

58th Annual AOA Research Conference— Abstracts, 2014

This issue of *The Journal of the American Osteopathic Association (JAOA)* features abstracts from the posters that will be presented at the 58th Annual American Osteopathic Association (AOA) Research Conference. These posters represent the most recent work of numerous osteopathic medical clinicians, researchers, educators, and students.

This year's abstracts are organized into 5 groups:

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To enhance the readability of this special feature to the *JAOA*, the abstracts have been edited for grammar and basic *JAOA* style. The content of these abstracts has not been modified; neither the AOA Council on Research nor *The Journal* assumes responsibility for the abstracts' content.

This year's AOA Research Conference will take place in Seattle, Washington, from Saturday, October 25, to Monday, October 27, during the AOA's 2014 Osteopathic Medical Conference & Exposition (OMED 2014).

For more information on the AOA Research Conference or other programs taking place during OMED 2012, access the conference's Web site at <http://www.osteopathic.org/omed>.

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Fellowship

◆SF1

Evaluation of the Effectiveness of Osteopathic Manipulative Treatment for Carpal Tunnel Syndrome: A Pilot Project

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Introduction: Osteopathic manipulative treatment (OMT) has been described as a treatment option for carpal tunnel syndrome (CTS), although there is limited research substantiating its effectiveness.

Hypothesis: OMT is an effective treatment for carpal tunnel syndrome.

Methods: In this single-blinded controlled trial, 9 participants with symptoms compatible with CTS and confirmatory diagnostic abnormalities on nerve conduction studies were enlisted. The main outcome measures were: Boston Symptom Severity Score for Carpal Tunnel Syndrome Questionnaire (BCTQ), Sensory Symptom Diagram (SSD), estimate of overall change, median nerve electrophysiologic evaluation (transcarpal tunnel motor and sensory conduction velocity and amplitude ratio), and carpal tunnel ultrasound (median nerve cross-sectional area, transverse carpal ligament length, and bowing). After institutional review board approval, participants underwent testing using all outcome measures before the first OMT session. Immediately after the first OMT session, median nerve electrophysiologic and carpal tunnel ultrasound evaluations were repeated. Participants then received weekly OMT for a total of 6 weeks, after which all main outcome measures were re-administered.

◆ Abstract entered in the SOMA Student Poster Competition.

Results: Significant improvements in symptoms and function after 6 weeks of OMT were documented on the BCTQ, and the improvements tended to be more pronounced on the treatment side. Patient estimate of overall improvement of symptoms was significantly greater for the treated side. No significant changes in median nerve electrophysiologic function or ultrasound morphology were documented. Transverse carpal ligament bowing did not change. Posttreatment, transverse carpal ligament length was significantly greater, but there was no side-to-side difference.

Conclusions: OMT effectively improves symptoms and disability associated with CTS. However, median nerve electrophysiologic function and morphology at the carpal tunnel did not change, suggesting the mechanism of action was not median nerve decompression at the carpal tunnel. OMT can successfully be used for CTS symptom and disability control.

Osteopathic Manipulative Medicine/Osteopathic Principles and Practice

◆P1

Effects of Osteopathic Manipulative Treatment in Lowering Perceived and Physiological Stress in Medical, Dental, and Pharmacy Student Populations

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Context: Burnout, suicidal ideation, and other forms of physiologic distress are incredibly common in medical, pharmacology, and dental students. Few studies have addressed osteopathic manipulative treatment (OMT) as a modality to reduce stress in these populations. Previous studies show that salivary immunoglobulin A (sIgA) is inversely correlated with stress, and OMT may raise this immunoglobulin level. Improved sIgA may increase physiologic immunity in medical students, serving to offset the effect of stress on professional students.

Hypothesis: It was hypothesized that OMT would reduce self-reported stress and increase sIgA in a population of health profession students.

Methods: The research protocol was approved by the LECOM–Bradenton institutional review board. 102 participants were randomly assigned to control, direct treatment (DT), or nondirected treatment (NDT) groups. The DT and NDT groups received 20 minutes of therapy (the former to core body areas, the latter to appendicular) followed by 10 minutes of supine rest once weekly for 4 weeks. Second-year osteopathic medical students trained and overseen by LECOM faculty performed the treatments. All groups completed electronic Self-Perceived Stress Scale (PSS) questionnaires before

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treatment (week 0), weekly following each treatment, and after the final treatment (week 4). Scores of the PSS were analyzed retrospectively using independent samples *t* test using SPSS software. Participants were excluded only if a participant became ill or opted to withdraw during the course of the study.

Results: Average change in PSS between surveys 1 and 4 and sIgA between DT and control groups significantly differed between surveys 1 and 4 (CI, 0.10-6.70, *P* = .04; CI, 1.10-20.4, *P* = .03, respectively). PSS between surveys 0 and 4 and sIgA between NDT and control groups differed significantly (CI, 1.60-11.0, *P* = .009; CI, 7.40-24.5, *P* = .00 respectively), and PSS between surveys 0 and 4 between NDT and DT groups differed significantly (CI, 0.27-9.50, *P* = .038).

Conclusion: DT and NDT groups demonstrated reduced physiologic and perceived stress compared with the control group. A significant greater reduction in perceived stress was observed in the NDT group vs the DT group. Overall, OMT has shown to be effective in reducing the distress in health professions students. Further studies should address possible student-physician error, differences in the rigors of health profession curricula, and the greater reduction in stress observed in the NDT population.

P2

Somatic Dysfunction Findings, Osteopathic Manipulative Treatment (OMT), and Response to OMT in Patients With Lumbago and Cervicalgia

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Introduction: Few studies have examined the relationship of somatic dysfunction findings and osteopathic manipulative treatment (OMT) with self-reported patient response to OMT.

Hypothesis: For patients with lumbago or cervicalgia, we describe the most common somatic dysfunctions and OMT techniques used and the effect of these techniques on patient response to OMT.

Methods: Data for patients diagnosed as having lumbago or cervicalgia who received OMT from 1 of 12 physicians were extracted from the DO-Touch.NET database. Physicians reported patients' diagnoses, somatic dysfunctions, and OMT used. Patient-reported response to OMT was measured immediately and 7 days after OMT. Summary statistics were calculated to determine the most common dysfunctions and techniques used and their effect on patient response.

Results: For the lumbago patients (n=26), the lumbar (96%), pelvis/innominate (77%), and sacrum/pelvis (77%) were most commonly treated. Motion restriction (MR) was most common in these regions (90%-92%). The most common techniques were muscle energy (ME) in the lumbar (50%) and sacrum/pelvis (38%) and articulatory in the pelvis/innominate (54%). Indirect (5/6) and high-velocity, low-amplitude (HVLA, 12/17) techniques were most frequently associated with positive patient response to OMT.

For the cervicalgia patients (n=23), the neck (96%), ribs (87%), and T1-4 (83%) were most commonly treated. The most common dysfunction was positional asymmetry (PA) in the neck (100%) and T1-4 (95%) and MR in the ribs (100%). The most common techniques were ME in the neck (57%) and T1-4 (39%) and articulatory in the ribs (43%). Indirect (9/10) and ME (13/15) techniques were most frequently associated with positive patient response.

For patients with both lumbago and cervicalgia (n=12), the neck (100%), lumbar (92%), and T1-4 (75%) were most commonly treated. Motion restriction was most common in these 3 regions (88%-100%). The most common techniques were ME in the lumbar (58%), myofascial release and soft tissue in the neck (42%), and soft tissue in T1-4 (33%). HVLA (5/6) and balanced ligamentous tension (2/3)

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techniques were most frequently associated with positive patient response.

Conclusion: Motion restriction and PA were the most commonly reported dysfunctions in patients with lumbago and cervicgia, suggesting osteopathic examination identifies characteristics beyond the localization of pain in diagnosing these conditions. Gentle direct techniques were most commonly used in the primary symptom area.

◆P3

Assessing the Relationship Between Hand Position and Palpatory Diagnosis Using Adjustable Static Pelvic Models

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Introduction: Pelvic somatic dysfunction diagnosis is taught at all osteopathic medical schools, but few methods have been developed to quantify student localization of landmarks.

Hypothesis: Students will be able to accurately identify the asymmetry of pelvic bony landmarks.

Methods: Six second-year osteopathic medical students, who scored in the top 8% of their class during first-year objective palpatory model assessments, participated in this study. A digital camera measurement system (DCMS) and adjustable static foam-covered pelvic models were used to assess the students' accuracy in localizing bony landmark positional asymmetry in the coronal plane. The landmarks assessed were pubic tubercles (PT), anterior

superior iliac spines (ASIS), ischial tuberosities (IT), posterior superior iliac spines (PSIS), and iliac crests from anterior (IC-A) and posterior (IC-P) sides. Students evaluated each landmark 6 times with models set at the following ranges of asymmetries: 2-4 mm (PT), 4-6 mm (IT, PSIS, ASIS), and 5-7 mm (IC-A, IC-P). Digit asymmetry was measured using the DCMS. Logistic regression was used to determine differences in reliability of direction of digit asymmetry and diagnosis between landmarks/positions. A second logistic regression was used to assess the relationship between diagnosis and digit asymmetry by landmarks/positions. **Results:** Overall, 90% (194 of 216) of diagnoses matched digit asymmetry. There was perfect reliability for IT and PSIS landmarks. The probability of the direction of digit asymmetry matching diagnosis did not depend on landmark (0.27; ASIS 0.97, PT and IC-A .84, and IC-P .77). Odds of diagnosing the right landmark as superior relative to the left increased by 90% for each 1-mm increase in asymmetry of palpating digits ($P < .001$) and depended on the specific landmark (0.02) where the estimated odds ratio (95% CI) of right landmark superior diagnosis at 0-mm digit asymmetry were 0.24 (0.05-1.2), 0.9 (0.27-3.2), 1.2 (0.20-7.3), 1.8 (0.34-9.4), 7.5 (1.1-49.0), and 51 (5.6-466.0) for IC-A, PT, PSIS, IT, ASIS, and IC-P, respectively.

Conclusion: Accurate diagnosis requires accurate landmark localization and accurate asymmetry assessment. Overall, these students showed good accuracy when identifying the asymmetry of their palpating digits during landmark assessment of the pelvis. Confounding factors could be eye dominance, body position in relation to the table, and posture of the examiner during palpation.

◆ Abstract entered in the SOMA Student Poster Competition.

◆P4

Assessing Palpatory Accuracy of Diagnosis of Osteopathic Medical Students Using Static Pelvic Models

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Introduction: Effective manipulative treatment should be based on accurate palpatory diagnosis. Pelvic somatic dysfunction diagnosis by assessing bony landmark asymmetry is taught at all colleges of osteopathic medicine; few objective measures have been used to evaluate categorical accuracy in diagnosing asymmetry.

Hypothesis: Measurement of digit asymmetry will be consistent with landmark asymmetry when students are accurate in their diagnosis.

Methods: The palpatory skills of 6 second-year osteopathic medical students evaluating the positional asymmetry of pelvic bony landmarks in the coronal plane were assessed using a digital camera measurement system (DCMS) and adjustable static foam-covered pelvic models. The students evaluated the pubic tubercles (PT), anterior superior iliac spines (ASIS), ischial tuberosities (IT), posterior superior iliac spines (PSIS), and iliac crests from the anterior (IC-A) and posterior sides (IC-P). Students evaluated each landmark independently 6 times with models set at the following asymmetries: 2-4 mm (PT), 4-6 mm (IT, PSIS, ASIS), and 5-7 mm (IC-A, IC-P). Digit asymmetry was measured using the DCMS and compared with the model asymmetry. A regression model was used to test for dif-

ferences between correct and incorrect diagnoses in the magnitude of model and digit asymmetry differences. Logistic regression was used to determine differences in diagnosis accuracy between landmarks and to assess the dependence of this accuracy on the magnitude of digit asymmetry.

Results: Overall, 88% (190 of 216) of diagnoses were correct. There was a significant difference ($P < .001$) between digit asymmetry and model asymmetry in correct diagnoses (mean difference = 2.7 mm) and incorrect diagnoses (mean difference = 4.4 mm). Overall, the probability of accurate diagnosis was lowest for IC-P (.67) and IC-A (.81). The remaining 4 landmarks were estimated above .90, with IC prone significantly lower (all $P < .02$). Likelihood of accurate diagnosis depended on the absolute value of digit asymmetry and the type of landmark ($P = .004$). For each 1-mm increase in absolute value of digit asymmetry, the odds of accurate diagnosis increase by 1.2, 1.4, 1.6, 3.0, 3.7, and 4.8 times for IC-P, IC-A, ASIS, PSIS, PT, and IT, respectively.

Conclusion: The DCMS showed that digit asymmetry was consistent with landmark asymmetry when obtaining an accurate diagnosis. Accurate diagnosis mostly improved with increased digit asymmetry and decreased distance between paired landmarks. Methods for improving the localization of the iliac crest need to be developed.

◆ Abstract entered in the SOMA Student Poster Competition.

P5

Pressure Pain Thresholds Are Altered as a Result of Variations in Technique When Examining Tender Points

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Introduction: The reliability of clinicians identifying tender and trigger points is poor.

Hypothesis: Objective data will demonstrate considerable technique variability in identifying tender points.

Methods: Three physicians palpated 28 points on the supraspinatus muscles of 4 adults who had at least 1 painful shoulder. Each blinded examiner identified up to 3 points on each shoulder. Thumb motion data during the examination were collected using an infrared camera motion capturing system. Each examiner pressed on identified skin reference points through a pressure sensor pad until pain was elicited. Customized software evaluated the rate at which the force was applied, angle of the thumb relative to the skin surface, orientation of the thumb relative to the spine, clockwise-counter-clockwise roll of the thumb, and location of the end of palpation relative to the starting point. Variability in the ending location was quantified as the mean distance of the examiners' ending locations from the center of those locations. The SD of the PPTs at each point was used to quantify the variability of the PPT. The mean and SD (variability) of the angle, orientation, and roll of the thumb within each test by each examiner were calculated as objective characteristics of the examination process. Pearson correlations were used to test the

relationship of variability of the ending location and variability of the PPT. General linear mixed models were used to examine how well PPT was predicted by the mean and variability of the angle, orientation, and roll of the thumb; by the rate of force; and by the examiner.

Results: The variability in the ending location between examiners was related to variability in PPT ($r=0.40$, $P=.03$). The mean angle of the thumb to the skin ($P=.006$) and variability of the roll of the thumb ($P=.002$) were related to PPT. An increase in the mean angle of 1° was associated with a 0.3 N decrease in PPT. An increase in the variability of the roll of 1° was associated with an increase of 5.1 N in PPT. Even after accounting for the mean angle and the variability of the thumb roll, examiners had significantly different PPTs ($P=.002$).

Conclusion: Variations in examination technique influence PPTs and are likely factors underlying the evidence indicating poor PPT reliability between examiners. Greater attention to standardizing the performance of tender/trigger point testing should be included in future research in this area.

Funding: Scan|Design Foundation.

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P6

Relationship of Lumbar Spine Calibrated Model Performance and Traditional Osteopathic Practical Examination Performance in First-Year Osteopathic Medical Students

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Introduction: The use of lumbar spine calibrated models that simulate asymmetry of the transverse processes has not been compared with the traditional methods of evaluation of palpatory skills within an osteopathic manipulative medicine curriculum.

Hypothesis: Lumbar calibrated model scores of osteopathic medical students will correlate with their lumbar spine practical examination scores.

Methods: Ninety-five students from the class of 2016 at A.T. Still University—School of Osteopathic Medicine in Arizona attended a 1-hour lecture and 3-hour laboratory about functional anatomy, diagnosis, and management of somatic dysfunction of the lumbar spine. Two weeks later, students were given a 30-minute practice session followed by a 30-minute testing session on lumbar calibrated models to assess the accuracy of identification of asymmetric posterior transverse processes of given segments. Four practical examinations were administered between September and June 2013 with a random subset of students given a practical examination to test their ability to diagnose lumbar spine or thoracic spine somatic dysfunction. On the practical examination, students were assigned 0, ½, or 1

point for components that assessed their ability to accurately diagnose somatic dysfunction. Generalized linear models were then used to determine whether calibrated model test results explained variation in the practical examination scores.

Results: A significant effect of model performance on a student’s cumulative practical score was found. The effect of a 20% increase in model performance showed an increase in the odds of a correct practical question by 43% ($P=.03$).

Conclusions: This study showed that increased scores in lumbar spine calibrated model examinations are related to increased scores on traditional osteopathic practical examinations. Standardized calibrated models providing objective feedback to students regarding their palpatory skills offers distinct feedback to current testing procedures. Future use of the calibrated models may be enhanced by offering more practice opportunities before model testing. Further research is needed to determine how these models could be further integrated into the educational format to optimize the development of palpatory skills.

◆ Abstract entered in the SOMA Student Poster Competition.

P7

Baseline Group Performance Over Time on Manual Skills Assessed by Lumbar Spine Calibrated Models

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Introduction: Little is known about how manual skills training influences students with different baseline skills at entry into osteopathic medical school. Static lumbar spine calibrated models were used to assess the palpatory skills of students evaluating positional asymmetry in the transverse plane.

Hypothesis: Osteopathic medical students will demonstrate sustained improvement in manual skills during their first year.

Methods: One hundred seventy-seven first-year osteopathic medical students completed baseline (BA), formative (FA, at time of skill acquisition), and summative palpatory assessments (SA). Foam-covered, bronze-cast lumbar spine models simulated positional asymmetries of the transverse processes. For the 3 assessments, asymmetries ranged from 2-6 mm and consisted of 10, 5, and 15 tests for BA, FA, and SA, respectively. The transverse processes were marked for BA, only the spinous processes were marked for FA, and the models were unmarked for SA. The students were assigned to 4 groups on the basis of their BA scores: group 1 (90% and 100%), group 2 (80%), group 3 (70%), and group 4 ($\leq 60\%$). A mixed linear model was fit to evaluate the percentage correct by group and time with random student effects. Mantel-Haenszel χ^2 tests were used to evaluate the association between BA, FA, and SA group rankings.

Results: Mean FA score was .94, .89, .95, and .94 for groups 1, 2, 3, and 4, respectively; mean SA score was .90, .86, .87, and .82 for groups 1, 2, 3, and 4, respectively. There was significant improvement from BA to FA in groups 2 to 4 (all $P < .001$). Group 1 had no significant change. Groups 3 and 4 significantly decreased from FA to SA by 7 percentage points and 12 percentage points ($P = .04$ and $P < .001$, respectively). SA rank was associated with BA and FA rank ($P = .002$ and $P = .048$, respectively). There was no association between BA and FA ranks.

Conclusion: Students with lower manual skills at baseline showed improvement at skill acquisition but were unable to maintain this improvement through the end of the year. Further research is necessary to determine the causes of this decline. Potentially relevant causes may be motivation and attitude about the relevance of manual skills, time spent maintaining skills, and fatigue at the time of testing. The top-performing students maintained their performance during the year, but a ceiling effect may have limited our ability to measure potential improvement.

◆ Abstract entered in the SOMA Student Poster Competition.

Clinical Studies

◆C1

Effects of Therapeutic Treatment With Angiotensin II Receptor Blocker on Intraspinal Inflammatory Cell Phenotype Following Experimental Spinal Cord Injury

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Introduction: We have shown beneficial effects of manipulating the renin-angiotensin system (RAS) to improve functional outcome after spinal cord injury in rats. Corresponding analyses of changes in gene expression at the injury site suggest that drug treatment altered several chemokines associated with infiltration of inflammatory cells. Compounds such as captopril, an angiotensin-converting enzyme (ACE) inhibitor, and losartan, an angiotensin II type 1 receptor (AT1R) blocker, have been associated with beneficial regulatory control of the neuro-inflammatory response in models of CNS disorders (eg, Alzheimer disease).

Hypothesis: We hypothesized that inhibition of RAS via administration of an angiotensin receptor blocker (ARB) would alter the phenotype of recruited macrophages and other immune cells in spinal-injured rats.

Methods: Anesthetized female Sprague-Dawley rats underwent a laminectomy at vertebral level T8 and were given SCI by lateral compression with modified forceps. Animals were treated daily with losartan (intraperitoneal) and killed at 7, 14, and 28 days postinjury. Immunohistochemistry spinal cords were excised at the above mentioned days and stored at -80°C in a OCT compound before being cut on a cryostat at 10 μm intervals. 0.1 M phos-

phate buffer was used as our primary buffer solution, and biotinylated horse antimouse (BHAM) was used as a secondary antibody. Myelin was evaluated using Eriochrome Cyanine histochemistry and sections were stained. Immunohistochemistry for proportional area of stained tissue was measured using NIH ImageJ software. Images were imported into ImageJ and converted to 8-bit grayscale. The cross-section of the spinal cord was outlined and a thresholding tool was used to highlight the positively stained tissue. To determine the proportional area, the area of positively stained tissue was measured and divided by the total cross-sectional area of the spinal cord. The epicenter section was defined by the tissue section exhibiting the least amount of spared myelin. Sections were analyzed at 2 mm increments up to 6 mm rostral and 6 mm caudal to the epicenter for each animal. Glial cells were assessed using 3 antibodies that recognize different antigens: GFAP, OX42, and CD206.

Results: GFAP: There was a significant effect of distance from the epicenter at 7 and 14 dpi, suggesting that the magnitude of GFAP expression differs across the rostrocaudal extent of the lesion. There was a significant effect of treatment with losartan observed at 28 dpi. Treatment with losartan decreased the magnitude of GFAP staining rostral and caudal to the epicenter, suggesting that inhibition of AT1R-altered lesion dynamics and the induction of the astroglial scar. OX-42: There was a significant effect of distance from the epicenter at 7, 14, and 28 dpi, suggesting that the macrophage response decreases as the distance from the epicenter increases. The overall macrophage response to injury was not affected by treatment with losartan, suggesting that beneficial effects on locomotor recovery were not due to changes in the magnitude of the inflammatory response to injury. CD206: The relative expression of CD206 was similar at all rostrocaudal lesion locations at 7 and 28 dpi. Given that the overall magnitude of the macrophage response diminished at sites distal to the lesion epicenter, but

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expression of CD206 was maintained, the findings suggest that macrophages further from the injury epicenter are more likely to express an M2, or reparative phenotype. There was no effect of losartan on the proportion of M2 macrophages at any time point assessed.

Conclusion: These findings suggest an effect of losartan on the astroglial scar, but not on the macrophage response to injury. Thus, it is possible that the beneficial effects observed on locomotor recovery in this model, and neuroprotective effects described in other models of CNS injuries, are not due to modulation of neuroinflammation, but instead may be due to effects on endogenous glial cells.

◆C3

Preliminary Study of Peel Force and Discomfort of Removal of Adhesive Barriers in Normal and Peristomal Skin

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Introduction: Adhesive barriers are critical to the function of both ostomy and wound care products. Previously demonstrated characteristics of peristomal skin, including parakeratosis, cracking, and loss of barrier function, may affect adhesive performance. Additionally, adhesive products must be designed to form a secure attachment while in use but release from skin with minimal impact and discomfort.

Hypothesis: The null hypotheses are that no difference exists between peristomal and normal skin and no difference exists between barrier materials.

Methods: This study was approved by the Loyola University Medical Center institutional review

board. Three peristomal and 6 nonperistomal control sites per participant (n=17) were selected. At each location, trans-epidermal water loss (TEWL), moisture, pH, sebum, and elasticity were measured. Three different commercially available barrier adhesive strips labeled A, B, and C were then applied. One of each type was secured to peristomal skin and 2 of each type were applied to nonperistomal abdominal skin. After 30 minutes, adhesives were removed using a peel force tester. Participants rated a discomfort level for each peel event using a visual analog scale. If time permitted, cutaneous properties (TEWL, moisture, pH, sebum, and elasticity) were remeasured at each site.

Results: Compared with nonperistomal abdominal skin, peristomal skin was characterized by significantly increased TEWL ($P<.0001$), decreased moisture level ($P<.0001$), decreased elasticity ($P=.0009$) and increased viscosity ($P<.0001$). Peristomal skin was associated with increased peel force for all barrier adhesives ($P<.0001$), with material A demonstrating a greater peel force than B or C ($P=.0037$). Discomfort was not significantly correlated with skin site or barrier material ($P=.1212$, $P=.7969$). After peeling, the skin had significantly increased TEWL ($P=.0006$), decreased moisture ($P<.0001$), and decreased pH ($P<.0001$).

Conclusion: Peristomal skin differs significantly from nonperistomal skin, which may affect adhesive function. While ostomy patients may be unable to detect differences in peel force as measured by pain, measurable alterations to the skin are occurring, likely a result of both the nature of peristomal skin and the adhesives themselves. Ostomy adhesives may be improved by balancing the need to form a secure barrier with desire to minimize physiologic disturbance to peristomal skin.

◆ Abstract entered in the SOMA Student Poster Competition.

C4

Relationship of Pelvic Landmark Positional Asymmetry Tests to Low Back Pain Syndromes

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Introduction: Low back pain is a major cause of disability and economic burden in the United States. While the examination of pelvic landmarks is commonly used in the evaluation of these patients, no objective data are known about their ability to identify and differentiate origins of low back pain.

Hypothesis: To determine whether positional asymmetry of pelvic landmarks is significantly different between no pain and pain groups and among the 3 pain groups.

Methods: After consensus training to standardize performance and interpretation of testing, 3 clinicians, blinded to groups, performed a focused structural examination of the pelvis and lumbar spine on 158 female volunteers with or without low back pain in the supine and prone positions. Positions of the iliac crests, anterior superior iliac spine, pubic tubercles, posterior superior iliac spine, sacral base, and inferior lateral angles of the sacrum were determined for asymmetry in the coronal and/or sagittal planes. Findings were compared with subgroups based on consistent findings between patients' history and localization of pain on examination: the controls with no pain (CTL), those with pain likely from spinal origins (LBP), those with unilateral

sacroiliac joint pain (SIJP), or those with widespread low back pain (WSP). Mixed linear models were used to test for differences in mean magnitudes of positional asymmetry between groups.

Results: There were 47 participants with LBP, 22 with SIJP, 37 with WSP, and 52 CTLs. Only 1 landmark, the pubic tubercle in the sagittal plane, differentiated between the pain (2.2 mm) and the no-pain (1.6 mm; $P=.01$) groups. The asymmetry of the ASIS and PSIS landmarks are greatest in the WSP group. For the ASIS in the coronal plane there was a difference in asymmetry between the SIJP (4.5 mm) and WSP (9.3 mm; $P<.001$) groups. For the PSIS in the coronal plane there was a difference between LBP (4.1 mm) and WSP (7.0 mm; $P=.01$) groups.

Conclusion: Findings associated with pubic tubercle asymmetry are statistically significant; however, they may not have clinical relevance. The increased asymmetries of the ASIS and PSIS landmarks in the WSP group are intriguing and require further research. Overall, the variability of the relative position of these tested landmarks was too large to be related to any specific group.

◆ Abstract entered in the SOMA Student Poster Competition.

C5

Dapagliflozin Add-on Therapy to Metformin Plus Sulfonylurea Improved Glycemic Control and Reduced Body Weight at 6 and 12 Months in Patients With Type 2 Diabetes

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Introduction: Many patients with type 2 diabetes mellitus do not reach glycemic goals with dual-agent therapy (eg, metformin [MET] plus sulfonylurea [SU]) and require an additional agent with an alternate mechanism of action. Dapagliflozin (DAPA) is a highly selective sodium-glucose cotransporter 2 inhibitor that improves glycemic control and produces body weight loss in patients with type 2 diabetes mellitus as monotherapy or add-on therapy to other agents.

Hypothesis: DAPA might provide improved glycemic control and attenuate SU-related body weight gain or produce body weight loss when added to ongoing MET plus SU therapy.

Methods: A placebo (PBO)-controlled, phase-3 study evaluated short- and long-term efficacy and safety of DAPA as add-on therapy to MET plus SU in T2DM (NCT01392677). Adult patients inadequately controlled with a maximum tolerated dose of SU (half maximum dose) and MET (1500 mg once daily) were randomized and treated with DAPA 10 mg/d (n=109) or PBO (n=109) for 12 months (24-wk randomized, double-blind period and 28-wk extension).

Results: Adjusted mean reductions from baseline at 6 and 12 months were greater with DAPA vs PBO for glycated hemoglobin (HbA_{1c}, baseline: 8.1% vs 8.2%, 6 mo: -0.86% vs -0.17% [difference {95% CI} -0.69% {-0.89% to -0.49%}]; 12 mo: -0.81% vs -0.08% [-0.74% {-1.01% to -0.46%}]) and fasting plasma glucose (FPG; 6 mo: -34.2 vs -0.8; 12 mo: -27.6 vs 11.5 mg/dL). More patients achieved HbA_{1c} <7.0% with DAPA vs PBO at 6 (32% vs 11%) and 12 (27% vs 11%) months. DAPA produced greater reductions in body weight (6 mo: -2.7 vs -0.6 kg; 12 mo: -2.9 vs -1.0 kg) and systolic blood pressure (6 mo: -4.0 vs -0.3 mm Hg; 12 mo: -1.0 vs 1.1 mm Hg) vs PBO. No patient discontinued owing to lack of glycemic control; 9% of patients with DAPA vs 44% with PBO were released from the study for lack of glycemic control during 12-month treatment. At 6 and 12 months with DAPA vs PBO, respectively, 49% and 70% vs 51% and 73% of patients reported adverse events, 1% and 6% vs 6% and 7% serious adverse events, and 13% and 16% vs 4% and 8% hypoglycemic events (none major). Genital infections were reported by 6% and 10% vs 0 and 1%, and urinary tract infections by 6% and 10% vs 6% and 11% of patients with DAPA vs PBO at 6 and 12 months, respectively; all were of mild or moderate intensity.

Conclusion: DAPA as add-on to MET plus SU improved glycemic control and produced body weight loss that was maintained for 12 months in patients with type 2 diabetes mellitus. DAPA was generally well tolerated during long-term treatment.

◆ Abstract entered in the SOMA Student Poster Competition.

C6

Saxagliptin Monotherapy in Patients With Type 2 Diabetes: Pooled Data From 4 Placebo-Controlled Trials

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Introduction: Monotherapy with a dipeptidyl peptidase-4 inhibitor is recommended in current type 2 diabetes mellitus (T2DM) treatment guidelines as an option in patients with T2DM that is inadequately controlled by diet and exercise and for whom metformin (MET) is contraindicated or not tolerated. In four 24-week, double-blind, placebo (PBO)-controlled, phase 3 trials in treatment-naive patients (NCT00121641, NCT00316082, NCT00698932, NCT00918879), saxagliptin (SAXA) 2.5 and 5 mg/d monotherapy significantly decreased the adjusted mean change from baseline in glycated hemoglobin (HbA_{1c}) by -0.40% to -0.64% vs PBO.

Hypothesis: A pooled analysis of data from the 4 trials has the potential to provide a better estimate of efficacy and safety outcomes across studies and subgroups.

Methods: Efficacy data were pooled by fixed-dose treatment and analyzed using an analysis of covariance model and adjusted for baseline value and trial. Treatment difference at week 24 in adjusted mean change in HbA_{1c} was the primary end point; secondary end points included proportion of patients achieving HbA_{1c} <7% and changes in fasting plasma glucose (FPG) and 2-h postprandial plasma glucose (PPG).

Results: The 1306 patients (mean age: 52 years; mean weight: 77 kg) were predominantly Asian (65%), with mean diabetes duration of 1.5 y and baseline HbA_{1c} of 8.1%. At week 24, the mean difference (95% CI) vs PBO in HbA_{1c} was -0.54% (-0.73% to -0.35%, *P*<.001) for SAXA 2.5 mg/d

and -0.51% (-0.62% to -0.39%, *P*<.001) for SAXA 5 mg/d. Effects of SAXA 5 mg/d vs PBO on HbA_{1c} were consistent across studies and race [white: -0.40% (-0.63% to -0.16%); Asian: -0.51% (-0.64% to -0.38%)], gender [men: -0.55% (-0.71% to -0.40%); women: -0.46% (-0.63% to -0.29%)], and age [<65 y: -0.50% (-0.62% to -0.38%); ≥65 y: -0.57% (-0.92% to -0.23%)] subgroups. A greater proportion of patients achieved HbA_{1c} <7% (SAXA 2.5 mg: 35%; SAXA 5 mg: 40%; PBO: 26%) and greater reductions in FPG and PPG were seen with SAXA vs PBO. For pooled safety data (SAXA: n=890; PBO: n=559), occurrences of adverse events (SAXA 2.5 mg: 66%; SAXA 5 mg: 53%; PBO: 45%) and reported hypoglycemia (SAXA 2.5 mg: 4%; SAXA 5 mg: 3%; PBO: 2%) were slightly higher with SAXA vs PBO. No case of confirmed hypoglycemia (fingerstick glucose ≤50 mg/dL with symptoms) occurred.

Conclusion: SAXA monotherapy is effective and well tolerated in patients with T2DM and is an appropriate treatment option when MET is contraindicated or not tolerated.

◆C7

Posteromedial Corner of the Knee—Integrating Regional Anatomy With the Clinical Arena to Advance Health Care Education and Treatment Delivery

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Introduction: Dysfunctional mobility is a common result from injuries sustained to the posteromedial corner (PMC) of the knee. Terminology of the PMC was introduced approximately 30 years ago and has become routine among musculoskeletal specialties. However, PMC borders and its contents are inconsistent in the literature.

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Objective: To investigate and identify borders and contents of the PMC.

Methods: We conducted a literature search for studies on PMC. Dissections of 103 embalmed cadaveric knees were performed to identify bony landmarks and structures of the PMC. Ultrasound was used to identify PMC structures on cadaveric and viable tissue.

Results: There was an inconsistency in PMC terminology, definition, boundaries, and contents. Dissection revealed definitive bony landmarks and identifiable contents: medial meniscotibial and meniscofemoral ligaments, posterior horn of medial meniscus, posterior oblique ligament, semimembranosus, oblique popliteal ligament, capsule, deep/superficial MCL, medial retinaculum, pes anserine, saphenous nerve and vein, and superior/middle genicular arteries and veins. Injuries to the medial knee are common and debilitating. Standardization of accurate morphology and terminology is essential for clinical communication and education. PMC is recognized terminology in musculoskeletal specialties, however, borders and contents are inconsistent. Contemporary anatomy texts and atlases do not use PMC terminology. PMC structures are layered and interwoven. A single named structure may not be the only damaged structure in this system. Dissection revealed structure orientation from superior to inferior and posterior to anterior that can be visualized as a column rather than a corner.

Conclusion: This study suggests a standardized classification of PMC structure organization, integrating anatomy, and clinical terminology that can be successfully viewed with ultrasound.

C8

Novel but Universal Subcondylar Classification System Based on Anatomical Features

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Introduction: Mandibular fractures date back to at least the 17th century BCE. Regardless of country or culture, mandibular fractures are and have been a relatively common phenomenon. As treatments for mandibular fractures have evolved, numerous classification systems have been proposed. One area of particular interest in the debate over best practices has been the definition of the *subcondylar* region of the mandible. Most classification systems use subcondylar terminology, which the authors feel is too nebulous. Definitions range from the thinnest point of the mandibular condyle to the ascending ramus (termed *condylar base*).

Objective: To investigate subcondylar classification and develop a universal classification by integrating anatomy and clinical conditions.

Methods: We conducted a literature search for studies on fractures of the mandible and/or subcondylar region. Observations were carried out with bone specimens as well as donor cadavers (DCs) dissections (n=40) with attention to mandibular morphology. Ultrasound was used to identify fractures of the subcondylar region.

Results: Multiple inconsistent submandibular classifications were found. Morphologic studies revealed that a line drawn parallel to the posterior-most aspect of the third molar through the mandible would accurately delineate an anterior border for distal mandibular fractures. In edentulous patients, this line may be drawn using the base of the retro-mandibular triangle. Morphologic studies and cadaveric dissection supported this conclusion.

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Ultrasound revealed subcondylar fractures in DCs. Subcondylar fractures are common and warrant a standard classification system based on integration of anatomy and clinical practice. Current systems do not appear to be based on anatomy, and they lack universal acceptance.

Conclusion: This study revealed a novel universal subcondylar fracture classification system that is logical, clinically relevant, and based on anatomic features with ultrasound application.

◆C9

Applying a Novel Ultrasound Finger Probe and FAST Examination to Identify Structures of the Abdomen and Thorax of Cadavers Wearing Personal Armor

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Introduction: Protective armor dates back to 1400 BCE and has been implemented to protect the wearer from various injuries. As weapons have advanced through the centuries, so too have the protective garments developed to minimize their affect. Progress has similarly been made within the fields of medicine, and currently using ultrasound (US) stands at center stage. US has a wide spectrum of uses in the area of trauma screening. One such use is the focused assessment for sonography for trauma (FAST) examination. This examination implements technology to identify free fluid in the spaces of perihepatic, perisplenic, pericardium, and pelvic regions.

Objective: To investigate if US can identify FAST examination structures on cadavers wearing protective armor.

Methods: Literature research was conducted regarding US use with cadavers wearing protective armor. Standard issue military flak jacket was

placed on 10 cadavers and 3 healthy men. Conventional and finger US probes were used to identify spaces in the abdomen and thorax using the FAST examination.

Results: Literature research revealed no known articles regarding US use during FAST examination with protective armor on cadavers and in situ. Conventional US probe was unsuccessful in identifying structures. US finger probe was successful in identifying spaces in the abdomen and thorax with cadavers and in situ and with armor. The ability to perform the FAST examination on patients wearing protective armor could potentially improve triage and delivery of health care in and around the battlefield. Currently protective armor is removed to assess the injuries placing the patient at increased risk during evaluation and transport. This study revealed a valuable tool allowing safe assessment of spaces involved in life-threatening injuries.

Conclusion: This study revealed that a novel US finger probe could be successfully applied to identify FAST examination anatomy spaces in the abdomen and thorax while wearing protective armor.

◆C10

Variable Modalities of Endotracheal Tubes to Visualize Vocal Cords Using Ultrasound on Donor Cadavers

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Introduction: One of the most important skill sets a clinician can acquire is to intubate a patient with a compromised airway. Physicians who do not practice this often would benefit from a training environment. Although not ideal, current training methods use synthetic mannequins.

Objective: To investigate endotracheal (ET) airway intubation of recently deceased donor cadavers (RDDCs) and embalmed donor cadavers (EDCs)

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using anterior midline neck ultrasound (US) confirming ET tube placement as a training tool.

Methods: We conducted a literature search for studies on airway intubation of cadavers using US of the anterior neck. RDDCs and EDCs received ET intubation with US guidance from 3 separate users. Cadavers were intubated using 3 variable conditions associated with the ET tube: standard ET tube placement, ET tube filled with water, and ET tube with a B-Braun echogenic needle placed within the tube. An US probe was placed both horizontally with a caudal attitude and vertically at the cricoid membrane.

Results: One study was found using US-guided ET tube placement in cadavers; however, the investigators applied the US probe to the chest. ET tube placement was successfully completed on 7 RDCs and 1 EDC by all 3 users' multiple attempts. The same consistent sign was identified on each attempt from all users regardless of variables as the cuff passed the cords. ET tube placement is both life-saving and used routinely in surgical procedures. Tremendous anxiety is associated with ET tube placement. Therefore, training methods using human anatomy is ideal. This novel pilot study demonstrated that a US probe was successful at identifying the cuff as it crosses the cords in both RDCs and EDCs, revealing the "cuff cord sign."

Conclusion: This study identified a novel US cuff-cord sign while successfully intubating cadavers. This could potentially be used in vivo.

◆C11

Relationship Between Pediatric Obesity Patterns and Injuries in the Emergency Department

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Background: The proportion of obese and overweight children treated in the emergency department has increased over the years as obesity risk factors have become more prevalent in society.

Hypothesis: Obese children are more likely to have more musculoskeletal injuries, with a larger proportion of lower extremity and upper extremity injuries than their nonobese counterparts. However, obese children may be less likely to sustain head and trunk or intraabdominal injuries.

Objective: To determine whether pediatric obesity risk factors are translated to increased injuries of specific types, and to identify changes in proportions of obese and overweight children presenting to the emergency department.

Methods: The study is an institutional review board–approved retrospective review of medical records to examine weights and injuries in children aged 2 to 16 years presenting to the emergency department in 2005 and 2013. The data collected included weight classifications and injury classifications of each patient. The patients in the study were split into 4 categories: underweight, average, overweight, and obese. The patients were further grouped into injury classifications: head, upper extremity, lower extremity, trunk, and unknown.

Results: The results of this study showed no significant changes in weight patterns from 2005 to 2013. Minor changes included an increase in overweight patients, a decrease in average greater than 50th percentile patients, and a decrease in obese patients. The overall injury pattern regardless of sex, weight, or year was as follows: lower extremity, upper ex-

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tremity, and head, with trunk and unknown injuries at a minimum. However, obese and overweight patients had a larger proportion of lower extremity injuries (50% and 46% respectively), in comparison with the 35% to 43% of lower extremity injuries in other weight groups, true to the hypothesis.

Conclusions: The study will aid in providing education on healthy habits, weight reduction, and injury prevention to parents and children to avoid common injuries and promote a healthier lifestyle and allow physicians to effectively diagnose and treat pediatric patients.

◆C12

**Lateral Ankle Sprain Anatomy—
Can the Bifurcate Ligament Be
Consistently Identified With
Ultrasound on Cadavers?**

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Introduction: The bifurcate ligament (BFL) is recognized by musculoskeletal specialists to be underappreciated regarding plantar flexion and inversion mechanism of injury in lateral ankle insults. The anterior to posterior orientation plane of the BFL is similar but lies inferior, and just anterior to the anterior talofibular ligament (ATFL) and may be injured in severe lateral ankle injuries (LAI). Undiagnosed BFL injury may explain delayed healing and reoccurring injury.

Objective: To investigate whether the bifurcate ligament could be identified using ultrasound (US) on donor cadavers (DCs) as a training exercise for anatomy education and clinical assessment.

Methods: We conducted a literature search for studies on US identification of the BFL on DCs. Dissection of 53 embalmed DCs (53 right, 53 left; n=106) was conducted to identify the BFL. Digital caliper measurements were taken from the apex of

the distal fibula (ADF) to the proximal point of the fifth metatarsal tuberosity (5MT) and ADF to the posterior point of the BFL (PBFL) in the neutral position (n=30 sides).

Results: A literature search revealed no studies on US of BFL on DCs. Measurements of ADF-5MT revealed (60.22 mm±0.43) and ADF-PBFL (42.18 mm±0.51), respectively. One study of 19 patients reported 95% identification accuracy with US of damaged ATFL, which was confirmed by arthroscopy. Ankle sprains are the most common lower limb injury that present to the health care system. The variable recovery times and relatively high incidence of recurrence in moderate to severe ATFL injuries suggest that one may benefit from identifying and examining BFL damage using a dependable, inexpensive image medium such as US. Measurements from this study suggest that a probe placed two-thirds distance between ADF-5MT in the plane of the great toe from the ADF affords visualization of the BFL.

Conclusion: This study reveals that the BFL can be consistently identified in DCs using US, thus enabling anatomists and clinicians access for analysis.

◆C13

**Novel Ultrasound Study Revealing
Live Scanning Viewed in Google Glass**

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Introduction: Ultrasound (US) has become the visual stethoscope while the physician's hand remains the palpation stethoscope. When learning to use a classic US probe, instructors often describe maintaining a tripod base with the operating probe hand to prevent altering the image plane. Another challenge when conducting US is for the user to alternate between viewing the US screen, the patient's

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face, and the probe region. Ideally, having the US image in Google Glass would potentially eliminate the above challenges.

Objective: To investigate whether a US image produced from a linear probe could be assessed using Google Glass.

Methods: We conducted a literature search for studies on the interface between Google Glass and live US scanning using a linear probe. Google Glass XE 16.1 was acquired for \$1,500.00. A Fukuda UF-760AG portable US imaging system with a SonicEye linear finger probe was used to scan a healthy human wrist to identify the radial artery and tendons before arterial blood gas sampling. Eye TV3 Video Decoder Software was obtained and used in concert with Google Hangout.

Results: A literature search revealed no known studies using Google Glass with an US image while scanning a live patient or cadaveric human. An image created from a manual linear probe was seen in Google Glass during live patient and cadaver examination. Eye TV3 Video Decoder and Google Hangout software were successful in relaying US imaging.

Discussion: US is gaining rapid exposure and use across all medical specialties. The ability to view the US image in Google Glass will potentially diminish US probe handling and image capturing issues. This pilot study is the first known US investigation to successfully demonstrate the interface between Google Glass and live US scanning.

Conclusion: This study revealed that live US scanning will produce an image that can be assessed while wearing Google Glass.

◆C14

Benefits of Novel Ultrasound Finger Probe With Compatible Google Glass Imaging During Live Scanning

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Introduction: Ultrasound (US) has become the visual stethoscope, while the physician's hand remains the palpation stethoscope. To integrate or fuse both modalities would seemingly create a more desirable examination, including data collection and patient experience. When learning to use a classic US probe, instructors often describe maintaining a tripod base with the operating probe hand to prevent altering the image plane. Using a finger probe prevents the usual probe angle issues during image capture because of increased probe stability with the hand placed firmly on the skin surface.

Objective: To investigate whether an US image produced from a linear finger probe could be assessed using Google Glass.

Methods: We conducted a literature search for studies on the interface between Google Glass and live US scanning using a linear finger probe. Google Glass XE 16.1 was acquired for \$1,500.00. A Fukuda UF-760AG portable US imaging system with a SonicEye finger transducer probe (5-12 MHz) developed by Sonivate Medical was used to scan a healthy human wrist identifying the radial artery and tendons before arterial blood gas sampling. Eye TV3 Video Decoder Software was used in concert with Google Hangout.

Results: A literature search revealed no known studies using Google Glass with an US image from a finger transducer while scanning a live patient or cadaver. An image created from a finger linear probe was seen in Google Glass during live and cadaveric patient examination. Eye TV3 Video De-

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coder and Google Hangout software were successful in relaying US imaging.

Discussion: US imaging has proven application for diagnostic and procedural techniques. Improved technology diminishes user error while decreasing length of training. When considering radiation benefits to the patient from US use, it seems necessary to promote these technologic advances. This study combined innovation from a novel finger transducer probe and viewing system to produce an image that can be assessed for diagnostic or procedural techniques.

Conclusion: This study revealed that a novel finger probe can produce an image compatible with Google Glass for assessment.

◆C15

Novel SonicEye Linear Ultrasound Finger Probe Can Be Used to Identify the Bifurcate Ligament When Placed Onto a Standardized Surface Anatomy Template

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Introduction: The bifurcate ligament (BFL) is injured during abnormal plantar flexion and inversion movements that are often undiagnosed. Some recognized musculoskeletal specialists believe the anterior talofibular ligament (ATFL) and the BFL can be injured by the same mechanism of injury. A previous study by the authors revealed the BFL could be consistently identified with ultrasound (US).

Objective: To investigate whether a novel US SonicEye finger probe (SFP) could be used to identify the BFL and a location where the BFL would consistently be viewed.

Methods: We conducted a literature search for studies on the use of a novel SFP to identify the BFL and a standardized footplate position to consistently

view the BFL using donor cadavers. Dissection of 106 (53 right, 53 left) embalmed donor cadaver ankles with subsequent osteologic landmark identification and measurements revealed a skin surface template to place the US SFP. Measurements were converted into percentages to standardize skin surface US SFP positioning template. Digital caliper measurements were taken from the apex of the distal fibula (ADF) to the proximal point of the fifth metatarsal tuberosity (5MT) and ADF to the posterior point of the BFL (PBFL) in 10° of plantar flexion.

Results: A literature search revealed no studies regarding novel US finger linear probe to identify the BFL and a standardized US footplate position. Measurements of ADF-5MT revealed 60.22 mm±0.43 and of ADF-PBFL revealed 42.18 mm±0.51. US SFP placement revealed positive BFL identification when placed two-thirds distance between ADF and 5MT pointing toward the first metatarsal joint.

Discussion: Ankle sprains are the most common lower limb injuries presented to the health care system. One study of 19 patients reported 95% identification accuracy with US of damaged ATFL, which was confirmed by arthroscopy. The variable recovery times and relatively high incidence of recurrence in moderate to severe ATFL injuries suggest that one may benefit from identifying and examining BFL damage using a dependable, inexpensive image medium such as US. This study revealed that a novel SFP could be used to identify the BFL. Measurements from this study suggest an SFP placed two-thirds distance between ADF-5MT in the plane of the great toe from the ADF affords visualization of the BFL.

Conclusion: This study reveals that the BFL can be consistently identified in DCs using a novel SFP on the BFL US footprint.

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◆C16

Identifying Mandibular Fractures Using SonicEye Linear Ultrasound Finger Probe

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Introduction: Traumatic injuries resulting in mandibular fractures are a common presentation in hospital emergency departments. Prevalence of mandibular fractures range from 13% up to 33% in adults and children, respectively, regarding craniofacial injuries presenting to emergency departments. Radiologic mediums used to identify mandibular fractures are x-ray (panoramic view) and computed tomographic scans; however, exposure to radiation, time efficiency, and costs urge the development of a more practical imaging medium. Ultrasound (US) provides a rapid, radiation-free image that is portable, and relatively cost-effective. Classic linear US probe (7.5 MHz) has been used to identify mandibular fractures.

Objective: To investigate whether a novel SonicEye linear finger probe could identify mandibular fractures.

Methods: We conducted a literature search for studies on the use of a finger probe in identifying mandibular fractures. Mandibular fractures were created in embalmed adult cadavers (n=8). A Fukuda UF-760AG portable US imaging system with a SonicEye linear finger probe was used to scan the mandibles of cadavers and record fracture location. Dissection was performed to reveal fracture site.

Results: A literature search revealed a study using classic linear probe identifying mandibular fractures; however, poor resolution led to an inability to assess the detail of multiple fractures. No studies using a linear finger probe were found. Using SonicEye linear finger probe in identifying fractures to the mandible was 100% successful.

Discussion: Previous study in 2001 using classic linear US probe revealed that mandibular fracture could be identified, however, resolution was poor and the morphology of multiple fractures could not be described adequately. This current study revealed a SonicEye linear probe could successfully identify fractures where the cortex was disrupted completely through bone at any particular site. Traditionally, US imaging of cadavers demonstrated a poorer quality compared with live scanning. US resolution continues to improve and warrants further studies when the patient can be spared radiation exposure and exorbitant financial costs.

Conclusion: This pilot study revealed the novel SonicEye linear probe can identify complete bicortical mandibular fractures. Further studies with cadaver and patients are needed.

◆C17

Applying Ultrasound Sliding Lung Sign to Cadaveric Tissue of Varied Preparations: Method of Identifying Endotracheal Intubation and Diagnosing Pneumothorax

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Introduction: Sliding lung sign (SLS) is used to confirm correct endotracheal tube (ETT) placement after intubation and to exclude a pneumothorax (PTX) in a critically injured patient. SLS is visualized when an ultrasound (US) transducer is placed on the second intercostal space of the mid-clavicular line of the anterior thoracic wall to observe the “sliding” of parietal and visceral pleura during respiration. SLS has been commonly used to assess lung function since Rantanen NW first described it in 1986.

Objective: To investigate whether SLS could be revealed on embalmed cadaveric tissue for ETT

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placement training and PTX assessment.

Methods: A literature search was conducted on US and anatomy journals and texts regarding SLS using donor cadavers of varied preparations (DCVPs). Intubation was conducted and confirmed with US before and 2 weeks after embalming (n=10; 5 male, 5 female) of DCVPs. To maintain an open mouth, a block was placed between first molars to facilitate ETT placement once the DCVPs were embalmed. Sonosite M-Turbo system using HFL50X probe and PaoLus system using biplanar finger array probe was placed at the second mid-clavicular, fourth axillary, and sixth lateral intercostal spaces of the thoracic wall to visualize SLS as the lungs were inflated manually using an Ambu bag.

Results: Literature research revealed no relevant articles. After intubation, SLS was visualized and recorded using both 2D and video mediums. All preparations revealed the SLS, which indicated correct ETT placement and PTX exclusion. ETT intubation and PTX assessment are important critical skills. Providing training on human tissue outside critical care settings may improve procedure success and diminish user anxiety. In viable tissue, visualization of the SLS confirms correct ETT placement after intubation and PTX exclusion.

Conclusion: This novel pilot study demonstrates that SLS can be successfully conducted on recently deceased and DCVPs, suggesting a valuable training method to assess life-saving procedures.

Basic Sciences

◆B1

Cancer Stem Cells as Potential Targets for Immunomodulatory Cancer Therapies

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Introduction: The failure of traditional chemotherapies to eliminate cancer stem cells (CSCs) is implicated in tumor relapses. The aim of this study was to isolate CSCs from HCA-7 human colon carcinoma cells and analyze their resistance to apoptosis. To the best of our knowledge, isolation of CSCs from HCA-7 cells has never been achieved.

Hypothesis: CSCs exhibit an innate resistance to apoptosis, making them challenging targets for conventional cytotoxic therapies.

Methods: After analysis of published data, we designed our CSC isolation strategy targeting selective expression of CD44 marker often detected on CSCs from various tissues and other cancer cell lines. Magnetic cell isolation was performed using streptavidin-coated magnetic FlowComp Dynabeads and DBX-biotin-labeled anti-CD44 rabbit monoclonal antibody. Isolated CD44-positive CSCs were cultured in ultra-low adherent plates or alginate gels followed by analyses of their properties compared with CSC-depleted HCA-7 carcinoma cells. Cell apoptosis was induced by a 30-min UV-C radiation, and proapoptotic and antiapoptotic responses were measured using a Proteome Profiler Human Apoptosis Protein Array (R&D Systems). Untreated CSCs and CSC-depleted HCA-7 cells + UV-treatment were used as controls.

Results: We successfully isolated CD44-positive CSCs from the HCA-7 carcinoma cell line. The identity of CSCs was confirmed by a sphere-

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forming assay based on their capacity for self-renewal and differentiation at the single-cell level in vitro. Isolated CSCs manifested strong resistance to UV-induced apoptosis measured by array profiling of 35 pro- and antiapoptotic proteins. The innate apoptotic resistance of CSCs is, at least in part, mediated by high levels of Bcl2 and XIAP antiapoptotic proteins in untreated cells, whereas UV-treated CSCs exhibited a 3 to 4-fold increase in cellular levels of catalase, which is shown to confer apoptotic resistance to tumor cells.

Conclusion: Isolated CSCs from HCA-7 cell line exhibit resistance to apoptosis owing to elevated levels of antiapoptotic Bcl2, XIAP, and catalase, which may serve as therapeutic targets for novel anticancer treatments.

◆B2

Effects of Carbamylation on Paraoxonase-1 Enzymatic Activities

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Introduction: The paraoxonase-1 (PON1) enzyme associated with high-density lipoprotein (HDL) has multiple activities, including the ability to degrade phosphotriesters, arylesters, and lactones, and possesses a cardioprotective antioxidant function. However, these activities may be susceptible to alteration via cyanate-mediated carbamylation during inflammation. Although carbamylation is known to alter the biologic function of several proteins, our laboratory is the first, to our knowledge, to investigate the effects on HDL and PON1.

Objective: To test the null hypothesis that carbamylation of HDL has no effect on PON1 paraoxonase, arylesterase, and lactonase activities.

Methods: HDL was isolated from pooled human plasma by ultracentrifugation. Isolated HDL (1 mg of protein/mL) was then exposed to potassium cyanate (KCN; 1-1,000 mM) for 24 hours to carba-

mylate HDL proteins. Carbamylation was quantified by measuring formation of homocitrulline, and PON1's phosphotriesterase, arylesterase, and lactonase activities assessed by standard enzymatic assays. All analyses were performed in triplicate in each of 3 separate experiments. Statistical analysis was performed by ANOVA with appropriate post-hoc testing.

Results: Treatment of HDL with KCN caused significant carbamylation. For example, whereas control HDL contained <1 μmol of homocitrulline/mg protein, in HDL treated with 1,000 mM KCN, homocitrulline increased to 153 ± 24 $\mu\text{mol}/\text{mg}$ protein ($P < .0001$). Similar (nonsignificant) carbamylation was seen at lower KCN concentrations. PON1's phosphotriesterase and arylesterase activities declined significantly (from 100% to $12\% \pm 2\%$ and $18\% \pm 10\%$ of normal, respectively) with increasing carbamylation ($P < .05$); lactonase activities were highly variable, and no significant difference was found. Finally, although we attempted to measure HDL antioxidant function, technical difficulties prevented us from obtaining results.

Conclusion: Carbamylation significantly decreased PON1 phosphotriesterase and arylesterase activities. Data concerning lactonase enzyme activity were inconclusive, and further efforts should be made to investigate the relationship between carbamylation and HDL antioxidant activity. Our preliminary results suggest that carbamylation of HDL's PON1 may translate to a reduction in cardioprotective function during development of atherosclerosis.

Funding: Financial support provided by Midwestern University. Student doctor Devine was a 2013 Kenneth A. Suarez CCOM Summer Research Fellow.

◆ Abstract entered in the SOMA Student Poster Competition.

◆B3

Evidence of Intranuclear Bacteria in Parkinson Disease

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Introduction: The human body hosts a complex system of an estimated 1 trillion microbes that outnumber our own cells by a factor of 10 or more. Host-specific variations of microbial communities have been linked to pathological states and are intensely researched. Parkinson disease (PD) is the most common movement disorder worldwide, with well-established pathology yet poorly defined origin and pathogenesis. As a consequence, the underlying circumstances of disease onset and progression are obscure in the vast majority (>90%) of all PD cases. Initial signs of PD-related cell death are seen in the olfactory bulb and the area postrema in the brainstem. Both areas lack a functional blood-brain barrier, allowing pharmaceuticals, chemicals, and pathogens to enter the central nervous system (CNS). Thereafter, cellular damage and inflammation gradually progress toward the substantia nigra of the midbrain, and last, the cerebral cortex. This pattern is reminiscent of a slow-moving bacterial infection, which is supported by our findings.

Hypothesis: The pathogenesis of PD can involve the transition of benign but opportunistic bacteria into the CNS parenchyma and its cells. We postulate that this paradigm can be demonstrated in ex vivo brain tissue from individuals with PD and also in cultured human cells.

Methods: Postmortem brain sections of advanced-stage PD and matching controls (n=12; Brain and Body Donation Program, Mayo Clinic, Arizona) were screened for bacterial markers using standard fluorescence immunohistochemical techniques. Ap-

plying standard bacterial and cell culture protocols, human dopaminergic neuroblastoma cells (SH-SY5Y) were infected with common bacterial microbiota. Results were scored via standard transmission electron microscopy (SEM).

Results: Our findings indicate the presence of Gram-positive bacteria in about 50% of the post-mortem PD specimens tested. Those bacteria were enriched in the cytoplasm of a small number of neurons in affected PD brains and absent in controls. SEM analysis of our cell-based experiment indicates that certain bacterial microbiota can invade human neuroepithelial cells.

Conclusion: We may have found a novel pathogenic mechanism by which PD can be caused or exacerbated. If confirmed in vivo, this work would be the first of its kind making a causative connection between the most common neurodegenerative movement disorder and bacterial infection of the brain.

◆B4

Epstein-Barr Virus LMP2A Enhances MIP-1a Expression in B Cell Lymphoma by Using Syk and Downstream Kinases

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Background: Epstein-Barr virus (EBV) is associated with the development of malignancies such as Hodgkin lymphoma. Hodgkin lymphoma is characterized by the presence of Hodgkin-Reed Sternberg (HRS) cells, which in EBV-associated Hodgkin lymphoma expresses latent membrane protein 2A (LMP2A). LMP2A is a membrane protein that is a functional homolog of the B cell receptor (BCR) and contains an immunoreceptor tyrosine activation motif (ITAM) that is critical for intracellular sig-

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naling. One important chemokine, MIP-1a, is highly expressed in EBV-associated diseases like Hodgkin lymphoma. Because previous studies indicate that MIP-1a levels are increased by BCR engagement in normal B cells, it is possible that LMP2A increases MIP-1a in a manner similar to BCR signaling.

Hypothesis: LMP2A activates Syk and downstream kinases to increase MIP-1a production in B-cell lymphomas.

Methods: ELISA and qRT-PCR was used to analyze supernatants from LMP2A-positive or LMP2A-negative B-cell lymphoma lines to determine whether LMP2A changes MIP-1a expression. Next, a B cell line expressing LMP2A with a mutation in the ITAM motif, which interacts with Syk tyrosine kinase, was used to measure changes in MIP-1a expression by ELISA. Last, to target downstream kinases, specific inhibitors were used to measure changes in MIP-1a expression in LMP2A-expressing cells by ELISA.

Results: We found that LMP2A-expressing cells produced more MIP-1a compared with LMP2A-negative cells. Next, we found that MIP-1a production returns to basal levels in cells expressing LMP2A with a mutation in the ITAM motif. Finally, specific inhibitors to LMP2A signaling decreased MIP-1a production in LMP2A-expressing cells.

Conclusion: These results indicate that LMP2A signaling through Syk and downstream kinases may enhance MIP-1a expression in Hodgkin lymphoma tumors, and identifies potential pharmacologic targets in EBV-associated diseases.

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◆B7

Oxidative Stress and Inflammation Correlated With Lower PON1 Lactonase Activity in Respiratory Patients: A Pilot Study

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Background: Paraoxonase-1 (PON1) is an esterase enzyme carried by HDL and exerts protective effects against oxidative damage. PON1 is well known for its atheroprotective function, but its connection to respiratory diseases has not yet been established. In chronic conditions such as chronic obstructive pulmonary disease (COPD), hypoxia causes a cascade of events that lead to the circulation of free radicals that attack PON1. In acute infections such as pneumonia, inflammation leads to oxidative stress and protein damage by myeloperoxidase (MPO).

Hypothesis: We hypothesized that, as a consequence of the inflammation and oxidative stress induced by respiratory disease, PON1 activity decreases in association with the severity of the condition.

Methods: The sample population of this pilot study consisted of 19 patients with respiratory diseases, 14 men and 5 woman, average age 67.5±11.9 years, and 10 age-matched healthy controls. Disease status among patients presented as the following: 9 COPD, 3 acute pneumonia, and 7 other conditions, including hypoxia and anemia. Blood samples from patients were obtained on admission within 48 hours of disease onset. For some patients, additional sera were obtained to track changes caused by treatment. PON1 lactonase activity was analyzed using dihydrocoumarin as the substrate.

Results: The data show that there is an association between PON1 activity and respiratory disease. Six of 9 patients with COPD and 3 of 3 patients with

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acute pneumonia demonstrated PON1 levels below the control average, 48.6 ± 12.3 U/L. Patients with acute pneumonia tended to have lower PON1 values (28.3 ± 16.2 U/L) compared with chronic respiratory patients (38.5 ± 6.9 U/L) (excluding 2 outliers). Over the course of treatment of 1 patient's pneumonia, PON1 rose by 118% (12.9 - 28.14 U/L) as C-reactive protein (CRP) fell by 98% (16.24 - 0.34 mg/dL). One patient being followed and treated for lung edema due to malnutrition showed a 72% increase (16.9 - 29.4 U/L) in PON1 activity and a 95% decrease (11.95 - 0.55 mg/dL) in CRP as they recovered. To understand the variance ($SD=15.4$ U/L) in the full COPD dataset, not excluding outliers, we subdivided the patients by smoking status and other major health conditions. It was found that patients with COPD who recently smoked or smoke heavily had, on average, significantly lower PON1 lactonase activity (34.8 ± 3.9 U/L), compared with that of patients with COPD who are not recent smokers or smoked lightly (60.0 ± 13.8 U/L).

Conclusion: There are noticeable changes in PON1 levels in patients with respiratory disease as compared with PON1 levels in the control group. These changes may be a result of acute phase changes in HDL, damage caused by free radical activity on PON1 or by effector proteins of the immune system such as MPO, PON1 dissociation, or a combination of the above factors. The conclusions of this principle pilot study will pave the way for a larger study currently underway.

◆B8

Immune Effects of DDE in a Murine Diet-Induced Obesity Model

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Introduction: Androgens have the ability to modulate the immune system. Anything that alters the actions of androgens also has the ability to modulate the immune system. DDE, the metabolic breakdown product of the pesticide DDT, acts as an androgen receptor antagonist; therefore, by inhibiting the actions of androgens, it may modulate the immune system. DDE is fat-soluble and is stored in adipose tissue. This purpose of this study is to contrast the activity of DDE in normal-weight female mice with the activity of DDE in obese female mice. This study will also help us better understand the immunologic consequence of both short-term and long-term DDE exposure.

Hypothesis: The hypothesis predicted that a longer DDE exposure time accompanied by a high-fat diet would allow DDE to exert its effects more pervasively.

Methods: This experiment was completed using 2 separate groups of mice. The first group had long-term exposure, and the mice were killed 4 weeks after their last dose of DDE. The second group had short-term exposure, and the mice were killed 24 hours after their last dose of DDE. Each study used 12 female mice. The studies were conducted identically. On their arrival, each set of mice was divided into 2 diet groups: high-fat and low-fat. After 8 weeks consuming their respective diets, 3 mice from each diet group received 2 doses of DDE that were given 48 hours apart. At the time of euthanization, the thymus and spleens were removed and made into single-cell suspensions. The cells were

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labeled with fluorescent monoclonal antibodies for CD3, CD4, CD8, and B220. Flow cytometry was then used to determine cell populations.

Results: Statistical analysis was done to compare the cell populations of the short-term DDE exposure group with the long-term DDE exposure group. The high-fat diet control group saw decreased CD4+ splenocytes in the long-term exposure group when compared with the short-term exposure group ($P < .05$). The high-fat diet DDE group showed a decrease in the number of CD4+/CD8+ splenocytes in the long-term exposure group when compared with the short-term exposure group ($P < .05$). The low-fat control group showed increased CD8+ splenocytes in the long-term exposure group when compared with the short-term exposure group ($P < .05$). In the thymus, the low-fat DDE group showed increased numbers of CD8+ thymocytes in the long-term exposure group when compared with the short-term exposure group ($P < .05$). The high-fat control group showed decreases in the number of CD3+ thymocytes in the long-term exposure group when compared with the short-term exposure group ($P < .001$).

Conclusion: Both diet and DDE can induce measurable immunologic changes in female mice.

◆B9

Soluble Receptor for Advanced Glycation End Product Levels Are Much Higher in Cord Blood Than in Maternal Blood and Correlate With Age: More Evidence for a Decoy Function?

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Introduction: Soluble receptor for advanced glycation end products (sRAGE) may be involved in feedback regulation of the toxic effects of RAGE-mediated signaling. Earlier studies from our laboratory showed that low-molecular-weight (LMW) AGE levels were much higher in cord blood than in maternal blood, presumably related to impaired excretion by poor-functioning kidneys in fetal life.

Objective: To measure sRAGE and AGE levels in cord and maternal blood to investigate the correlation between the two.

Hypothesis: We hypothesized that sRAGE are higher in cord blood as a compensatory mechanism for high levels of LMW AGE.

Methods: This pilot study included blood samples from 10 mother-infant dyads, as well as 6 adult controls. The neonates were healthy, appropriate for gestational age, and born by spontaneous, uncomplicated vaginal delivery. AGE and LMW AGE were measured by standard fluorescence assays. Serum sRAGE was measured by an enzyme-linked immunosorbent assay using the Quantikine Human RAGE Immunoassay (R&D Systems Inc).

Results: sRAGE were more than 3-fold higher in cord blood than in maternal blood (2.20 ± 0.88 vs 0.63 ± 0.15 ng/mL, $P < .0001$). LMW fluorescent AGEs were almost 3-fold higher in neonate cord

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blood than in maternal blood ($P < .00001$). The ratio LMW/total serum fluorescent AGEs was also more than 2-fold higher in cord blood than in adults ($P < .00001$). The univariate correlation analysis showed that sRAGE was significantly positively correlated with LMW AGEs ($r = 0.43$, $P < .01$). Mothers also exhibited lower sRAGE than control adults (0.63 ± 0.15 vs 1.03 ± 0.22 ng/mL; $P < .0001$).

Conclusions: Neonates have sRAGE levels that are much higher than those of their mothers or control adults. We show an independent, significant correlation between circulating sRAGE and LMW AGE. Our findings suggests that the increase of sRAGE is caused by the upregulation of RAGE to prevent cell and tissue damage by inflammatory and oxidative molecules such as AGE. Incidentally, we also found that mothers exhibit significantly lower sRAGE levels compared with adult controls, although the significance of this finding is yet to be determined. Future studies are warranted to elucidate the biological mechanisms of the association between sRAGE and AGE in neonates and the changes occurring postpartum.

◆B10

Lymphatic Pump Treatment of Rats With Adjuvant-Induced Arthritis Reduces Joint Inflammation and Systemic Inflammatory Cytokine Production

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Introduction: Rheumatoid arthritis (RA) is one of the most prevalent chronic inflammatory autoimmune diseases affecting nearly 1% of the population. The exact mechanism of disease manifestation is unknown. However, it is thought to result from the breakdown of immune tolerance, the production of proinflammatory cytokines, and, more specifi-

cally, aberrant T-cell immunity. Lymphatic pump treatment (LPT) is an osteopathic manipulative treatment technique used with the intent to increase lymphatic flow and alleviate edema.

Hypothesis: We hypothesize that LPT can reduce arthritis in the rat adjuvant-induced arthritis (AIA) model of RA in part by altering proinflammatory cytokine expression.

Methods: Thirty-three female Lewis rats with AIA were placed into 2 groups. The test group of animals received LPT 3 times per day over the course of 3 days. LPT was performed by rhythmically pressing below the rib cage 30 times over a 30 second period, while the sham control group was held for 30 seconds. Articular index scoring and caliper measurements were taken on hind ankles through the course of the study. Hind ankles were collected and homogenized to collect protein lysates. Peripheral blood was also collected and analyzed by flow cytometry. A rat cytokine/chemokine magnetic immunoassay was performed to quantify the effects of LPT on the proinflammatory cytokines in the pathogenesis of rat AIA.

Results: AIA rats receiving LPT had reduced ankle edema as assessed by significantly smaller ankle circumference measurements and lower articular index scores compared with the sham control group. Results from the rat cytokine/chemokine immunoassay showed significantly decreased levels of GRO and MIP-1 α in the serum of AIA rats treated with LPT compared with the sham control animals. Additionally, the sera levels of IL-17, IL-18, IP-10, Fractalkine, LIX, and RANTES were decreased in the LPT treatment group; however, this was not statistically significant.

Conclusion: These results show that LPT can significantly reduce inflammation in the joints of AIA rats. Our study also suggests that LPT can alter the levels of cytokines in the sera of arthritic rats receiving LPT.

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◆B11

Insulin Signaling and Obesity: Role of Ceramide in Adipocyte Insulin Resistance

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Introduction: Epidemiologic studies indicate that central obesity is the strongest risk factor for type 2 diabetes mellitus (T2DM). An early defect occurring in the pathogenesis of T2DM is diminished insulin sensitivity in insulin-responsive tissues. A common feature of obese individuals is low-grade inflammation, mediated by cytokines such as tumor necrosis factor α (TNF- α) secreted by macrophages in the adipose tissue. The increased secretion of TNF- α contributes to an altered systemic as well as adipose tissue lipolysis, leading to elevated levels of circulating free fatty acids (FFA). Enhanced availability of FFA has been shown to increase the amounts of ectopic lipid stores in both adipose and nonadipose tissues, further enhancing the risk for T2DM.

Objective: To determine the effect of ceramide on the total protein expression and protein phosphorylation of key signaling molecules within the insulin signaling cascade in adipocytes.

Methods: Using Western blot analysis, we determined the total protein expression of insulin receptor β subunit (IR- β), phosphorylated insulin receptor β (p-IR β), protein kinase B (PKB/Akt), and phosphorylated protein kinase B (p-Akt) in 3T3-L1 adipocytes after treatment with ceramide for 24 hours, 48 hours, and 72 hours, respectively.

Results: Our results indicate no significant changes in total protein expression of IR- β . However, total p-IR β was significantly enhanced ($P=.0002$) after treatment with ceramide for 72 hours followed by insulin treatment for 1 hour. Total protein expression of Akt was significantly increased ($P=.384$)

after ceramide treatment for 48 hours. p-Akt was not significantly altered in any of the treatment groups.

Conclusion: These findings provide evidence for the ability of ceramide to interfere with insulin signaling and to alter protein expression. In addition, these data suggest a possible mechanism for the effect of FFAs in the development of insulin resistance, therefore increasing the possibility of improved therapeutic treatments.

Medical Education

ME1

Early Outcomes of the Accelerated Physician Assistant Pathway (APAP): A 3-Year Curriculum for Physician Assistants (PAs) to Obtain a Doctor of Osteopathic Medicine (DO) Degree¹

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Introduction: On May 22, 2010, the American Osteopathic Association Commission on Osteopathic College Accreditation approved Lake Erie College of Osteopathic Medicine's application for the accelerated physician assistant pathway (APAP), an accelerated curriculum providing 12 seats for PAs to obtain DO degrees in 3 years.

Hypothesis: PAs who seek medical degrees represent a largely untapped pool of applicants with maturity and clinical experience and were projected to succeed didactically and choose primary care specialties at higher rates. The inaugural class matriculated in 2011. Statistical assessment was performed and outcome measures are presented.

Methods: Twenty-five PAs enrolled in the first 3 classes: 7 in the Class of 2014, 9 in the Class of 2015, and 9 in the Class of 2016. Fifty-one PAs ap-

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plied for the Class of 2017, with all 12 seats being offered. Mean age was 32 years compared with 25 for the national mean; 19 were men (76%), 6 were women, and 11 were married (44%). The mean length of clinical practice as a PA was 5.35 years.

Results: Grade point averages for APAP Class of 2014 were 3.31 compared with a 3.18 class mean (+0.12) at the end of the first year and 3.56 compared with 3.12 class mean (+0.46) at the end of the second year. Class of 2014 APAP students scored 123 points higher than the class mean for the Comprehensive Osteopathic Medical Self-Assessment Examination. Comprehensive Osteopathic Medical Licensing Examination means were 620 for level 1 and 636 for level 2, 91 and 94 points above the national mean, respectively. None of the 25 students has been lost to attrition. APAP requires 50% of available seats to be allocated to students who agree to go into primary care fields. In the Class of 2014, only 2 of 7 (28.5%) of students selected primary care slots at matriculation. However, after the 2014 match, 4 of the 7 (57%) students chose primary care residencies.

Conclusion: APAP provides a 3-year curriculum for PAs to obtain DO degrees. Enrollment and applications have progressively increased. APAP students are 7 years older at matriculation than the mean for the class and have an average of 5.35 years of clinical practice as PAs. These students carry higher GPAs, demonstrate higher performance measures on national performance examinations, and have selected primary care specialties at high rates, making them ideal candidates for medical school matriculation.

1. Kauffman M, Ferretti S. The Accelerated Physician Assistant Pathway: a three-year medical school curriculum for physician assistants to obtain DO degrees. [published online ahead of print May 21, 2014]. *Academic Med*. doi:10.1097/ACM.0000000000000307.

ME2

Assessment of International Health Electives in AOA-Accredited Residency Programs

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Introduction: International health electives (IHEs) are becoming popular in graduate medical education training programs because of the growing interest in global health experiences among medical graduates. The value of an IHE during medical education is already well established and subsequently has compelled colleges of osteopathic medicine to create student level IHEs. However, little is known about whether IHEs are common among osteopathic-focused residency programs and whether there are any unique challenges and concerns that exist in developing a resident-level IHE in osteopathic-focused programs.

Hypothesis: There are very few IHEs among osteopathic-focused residency programs within the United States. Programs with established IHEs are more likely to fill all of their residency positions, and the directors of these programs are more likely to report cultural sensitivity as a competency gained through involvement in IHEs.

Methods: An online survey was created in Survey Monkey and e-mailed to all of the American Osteopathic Association (AOA)-accredited residency program directors in the United States. Survey Monkey recorded all of the responses, and data

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were analyzed using Excel and STATA statistical package. The institutional review board at Nova Southeastern University College of Osteopathic Medicine approved this study.

Results: The survey was sent to 887 program directors, and 165 responded to the survey. Most were programs without IHEs (66%). Among the programs with IHEs, most were family medicine programs (53%). Among the programs with IHEs, 39% of them had an existing parallel Accreditation Council for Graduate Medical Education program at their institution, and 35% were dually accredited programs. The majority of AOA-accredited residency programs do not currently have IHEs, despite the overwhelming interest in and desire of graduating medical students. Reasons for not having an IHE varied, but the most common obstacle was financial.

Conclusion: Although more studies need to be conducted, osteopathic-focused residency programs that have IHEs are more likely to attract more graduates into their programs. Most osteopathic-focused residency programs are interested in establishing and maintaining IHEs for their residents and are seeking financial and logistical resources to do so.

◆ME3

Effect of Student Orientation Before an Anesthesia Rotation

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Background: A notable part of a medical student's education comes from contact with interns and residents during the clerkship years. Rotations that lack a residency stray from this design. A rotation in anesthesiology further poses unique obstacles, be-

cause it is a busy service with multiple attending physicians and no didactic lectures. Preclerkship instruction in the area of anesthesia is limited, and many of the medications, procedures, and processes are unique to the area. In addition, at SJMO, the rotation is confined to a 2-week period. Despite challenges, students can have a successful experience.

Objective: To assess whether an orientation before the rotation can improve students' experience or affect their interest in anesthesiology.

Hypothesis: An anesthesiology orientation program that reviews medications, procedures, and processes unique to field before a rotation will improve the experience and increase interest in anesthesiology

Methods: A survey was administered to students who completed their rotation from July to December 2013 to serve as a historical control. Then, an orientation program was given to subsequent students before the rotation starting January 2014, and they completed the same survey after the rotation.

Results: "The knowledge/skill I acquired this rotation is directly applicable to my future career" had a $P < .04$, and "I am interested in pursuing anesthesia after this rotation" and "I feel the procedures I performed were consistent with my level of experience" are trending toward statistical significance.

Conclusion: There is a unique model of medical education during the anesthesia rotation for students at SJMO as a result of the lack of a residency, a shortened length of 2 weeks, and contact with different attending physicians daily. Preliminary results show that an orientation that introduces students to the anesthesia setting can positively affect the experience. The knowledge and skill directly applicable to their future career regardless of intended specialty acquired during the rotations increases. The study is in its early stages, and it is encouraging that 2 other measures are trending toward statistical significance.

◆ Abstract entered in the SOMA Student Poster Competition.

ME4

Interprofessional Examination of Students' Attitudes Toward Electronic Professional Behaviors

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Objective: To show that differences exist among pharmacy, osteopathic medical, dental, and physician assistant (PA) students' attitudes toward e-professionalism behaviors.

Methods: A survey consisting of demographic questions and 30 professionalism electronic behavioral scenarios in 4 electronic domains (blogs, e-mail, social media, and media sharing) and was reviewed, condensed, and modified to include 16 non-discipline-specific and student-centered scenarios and 2 demographic questions. Students used a Likert scale to respond to their level of agreement regarding whether the scenarios described represented professional behavior. The survey was administered in person to first-year graduate students in selected class sessions in the colleges of pharmacy, osteopathic medicine, dental medicine, and health sciences (PA program) during the fall quarter of 2013. Kruskal-Wallis and χ^2 tests were used to analyze intergroup differences in nominal and ordinal data, respectively.

Results: Response rates were 24.5%, 96.5%, 97.6%, and 94.2% for pharmacy, osteopathic medicine, dental medicine, and PA students, respectively. There was a statistical difference in sex distribution across programs ($P < .05$), but no statistical difference in age. There were statistically significant differences in the perception of professionalism in 5 of

the 16 scenarios (3 social media scenarios, 2 media-sharing scenarios) ($P < .05$). In 4 of 5 of these differences, PA students appeared more likely to perceive the behaviors as unprofessional compared with the other groups.

Conclusions: While most respondents were able to recognize unprofessional behaviors in electronic domains, some cohorts appeared better able to do so. The results may suggest that students in the different colleges have different perceptions of professional electronic behavior coming into the program, or different colleges' policies or orientation education may influence their students' perception of acceptable behavior in a professional setting.

◆ME5

Central Column Knee Classification: A Novel Approach to Augment Specific Knee Structures of Clinical Relevance

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Introduction: Injuries to the central knee are common and debilitating. Commonly injured structures were observed via ultrasound. Understanding structural relationships is essential for examination, diagnosis, treatment, and rehabilitation. Musculoskeletal specialties refer to the anatomical importance of the posteromedial and posterolateral corners of the knee. However, the central region of the knee has not been afforded the equivalent classification and description. This region can be described as a column and includes some of the most commonly injured structures of the knee.

Objectives: To investigate the borders and contents of the central column (CC) of the knee and to provide a novel learning approach that integrates regional anatomy with common clinical conditions.

Methods: We conducted a literature search for

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studies on the CC. Dissections of 103 embalmed cadaveric knees were performed to identify bony landmarks and structures of the CC. Ultrasound was used to identify CC structures on cadaveric and viable tissue.

Results: No studies referring to structures organized as a CC of the knee were found. Dissection revealed bony landmarks and contents: intercondylar notch, patella, tibial tuberosity, intercondylar eminence, infrapatellar fat pad, retinacula, capsule, quadriceps femoris, patellar, biceps femoris and 4 other muscle-tendon complexes, oblique popliteal, anterior and posterior cruciate and 3 other ligaments, popliteal vein and artery, middle genicular and 3 other arteries, tibial nerve, supra/infrapatellar and 2 other bursae, and anterior/posterior horns of medial/lateral menisci. This study identified central knee structures and created a column-based model to nurture detailed understanding of anatomic relationships in this fertile pathological area for education, training, and research.

Conclusion: This study identified central knee structures and created a column-based model to nurture detailed understanding of anatomic relationships in this fertile pathological area for education, training, and research.

ME6

Evidence of Successful Streaming With Audiovisual Quality Using Google Glass to Integrate the Anatomy of a Clinical Examination

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Introduction: Streaming has become a valuable interface, enabling institutions to share presentations and deliver curriculum, particularly when multiple locations are involved. It also improves

andragogy and methodology. Streaming technology confers multiple advantages in global communication within the medical field.

Objective: To investigate whether Google Glass could be used to actively stream while describing the shoulder anatomy of a clinical examination technique to recipients at a distant site.

Methods: We conducted a literature search for studies on the use of Google Glass to stream shoulder anatomy during a clinical examination technique. Google Glass recorded a description of the anatomy of a healthy male volunteer while a provocative shoulder physical examination technique was performed. Five hours of software and hardware training was conducted using 1-minute mock tutorials streaming from Google Glass using Livestream for Glass software and viewed on both Macintosh and PC with Livestream software. The clinical shoulder examination technique was then streamed live to a distant site on a Samsung Galaxy S4 cell phone on the Verizon Wireless network. A quality audiovisual survey on streaming was then conducted.

Results: No known studies were found on Google Glass streaming of a shoulder clinical examination technique to a distant site. A 4-minute Google Glass recording of a clinical shoulder examination technique was successfully streamed live to a distant site. Survey results reported 100% agreement of a quality audiovisual streaming (N=20).

Discussion: The health care field is connected through a multitude of networks worldwide, and many health care institutions have satellite campuses. Live streaming technology provides the opportunity to share resources and expertise to further medical knowledge.

Conclusion: This novel study using Google Glass to stream an audiovisual recording of a shoulder examination technique was successful.

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◆ME7

Evidence of Successful Recording and Quality Audiovisual Stimulation Using Google Glass in the Anatomy Laboratory

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Introduction: There are known established andragogy methods that are unique to adult learning; however, a successful curriculum is dynamic in nature and is able to integrate technology with the evolving skills of present-day students.

Objective: To investigate whether Google glass could be used to record a quality audiovisual clinical anatomy dissection to support andragogy learning.

Methods: We conducted a literature search for studies on the use of Google Glass recordings of anatomy dissection tutorials. A male donor cadaver was prepared using Freedom Art embalming solution. Five hours of software and hardware training was done while performing 1-minute mock tutorials recorded in .mp4 format. Recorded tutorials were viewed on both Macintosh and PC computers using VLC 2.1.4 software. A survey assessing audio and visual quality of the tutorial recording was given to 20 people.

Results: No known studies on Google Glass recording of anatomy laboratory dissections were found. A 5-minute Google Glass recording of an anatomy dissection tutorial was successfully completed and compiled in .mp4 format. The .mp4 was transferred to both Mac and PC computers and subsequently opened and viewed using VLC 2.1.4 software. The survey reported 100% agreement of a quality audiovisual recording (N=20).

Discussion: Today's health care student is technologically savvy and expects an element of hi-tech delivery of education. This novel study successfully

integrated Google Glass technology in the anatomy laboratory setting. The quality of the audiovisual recording was very well received. Google Glass recordings allow viewers to experience a face-to-face point of view rather than the classic birds-eye view from an overhead camera system. This study has formally demonstrated that Google Glass can record tutorials for medical education.

Conclusion: This novel Google Glass investigation revealed that recording a tutorial on anatomy can provide a quality andragogy learning experience.

◆ME8

Anatomy Presentations Delivered to Distant Sites Using Google Glass: Evidence Supporting a Successful Andragogy Learning Method

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Introduction: Many students today benefit from viewing lectures and other educational presentations repetitively.

Hypothesis: Giving health care students a method to record educational presentations and view them at his or her discretion would enhance the learning experience.

Objective: To investigate whether a Google Glass presentation could be recorded at a distant site.

Methods: We conducted a literature search for studies on the Google Glass recording of a presentation at a distant location. A male donor cadaver was prepared using Freedom Art embalming solution. Five hours of software and hardware training was acquired while performing 1-minute mock tutorials recorded in .mp4 format. Twenty people were given a survey that assessed the audio and visual quality of the recording.

Results: No known studies on Google Glass re-

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recording of an anatomy presentation at a distant location were found. A 5-minute Google Glass recording of an anatomy dissection tutorial was successfully completed and viewed on both Macintosh and PC computers, and was subsequently opened and viewed using VLC 2.1.4 software. The survey reported 100% agreement of a quality audiovisual recording (N=20).

Discussion: Today's health care student is technologically savvy and expects an element of hi-tech delivery of education. This novel study successfully integrated Google Glass technology in the anatomy laboratory setting. The quality of the audiovisual recording was very well received.

Conclusion: This novel Google Glass investigation revealed that recording at a distant site can be done successfully therefore, providing the adult learner autonomy.

◆ME9

Evidence That Google Glass Recording and Editing Can Be Performed Using Final Cut Pro Software

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Introduction: Audiovisual recording of educational presentations is an important part of academia in the health care field. Many video journals are evolving, and their effect on understanding methods is extremely helpful. The ability to edit Google Glass educational recordings allows one to prepare customized presentations.

Objective: To investigate the compatibility of a Google Glass audiovisual recording with Final Cut Pro editing software.

Methods: We conducted a literature search for studies on the compatibility of a Google Glass audiovisual recording with Lightworks and Final Cut

Pro editing software. Five hours of training on Final Cut Pro editing software and 3 hours of training on Google Glass recording hardware was acquired. Recorded audiovisual sessions in .mp4 format were downloaded to a Macintosh computer and edited with Final Cut Pro.

Results: No known studies on Google Glass recording and editing with Final Cut Pro were found. A 9-minute Google Glass recording for video manuscript in .mp4 format was successfully conducted. The .mp4 was successfully edited into a 5-minute video manuscript presentation with Final Cut Pro, which was compatible with both Macintosh and PC computers.

Discussion: The ability to create specific audiovisual presentations while integrating text and still and animated imaging continues to provide the learner with multiple mediums of stimulation, facilitating the integration of technology for the adult learner. Educational videos that incorporate multiple teaching modalities should improve learning.

Conclusion: This novel Google Glass investigation revealed the successful compatibility of Final Cut Pro editing software and .mp4 formatted audiovisual recordings from Google Glass.

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