treatment and continue to be the cornerstones of structural assessment.

I am not suggesting that fitness professionals attempt to take on the roles of these healthcare practitioners, but by emulating them in areas of non-invasive, low risk structural assessments we all benefit. After all, our job involves applying load to structure (our clients) in order to improve function. If structure determines function, then surely learning to assess structure is the first step to improving function.

In part three of this series we will feature extensor chain firing order test, TVA strength assessment and range of motion assessment. fp

Dax Moy is a Corrective & Performance Exercise Specialist and Master Personal Trainer working in London. He is currently running courses on Kinetic Chain Assessment and Corrective Exercise Prescription. For further information log on to www.daxmoy-pts.co.uk or call 020 7354 3550.

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Technical Editor's Note: Dax Moy observes that the assessment principles and practices outlined here are typical tools of the qualified professional in the fields of physiotherapy, osteopathy and chiropractic. Fitness professionals would be well advised to ensure that their training, skills, expertise and competence with respect to performing such assessments match or exceed those of the aforementioned healthcare clinicians.