Thrust joint manipulation utilization by U.S. physical therapists*

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ABSTRACT

Study Design: Online survey study.

Objective: To determine physical therapists' utilization of thrust joint manipulation (TJM) and their comfort level in using TJM between the cervical, thoracic, and lumbar regions of the spine. We hypothesized that physical therapists who use TJM would report regular use and comfort providing it to the thoracic and lumbar spines, but not so much for the cervical spine.

Background: Recent surveys of first professional physical therapy degree programs have found that TJM to the cervical spine is not taught to the same degree as to the thoracic and lumbar spines.

Methods: We developed a survey to capture the required information and had a Delphi panel of 15 expert orthopedic physical therapists review it and provide constructive feedback. A revised version of the survey was sent to the same Delphi panel and consensus was obtained on the final survey instrument. The revised survey was made available to any licensed physical therapists in the U.S.A. using an online survey system, from October 2014 through June 2015.

Results: Of 1014 responses collected, 1000 completed surveys were included for analysis. There were 478 (48%) males; the mean age of respondents was 39.7 ± 10.81 years (range 24–92); and mean years of clinical experience was 13.6 ± 10.62 . A majority of respondents felt that TJM was safe and effective when applied to lumbar (90.5%) and thoracic (91.1%) spines; however, a smaller percentage (68.9%) felt that about the cervical spine. More therapists reported they would perform additional screening prior to providing TJM to the cervical spine than they would for the lumbar and thoracic spines. Therapists agreed they were less likely to provide and feel comfortable with TJM in the cervical spine compared to the thoracic and lumbar spines. Finally, therapists who are male; practice in orthopedic spine setting; are aware of manipulation clinical prediction rules; and have manual therapy certification, are more likely to use TJM and be comfortable with it in all three regions.

Conclusion: Results indicate that respondents do not believe TJM for the cervical spine to be as safe and efficacious as that for the lumbar and thoracic spines. Further, they are more likely to perform additional screening, abstain from and do not feel comfortable performing TJM for the cervical spine.

Clinical Relevance: Our research reveals there is a discrepancy between utilization of TJM at different spinal levels. This research provides an opportunity to address variability in clinical practice among physical therapists utilizing TJM.

KEYWORDS

Thrust joint manipulation; manipulation; manual therapy; mobilization; survey

Introduction

Thrust joint manipulation (TJM) is defined as a high-velocity low-amplitude thrust technique which can be distinguished from other joint mobilization techniques that do not utilize a final thrust maneuver.^{1,2} A recent survey of physical therapist professional degree programs in the United States found that all but one, of the 147 responding programs, were currently teaching TJM in their curriculum.³ An interesting finding was that of the spinal regions, the cervical spine received the least amount of emphasis, with 52 out of 147 (35%) responding programs *not* teaching TJM to the cervical spine.³ This is in contrast to TJM in the lumbar and thoracic regions, which was taught in virtually all responding programs

(99 and 97% respectively).³ Although this is an increase from 47% of responding programs that excluded cervical techniques found in an earlier study,⁴ it is evident that cervical spine TJM continues to be taught at a lower rate than TJM for other spinal regions. If physical therapists are not being taught cervical spine TJM in their first professional degree programs, it is reasonable to conclude that those wishing to learn and safely practice this intervention must be looking to post-professional programs such as manual therapy certification, orthopedic residencies and/or fellowships.

There is conflicting evidence on the utilization of cervical spine TJM by physical therapists for patients with neck pain. Hurley et al⁵ conducted a postal survey of

150 randomly selected physical therapists in Ontario, Canada, who regularly performed spinal manipulation. Of the 118 respondents, only 41 (34.7%) indicated that they would perform cervical spine TJM where it was indicated. In an Australian, multi-center RCT of physical therapy management of cervicogenic headache, Jull et al⁶ reviewed the treatment records of 100 subjects who received only manual therapy, or manual therapy with exercise. Their results indicated that TJM to the cervical spine was used in only 20.2% of the 1090 treatments provided to the 100 subjects.

The fact that TJM to the cervical spine is not being taught to the same degree as other regions of the spine within first professional physical therapy programs, and that physical therapists tend to use it less frequently in clinical practice, leads us to wonder how TJM to the spine is viewed by physical therapists currently practicing in the United States (U.S.). Therefore, the purpose of this study was to survey physical therapists to determine their utilization of TJM within the three spinal regions; their thoughts about safety and efficacy of TJM to the spinal regions; and to discover any perceived barriers to utilization of TJM.

Methods

We developed, piloted, and delivered an electronic survey to U.S. physical therapists. It was based upon previous paper surveys.⁴ Reporting of methods and results followed the checklist for reporting results of internet E-surveys (CHERRIES).⁷ Sample size (800) was determined using the following sample-size calculation formula.⁸

$$N_s = \frac{(N_p)(p)(1 - p)}{(N_p - 1)(B/C)^2 + (p)(1 - p)}$$

where: N_s = completed sample size for desired level of precision, N_p = size of population, p = proportion of population expected to choose one of the two response categories, B = acceptable amount of sampling error; .03 = $\pm 3\%$ of the true population value, C = Z statistic associated with the confidence level.⁸

For this study, the population (N_p) was drawn from data from the United States Department of Labor, Bureau of Labor Statistics as of May 2014.⁹ N_p was calculated at 200,670 physical therapists. The proportion of the population (p) expected to choose one of the two response categories (to participate or not) was designed as a 50/50 split or 0.50. The acceptable amount of sampling error (B) was set to 0.03, while the confidence level (C) was established at 90%, with a corresponding Z statistic of 1.645. The resulting N_s or completed sample size was 748, which was rounded up to a sample size of 800.

Survey development

A preliminary survey was distributed in June 2014 to a Delphi panel consisting of 15 licensed physical therapists

who were experts in performing, teaching, and researching TJM. Feedback from the Delphi panel was incorporated and a revised survey instrument was sent back to 10 of the members of the Delphi panel in July 2014 for further comments/feedback. Once consensus ($\geq 70\%$ agreement) was achieved from the 10 members, the final survey was adopted. It was then sent to a random sample of 20 licensed physical therapists to determine test-retest reliability. The survey was completed on two separate occasions, 2 weeks apart, by the same 20 physical therapists and comparisons demonstrated the survey to be reliable with 19 of the 20 PTs responding identically on both occasions for all survey questions. All questions are listed in Appendix A, as they appeared in the final version of the survey.

The first page of the survey provided a description of the study and its objectives, and then asked for informed consent. Survey questions first asked for demographic information, years and nature of clinical experience, manual therapy certifications (if any), practice settings, and whether or not the respondent was aware of any clinical prediction rules (CPRs) for provision of TJM.¹⁰⁻¹² The next four questions examined respondents' beliefs about: (a) safety and effectiveness of TJM for each of the three spinal regions; (b) whether they would routinely perform additional medical history screening prior to TJM for each of the three spinal regions; (c) whether they regularly provided TJM for each of the three spinal regions; and (d) their level of comfort performing TJM for each of the three spinal regions. The final question asked about perceived barriers to the use of TJM in the spine by physical therapists.

Adaptive questioning was not used, and all respondents had the opportunity to answer each of the 15 questions. Questions were presented in the same order for every respondent, and it was not mandatory to respond to every question that was displayed. The survey could be completed on any computer or electronic device with an internet browser and internet access.

The link to the finalized survey was then distributed via social media and word of mouth to target a convenience sample of any practicing physical therapists within the U.S. Social media (e.g. Facebook, Twitter, and LinkedIn) notifications were also posted, with permission, to the notice boards and associations representing physical therapists within the U.S. Completion of the survey was entirely voluntary, and any practicing physical therapist in the U.S. was eligible to participate.

Data processing and statistical analysis

Individual responses were exported to Microsoft Excel (2013), and data were erased for cases where respondents had refused consent by exiting the survey without answering any questions. Data were then exported into

statistical analysis software (SPSS Version 21; SPSS Inc, Chicago, IL).

Descriptive statistics were calculated for each of the variables to determine the demographics of the survey respondents, and their awareness of CPRs for spinal manipulation. Because the data were ordinal, we analyzed levels of agreement with the four questions that examined beliefs regarding TJM using a non-parametric Friedman's ANOVA for each question. If statistically significant differences were found, *post hoc* comparisons were conducted (Wilcoxon signed rank test) with a Bonferroni corrected $\alpha = 0.0167$ (.05/3 comparisons). Frequency counts for the survey-provided choices for perceived barriers to providing TJM to the spine were obtained, and qualitative analysis of the manually entered responses to the choice of 'Other' was undertaken to look for specific themes.

To better understand therapist attributes associated with their beliefs about TJM, ordinal logistic regression was performed for 3 of the 4 questions that examined respondents' beliefs. Modeled questions were: (1) safety and effectiveness of TJM for each of the 3 spinal regions; (2) whether they regularly provided TJM for each of the 3 spinal regions; and (3) level of comfort performing TJM for each of the 3 spinal regions. The responses to these questions for the 3 spinal areas (cervical, thoracic, lumbar) were the dependent variables in the models. Prior to modeling, all questions (independent variables) from the survey were tested for collinearity with each other. Entry-level degree and highest earned degree, awareness of CPRs and with which CPRs respondents were familiar, as well as age and years of practice were collinear and so only one (highest degree, awareness of CPRs, and years of practice) from each pair was used in the modeling. For modeling, practice setting and special certifications were dichotomized so that respondents either practiced

in 'Outpatient Orthopedics (Spine)' or not, and either had a 'special certification' or not. For all models, predictor variables included: years of practice, percentage of patients seen with the particular spine region related to the question (e.g. lumbar patients for the questions about lumbar spine; lumbar and SI were combined), gender, highest earned degree, practice setting, awareness of CPRs, and special certification.

Results

The survey was opened on 12 October 2014 and remained open until 12 June 2015. It was accessed 1018 times, and there were four respondents who did not consent to participate/answer any questions. Of the 1014 respondents who had given consent, 1000 (98.6%) completed the survey by providing answers to the four questions about TJM in the three regions of the spine and results from these respondents were analyzed. Data from the remaining 1.4% of respondents, who did not complete our *a priori* determined minimum number of questions, were excluded.

Demographics

Of the 1000 valid responses, 519 were female (51.9%), 478 were male (47.8%), and 3 declined to indicate. Mean age for the sample was 39.8 ± 10.67 (range 23–85) (Table 1). Respondents lived, based on computer IP addresses used to complete the survey, in all but three states in the U.S., with most respondents located in the Midwest.

Details of first professional degree and highest earned degree for the survey respondents are provided in Table 1. When compared by gender, males tended to have higher first professional degrees than females ($p = .003$), and higher 'highest earned degrees' than females ($p = .000$).

Table 1. Demographics of the survey responders.

	Group (n = 1000)	Males (n = 478)	Females (n = 519)	p value
Age (mean $\pm$ SD) (992 responded)	39.8 $\pm$ 10.67	39.5 $\pm$ 10.07	39.9 $\pm$ 11.17	.583†
Years of practice (992 responded)	13.5 $\pm$ 10.61	13.0 $\pm$ 9.81	14.1 $\pm$ 11.24	.097†
Entry-level degree (993 responded)				
DPT	426 (42.9%)	204 (47.9%)	222 (52.1%)	.003*
MPT/MSPT	310 (31.2%)	173 (55.8%)	137 (44.2%)	
BPT/BSPT	228 (23.0%)	89 (39.0%)	139 (61.0%)	
Certificate/other	29 (2.9%)	11 (37.9%)	18 (62.1%)	
Highest degree (992 responded)				
PhD/DSc/EdD	41 (4.1%)	29 (70.7%)	12 (29.3%)	.000*
DPT	592 (59.7%)	299 (50.5%)	293 (49.5%)	
MPT/MSPT	197 (19.9%)	96 (48.7%)	101 (51.3%)	
BPT/BSPT	116 (11.7%)	36 (31.0%)	80 (69.0%)	
Certificate/other	46 (4.6%)	16 (34.8%)	30 (65.2%)	
Manual Therapy/clinical speciality certification (y/n)	480 (48%)	277 (57.7%)	203 (42.3%)	.000*
OCS	231 (23.1%)	153 (66.2%)	78 (33.8%)	.000*
FAAOMPT	95 (9.5%)	79 (83.2%)	16 (16.8%)	.000*
MTC	41 (4.1%)	31 (75.6%)	10 (24.4%)	.000*
CertMDT	34 (3.4%)	26 (76.5%)	8 (23.5%)	.001*
COMT	45 (4.5%)	26 (57.8%)	19 (42.2%)	.177*
Other certification	247 (24.7%)	133 (53.8%)	114 (46.2%)	.032*

Notes: DPT = doctor of physical therapy; MPT = master of physical therapy; MSPT = master of science in physical therapy; BPT = bachelor of physical therapy; BSPT = bachelor of science in physical therapy; OCS = orthopedic certified specialist; FAAOMPT = fellow of the American academy of orthopedic manual physical therapists; MTC = manual therapy certified; CertMDT = certificate in mechanical diagnosis therapy; COMT = certified orthopedic manual therapy.

*Pearson Chi-Square analysis. †Independent samples t-test.

Figure 1. Levels of agreement with the statement 'Thrust Joint Manipulation in the XXX spine is safe and effective for patients in which it is indicated.'

Notes: Wilcoxon signed ranks test revealed significant differences between thoracic and lumbar spines ($p = .001$); between thoracic and cervical spines ($p = .000$); and between lumbar and cervical spines ($p = .000$).

Of the 480 respondents that reported having completed some form of manual therapy or clinical specialty certification, 277 (57.7%) were male and this was a statistically significant higher proportion than females ($p = .000$). Of the various manual therapy/clinical specialty certifications listed, males were proportionally more represented for all ($ps < .05$) except certified orthopedic manual therapist (COMT) ($p = .177$) (Table 1).

Mean years of clinical practice for the survey sample was 13.5 ± 10.61 years (range 1–50), with no difference between males and females. Respondents were able to check multiple practice settings if applicable and 81% reported their practice setting as 'orthopedic spine'; 78% as 'orthopedic extremities'; 16% as 'acute/ inpatient care'; 6% as 'pediatrics'; 7% as 'skilled nursing'; 8% as 'home health'; and 14% as 'other'.

Awareness of manipulation clinical prediction rules

In response to the question 'are you aware of any clinical prediction rules (guides) for patients with neck or back pain who are more likely to benefit from spinal manipulation?', 83.7% responded 'yes.' Of those that responded in the affirmative, 78.3% knew about the lumbar TJM for low back pain; 61.4% knew about the thoracic TJM for neck pain; and finally, 52.8% knew about the cervical TJM for neck pain CPRs.

Safety and efficacy of TJM by spinal region

For levels of agreement with the statement 'Thrust Joint Manipulation in the XXX spine is safe and effective for patients in which it is indicated,' non-parametric Friedman's ANOVA revealed a statistically significant difference among the means $\chi^2(2) = 704.291$, $p = .000$. Post hoc comparisons (Wilcoxon signed rank test) with a Bonferroni corrected $\alpha = .0167$ (.05/3 comparisons) revealed a significant difference between the lumbar and thoracic spinal regions ($p = .001$); between lumbar and cervical spinal regions ($p = .000$); and between thoracic

and cervical spinal regions ($p = .000$). Therapists believed that TJM was more effective and safe in the thoracic spine than in the lumbar and cervical spines, and more effective and safe in the lumbar than in the cervical spine (Figure 1).

Additional screening prior to performing TJM by spinal region

For levels of agreement with the statement 'Prior to performing Thrust Joint Manipulation to the XXX spine, I would routinely perform additional medical history screening,' a statistically significant difference was found among the means $\chi^2(2) = 212.297$, $p = .000$. Post hoc comparisons revealed a significant difference between each of the spinal regions ($ps = .000$). Therapists reported they would conduct additional screening prior to performing TJM in the cervical spine more than they would for the lumbar and thoracic spines, and more in the lumbar spine than they would for the thoracic spine (Figure 2).

Regularly providing TJM by spinal region

For levels of agreement with the statement 'I regularly provide Thrust Joint Manipulation to the XXX spine where it is indicated,' a statistically significant difference was found among the means $\chi^2(2) = 742.855$, $p = .000$. Post hoc comparisons revealed a significant difference between each of the spinal regions ($ps = .000$). Therapists agreed that they regularly provided TJM in the thoracic spine more than they would for the lumbar and cervical spines, and more in the lumbar spine than they would for the cervical spine (Figure 3).

Comfort providing TJM by spinal region

For levels of agreement with the statement 'I am comfortable performing Thrust Joint Manipulation to the XXX spine in patients that require it,' a statistically significant difference was found among the means $\chi^2(2) = 790.956$, $p = .000$. Post hoc comparisons revealed a significant

Figure 2. Levels of agreement with the statement 'Prior to performing Thrust Joint Manipulation to the XXX spine, I would routinely perform additional medical history screening.'

Notes: Wilcoxon signed ranks test revealed significant differences between each region of the spine ($p = .000$).

Figure 3. Levels of agreement with the statement 'I regularly provide Thrust Joint Manipulation to the XXX spine where it is indicated.'

Notes: Wilcoxon signed ranks test revealed significant differences between each region of the spine ($p = .000$).

Figure 4. Levels of agreement with the statement 'I am comfortable performing Thrust Joint Manipulation to the XXX spine in patients that require it.'

Notes: Wilcoxon signed ranks test revealed significant differences between each region of the spine ($p = .000$).

difference between each of the spinal regions ($p = .000$). Therapists agreed they were comfortable performing TJM in the thoracic spine more than they would be for the lumbar and cervical spines, and more in the lumbar spine than they would be for the cervical spine (Figure 4).

Barriers to the use of TJM by physical therapists

Lack of adequate mentoring and entry-level training were chosen the most by respondents (64.9 and 63.8%, respectively) as a barrier to the use of TJM. Concerns about safety and lack of postgraduate

training were chosen by 56.7 and 54.5%, respectively, and legislative efforts by other professions to preclude physical therapists from using TJM was chosen by 33% as barriers. Only 9.5% chose lack of evidence for its effectiveness as a barrier to the use of TJM in the spine.

One hundred and twenty-one therapists (12.1%) chose 'other' as a barrier to providing TJM and were then able to enter free text. The comments provided by these responding therapists were qualitatively analyzed and grouped into specific themes (Appendix B).

Table 2. Ordinal logistic regression model results for the question, 'I am comfortable performing thrust joint manipulation to the XXX spine in patients that require it.'

	Cervical OR (95% CI)	Thoracic OR (95% CI)	Lumbar OR (95% CI)
<i>Gender</i>			
Male	2.78 (2.17–3.55)	3.06 (2.22–4.22)	3.23 (2.43–4.26)
Female	Ref	Ref	Ref
<i>Ortho spine practice</i>			
Yes	Ref	Ref	Ref
No	0.69 (0.50–0.96)	0.30 (0.20–0.44)	0.48 (0.33–0.69)
<i>CPR aware</i>			
Yes	2.82 (1.88–4.22)	10.75 (6.26–18.48)	6.61 (4.13–10.56)
No	Ref	Ref	Ref
<i>Manual therapy certification</i>			
Yes	Ref	Ref	Ref
No	0.43 (0.34–0.55)	0.50 (0.37–0.68)	0.47 (0.35–0.61)

Notes: Bold OR's indicate significant results, CPR = clinical prediction rule. Models adjusted by: years of therapist experience, the proportion of patients that they treat with the modeled spine region, and highest earned degree.

Table 3. Ordinal logistic regression model results for the question, 'I regularly provide thrust joint manipulation to the XXX spine where it is clinically indicated.'

	Cervical OR (95% CI)	Thoracic OR (95% CI)	Lumbar OR (95% CI)
<i>Gender</i>			
Male	2.69 (2.10–3.44)	2.25 (1.73–2.92)	2.94 (2.24–3.85)
Female	Ref	Ref	Ref
<i>Ortho spine practice</i>			
Yes	Ref	Ref	Ref
No	0.64 (0.46–0.90)	0.26 (0.17–0.38)	0.37 (0.25–0.54)
<i>CPR aware</i>			
Yes	2.83 (1.84–4.36)	6.57 (4.10–10.53)	5.28 (3.33–8.37)
No	Ref	Ref	Ref
<i>Manual therapy certification</i>			
Yes	Ref	Ref	Ref
No	0.44 (0.34–0.56)	0.48 (0.36–0.62)	0.49 (0.38–0.63)

Notes: Bold OR's indicate significant results, CPR = clinical prediction rule. Models adjusted by: years of therapist experience, the proportion of patients that they treat with the modeled spine region, and highest earned degree.

Modeling

For all three modeled questions, individual models were generated for each of the spinal regions about which participants were asked to respond (cervical, thoracic, and lumbar), such that nine total models were created (Tables 2–4). All models were adjusted for gender, years of practice, proportion of patients seen with spine pathology, education level, awareness of CPRs, manual therapy certification, and practice setting. Results indicated that, depending on spine region, the odds of male therapists being more comfortable with TJM were 2.78–3.23 times greater than that of females. The odds of therapists that do not practice in an outpatient orthopedic setting on patients with spinal pathology being comfortable with TJM were 31–70% less than the odds for therapists who do such practice. The odds of therapists who are aware of spine CPRs being comfortable with TJM were 2.82–10.75 times greater that of therapists unaware of the CPRs. Finally, the odds of those without manual therapy certification being comfortable with TJM were 50–57% less than that of therapists with manual therapy certification (Table 2).

The odds of male therapists regularly performing TJM were 2.25–2.94 (depending on spine region) times greater than that of females. The odds of therapists that do not practice in an outpatient orthopedic setting on

patients with spinal pathology regularly performing TJM were 36–74% less than the odds for those who do such practice. The odds of therapists who are aware of spine CPRs regularly performing TJM were 2.83–6.57 times greater than that of therapists unaware of the CPRs. Finally, the odds of therapists without manual therapy certification regularly performing TJM were 51–56% less than that of those with manual therapy certification (Table 3).

Finally, the odds of male therapists feeling TJM are safe and effective were 1.69–2.35 (depending on spine region) times greater than that of female therapists. The odds of therapists who are aware of spine CPRs feeling TJM is safe and effective were 2.84–12.30 times greater than that of those unaware of the CPRs (Table 4).

Discussion

The results of the survey demonstrate that 66.5% of respondents agreed (completely or somewhat) that they regularly use TJM in the thoracic spine where it is indicated (Figure 3) and 75.9% were comfortable doing so (Figure 4). Significantly lower proportions were found for utilization and comfort providing TJM in lumbar spine, 52.9 and 66.5%, respectively. These utilization rates are much lower than the 97% for the lumbar spine and 92% for the thoracic spine reported by Adams and Sim¹³;

Table 4. Ordinal logistic regression model results for the question, 'Thrust joint manipulation in the XXX spine is safe and effective for patients in which it is indicated.'

	Cervical OR (95% CI)	Thoracic OR (95% CI)	Lumbar OR (95% CI)
<i>Gender</i>			
Male	1.69 (1.34–2.14)	2.31 (1.36–3.94)	2.35 (1.49–3.72)
Female	Ref	Ref	Ref
<i>Ortho spine practice</i>			
Yes	Ref	Ref	Ref
No	0.76 (0.55–1.06)	0.29 (0.18–0.49)	0.50 (0.32–0.79)
<i>CPR aware</i>			
Yes	2.84 (1.93–4.18)	9.55 (5.23–17.42)	12.30 (5.98–25.29)
No	Ref	Ref	Ref
<i>Manual therapy certification</i>			
Yes	Ref	Ref	Ref
No	0.68 (0.53–0.86)	0.82 (0.49–1.36)	0.65 (0.43–0.98)

Notes: Bold OR's indicate significant results, CPR = clinical prediction rule. Models adjusted by: years of therapist experience, the proportion of patients that they treat with the modeled spine region, and highest earned degree.

however, this may be explained by the fact that they limited their survey to manipulative physical therapists in the U.K. whereas our study was open to any practicing physical therapist regardless of practice setting. Our results show that only 33% of physical therapists regularly provide, and 39.1% are comfortable performing, TJM in the cervical spine. Although this utilization is somewhat comparable to the 34.7% of Canadian physical therapists, who regularly perform spinal manipulation,⁵ it is much lower than the rates reported by Adams and Sim.¹³ They found rates of 80% for the lower cervical, 66% for the middle cervical, and 22–24% for the upper cervical spine.¹³

There may be many reasons why TJM is not being utilized as often in the cervical spine as it is in the other areas of the spine. There is conflicting evidence on whether TJM is better than other forms of manual therapy or exercise,^{12,14–16} and this may well explain the lower utilization rate. Another reason is that it receives the least emphasis in teaching within physical therapist professional degree programs.³ The latest survey of U.S. programs found that 35% do not teach TJM to the cervical spine, whereas almost all do teach it for the lumbar (99%) and thoracic regions (97%).³ This may also explain why our study found that respondents were least comfortable performing TJM to the cervical spine in patients where it is appropriate and indicated.

The findings from the ordinal logistic regression modeling provide some interesting thoughts about therapists' attributes associated with their beliefs about TJM. We found that male therapists were 2.78–3.23 times more likely (depending on spinal region) to be comfortable, and 2.25–2.94 times more likely to regularly provide TJM than female therapists. This finding cannot be explained by the fact that more male therapists tended to have manual therapy and/or clinical specialty certifications as the modeling adjusted for specialty certification. We also found that after adjusting for gender, respondents without specialty certification were 51–56% less likely to use, and 50–57% less likely to report being comfortable providing, TJM to any region of the spine. Results show

that male therapists tended to represent a greater proportion of the higher entry-level and earned professional degrees, and while this might suggest greater awareness of CPRs, this was also adjusted for in the modeling and cannot explain why male therapists were more likely to be comfortable and regularly provide TJM. There may be other factors (such as size, strength, confidence, and interest in TJM) which we did not ask about in the survey, which might help explain this difference between the genders.

With respect to the safety and efficacy of TJM, results demonstrate that a majority of the respondents agreed that TJM was safe and effective in all of the spinal regions (Figure 1). The cervical spine had the least number of therapists agreeing that TJM was safe and effective (68.9%) when compared to the thoracic and lumbar spines (91.1 and 90.5%, respectively). This is likely reflective of the evidence suggesting that there are greater risks associated with performing TJM in the cervical spine,^{17–19} that there is less evidence to support its effectiveness,^{12,15} and that it is taught less in first professional degree programs.³ However, it is interesting to note that therapists also believed that TJM was more effective and safe in the thoracic spine compared to the lumbar spine. This finding may be more reflective of recent research into the regional interdependence approach,^{20,21} which highlights the value of TJM to the thoracic spine in patients with neck pain when combined with therapeutic exercise.^{11,22,23} However, it should be noted that in a subgroup of patients with low back pain, there is high level evidence to support the use of TJM in the lumbar spine.^{10,24} It is also possible that therapists may not be as aware of adverse events associated with TJM to the thoracic spine, and a recent systematic review has highlighted the need for therapists to monitor the forces they use in this area of the spine and reconsider the risks.²⁵

When asked to consider any barriers to the use of TJM by physical therapists, a majority of respondents felt that inadequate training (entry-level and postgraduate), insufficient mentoring and safety were of greatest concerns. While all professional physical therapy programs

teach TJM in their curriculum,³ there is a large amount of variation in the amount of training provided by programs, and so it is not surprising that 63.8% of respondents chose this as a barrier. Lack of adequate mentoring was chosen by 64.9% and this may be reflective of inadequate clinical opportunities to practice TJM to the spine. Boissonnault et al.¹ found that although TJM was being taught in entry-level programs, students were not given opportunities to practice the skill on patients by their clinical instructors. If such practice opportunities are not available during entry-level training, it makes sense that therapists wishing to develop skills in TJM would seek postgraduate training and lack of such training was seen as a barrier by 54.5% of respondents. Interestingly, this study found that therapists who had undergone such training via manual therapy or specialty certification were more likely to provide TJM and more comfortable when doing so. Finally, concerns about safety were chosen as a barrier to the use of TJM by 56.7% of therapists.

Limitations

All web-based and online surveys have some form of bias, such as underrepresentation of non-internet/ social media users.⁸ Following the CHERRIES checklist, our survey had excellent participation (99.6%) and completion (98.6%) rates; however, we could not calculate the view rate as the online platform did not provide a count of unique visitors to the website.

The online survey platform was not able to restrict access to one response per device; therefore, single participants may have completed the survey multiple times. We examined for duplicate responses for the following: age; gender; entry-level degree; highest earned degree; years of clinical practice; practice setting. None were found, supporting the assumption of unique respondents.

Selection bias is also a possibility as much of the publicity was generated by professional organizations with a focus on TJM. Although we did have therapists who indicated that they practice in a setting other than orthopedics, the majority of respondents' practice setting included orthopedic spine (81%) and orthopedic extremities (78%). Finally, this study's inclusion of only U.S. physical therapists does not allow for generalization to physical therapists practicing TJM in other countries.

Conclusion

Physical Therapists who responded to the survey agreed that TJM was (a) effective and safe; (b) regularly provided; and (c) comfortably performed in the thoracic spine, followed by the lumbar spine, and least so in the cervical spine. The odds of being more *comfortable* and more regularly *providing* TJM were higher if therapists were male, practicing in an outpatient orthopedic setting on patients

with spinal pathology, aware of spine CPRs, and had manual therapy certification. Finally, the odds that therapists agreed that TJM was *safe and effective* were higher in males and in those who were aware of spine CPRs.

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Contributors

(Puentedura) – conceived and designed the study, obtained funding, and ethics approval, analyzed the data, wrote the entire article, and revised the article. (Slaughter) – obtained funding, collected, and analyzed the data, and revised the article. (Reilly) – obtained funding, collected, and analyzed the data, and revised the article. (Ventura) – obtained funding, collected, and analyzed the data, and revised the article. (Young) – analyzed the data, and revised the article.

References

- 1 Boissonnault W, Bryan JM. Thrust joint manipulation clinical education opportunities for professional degree physical therapy students. *J Orthop Sports Phys Ther.* 2005;35(7):416–23.
- 2 Mintken PE, Derosa C, Little T, Smith B. Moving past sleight of hand. *J Orthop Sports Phys Ther.* 2010;40(5):253–55.
- 3 Noteboom JT, Little C, Boissonnault W. Thrust joint manipulation curricula in first-professional physical therapy education: 2012 update. *J Orthop Sports Phys Ther.* 2015;45(6):471–76.
- 4 Boissonnault W, Bryan JM, Fox KJ. Joint manipulation curricula in physical therapist professional degree programs. *J Orthop Sports Phys Ther.* 2004;34(4):171–81. discussion 179–181.
- 5 Hurley L, Yardley K, Gross AR, Hendry L, McLaughlin L. A survey to examine attitudes and patterns of practice of physiotherapists who perform cervical spine manipulation. *Man Ther.* 2002;7(1):10–18.
- 6 Jull G. Use of high and low velocity cervical manipulative therapy procedures by Australian manipulative physiotherapists. *J Physiother.* 2002;48(3):189–93.
- 7 Eysenbach G. Improving the quality of web surveys: the checklist for reporting results of internet E-surveys (CHERRIES). *J Med Internet Res.* 2004;6(3):e34.
- 8 Dillman DA. Mail and internet surveys: the tailored design method. 2nd ed. Hoboken (NJ): John Wiley; 2007.
- 9 Bureau of Labor Statistics. Occupational employment and wages, May 2014: 29-1123 physical therapists. 2014 [cited 2016 Feb]. Available from: <http://www.bls.gov/oes/current/oes291123.htm>
- 10 Flynn T, Fritz J, Whitman J, Wainner R, Magel J, Rendeiro D, Butler B, Garber M, Allison S. A clinical prediction rule for classifying patients with low back pain who demonstrate short-term improvement with spinal manipulation. *Spine.* 2002;27(24):2835–43.

- 11 Cleland JA, Childs JD, Fritz JM, Whitman JM, Eberhart SL. Development of a clinical prediction rule for guiding treatment of a subgroup of patients with neck pain: use of thoracic spine manipulation, exercise, and patient education. *Phys Ther.* 2007;87(1):9–23.
- 12 PuenteDura EJ, Cleland JA, Landers MR, Mintken PE, Louw A, Fernández-de-las-Peñas C. Development of a clinical prediction rule to identify patients with neck pain likely to benefit from thrust joint manipulation to the cervical spine. *J Orthop Sports Phys Ther.* 2012;42(7):577–92.
- 13 Adams G, Sim J. A survey of UK manual therapists' practice of and attitudes towards manipulation and its complications. *Physiother Res Int.* 1998;3(3):206–27.
- 14 Dunning JR, Cleland JA, Waldrop MA, Arnot CF, Young IA, Turner M, Sigurdsson G. Upper cervical and upper thoracic thrust manipulation versus nonthrust mobilization in patients with mechanical neck pain: a multicenter randomized clinical trial. *J Orthop Sports Phys Ther.* 2012;42(1):5–18.
- 15 PuenteDura EJ, Landers MR, Cleland JA, Mintken PE, Huijbregts P, Fernandez-De-Las-Peñas C. Thoracic spine thrust manipulation versus cervical spine thrust manipulation in patients with acute neck pain: a randomized clinical trial. *J Orthop Sports Phys Ther.* 2011;41(4):208–20.
- 16 Cook C, Learman K, Showalter C, Kabbaz V, O'Halloran B. Early use of thrust manipulation versus non-thrust manipulation: a randomized clinical trial. *Man Ther.* 2013;18(3):191–98.
- 17 Di Fabio RP. Manipulation of the cervical spine: risks and benefits. *Phys Ther.* 1999;79(1):50–65.
- 18 Ernst E. Manipulation of the cervical spine: a systematic review of case reports of serious adverse events, 1995–2001. *Med J Aust.* 2002;176(8):376–80.
- 19 PuenteDura EJ, March J, Anders J, Perez A, Landers MR, Wallmann HW, Cleland JA. Safety of cervical spine manipulation: are adverse events preventable and are manipulations being performed appropriately? A review of 134 case reports. *J Man Manip Ther.* 2012;20(2):66–74.
- 20 Bialosky JE, Bishop MD, George SZ. Regional interdependence: a musculoskeletal examination model whose time has come. *J Orthop Sports Phys Ther.* 2008;38(3):159–60. Author reply 160.
- 21 McDevitt A, Young J, Mintken P, Cleland J. Regional interdependence and manual therapy directed at the thoracic spine. *J Man Manip Ther.* 2015;23(3):139–46.
- 22 Cleland JA, Glynn P, Whitman JM, Eberhart SL, MacDonald C, Childs JD. Short-term effects of thrust versus nonthrust mobilization/manipulation directed at the thoracic spine in patients with neck pain: a randomized clinical trial. *Phys Ther.* 2007;87(4):431–40.
- 23 Cleland JA, Mintken PE, Carpenter K, Fritz JM, Glynn P, Whitman J, Childs JD. Examination of a clinical prediction rule to identify patients with neck pain likely to benefit from thoracic spine thrust manipulation and a general cervical range of motion exercise: multi-center randomized clinical trial. *Phys Ther.* 2010;90(9):1239–50.
- 24 Childs JD, Fritz JM, Flynn TW, Irrgang JJ, Johnson KK, Majkowski GR, Delitto A. A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: a validation study. *Ann Intern Med.* 2004;141(12):920–28.
- 25 PuenteDura EJ, O'Grady WH. Safety of thrust joint manipulation in the thoracic spine: a systematic review. *J Man Manip Ther.* 2015;23(3):154–61.