Rationale
Spinal Mechanics
by John Bayliss DO

Quote M.C. McGrath *Musculoskeletal Research Group university of Otago Dunedin, New Zealand from Clinical considerations of sacroiliac anatomy: review of function, motion and pain.*

"Manipulation of the sacroiliac joint has been shown to leave the position of the joint unchanged when compared with its pre-manipulated position" *Page 22 Journal of Osteopathic Medicine volume 7 Number 1 April 2004*

This statement if factual, would explain why manipulative therapies do not do as well as expected in clinical trials. But it also has the implication that the research group came to this conclusion because they were not manipulating the joints correctly. If this was the case, it must be assumed that it was not through lack of skill or professionalism but for another reason. The most obvious being the physiological model these therapists were basing their manipulations on, was in some way flawed.

Posture dysfunction

Observation of patients leaving clinics after treatment confirmed that they were leaving vertical and with their spines in the mid-line. But, their shoulders and the angles of their legs and feet were still not fully symmetrical. Which again cast doubt on the physiological model the treatments were based upon.

Overview

Using engineering principles I looked afresh at the way the sacroiliac and spinal joints articulate. In doing this I used two model types. These model types were based on the mobility limitations of the third lumbar vertebrae. L3 can either rotate and side-bend to opposite sides which is a flexion movement (backward bending) or it can rotate and side-bend to the same side, which is extension.

From the meticulous records of the thousands of patients that I have treated in my practice over the years, the most common presenting subluxation patterns were the L3-right-right and L3-left-right. With this in mind, I used these two models.

Introduction to my experimentation

I started the project by re-examining the theories of spinal mechanics outlined in the classic books by Dr Fryette and Dr I. A. Kapandji, but the problem was I could not apply the theories described to the way the body moves in the real world. Worse still, none of the theories could be demonstrated to work either singularly or synergetically with their surrounding joints. This highlighted a serious flaw in the physiological model. A theory that cannot be demonstrated is not a working theory.

There was only one option left open to me if I was to discover how spine and sacroiliac articulate in 'real world' movements and that was too look at these joints for myself with fresh eyes. However, I did not foresee that I would have to formulate theories not only individually but conceptually.

I would like to make it clear that my work is original and purely about how the sacroiliac and spine articulate and subluxate. It is not about the clinical implications that follow subluxation patterns other from a bony point of view. It is, as the title says about spinal mechanics and bony locking.

Considering best approach

I considered three different approaches:

1 Do I take a sample of people and make notes of all the angles of their joints and then go back to the drawing board and try and work out how they got like that?

Comment
These sample people would need to be naturally 100% free of subluxations so as not to confuse the results, especially where X-ray and other imaging are part of the research.

It is extremely unlikely that such a sample of people exists; further, the imaging would need to take account of the whole spine in a weight bearing and mobile environment and not just a selected area of isolation. *This is where things went wrong before.*

Rationale
Whilst this is a frequently attempted and favoured method of research it would be very time consuming and would leave considerable room for error, as whilst I could palpate the joints and know their plane of movement, or see the X-ray/imaging results (if such equipment existed), it would still be conjecture as to how they got like that. In other words the theory structure leaves room for doubt and that would consign the theory to the dump.

2 Do I go about thinking up an ideological theory and then set about proving it?

Rationale
This theory can be likened to a child who wants to build a red sports car. His first thoughts are on where to buy the red paint. Only when he has the paint, does he think he needs to design a car to match, and when that proves too difficult he thinks, perhaps he should try another colour. This again would be a non-starter and destine the theory to the dump.

3 Do I start with an open mind, begin my experimentation by examining the articular surfaces of the bones and see what waits to be discovered? When I have come up with a working model, only then do I compare the results of my experimentation to the spines of real people, via movement tests, observation and palpation.

Rationale
This promised a scientific result that would be based upon solid engineering principles that could be replicated by others. This meant disregarding everything that went before and thinking dynamically; I chose this route. The palpation, X-rays etc and research would therefor come later.

The spine and sacroiliac joints work in synergetic harmony.

It is impossible to look at a single joint or series of joints in a certain area such as the sacroiliac, lumber, thoracic or cervical in isolation because the body does not work like that. The body works as complete interacting mobile unit.

Where to start

For me, there was only one place to start and that was by examining one of the most basic human movements: walking

Leaving aside muscles, walking involves many different forces, the main ones being:

- Weight bearing and weight leaning
- Weight lifting and leg direction
- The changing angles of the ilia and hip joint
- The reciprocal action of the sacroiliac joints
- The lumbar vertebrae accommodation for this action and
- The action of side-shift

Walking involves a very complicated three dimensional set protocols that need to work in harmony.

Later in this document I have explained why current models of the sacroiliac joints do not complement the walking action.

In the beginning

From observing the way people sway their hips when walking I realised that side-shift was an important factor, but what I did not realise until later was just how much of an important factor it was to become.

Once I understood the principles of side-shift, weight distribution and balance everything fell into place. I was able experiment and begin to understand how joints work individually and how they synergistically interrelate with real world movements. I discovered:

- How the sacroiliac Joints articulate
- The importance of side-shift
- How L1 works
- How the thoracic vertebrae articulate
- How subluxations are created

The joint that gave me the most problem understanding was L1. Every book I have read and all that I was taught at college described L1 as just another lumber vertebrae. But it most certainly is not. It most certainly is not. It is one of the most complicated and multi-functional joints in the body.

In understanding the importance of side-shift I was able to work out how incorrect employment of this force causes subluxations to occur.

Where to start

I have read many books on spinal mechanics and there is not one of them where I have not had to re-read a certain paragraph repeatedly to make sense of what the author was saying. This was due to several factors, but the main one was that they were starting the explanation of their theories from a mid point. It was like coming into their version of a conversation that they had picked up on halfway through someone else's conversation. The conversation was so ambiguous that it was impossible to predict which direction it would take. This led to many varying theories from different factions. And no one theory could be said to be better than another. What everybody wanted to know was what started the conversation in the first place. And that is what I set out to discover, for only then could we begin to predict what the final outcome of the conversation could be. Theories must start from sound demonstrable bases.

L3 as a possible starting Point

L3 Joint

Probably the most recorded movement depicting the rotation of the spine is the articulation of L3 in extension (neutral and forward bending).

So here is one mid point in the conversation. So let us carry out a few simple tests to see where this fits into the conversation.

The tests are designed in a way that can be easily replicated.

Test A for rotation

Ask a colleague to sit sideways on a plinth with their back straight and their feet firmly on the floor. Their weight must be equally balanced on both buttocks. Stand or squat behind the colleague and place your hands around their pelvis in such a way as to completely immobilize it. In this way the lumbar rotation is isolated. If muscles are the singular cause of lumbar rotation the L3 joint will rotate.

Ask your colleague to rotate slowly in either direction and be very careful not to force the movement. This will lever the pelvis, so take care to immobilize the movement in all planes.

The result of this test is that the back locks after only a few degrees of rotation. Similar findings were more precisely recorded in Dr Kapandji's book on page 119.

Test B for side-bending

So we know the joint cannot rotate very far when the pelvis is immobilized. So let us test side-bending. If the test above is repeated but instead of rotation, side-bending is attempted we find side-bending is also restricted to only a few degrees.

Test C for combined side-bending and rotaion

Next we need to check what happens in the lumbar when side-bending and rotation are combined with the pelvis immobilized. Again, be sure not to allow even small amounts of pelvic movement to influence your results. Ask the colleague to side-bend their lumbar as best they can and then attempt rotation to the opposite side. If Fryette's Laws are correct this combination movement should account for real world lumbar rotation. However, the amount of rotation possible is still minimal and the lumbar vertebra quickly lock.

So what has been learned from these primitive experiments?

These simple tests indicate that isolated combinations of side-bending and rotation in the lumbar spine most certainly do not account for the amount of lumbar rotation a normal person takes for granted in the real world. Judging by the leverage placed on the pelvis during the tests, the pelvis could have a role to play in lumbar rotation. If so, we need to establish that role. To find this out we need to experiment further.

Test D adding pelvis side-bending

With your colleague in the same position on the plinth as in test C, place a book approximately 25 mm thick under their right ischial tuberosity so as to side-bend the sacrum to the left. The weight of the body is thus taken on the left buttock. If the person sits up straight the lumbar becomes side-bent to the left.

Now ask you colleague to rotate to the right. Be sure to block all pelvic side-shift to the left.

The result is that your colleague will be able to rotate further to the right in the lumbar than when the sacrum was horizontal. The test proves that side-bending of the pelvis improves the degree of lumbar rotation.

However, observe that the circumference of rotation is still not what one expects in the real world of lumbar rotation. So another test is needed.

Test E adding side-shift

With your colleague in the same position as in test D, with the book under their right ischial tuberosity and their weight on the left buttock, try this next test. Again do not attempt to immobilize the pelvis. Ask your colleague to side-shift their pelvis to the left, and observe that the lumbar rotates automatically to the right without any levered effort from the muscles in sufficient circumference to meet real world movements.

**Observe the thoracic movement. If you repeat test E with the person sitting up straight you will notice that the thoracic spine refuses to rotate right. Do not force it to rotate; the mechanics are designed to stop rotation in thoracic extension. The reasons for this are explained in detail in the DVD. The DVD also goes into much more mechanical detail about how the pelvis influences lumbar flexion rotation than the above crude tests. It also shows how the pelvis influences lumbar extension rotation.*

What the tests tell us is that the start of the previously mentioned conversation has a lot to do with the pelvis having the ability to provide the angle and side-shift required by the lumbar vertebrae to to provide movements we take for granted in the real world.

The next stage then is to look at the workings of the pelvis.

The Pelvis

The pelvis is designed to accommodate the action of the hip joints, the sacrolumbar joint, the synthesis pubis joint and the sacroiliac joints.

For a real world theory to apply to the pelvic articulations, the theory has to fulfil working criteria. These criteria are:

1 It has to account for the walking action of the legs.

2 It has to account for the way the vertebral spine moves to complement the walking mechanism.

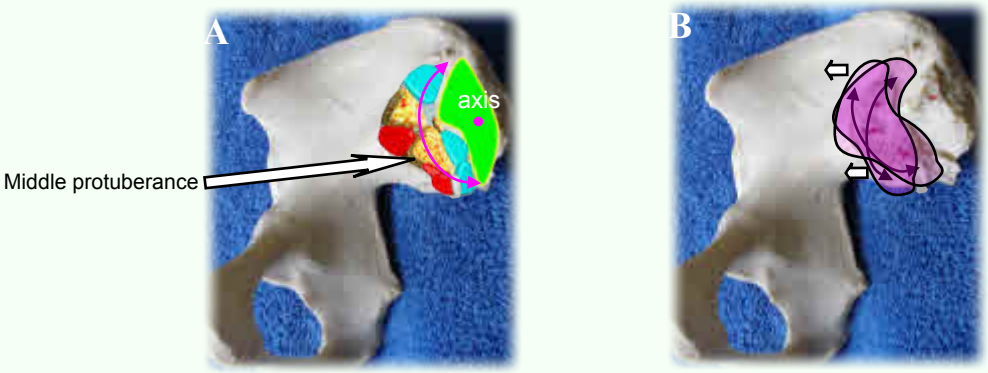
3 It has to act as a precursor for the vertebral spine to side-bend and rotate in both forward and backward bending.

4 It has to act as a precursor for the thoracic spine to rotate in lumbar extension.

5 It should not dislocate when completing items 1, 2, 3 and 4.

Nature leaves nothing to chance, all things have their place and function and interact perfectly in harmony with their surroundings. The world we live in is an unbelievable engineering feat and when you observe the human body you are taken aback by how perfectly it is designed. With such perfection, it is absurd that nature would design the sacroiliac joints with a built-in flaw that causes them to semi-dislocate every time a person puts their foot forward. Yet this, unbelievably is the basis of most of current sacroiliac theories.

When we walk behind someone and observe the action of walking, one of the most obvious movements is that the person sways from side to side with each step. When the pelvis sways to the left the right leg goes forward and when the pelvis sways to the right the left leg goes forward. Yet this basic observation is not accounted for in any of the current sacroiliac theories. Let us look at one the most popular theories: The ***Nutation Theory***



The articulation assumes that the facets dislocate at the superior and inferior borders even after a minimum of rotation as shown in figure B on the previous page. This seems to be an odd theory because it presumes that the normal physiological movement is based on the semi-dislocation of the joint.

If we pretend that the bony protuberance running down the the middle of the anterior border of the iliac articulator surface is like a circular tram line, which our eyes tell us is untrue, and if we forget that the anterior protuberance is there to stop the sacrum slipping during weight bearing, what could be achieved by such a vertical rotation movement?

Well if we indulge ourselves in this theory and imagine both innominates moving anteriorly against both sides of sacral facets at the same time both legs would be weight bearing and parallel. How the person moves forward after this would be very interesting to witness. Presumably with the jump of a kangaroo.

If we were to entertain the idea that the nutation theory allows for each ilium to move independently on either side of the sacrum, the shape of the iliac facets would guide one leg outwards and forward. Whilst the other leg would be guided inwards and backward, which is an odd gait by anybodies standards.

If one side of the ilium rotates in one direction and the ilium on the other side rotates in the opposite direction, the sacrum would have to remain level at all times. Trapped in the middle, the sacrum would be unable to side-bend and therefore would deprive the lumbar vertebrae of real world rotation during walking or standing.

If the person attempted to side-bend their pelvis to overcome this little problem, the leg on the opposite side to that being leaned into would be forced laterally and upwards. So every time the person wanted to rotate they would have to cock a leg.

Other Theories

If you look at picture ‘C’ below the three poles have been drawn in together with their planes of axes. Notice how they would cause the sacral facet to overlap the anterior perimeter of the iliac facet.

Any theory that relies on semi-dislocation to explain a normal physiological articulation cannot be taken seriously as either valid or scientific, so I am not going to waste time on this one.

Sacroiliac joint conclusion

If you compare the dislocated angles of the facets in the ‘nutation’ or ‘three pole’ theories you will see a great similarity because both theories largely describe the same semi-dislocation. Both of these theories must have resulted from the research group subjects having subluxated sacroiliac joints and the researchers not taking this obvious point into account or looking at the how the joints integrate with walking and spinal movements.

As I said at the beginning on this document, to find a group of people 100% naturally free of sacroiliac subluxations is nigh on impossible. That is why I felt the only way to work out how the sacroiliac joints articulate is to work out the physiology with regard to real world function of the joint.

Thoracic Vertebral Joints

According to Fryette's Laws the thoracic column can rotate and side-bend to the same side in thoracic extension and side-bend and rotate to opposite sides in thoracic flexion.

Our simple test earlier in this chapter proved that the thoracic spine cannot rotate in thoracic extension and for a very good reason which is explained in the DVD. The thoracic spine can rotate in forward bending but the way it does this has little to do with Fryette's Laws.

If the thoracic vertebrae really side-bent and rotated in thoracic flexion (forward bending) the attached ribs would be put into extreme torsion with every rotation. The energy needed to side-bend the transverse process with a short lever muscle sufficiently raise a rib as shown in **figure ‘D’,** would take a very powerful muscle.

Consider what would happen to the left rib if side-bending of this type was a valid movement? Supposing the angle of the left transverse process of a thoracic vertebra was 3 degrees, by the time the rib reached the apex of its conical curve, that 3 degrees would have increased by several degrees

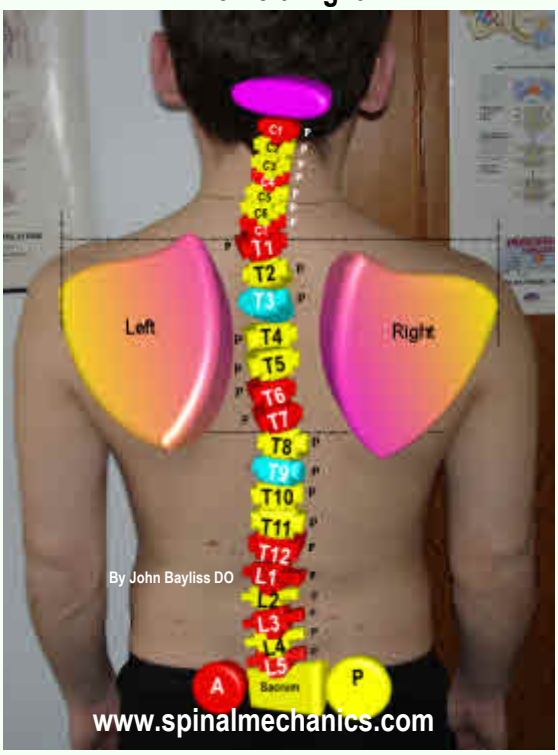
This would considerably stretch the inter-costal muscles and if all the thoracic ribs were side-bent in a similar manner and held in this position for long periods, as happens in the real world, the inter-costal muscles on the left side would not be able to function optimally. Also like a see-saw, what goes up one side goes down the other, so the right side ribs would be compressed.

Breathing is essential for life and therefore it is very unlikely that nature would evolve a design for the rib cage that hinders it. The musculo-skeletal frame is not designed with built in faults like this. So here is another example of a poorly conceived theory.

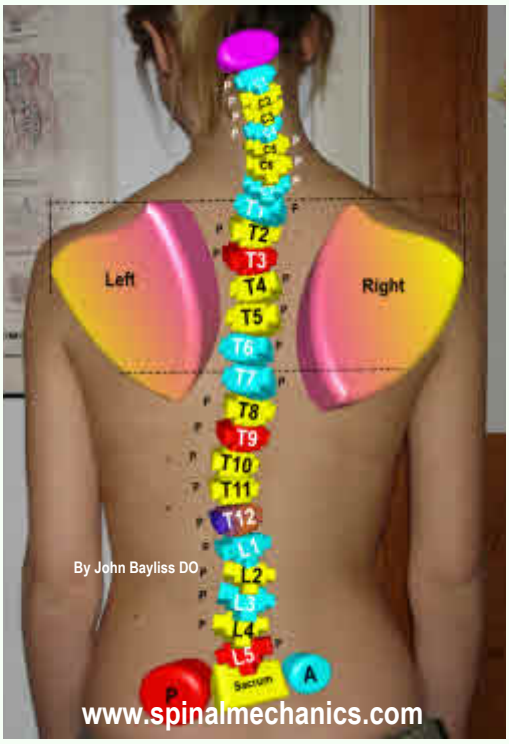
The way around this problem to compliment the normal rib bucket handle mechanism and keep the ribs parallel is explained and demonstrated in great detail in my DVD.

The pictures are of the two models. As you can see, the computer generated mathematically calculated three dimensional angles of every joint have been superimposed over the relative photographs. No one yet my knowledge has been able to do this before. Osteopaths and Chiropractors have always been able to palpate and draw these same curves; the only difference is that before, no one could scientifically demonstrate the underlying science and mathematics.

L3-Left-Right



L3-Right -Right



P = Posterior, A = Anterior. Subluxations are shown as follows: Red = Vertebra backward bent and Blue = Forward bent. Yellow = Position change only.

Conclusion

As you can now see existing theories are seriously flawed, but numerous research papers have led to their general acceptance.

Personally I will not work with a theory I cannot trust, therefore I disregarded the books and research and investigated the bony movement of the spine for myself.

I started by looking at the whole picture, not an out of context focus joint with no regard to how that joint interrelated with the other joints of the spine and finished with two demonstrable models.

I use the term 'real world' with regard to the elements of the body and their relative and collective movements in order to differentiate between what actually happens in real life and what, largely as a result of conjecture and bad science, has been wrongly assumed to happen.

References:
Principles of Osteopathic Technic By H Fryette.
The physiology of the Spine volume 3 I Kapandji
Delmas, Weisal, Farabeuf, et al.

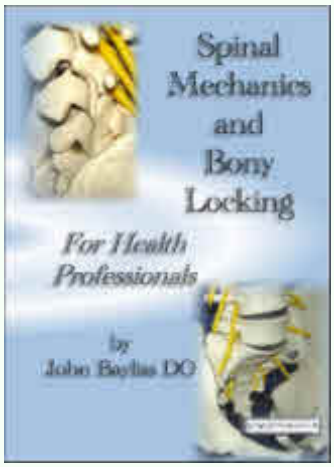
Why I presented my work on a DVD

This is the year 2007 and the DVD is a great medium to present a whole new concept of theories that not only compliment each other but can be seen to be working.

Spinal mechanics is a very complicated science subject that involves three dimensional thinking. And because of this many students and practitioners find it hard to understand the subject. But this is not a subject that can be dismissed, it is foundation knowledge for Osteopaths and Chiropractors.

I chose DVD as the initial medium to present my new theories, because when you see joints moving it makes their function and how they interrelate with other joints easier to understand. Not everybody can readily think in three dimensions and the action the spine and sacroiliac take is three dimensional.

Peter O'Toole of 'Springfield Productions UK' professionally filmed and edited the DVD. The presentation contains clear high quality sound and photography.



Go to: ***www.spinalmechanics.com*** to find out more about the DVD:

Spinal Mechanics and Bony Locking
For Health professionals
by John Bayliss DO