ROTATION TRAINING – How Dangerous is it?

In an industry where controversy is the norm – the search for truth is no simple task

Sadly, a lack of agreement in both research and 'expert' opinion, tends to create more confusion than understanding

So as a trainer, how do we separate the fact from fallacy?

In the words of Nick Tumminello

'If it doesn't make *scientific* sense, and it defies *common* sense, then it must be *non*sense.'

So let's apply this logic and see if we can make 'sense' out of this controversial and often misunderstood topic

Let's start with the research (*scientific* sense)

Although there is a paucity of studies that hold true to function –it has been purported that rotation offers significant risk of injury to the lumbar spine

The research suggests the following mechanisms for injury:

- Rotation can result in a delamination (slow removal of annular layers)
- Rotation combined with flexion loading can result in a disc injury
- Rotation combined with extension and/or lateral flexion loading can result in a facet and/or pars related injury

Here we must ask an important question (*common* sense)

Why has rotation of the lumbar spine proven to be so damaging –yet from an evolutionary perspective rotation is an important part of human movement?

Let me start this discussion with the following comment

'Rotation is not the concern – <u>where</u> the rotation takes place is the concern'

Although the spine as a whole has evolved to allow for rotation – regional contribution from the lumbar area is very minimal

- Thoracic rotation ~ 60-70°

  Segmental contribution as high as 7-10° in the mid thoracic area (T3-T9)

- Lumbar rotation ~ 10-15°

  Segmental contribution as small as 0-2° at L1-L5 and 0-5° at L5-S1

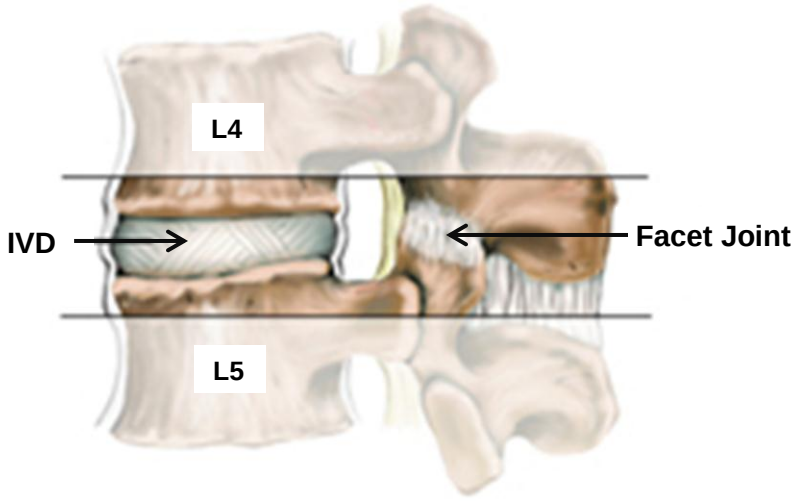
Structurally, the lumbar spine is designed to prevent/control rotation – not allow for rotation

It is this limited capacity for rotation that makes the lumbar spine vulnerable to injury

What limits/controls rotation in the lumbar spine?

If we take a reductionist approach to understanding the mechanics of the lumbar spine –we identify the smallest working unit called the motion segment

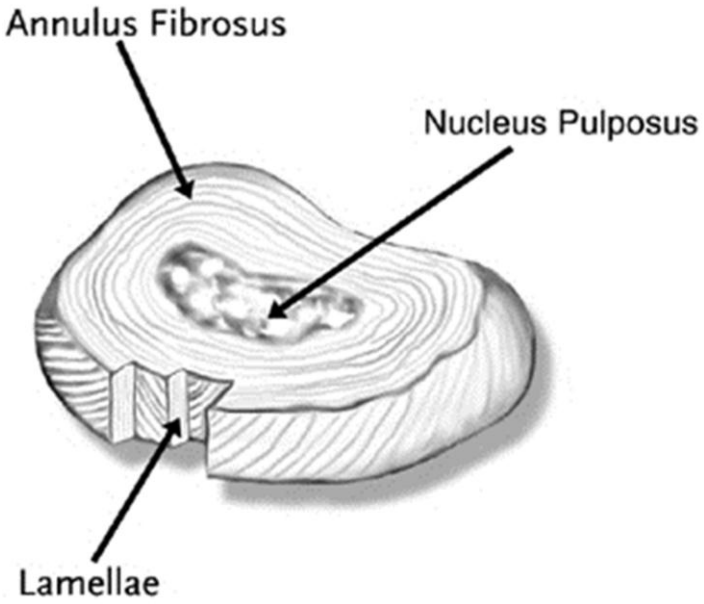
The motion segment is a three joint complex –comprising of one intervertebral disc (IVD) and two facet joints



Collectively these three joints provide passive (structural) constraint to segmental rotation

How does the intervertebral disc limit/control rotation?

If we take a closer look at the intervertebral disc you will observe that the annulus fibrosus is made up of approximately 16-20 concentric rings of alternating fiber alignment



The inherent strength of this arrangement:

- By having half the fibers run at a 45° upslope and the other half running at a 45° downslope –it allows the annulus to oppose movement in all directions

The inherent weakness of this arrangement:

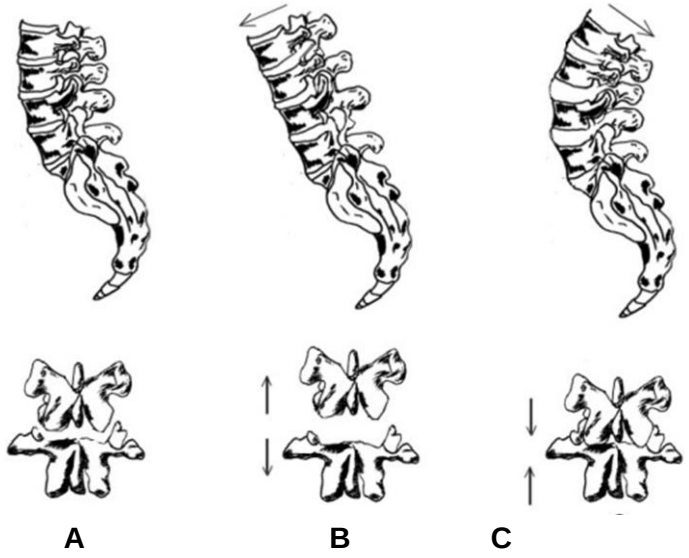
- With rotation only half the annular fibers will be aligned in the direction to limit/control this movement

How do the facet joints limit/control rotation?

By design, the facets permit specific directions of motion and deny or modify opposing directions of motion

In the lumbar spine the facet joints are oriented in such a way as to limit rotation – but this ability is dependent on spinal position

The following image demonstrates facet geometry and the ability to limit/control rotation in different spinal positions



A **B** **C**

A. Opposition of the facets in a neutral spine limits rotation

B. Separation of the facets with flexion reduces their ability to limit rotation

C. Approximation and opposition of the facets with extension prevents rotation

How can *dynamic* rotation injure the lumbar spine?

As stated earlier,

Structurally, the lumbar spine is designed to prevent/control rotation – not allow for rotation

It is this limited capacity for rotation that makes the lumbar spine <u>vulnerable</u> to injury

Injury to the lumbar motion segment can result from:

1. Rotation (loaded/unloaded)

   Although research has suggested that isolated rotation of the lumbar spine may not be a direct mechanism for disc injury – repetition over time can result in delamination or weakening of annular integrity

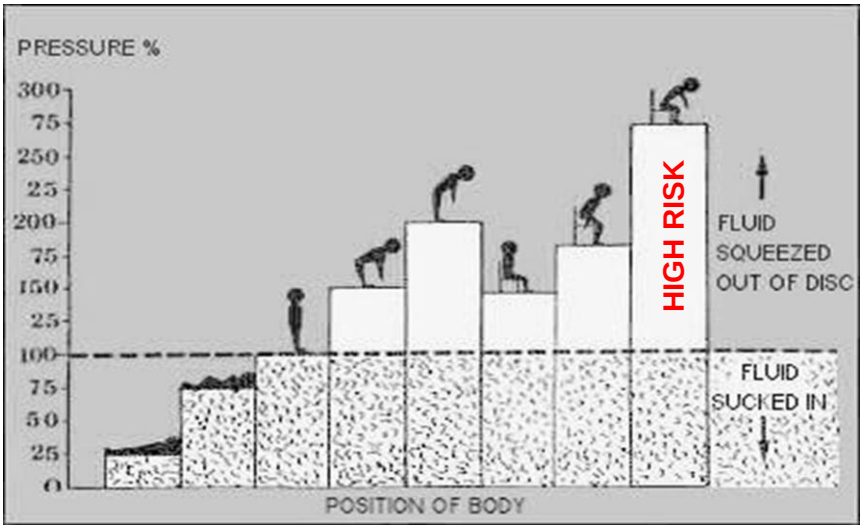
2. Rotation with flexion (loaded/unloaded)

   It can be inferred from the research that isolated rotation with flexion can be a mechanism for disc injury

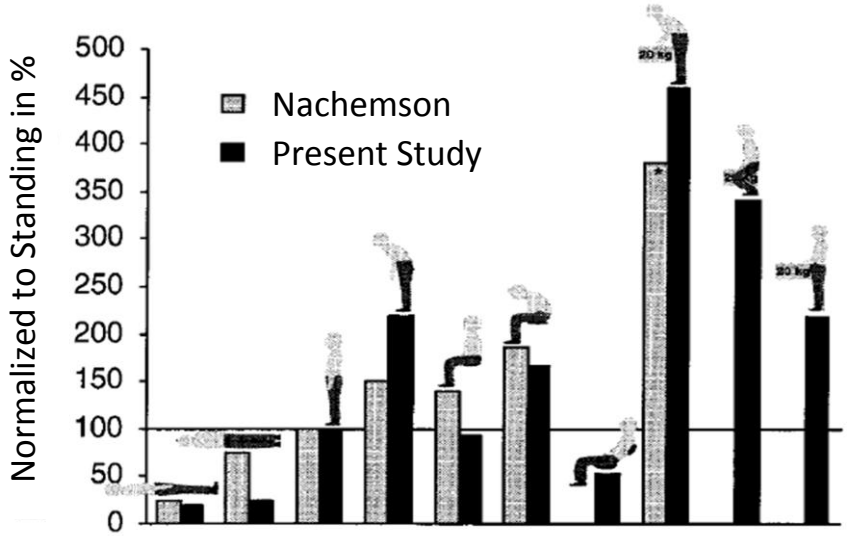
   - Separation of the facets with flexion reduces their ability to limit rotation –placing more demand/load on the annulus

   - Spinal flexion increases intradiscal pressure and demand/load on the annulus

     Nachemson (1960's) Intradiscal Pressure Measurements



An update to Nachemson's pioneering research can be found in SPINE Volume 24, Number 8, pp 755-762



3. Rotation with extension and/or lateral flexion (loaded/unloaded)

   Isolated rotation and lateral flexion can be considered one of the most damaging movements for the lumbar spine

   - The facet joints are loaded non-specifically and vulnerable to a compressive/shear related injury

How can we respect this information when training clients?

Based on benefit to risk, it is recommended to limit/avoid all exercises that involve *dynamic* rotation about a fixed pelvis or trunk – in both loaded and unloaded movements

1. Isolated *dynamic* rotation training

- Movements contradictory to lumbar biomechanics (fixed pelvis)

A. Twist Machine (Upper)

   - Rotation of the lumbar spine on a fixed pelvis

   - Repetition over time can result in a delamination/disc related injury

B. Seated Wood Chop (Dynamic)

   - Rotation/flexion of the lumbar spine on a fixed pelvis

   - Repetition over time can result in delamination/disc related injury

C. Seated Reverse Wood Chop (Dynamic)

   - Rotation/extension of the lumbar spine on a fixed pelvis

   - Repetition over time can result in facet/pars related injury

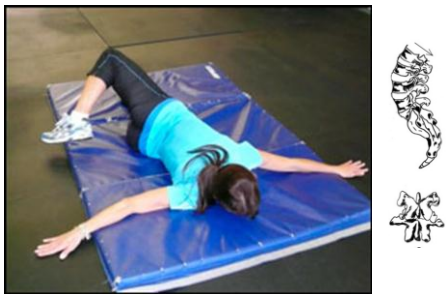
2. Isolated *dynamic* rotation training

- Movements contradictory to lumbar biomechanics (fixed thorax)

A

B

C



A. Twist Machine (Lower)
   - Rotation of the lumbar spine on a fixed thorax
   - Repetition over time can result in a delamination/disc related injury

B. Iron Cross (warm up/mobility)
   - Rotation/flexion of the lumbar spine on a fixed thorax
   - Repetition over time can result in delamination/disc related injury

C. Scorpion Twist (warm up/mobility)
   - Rotation/extension of the lumbar spine on a fixed thorax
   - Repetition over time can result in facet/pars related injury

How can isolated warm up/mobility movements on the floor (unloaded) pose a danger to the lumbar spine?

It has been suggested that the lumbar spine is more vulnerable to rotation (torque loading) in the absence of axial loading

To reference Mel Siff,

'A certain degree of compressive preloading locks the facet assembly of the spine and makes it more resistant to torsion. This is the reason why trunk rotation without vertical compression may cause disc injury, whereas the same movement performed with compression is significantly safer.'

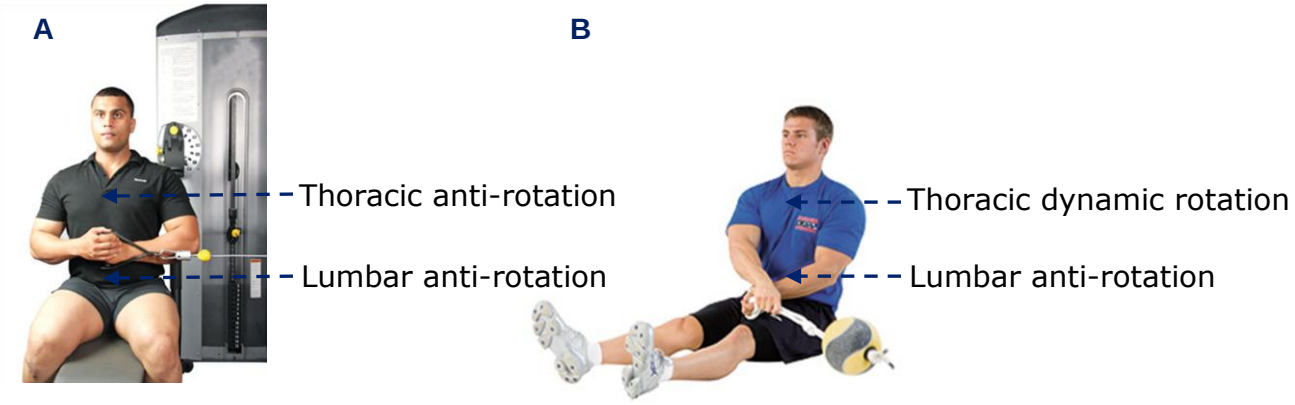
Note
The risk associated with these isolated warm up/mobility movements can be minimized by avoiding the extremes in range of motion

Is there a way to make isolated (fixed pelvis or torso) rotation training safe?

The benefit to risk can be improved if the *dynamic* rotation is replaced with *anti-rotation* – which prevents movement taking place in the lumbar spine

3. Isolated *anti-rotation* training

- Movements that respect lumbar biomechanics (fixed pelvis)



A. Seated Pallof Press

   The client/athlete presses the arms out straight –which increases the demand on core strength and control for anti-rotation

B. Seated Tornado Ball

   The client/athlete explosively swings the ball –which increases the demand on core strength and control for anti-rotation

Important

Dynamic rotation takes place in the thoracic spine **not** the lumbar spine

- The thoracic spine is structurally designed to allow for rotation (~60-70°)

- The lumbar spine is structurally designed to limit/control rotation (~10-15°)

This is an advanced anti-rotation exercise that is intended for selected athletes based on the needs analysis of their sport

It's important to remember that just because we can reduce the risk of an exercise – it does not mean it increases the benefit

Interestingly, anti-rotation is now considered by many 'authorities' to be more specific to core function –suggesting the ability to resist/prevent rotation is more important than the ability to create it

To Reference Porterfield and Derosa

'Rather than considering the abdominals as flexors and rotators of the trunk- for which they certainly have the capacity- their function might be better viewed as anti-rotators and anti-lateral flexors of the trunk.'

Porterfield and Derosa, Mechanical Low Back Pain 1998, p99

What is the best way to train this anti-rotator function?

Although anti-rotation minimizes the risk to the lumbar spine during isolated rotation training –the benefits of training rotation with a fixed pelvis or torso are limited and generally non-specific to function

For rotation training to be specific to function –training should be performed in the positions and/or movements that relate to the needs of the client/athlete

Integrated (pelvis and torso free to move) anti-rotation training performed on the feet –is considered to have the best carry over to function

4. Integrated *anti-rotation* training

Beginner Option: Standing Pallof Press

The client/athlete presses the arms out straight –which increases the demand on core strength and control for anti-rotation

The client/athlete adopts an athletic stance or a stance variation specific to their needs

Intermediate Option: Standing Landmines (Arc Training)

The client/athlete swings the bar in an arc –which increases the demand on core strength and control for anti-rotation and anti-lateral flexion

- Combat handles added to the bar can improve the training effect

Combat handles

The client/athlete adopts an athletic stance or a stance variation specific to their needs

Advanced Option: Standing Tornado Ball (Horizontal)

The client/athlete explosively swings the ball –which increases the demand on core strength and control for anti-rotation

The client/athlete adopts an athletic stance or a stance variation specific to their needs

When performing anti-rotation training – should the client/athlete perform an abdominal hollowing or abdominal bracing strategy to control the load?

Let me start this discussion with the following comment

'What is true for an unloaded environment – may not be true for a loaded environment'

To illustrate, let's take the following example of Respiration

As a person moves from an unloaded to loaded environment you will see a change in the respiratory strategy used

In an unloaded environment – diaphragmatic breathing

In a loaded (submaximal) environment – paradox breathing

In a loaded (maximal) environment – valsalva's manoeuver (breath hold)

Why the need for these different strategies?

As the load increases the need to control and/or overcome the load takes precedence over the need to breathe – with maximal loads creating a breath hold effect

So what this example illustrates – is that the best breathing strategy in an unloaded environment is <u>not</u> the best breathing strategy in a loaded environment

How do we apply this logic (*common* sense) to the abdominal hollowing and abdominal bracing debate?

I will illustrate with another example,

Imagine your car has broken down and you have to push it up a steep hill

As you position yourself behind the car (heavy load) and start to push you will notice two things happen:

1. You will momentarily stop breathing (valsalva's manoeuver) in response to the <u>large</u> load you are trying to overcome

2. A reflexive tensing/<u>bracing</u> of the abdominal muscles in response to this large load/breath hold response

What this load/breath hold/bracing response demonstrates – is that abdominal bracing (not hollowing) is the natural strategy selected by the body in response to loading

Why would the body naturally select this bracing strategy over hollowing?

Research conducted by Stuart McGill, has demonstrated that abdominal bracing offers a higher stability index than abdominal hollowing

So clearly, this is the strategy we should be recommending to our clients/athletes when performing anti-rotation training

BUT

Not all braces are created equal!!

Just because something is natural in the body – does not mean it will be without problems

As demonstrated by Stuart McGill – An optimal brace involves concomitant involvement of both the deep (stability) and superficial (strength/control) muscles of the core

But is this what always happens?

Unfortunately no,

A lot of client/athletes will present with a suboptimal brace – where inhibition/dysfunction of the deep (stability) muscles can delay/prevent their involvement in the bracing response

Or put another way,

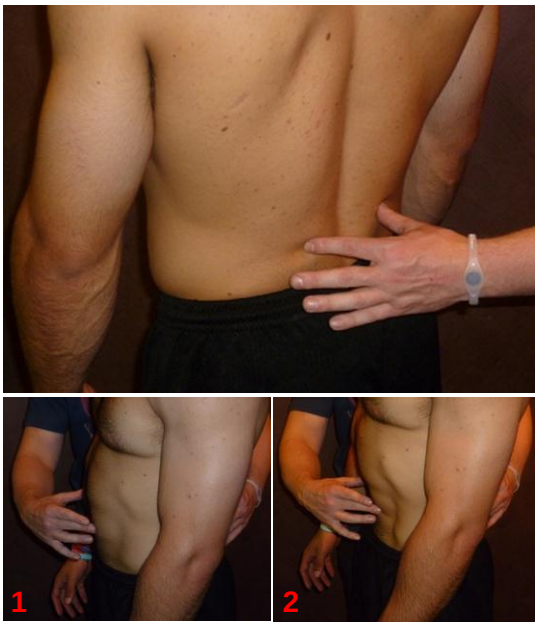
This suboptimal brace is an injury waiting to happen!

How can we identify this suboptimal brace?

Unfortunately it's not just a matter of observation – as visually there is no discernable difference between an optimal and suboptimal brace in response to load

The only way to differentiate an optimal from a suboptimal brace – is to assess the deep (stability) muscles directly for signs of inhibition/dysfunction

A test I developed to assess for inhibition/dysfunction of the deep abdominal wall (TVA) and its ability to function as part of a brace – is the 'Standing TVA Activation Test'



Passed Test:

The client/athlete performs an abdominal hollowing movement without increased tone of the palpated erector spinae

Failed Test:

The client/athlete performs an abdominal hollowing movement with increased tone of the palpated erector spinae

For a video demonstration of this test go to www.FMAStrengthtraining.com and review the online version of this article

In summary,

If the client/athlete passes this test – it is safe to perform anti-rotation training with load and allow them to do what is natural and BRACE

Is it ever safe to perform integrated *dynamic* rotation training?

To answer this question we must understand the mechanics of lifting –as it relates to load transfer

Let's apply the **Load Transfer Model™** to the Wood Chop exercise

To perform this movement safely (benefit to risk) the client/athlete must demonstrate:

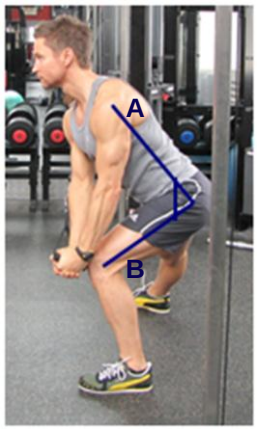
1. The orthopedic profile for the lift/technique

   - Positional/mobility demands

2. The strength profile for the lift/technique

   - Strength/control sequence

First let's look at the <u>orthopedic profile</u> for the wood chop

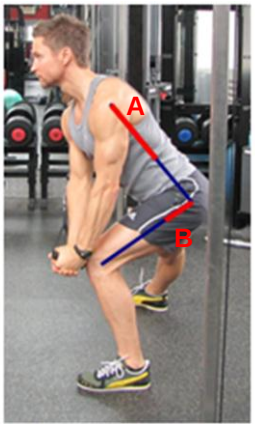


The reference line positions for the wood chop

A. Hip-Shoulder Line

B. Hip-Knee Line

This reference line (A-B angle) maintains a <u>neutral</u> lumbar spine to minimize compressive loading



The movement (rotation) areas for the wood chop

A. Thoracic spine (~70°)

B. Hip joint (~40° IR / ~45° ER)

Movement (rotation) takes place at the hips and thoracic spine <u>not</u> the lumbar spine to prevent torque/shear loading

<u>Important</u>

If the client/athlete cannot achieve the <u>positional</u> and <u>mobility</u> demands of the movement – risk of injury to the lumbar spine is increased

Now let's look at the strength profile for the wood chop

The wood chop is a complex technique made up of the following three movements:

- Lunge
- Twist (Thoracic Spine / Hip Joints)
- Pull

The Strength (Force) Sequence

Force generation from the ground up

- Lateral lunge (1)
- Twist (2)
- Pull (3)

The Strength (Control) Sequence

Central strategy for control

- Abdominal brace
- Anti-rotation function

Important

If the client/athlete cannot demonstrate the correct strength (force) and/or strength (control) sequence for the movement – risk of injury to the lumbar spine is increased

How can we apply this understanding to improve the benefit to risk of integrated dynamic rotation training?

Firstly, when would there be a need for integrated dynamic rotation training?

As stated earlier,

For rotation training to be specific to function –training should be performed in the positions and/or movements that relate to the needs of the client/athlete

Take a sport like Mixed Martial Arts (MMA)

The body can be placed in positions where perfect form/technique is prevented

To condition a client/athlete for the extremes of this sport often necessitates 'imperfect' training methods

Or in the words of Mel Siff,

'Practicing with imperfectly executed techniques'

Although there is risk involved with 'imperfect' training techniques –the risk can be reduced with application of the load transfer model™

5. Integrated dynamic rotation training (imperfection training)

Advanced Option: Standing Landmines (Arc Training)

The risk of sustaining a rotation/flexion related injury to the lumbar spine can be reduced if:

1. The client/athlete can perform the positional/mobility demands of the movement for efficient load transfer

   The greater the movement (rotation/flexion) at the hip and thoracic spine – the less demand placed on the lumbar spine

   This minimizes the risk of injury by avoiding the extremes in lumbar range of motion

2. The client/athlete can perform the strength (force)/strength (control) sequence of the movement for efficient load transfer

   By summating forces from (1) » (2) » (3) the compressive/torque loading at the lumbar spine is reduced

   This minimizes the risk of injury by avoiding the extremes in lumbar loading

   i.e. (2) » (3) strength (force) sequence increases the risk

Important

The benefit to risk of integrated *dynamic* rotation training can be improved when client/athlete assessment and lift/technique application are based on the Load Transfer Model™

Closing comments,

Rotation Training – How Dangerous is it?

The answer to this question is dependent on <u>which</u> method of rotation training is to be used

- Isolated *anti-rotation* training ☑
- Isolated *dynamic rotation* training ☒
- Integrated *anti-rotation* training ☑
- Integrated *dynamic rotation* training (imperfection) ☑ ☒

And remember, when confronted with conflicting information on how you should or should not train

'If it doesn't make *scientific* sense, and it defies *common* sense, then it must be *non*sense.'

Thank you for reading ☺

Mark Buckley

FMA Strength Training – The 'RAW' Facts

www.FMAStrengthTraining.com