Use of thrust joint manipulation by student physical therapists in the United States during clinical education experiences

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ABSTRACT

Introduction: Thrust joint manipulation (TJM) is used in physical therapy practice and taught in entry-level curricula in the United States (US); however, research regarding implementation by student physical therapists (SPTs) is scarce.

Objectives: To explore the use of TJM in SPT clinical education and factors influencing implementation.

Methods: In a cross-sectional exploratory study, accredited physical therapy (PT) programs in the US ($n = 227$) were invited to participate in an electronic survey. SPTs were queried about TJM use and their clinical instructor's (CI) credentials during their final musculoskeletal clinical experience.

Results: Forty-five programs participated in the study, consisting of 2,147 SPTs. Of those, 414 (19.3%) responses were used for analysis and 69% reported using TJM. SPTs who utilized TJM were more likely to have a CI who used TJM ($p < 0.001$) and/or had advanced certification/training in manual therapy ($p < .001$). A majority of students agreed or strongly agreed that their academic preparation provided them with clinical reasoning tools (84%) and psychomotor skills (69%) necessary to perform TJM. SPT use of TJM was facilitated by CI clinical practice, SPT competence in psychomotor skill, confidence in clinical reasoning, and practice setting. A main barrier to student use of TJM was CI lack of TJM use.

Conclusions: Clinical practice of the CI appears to be a key factor in determining student use of TJM. Level of evidence: 2b

KEYWORDS

Thrust joint manipulation;
clinical Education; student
physical therapist

Introduction

Thrust joint manipulation (TJM) is a key component of musculoskeletal physical therapy (PT) practice [1]. TJM is defined as a 'high velocity, low amplitude therapeutic movement within or at end range of motion' [2]. TJM is used in PT practice to treat patients with musculoskeletal spinal and extremity conditions [3–7]. Clinical practice guidelines recommend TJM as part of a multimodal approach to patient care [8–10]. The following factors have contributed to an increased emphasis on the development of musculoskeletal competencies in PT education. Firstly, the transition to an academic Doctor of Physical Therapy (DPT) as the entry-level degree in the US. Secondly, the increased accessibility to PT services with some form of direct patient access in every state. These musculoskeletal competencies include TJM and associated clinical reasoning and differential diagnosis skills. Instruction in both thrust and non-thrust techniques is part of the entry-level curricular content in PT programs in the US.

The development of TJM curricula in the US has been documented. In 2002, Boissonnault et al. [11] investigated TJM curricula in the US. They found that 44% of programs were teaching TJM and an additional 31% planned to do so. Since the publication of that study, the American Physical Therapy Association (APTA) and the Commission on Accreditation in Physical Therapy Education (CAPTE) have taken measures to standardize PT education of TJM. For example, the APTA Manipulation Education Manual for Physical Therapist Professional Degree Programs [2] was published in 2004. Instruction in TJM was recommended in *A Normative Model of Physical Therapist Professional Education* [12] in 2004 and has been included in the required elements of DPT education since 2006 by CAPTE [13]. TJM is also included in the Minimum Required Skills for Physical Therapist Graduates at Entry Level [14]. A subsequent survey of US entry-level education by Noteboom et al. [15] in 2012 found that TJM content was better integrated into curricula and the number of programs teaching TJM had increased to 99%.

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Classroom and laboratory preparation for TJM includes instruction in safe and effective performance of joint assessment and treatment. Development of clinical reasoning skills to choose technique and dosage are important facets of this training. Cognitive processing has been identified as an important component of orthopedic manual PT psychomotor skill acquisition [16]. This includes critical thinking, decision-making, and problem-solving. Development of clinical expertise takes a long time, significant coursework and mentorship. Expert clinicians exhibit strong clinical reasoning skills, defined as ‘the thinking and decision-making processes that are used in clinical practice’ [17]. Clinical education experiences provide students with an opportunity to integrate cognitive and motor skills, including TJM, learned as part of their core curriculum [18]. During these experiences, students are under the supervision of a licensed physical therapist who is designated as their clinical instructor (CI). The CI provides individualized mentorship during clinical practice, which is an important component of student skill acquisition [19]. It is essential that students have an opportunity to apply skills learned in the classroom and laboratory setting, during clinical education experiences.

A number of authors have investigated TJM clinical educational opportunities for SPTs during their clinical education experiences. In 2005, Boissonnault et al. [20] surveyed clinical education academic program coordinators and CIs in outpatient orthopedic settings. They found the availability and scope of TJM clinical educational opportunities were limited, variable, and were not considered in selection of clinical education sites for students [20]. Previous authors investigated student use of TJM and found that while TJM was consistently included in academic preparation, there were fewer opportunities to utilize techniques clinically and CIs underutilized TJM [21,22]. While TJM is thought to be an effective and safe treatment by PTs [23], it appears to be underutilized during SPT clinical education experiences.

Since these studies were published, physical therapist education and practice have continued to develop and evolve. It is important to collect data to identify current trends in order to update how SPTs successfully apply TJM skills in the clinical education setting. The purpose of this study was to investigate clinical practice of SPTs in outpatient musculoskeletal settings. Specifically, the goal was to provide an update on student use of TJM during clinical education experiences and to examine factors influencing their use of TJM.

Methods

Design

This was a cross-sectional exploratory study using an electronic survey of US DPT students. This study was

approved by the Northeastern University Institutional Review Board.

Participants

The authors invited 227 accredited PT programs in the US to participate in an electronic survey in Spring 2018. The list of programs was obtained from the current CAPTE directory of accredited US PT programs [13]. The study population consisted of students who had completed musculoskeletal course work and had finished or were concluding their final outpatient musculoskeletal clinical education experience.

Survey development and design

The survey instrument was initially developed based on a literature review of PT education and musculoskeletal clinical practice [1,12,24]. The survey was then sent to five manual therapy experts across the US, and modified based on feedback (Appendix 1). All items were asked regarding students’ last outpatient musculoskeletal clinical experience. The first section of the survey asked general demographic information, including clinic location, practice setting, and qualifications of students’ CIs. The remainder of the survey queried student clinical practice, including diagnosis and treatment, use of TJM including frequency, body region, barriers, and facilitating factors. SPTs were asked to rate their confidence in clinical reasoning, as well as confidence in psychomotor skills and academic preparation for use of TJM, using a 5-point Likert Scale.

Survey distribution

The online survey tool, Qualtrics (Qualtrics, Provo UT), was used to host, format, and distribute the survey [25]. The researchers sent a link to the survey to PT program chairs. The program chairs were asked to send the survey to final year DPT students who were concluding or had finished their final outpatient, musculoskeletal clinical experience. The survey invitation also asked program chairs to document how many students received the survey. After receiving the initial e-mail, participants were given 2 weeks to respond before follow-up reminder e-mails were sent. Response collection was concluded in June 2018.

Statistical analysis

Descriptive statistics were calculated to present the percentage and frequency of responses to the demographic and clinical management questions. Chi-square tests were used to compare categorical variables among students who utilized TJM and those who did not. These variables included CI certification, years of experience, use of TJM, and student use of clinical decision tools. The

statistical analyses were performed using IBM SPSS V20 (SPSS Inc., Chicago, IL, USA). The p value was set at 0.05 for all analyses.

Results

Fifty-four programs (19%) responded to the survey invitation. Of those, 45 programs had SPTs who met criteria for the survey. An estimated 2,147 SPTs received the survey; 665 responded. Figure 1 shows the survey response rate. Partial survey responses were not included. The final analysis included 414 (19.3%) SPTs who completed the survey; however, the overall response rates to individual questions varied.

Respondents practiced in 45 different states across the US. They were 62% female, 38% male, 52% under the age of 25, and 54% working in a private outpatient setting (Table 1). One hundred and eighty-five (52%) SPTs reported that their CI's had more than one certification. The characteristics and qualifications of the CIs are displayed in Table 2. A total of 58% (238) of SPTs reported that their CI performed TJM as part of their clinical practice.

Student use of thrust joint manipulation

Student use of TJM can be seen in Table 3. TJM was used to varying degrees by 69% of SPTs, most commonly at the thoracic and lumbosacral region. The majority of SPTs (61%) did not deliver TJM to the cervical spine. TJM was more likely to be performed by students working in a Health and Wellness facility ($p < .05$) (Table 3).

Non-TJM was used by 97% (411) of STPs.

Confidence in clinical reasoning and psychomotor skills

A majority of students reported being *extremely* or *somewhat confident* in clinical reasoning (56%) and *extremely* or *somewhat competent* in psychomotor skills (56%) (Table 3).

Factors associated with TJM use

Factors that positively and negatively facilitated student use of TJM can be seen in Table 4. CI use of TJM was cited by 27% of students as positively influencing

Figure 1. Flow chart of the survey response rate.

Table 1. Demographics of study respondents.

What is your age (in years)?	
	n (%)
Under 25	216 (52%)
26–30	152 (37%)
Over 30	44 (11%)
Total	412 (100%)
What is your gender?	
	n (%)
Female	255 (62%)
Male	156 (38%)
Other	1 (0%)
Total	412 (100%)
Program Location by Region?	
	n (%)
Northeast	164 (40%)
Midwest	113 (27%)
South	73 (18%)
West	63 (15%)
Total	413 (100%)
What best describes the clinic setting?	
	n (%)
Health and Wellness Facility	16 (4%)
Health System or Hospital Based	155 (38%)
Industry	15 (4%)
Research Center	0 (0%)
Private Outpatient Office	221 (54%)
Academic Institution	6 (1%)
Total	413 (100%)
In which region was the clinic located?	
	n (%)
East North Central (IL, IN, MI, OH, WI)	55 (13%)
East South Central (AL, KY, MS, TN)	12 (3%)
Middle Atlantic (NJ, NY, PA)	78 (19%)
Mountain (AZ, CO, ID, MT, NM, NV, UT, WY)	65 (16%)
New England (CT, ME, MA, NH, RI, VT)	43 (10%)
Pacific (AK, CA, HI, OR, WA)	41 (10%)
South Atlantic (DE, FL, GA, MD, NC, SC, VA)	54 (13%)
West North Central (KS, MN, MO, ND)	29 (7%)
West South Central (AR, LA, TX)	32 (8%)
Total	410 (100%)

their use of TJM *a great deal*. Several factors were identified that facilitated student use of TJM. They were more likely to have a CI who also used TJM, (79% of students who used TJM) compared to only 10% of the students who did not use TJM ($p < 0.001$). They were also more likely to have a CI with specialty certification or advanced training in orthopedics or manual therapy (59%), compared to only 37% of students who did not use TJM ($p < .001$). Students who used TJM were also more likely to use manual therapy clinical decision tools to assist with clinical decision-making ($p < 0.001$).

The most significant factor that negatively influenced student use of TJM was their CI not using TJM. This was reported as negatively impacting TJM use *a great deal* by 28% of **all** students and 66% of students who did **not** use TJM. When looking specifically at barriers among students who did **not** use TJM, several were identified that negatively impacted practice *a great deal* or *a lot*. These included: CI did not use TJM (77%), patient caseload (43%), practice setting (41%), lack of competence in psychomotor skills (34%), lack of

confidence in clinical reasoning (24%), and state practice act regarding use of TJM (9%). Years of CI experience using TJM was not significant.

Academic student preparation

Regarding academic preparation (84%) *agreed* or *strongly agreed* that their academic classroom preparation provided them with the clinical reasoning tools necessary for success during their clinical experience. Sixty-nine percent of students *agreed* or *strongly agreed* that they had the necessary academic preparation in TJM psychomotor skills (Table 3).

Discussion

The major findings of this study are twofold and relate to: (1) the utilization of TJM by SPTs and (2) the barriers and facilitating factors for student use of TJM.

Student use of TJM

SPT TJM utilization of 69% is similar to a previous national survey finding that 66% of students who had completed an outpatient clinical experience performed TJM when clinically indicated [22]. This study's finding that spinal TJM was used most frequently in the thoracic region, followed by the lumbar and cervical spine, respectively, is similar to the findings of Puente-dura [23].

CI use of TJM

This study's reported TJM rate of 58% by CIs was similar to Struessel et al. [22] who found that 57% of CIs used TJM. It was higher than both Sharma et al. [21] who reported 48% of CI's utilized TJM and Walsh et al. [26] who found 41% of CI's used TJM for the lumbar spine. This study's reported CI use of TJM is lower than the use of TJM reported by Puente-dura et al. [23]. They found that 66.5% of respondents *agreed (completely or somewhat)* that they regularly used TJM in the thoracic spine when indicated, 52.9% in the lumbar spine and 33% in the cervical spine.

Barriers and facilitators of TJM use

This study's finding that students had more opportunities to practice TJM if the student's CI frequently performed TJM are similar to those of previous authors [21]. Conversely, a lack of support from clinical instructors can be a barrier to evidence-based practice [27]. SPTs utilized non-TJM (97%) at a much higher rate than TJM. Allowing for variation in case-load and the likelihood that some patients were not appropriate candidates for manipulation, lower SPT

Table 2. Clinical Instructor (CI) characteristics.

How many years of clinical experience did your primary clinical instructor(s) have as a physical therapist?			
	n (%)		
1–5 years	132	(32%)	
6–10 years	121	(29%)	
11–15 years	54	(13%)	
16–20 years	50	(12%)	
20+ years	56	(14%)	
Total	413	(100%)	
Did your primary clinical instructor have any of the following? (Please check all that apply)			
	YES n (%)	NO n (%)	TOTAL Total n
Doctor in Physical Therapy	324 (80%)	81 (20%)	405
OCS (Orthopedic Clinical Specialist) *	116 (35%)	216 (65%)	332
SCS (Sports Clinical Specialist) *	36 (12%)	256 (88%)	292
MTC (Manual Therapy Certified) *	41 (14%)	257 (86%)	298
FAAOMPT (Fellow of the American Academy of Orthopedic Manual Physical Therapists) *	30 (10%)	262 (90%)	292
COMT (Certified Orthopedic Manual Therapist)	31 (11%)	260 (89%)	291
MDT (McKenzie Certification)	48 (16%)	246 (84%)	294
APTA Credentialed Clinical Instructor	214 (63%)	124 (37%)	338
Completion of Fellowship Program or Residency in Orthopedic Manual Physical Therapy*	41 (14%)	255 (86%)	296
Other	56 (38%)	90 (62%)	146
One or more advanced or Manual Therapy certification; OCS,SCS, MTC, FAAOMPT, COMT, completion of fellowship or residency†	185 (52%)	169 (48%)	354
Did your primary clinical instructor use Thrust Joint Manipulation in their clinical practice?			
	n (%)		
Yes	238	(58%)	
No	175	(42%)	

Italics indicate significant difference in use of TJM between CI's with and without this certification.

* $p < .05$, † $p < 0.001$

use of TJM may be due to the lower utilization by CI's. A previous study by Struessel et al. [22] also identified lack of CI use of TJM as a barrier to student use of TJM, and reported significantly lower student utilization of TJM if the CI did not or rarely used TJM. Over half of respondents (54%) in that survey reported that it was their perception that their CIs were not completely comfortable with students performing TJM and, as a consequence, performance of TJM was limited in some way [22]. An analysis by Struessel et al. [22] of SPTs who completed an outpatient clinical experience found the main reasons for *not* or *rarely performing* TJM, were student-related factors. These included a lack of confidence (55%) and lack of personal skills, (48%). Other less frequently cited barriers were; patient safety concerns (28%); lack of staff to provide adequate feedback (22%); and not feeling academically prepared (26%) [22].

Our findings among SPTs who did **not** use TJM indicate external factors (CI clinical practice, patient caseload, and practice setting) may be more likely to negatively impact TJM use than student-related factors. Intrinsic factors such lack of confidence and skill in the techniques did not appear to be as much of a barrier. Another factor that may influence student use of TJM would be an incongruence between the student's didactic training and the type of TJM used by the CI. It is also evident that state practice act restrictions still play a role in use of TJM.

Previous studies have found that physical therapists with manual therapy or specialist certification were

more likely to use TJM in their clinical practice and were more comfortable doing so [23,26]. In this study, 52% of CI's had an advanced certification, or training in orthopedic physical therapy. This is similar to the findings of Puentedura et al. [23], who found that 48% of US PT's had some form of manual therapy or clinical specialty certification. Walsh et al. [26] found that 13% of CI's in their study had specialty certification, and 0.7–2% were residency or fellowship trained, but 74% had to continue medical education for low back pain.

Recommendations

Sufficient practice and feedback based on motor learning theory are important components in the acquisition and retention of TJM skills [28,29]. Adequate feedback in turn promotes improved student self-assessment skills [28]. Additionally, students report more effective learning when an experienced practitioner demonstrates the TJM techniques [30]. Therefore, it is vital that students have adequate practice time and appropriate feedback in the academic setting from educators with expertise in TJM, in order to successfully acquire and retain these motor skills. Consistency among educators, and use and development of best teaching methods and practices based on motor learning and educational theory play an important role in developing TJM skills [16,28,29,31,32].

Table 3. Student use of Thrust Joint Manipulation.

How frequently did you use Thrust Joint Manipulation for patient care during this clinical experience?							
	n (%)						
0%	129 (31%)						
1–25%	198 (48%)						
26–50%	52 (13%)						
51–75%	25 (6%)						
76–100%	10 (2%)						
Total	414 (100%)						
By the end of the experience, how confident were you in applying your clinical reasoning skills using Thrust Joint Manipulation for patient care?							
	n (%)						
Extremely confident	38 (9%)						
Somewhat confident	194 (47%)						
Neither confident nor not confident	77 (19%)						
Somewhat lacking in confidence	76 (18%)						
Extremely lacking in confidence	29 (7%)						
Total	414 (100%)						
By the end of the experience, how competent were you in your psychomotor skills using Thrust Joint Manipulation for patient care?							
	n (%)						
Extremely competent	44 (11%)						
Somewhat competent	188 (45%)						
Neither competent nor not competent	79 (19%)						
Somewhat lacking in competence	70 (17%)						
Extremely lacking in competence	33 (8%)						
Total	414 (100%)						
Did your academic classroom preparation provide you with the clinical reasoning tools necessary for success in this clinical experience?							
	n (%)						
Strongly agree	112 (27%)						
Agree	234 (57%)						
Neither agree nor disagree	54 (13%)						
Disagree	12 (3%)						
Strongly disagree	2 (0%)						
Total	414 (100%)						
Did your academic preparation provide you with the Thrust Joint Manipulation psychomotor skills necessary for success in this clinical experience?							
	n (%)						
Strongly agree	94 (23%)						
Agree	191 (46%)						
Neither agree nor disagree	79 (19%)						
Disagree	40 (10%)						
Strongly disagree	9 (2%)						
Total	413 (100%)						
	Health and Wellness Facility	Health System or Hospital based	Industry	Private Out patient	Academic Institution	Total	
Student Did NOT Use TJM	0%	37%	20%	31%	17%	129	
Student DID use TJM	100%*	63%	80%	69%	83%	284	
Total	16	155	15	221	6	413	
*Students in this setting more likely to perform TJM. <i>p</i> <0.05							
Percentage of Thrust Manipulation Techniques for specific body regions.							
	0%	1–5%	6–20%	21–50%	51–75%	76–100%	Response (n)
Cervical Spine	61%	21%	10%	5%	3%	0%	261
Thoracic Spine	5%	22%	26%	23%	18%	6%	280
Lumbo-sacral Region	17%	28%	26%	15%	11%	3%	275
Extremities	45%	27%	16%	8%	2%	1%	262
Characteristics of students who used TJM compared to those who did not.							
	Student Used TJM		Student did NOT use TJM		Total		
CI Used TJM †	225 (79%)		13 (10%)		238		
CI did NOT use TJM	59 (21%)		116 (90%)		175		
Total	284		129		413		
CI had advanced training/certification †	(145) 59%		(40) 37%		185		
CI did NOT have advanced certification	100 (41%)		69 (63%)		169		
Total	245		109		354		
Student DID use manual therapy clinical decision tool†	266 (93%)		88 (86%)		354		
Student did NOT use manual therapy clinical decision tools	19 (7%)		41 (32%)		60		
Total	285		129		414		

†denotes statistical significance between groups $p < 0.001$ *denotes statistical significance between groups $p < .05$

It is important that academic programs provide students with a strong foundation in manual therapy skills and for clinical education experiences to provide students with opportunities for mentorship by clinical instructors with advanced manual therapy training in order to further develop their competency. Students with an interest in musculoskeletal clinical practice would benefit from clinical placements with clinical instructors who have advanced skills and competence in this area. Our findings highlight the important role of residencies and fellowships in the development of skills for CIs by providing more intense and frequent exposure to mentorship in providing TJM.

Opportunities for physical therapists to develop musculoskeletal skills and competencies through such residencies and fellowships have increased and the number of residency programs has steadily grown over the last 10 years [33,34]. Jensen and colleagues have made several recommendations as part of a transformative call for reform of physical therapy education [35]. These recommendations, based on the National Study of Excellence and Innovation in Physical Therapist Education, have called for the creation of strong and equal partnerships between academic and clinical facilities. These partnerships should advance excellence in clinical learning and practice, highlighting the critical role of clinical education in the application of knowledge learned in the academic setting [35]. Becoming an expert clinician requires strong clinical decision-making and takes years of clinical practice along a continuum of many dimensions [36]. SPTs develop skills and progress from being novice to expert as they rely more on reflection

and metacognitive skills in addition to their knowledge base and cognitive skills [37]. The clinical education experience should promote the transition of these cognitive skills necessary to use TJM, from the academic to the clinical setting.

Limitations

A strength of this study is that the clinical experiences of students took place in a wide variety of clinical settings in different regions of the US; however, several limitations might have influenced our findings. Online survey response rates vary widely and tend to be lower than other survey formats [38]. While the response rate to this survey was relatively low it is typical of other online surveys of both student and practicing physical therapists [39–41]. The findings of this study may not accurately represent all physical therapist students in the US. The estimated total number of PT graduates by CAPTE from US accredited physical therapist programs in 2018 is 10,672 [13]. This study's response total of 414 represents approximately 3.9% of all graduating PT students. Accordingly, this may be a source of selection bias. Similarly, students with a specific interest in TJM may have been more likely to respond to this survey creating a potential self-selection bias. To preserve confidentiality of results, the researchers did not analyze programs individually, which would have allowed a comparison of programs and identification of any outliers. Since the researchers did not contact the CIs directly, the responses regarding CI clinical practice and

Table 4. Factors that facilitated TJM and barriers to TJM.

How much did the following factors facilitate your use of Thrust Joint Manipulation (TJM) during this experience?						
	A great deal	A lot	A moderate amount	A little	None at all	Total Response (n)
Clinical Instructor use of TJM	27%	27%	17%	15%	13%	281
Competence in psychomotor skills performing TJM	15%	35%	27%	15%	8%	284
Confidence in clinical reasoning regarding selection of TJM	14%	37%	25%	17%	6%	283
Practice setting	14%	37%	25%	14%	9%	283
Patient caseload	12%	31%	22%	17%	18%	283
Other	2%	2%	11%	2%	82%	44
How much did the following factors act as barriers or negatively influence your use of Thrust Joint Manipulation (responses of ALL students)?						
	A great deal	A lot	A moderate amount	A little	None at all	Total Response (n)
Clinical Instructor did not use TJM	28%	10%	10%	10%	42%	408
Lack of competence in psychomotor skills	8%	16%	19%	37%	20%	404
Lack of confidence in clinical reasoning regarding selection of TJM	6%	13%	20%	37%	24%	403
Practice setting	13%	9%	11%	19%	49%	400
Patient caseload	12%	13%	16%	23%	36%	399
State Practice Act regarding use of TJM	5%	4%	6%	10%	77%	398
Other	5%	6%	4%	3%	82%	78
Barriers to TJM use: Answers of students who did NOT use TJM						
	A great deal	A lot	A moderate amount	A little	None at all	Total Response (n)
Clinical Instructor did not use TJM	66%	10%	6%	4%	14%	128
Lack of competence in psychomotor skills	16%	19%	28%	24%	14%	123
Lack of confidence in clinical reasoning regarding selection of TJM	11%	13%	28%	28%	20%	123
Practice setting	28%	12%	15%	19%	26%	121
Patient caseload	22%	21%	17%	16%	23%	122
State Practice Act regarding use of TJM	11%	3%	9%	11%	67%	123
Other	9%	0%	6%	0%	85%	34

qualifications are based on the student's perceptions and not corroborated by the CI.

Conclusion

Clinical practice of the CI appears to be a key factor in determining student practice in this study, highlighting the critical importance of the clinical instructor to the success of the SPT. Standardization of both TJM instruction in the academic setting, and of clinical education expectations, is key for students to receive equivalent opportunities to develop clinical reasoning and practice skills. Future research should explore teaching methods of TJM in the academic and clinical setting and query clinicians' clinical decision-making regarding TJM.

Disclosure statement

No potential conflict of interest was reported by the authors.

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