

## Masterclass

# The Mulligan concept: Its application in the management of spinal conditions

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**SUMMARY.** The Mulligan concept encompasses a number of mobilising treatment techniques that can be applied to the spine, these include ‘NAGs’ (natural apophyseal glides), ‘SNAGs’ (sustained natural apophyseal glides), and ‘SMWLMs’ (spinal mobilisations with limb movements). These techniques are described and the general principles of examination and treatment are outlined. Clinical examples are used to illustrate the concept’s application to the spine, how it has evolved and been integrated into constantly changing physiotherapy practice. New applications are considered which can assist in the correction of dysfunctional movement. The paper reflects on the possible role that this concept has to play within evidence-based practice. A future research direction is proposed in the light of presently available preliminary research results. © 2002 Published by Elsevier Science Ltd.

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## INTRODUCTION

The Mulligan concept is now an integral component of many manual physiotherapists’ clinical practice. Brian Mulligan pioneered the techniques of this concept in New Zealand in the 1970s. The concept has its foundation built on Kaltenborn’s (1989) principles of restoring the accessory component of physiological joint movement. Mulligan proposed that injuries or sprains might result in a minor positional fault to a joint thus causing restrictions in physiological movement. Unique to this concept is the mobilization of the spine whilst the spine is in a weight bearing position and directing the mobilisation parallel to the spinal facet planes (Fig. 1) (Mulligan 1999). Passive oscillatory mobilisations called ‘NAGs’ (natural apophyseal glides) and sustained mobilisations with active movement ‘SNAGs’ (sustained natural apophyseal glides) are the mainstay of this concept’s spinal treatment (Mulligan 1999). Mulligan proposed that when an increase in pain-free range of movement occurs with a SNAG it is primarily the correction of a positional fault at the zygapophyseal joint, although a SNAG

also influences the entire spinal functional unit (SFU). Recently, the evolution of this concept has supported the use of a transverse glide applied to the spinous process with active spinal movement. A further development in the 1990s was spinal mobilisations with limb movements (SMWLMs). Here a sustained transverse glide to the spinous process of a vertebra is applied while the restricted peripheral joint movement is performed actively or passively (Mulligan 1999). The mobilisation must result in a symptom-free movement. Mulligan (1999) proposed that their application was appropriate when peripheral joint limitation of movement could be spinal in origin. This has further evolved into simultaneous gliding of spinal and peripheral joints with movement. Mobilisations with movements (MWMs) is the terminology used when applying an accessory glide to an active peripheral joint movement and is described in other texts (Mulligan 1993, 1999; Exelby 1996).

Literature on the efficacy of Mulligan’s techniques is lacking and dominated by descriptive or case report publications (Wilson 1994, 1997, 2001; Exelby 1995, 1996, 2001; Vicenzino & Wright 1995; Hetherington 1996; O’Brien & Vicenzino 1998; Lincoln 2000; Miller 2000). Recently, however, research measuring the neurophysiological or mechanical effects has been conducted (Kavanagh 1999; Hall et al. 2000; Vicenzino et al. 2000; Abbot et al. 2001a, b). The majority of this research is confined to peripheral MWMs.

In this masterclass, the principles of examination and treatment are outlined and clinical examples are used to illustrate the concept’s application to the

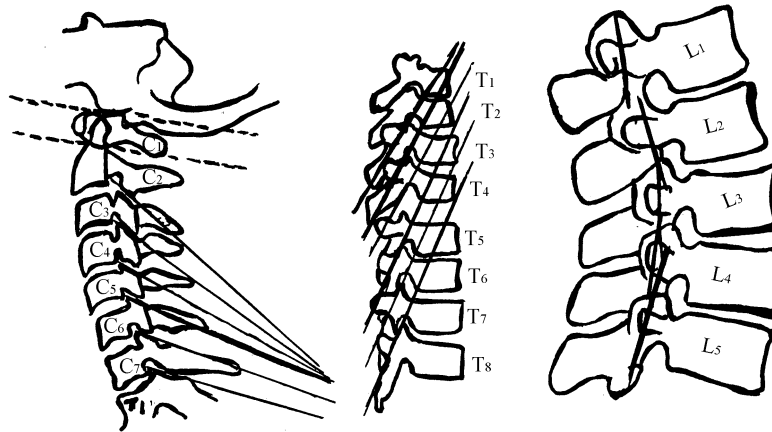
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**Fig. 1**—Orientation of zygapophyseal joints. (Reproduced by kind permission of Chartered Society of Physiotherapy from *Physiotherapy* 81(12): 724–729.)

spine and how it has evolved and been integrated into physiotherapy practice. New applications are described which can assist in the correction of dysfunctional movement. A future research direction is proposed in the light of preliminary research results.

## EXAMINATION

By definition SNAGs involve manually facilitating restricted joint gliding to allow pain-free movement. This in itself can be a simple differential diagnostic tool. SNAGs and MWMs can be a powerful complementary assessment tool when differentiating between more complex clinical presentations e.g. lumbar spine, sacroiliac joint and hip.

The Mulligan concept of accessory gliding with active movement can be further expanded in our clinical practice to justify its place in the assessment of muscle dysfunction. When analysing a functional movement the cause of the symptoms can be established by integrating this concept with Sahrman's theories (2002) namely 'the pathway of instantaneous centre of motion' and 'relative flexibility'. Clinically, a SNAG on a painful mobile level may not always achieve a full pain-free movement whereas restricting the movement of a painful mobile segment or gliding a nearby stiff segment does achieve the desired result. For example, a patient with right-sided C5/6 Cervical and upper arm symptoms of low irritability presented with a limitation of right cervical spine rotation. Full-range right rotation was achieved by applying a left unilateral SNAG on C1 in its horizontal treatment plane. Interventions at other levels had been unsuccessful. The possible explanation may be that the upper cervical spine segment was blocked causing lower cervical spine overstrain. Amevo et al. (1992) demonstrated in cervical pain patients that abnormal instantaneous

axes of rotation (IAR) in the upper cervical spine significantly correlated with pain found in the lower cervical spine segments.

This analysis of functional movement must be used in collaboration with other components of the assessment procedure and is valuable in helping to identify areas on which to focus more specific examination procedures. Intervertebral physiological and accessory active and passive motion testing (Maitland 1986) performed in weight bearing or lying is a necessity when the concept is used in this way. While the Mulligan concept is essentially an articular technique, the principles can be applied to the myofascial system. Fascial tension can be altered or muscle trigger point pressure applied and the response to the movement restriction noted.

## TREATMENT

The strength of this concept also lies in its adaptability and ability to be integrated with most other commonly used musculoskeletal concepts (Wilson 1994, 1995; Exelby 1995). Some clinical examples will illustrate the diversity of this concept in multi-structural integrated treatments.

## NAGs

Mulligan (1999) described NAGs for use in the cervical and upper thoracic spine. NAGs are passive oscillatory techniques performed parallel to the facet joint planes. The anatomical configuration of the upper two joints of the cervical spine necessitates a glide in a more horizontal plane. They are performed with the patient seated. A pillow supporting the arms will reduce tension in the neural tissue and myofascia around the neck and scapula. NAGs are invaluable

when performed well and can be used on most spinal pathology. They are the treatment of choice for more acute inflammatory pathology (Exelby 1995; Mulligan 1999). In the author's experience they are less successful in the cervical spine if patients present with fixed forward neck postures with adaptive posterior soft tissue shortening. In this type of patient a NAG directed in a superoanterior direction may be more difficult and compression of the facet joint surfaces instead could occur. NAGs are particularly useful in the cervical spine for mobilising stiff joints that neighbour hypermobile segments. In this case they are modified and applying the NAG with the thumb, frees up the other fingers to fix the mobile segment anteriorly (Fig. 2). By positioning the patient in side-lying or supported forward sitting NAGs can be performed to the rest of the thoracic spine and even the lumbar spine. In the thoracic spine they can be used for mobilising segments that are fixed in extension (Fig. 3). These patients often have an adverse response to posteroanteriorly directed mobilisations performed in the traditional prone position.



Fig. 2—Localised NAG fixing level below anteriorly.



Fig. 3—NAGs applied in side-lying position to promote flexion in an extended thoracic spine.

## SNAGs

SNAGs as a treatment modality can be applied to all the spinal joints, the rib cage and the sacroiliac joint and are described in detail in Mulligan's book (1999). They provide a method to improve restricted joint range when symptoms are movement induced. The therapist facilitates the appropriate accessory zygapophyseal joint glide while the patient performs the symptomatic movement (Fig. 4). The facilitatory glide must result in full-range pain-free movement. Sustained end range holds or overpressure can be applied to the physiological movement. This previously symptomatic motion is repeated up to three times while the therapist continues to maintain the appropriate accessory glide. Further repetitions may be performed depending on the severity, irritability, and nature of the pathology (Maitland 1986). Failure to improve the comparable movement would indicate that the therapist has not found the correct contact point, spinal segment, amount of force, direction of mobilisation, or that the technique is simply not indicated. SNAGs are most successful when symptoms are provoked by a movement and are not multi-level (Mulligan 1999; Wilson 2001). They are not the treatment of choice in conditions that are highly irritable (Maitland 1986).

Although SNAGs are usually performed in functional weight-bearing positions they can be adapted for use in non-weight-bearing positions. For example they can be applied in lying to McKenzie lumbar spine extensions or they can be applied to the lumbar spine joints in a four-point kneel position (Exelby 2001).

*Facilitating functional movement patterns with SNAGs*  
In problematic patients with mechanical stability dysfunction, treatment of the restriction may not result in long-lasting changes in symptoms. There is a need for these patients to change their posture and dysfunctional movement within their functional

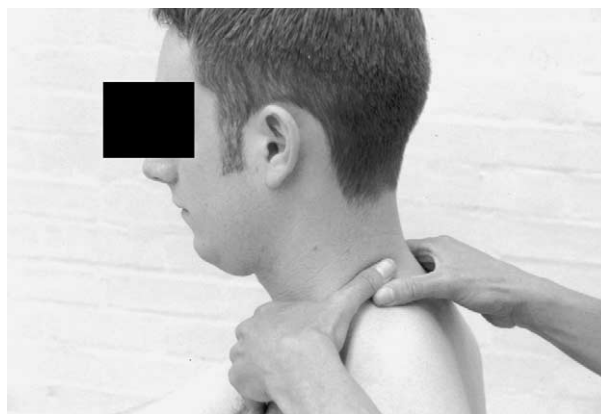


Fig. 4—A unilateral SNAG applied to the left C5 zygapophyseal joint.

demands of daily living (O'Sullivan 2000). Various strategies used by physiotherapists may improve proprioception via joint and muscle receptor input to assist this functional adjustment. In the author's experience this concept can be modified so that an articular glide can be applied to an active corrected movement pattern which can help to provide proprioceptive input to an unfamiliar movement. The application can be progressed to more challenging positions and tasks.

An illustrative example may be a patient that presents with a loss of lower lumbar spine segmental lordosis and excessive upper lumbar spine extension. Passive intervertebral joint testing reveals a limitation of lower lumbar spine extension. A SNAG can be applied to these stiff joints in positions of side lying, sitting or standing while the patient performs a localised anterior tilt with the upper lumbar spine fixed in some degree of flexion (Fig. 5).

*Spinal mobilisation with limb movements (SMWLMs)*  
These techniques can be used for restricted upper or lower limb movements that could be as a result of a spinal joint dysfunction or abnormal neural dynamics (Mulligan 1994, 1995, 1999; Wilson 1994, 1995). A transverse glide is applied to a spinous process by the therapist. This transverse glide results in a rotation of the vertebra to which it is applied. The vertebra can be rotated either way and the neighbouring segment



**Fig. 5**—The upper lumbar spine is fixed in flexion, a SNAG is applied to the spinous process of L5 while the patient actively performs lower lumbar spine extension.

can also be fixed by applying an opposite glide to its spinous process (Mulligan 1999). The latter application is useful when stiff and mobile segments lie adjacent to each other. The direction and level of application is determined by a combination of examination findings such as the symptom referral pattern, palpation of the spine with the active limb movement, passive physiological intervertebral movements (PPIVMs), passive accessory intervertebral movements (PAIVMs) and alignment of the vertebra. These examination procedures will help to provide a more comprehensive picture of the movement dysfunction and reduce experimental gliding with the restricted movement. The author has found in her clinical experience that a corrective glide on the implicated rotated segment achieves the best results.

#### *Spinal mobilisations with arm movements*

Arm movements with cervical and upper thoracic glides (SMWAM) can be applied in weight-bearing or non-weight-bearing positions (Mulligan 1994) (Fig. 6). They can be applied to a general functional movement e.g. a back swing in golf or more specific neural testing positions. An example of the latter may be a limitation of the median nerve upper limb tension test (ULTT 1) (Butler 1991). The patient is positioned with the upper arm supported, the comparable movement is active elbow extension. The therapist applies a transverse glide on a spinous process that enables pain-free elbow extension. The glide is maintained and the pain-free elbow extension is repeated. Neural tissue must be given the respect it deserves, too much repetition of an aggravating movement when trying to identify a pain-easing glide may result in neural tissue irritation. Sound clinical decision making is necessary to decide if this technique is appropriate to the presenting clinical findings. In the above example C7 was restricted and rotated. Elbow extension was improved with a



**Fig. 6**—A sustained transverse glide applied to T1 while the patient performs active shoulder abduction.

corrective transverse glide applied to the spinous process of C7 (Fig. 7).

*Spinal mobilisations with leg movements (SMWLMs)*  
In the lower limb the application of this technique is usually indicated when there is a restriction of the straight leg raise (SLR) (Mulligan 1995, 1999). Once the lumbar spine has been palpated, usually in prone, for intervertebral pain, restriction and alignment, the patient is placed in side-lying position. Further spinal palpation can be carried out with limb movement to assess intervertebral mobility. A transverse glide is applied to a spinal segment while a second person performs a passive SLR. The neighbouring joint can be fixed with an opposing transverse glide. The spinal glide must result in a pain-free passive SLR. The technique can be successfully modified for use by a single therapist (Fig. 8). The thigh and hip are supported on a pillow, the transverse spinal glide



**Fig. 7**—Active elbow extension performed in a modified ULLT 1 position. A transverse glide is applied to the C7 spinous process to correct its rotated position. This results in pain-free active elbow extension.



**Fig. 8**—A SMWLM is performed in side-lying position. The patient's hip is flexed and supported on a pillow. A corrective transverse glide is applied to L5 with L4 fixed while the patient performs active knee extension.

must alleviate the symptoms provoked by active knee extension with or without ankle dorsiflexion. Applying ischaemic compression pressure to the piriformis trigger point (Travell & Simons 1992) while the patient performs active knee extension can also result in marked improvement in sciatic pain and SLR mobility when the spinal glides have proved unsuccessful. This has often proved more successful than releasing piriformis passively. The groups of patients that benefit particularly with this technique are those with a positive piriformis trigger point (Travell & Simons 1992), more chronic symptoms, and post spinal surgery patients. The latter are often left with residual moderate buttock and leg aching.

Further examination of other interfaces in the limbs (Wilson 1994, 1995; Exelby 1996) has been investigated and can be used in conjunction with passive joint or myofascial release work. It is important to remember that the full explanation for the changes in symptoms is probably far more complex than an alteration of local abnormal biomechanics alone.

#### POSSIBLE MECHANISMS AND FUTURE RESEARCH

To date there is no published research establishing the efficacy of the treatment of the spine with this concept. An initial step may be to establish which sub-groups of spinal conditions respond to particular techniques. Multi-centre collection of case study data could identify trends and form the framework on which to base larger studies. For instance, the case series on 'acute locked back' (Exelby 2001) could form the basis for further data collection and research.

A mobilisation with an active movement (MWM) is only one component of the Mulligan concept. Research can take many different pathways but one question in particular to be considered with MWMs is whether the application of a mobilisation *with* an active movement can provide a greater modulatory affect on pain and the motor neurone pool than passive mobilisation in isolation.

Two papers on the application of MWMs to a subgroup of patients with tennis elbow could provide some clues to these neurophysiological responses. A sustained lateral elbow glide with gripping resulted in immediate significant changes of pain-free grip strength (Abbot 2001a). Vicenzino et al. (2000) randomised, double blind controlled study on tennis elbow patients evaluated the effects of the same elbow lateral glide technique on pain-free grip strength (PFGS) and pressure pain threshold (PPT). This study demonstrated an immediate 50% increase in PFGS, with only a 10% increase in PPT. Of particular interest in these studies is what can be

interpreted as the significant modulatory affect to the motor neurone pool. Another study on a similar group of patients that received a cervical spine treatment resulted in a different response with a PPT increase in the order of 25–30% and a PFGS improvement of only 12–30% (Vicenzino 1996, 2000). Comparative studies on tennis elbow subjects will provide further information about the treatment responses of various therapeutic techniques. The use of electromyography (EMG) may give more insight into the interface between pain inhibition and motor response.

To establish the clinical efficacy of therapeutic approaches in the treatment of spinal conditions, methodology that more accurately reflects current clinical practice has been used with specific technique application left to the therapist's discretion. For example, to reflect present popular clinical practice 'manual therapy' has been compared to a 'spinal stabilisation exercise programme' in a chronic low back pain subgroup (Goldby 2001) and a cervicogenic headache population (Jull 2000a). The Mulligan Concept in the light of its manual application to joints would not fit into the 'exercise category' and yet it is more than a passive mobilisation especially in the light of some of its applications to correct movement patterns as proposed by the author.

There is sufficient evidence to demonstrate that stimulation of joint receptors via passive mobilisations or manipulation will have an immediate reflex effect on segmental muscle activity (Thabe 1986; Taylor et al. 1994; Murphy et al. 1995). Colloca and Keller (2001), Herzog et al. (1995), Katavich (1999) and Sabbahi et al. (1990) have also considered the afferent input of manual therapy techniques on other tissues such as muscle. Despite this evidence, Jull's (2000a) RCT on the management of headaches revealed that manipulative therapy *alone* did not improve performance in the cranio-cervical test of deep flexor function and specific exercise *alone* did not improve cervical segmental motion as assessed by manual examination as effectively as manipulative therapy.

A number of investigative procedures are available to test muscle activity e.g. EMG and ultrasound (Hides et al. 1992, 1995; Hodges 1999; Jull 2000b; Moseley et al. 2000), proprioceptive deficits (Revel et al. 1991) and pain response (Vicenzino 1995). These could be used in comparative studies to determine whether there are advantages to the use of MWM's on segmental muscle activity, kinaesthetic sense and pain when compared to other passive manual therapy techniques or direct muscle facilitation. This direction for future research will establish what role these techniques have to play in the correction of movement patterns and the facilitation of local muscle activity.

## CONCLUSION

The strength and enduring capabilities of this concept lie in the founder's philosophy of encouraging integration of these techniques into the individual therapist's clinical practice. This has resulted in a constantly evolving concept that has stood the test of time. Clinical examples serve to illustrate the general use of this concept's principles and how it can also be incorporated with functional activity to assist in correcting joint positional faults within improved quality movement patterns. In the light of present physiotherapy evidence based practice, a future research direction for this concept is proposed.

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