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Major limb amputation and the relevance of osteopathic manipulative medicine in management

Zachary Comeaux, DO, Edwin Avallone, OMS-4

From the West Virginia School of Osteopathic Medicine, Lewisburg, WV.

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Major limb amputation, traumatically or nontraumatically induced, is a major life-changing event, often precipitating chronic pain, dysfunction, and altered self-image. This article explores the relevance of osteopathic manipulative treatment in management of the patient with major limb amputation, using the lower limb as an example and focusing primarily on issues related to gait and psychological independence.

An estimated 185,000 Americans undergo major limb amputation each year for a total prevalence of approximately 1.5 million. Academic estimates reflect that lower limb amputation represents 30% of all amputations.[1] Although lower limb amputation among casualties from improvised explosive devices is respectfully recognized as a tragic cost of war, specific incidence figures are guarded information. However, the risk for lower extremity amputation is estimated at 15 to 40 times higher among persons with diabetes than among persons without diabetes.[2] Regardless of cause, major limb loss, an arm or a leg in colloquial terms, reflects a significant life-changing event.

The immediate postsurgical period involves a disciplined approach requiring pain management as well as rehabilitative services. Care depends largely on context and resources. Once optimal adjustment is reached, the patient usually becomes preoccupied with periodic maintenance of the prosthesis and pain management, including phantom limb pain if present. Yet, latent issues—both physical and psychological—may remain. Although literature review is limited to one case report,[3] clinical experience suggests means by which osteopathic manipulation may be a significant contributing factor in ongoing patient management in this context.

Gait-critical structure and function changes with amputation

Studies have long shown the increased energy use by unilateral lower limb amputees, even with the use of prosthetic devices.[4] Use of assist devices such as crutches yields similar results.[5] Reflecting on the basic osteopathic tenet that the body functions as a unit, this makes sense, but why?

In addition to neurologically controlled specific muscle activation, development of momentum involves articular flexibility and soft tissue compliance regionally, but often of the whole body. In the specific example of gait, the arrangement of the torso and limbs may be considered to contribute to balance and efficient energy use. The author theorizes that the role of the fascia of the torso, as cited by Vleeming,[6] is critical. Vleeming describes the diagonally crossed relations of the thoracolumbar fascia as a point of reciprocal interaction between the lower extremity (gluteal muscles) and the upper extremity (notably the trapezius and latissimus muscles) and associated fascia. Myers[7] and van der Wal[8] reiterate these same regional functional anatomic relationships. Efficient, normal gait depends on gross axial

Corresponding author: Zachary Comeaux, DO, West Virginia School of Osteopathic Medicine, 400 N. Lee St., Lewisberg, WV 24901.
E-mail address: zcomeaux@osteo.wvsom.edu.

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symmetry maintained in dynamic balance. The authors of this article suggest that unimpaired upper and lower extremities, as well as a flexible spine and distensible connective tissue matrix, contribute to efficient gait by channeling much of the kinetic energy of each cycle as potential energy for the next stride. The radial arrangement of muscle fibers around the hub of the L3 area mirrors this aspect of function. This efficiency is based on an intact body and the reciprocal contribution of paired limbs. Major limb amputation, upper or lower, significantly compromises symmetric balance and therefore effective, rhythmic, and energy-efficient gait.

As cited above, limb loss, as well as the use of gait-assist devices, impairs torso torsion, which serves to conserve energy between strides and increase energy cost in assisted gait.[5] In lower limb amputation in particular, the use of a prosthesis hampers rhythmic recoil of connective tissue in the trunk present in normal gait. Thus the mechanism for the relay of energy from stride to stride is compromised. A review of diagonal linear arrangement of the paraxial muscle fibers of the trunk as well as of the lumbosacral fascia reminds us of the force distribution involved with the trunk and pelvis in normal gait. As a consequence of disrupting regional force distribution and tissue load characteristics, other tissues—often the contralateral partner in paired relationships such as the knees, hips, or associated musculature—encounter increased work in a less efficient manner. Over time, this can lead to increased wear.

The removal of the distal attachment of the thigh musculature caused by above-knee amputations (AKAs) alters limb movement (most notably on the side of the prosthetic limb) during the swing phase of gait. As such, it represents a "somatic dysfunction." Chronic somatic dysfunction quite frequently leads to compensation elsewhere. Secondary muscles, including the iliacus, psoas, and quadrates lumborum, assume more of an active role in limb displacement, replacing natural recoil and coordinated swing. The hypertonia associated with relative overuse of these muscles may create compensatory spinal dysfunctions at their proximal lumbar attachments. These in turn can lead to further compensation or decompensation at the lumbosacral junction, or at the contralateral sacroiliac joint, among other tissues, because of asymmetric loading and wear.

Role of the upper extremity

The upper extremity's participation in gait as arm swing, along with torsion of the thorax, is another major element of energy conservation between gait cycles. The literature cited above on efficiency of crutch use supports this. Upper limb amputation, in a fashion similar to lower limb amputation, can alter gait rhythm in this way, also contributing to asymmetric gait. However, the fact that the upper extremity is not involved in weight-bearing diminishes its role in force transfer. As a result, upper limb loss leads to less intense secondary complications.

However, upper limb function becomes more critical in the lower limb amputee who elects to use crutches rather than rely on a leg prosthesis. This situation results in weight-bearing being transferred to the shoulder joints as well as a different force distribution (traction versus compression) to the lumbar spine and pelvis during the swing phase. Accelerated osteoarthritic changes may occur, especially in the glenohumeral joints.

Role of OMT

Osteopathic manipulation is commonly conceptualized to restore normal function by reestablishing normal relationships in functional anatomy. Diagnosis is made by assessing for somatic dysfunction based on body symmetry, tissue texture, tenderness, and quality of motion.[9] When complete structural integrity cannot be restored, such as is the case with amputation, another function is to optimize function in the face of the chronic or permanent impairment. As a secondary or tertiary preventive strategy, osteopathic manipulation can decrease the effect of compensation or decompensation in affected joints, ligaments, and musculature. Need or benefit will vary on a case-by-case basis dependent on history and findings. Any osteopathic approach to pain or dysfunction requires seeing the patient from the point of view of rational problem solving, and searching for causes rather than syndrome labels and algorithmic solutions. In the patient with amputation, pain may present for all the reasons possible in the intact patient. In addition, one should factor in the altered structure and consider the problem of gait dynamics mentioned above.

A case

Charles is a 48-year-old above-knee amputee, the surgery 12 years ago resulting from a gunshot wound acquired during a dispute among peers. He presented new to a family medicine practice for continuation of narcotic pain medication. He complained of limited stump pain that tended to worsen with bad weather. However, his more salient complaints were low back pain and phantom limb pain, the latter occurring episodically, beginning as a severe stabbing sensation on this absent foot and progressing up to the stump. His low back pain was an ache from his mid to low back. The patient admitted to narcotic habituation and that a refill was the main reason for making the appointment.

Musculoskeletal examination revealed right upper thigh amputation, with the hip and sacroiliac joint remaining intact. Tissue texture change at the thoracolumbar junction with T12 flexed, rotated, and side-bent left corresponded to a positive right iliopsoas tender point anteriorly (origin and insertion). L5 was extended, side-bent, and rotated left. The sacrum demonstrated findings consistent with left-on-left rotation with a compensatory posterior rotation of the innominate bone.

Because the patient had been through a short period without medication, we used the occasion to reset a new base line for narcotics, introducing gabapentin and tramodol before resuming hydrocodone at a lower dose. During the drug negotiation period, we introduced the patient to the rationale for OMT and the patient received muscle energy, myofascial release, and articulation for the identified dysfunctions using conventional protocols.[10] Procedures were modified, using a firm grip on the lateral ilium in situations normally calling for the use of the lower limb as a long lever, to avoid unseating the prosthetic limb. The patient, over a period of six weeks, acquired a level of comfort and requested continued OMT as maintenance. Episodic phantom pain recurred inconsistently.

Continuing need

In addition to the secondary preventive benefits related to the physical need to amputate, amputation represents an unpredicted stressor. Altered functional capacity and social function add another level of adaptive stress. Either of these can readily lead to anxiety or depression. Permanency leads to fatalism. If the inciting cause were traumatic, as in combat, the patient may additionally have to deal with posttraumatic stress disorder.

Traditional osteopathic research and literature cite the role of the sympathetic nervous system in segmental facilitation as well as viscerosomatic and somatovisceral reflexes.[11] Anxiety and depression, considered at the somatic level, may be conceptualized as a generalized state of facilitation, hypersympathetic arousal, resulting in somatosomatic hyperarousal, creating an affective loop. Treatment of selective thoracic somatic dysfunctions, if present, along with rhythmic thoracolumbar myofascial release may decrease baseline anxiety. A protocol for dealing with this is also routine in Robert Fulford's percussion vibrator treatment.[12]

The elusive phantom limb differential mechanisms

Numerous pain syndromes have been described in the literature in relation to amputated limbs, usually initiating the primary discrimination among phantom limb pain, phantom limb sensation, and stump pain. Diagnosis may also be confounded by the continuum in which these processes manifest. The hallmark difference between stump pain and phantom limb pain or sensation is the presence of peripheral nervous tissue transmitting the pain signals. Intrinsic stump pathology such as scarring and neuroma formation may complicate existing phantom limb pain. Phantom limb sensation describes a patient who has undergone amputation yet retains sensation in an absent limb or the sensation of voluntary movement. If those sensations of an absent limb include pain, the diagnosis strongly suggests phantom limb pain. There is an ongoing debate regarding residual peripheral stimulation of nerve endings versus afferent parietal cortex sensitization as a primary cause of symptoms.[13,14] Complex regional pain syndromes I and II, nerve transection–related pain, posttraumatic neuralgia, and central pain syndromes, as well as occult tumor, also deserve consideration in a patient presenting with phantom pain. Comorbid anxiety and depression may enhance the extent or significance of the symptoms. Thoughtful touch can add to the interdisciplinary treatment of this component.

Whether a peripheral or central mechanism is responsible, phantom sensations may be attenuated by feelings of well-being after OMT. In addition, the structural basis of osteopathic diagnosis and treatment can lead to a shift of attitude and attention from fatalism to empowerment, especially when combined with appropriate home exercise to enhance the intent of the manipulation. This has been the case in the ongoing management of the case cited above.

Conclusion

Despite the trend toward evidence-based preference in practice, compassionate treatment of a number of conditions remains a medical responsibility. Rational use of osteopathic manipulation in a case-specific context appears to have a place. Treatment is based on common fundamental principles, but in the amputee, correcting for compensations and decompensations after structurally altered gait is a starting point. Attitude is an additional dimension of function targeted in OMT. The authors recognize the absence of supportive outcome studies but hopes this article will stimulate interest in this area.

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