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Teaching and use of cervical high-velocity, low-amplitude manipulation at colleges of osteopathic medicine

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Abstract

Context: Despite the documented effectiveness of high-velocity, low-amplitude (HVLA) treatment of the cervical spine, concerns about patient safety potentially limit didactic instruction and use in clinical practice. Understanding how cervical HVLA is taught and employed is of interest to osteopathic educators and clinicians.

Objectives: To characterize the perspectives of osteopathic manipulative medicine/osteopathic principles and practices (OMM/OPP) departments within colleges of osteopathic medicine (COMs) in the US regarding patterns of teaching and practice of HVLA treatment of the cervical spine.

Methods: A questionnaire was distributed on April 11, 2019 in paper format to OMM/OPP department chairs or designated faculty member attendees at the Educational Council on Osteopathic Principles biannual meeting. If the department chair was not available, the survey was provided to the faculty member designated to represent the Chair of the institution at ECOP. All respondents in this category returned the survey in paper before they left the meeting. The OMM/OPP department chairs who did not attend or send representatives to the ECOP meeting were sent the survey by email on April 11, 2019 and given three opportunities over 6 weeks at 2-week intervals to reply to this voluntary online survey. The survey was given or sent to a total of 51 OMM/OPP department chairs or

representatives. Six questions elicited demographic information pertaining to status, age, gender, ethnicity, board-certified specialty, and COM affiliation. Nine questions examined perspectives related to the instruction of cervical HVLA manipulation and treatment.

Results: Of the 51 OMM/OPP department chairs surveyed, 38 (74.5%) responded, 32 to the paper survey at the ECOP meeting and six to the digital survey. Respondents were primarily dual Board-certified in Family Medicine and Neuromuscular Medicine (55.3%). At over 90% (35) of the COMs for which department chairs responded to the survey, cervical HVLA instruction occurs in the curriculum primarily during program years 1 and 2. Instruction in cervical HVLA to the 2nd through 7th cervical vertebral levels occurred in 97% (37), while 11% (4) of the COMs excluded the occipital-atlanto (OA) and atlanto-axial (AA) joints. A high percentage (81.6%; 31) of the OMM/OPP department chairs or representatives reported employing cervical HVLA techniques within their practice. Among the respondents, 40.5% (15) reported that 0–25% of their school's medical school class could perform cervical HVLA competently upon graduation, whereas 27% (10) said that 51–75% of their class could perform cervical HVLA.

Conclusions: A majority of COMs provide education in their curricula related to cervical HVLA primarily in the first 2 years of medical education. However, instruction often excludes cervical HVLA to the upper regions of the cervical spine. At COMs where HVLA to the cervical spine is not taught, that decision is because the techniques are thought to be too difficult and the attendant medicolegal risk perceived to be too high. OMM/OPP department chairs expressed confidence in only a small proportion of their graduates having the ability to competently apply HVLA to the cervical spine immediately after completing their pre-doctoral medical training.

Keywords: atlanto-axial; cervical spine; high-velocity, low-amplitude; medical schools; occipital-atlanto; osteopathic manipulative medicine; osteopathic principles and practices.

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Osteopathic medical schools typically teach osteopathic manipulative medicine/osteopathic principles and practices (OMM/OPP) during the 1st and 2nd years of medical school and provide additional training in the 3rd and 4th years, when clinical instruction occurs. The Education Council on Osteopathic Principles (ECOP), which consists of representatives from each accredited US college of osteopathic medicine (COM), has developed and approved content for educational modules to be included as guidelines for the teaching of OMM/OPP [1]. These teaching modules do not constitute an entire curriculum or specify recommended methods of instruction or assessment. As such, the timing and delivery of OMM/OPP, including specific techniques that are taught, vary widely among medical schools. Typically, students obtain cognitive knowledge from didactic presentations in anatomy, biomechanics, and somatic dysfunction, then combine that knowledge with motor skills learning under the direction of an expert clinician [2].

High-velocity, low-amplitude (HVLA) treatment of the cervical spine is a relatively safe treatment for neck pain when compared to other common interventions [3]. Cervical HVLA can decrease pain, relieve muscle tension, and increase mobility, explaining why many patients seek osteopathic physicians, chiropractors, physical therapists, and other practitioners of manipulation [4]. Cervical HVLA improves function by providing a rapid, therapeutic force of brief duration through a restrictive barrier to spinal motion.

Reports of neurovascular complications associated with the use of cervical HVLA [5, 6] could possibly cause hesitation among medical school faculty to teach and/or use these techniques, although the literature shows no evidence supporting or detracting from that theory. Although rare, complications have been reported to include spinal disc herniations, radiculopathies, hematomas, and diaphragmatic paralysis [2]. Although patients treated with cervical HVLA have been shown to experience no adverse complications [6], the potential risk of stroke is not zero [7]. An estimated one in 20,000 spinal manipulations have resulted in a vertebral artery dissection and ischemic infarction, but the exact incidence of this complication is unknown [8]. The risk appears to be more prominent at the level of the atlanto-axial (AA) joint because the vertebral artery is most subject to shearing forces during cervical rotation at this level [4].

A 2010 Cochrane systematic review assessed 1,522 patients across 27 randomized, controlled clinical trials on the use of manipulation and mobilization of the cervical spine for patients with neck pain [9]. Only one-third of the trials (8 of 27) reported on whether side effects from cervical

spine manipulation occurred [9]. Five of these eight trials reported benign and transient side effects, consisting of headache, neck pain, stiffness, minor discomfort, and dizziness, whereas the other three trials reported no side effects at all [9]. A 2012 systemic review [10] of the literature from 1966 to 2012 analyzed five case-control studies to determine whether an association exists between neck manipulation and stroke [10]. The authors concluded that while evidence was “lacking for a strong association between neck manipulation and stroke,” the evidence was also “absent for no association” [10].

The American Osteopathic Association (AOA) position statement on Osteopathic Manipulative Treatment of the Cervical Spine, reaffirmed in 2019 by the AOA House of Delegates, recommends clinical use of cervical HVLA when indicated [11]. Specifically, it stated that “it is the position of the American Osteopathic Association that all modalities of osteopathic manipulative treatment of the cervical spine, including HVLA, should continue to be taught at all levels of education, and that osteopathic physicians should continue to offer this form of treatment to their patients,” and further, that “serious adverse events are seen as a rarity, and it is estimated that they occur in the range of every 20,000 to 250,000,000 manipulation[s] performed.” [11] The overall risk of adverse events to the patient is less than other commonly utilized treatment modalities such as the utilization of nonsteroidal anti-inflammatory drugs, cervical epidural steroid injections, and facet injections [11]. Previous authors [12] have recommended that when teaching cervical HVLA, instructors and students should be confident in the diagnoses being discussed as well as the attendant treatment.

Based on our review of the literature surrounding the teaching and clinical use of cervical HVLA, we developed a survey to answer the following questions: How and when is cervical HVLA incorporated into the curriculum?; If it is not incorporated into the curriculum, what are some common reasons for not doing so?; How confident are clinical faculty in the ability of students to perform the techniques competently upon graduation?; To what extent do clinical faculty use these techniques within their own practices? The aim of this study was to characterize the perspectives of OMM/OPP department chairs at COMs in the United States regarding teaching and practice patterns around cervical HVLA. Understanding and knowing how cervical HVLA is incorporated into the medical school curriculum, how it is taught, and how it is employed in schools and clinical practice could be of interest to osteopathic educators as well other practitioners of manual therapies.

Methods

Study design

This was a descriptive, exploratory, survey-based study and therefore there were no *ex ante* formal null hypotheses. The study was reviewed and approved by the Campbell University Office of Research Compliance.

Survey distribution and data collection

We administered a brief, anonymous survey (Supplemental Material) to 51 OMM/OPP department chairs at COMs during their attendance at the biannual ECOP meeting on April 11, 2019. At the ECOP meeting, paper versions of the survey were handed to OMM/OPP department chairs by one of the authors of the study (T.M.), who is also an ECOP member. If the department chair was not available, the survey was provided to the faculty member designated to represent the chair of the institution at ECOP. All respondents returned the survey in paper before they left the meeting. OMM/OPP department chairs who did not attend or send representatives to the ECOP meeting were sent the survey by email (via SurveyMonkey; SVMK, Inc.) on April 11, 2019 and given three opportunities over six weeks (at two-week intervals) to respond to the voluntary online survey. The survey was given or sent to a total of 51 COMs Department Chairs or representatives.

A total of 15 questions were included on the survey: six regarding general demographic information including age, sex, race/ethnicity, Board certification specialty, and COM affiliation (optional); and nine regarding cervical HVLA in the medical school curriculum and clinical practice. Respondents were questioned about the three regions of the cervical spine as related to the use of cervical HVLA: occipital-atlanto (OA), AA, and cervical vertebrae 2–7 (C2-7; “lower cervical vertebrae” on the survey). These regions were delineated based upon their unique biomechanical motions and possible perceived differences in risk related to manipulation.

Data analysis

Data were analyzed using frequencies/percentages for categorical variables. Data collected from respondents were explored to determine the frequency of use/practice of these techniques to treat underlying musculoskeletal dysfunction. This is primarily a descriptive study and did not involve inferential statistical methods to test *a priori* hypotheses from the data obtained.

Results

Demographics

Of 51 survey recipients, 38 (74.5%) responded, 32 to the paper survey at the ECOP meeting and six to the digital survey. Table 1 outlines the demographic characteristics of the respondent sample. Of the 38 respondents, 20 (52.6%) were men and 18 (47.4%) were women. The

self-reported race/ethnicity of respondents was as follows: 34 (89.6%) White, 1 (2.6%) Asian, 1 (2.6%) Black or African American, 1 (2.6%) Hispanic or Latino, and 1 (2.6%) Native Hawaiian or Pacific Islander. Approximately half (21; 55.3%) of the respondents were 51 years of age or older (range, 30–50 years). All respondents had obtained board certification in Neuromusculoskeletal Medicine. Some respondents also listed certifications in sports medicine as well as physical medicine and rehabilitation (PM&R).

Curricular integration of cervical spine HVLA

At least 80% (32) of the respondents reported HVLA to at least one of the identified cervical spine regions taught at their COM in years 1–4. This education was primarily delivered during years 1 and 2. Overall, 13.2% (5) of respondents reported that their COM did not teach HVLA of the OA, 10.6% (4) did not teach HVLA to the AA, and 2.6% (n=1) did not teach HVLA to C2-7 (Table 2).

Teaching methods of cervical spine HVLA

At 37 of the 38 (97.4%) respondent osteopathic medical schools that teach cervical HVLA, the most common

Table 1: Demographic characteristics of the respondent sample.

Characteristics	n (%)
Department chair	
Yes	33 (86.8)
No	5 (13.2)
Sex	
Male	20 (52.6)
Female	18 (47.4)
Self-reported race/ethnicity	
White	34 (89.6)
Asian	1 (2.6)
Black/African American	1 (2.6)
Hispanic/Latino	1 (2.6)
Native Hawaiian/Pacific Islander	1 (2.6)
Age, years	
30–40	8 (21.1)
41–50	9 (23.7)
51–60	13 (34.2)
61+	8 (21.1)
Board certification	
FM	0 (0)
NMM	16 (42.1)
IM	0 (0)
FM/NMM	21 (55.3)
IM/NMM	1 (2.6)

FM, family medicine; IM, internal medicine; NMM, neuromusculoskeletal medicine.

Table 2: Curriculum stages at which respondents reported that high-velocity, low-amplitude treatment technique for the cervical spine is introduced at their college of osteopathic medicine.

Education level	OA, n (%)	AA, n (%)	C2-7, n (%)
Program year 1	18 (47.4)	20 (52.6)	21 (55.3)
Program year 2	14 (36.8)	14 (36.8)	15 (39.5)
Program year 3	0	0	0
Program year 4	0	0	1 (2.6)
Undergraduate fellowship	1 (2.6)	0	0
Postgraduate	0	0	0
Do not teach	5 (13.2)	4 (10.6)	1 (2.6)

AA, atlanto-axial; C2-7, cervical vertebrae 2–7; OA, occipital-atlanto.

teaching method by 27 (72.9%) of the COMs was hand-over-hand monitoring of the student by faculty while the student provides an HVLA-activating force for the first time on the subject. Additionally, 16 (16.2%) COM respondents reported conducting some form of medical clearance prior to HVLA instruction. The survey was not specific with regard to the definition of medical clearance.

Assessment and perception of student competency

Competence of students in performing cervical HVLA techniques is determined by practical exam at 81.6% (31) of COMs, as reported by affiliated respondents. Related to the practical examination, 23.7% (9) of respondents reported that their COM students provided the setup of HVLA without thrust, while 47.4% (20) reported setup of HVLA with thrust at their COM. The remaining schools (15; 39.5%) did not respond to the question about competency assessment on the survey. Finally, as shown in Figure 1, 15 (40.5%) respondents believed that only 0–25% of their COM's graduating classes could perform cervical HVLA competently upon graduation, whereas 10 (27%) believed that 51–75% of their school's medical

school classes were able to demonstrate competency for cervical spine HVLA.

Rationale for not teaching cervical spine HVLA

The schools that do not teach cervical HVLA to at least one of the identified cervical spine regions (4; 10.5%) or discontinued it from the curriculum altogether (1; 2.6%) responded that students may learn techniques on clerkship and/or OMM rotations during their third and fourth years. One respondent (2.6%) selected "Techniques are too difficult" and 2 (5.3%) selected "The medicolegal risk is too high" as the reason for not teaching cervical HVLA. Lastly, one of these schools reported an adverse event in the past involving a herniated cervical disc in a student.

Clinical practice of cervical spine HVLA

Respondents were asked to indicate their utilization of HVLA techniques within their own clinical practice; the majority (31; 81.6%) of respondents reported that they employed cervical HVLA within their practice, with approximately half of those providing some form of cervical HVLA at least weekly (21; 55.3%). Of the 31 respondents who employed HVLA of the cervical spine, 25 (80.6%) apply it to the OA, 23 (74.2%) apply it to the AA, and 31 (100%) apply it to C2-7. Further, of the 31 schools that use HVLA, 28 (90.3%) include verbal informed consent as part of their process, 7 (22.6%) include written informed consent, 17 (54.8%) include patient education, 19 (61.3%) include neurologic exam prior to treatment, 12 (38.7%) include a physical exam testing for vertebrobasilar artery insufficiency, and 14 (45.2%) include physical exam testing for osteoligamentous integrity. Five of 38 respondents (13.2%) did not have a clinical practice. A small percentage of the total respondents (2; 5.3%) did not perform these techniques, either because they believe cervical HVLA is not appropriate (1; 2.6%) or they do not feel comfortable performing it (1; 2.6%) (Table 3).

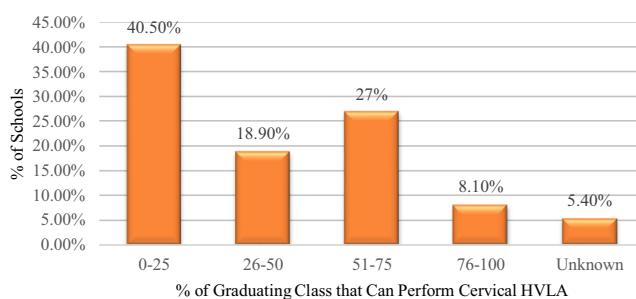


Figure 1: Respondents' perceptions of students' competency to perform cervical HVLA upon graduation.
HVLA, high-velocity, low-amplitude.

Table 3: Clinical practice of high-velocity, low-amplitude treatment technique by cervical spine region.

Number of respondents n (% of respondents)	OA	AA	C2-7
31 (81.6%)	25 (65.8%)	23 (60.5%)	32 (84.2%)
5 (13.2%)	Do not have clinical practice		
2 (5.3%)	Techniques not appropriate or they do not feel comfortable performing them		

AA, atlanto-axial; C2-7, cervical vertebrae 2–7; OA, occipital-atlanto.

Discussion

The results of this study showed that at least 80% of the respondents reported teaching cervical HVLA to one or more of the identified cervical spine regions taught at their COM in years 1–4. Overall, 13.2% of respondents reported that their COM did not teach HVLA of the OA, 10.6% did not teach HVLA to the AA, and 2.6% did not teach HVLA to C2–7. There were four schools that did not teach cervical HVLA to at least one of the identified cervical spine regions and one school discontinued it from the curriculum altogether. These data suggest that there is hesitancy around teaching cervical HVLA, with concern regarding the upper cervical spine regions (OA and AA joints). We interpreted the responses that cervical HVLA is too difficult (1; 2.6%) or too highly associated with medicolegal risk (2; 5.3%) to indicate that OMM/OPP department chairs and/or designated faculty members have some concern regarding potential adverse events with cervical HVLA. Interestingly, physician practice of HVLA by cervical region mirrors its teaching in schools. The OMM/OPP department chairs and/or designated faculty members, from their self-reporting, are less likely to practice cervical HVLA to the OA and AA joints than to the C2–7 regions, a pattern also seen in the data showing that cervical HVLA to the OA and AA are less frequently taught compared to the C2–7 regions. The single respondent who stated that cervical HVLA is either not appropriate or does not feel comfortable performing it reported having infants and very young children as their primary patient population, and this is a group in which HVLA techniques are contraindicated.

Most osteopathic medical schools in this study evaluated competency with a practical examination during which students demonstrated some or all components of cervical HVLA. Nearly half (47.4%) of the schools, when assessing competency, expected students to perform cervical HVLA with thrust. Approximately one-quarter of schools (23.7%) expected students to perform cervical HVLA without thrust. The finding that 40.5% of respondents perceived that 25% or less of their

graduating class could perform cervical HVLA competently upon graduation is disconcerting and would suggest that the osteopathic educational community should further study the factors limiting effective teaching of cervical HVLA in the medical school setting.

Several precautionary measures are utilized among osteopathic medical schools when teaching cervical HVLA. Hand-over-hand monitoring by faculty and some form of medical clearance of the subject prior to cervical HVLA practice are common risk mitigating strategies employed by schools that do teach cervical HVLA. This suggests an inclination toward ensuring that these techniques are performed safely. Educational and clinical behaviors might be altered if screening maneuvers could identify patients at increased risk for vertebral artery dissection and other neurovascular complications [7]. Unfortunately, current screening modalities demonstrate low sensitivity and specificity for identifying patients at risk for cerebrovascular events following spinal manipulation [6]. Patients with atherosclerotic vascular disease risk factors, such as diabetes or hypertension, do not appear to have an increased risk for stroke after spinal manipulation [13]. Therefore, the attempts by practitioners of manipulative treatment to assess vertebral artery patency prior to spinal manipulation have not been successful with screening patients at risk [14].

With the lack of reliable screening methods, it is prudent for practitioners to consider the totality of the clinical presentation to determine whether cervical HVLA is appropriate and safe. Practitioners should also consider their own skill level and the preferences of the referring provider [15]. Respondents in this study reported that they most commonly provide verbal informed consent (90.3%), education (54.8%), and neurologic exam (61.3%) prior to cervical HVLA treatment. A smaller percentage of respondents tested for vertebrobasilar artery insufficiency (38.7%) and osteoligamentous integrity (45.2%).

Our study results may inform curriculum development, modifications, and programming in osteopathic medical education as well as other allied health science programs. Greater awareness of current practices could lead to the development of better and safer educational and clinical application of these techniques.

Conclusions

Cervical HVLA is widely taught in osteopathic medical schools throughout the United States. Previous reports of adverse events appear to have influenced how cervical

HVLA is incorporated and taught within the osteopathic medical school curriculum. Some respondents' schools avoid incorporating cervical HVLA to the upper regions of the cervical spine. A similar pattern was mirrored among the respondents in their clinical practices. Furthermore, OMM/OPP department chairs and/or designated faculty members reported that a high percentage of their graduating classes did not possess competency in these techniques. Further research should be directed at how to restructure curricula to increase the proportions of students with competency in these areas upon graduation and further advance osteopathic medical education.

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