Function requires mobility with stability of the joints. When treating dysfunction, the therapist should use an integrated approach which targets not only restoring form closure (joint positioning), but also restoration of force closure (muscular stabilization and compression of the joints) and retraining of motor control and timing (coordination and appropriate timing of muscle contractions during motion) of all the contractile structures within the region. (Lee & Lee 2004) Mobilization and traction are two manual therapies commonly employed in the treatment of the spine. As well, practitioners need to be aware of the state of the adjacent muscles and address the myofascial as well as the skeletal systems.

MOBILIZATION
FORM closure involves mobilization or manipulation aimed at restoring mobility and/or correction of osseous alignment. “If exercise is prescribed first, without 1st restoring joint mobility (form closure), the patient’s pain and dysfunction often gets worse.” (Lee & Lee 2004)

Mobilization has been described as the gentler coaxing of a movement by passive rhythmical oscillations performed at the beginning, within or at the limit of range. (Maitland et al 2005) According to Maitland, mobilizations can be used in two basic sets of circumstance: 1) The treatment of stiffness; 2) The treatment of pain rather than stiffness.

The method of the mobilizations will differ depending on its objective (Maitland et al 2005):
1) Minimal symptoms: use a staccato technique similar to staccato notes played when plucking violin strings
2) Moderate symptoms: use a staccato technique similar to staccato notes played with the bow on the violin
3) Severe symptoms: use oscillatory movements of smooth and even nature such that a change in direction of movement is unperceivable

Maitland also described a grading scale for the application of mobilizations which varies the amplitude of the mobilization and the range of the mobilization. See figure 1.1. (Maitland et al 2005) The grades are described as follows (Maitland 1966):
- Grade 1: Gentlest. Performed with pressures so light and amplitudes so tiny as may be considered ineffective. Used when pain and more particularly mm spasms are easily evoked by very gentle passive movement.
- Grade 2: Large amplitude in painless part of joint’s range. Where in the range is guided by pain and spasm so as to avoid both.
- Grade 3: Big amplitude movement and done to ‘knock’ at the limit of range. Used when pain is felt at the limit of range and is moderate and not associated with spasm.
- Grade 4: Tiny amplitude: performed with joint at maximal stretch and used only when examination finds the range to be almost full, not protected by muscle spasm, and when there is very little pain.
- Grade 5: manipulation: An extension of grade 4 – the joint is suddenly moved through a very small amplitude, but at high velocity before patient is aware of it.
Effects of Mobilization

It is known that passive and active movements help in preservation of full range of motion (ROM) and the strength and flexibility of periarticular tissue. (Maitland et al 2005; Björnsdóttir & Kumar 1997) Physiological movements are described as active and passive functional movements. Accessory movements are movements that can only be conducted passively by a 3rd party (therapist) or as a conjunct accessory motion within a physiologic motion (i.e. rotations in the knee joint). Both physiological and accessory movements can be utilized in order to mobilize a joint.

The most readily thought of effect of mobilizations are mechanical. Mobilizations can restore voluntary movement, aid in cartilage nutrition, aid in intervertebral disc nutrition, aid in metabolism of soft tissue structures and improve the rate and quality of tendon repair. (Zusman 1986; Björnsdóttir & Kumar 1997) In order to achieve the mechanical effect, repetitive passive joint movements (oscillations) need to be carried out at the limit of the joint’s available range and tissues need to be stretched. (Zusman 1986)

The neurological effects of mobilizations are reportedly a reduction in acute pain and inhibition of reflex muscle contractions. (Zusman 1986; Katavich 1998; Björnsdóttir & Kumar 1997; Zelle et al 2005) The achievement of neurological effects requires repetitive (oscillatory) or sustained manual stimulation which results in a hysteresis effect. The hysteresis effect involves inhibition of low threshold mechanoreceptors (group I & II), inhibition of high threshold nociceptors (group III & IV), both of which result in a reduction of intra-articular pressure and peripheral afferent discharge. (Zusman 1986; Katavich 1998; Conroy & Hayes 1998; Sterling et al 2001)

The following is a list of CLINICAL finding pertaining to mobilizations or manipulations:
- **DOES NOT** improve mobility (in shoulder impingement cases already receiving comprehensive therapy) (Conroy & Hayes 1998)
- **DOES NOT** Provide permanent changes in passive cervical ROM (Nilsson et al 1996)
- **DOES NOT** Change vertebral stiffness (Goodsell et al 2000; Lee et al 1993, Allison et al 2001)
• **DOES NOT** Alter sacrum-ilium joint position (Tullberg et al 1998)
• **DOES NOT** have pain-relieving effects (Mulligan technique for subacute ankle sprains) (Collins et al 2004)
• **DOES** have immediate hypoalgesic effect on the cervical spine (Sterling et al 2001)

In a literature review specific to sacroiliac joint mobilization or manipulation, results were as follows:

• Manipulation might influence soft tissue structures, such as joint capsules, muscles, ligaments, tendons and postures but does not alter the position between the sacrum and the ilium on roentgen stereophotogrammetric analysis (Tullberg et al 1998)
• A structured physical therapy program aimed at restoring joint mechanics and strengthening muscular stabilizers can produce good long-term results in 95% of patients. (Sasso et al 2001)
• Full pain relief for patients suffering from SIJD can be achieved with manipulation of the SIJ (Grieve 2001)
• H-reflex (Hoffman reflex) was significantly decreased in the ipsilateral leg following a sacroiliac joint manipulation (Murphy et al 1995)
• Manipulation of the SIJ is more effective at reducing perceived hip pain than hip mobilizations (Cibulka & Delitto 1993)
• SIJ manipulation causes a reflex reaction in the gluteus maximus muscles and deltoid muscles (Symons et al 2000, Herzog 1999)
• A manipulative procedure purported to be specific to the SIJ changes innominate tilt bilaterally and in opposite directions (Cibulka et al 1998)
• Manipulation may be able decrease the delay (latency) in feed forward activation of Transverse Abdominus/Internal Oblique during shoulder flexion movements. (Marshall & Murphy 2006)

It is important to note that some unfavourable findings or discrepancies in the literature may be due to selection of an inappropriate treatment technique for the injury studied or selection of an inappropriate testing method. IF, in fact, mobilizations do NOT alter joint position, biomechanics, mobility or stiffness, then perhaps we can choose ANY mobilization technique to result in pain relief and reduction of muscle spasm, followed by neuromuscular retraining. More research is needed to quantify, qualify, and validate the mobilization and manipulation effects that clinicians find in daily practice.

Table 1.1 summarizes all of the realized and postulated cellular effects of mobilizations:

<table>
<thead>
<tr>
<th>Mobilization Effect</th>
<th>Postulated Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical effects: connective tissue remodelling</td>
<td>Cellular modulation&lt;br&gt;Release of enzymes to breakdown cross links&lt;br&gt;Simulation of fibroblast synthesis of collagen proteoglycans&lt;br&gt;Realignment of old fibers (piezoelectric current)&lt;br&gt;Increase interfiber distance (break cross links)&lt;br&gt;Increase interfiber lubrication (proteoglycans bind with H2O)&lt;br&gt;Alignment of new fibers (piezoelectric current)&lt;br&gt;Stretching articular capsule / segmental muscle&lt;br&gt;Breaking intraarticular adhesion&lt;br&gt;Vertebral movement – definite motion of vertebra in cadavers returns to same position; not well studied in patients</td>
</tr>
</tbody>
</table>
Articular cartilage changes | Alter joint lubrication  
Enhance cartilage nutrition  
Movement of joint inclusions (meniscoids) or loose bodies (cartilage fibrillation)  
Shift hard fragment of intervertebral disc  

Neurological effects * | Stimulate Type I and Type II mechanoreceptors  
Inhibit transmission of nociceptive impulses  
Decrease pain perception  
Relieve mechanical irritation of nervous system  
Activation of articular mechanoreceptors  
Stimulation of sympathetic nervous system  

Neuromuscular responses * | Alter afferent input to effect efferent output (gamma bias)-relax muscle:  
Stimulation of muscle spindle; Stimulation of the Golgi tendon organ causes reflex inhibition of segmental muscle  
Alter segmental (and more distal) muscle activity  
Reflex muscle response locally and at a distance  
Decrease spinal segmental facilitation  

Alter circulation | Increase supply of materials required for healing  
Remove chemical irritant, hence decrease nociceptor stimulation  

Physiological * | Increase beta-endorphin levels  
Immune system effects  

Joint tissue Response | Increase capsule elasticity  
Improve articular cartilage nutrition  
Improve circulation  
Restoration of joint play / accessory glides  
Restoration of passive / active movement  
Decreased pain perception  

(Note * = studies conducted to validate these effects)

Table 1.2 describes how physical therapists approach the application of mobilizations in the human patient.

Table 1.2. Technical Summary of Mobilization Treatment Application (Maffey LL 2007)

- Patient consent received (informed of nature and purpose of mobs, alternate forms of assessment/Rx, associated risks & benefits)  
- Select starting position (relaxed and comfortable)  
- Select starting position of the clinician  
- Select treatment grade  
- Select a sustained oscillatory technique  
- Select duration and speed of oscillatory technique (shorter for acute conditions)  
- Increase the intensity and duration of treatment only when evidence exists that increased dose will not exacerbate pain  
- Select reassessment technique to use before, during and after treatment  
- Select home program to maintain treatment effects
Table 1.3 describes considerations and contraindications regarding mobilizations in the human patient.

<table>
<thead>
<tr>
<th>Table 1.3. Factors Involving the Clinician and Patient Relationship to Consider as a Contraindication for Mobilization or Manipulation (Maffey LL 2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Insufficient subjective assessment of the patient, that is, inadequate information about coexisting conditions, disease, and/or medication or in general the patient has an inability to communicate or is an unreliable historian</td>
</tr>
<tr>
<td>• Poor appraisal of the patient as a reliable historian</td>
</tr>
<tr>
<td>• Patient is intoxicated or heavily medicated</td>
</tr>
<tr>
<td>• Patient age: children (skeletal maturity, consent issues) / elderly (tissue health / integrity issues)</td>
</tr>
<tr>
<td>• Failure to discuss the assessment finding and treatment options with patient</td>
</tr>
<tr>
<td>• Failure to receive or to agree with patient consent</td>
</tr>
<tr>
<td>• Insufficient scanning examination or detailed biomechanical examination</td>
</tr>
<tr>
<td>• Inappropriate findings, end feel, or patient response with the following:</td>
</tr>
<tr>
<td>Scanning examination</td>
</tr>
<tr>
<td>Biomechanical testing</td>
</tr>
<tr>
<td>Stress testing (positive for level desire to treat or cautionary if above or below joint / level treating)</td>
</tr>
<tr>
<td>Dizziness reproduction testing</td>
</tr>
<tr>
<td>• Clinician’s insufficient awareness of contraindication and conditions requiring extra care and gentleness</td>
</tr>
<tr>
<td>• Clinician’s physical limitations for the technique</td>
</tr>
<tr>
<td>• Lack of proper equipment for the technique (e.g. not using a high/low plinth)</td>
</tr>
<tr>
<td>• Pain in the position of the technique</td>
</tr>
<tr>
<td>• Patient’s joint placed in a fully closed packed position</td>
</tr>
</tbody>
</table>

To add to the list above regarding using mobilizations on the canine patient, it would be prudent to add

• Temperament of the dog (i.e. highly anxious / fearful or aggressive)

• Owner anxiety or lack of comprehension of the treatment to be administered

TRACTION

Conservative treatment for cervical disc disease in humans may include cervical traction, analgesic and/or anti-inflammatory medications, and physiotherapy. (Constantoyannis et al 2002; Erhard et al 2004) Traction may have an important role in breaking the “cycle of pain” in cervical radiculopathy caused by herniated discs. The cycle begins when nerve roots are entrapped within the intervertebral foramina. Irritated nerves produce a reflex response to the patient’s cervical muscles, causing those muscles to contract, further narrowing the foramina and increasing neck pain. Intermittent traction helps relieve the inflammatory reaction of nerve roots by improving the circulation and reducing swelling to surrounding tissues. Gentle alternations of stretching and relaxation of soft tissue structures (such as with gentle traction) in the neck prevents the formation of adhesions of the dural sleeve. Human patients with radiculopathy symptoms lasting more than 12 weeks show less favourable improvements with traction, and early intervention is believed to be more successful. Exposure of a herniated disc material in the cervical spine (C/S) to the vascular environment of the epidural space contributes to its resorption and regression. Large extruded discs have wider exposure to resorption mechanisms and
tend to regress more rapidly. The response to early therapeutic intervention in cases where there is a large extruded disc is therefore more favourable. (Constantoyannis et al 2002; Malanga & Nadler 1999)

Treatment protocols that include traction appear to be highly effective in individuals with lumbar pain related to a confirmed herniated lumbar disc with radiculopathy. (Jam 2005) Reports indicate that a treatment protocol which partly included traction as well as other physiotherapy interventions resulted in 90% good or excellent outcome and a in 92% return-to-work rate in 64 patients with CT scan-proven herniated lumbar disc and EMG-proven radiculopathy. (Sal & Saal 1985) In another study, lumbar traction was most likely to be beneficial in patients with acute radicular pain of less than 6 weeks duration and concomitant neurological deficits. (Krause et al 2000)

Conservative treatment (physiotherapy and traction) should always be considered in cases of intervertebral disc disease, even in cases with large-sized disc herniations and/or recurrence of pain. (Constantoyannis et al 2002; Erhard et al 2004) Contraindications for traction therapy include infection, neoplasm, osteoporosis, bilateral pars interarticularis defect, grade 2 or higher spondylolisthesis, fractures, and spinal instrumentation. (Deen et al 2003)

This author has found traction to be able to provide pain relief and functional improvement in dogs suffering from neck or back pain with or without mild to moderate neurological deficits (conscious proprioception deficits) by using traction protocols in addition to therapeutic modalities.

THE MYOFASCIAL SYSTEM

There is a variance of myofascial states that may accompany a vertebral dysfunction (Table 1.4). Treatment of the muscle states is also discussed.

<table>
<thead>
<tr>
<th>Muscle Tone</th>
<th>Description</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertonicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Involuntary splinting</td>
<td>Muscle response is triggered by nociception in an effort to splint the back from further stress and injury.</td>
<td>Ignore the muscle reaction and treat the cause</td>
</tr>
<tr>
<td>Chemical splinting</td>
<td>Also involuntary (as above), it results in the retention of waste products which give rise to back pain. Overuse can also cause chemical splinting. Muscle retaining waste metabolites will appear to have an elevated resting tone and are tender and doughy to touch.</td>
<td>Treatments can include heat, manual muscle therapies, stretching and treatment of the underlying cause.</td>
</tr>
<tr>
<td>Voluntary splinting</td>
<td>Voluntary splinting occurs if nociception reaches the threshold for pain, and the patient voluntarily splints the affected</td>
<td>Treatment involves the prescription of movement and motion needs to be</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Hypotonicity</th>
<th>part.</th>
<th>encouraged.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disuse atrophy</td>
<td>The presence of pain or stiffness has resulted in a loss of normal mobility. The muscles may feel to have lost bulk, lack normal none and feel somewhat fibrous.</td>
<td>Treatment is to restore motion, heat, and treatments to encourage circulation, followed by specific exercises.</td>
</tr>
<tr>
<td>Wasting &amp; fibrosis</td>
<td>The result of neurological or surgical interference with normal nerve conduction.</td>
<td>Treatment is to promote circulation and exercises to train the remaining muscles.</td>
</tr>
<tr>
<td>Normal tone / shortened tissues</td>
<td>Adaptive shortening results from muscles being held in a shortened position.</td>
<td>Treatment includes muscle elongation by stretching or massage.</td>
</tr>
<tr>
<td>Compartment syndrome</td>
<td>Hypertrophy can result in muscle restriction within their fascial compartments, resulting in chronic unilateral or bilateral paravertebral back pain.</td>
<td>Treatment includes mobilizations to vertebral structures and stretching out of the connective tissue envelope</td>
</tr>
</tbody>
</table>

While it is important to address abnormal tone of the spinal muscles, often the primary treatment is to focus on the underlying causes (i.e. the vertebral dysfunction) in order to resolve the muscle issues.

References:


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