Original Research Article

Neuromuscular dentistry: An untapped resource for enhanced patient care

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Abstract

Background: Neuromuscular Dentistry (NMD) integrates treatment to balance oral and facial structures by addressing the relationships among teeth, muscles, nerves, and the Temporomandibular Joint (TMJ). Changes in teeth alignment and jaw position can affect the cranio-maxillofacial complex, leading to neck pain and Temporomandibular Disorders (TMD). A deep understanding of Neuromuscular Dentistry opens new doors to comprehensive patient care. This study aims to assess the knowledge, awareness, and practice of NMD among dental professionals like Orthodontists, General Dental Practitioners (GDP), and other dental specialists.

Materials and Methods: We conducted a nationwide web-based survey of 26 self-administered validated questionnaires. A total of 324 dental professionals participated in the survey. Data was analyzed using Microsoft Excel and SPSS version 22. Statistical tests like Shapiro-Wilk, Mann-Whitney U, Kruskal-Walli's, and Chi-Square were used to compare variables. A p-value of ≤0.05 was considered significant.

Results: The overall mean awareness of NMD among participants was significantly associated with the designation (p=0.010) and experience of dentists (p=0.045), with higher scores among orthodontists and dentists with more than 5 years of clinical experience. Knowledge scores were also higher for these groups, with a significant difference seen with clinical experience (p=0.048).

Conclusion: Most dentists knew of NMD but needed more knowledge about specific diagnostic tools and treatments. Orthodontists and experienced dentists scored higher awareness and knowledge scores. Most expressed interest in further NMD education. These findings emphasize integrating NMD principles into dental curricula to enhance patient care and promote holistic dental practices.

Keyword: Temporomandibular Disorders, Neuromuscular Dentistry, Knowledge assessment, Awareness, Cranio-maxillofacial complex

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1. Introduction

The future of dentistry may be more than just a perfect smile. The field is undergoing dynamic changes that could pave the way for holistic well-being and overall health.[1] Neuromuscular dentistry (NMD) is an innovative approach focused on understanding how occlusion can have profound implications for the entire body.[2-3] It provides a comprehensive approach that transcends traditional dental paradigms. Neuromuscular Dentistry seeks to achieve a harmonious balance within the oral and facial structures by addressing the relationships among teeth, muscles, and their associated nerves, as well as the temporomandibular joint (TMJ).[3] It places a strong emphasis on achieving a balanced occlusion (physiologic bite), which can help reduce

migraines, neck pain, and temporomandibular disorders (TMD).[4]

TMD is a multifaceted and intricate condition characterized by pain and tenderness in the TMJ, masticatory muscles, and surrounding soft tissues.[5] It is identified as the most prevalent condition, which is musculoskeletal in origin.[6] The diagnosis and treatment of TMD pose significant challenges because of multiple etiological factors associated with the disorder. This is where the significance of Neuromuscular Dentistry comes into play. Advanced diagnostic tools, such as electromyography (EMG) and computerized mandibular scanning (CMS), are employed in neuromuscular dentistry to assess muscle activity and jaw function.[7] These technologies provide valuable insights into

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the patient's unique neuromuscular dynamics, enabling dentists to tailor treatment plans based on individual needs that extend beyond merely addressing symptoms, aiming for long-term solutions.

Deep knowledge and awareness of neuromuscular dentistry open new doors to comprehensive patient care. Understanding neuromuscular dynamics will pave the way for innovative treatment modalities. Unfortunately, as it is a novel field, there is a lack of existing evidence on the knowledge and practice of NMD among Orthodontists and other dental professionals. Thus, A meticulously designed study protocol was implemented to conduct the first-ever assessment of the knowledge, awareness, and practice of NMD among Orthodontists, general dental practitioners (GDPs'), and other dental specialists in India. By doing so, we intend dental professionals to enhance their understanding of neuromuscular dentistry, enabling them to stay abreast of current knowledge and practices. This, in turn, empowers them to provide holistic treatment approaches that target the underlying causes of temporomandibular disorders (TMD).

2. Materials and Methods

A nationwide web-based cross-sectional survey was conducted using a self-modified validated questionnaire, and participants included practicing Orthodontists, General Dental Practitioners (GDPs), and other dental specialists. A Random sampling technique was chosen for sample selection, and the approach to the participants was made through social media groups, email conversations, and text messages mentioning the link. The sample size was calculated based on previous research reports using G Power software (Version 3.1.9.7), and the minimum required sample size was 222. Over three months, 324 responses were gathered from a diverse cross-section of participants representing various demographics and geographical regions across the country via Google Forms. Appropriate permission was obtained from the Scientific Advisory Committee and the Institutional Ethics Committee (Ref: 217/IRB-IBSEC/SIST).

Before initiating the main survey, a pilot survey with a sample size of sixty (n=60) was conducted to assess the face validation, feasibility, and accessibility of the study. The questionnaire was constructed on the basis of previous research findings, and content validation was performed by a panel of experts. The questionnaire comprised 26 self-administered questions categorized into five sections: demographic information (2 questions), awareness (6 questions), knowledge (10 questions), practice (6 questions), and miscellaneous (2 questions).

2.1. Statistics

The data collected were entered in the Microsoft Excel sheet (Version 2021) by the examiner and analyzed using the Statistical Package for Social Sciences (SPSS) version 22 (IBM Corp. in Armonk, New York, USA). The normality of the data was tested using the Shapiro-Wilk test. The mean comparison of awareness and knowledge according to variables was tested using the Mann-Whitney U test and Kruskal-Walli's test followed by post hoc analysis using Dunn's test. The comparison of practices based on variables was done using the Chi-Square test. $P \leq 0.05$ was considered to be statistically significant.

3. Results

A total of 324 participants completed the questionnaire and were included in the final analysis. GDPs made up 52.5 % of the research participants, followed by orthodontists (30.9%) and other dental specialists (16.7%). The majority of dentists have an experience of 0-5 years (86.4%).

On a positive note, more than 2/3rd of the study participants were aware of the term Neuromuscular Dentistry (75.9%), and the source of awareness was academic books (27.2%), conferences/CDE programs (23.5%), web-based (18.5%), and journals (6.8%). Most participants in Neuromuscular dentistry advocate a comprehensive evaluation covering the TMJ (72.9%) and masticatory muscles (85.7%). However, it is imperative to acknowledge that assessing teeth and jaw positioning is equally essential in this field. Surprisingly, a proportion of participants lacked awareness of these aspects (59.4% and 48.9% respectively). The majority of participants reported that occlusal disturbances and lack of maximum intercuspation lead to muscular imbalance (96.9%). However, most of them were not aware of Rocabado mapping (61.6%) and neuromuscular Orthotics (60.9%). Furthermore, a considerable percentage of dentists consider that there is no definitive treatment for TMD (62.3%).

Nearly all dentists knew the consequences of TMD (91.6%) and the impact of occlusion and posture on TMD (93.9%). 1/3rd of the dentists reported that hereditary factors could be an etiological factor (26.5%) apart from psychological, biological, and structural factors. Furthermore, only a few dentists are aware that Electrosonography (ESG) (36.3%), Computerized Mandibular Scanning (CMS) (13.6%), and Joint Vibration Analysis (JVA) (41.6%) can also be used as diagnostic tools in addition to Electromyography (EMG) and Magnetic Resonance Imaging (MRI). Knowledge of intraoral findings related to TMD was not satisfactory, as a considerable percentage of subjects responded that abrasion (21.9%) and erosion (13.6%) can lead to TMD.

On a negative note, only 21.2% of dentists know the conditions that can be diagnosed and treated using NMD. Additionally, a significant majority (97.7%) mistakenly believe that TMD is the only condition addressable with NMD. Also, less than 1/3rd of them had heard about the K7 Jaw tracking device (26.5%), knew that bite registration for fabricating orthotic is done during jaw tracking (15%), and

considered that extraction of third molar aggravates TMD (15.2%). Nonetheless, half of the dentists identified that EMG can be applied to TMD patients before and after the treatment (50.8%).

The overall mean awareness of NMD among participants was significantly associated with the designation (p=0.010) and experience of dentists (p=0.045). The mean awareness score was comparably higher among orthodontists and dentists with more than 5 years of clinical experience (Figure 1). Likewise, the mean knowledge scores were also higher among orthodontists and dentists with >5 years of experience (Figure 2); a significant difference was seen only with clinical experience (p=0.048). (Tables 1 and 3)

Regarding clinical practices, 63.6% of them attended only 1-5 TMD patients in a 3-month duration and 43.2% of their patients reported back with a complaint of TMD after an occlusal restoration or extraction. Significantly, dentists from other specialties and dentists with more than 5 years of experience reported more exposure to patients with TMD, followed by Orthodontists. Only a few of them always examine muscles of mastication and TMJ (36.4%) and evaluate the cervical spine in patients with TMD (15.9%). Furthermore, significantly, the majority of GDPs, other dental specialties, and dentists with experience of <5 years do not evaluate the cervical spine (p=0.047; p=0.016 respectively).

The most common TMD-related symptoms encountered were Facial/TMJ pain (90%), followed by clicking (78.7%), headache (60%), earache (43.1%), neck/shoulder pain (38.2%), and toothache (35.2%). The treatment modalities most commonly used for TMD patients are a combination of one or more, like splint therapy (75%) drug therapy (73.4%), occlusal correction (72.7%), TENS (41.6%), and Trigger point management (40.9%). None of the above comparisons were statistically significant based on the designation. Notably, dentists with more than five years of experience

favour splint therapy, whereas those with less than five years of experience favour medication therapy.

A noteworthy finding is that the majority of dentists showed interest in knowing more about NMD (78.4%) and considered the following sources that can help in gaining knowledge: conferences (78.7%), academics (70.45%), workshops (65.9%), and journals (55.3%).
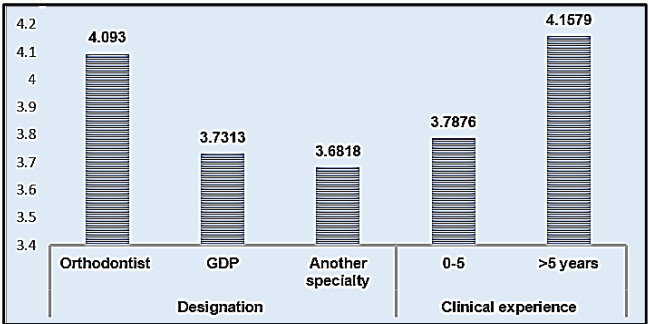
Graph 1: Mean comparison of awareness based on variables
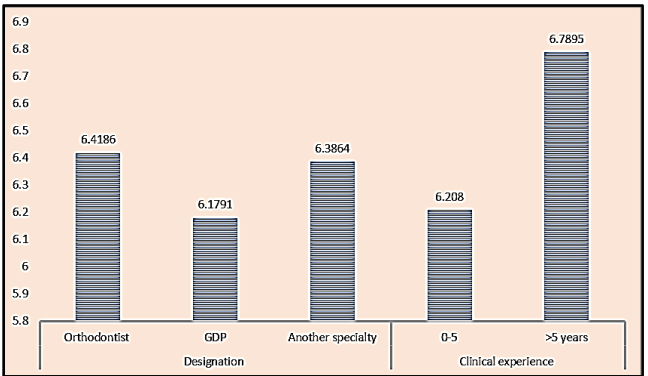
Graph 2: Mean comparison of knowledge based on variables

Table 1: Mean comparison of awareness based on variables

Variables		n	Mean	SD	Test statistic	P value
Designation	Orthodontist	86	4.0930	0.98969	9.198	0.010*
	GDP	134	3.7313	0.92715		
	Another specialty	44	3.6818	1.07342		
Clinical experience	0-5	226	3.7876	0.97481	-2.005	0.045*
	>5 years	38	4.1579	1.00071		
Total sample		264	3.8409	0.98529	-	-

Kruskal Wallis test; Mann Whitney U test; p≤0.05 considered statistically significant

Table 2: Pairwise comparison – post hoc analysis

Variable	Comparison between		P value
Designation	Orthodontist	GDP	0.042*
		Another specialty	0.007*
	GDP	Another specialty	1.000

Dunn's test; p≤0.05 considered statistically significant

Table 3: Mean comparison of knowledge based on variables

Variables		n	Mean	SD	Test statistic	P value
Designation	Orthodontist	86	6.4186	1.40976	1.861	0.394
	GDP	134	6.1791	1.64454		
	Another specialty	44	6.3864	1.41776		
Clinical experience	0-5	226	6.2080	1.51030	-1.980	0.048*
	>5 years	38	6.7895	1.59658		
Total sample		264	6.2917	1.53358	-	-

Kruskal Wallis test; Mann Whitney
U test; p≤0.05 considered statistically significant

4. Discussion

Occlusion is, in fact, the basis of dentistry; nonetheless, it is sometimes believed that occlusal interferences are the only risk factor for the development of temporomandibular disorders (TMDs), although this is untrue. Owing to the TMJ's tight proximity to the cervical and scapular regions, abnormalities or changes in one area may impact the other.[3] The goal of Neuromuscular Dentistry, a subspecialty of dentistry, is to restore harmony to the neuromuscular system by shaping and controlling human anatomy. It helps relieve pain and discomfort and enhances the quality of life of patients by establishing a balanced relationship among the teeth, TMJ, jaw muscles, and all associated tissues.[8]

According to our findings, we observed that most dentists were aware of the term Neuromuscular Dentistry. Academic books and conferences are active sources of information; thus, education through various modes is likely to be effective. However, basic awareness and knowledge of the NMD philosophy, etiologic factors, diagnostic modalities, and treatment methods are lacking. Nonetheless, the level of awareness and knowledge was comparably higher among orthodontists and experienced dentists. Significantly, dentists from other specialties and dentists with more than 5 years of experience reported more exposure to patients with TMD. Most dentists showed an interest in learning more about NMD.

The primary distinction between Traditional Dentistry (TD) and Neuromuscular Dentistry (NMD) is that the former concentrates only on teeth and joints, whereas the latter considers teeth, muscles, nerves, and proper jaw alignment. Most of the present study subjects lack awareness and are comparably lower than the findings of Mehrotra et al.[9] However, the participants in this study were aware that occlusal interferences could alter posture and equilibrium in addition to the onset and severity of muscle imbalances and TMDs. Particularly in individuals who require equilibrium to perform their activities properly, this postural instability might cause harm.[10] Namita et al. also observed that 98% of the study subjects agreed that occlusal disturbances cause TMDs and other complications.[11]

Dr. Mariano Racabados's "pain map" divides the TMJ topographically into eight regions, making it possible to identify joint diseases early. This advantage therapeutically directs the dental professional to identify pain at particular, anatomically defined joint sites and to track the treatment's progress at each session.[12] By using the muscles' functional movement and measurement to realign the jaw to its proper position, the neuromuscular orthotic appliance helps reduce pain. On a negative note, almost 2/3rd of the dentists was not aware of these diagnoses and management techniques of TMD, which might be due to a lack of clinical practice, training, and continuing education courses emphasizing the need to develop and strengthen the curriculum regarding the issue.

TMD is known as the "great impostor" because of its wide range of effects, such as pain in the periauricular area, the temporomandibular joint (TMJ), or the muscles of mastication; clicking sounds during mandibular function; and restrictions in mandibular range of motion.[13] In the present study, on evaluation of the knowledge on consequences of TMDs, 91.6% had knowledge, which could be attributed to the fact of exposure to basics on TMDs during their academics. In addition, most research globally[14-18] found that dentists knew enough about the fundamental symptoms and indicators of TMD, but they knew very little about the diagnosis and treatment options. These findings are consistent with the current study's observations.

The interaction of psychological, physiological, structural, postural, and genetic factors indicates that the etiology of TMD is complex and multifaceted.[19] In addition, during the past few years, there has been a discernible build-up of evidence supporting a biopsychosociological approach to TMD treatment rather than the use of mechanical therapies. Recent work has shown that hereditary factors interact with environmental exposures, thereby determining the course and outcome of TMDs.20[20] Such a new understanding of genetics in the pathophysiology of TMD was lacking among the present study dentists and in a study by Elyas et al.[21] Furthermore, the literature on understanding the etiology of TMDs did not incorporate the role of hereditary, which might play an effective role in the management.

The knowledge on the role of EMG as a diagnostic tool in NMD was comparably higher in the present study dentists, in comparison to the Maharashtra dentists.[9] However, the method of its application was comparably lacking in our study. Furthermore, most dentists did not know the various

diagnostic tools such as ESG, CMS, JVA, and K7 jaw tracking in the diagnosis of TMDs. Baharvand et al,[5] Patil et al,[22] and DeBoever et al[23] reported lower knowledge and practices toward various diagnostic methods, stating time constraints and exposure to similar cases resulting in hasty diagnosis and management based on the first sign and symptom. Sajjanar et al. further noted that while 81% of them treat patients with TMD, only 11.5 % employ diagnostic imaging techniques in addition to a history and physical examination for assessment.[24]

In this study, almost 2/3rd of dentists have clinical routine TMD patients and treated them at the clinics, but the correct method of examining the patients is deficient. The present study's findings are in line with the previous studies conducted by Sajjanar et al,[24] Kakudate et al,25[25] and Elyas et al.[21] However, a lower clinical exposure to patients with TMD was reported by Chandran et al.[18] The most frequently reported TMD symptoms were pain, clicking, headache, and earache, as reported by Osiewicz et al.[14] Clicking during mouth opening and closing, followed by limitation of mouth opening, and pain in the area in front of the ears were mostly reported by patients in studies by Park HS[26] and Kim KH et al.[27] The differences in the findings may be due to differences in sample characteristics and the rate of exposure to patients with TMD.

The treatment modalities practiced by dentists are diverse; it was noted that occlusal interference correction was primarily practiced, followed by drug therapy, TENS, and trigger point management. Similar treatment modalities were practiced by Karnataka dental students.[28] The common treatment modalities offered by GDPs in the study by Sajjanar et al. were occlusal splinting and patient counseling.[24] A systematic review and meta-analysis by List and Axelson observed that the above measures were effective in alleviating TMD-related symptoms. However, the effect of occlusal adjustments appears to have no effect.[29] Furthermore, none of the occlusal adjustment studies provided evidence supporting the use of this therapeutic approach.[30]

5. Limitations

Despite our best efforts, the study results were restricted to certain areas because of the limitations of our study. First, our data is subjected to individual bias due to the subjective nature of responses, as participants might overestimate their knowledge of NMD or interpret and understand the questions differently. Second, because of the cross-sectional nature of our study, we could not assess the impact or change in knowledge over time. Third, the limited sample size could have affected the study's statistical power, reducing the ability to detect subtle differences and trends. Future research with a more extensive cohort is essential to validate these results and provide a more comprehensive understanding of the awareness and knowledge of neuromuscular dentistry among dental professionals.

6. Conclusion

It was observed that the awareness and knowledge of NMD are quite low, especially among GDP and other specialty practitioners and dentists with less experience. The findings of this study underscore an imperative necessity for enhanced NMD education and training, especially for dentists who frequently encounter patients with TMD. It is essential to strengthen the NMD curriculum to offer continuing education to enhance treatment outcomes. Furthermore, comprehensive TMD patient care would require interdisciplinary collaboration within dentistry specialties and other healthcare fields. Efforts toward increasing awareness and knowledge about NMD and various technologies will help dentists improve patient well-being through holistic treatment approaches that target the underlying causes of temporomandibular disorders (TMD).

7. Source of Funding

None.

8. Conflict of Interest

None.

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