Strategies to overcome size and mechanical disadvantages in manual therapy

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The practice of manual therapy (MT) is often difficult when providing care for large patients and for practitioners small in stature or with other physical limitations. Many MT techniques can be modified using simple principles to require less exertion, permitting consistency with standards of practice even in the presence of physical challenges. Commonly used MT techniques are herein described and demonstrated with alternative preparatory and movement methods, which can also be adopted for use in other techniques. These alternative techniques and the procedures used to adapt them warrant discussion among practitioners and educators in order to implement care, consistent with the best treatment evidence for many common musculoskeletal (MSK) conditions. The inclusion in educational curricula and MT training programs is recommended to enrich skill development in physical therapists (PTs), spanning entry-level practitioners to those pursuing advanced manual skills.

Keywords: Manual therapy, Manipulation, Obesity, Professional issues

Introduction and Scope of the Problem

Numerous evidence reviews of clinical trials have recently elevated the support for manual examination and treatment methods.^{1–7} Additionally, physical therapy clinical practice guidelines specifically cite manual interventions in multimodal approaches for patients with musculoskeletal (MSK) disorders.^{8–12} As such, the utilization of orthopaedic MT can be considered an important skill set among those practitioners evaluating and treating patients with MSK disorders.

The instruction and acquisition of MT skills in physical therapy educational curricula, clinical educational experiences, continuing education courses and in residencies and fellowships remain diverse and challenging.^{13–21} Many techniques can require considerable exertion by the practitioner to move patient body segments of substantial mass, which may be particularly problematic for practitioners of smaller stature or those with physical limitations. This technical challenge of moving large body segments of patients is likely to continue and perhaps become more frequently encountered in the future. Recent data indicate that obesity is present in 34.9% of the US adult population (78.6 million) and 17% of the youth, potentially foreshadowing the dilemma to future physical therapy practice.²² This is particularly noteworthy for patients with obesity, as a condition that has been shown to affect treatment outcomes to MSK conditions.^{23–26}

The expanse of the problem extends beyond technical challenges in performing techniques. The lifetime prevalence of MSK disorders among PTs has been reported to be as high as 91%²⁷ with a one year incidence as high as 21–33%.^{28–30} These high rates of MSK disorders have been attributed to work-related activities.^{31–33} Further, an estimated 14–32% of PTs have lost work time^{27,34} and up to one in six may change work settings or leave the profession because of work-related MSK disorders.²⁷ MSK disorders in PTs may affect activities at home, cause consideration of alternate career paths and raise concerns about longevity in clinical practice.³⁵ The outpatient setting is reportedly involved in 22–64% of PT work-related MSK disorders.^{28,36,37} MT, specifically, has been implicated in multiple studies to be the provocative activity in many of these disorders, largely on the basis of awkward postures and exertion through the upper extremity.^{27,28,32,33,37–42} Body regions of commonly reported work-related MSK disorders in physical therapists are described in Table 1. Data on specific causal relationships of MT and PTs' MSK injuries and detailed injury patterns warrant further study.

The exertion associated with the administration of force with manual techniques may be a factor in these injuries. Experimental studies quantifying force delivery with long lever MT thrust techniques to the lumbosacral region (patient side-lying) has been measured as high as 323 Newtons (72.6 lb-force)–550 Newtons (123.6 lb-force).^{43–45} Non-thrust technique forces, although generally considered lower in magnitude, may

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Table 1 Most frequently reported work-related MSK disorders in physical therapists²⁷⁻⁴²

Body region	One-year incidence rate (%) ²⁸
Low back	6.6
Hand and wrist, includes thumbs	5.3
Neck	4.9
Shoulder	3.2
Upper back	2.4
Hip and thigh	2.3

still generate substantial force, measuring as high as 158 (35.5 lb-force)–250 Newtons (56.2 lb-force).⁴⁶⁻⁴⁹

With these complexities present, the authors' purpose for this paper is to propose that physical therapy educational curricula, postgraduate education programs, and continuing education offerings include instruction in MT techniques for PTs and students who are smaller in stature, with physical limitations, or those treating larger patients. Rendering clinical care consistent with evidence-supported practice, as well as the best interests of physical therapy students, demands the inclusion of methods and strategies to tailor to potential size disadvantages and other practitioner factors while treating patients of larger physique.

Strategies to Minimize Practitioner Disadvantages

Strategies to lessen the stresses on the practitioner during the delivery of MT techniques can include prudently employing several inter-related and integrated methods.

During the performance of MT, the practitioner typically utilizes internally generated movement and force for delivery through the body (e.g. hands, forearm, etc.) to facilitate therapeutic movements within the patient at targeted regions or specific joints while considering and managing external factors (e.g. patient position, table height, etc.). For practitioners at a physical disadvantage, the integration of these internal and external influences may be significantly different than for those of similar or greater stature than their patients. The ability to generate adequately controlled force, acceleration and displacement from the practitioner's upper extremities, particularly the hands, to facilitate therapeutic benefit in the patient may require proportionally more exertion and effort and may exceed, in some cases, the practitioner's capacity when the patient's size presents a physical challenge. The PT, in such circumstances, must consider alternate strategies in order to bring about a similar result.

This paper proposes that a fundamental principle to orthopaedic manual PT is to minimize the external "resistance" moment arm by maximizing the advantage of the internal "effort" moment arm to successfully perform manual techniques. This is especially relevant for the size disadvantaged practitioner. Alignments may be created using patient and practitioner positioning such that superincumbent body weight and mass of the practitioner combined with gravity allow relative increases in the moment arm generated by the practitioner compared to

using some traditional techniques. Similarly, the size disadvantaged or physically challenged practitioner may need to utilize and control external factors to a greater degree than with traditional techniques. The use of tools (e.g. belts, wedges, foam rollers, etc.) and adjustment of the table or treatment surface height, as examples, may allow the practitioner greater ability to generate precise force or movement. Also, the resistance or external moment can be reduced if small segments of the patient's body can be moved rather than large regions. This may include, for example, having the patient actively involved with pre-positioning or passively moving smaller patient body segments instead of larger segments. The use of short lever therapeutic movements rather than long lever techniques, for instance, requires passive movement of less mass. The vertebrae of the target segment may be directly moved rather than using neighbouring regions of the patient's body, such as the thoracic spine or pelvis, to bring about the targeted movement. Additionally, patient positioning and tools may allow gravity assistance to accomplish the desired therapeutic movement with only guidance from the practitioner.

In the example techniques provided in this proposal, these internal and external influences are altered from traditional techniques to accomplish the therapeutic movement.

General Considerations for the Size Disadvantaged Practitioner

- (1) Pre-positioning: Pre-position the patient or complete the technique using smaller body segments of the patient. Additionally, the patient may be able to participate in the pre-positioning process.
- (2) Gravity Assistance:
 - (a) Patient or Practitioner: Position the patient and practitioner to allow the practitioner's upper body weight to be more directly superior in space to the target area of the technique to maximize the effect of gravity.
 - (b) Table or treatment surface: Change the table or treatment surface (height, angle, etc.) to allow the practitioner's body mass to be more directly superior in space to the target area of the technique.
- (3) Mechanical advantage:
 - (a) Tools: The technique can be altered using tools to improve the practitioner's mechanical advantage or augment the PT's force for more efficient delivery to the patient.
 - (b) Shorter lever arms: Use alternate methods that do not require moving as large a portion of the patient's

Figure 1 Alternative technique for lumbopelvic regional manipulation.

weight to accomplish the desired result (e.g. short lever vs. long lever techniques).

Model Techniques

Four examples of manual techniques are provided, which utilize various combinations of the previously described physical factor enhancements to overcome disadvantages in the practitioner–client relationship when delivering MT. Pragmatically, combining the strategies may enhance the efficiency of each, creating a synergistic effect. The benefit for the practitioner may include less exertion and strain with techniques, potentially reducing the risk of injury or exacerbation of an existing problem.

Lumbopelvic regional manipulation

The lumbopelvic regional manipulation is a commonly used intervention with evidence supporting its benefit in patients with low back pain.^{9,18,50} This technique was used to derive and validate a clinical prediction rule for the treatment of patients with low back pain.^{51,52} Historically considered a manipulation to the sacroiliac joint,^{53–55} positive effects have also been observed in multiple segments of the lumbar spine.⁵⁶

Preparation for the lumbopelvic regional manipulation begins with the patient lying supine and the practitioner passively positioning the trunk into lateral flexion followed by opposite direction rotation. Once the trunk is stabilized in this position, a high velocity, low amplitude thrust is delivered through the anterior superior iliac spine (ASIS) of the presumably affected side. The patient positioning done by the practitioner may require moving the lower extremities to initiate trunk lateral flexion. Separately, the practitioner side bends the superior torso, increasing the trunk lateral flexion. This is followed by opposite trunk rotation by passively positioning the patient's shoulders. A frequent technical challenge is sustaining the lateral flexion with the addition of rotation. The traditionally taught

sequencing of this technique has the practitioner attempting to achieve the patient positioning with minimal change in stance from the patient's convex side, while the patient's laterally flexed position is maintained during rotation by lifting or pulling the patient's upper trunk into opposite rotation.^{51,52} With the practitioner standing to the patient's convex side with one arm stabilizing the upper body, the other hand is placed on the ASIS with an extended elbow. Small multi-planar movements are added to specifically engage the motion barrier, before the thrust is administered by a force directed through the patient's ASIS in a posterior–inferior direction relative to the patient.

Practitioners may have difficulty positioning a large patient's body segments during preparation and thrust. If adequate positioning cannot be achieved, the practitioner's ability to stabilize the trunk and engage the barrier may be compromised. Problems may include improper patient positioning, inadequate locking, the practitioner using distant lever arms (away from the centre of mass), faulty body mechanics and inadequate force / speed generation. The result may be inordinate practitioner exertion, patient or practitioner discomfort, diminished clinical effect, and, ultimately, technique abandonment.

An alternate method of accomplishing the technique, with potentially less exertion in the preparation and thrust, uses different pre-positioning to leverage maximal use of the practitioner's superincumbent weight assisted by gravity. The supine patient actively laterally flexes the trunk, if possible. The practitioner assists the completion of the motion in two steps: first, by moving the patient's lower extremities to the end-range lateral flexion by standing at the end of the table of the patient's feet and, secondly, completing the lateral trunk flexion of the upper body by walking to the head of the table and manoeuvring the body at the shoulders. By moving first to the patient's feet and then to the patient's head, the horizontal distance from the practitioner's base of support is reduced in comparison to the more traditionally taught set-up of passively moving the patient's upper and lower body while the practitioner is standing at the level of the pelvic region, lifting through a longer moment arm. The shorter moment arm reduces the lifting load for the practitioner. Trunk rotation is accomplished by gently rolling the upper body with care to maintain the lateral flexion, again by standing near the head of the table. If lateral flexion is not maintained, this preparatory positioning is regained by pushing the patient's upper trunk, principally from the practitioner's base of support, rather than lifting or pulling. Contrary to the traditional technique,^{18,57,58} the practitioner stands on the concave side of the patient's trunk then kneels on the plinth so that the anterior thigh of the lower limb near the patient's head is supporting the patient's posterior upper trunk and shoulder region. The same side hand of the practitioner can assist stabilizing the patient's upper body, while the palm of the other hand is placed over the ASIS with the elbow extended. Once an optimal barrier is achieved by applying

Figure 2 Lumbar translatoric lateral flexion.

Figure 3 Thoracic spine anterior-posterior manipulation with a foam roll.

pre-load, a high velocity low amplitude thrust is delivered by thrusting with the practitioner's body weight through the patient's ASIS via the extended elbow, maximizing the benefit of gravity (Fig. 1; Video 1).

This alternative positioning for lumbopelvic manipulation maximizes the use of gravity and superincumbent weight to assist the manipulation and stabilization forces consistent with the line of gravity in the pre-thrust preparation. In the authors' opinion, compared to the traditional method, the set-up theoretically minimizes the practitioner's effort of pulling and lifting of the patient's trunk.

Lumbar translatoric glide in lateral flexion

Translatory manual techniques have been described by Krauss and colleagues⁵⁹ subsequent to development by Evjenth and Gloeck,⁶⁰ in consultation with Kaltenborn. In contrast to many traditional methods, the translatory techniques focus on short lever mobilizations and

manipulative thrusts. As such, fewer body sections and less mass are passively moved to accomplish the therapeutic movement.⁵⁹

An example is the lumbar translatory glide technique. The sequence to position the patient for the technique can begin with the patient initially prone or sitting. From the seated position, the patient simply places the treatment side upper extremity in shoulder extension, posterior to the trunk upon assuming a side-lying position. The practitioner may assist the patient by raising the patient's lower extremities onto the table surface. Alternately, if the patient begins in prone, the practitioner can use a gentle sweeping motion to position the patient's knees and hips into a flexed and side-lying position towards the side of the table nearest to the practitioner by pushing the patient's lower extremities, using the practitioner's hips to cradle and simultaneously pull the patient's knees. The patient is in combined trunk side-lying and rotation with the hips and knees flexed to achieve lumbar and thoracic spine flexion. A small amount of contralateral rotation is introduced, assisted by gravity, by positioning the patient's shoulders. The hinged treatment table segment can be lifted to create greater trunk lateral flexion on the target side.

Once the patient is pre-positioned, the practitioner faces the patient and places the knee nearer the patient's pelvis on the treatment table with the anterior thigh supporting the patient's abdomen. The ulnar border of the hand nearer the patient's head is seated against the lateral aspect of the spinous process of the superior vertebra of the target segment opposite the treatment side. The PT's other hand reinforces the initially placed hand in direct contact with the patient. With the trunk stabilized and the practitioner aligned directly over the patient's lumbar spine, a translatory force is applied against the lateral aspect of the spinous process of the superior lumbar vertebra of the target segment (concave side) by allowing the superincumbent weight to drop through the practitioner's upper extremities. The practitioner's movement is directed towards the table, assisted by gravity and may be thrust or non-thrust (Fig. 2; Video 2). The patient's pre-positioning with adaption of the hinged table to enhance lateral flexion of the spine allows the practitioner to apply force consistent with gravity, while achieving a therapeutic movement.

Thoracic anterior-posterior manipulation with a foam roll

Thoracic spine manipulation has been shown to be an effective MT intervention for a variety of MSK conditions. Beyond thoracic pain and rib dysfunction, evidence also supports thoracic spine manipulation for the treatment of neck pain, cervical radiculopathy, temporomandibular dysfunction and shoulder pain, including signs and symptoms of rotator cuff tendinopathy.^{1,5,61-66} The concept of regional interdependence suggests that the thoracic spine treatment may yield meaningful clinical changes to these

Figure 4 Hip mobilization over a towel roll, posterior to anterior.

areas, perhaps based on biomechanical and neurophysiological relationships.^{8,67-69}

As a standard of orthopedic clinical practice,⁸ one commonly method taught in both graduate and postgraduate education is the supine anterior–posterior (A–P) thoracic manipulation (otherwise known as the sternal thrust).^{4,67,70,71} The supine patient interlocks fingers across the base of the neck to allow support for the cervical spine and create a lever. The practitioner reaches around the patient posteriorly with the manipulative hand to stabilize the inferior vertebra of the targeted motion segment. The other hand holds the patient's elbows to stabilize the upper trunk. Once adequate patient positioning and pre-load are achieved, a high velocity, low amplitude, A–P force is applied by pushing down through the patient's arms, consistent with the long axes of the humeri. This technique may present several physical barriers to the out-sized practitioner, such as the inability of the manipulative hand to reach around a patient with a large trunk, inadequate force application or direction because of disproportionate practitioner to patient mass. Additionally, some practitioners report their hands to be too small to achieve adequate stabilization between the patient's overlying body mass and the table.

A variation of the A–P thoracic manipulation technique uses a tool, in this case, a foam roller (approximately 4–6 inches/10–15 cm diameter), and alternate positioning to augment the force of the thrust assisted by gravity. The patient lies supine on either a treatment table or floor with fingers interlocked posterior to the base of the neck. The foam roller has been previously placed under the patient across the mid-thoracic spine region, inferior to the targeted segment. The therapist stands over the patient, adducting the elbows while slightly flexing the thoracic region. Patient positioning can be amended and pre-loading achieved by the practitioner further adjusting the patient's upper trunk by leveraging through the manual contact with the patient's elbows. A high velocity, low amplitude, A–P force is applied through the patient's

elbows, pushing towards the floor consistent with the long axes of the humeri (Fig. 3; Video 3).

The modified technique uses the strategies of tools (foam roller) and the practitioner optimizing body alignment for gravity assistance. Additionally, the direct force resulting from the combined patient's and practitioner's weights are delivered through the tool rather than the practitioner's hand.

Hip Mobilization, Posterior to Anterior (P–A)

MT directed at the hip has been used to treat of a variety of conditions such as hip osteoarthritis, knee osteoarthritis, knee pain and low back pain.⁷²⁻⁷⁶ One commonly taught mobilization is the P–A hip mobilization.^{21,77}

As classically taught, the practitioner stands to the side of a prone patient. One hand supports the patient's leg in slight hip extension while the other applies an oscillatory force in the P–A direction at the posterior hip.^{18,77} This technique may be physically difficult for a smaller practitioner to manage for two reasons: inadequate strength and endurance to lift and hold the patient's leg while employing a short lever arm and lack of height to generate an efficient mobilization force and direction.

A modification of the P–A hip mobilization practices an alternate patient position and the tool of a towel roll to facilitate gravity assistance during the therapeutic motion. The patient lies supine, close to the edge of the table (the non-treatment hip may be flexed to prevent the lumbar spine from extending). A towel is rolled and placed under the extended proximal femur (area of gluteal fold) and the patient lowers the limb off the edge of the plinth, which may be assisted by the practitioner. The ASIS is stabilized with one hand while the practitioner implements a posteriorly directed oscillatory force through the distal femur, creating a fulcrum with the towel roll directing a P–A force through the area of the hip joint (Fig. 4; Video 4).

This technique uses a combination of assistive strategies: a towel roll for a tool, optimizing mechanics of the practitioner with positioning of the patient and use of gravity to assist the practitioner apply a force in the P–A direction.

Discussion

The use of MT as an effective and cost-saving intervention in the management of some MSK disorders is widely accepted.⁸⁻¹² The observation of the authors is that many students and practitioners, however, may encounter difficulties in the delivery of manual interventions due to physical factors, such as small stature or other physical challenges. Additionally, large patient size is frequently a factor, exacerbated by ever increasing rates of obesity in the populace. Traditional manual treatment techniques directed at regions such as the lumbopelvic region, thoracic spine and hip, often require moving substantial portions of the patient's body mass through exertion on the practitioner's part. These techniques potentially increase

the risk for work-related MSK disorders in practitioners and can impact career trajectories and longevity. Students and practitioners encountering difficulty with performance of these techniques may compromise their clinical reasoning processes and subsequently choose other less evidence-supported interventions for their patients with possible consequences in patient outcomes. The need exists for students and practitioners to have access to alternative manual techniques to allow practice consistent with the standard of care and without elevating risk for compromise to their own well-being. Students in educational curricula may benefit from their programs' considering an expanded scale of multidimensional clinical problems likely to be encountered. The needs of all students, including those small in stature or confronting their own physical challenges, warrant consideration in the instruction, acquisition and assessment of manual skills. In addition to the full spectrum of manual techniques, thrust and non-thrust, as required by the Commission on Accreditation in Physical Therapy Education,⁷⁸ the physical capabilities of all students and entry-level practitioners also need to be considered. Similarly, postgraduate MT programs, particularly residency and fellowship programs, may need to include alternative MT strategies and techniques to accommodate smaller stature participants or those with physical limitations to encourage full competence in the administration of MT within a comprehensive treatment strategy for MSK conditions. Numerous techniques and alternate strategies exist with the aforementioned methods being only examples. These techniques are models of principle application and are not prescriptive. Additionally, practitioners may create or modify their own techniques by employing the described basic principles to maximize their own capabilities.

No data exist on whether techniques such as these actually reduce the risk of work-related MSK disorders among practitioners or encourage the use of MT for those outsized by their patients. Validating the performance of these techniques as reductive of injury risk compared to many traditional techniques will be difficult to accomplish. Isolating these as the only variable associated with less injury would be methodologically challenging for investigators. A survey of final-year physical therapy students, however, cited alternate manual techniques as a preferred strategy to lessen their risk of injury upon entering practice.⁷⁹ Additionally, the experiences of the authors during MT instruction is that practitioners and students report perceiving less physical strain and exertion when performing techniques such as these. Practitioners small in stature or with other physical challenges of their own have spontaneously reported greater comfort in performing MT using these approaches during classroom and postgraduate clinical instruction by the authors. The *prima facie* value of less physical strain in performing these techniques merits their consideration in simultaneously enhancing practitioner

efficiency, promoting well-being for the practitioner as an individual and potentially improving patient outcomes by consistency with the standard of care. Additional research validating the effectiveness of these techniques in patient outcomes is needed.

Conclusion

MT techniques, which require less exertion and impose less strain on the practitioner, are potentially of value for the clinician and the patient. Practice patterns consistent with the standard of care can be maintained by small practitioners or those with other physical limitations, or simply when PTs are administering care for large patients. In enhancing evidence-supported practice, patient outcomes and the well-being of practitioners may be positively affected. These techniques and the methods by which other techniques can be similarly modified should be considered for inclusion in physical therapy educational curricula, clinical education, postgraduate training programs and standard clinical application.

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Conflict of Interest

The authors have no conflicts of interest represented herein.

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