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Optimal Performance

Greater Peterborough Athletics Network

Coach Development Biomechanics Workshop

23rd October 2013

Introduction

As a child, my main love was athletics, and striving to be the best heptathlete I possibly could. Sadly, in my late Teens, my body became broken, and thus so was my heart! Since then, I have strived instead to do what I can as a Physiotherapist to help athletes get the best out of themselves and hopefully stave off those broken bodies for as long as physically and mentally possible.

I have developed my work, thoughts and practice through many means; personal development, courses, reading, observation and listening to athletes. I hope that I have managed to summarise some of my current beliefs for you today in a way that will help you or your athletes in the future.

Please see the references at the end of this hand-out if you wish to delve deeper into the work of some of my gurus!

Aim

The aim of this workshop therefore is to enhance your knowledge on how I believe you can help to:

- Prevent injury
- Manage an existing injury
- Optimise athletic performance

I believe that biomechanically, the answers to the above are in fact all the same. If everything in the body was where it should be, doing what it should do, when it should do it, then no abnormal intrinsic stresses would be put on the body, and any extrinsic ones would be better controlled, thus preventing injury. The body would naturally heal any existing pathology if no further stresses were causing a further inflammatory response, and the body would ultimately be able to "move beautifully" (J.Elphinston) in whatever task was demanded of it...Simple!

Mechanics of the body

The human body is made up of many systems but today's presentation is concerned with the:

- Passive system; the alignment of bones and mobility of joints

- Active system; the length and dynamic control of muscles and extensibility of surrounding fascia

- Neural system; the length or mobility of nerves

Athletic Needs

So, what does the body need to achieve optimal performance?

- Functional mobility
  - Joints
  - Muscles
  - Nerves

- Dynamic control
  - Through full functional range
  - Ability to dissociate segments with control

- Muscle activation
  - Correct firing patterns, timing and sequencing

- Proprioception and balance
  - Feedback about the environment to the brain

To get the best out of your athlete, their pelvis needs to be moving correctly and their spine and peripheral joints must be mobile enough for their event.

Muscles must not to be in protective spasm, but be sufficiently flexible for the task in hand and able to contract at the right intensity and in the right order.

Likewise, nerves need to be the correct length and mobility for the athlete's event and must be able to send messages to and from the brain to joints and muscles concerning where the body is in space, which muscles have to contract, when, in what order and how much.

Stabilising muscles must be firing automatically at the lowest threshold necessary to control the body dynamically throughout the required movement.

If the tracking is out on your car, then the tyres will wear abnormally. The same principle applies to your body.

If any of these things are missing or faulty, then the body will tend to try and restore the balance by any available means, and thus dysfunctions begin.

Joanne Elphinston believes that frequently we have subconsciously put up barriers or blocks that need unlocking to enable movement efficacy, and aren't necessarily fundamentally lacking in these skills or abilities.

Doug Heel's work follows similar principles, believing that physically or psychologically traumatic events can "switch off" muscles, or alter muscle firing patterns and his Activation Techniques work to address this.

Normal Movement

Passive System

When we lift our left knee up to walk or run, our pelvis (ilium) on the same side rotates backwards and up, the pelvis on the opposite (right) side rotates forwards and down, (M.Haines, Intelligent Training Systems™ 2009).

At the same time the pelvis rotates clockwise around a vertical axis (the spine) so the thoracic spine should counteract this by rotating anti-clockwise (right arm forwards), (J. Elphinston, Elphinston Performance Ltd).

Gait

As our foot strikes the ground, our foot arch flattens (pronates) to absorb force, before lifting (supinating) to toe off.

Our big toe must extend sufficiently to propel the body forwards and evenly over the foot to enable our glutes to fire and our hip to extend before we take our next step.

Active System

Smaller stabilising muscles in the body work to control joints when the body is both still and moving.

It is vital that these muscles are trained to fire through full joint range, not simply when the joint (e.g. spine, hip or shoulder) is fixed in neutral.

Larger global muscles contract to move parts of the body whilst these stabilisers maintain control, thus enabling efficient, fluid movement.

The fascial system, including tendons and ligaments, connects the muscles throughout the body, transferring forces and tension as necessary.

Neural System

The neural system is continuous throughout the whole body. The spinal cord extends down from the brain with nerves passing out of it like tree roots to supply the whole body right down to the tips of the fingers and toes.

The nerves must be sufficiently mobile to allow the athlete to perform any movement necessary for their event.

The nerve's pathway must not be blocked, thus ensuring full conduction of nerve impulses (or messages) to and from the brain to joints, muscles and skin so the brain can co-ordinate movement.

Modern Day Normal Movement

As humans have evolved, so have so-called "normal movement" patterns. What used to be normal when man lived in caves and hunted is questionably not what we see in today's population? Today's "Normal Movement" is rarely "Natural Movement." (Katy Bowman, 2013)

When training your athletes you need to consider what they are doing when you are not with them. If they are sitting slumped over a desk for hours on end, this will make your job harder as you try to reverse these learned movement patterns in the little time you have with them. Try to educate them on good posture and movement becoming a habit.

Get them to imagine a helium balloon attached to their head, gently lifting the head and neck off their shoulders...the rest of the body should follow. (J.Elphinston).

During daily life, we rarely move our joints through their full ranges of motion, thus promoting inappropriate joint stiffness and muscle imbalances. Spending just a few minutes dotted throughout the day reversing these static postures or rubbing our "Activation Points" (D.Heel), can produce great benefits to our health and wellbeing.

Abnormal Movement

If our pelvis is abnormally rotated due to something innocuous such as turning in bed, or a slip off a kerb, a bad postural habit or jarring during training, then muscles around the pelvis, spine and shoulder, in particular Piriformis, Quadratus Lumborum (QL), Pec Minor and Infraspinatus, can go into spasm and lock the pelvis in this abnormal position, (M.Haines, Intelligent Training Systems™ 2009).

A pelvis may also be dysfunctional due to a stiff thoracic spine (and vice versa) due to their myofascial links through the kinetic chain and the need for co-ordinated movement and mobility between the two areas.

If, due to stiffness of the big toe joint, or poor dynamic control, we are unable to roll over our toes evenly during toe off, then this will immediately produce a torsional force on the ankle, lower leg, knee, hip etc. This will reduce the efficiency of movement and often predispose to injury. (Karrasch,N. 2009)

If our stabilising muscles aren't firing correctly, then to gain stability or control of our joints the global muscles will take over this role. Not having been designed for such a task, they can over compensate, producing static stability and thus stiffness at the joint rather than dynamic control through the desired movements. This new role also renders the global muscles unable to optimally perform their original task as prime movers and therefore the body is unable to move as fast or powerfully as it should.

Unless 'recalibrated,' these altered firing patterns can persist potentially for years after physical or emotional trauma.

Nerve Mobility

Protective or inappropriate muscle spasm around the spine and pelvis can compress the sciatic nerve that runs from the spine down the back of the leg to the toes, thus limiting its mobility. If the nerve is functionally shortened, then the hamstrings and/or calf muscles can go into spasm to prevent the nerve being over stretched and damaged. This may be why some athletes can never seem to lengthen their "tight hamstrings" through stretching because they are in fact protecting the nerve, and stretching a muscle in spasm just increases the spasm.

The same principle can be applied to any nerve within the body.

Sudden and severe muscle spasm can present like a muscle tear when in fact it is just the body's way of preventing nerve damage. This may be why some athletes appear to make such rapid recoveries from apparent torn muscles.

Tension at any point within the nervous system can present as pain anywhere else throughout the system.

Leg Length Discrepancy (LLD)

Specialists report that it is extremely difficult to accurately assess for LLD, but I believe that insoles/orthotics should not be put in shoes to correct an apparent LLD caused by an abnormal pelvic rotation as the body will then have to compensate elsewhere.

It may compensate in a number of ways including:

1) Excessive foot pronation with tibial rotation to shorten the longer leg.

2) Excessive foot supination with tibial rotation to lengthen the shortened leg.

3) Excessive knee flexion with hip medial rotation to shorten the longer leg.

4) Spinal scoliosis (sideways "S-shaped" curve).

5) Limited thoracic rotation

6) Spasm in the Infraspinatus muscle at the back of the shoulder. This then alters the mechanics of the shoulder and can cause shoulder problems such as impingements.

7) Tethering of the median/ulnar/radial nerves down the arm due to muscle spasm around the shoulder girdle.

.....consequently an abnormally rotated pelvis with restricted mobility can cause foot, ankle, shin, knee, hip, pelvic, lumbar, thoracic, cervical, shoulder, arm, elbow or hand pain!!

Endurance Runners

Repetitive excessive pronation or supination and associated tibial & femoral rotation, reduced toe off, genu valgus or varus, pelvic drop or spinal scoliosis puts abnormal stresses on the body stride after stride, resulting in pain.

Core Stability??

Core stability has been described as:

"The ability of the trunk to support force production and withstand the forces acting upon it."
(Elphinston J. & Pook P., 2000)

In recent years "core stability" became a buzz term and every athlete was concentrating on training the muscles around their trunk and pelvis to keep their body stable to perform their event with greater skill and reduced risk of injury.

"Core stability" training became and indeed remains popular. However, as with everything, ideas and knowledge have moved on, and it is more accepted now to think about movement efficacy, not purely stability.

If your biomechanics are faulty then by stabilising your core you are fixing yourself in the wrong position, thus causing your body to compensate for the dysfunction, ultimately leading to a drop in performance or injury. Inefficient biomechanics can also inhibit muscle contraction and prevent the attainment of good muscular control.

In how many athletic events or activities of daily living do we actually want the spine to stay fixed in one position? Surely we need to be training the body to be controlling and integrating all its components dynamically through different movement patterns and out of the "safe" neutral zone.

During running and most of the athletic events, the body needs to recruit the stabilising muscles subconsciously and at a low level during athletic performance and thus training needs to reflect this and not just concentrate on working the core maximally.

Shoulder Imbalances

Pelvic dysfunctions can cause muscle spasms in the shoulder, and equally, shoulder imbalances or injuries can cause pelvic dysfunctions, so both need to be considered when problem solving with an athlete.

Spasm in shoulder muscles can alter the position of the ball in the socket of the shoulder, (humeral head in the acetabulum), thus leading to impingement (pinching) of structures and ultimately pain and soft tissue damage.

Spasm can also compress nerves passing through the arm, thus limiting mobility and altering desired running or throwing techniques.

Neuromuscular control of the lower limb

If the muscles around the hip and leg aren't firing correctly, or aren't strong enough to control the medial and valgus (inwards) forces of the thigh and knee when the foot lands on the ground, this leaves the ligaments as the main stabilising factors, rendering the knee and ankle vulnerable to injury.

This may be quite subtle, presenting as the pelvis dropping on the opposite side to heel strike, the weight bearing thigh rotating inwards, the knee knocking in, rolling outwards over your toes, or the trunk swaying excessively to the same side.

It may not seem much initially, but with repeated impact during endurance events, or higher impact during explosive events, the consequences can range from simple to debilitating foot, ankle, shin, knee, hip pain, or a possible ruptured cruciate ligament of the knee or Achilles tendon.

Additionally, techniques will be inefficient with energy leaks leading to a reduction in athletic performance.

Balance

This may sound like a bizarre question, but how many of us can actually "feel the floor" with our feet as we stand?

If we have poor proprioception and are not fully aware of what is going on beneath our feet, then our bodies will not be able to adjust themselves optimally to perform, be it keeping balance on a bumpy trail run or maintaining perfect positioning to take off in the jumps or hurdles.

Wake up your feet, wipe them on a doormat, and see what effect it has on the rest of your body!

Summary

Loss of body alignment, nerve and joint mobility, proprioception, balance and dynamic muscular control can cause inefficiencies in movement, reduce performance, and be the cause of injuries throughout the body.

I have put together a few simple tests and subsequent corrective exercises / activities for you to get the best out of yourself or your athlete....Hope they help!

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Test	Method	Note	Activity
1. Finding your feet	March on the spot then stand still.	Note where most of the weight is on your feet, i.e. front, back, insides, outsides, right or left foot.	1. Switch on your balloon 2. Wipe your feet
2. Leg Length Discrepancy (LLD)	Standing, place fingers horizontally on top of pelvic bones at the side of your body.	Note if one side is higher than the other. Use a mirror or a friend's eyes if necessary!	1. Trigger point piriformis or TFL muscles in buttocks 2. Pelvic / rib dissociation
3. Single leg balance	Standing, keep fingers on pelvic bones, lift one foot off floor. Repeat other side.	Note whether pelvis stays level or drops down or raises on the non-weight bearing side.	1. Wipe your feet 2. Hip hitching 3. Single leg running 4. Gluts activation points (neck & belly)
4. Calf raises	Standing, hands on hips (or wall if you need to balance!). Go up onto your toes as high as possible.	Look at your feet and note where your weight has gone. Is it even over all five toes, incl. the big toe, or have you rolled out onto the outer toes?	1. Tennis ball massage under foot 2. Sitting or standing toe rolls 3. Wipe your feet
5. Pelvic / rib dissociation	Standing, move hands up onto your ribs. Keep ribs still as you rotate your pelvis clockwise and anti-clockwise.	Note inability to do this, or any asymmetry in range to either side.	1. Pelvic / rib dissociation (double leg) 2. Progress to single leg running
6. Sciatic nerve tension	Standing, leg out straight in front of you. Stick bottom out and keep back straight as you lean forwards, aiming chest towards toes. Stop at point of stretch. Repeat other side.	Note where stretch is felt. If felt anywhere other than hamstrings, then stop. If only in hamstrings, then gently pull foot up towards you. Note if stretch intensity or location changes.	1. Sciatic nerve mobilisations in standing 2. Trigger point piriformis or TFL muscles in buttocks 3. Psoas and gluts activation points (neck and belly)
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Name:	Date:		RSPhysio&Rehab physiotherapy assessment, treatment and rehabilitation
Test	**Comments**	**Tick**	**Activity**
1. Finding your feet			1. Switch on your balloon 2. Wipe your feet
2. Leg Length Discrepancy (LLD)			1. Trigger point piriformis or TFL muscles in buttocks 2. Pelvic / rib dissociation
3. Single leg balance			1. Wipe your feet 2. Hip hitching 3. Single leg running 4. Gluts activation points (neck & belly)
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Corrective Activity

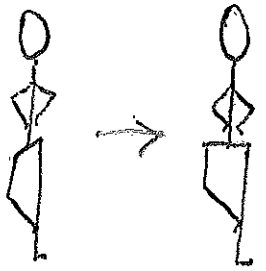
Balloon
Imagine a helium balloon attached to your head, gently lifting the head and neck off your shoulders...the rest of the body should follow.

Wipe your feet
Wipe your bare feet on a spikey doormat to "wake up" the sensors.

Pelvic / rib dissociation
Standing, place hands up onto your ribs. Keep ribs still as you rotate your pelvis clockwise and anti-clockwise.

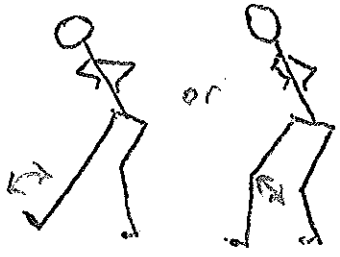
Trigger points
Use tennis ball or knuckles to rub into specific point as deep as tolerable for a few seconds to a few minutes daily.

Activation points
Rub specific point as deep as tolerable for a few seconds, intermittently throughout the day.



Hip hitching
Stand on left leg. Place right foot behind left calf. Let right side of pelvis drop down, keeping left knee straight (but soft). Using muscles on side of left hip, hitch right side of pelvis up as high as possible, then slowly lower. Repeat other side.

Single leg running
Stand on one leg. Lock hip into socket. Keep pelvis level. Imitate running arms with relaxed and gently rotating ribs. Allow the pelvis to rotate in opposite direction. Swap sides. If necessary, start with toes from the non-weight bearing leg lightly balancing on the floor.



Sciatic nerve mobilisations
Standing, leg out straight in front of you. Stick bottom out and keep back straight as you lean forwards, aiming chest towards toes. Stop at point of stretch. Gently pull foot up and down, or bend and straighten knee x15 x2 each leg.

Activation points & Trigger points.

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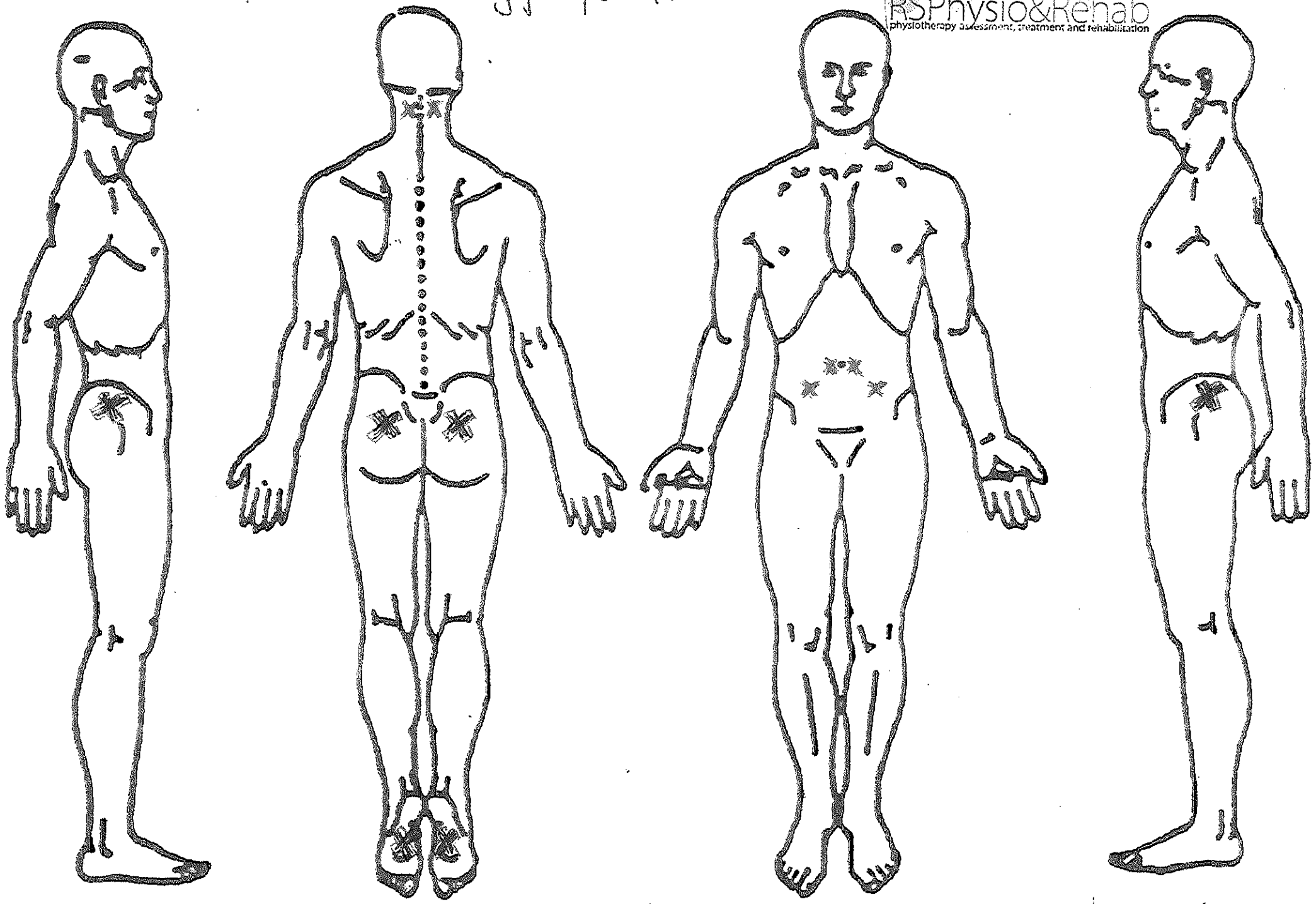

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