The status of temporomandibular and cervical spine education in post-professional physical therapy training programs recognized by Member Organizations of IFOMPT: an investigation of didactic and clinical education

Stephen M. Shaffer^a, Sarah H. Stuhr^b , Phillip S. Sizer^a , Carol A. Courtney^c and Jean-Michel Brismée^a

^aProgram in Physical Therapy, Department of Rehabilitation Sciences, School of Health Professions, Texas Tech University Health Sciences Center, Lubbock, TX, USA; ^bSchool of Physical Therapy, College of Health Professions, Pacific University, Hillsboro, OR, USA; ^cDepartment of Physical Therapy, College of Applied Health Sciences, University of Illinois at Chicago, Chicago, IL, USA

ABSTRACT

Objectives: The purpose of this investigation was to establish an international baseline of the quantity of physical therapist education on temporomandibular disorders (TMD) during post-professional Orthopedic Manual Physical Therapy (OMPT) education.

Methods: An electronically distributed survey was sent to programs and data analyzed for trends, including a comparison of TMD and cervical spine disorders education. Current data were compared to pre-existing data from the United States.

Results: For the current data-set, the Mann-Whitney U test demonstrated statistical significance when comparing TMD and cervical spine disorders education for both the hours of didactic training provided ($p < 0.0001$) and the number of patients seen during clinical training ($p < 0.006$). When comparing the United States and international data, statistically significant greater exposure was reported for both didactic ($p < 0.0001$) and clinical education ($p < 0.006$) of TMD topics in the United States but not for didactic ($p = 0.23$) or clinical education ($p = 0.15$) of cervical spine topics.

Discussion: These data again indicate a lack of uniformity between post-professional training programs in OMPT with respect to TMD education. There is, however, consistency in that most programs provided more training on cervical spine disorders than TMD. Based on these findings, further investigations are appropriate to determine if TMD education is adequate during post-professional OMPT education.

Level of Evidence: 5.

KEYWORDS

Temporomandibular disorders; TMD; neck pain; physical therapy specialty; training programs; professional education; orthopedics; manual therapy

Introduction

Despite ample epidemiological data suggesting that both temporomandibular disorders (TMD) [1–7] and cervical spine disorders [8–13] have similarly high prevalence rates, a recent publication identified a widespread discrepancy between the extent to which physical therapists enrolled in post-professional Orthopedic Manual Physical Therapy (OMPT) training programs in the United States are exposed to each of these content areas [14]. For both didactic and clinical education, post-professional students underwent statistically significant lower levels of TMD education in comparison to cervical spine disorders education. Of note, this issue is of clinical relevance not only because of the available data regarding the prevalence rates of these two region-specific heterogeneous groups of common musculoskeletal disorders but also because other categories of healthcare professionals such as dentists [15–18] and physicians [19] are not trained to thoroughly evaluate

and/or manage musculoskeletal diagnoses such as TMD.

The purpose of this investigation was to establish an international baseline of the quantity of physical therapist education on TMD during post-professional OMPT training. In addition, the education background of TMD instructors was analyzed in terms of breadth and adequacy. These data were compared to cervical spine education data and to pre-existing data from the United States. This comparison was completed because the United States has considerably different healthcare systems than other International Federation of Orthopaedic Manual Physical Therapists (IFOMPT) jurisdictions and may, as a result, not be indicative of wider trends.

Methods

The local Institutional Review Board granted exempt status for this study because it met both institutional and federal guidelines designed to protect human

subjects (i.e. the study did not include human experimentation and did not collect private health information). Subsequently, IFOMPT was contacted regarding the possibility of conducting an anonymous survey of programs recognized by Member Organizations (MO) of IFOMPT (See Supplementary Material). After the request was reviewed and approved by the IFOMPT Executive Committee, an official list of liaisons from each MO was obtained directly from IFOMPT. Despite being part of that contact list, the liaison for the American Academy of Orthopaedic Manual Physical Therapists (AAOMPT) was excluded from participation because programs with the United States were surveyed in a previous study [14]. The remaining list included contacts located in 21 different nations/jurisdictions but only 14 (67%) of the designated liaisons responded when contacted about participation in this survey. One of these nations/jurisdictions was later excluded from data collection because, despite the IFOMPT liaison responding to state that the appropriate program director would contact the principal investigator directly, no contact was received. As a result, the total sampling frame cannot be reported on because program data were not received from a total of eight jurisdictions.

Once a list of program contacts was compiled, an online survey was distributed electronically to each participating director and/or designated representative of each post-professional training program recognized by those MOs of IFOMPT that were included in the study. The communication via electronic mail was provided as a letter in PDF format outlining the nature and purpose of the survey and included a web-link through which each program director or designated representative could locate and complete the survey. The letter ensured each participant that all data would remain confidential such that only the principal investigator would have access to which directors or designated representatives had completed the survey as well as what their responses entailed.

The surveys were first distributed in April of 2015. Three and six weeks later the surveys were again sent out to each individual that had not yet responded, though no attempts were made to track individual respondents apart from excluding them from follow up requests to

participate. Consent for participation was obtained by including a question regarding consent at the beginning of the survey. Survey questions had been pilot tested and validated electronically and were the same as those utilized by Shaffer et al. [14] so that the data sets could be compared. No attempts were made to rank or individually comment on program responses. No personal identification data or health information were collected during this investigation. Upon receiving the data, SPSS (version 23) was utilized to run the Mann-Whitney U test to compare the hours of didactic training and number of patients seen during both TMD and cervical spine disorders education as well as to compare both TMD and cervical spine disorders didactic and clinical education between the current IFOMPT data-set and the previously reported AAOMPT data-set.

Results

A total of 38 programs (62%) from 13 different nations/jurisdictions were included in the investigation. The number of programs within each nation/jurisdiction ranged from 1 to 10 with an average of 2.9 programs per country. These nations/jurisdictions included Australia, Austria, Canada, Denmark, Greece, Hong Kong, Ireland, Italy, the Netherlands, New Zealand, Norway, South Africa, and the United Kingdom. Table 1 lists the number of programs located in each jurisdiction. The survey was distributed to each of the 38 post-professional OMPT training programs with 22 programs responding (58%).

All but one responding program director or representative (95%) reported that their regulatory body required education content on cervical spine disorders to be included in their curriculum whereas all but three (86%) reported that education content on TMD was required. The majority of respondents (77%) reported overseeing one post-professional training program with one respondent (5%) overseeing two programs and three respondents (14%) overseeing three programs. One program respondent (5%) reported training an average of three post-professional students over the previous three years, four (18%) reported training an average of 10 students, and one each (5%) trained an average of 14 and 15 individuals. The remaining 14 programs (64%) trained, on average, greater than 15 post-professional students per each of the three preceding years. One respondent (5%) did not answer this survey item.

Regarding TMD education, thirteen programs (59%) reported providing both didactic and clinical training, six programs (27%) reported providing didactic but not clinical training, two programs (9%) reported providing neither didactic nor clinical education, and one respondent (5%) reported providing didactic training but did not respond regarding clinical training. All programs reported providing both didactic and clinical education on cervical spine disorders. Didactic TMD education

Table 1. Program number by nation/jurisdiction.

Jurisdiction	Number of programs
Australia	5
Austria	2
Canada	2
Denmark	1
Greece	3
Hong Kong	1
Ireland	1
Italy	2
The Netherlands	6
New Zealand	2
Norway	1
South Africa	2
The United Kingdom	10

ranged from 0 (9%) to 16–20 h (9%) with the largest number of programs providing 1–5 h (50%). Didactic education for cervical spine disorders ranged from 1 to 5 (5%) to >25 h (71%). Clinical education for TMD ranged from 0 (32%) to > 25 patients (5%), though 50% of programs included only 1–5 patients on TMD. Clinical education for cervical spine disorders ranged from 1 to 5 (9%) to >25 patients (45%). A detailed comparison of exposure to temporomandibular and cervical spine disorders education in programs recognized by MOs of IFOMPT for both didactic and clinical training is presented in Figure 1.

The Mann-Whitney U test demonstrated statistical significance when comparing TMD and cervical spine disorders education for both the hours of didactic training provided ($p < 0.0001$) and the number of patients seen during clinical training ($p < 0.006$). When comparing the current international data-set to the previously reported AAOMPT data-set [14], statistical significance was demonstrated for both didactic ($p < 0.0001$) and clinical education ($p < 0.006$) of TMD topics but not for didactic ($p = 0.23$) or clinical education ($p = 0.15$) of cervical spine disorders topics. A detailed comparison of exposure to temporomandibular and cervical spine disorders education for both didactic and clinical training is presented in Table 2.

Seventeen programs (77%) reported having access to a clinician with ideal academic and clinical expertise to teach advanced orthopedic knowledge and skills on TMD-related topics at the post-professional level. Three programs (14%) reported not having access to an ideally

trained educator, two of which reported providing both didactic and clinical training on TMD-related topics. Only one program (5%) reported not having access to a clinician with ideal academic and clinical expertise to teach advanced orthopedic knowledge and skills on cervical spine disorder-related topics at the post-professional OMPT training level.

Thirteen programs (59%) reported the means through which their educators obtained post-professional education on TMD-related topics. Five (23%) reported having educators who had completed a certification process, two (9%) had educators who completed weekend course training, two (9%) reported having educators whose training involved a residency program, two (9%) reported relying upon educators who had undergone fellowship training, and one each (5%) underwent Masters of Science training in OMPT and a week long university training process. No programs reported this training to involve conference-based training and nine programs (41%) provided no answer for this survey item.

Each program was asked if their curriculum requires an increased emphasis on TMD-related topics. Eleven respondents (50%) replied 'yes,' ten (45%) responded 'no,' and one (5%) left this survey item blank. When asked if their post-professional training program requires an increased emphasis on cervical spine-related topics, five programs (23%) responded 'yes' whereas seventeen (77%) responded 'no.' Additional comments of interest are listed in Table 3.

Figure 1. Comparison of Temporomandibular and Cervical Spine Disorders Education in Programs Recognized by Member Organizations of IFOMPT.

Key: IFOMPT = International Federation of Orthopaedic Manual Physical Therapists, § p value for the Mann-Whitney U test.

Table 2. Comparison of didactic and clinical education exposure to TMD and cervical spine disorders between the AAOMPT and IFOMPT data sets

		TMD Data		Cervical Data	
		AAOMPT	IFOMPT	AAOMPT	IFOMPT
		Didactic	Didactic	Didactic	Didactic
Statistical significance	Hours*	$(p < 0.0001)^{\S}$		$(p = 0.23)^{\S}$	
	0	1 (7%)	2 (9%)	0	0
	1–5	8 (53%)	11 (73%)	0	1 (5%)
	6–10	6 (40%)	5 (23%)	0	3 (14%)
	11–15	0	1 (5%)	0	0
	16–20	0	2 (9%)	6 (40%)	1 (5%)
	21–25	0	0	2 (13%)	1 (5%)
	>25	0	0	7 (47%)	15 (68%)
		AAOMPT Clinical	IFOMPT Clinical	AAOMPT Clinical	IFOMPT Clinical
Statistical significance	Patients**	$(p = 0.01)^{\S}$		$(p = 0.15)^{\S}$	
	0	1 (7%)	7 (32%)	0	0
	1–5	12 (80%)	11 (50%)	0	2 (9%)
	6–10	2 (13%)	2 (9%)	0	7 (32%)
	11–15	0	0	1 (7%)	0
	16–20	0	0	2 (13%)	2 (9%)
	21–25	0	0	2 (13%)	0
	>25	0	1 (5%)	10 (67%)	10 (45%)

Notes: TMD = temporomandibular disorders, AAOMPT = American Academy of Orthopedic Manual Physical Therapists, IFOMPT = International Federation of Orthopaedic Manual Physical Therapists.

*indicates the average number of hours of exposure during didactic training over the previous three years; **indicates the average number of patients exposed to during clinical training over the previous three years; § indicates p value for Mann-Whitney U test.

Table 3. Additional comments provided by respondents.

- 'The reason why TMD is not covered is because not all areas of the body can be taught in greater depth and priority needs to be given to more common conditions. I do however think that although there is no didactic teaching on this topic that it may be a good idea to include a self-study assignment to the curriculum on TMD.'
- 'Our greatest limitation in our education of TMD assessment and management is the lack of TMD presentations on our supervised clinical placements. This simply relates to the lack of TMD referral to physiotherapy generally.'
- 'In our program, the teaching content is not strictly separated. Cervical spine and TMD problems are linked in the classroom. Therefore, it is difficult to assign the number of lessons exactly. The same applies to the clinical internship.'
- 'The clinical placements (mentorship) are completed in general clinics (i.e. hospital outpatients and private practices). They may not see a patient with a TMJ during that time, as they do not present as frequently as other conditions. It would be wonderful if we could send students on placements where they only see patients with conditions affecting knees or backs or TMJ's ... however the [national] health system and private practices are not set up like this ... I feel that TMJ disorders are a huge untapped market for physiotherapists/physical therapists and that we can make a significant difference to the quality of the life in these patients/clients.'

Discussion

This investigation follows a similar study involving post-professional training programs within the United States [14] but was the first of its kind to include an international subject pool. The data suggest that international post-professional OMPT education programs expose learners to TMD topics to a significantly lesser extent than cervical spine disorders topics. This is true despite a striking similarity between the available epidemiological data of these two region-specific heterogeneous groups of common musculoskeletal disorders [1–13]. As a result, it appears that well established, prominent orthopedic manual physical therapists on an international basis may not currently be prepared to serve as the vanguard for

the physical therapy profession with respect to the evaluation and management of TMD.

In comparison to previous data collected within the United States, there was a downward trend with respect to the percentage of programs providing both didactic and clinical training on TMD, which decreased from 87% to 59% of programs. Additionally, six programs (27%) reported providing didactic but not clinical training and two programs (9%) reported providing neither didactic nor clinical education on TMD. While these data appear relatively similar upon initial visual examination (Table 2), when compared to the data from the United States the didactic training data for IFOMPT demonstrate an overall trend toward providing more training and the clinical data for IFOMPT demonstrate both a trend toward providing less training and contain one outlier that provided a much higher level of training. These findings likely explain why a statistical significance difference was identified between the AAOMPT and international data sets for TMD education. Similar trends were not observed regarding education on cervical spine disorders in that all programs both within the United States and internationally conducted similar levels of cervical spine disorders education in both the didactic and clinical settings. These findings likely explain why statistical significance was not identified between the AAOMPT and international data sets for this portion of the data.

Exposure to TMD education content was always lower than cervical spine content in the United States [14]. In contrast, some programs in the international data-set reported relatively low content exposure to cervical spine disorders education while some programs reported relatively high exposure to TMD content. For example, in the international data-set four programs reported 6–10 h

or less of didactic education for cervical spine disorders while three reported 11–15 h or greater being dedicated to TMD didactic content. The same was true in the case of clinical content where 9 programs reported providing exposure to 6–10 cervical spine disorders patients during clinical training while one provided exposure to >25 patients with TMD. Despite the outliers, the data again represent a training process that inherently favors cervical spine disorders education when compared to TMD education.

In the current data-set, 23% of the respondents reported that their programs required an increase in education exposure to cervical spine disorders content whereas 50% responded in the same way regarding TMD content. This shows an inverse relationship with the data previously acquired from the United States where 40% of programs believed they needed increased cervical spine disorders content but only 20% believed the same to be true for TMD.

As was the case in the previous study [14], these data in conjunction with the provided comments indicates that, even at the post-professional education level, little importance is placed on the temporomandibular region in many but not all programs. It was initially suspected that the scarcity of access to TMD patients seen in the United States might not be repeated in the international study based on the major differences seen in the health care systems that these nations/jurisdictions rely upon; however, the current data-set indicates otherwise. Similar trends were even observed in that respondents from both studies indicated that access to patients with TMD is at times an obstacle in education settings. While this study did not investigate the potential reasons for these findings, it certainly could be the case that obstacles to patients obtaining quality TMD services within physical therapy clinics arise both from within the physical therapy profession and from professions that constitute potential referral sources. If the findings of this study are indicative of wider trends within the profession then two general pathways forward may be required. First, the physical therapy profession may need to bolster their current curricular content relative to TMD topics. Second, physical therapists may need to collaborate with potential referral sources in an attempt to highlight their musculoskeletal skillset and therefore direct appropriate patients to physical therapy clinics. There were also examples of programs from both data sets that taught these two subject matters concurrently, which may indicate that preexisting and successful examples already exist within the profession.

The potential education failure to provide sufficient training on TMD generates the possibility that patients are left with less than ideal healthcare options when afflicted with TMD. This investigation, however, did not seek to determine whether or not program graduates are sufficiently skilled at providing healthcare services and it

should therefore be noted that the possibility exists that the appropriate knowledge and skills are being developed despite a relatively limited exposure to TMD education content. Further investigation would be required to appropriately determine both the knowledge and skill level of graduates.

Future investigations could include attempts to gain insight with respect to why TMD content is not being taught in certain institutions. Other studies could seek to investigate student versus licensed practitioner knowledge and skill levels on TMD and cervical spine disorders topics. Additionally, patient accessibility to healthcare providers that can successfully address TMD should be investigated as well as the perceptions of physical therapists regarding their abilities to provide effective and efficient clinical services for both cervical spine disorders and TMD. Similarly, relevant data could be elucidated further through studies aimed at treatment outcomes, a process previously utilized in the investigation of TMD. [20–28] These investigations could include student physical therapists, licensed physical therapists, and those physical therapists with post-professional education such as residency, fellowship, and post-professional degree training.

Conclusion

In combination, the data presented both in the previously published paper on AAOMPT programs and the current data presented on international programs indicates that there is a lack of focus placed on TMD content in post-professional OMPT training programs globally. This lack of focus is not uniform across all programs but it is widespread. The origin of this phenomenon appears to be based on multiple variables that may be relatively consistent across national/jurisdictional borders, though the available data on TMD-related topics is currently limited and further investigation will be required to more fully understand this and related topics.

Limitations

There are multiple limitations of this investigation. First, the survey process relied upon self-reporting, which clearly presents the potential for receiving responses that were partially inaccurate or biased. Second, while the official language of IFOMPT is English, it is certain that the primary language of some participants was not English and that some of the questions may have been misunderstood or misinterpreted. As a result, language barriers may have impacted both participation and response rates. Another barrier could have included different education structures within various participating nations/jurisdictions, which could have led to some of the questions being comprehended poorly regardless of whether or not the wording itself was understood.

Additionally, the relevance of this study is limited in scope because the investigation only contacted a small portion of the international physical therapy profession. Moreover, the physical therapy community and teaching institutions may consider the cervical spine to be a more complex and important anatomical region than the TMJ. This holds the potential to generate bias regardless of whether or not certain assumptions are true. Lastly, as it was stated earlier, this investigation did not seek to collect data regarding the status of program attendees' knowledge or skill levels upon acceptance into or graduation from each program. This limits any final conclusions that can be made regarding potential reforms that can and/or should be made to current education curriculum.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Stephen M. Shaffer, PT, ScD, FAAOMPT is a clinical and academic expert in temporomandibular disorders (TMD). In 2005 and 2009 he completed residency and fellowship training in Orthopedic Manual Physical Therapy at the Institute of Orthopedic Manual Therapy in Woburn, Massachusetts and the University of Illinois at Chicago, respectively. In 2013, he completed academic doctoral training in Physical Therapy at Texas Tech University Health Sciences Center in Lubbock, TX where his dissertation addressed TMD. Shaffer, and his colleagues have since co-authored several papers on TMD and Shaffer has presented on TMD in a wide variety of capacities.

Sarah H. Stuhr, PT, DPT, FAAOMPT is a graduate of the University of Colorado Denver Doctor of Physical Therapy program. In 2013, she completed the University of Illinois fellowship in Orthopedic Manual Physical Therapy and is credentialed by the American Academy of Orthopedic Manual Physical Therapists. She currently owns and operates a private practice, Physio PDX, in Portland, OR and specializes providing care for patients with complex musculoskeletal conditions, persistent pain, and temporomandibular disorders. Additionally, Dr. Stuhr serves as Adjunct Faculty at Pacific University's Doctor of Physical Therapy program where she assists weekly in both Orthopedic and Anatomy classes.

Phillip S. Sizer, PT, PhD is Professor and Program Director of the Doctor of Science Program in Physical Therapy and is faculty in both the PhD Program in Rehabilitation

Science and the Medical Pain Fellowship Program in the Department of Anesthesiology at Texas Tech University Health Sciences Center in Lubbock, TX, USA. Additionally, Sizer, PhD, is the Director of the Clinical Musculoskeletal Research Laboratory at the Center for Rehabilitation Research at the same institution. Sizer, PhD, is known for his scholarship in the areas of clinical pathoanatomy, motor control, musculoskeletal diagnostics, and manual therapy education with authorship of 80+ peer-reviewed papers.

Carol A. Courtney PT, PhD, ATC is Clinical Associate Professor and Director of the post-professional Fellowship in Orthopedic Manual Physical Therapy at the University of Illinois at Chicago. Courtney, PhD, has clinical expertise in the management of chronic musculoskeletal pain and sports injury. Her research investigates the effects of knee joint injury and osteoarthritis on pain processing and joint function as well as the modulation of pain mechanisms through manual therapy interventions. She has authored over 100 peer-reviewed publications, book chapters and conference presentations, and has presented both nationally and internationally on this research.

Jean-Michel Brismée, PT, ScD is a professor in the Doctor of Science Program in Physical Therapy at Texas Tech University Health Sciences Center (TTUHSC) in Lubbock, TX, USA. Dr. Brismée, PhD, teaches at TTUHSC in the areas of Kinesiology and Orthopedics and is involved in clinical research in Orthopedics, Manual Therapy, and Movement Sciences. He has authored over 90 scientific papers in revered journals and is an author of two books and a series of 12 DVD's on the differential diagnosis and management of orthopedic conditions. He maintains clinical practice in outpatient orthopedics at the University Medical Center in Lubbock, Texas.

ORCID

Sarah H. Stuhr <http://orcid.org/0000-0002-2205-0442>

Phillip S. Sizer <http://orcid.org/0000-0001-9196-3766>

References

- [1] De Kanter RJ, Truin GJ, Burgersdijk RC, et al. Prevalence in the Dutch adult population and a meta-analysis of signs and symptoms of temporomandibular disorder. *J Dent Res.* 1993;72:1509–1518.
- [2] Carlsson GE. Epidemiology and treatment need for temporomandibular disorders. *J Orofac Pain.* 1999;13:232–237.
- [3] List T, Wahlund K, Wenneberg B, et al. TMD in children and adolescents: prevalence of pain, gender differences, and perceived treatment need. *J Orofac Pain.* 1999;13:9–20.
- [4] Magnusson T, Egermark I, Carlsson GE. A longitudinal epidemiologic study of signs and symptoms of temporomandibular disorders from 15 to 35 years of age. *J Orofac Pain.* 2000;14:310–319.
- [5] Egermark I, Carlsson GE, Magnusson T. A 20-year longitudinal study of subjective symptoms of

- temporomandibular disorders from childhood to adulthood. *Acta Odontol Scand*. 2001;59:40–48.
- [6] Al-Jundi MA, John MT, Setz JM, et al. Meta-analysis of treatment need for temporomandibular disorders in adult nonpatients. *J Orofac Pain*. 2008;22:97–107.
 - [7] Plesh O, Adams SH, Gansky SA. Racial/Ethnic and gender prevalences in reported common pains in a national sample. *J Orofac Pain*. 2011;25:25–31.
 - [8] Hult L. Cervical, dorsal, and lumbar spinal syndromes. *Acta Orthop Scand*. 1954;17:175–277.
 - [9] Holmström EB, Lindell J, Moritz U. Low back and neck/shoulder pain in construction workers: Occupational workload and psychosocial risk factors: Part 2. Relationship to neck and shoulder pain. *Spine*. 1992;17:672–677.
 - [10] Helewa A, Goldsmith CH, Lee P, et al. The prevalence of neck pain in a university community. *Phys Ther*. 1994;74:S26.
 - [11] Côté P, Cassidy JD, Carroll L. The Saskatchewan health and back pain survey: The prevalence of neck pain and related disability in Saskatchewan adults. *Spine*. 1998;23:1689–1698.
 - [12] Manchikanti L, Singh V, Datta S, et al.; American Society of Interventional Pain Physicians. Comprehensive review of epidemiology, scope, and impact of spinal pain. *Pain Phys*. 2009;12:E35–70.
 - [13] Hoy D, March L, Woolf A, et al. The global burden of neck pain: estimates from the global burden of disease 2010 study. *Ann Rheum Dis*. 2014;73:1309–1315.
 - [14] Shaffer SM, Brismée JM, Courtney CA, et al. The status of temporomandibular and cervical spine education in credentialed orthopedic manual physical therapy fellowship programs: a comparison of didactic and clinical education exposure. *J Man Manip Ther*. 2015;23:51–56.
 - [15] Türp JC, Kowalski CJ, Stohler CS. Temporomandibular disorders—pain outside the head and face is rarely acknowledged in the chief complaint. *J Prosthet Dent*. 1997;78:592–595.
 - [16] Gonzalez YM, Mohl ND. Care of patients with temporomandibular disorders: an educational challenge. *J Orofac Pain*. 2002;16:200–206.
 - [17] Attanasio R. The study of temporomandibular disorders and orofacial pain from the perspective of the predoctoral dental curriculum. *J Orofac Pain*. 2002;16:176–180.
 - [18] Steenks MH. The gap between dental education and clinical treatment in temporomandibular disorders and orofacial pain. *J Oral Rehabil*. 2007;34:475–477.
 - [19] Dicaprio MR, Covey A, Bernstein J. Curricular requirements for musculoskeletal medicine in American medical schools. *J Bone Joint Surg Am*. 2003;85-A:565–567.
 - [20] Magnusson T, Syrén M. Therapeutic jaw exercises and interocclusal appliance therapy. A comparison between two common treatments of temporomandibular disorders. *Swed Dent J*. 1999;23:27–37.
 - [21] Wright EF, Domenech MA, Fischer JR Jr. Usefulness of posture training for patients with temporomandibular disorders. *J Am Dent Assoc*. 2000;131:202–210.
 - [22] Nicolakis P, Erdogmus B, Kopf A, et al. Exercise therapy for craniomandibular disorders. *Arch Phys Med Rehabil*. 2000;81:1137–1142.
 - [23] Nicolakis P, Burak EC, Kollmitzer J, et al. An investigation of the effectiveness of exercise and manual therapy in treating symptoms of TMJ osteoarthritis. *CRANIO®*. 2001;19:26–32.
 - [24] De Laat A, Stappaerts K, Papy S. Counseling and physical therapy as treatment for myofascial pain of the masticatory system. *J Orofac Pain*. 2003;17:42–49.
 - [25] DuPont JS Jr. Clinical use of iontophoresis to treat facial pain. *Cranio*. 2004;22:297–303.
 - [26] Crider A, Glaros AG, Gevirtz RN. Efficacy of biofeedback-based treatments for temporomandibular disorders. *Appl Psychophysiol Biofeedback*. 2005;30:333–345.
 - [27] Mulet M, Decker KL, Look JO, et al. A randomized clinical trial assessing the efficacy of adding 6 × 6 exercises to self-care for the treatment of masticatory myofascial pain. *J Orofac Pain*. 2007;21:318–328.
 - [28] Haketa T, Kino K, Sugisaki M, et al. Randomized clinical trial of treatment for TMJ Disc displacement. *J Dent Res*. 2010;89:1259–1263.