The Proprioceptive Lumbar Spine & The role of manual therapy

Dr Neil Langridge DClinP MSc MMACP BSc (Hons)
Consultant Physiotherapist
What do we do?

- Manual therapy
- Pain control
- Movement
- Re-educate
- Muscular activity
- Exercise – LBP
- ROM
- Control
- Balance
- Strength
- Endurance
- Posture
Aims

• Construct an argument that links;
  - Proprioceptive loss in Low Back Pain
  - Manual therapy/Manipulation
  - Rehabilitation
What is proprioception in the spine?

- Muscle spindles
- Golgi Tendon Organs
- Joint receptors
- Informing the cerebellum of position sense, force, effort.
- A role in the neural control of movement.
Proprioception

- Key component of the sensorimotor system and is responsible for providing the central nervous system with afferent information
- Vital for neuro-muscular control
- Contributes to dynamic joint stability
Muscle spindles

• Vibration and movement induce the reality or illusion of lengthening.
• Giving information regarding the length and rate of change at any given time.
• High levels in the paraspinals.
• Well recognised that deficits occur in the peripheral system.
Relationship to motor control

ASSESSMENT

Sensory feedback

Muscle tone

OUTPUT

INPUT
Appropriate patterns/postures

- Loss of discrete cortical control of muscles groups DM v ES. Tsao et al 2011
- O’Sullivan, Dankaerts et al 2003; 2007 etc global control of trunk neutral – sub-classification system
As therapists we analyse and look to “optimise” loading, and balance across the spine.

Many of these extreme postures are therefore continually either under or over stimulating the natural proprioceptive input to the nervous system.
Lumbar proprioceptive deficits

- 44 subjects – LBP V Healthy control - (Brumagne et al 2000)
- Measured sacral tilt position – asked to then fully tilt forward – then return.
- Repeated 5 times
- Measured accuracy
- Followed this with vibration across the muscle – to induce sensation of lengthening
Results (Brumagne et al 2000)

- **No vibration**
  - Significant undershot of target
  - Control = accurate

- **Vibration**
  - Patient group improved
  - Control group worsened
This suggests;

- Manual therapy: • Proprioceptive influence
- Exercise: • Postural control
There is always a different view

- 24 participants – healthy versus LBP - (Lee et al 2010)
- Motion perception
- Active repositioning
- Passive repositioning
Results (Lee et al 2010)

- Motion palpation
  - Control perceived smaller trunk displacement
  - Axial rotation had the greatest threshold

- Passive reposition
  - No difference

- Active reposition
  - No difference
(Johanson et al 2011)

- 32 individuals
- Healthy versus LBP
- Measured postural sway
- Applied muscle vibration
- Aware that Gastrocnemius = backward - Multifidus = forward sway
- Back muscle fatigue was introduced
When on unstable surface – LBP greater sway

Greater use of ankle proprioception

Poorer endurance times -
Results (Johanson et al 2011)

Fatigue did not change the output on stable surface – LBP still poorer than healthy.

LBP fatigue increased the use of ankle proprioceptors on unstable surfaces.
This suggests;

- Postural strategies
  - Compensation – ankle, visual?

- Endurance
  - Plays a part in postural control
Using a sub-classification system

- Sheeran et al (2012)
- Used O’Sullivan classification – Flexion and active extensor – ROM, sit to stand, standing, and single leg stance.
- Re-positioning – Flexion – over-estimated thoracic target/under-estimated lumbar
- Extension – opposite
- Poorer than healthy matched controls
Stimulation of joint afferents (Indahl et al 1995, 1999)

- A = stimulating electrode
- B = Annulus fibrosus nerve
- C = Nerve root
- D = DRG
- E = Multifidus
- F = EMG
Results

• Stimulate the disc = induced MF in multiple sites/contralateral
• Stimulation of Z-joint = ipsilateral and segmental
• Introduce lidocaine to Z-joint = reduces EMG esp capsule.
• Significant motor potential change with saline – stretch the capsule.
• Lasted 5 minutes
• Suggesting a regulatory function on muscle spindle activity via the joints and capsule.
This suggests;

- Pain over stimulates system
  - Proprioceptive influence
- Manual therapy
  - Has a part to play in re-organisation
Manipulation and EMG (Bicalho et al 2010)

- 20 versus 20 CLBP and control
- EMG – flexion/extension – included a relaxation phase
- Pain intensity
- No flexion phase change
- Significant relaxation and extension phase
- VAS improvement
- ROM improved for both
Manipulation and muscle spindles

- Many studies have shown that spinal manipulation increases the discharge rate of muscle spindles deep in the paraspinals. (Pickar & Wheeler 2001; Pickar and Kang 2006; Pickar et al 2007)

- This is compared to the pre-load phase.

- Some afferents exhibit an increase at specific thrust directions.

- Short silent phase – shorter when quicker.

- It creates a higher frequency of sensory input as compared to daily motion.
There is the element of SO WHAT?
- Paraspinal – excitation
- PA manipulation – increases output (Herzog 1999)
- Poor re-positioning
- Poor segmental control
- Poor segmental loading

- Paraspinal – inhibition
- PA manipulation – decreases paraspinal output (DeVocht et al 2005)

REHABILITATION EFFECTS
Feed Forward Mechanism

- Anticipatory control
- Control of perturbation
- Linked with TRa MF PF for segmental control
- Facilitate this with appropriate postures
Marshall and Murphy (2006)

- 17 subjects
- Deficient feed-forward mechanism
- Manipulation SIJ
- Based on a lack of SIJ movement on the side of TRa/IO dysfunction
- Outcome 34% increase in FFM
Follow up (2008; 2010)

- Patients treated with manipulation and exercise
- Continued FFA improvement at a 1 year FU
- FFA deficits correlate with self-rated disability
Ferreira et al (2007)

- 20 subjects with LBP V Control
- EMG – TrA, IO, EO, Deltoid, RA
- Rapid arm movement
- Grade IV (rather than V) 30 secs

- Post intervention
- TrA no change
- IO and EO – improvements
- RA no change

Muscular responses – but no carry over and mobilisation differed from manipulation
Manipulation (cavitation)

- LBP V Controls (Clark et al 2011)
- Stretch reflex – measurement
- Erector spinae – EMG change
- Significant - with audible cavitation
Learman et al 2009 -

- Manipulation group
- Joint position sense – improved
- Maintained (1 week)
- TTDPM – improved – not maintained

- Sham – positional
- Joint position sense improved
- Not maintained (1 week)
- TTDPM – no change

CONSIDER THE LINK TO EXERCISE MANAGEMENT
Take it to practice

- We want to retrain movement
- We want to retrain motor control
- We want to enhance appropriate strategies
- We want to provide segmental support

Manual therapy

Bespoke exercise

Improved function
Simple framework

Find the dysfunctions – spine and motor
Correct segmental – facilitate NMC
Rehabilitate the proprioceptive motor control loss

Gross and specific posture
Proprioceptive rehab (Magnusson et al 2008)

- 2 groups – CLBP
- Group 1 – bio-feedback
- Group 2 – Standard rehab group
- VAS, ROM, SF 36
- Significant improvement in bio-feedback
- Immediate, 6/52 and 6/12
Management options (example)

mobilisation

Stimulate proprioceptors, reduce pain, pragmatic choice of applied forces
Directionally specific
Re-training post Manip

- Practice re-positioning.
- Use mirror/tape and consider;
- Speed.
- Effort.
- Weight transference.
- Amount of over and under shoot.
- Alter surfaces – balance board.
• **All the other good stuff**
• Movement patterns
• Speed
• Eccentric
• Endurance
• Accuracy
• Timing
What can we conclude?

- The spine loses proprioceptive input with dysfunction
- It can be facilitated with manual therapy / exercise
- Manual therapy and exercise should therefore link
- It has a part to play in CLBP management
Many Thanks for your attention.
Neil.langridge@southernhealth.nhs.uk