Restoring Full Squat Range of Motion by Applying OMT to Superior Innominate Shear: A Case Report

Drew D. Lewis, DO, FAAO, and Jonathan Pickos, OMS V

CASE REPORT

Abstract

Hamstring injuries in sports are common and often require rest or more active rehabilitative efforts before returning to sport-specific participation. This case report provides a potential framework of osteopathic manipulative treatment (OMT) for an acute traumatic superior innominate shear where traditional medical treatment, including physical therapy sessions, failed to provide significant and/or complete resolution.

In the present case report, a 17-year-old male high-school athlete presented with hamstring strain and proximal hamstring and low back pain, following a hurdle injury with fall on extended knee. He was found to have significant somatic dysfunctions related to his condition. An OMT approach was utilized to provide relief, restore his full squat range of motion, and ultimately return to non-restricted football and basketball participation.

From the Des Moines University College of Osteopathic Medicine in Iowa.

Financial disclosures: None reported.

Correspondence address:
Drew D. Lewis, DO, FAAO, FAOCPMR
Associate Professor, OMM Department
Des Moines University
3200 Grand Ave.
Des Moines, IA 50312
(515) 271-1429
drew.d.lewis@dmu.edu

Submitted for publication September 20, 2018; final revision received December 20, 2018; accepted for publication January 25, 2019.

Background

Hamstring strains represent a large portion of musculoskeletal injuries in sports at the high school, collegiate, and professional levels with track, football, and rugby athletes being particularly susceptible to these injuries.[1] The common origin of the hamstring musculature on the ischial tuberosities of the pelvis represents a possible intersection for hamstring injuries and unilateral superior innominate shears. By extrapolation, it is possible that a superior innominate shear could cause a hamstring strain and vice versa. The overall incidence of unilateral superior innominate shear, otherwise known as innominate upslip,[2] has not been identified or examined.

Travell and Simons[3] detailed the relationship between painful conditions related to dysfunction of the quadratus lumborum muscle and the predisposing and perpetuating issue of a leg length discrepancy or short leg syndrome. In the authors' experience, quadratus lumborum strains can be causative or maintaining factors of superior innominate shear somatic dysfunction and similarly painful conditions.

In a study by Qureshi et al[4] examining the effects of somatic dysfunctions (SD) on leg length discrepancy (LLD), the authors found 26% of participants displayed a left superior shear, and approximately 7% demonstrated a right superior shear, all of which were asymptomatic. The possible connection between hamstring strain injuries and superior innominate shear has not been further investigated.

The purpose of this case report is to provide an osteopathic manipulative medicine approach to a patient who is an athlete suffering from chronic hamstring strain symptoms related to a track and field injury that failed to resolve with physical therapy.

Optimal management of the patient's recovery included addressing significant somatic dysfunctions, progressive increases in activity participation for athletics, and stretching prescription for persistent muscular tightness.

Report of Case

Presentation

A 17-year-old boy presented to the authors in a clinical setting. He described a chief complaint of 10 weeks of right proximal hamstring pain, decreased range of motion, and limited activity in high

(continued on page 8)

(continued from page 7)

school summer football sports preparation. The symptoms started during track season after a misstep during hurdle training where the patient described clipping a hurdle with his back (left) leg and landing with the right leg at approximately 45 degrees of hip flexion with the leg fully extended and ankle dorsiflexed *(see Image 1)*. He described a burning, pins and needles as well as sharp-stabbing pain with tightness. Pain was rated a 5 to 7 out of 10.

Image 1. *Patient's mechanism of injury re-enacted: ankle dorsiflexed, knee fully extended, hip at approximately 45° of flexion.*

Symptoms were present over the whole posterior thigh region but radiated up into the buttock at times *(see Figure 1)*. Symptoms were aggravated with walking or sitting for extended periods. Pain was persistent since the injury and range of motion worsened with increasing activity. The patient also reported weakness in the knee with "cutting" movements and the knee giving out on him once while playing basketball. No knee pain, clicking, or swelling occurred either immediately after the hurdle injury or later, and he denied any diagnosed knee joint condition. He denied any prior injuries to the knee, hip, or low back. Functionally, he reported jogging was OK but running was not tolerated. He had to cancel playing in the summer basketball league and was anxious that he would not be able to participate in summer football training.

The patient did not have any imaging done after the injury. He described using ice as needed. Ibuprofen was taken as needed with mild relief. He reported attending 12 physical therapy sessions focused primarily on strengthening with minimal improvement in symptoms.

His goals were to "get better and go back to sports without pain."

Medical History and Review of Systems

Medical history was significant for growth of 8 inches (height 77 in.) over the prior 2-3 years. Cetirizine was taken daily for environmental allergies, and the patient reported a history of asthma.

The patient did not have a history of any surgeries. Family and social history were also non-contributory.

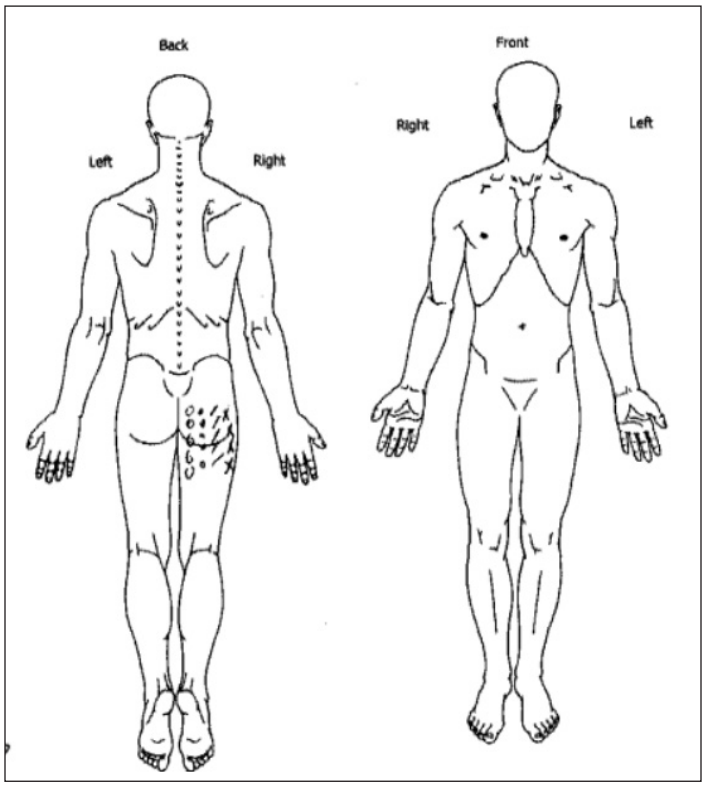
Physical and Osteopathic Structural Exam

The patient's vital signs were stable. Upon cognitive examination, the patient was alert, oriented, and in no acute distress. He followed commands without difficulty. Mood and affect were appropriate, and he was well groomed. Language was normal in fluency, content, context, intelligibility, and response latency. Gait exam revealed slight tilt of torso to left; otherwise, no ataxia or imbalance was appreciated. Heel and toe walking were without weakness or difficulty. Cranial nerves were grossly intact. Gait exam revealed normal stride, heel/toe progression without gross asymmetry or deviation.

A modified ASIA (neurologic) exam[5] was performed for the lower half of the body. Sensation was intact to light touch in the bilateral L2-S2 dermatomes. Deep tendon reflexes were 2/4 in the bilateral patella and 2/4 in the bilateral Achilles. A motor exam revealed 5/5 full strength in lower limb muscles assessed, including hip

(continued on page 9)

Figure 1. *Pain diagram on initial visit intake form. Legend: o o o = pins and needles; • • • = tightness; / / / = stabbing; X X X = burning; ▲ ▲ ▲ = aching*



(continued from page 8)

flexors (L2), knee extensors (L3), ankle dorsiflexors (L4), great toe extensors (L5), and knee flexors (S1). Plantar reflex responses were downward bilaterally. Clonus in the ankle was 1 beat bilaterally.

Active lumbar (trunk) range of motion (ROM) was without pain or gross deficits in flexion, extension, sidebending, and seated rotation.

Straight leg raise produced pain in the upper thigh on the right, but was negative on the left. Bragard test was negative bilaterally. An Adams forward bend test was negative for rib hump or signs of scoliotic curvature. Unilateral supine hip flexion was pain free and Thomas sign was absent bilaterally. Passive hamstring ROM testing (supine, hip flexed 90°) revealed -35° from full extension on the right, but only -5° full extension on the left. Hip ROM revealed passive external rotation was mildly restricted to 40° on the right, and grossly normal at 55° on the left. Hip internal rotation ROM was grossly normal and pain-free bilaterally. Patrick (FABER) testing was positive on the right with lateral hip pain produced.

Examination of the bilateral knees revealed no swelling, redness, bony prominences, effusion, or other abnormalities on inspection and palpation. Right knee testing revealed negative anterior and posterior drawer, Lachman, McMurry (medial/lateral), varus and valgus testing.

Physical examination findings were significant for decreased range of motion when attempting to squat to full depth *(see Image 2)* as well as decreased range of motion with knee extension on the right. Hip flexion, internal rotation, external rotation, and knee flexion were without gross deficits bilaterally.

A focused structural exam was performed at the first visit. The following somatic dysfunctions were appreciated: right quadratus lumborum (QL) tender point, biceps femoris (BF) tender point, left-on-left forward sacral torsion, and right superior innominate shear (upslip).

First Treatment

The somatic dysfunctions were treated with osteopathic manipulative treatment (OMT) techniques. Still technique was used for the right superior innominate shear. Counterstrain was used for tender points of the quadratus lumborum and semimembranosus muscles. Soft tissue techniques were used for general muscular tightness in the thoracic and lumbar regions *(see Table 1)*. On reexamination, the somatic dysfunctions were resolved, and the patient experienced immediate improvement in range of motion (approximately 25° by visual estimation) while squatting.

(continued on page 10)

Image 2. *Patient's decreased squat range of motion on initial presentation to the clinic.*

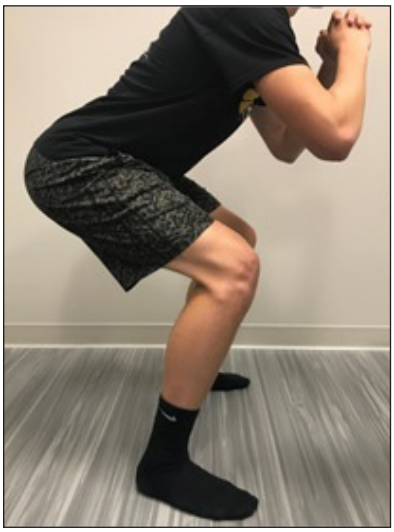


Table 1. *First OMT session, given at initial visit.*

Body area	Somatic dysfunctions	Technique applied
Lower extremity	Semimembranosus tender point (tp), right	Counterstrain (CS)
Lumbar	Lumbar paraspinal tightness, bilaterally Quadratus lumborum tp, right	Soft tissue (ST) CS
Thoracic	Thoracic paraspinal tightness, bilaterally	ST
Pelvis	Superior innominate shear, right	Still
Sacrum	Left-on-left forward sacral torsion	Muscle energy (ME)

Table 2. *Second OMT session, given 1 week after initial visit.*

Body area	Somatic dysfunctions	Technique applied
Lower extremity	Semimembranosus tp, right Piriformis tight, right Psoas tight, left	CS ME, Still ME
Lumbar	Lumbar paraspinal tightness, bilaterally Quadratus lumborum tp, right Iliac crest high, left pelvic roll, right fascial pattern	ST CS ME
Thoracic	Thoracic paraspinal tightness, bilaterally Thoracolumbar shift, right fascial pattern	ST ME
Pelvis	Superior innominate shear, right Anterior rotation, right innominate	Still ME, leg tug
Sacrum	Left-on-left forward sacral torsion	ME

(continued from page 9)

Second Treatment

The first follow-up visit occurred 1 week later. The patient reported significant improvement, decreased pain, and increased ability to participate in football practice.

A broader osteopathic structural exam was performed, revealing significant somatic dysfunctions of the lower extremities, pelvis, sacrum, lumbar, and thoracic spine *(see Table 2)*.

Figure 2. *Pain diagram on follow-up at third OMT session. Legend: o o o = pins and needles; • • • = tightness; / / / = stabbing; X X X = burning; ▲ ▲ ▲ = aching.*

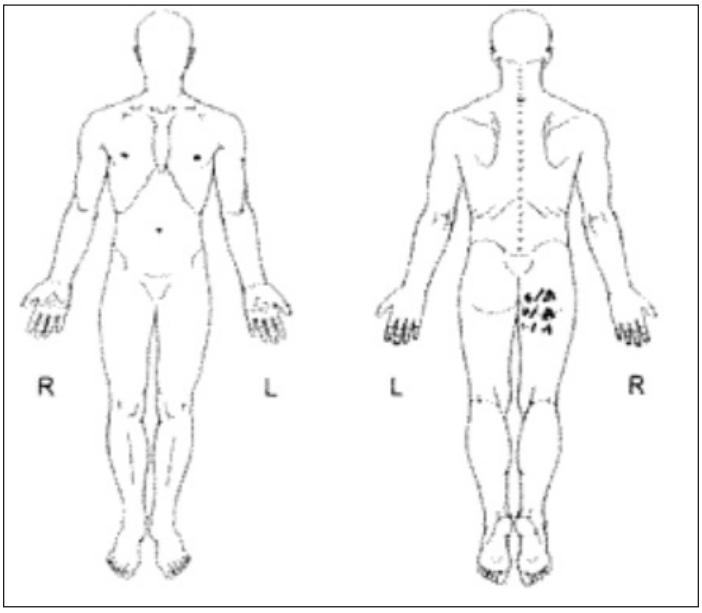
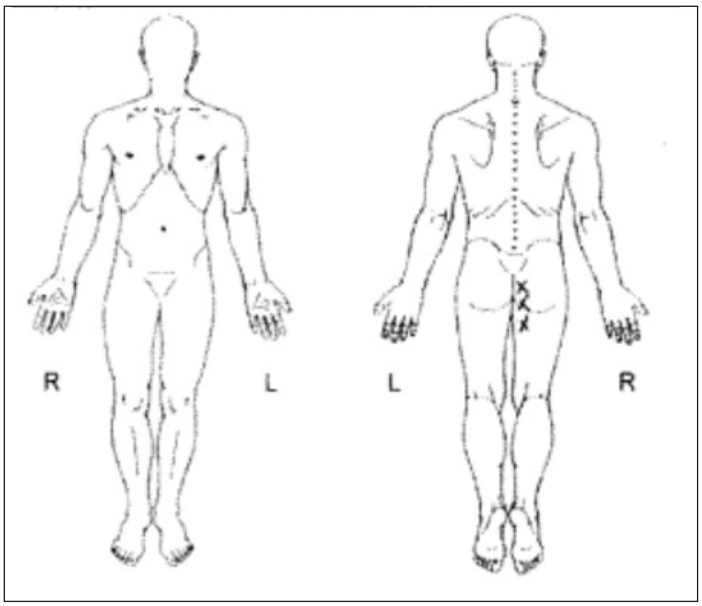


Figure 3. *Pain diagram on follow-up at fourth OMT session. Legend: ▲ ▲ ▲ = aching; / / / = stabbing; # # # = weakness.*



Treatment Course

At the third visit, 2 weeks after the initial visit, the patient reported tolerating athletics and weightlifting well. He still experienced residual tightness in the proximal hamstring that minimally limited his participation in football practice *(see Figure 2)*. He rated his pain 3/10 and was doing much better from his initial presentation. He had yet to participate in basketball at full speed and was planning to do so between his third and fourth visits.

The patient continued to demonstrate a minimal superior innominate shear on the right side as well as a residual tender point in the right quadratus lumborum muscle *(see Table 3)*.

At the fourth visit, 3 weeks after the initial visit, the patient reported minimal hamstring tightness, rating his pain 3/10 *(see Figure 3)* and reporting continued improvement in activity for football practice. He also participated in full-contact basketball and experienced no significant symptoms.

He continued to demonstrate a significantly improved and now minimal superior innominate shear on the right side as well as a residual tender point in the right quadratus lumborum muscle *(see Table 4)*.

At the conclusion of the fourth OMT treatment, a self-stretch for the right QL was prescribed and demonstrated, and a patient education handout was provided. The goal of this self-stretch was

(continued on page 11)

Figure 4. *Pain diagram on follow-up at the fifth OMT session. Legend: ▲ ▲ ▲ = aching; / / / = stabbing; # # # = weakness.*

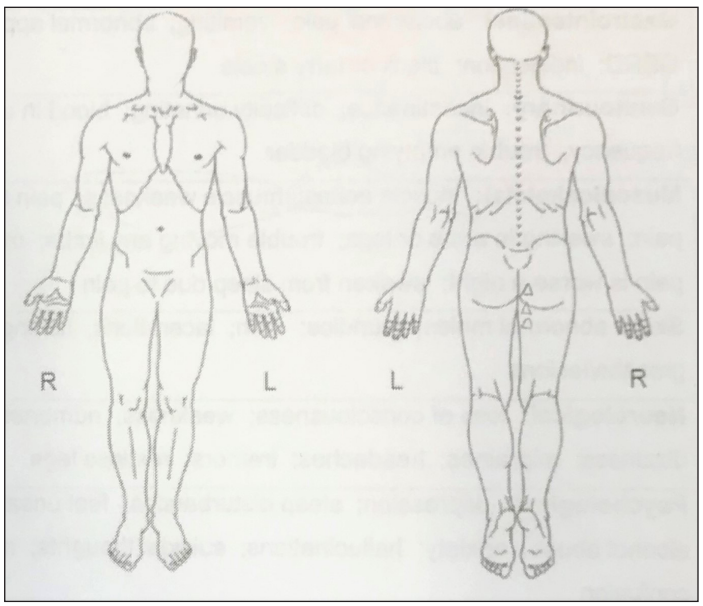


Table 3. *Third OMT session, given 2 weeks after initial visit.*

Body area	Somatic dysfunctions	Technique applied
Lower extremity	Semimembranosus tender point (tp), right Biceps femoris tp, right Psoas tight, left Piriformis tight, left	CS CS ME ME, Still
Lumbar	Lumbar paraspinal tightness, bilaterally Quadratus lumborum tp, right Iliac crest high left, pelvic roll right fascial pattern	ST CS ME
Thoracic	Thoracic paraspinal tightness, bilaterally Thoracolumbar shift, right fascial pattern	ST ME
Pelvis	Superior innominate shear, right (but considerably improved) Anterior rotation, right innominate	Still ME, leg tug
Sacrum	Left-on-left forward sacral torsion	ME

Table 4. *Fourth OMT treatment, given 3 weeks after initial visit.*

Body area	Somatic dysfunctions	Technique applied
Lower extremity	Semimembranosus tp, right Piriformis tight, right Psoas tight, right	CS ME, Still ME
Lumbar	Quadratus lumborum tp, right Iliac crest high left; pelvic roll, right fascial pattern	CS ME
Thoracic	Thoracolumbar shift, right fascial pattern	ME
Pelvis	Superior innominate shear, right (*minimal*) Anterior rotation, right innominate	Still Leg tug
Sacrum	Left-on-left forward sacral torsion	Ischial tuberosity spread

Table 5. *Fifth OMT session, given 7 weeks after initial visit.*

Body area	Somatic dysfunctions	Technique applied
Lower extremity	Biceps femoris tp, right Piriformis tight, left Psoas tight, right	CS ME, Still ME
Lumbar	Quadratus lumborum tp, left Iliac crest high left; pelvic roll, right fascial pattern Paraspinal tightness, bilaterally	CS Still Soft tissue
Thoracic	Thoracolumbar shift, left fascial pattern Paraspinal tightness, bilaterally	Still Soft Tissue
Pelvis	Superior innominate shear – *not present* Anterior rotation, right innominate	– Leg tug
Sacrum	No dysfunction appreciated	–

(continued from page 10)

to help address the persistent minute right superior innominate shear and maintain balance of the pelvis long-term.

Fifth Treatment

At the fifth visit, 7 weeks after the initial visit, the patient reported minimal right hamstring tightness, rating his pain (<2/10) *(see Figure 4)*. He described continued improvement in activity for football practice, and he also reported full participation with basketball with no significant symptoms experienced.

His minimal superior innominate shear and sacral torsion from the prior visit resolved and did not return. Some common compensatory (fascial) patterns were present as well as a few tender points *(see Table 5)*.

At the end of the fifth visit, the patient demonstrated his squat range of motion, which he described as feeling full, without restriction *(see Image 3)*.

(continued on page 12)

Image 3. *Patient's increased squat range of motion after fifth OMT treatment.*

(continued from page 11)

Discussion

This case presents an example of the utility of OMT in an athlete with hamstring strain and proximal hamstring and low back pain. He presented with numerous somatic dysfunctions that would not have resolved without a detailed understanding of the mechanism of injury and a thorough osteopathic structural exam.

The mechanism of injury in this case, that of a hurdler landing on the right lower extremity with the hip in relative flexion and knee fully extended, certainly would not surprisingly support a superior shear dysfunction of the innominate. But as the hip was flexed approximately 45° per the patient's account, it is not surprising that there would also be an induced innominate rotation. As we use leg tugs at approximately 30° to de-rotate an anterior rotation, it may be surmised that a compression through the extended landing leg (right) into the pelvis at >30° of flexion would induce an anterior innominate rotation. The anterior innominate rotation would separate the hamstring origin and insertion, which may have contributed to irritation and attachment pain in the region of the muscle's origin, the ischial tuberosity.[6]

In the authors' experience, quadratus lumborum strains are extremely common to find with superior innominate shears, are often concomitant findings ipsilateral to the shear, and may be either a cause of or secondary to the superior innominate shear. In this case, the quadratus lumborum strain would appear to have occurred secondarily, with the mechanism of injury fitting a likely cause for a superior innominate shear. Whether cause or contributor to the innominate shear, resolving somatic dysfunction of the quadratus lumborum is imperative to achieve correction of superior innominate shear dysfunction. In this patient's case, the resolution of the right superior innominate shear occurred concurrently with the resolution of the right quadratus lumborum strain.

In 5 visits, a young man with 10 weeks of pain (7/10), decreased squat range of motion, and decreased physical activity in athletics was able to obtain full squat depth range of motion and progress to full-speed, full-contact participation in football and basketball. These outcomes correlated with restoration of normal pelvic alignment by reducing a significant superior innominate shear, otherwise known as an innominate upslip.[2] Unilateral superior innominate shear dysfunctions result in changes to the position of the sacroiliac joint and alter mechanics in global movement of the pelvis.[2] This may provide an explanation as to why the patient experienced significant pain and decreased range of motion when attempting to perform a full squat and with side-to-side movements in athletics.

The patient experienced no pain or discomfort during the treatments applied and experienced an immediate improvement in ability to squat fully and without pain. Research has not been done to examine how long it takes after a superior innominate shear from a traumatic mechanism to resolve on its own. However, this case demonstrates it is possible for individuals to experience prolonged symptoms up to 10 weeks after initial injury, and traditional medical diagnosis and treatment (eg, rest, anti-inflammatory medications, and physical therapy) may not identify the source of pain and may not provide significant improvement.

OMM was provided on 5 occasions. Treatments focused on key somatic dysfunctions of the lumbar spine, pelvis, and lower extremities to address pain in the proximal hamstring region and decreased range of motion.

Conclusion

The patient demonstrated a mechanism for acute traumatic superior innominate shear in an athlete that failed to resolve over 10 weeks, which included 12 physical therapy sessions. The mechanism of injury demonstrated may represent a common injury pattern for athletes participating in track and field sports, especially hurdlers, who present with a complaint of hamstring pain, tightness, and/or significant activity limitations. Further, the superior innominate shear not traditionally being considered in clinical practice may contribute to prolongation of symptoms and transitioning from acute to chronic injury.

To date, minimal research has been conducted on the incidence and prevalence of traumatic innominate superior innominate shear, and it would be beneficial for further research to collect data on these numbers as well as best clinical practices for management of acute and chronic traumatic superior innominate shear injuries.

References

1. Heiderscheit BC, Sherry MA, Slider A, Chumanov ES, Thelen DG. Hamstring strain injuries: Recommendations for diagnosis, rehabilitation and injury prevention. *J Orthop Sports Phys Ther*. 2010;40(2):67-81. doi:10.2519/jospt.2010.3047
2. DeStefano LA. *Greenman's Principles of Manual Medicine*. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2011:350-355.
3. Simons DG, Travell JG, Simons LS. *Travell and Simons' Myofascial Pain and Dysfunction: The Trigger Point Manual*. Vol 2. The Lower Extremities. Baltimore, MD: Williams & Wilkins; 1992:28-84.
4. Qureshi Y, Kusienski A, Bemski JL, Luksch JR, Knowles LG. Effects of somatic dysfunction on leg length and weight bearing. *J Am Osteopath Assoc*. 2014;114(8):620-630. doi:10.7556/jaoa.2014.127
5. Lewis DD, Figueroa JS, Summers GK, Polk JD. Introducing MAAP: the modified ASIA examination for ambulatory patients. *The AAO Journal*. 2014;24(2):40-45.
6. Heinking KP, Kappler RE. Pelvis and sacrum. In: Chila AG, executive ed. *Foundations of Osteopathic Medicine*. 3rd ed. Baltimore, MD: Lippincott Williams & Wilkins; 2011:589. ■