

## Examination of a Large Patient Population for the Presence of Symptoms and Signs of Temporomandibular Disorders

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**ABSTRACT:** Temporomandibular Disorder (TMD) is a term generally applied to a condition or conditions characterized by pain and/or dysfunction of the masticatory apparatus. Its characterization has been difficult because of the large number of symptoms and signs attributed to this disorder and to variation in the number and types manifested in any particular patient. For this study, data on 4,528 patients, presenting over a period of 25 years to a single examiner for TMD treatment, was made available for retrospective analysis and determination of whether the TMD care-seeking patient can be profiled, particularly pain difficulties. All patients in this database filled out a questionnaire and were examined for the prevalence of a range of symptoms and clinical examination findings (signs) commonly attributed to TMD. There was no attempt in this study to assign patients to TMD diagnostic subcategories. The data collected were analyzed to determine which of these symptoms and signs were sufficiently "characteristic of the TMD condition" that they might be used in diagnosis, research and treatment, especially in patients needing relief from pain and discomfort. All 4,528 patients reported symptoms and all but 190 of them also showed signs upon examination. Symptoms most commonly reported on the questionnaire included (i) pain (96.1%), (ii) headache (79.3%), (iii) temporomandibular joint discomfort or dysfunction (75.0%) and (iv) ear discomfort or dysfunction (82.4%). In the 4,338 patients who showed signs, the most prevalent was tenderness to palpation of the pterygoid muscles (85.1%), followed by tenderness to palpation of the temporomandibular joints (62.4%). Pain symptoms and signs were often accompanied by compromised mandibular movements, TMJ sounds and dental changes, such as incisal edge wear and excessive overbite. Clearly prevalence of pain disclosed by the symptoms and signs examinations was high. Patients showed variable prevalence and nonprevalence of eight categories of painful symptoms and seven categories of painful signs. Despite the variability, these might be developed in the future into TMD scores or indices for studying and unraveling the TMD conundrum.

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**T**emporomandibular disorders (TMD) have been reported in over ten million men, women and children in the United States.<sup>1</sup> According to the Nuprin Report (Bristol-Myers Co.),<sup>2</sup> in which 1,254 persons were questioned, 27% reported having experienced dental pain, and 73% reported headaches during the previous 12 months. Twelve percent of patients who reported headache sought care from a dentist for the pain.

TMD is a problem with which it is hard to come to grips. It is a term that is used to describe a cluster of conditions that involve alteration of the structure and/or function of the masticatory system.<sup>3-21</sup> The main anatomical components of this system include the temporomandibular joints, the masticatory neuromuscular system and the occluding teeth. Patients believed to have TMD generally present to the practitioner with pain and con-

founding disorders of the contiguous and noncontiguous structures of the head and neck, upper quadrant, central nervous system, and/or systemic musculo-skeletal disease. This results in lack of clarity and a diffuse definition of what comprises TMD. In turn, this has made difficult the diagnosis and treatment of this condition along with progress of research and patient care in this area.

The purpose of this study was to perform a retrospective analysis of data on a large population of patients who presented themselves to a single dentist for TMD evaluation in an attempt to identify a manageable group of primary symptoms and signs (the latter obtained by clinical examination) that essentially define the TMD condition and especially the pain associated therewith.

## Materials and Methods

Over a twenty-five year period, 4,528 men, women and children between 11 and 70 years of age, were interviewed and examined by a single dentist. Most patients (3,393) were seen in a private dental practice setting and the rest (1,135) at a facial pain/temporomandibular joint clinic in a metropolitan hospital.

Symptoms were determined from a questionnaire provided to each patient to fill out as part of the normal procedure of evaluating patients related to temporomandibular disorders. Because the majority of the patients in the hospital clinic were Hispanic, a Spanish/English version of the questionnaire was prepared and used. This was followed by a clinical examination performed by the one dentist. It consisted of extraoral and intraoral muscle palpation, temporomandibular joint (TMJ) palpation, stethoscopic auscultation of the TMJ for joint sounds, determination of the range of mandibular motion, and visual examination of the dentition for abnormalities. To ensure anonymity, each patient was assigned a code number. The history/symptom and clinical examination data were then entered into a database program (FoxPro, Microsoft, Redmond, WA) written for data acquisition and analysis.

## Results

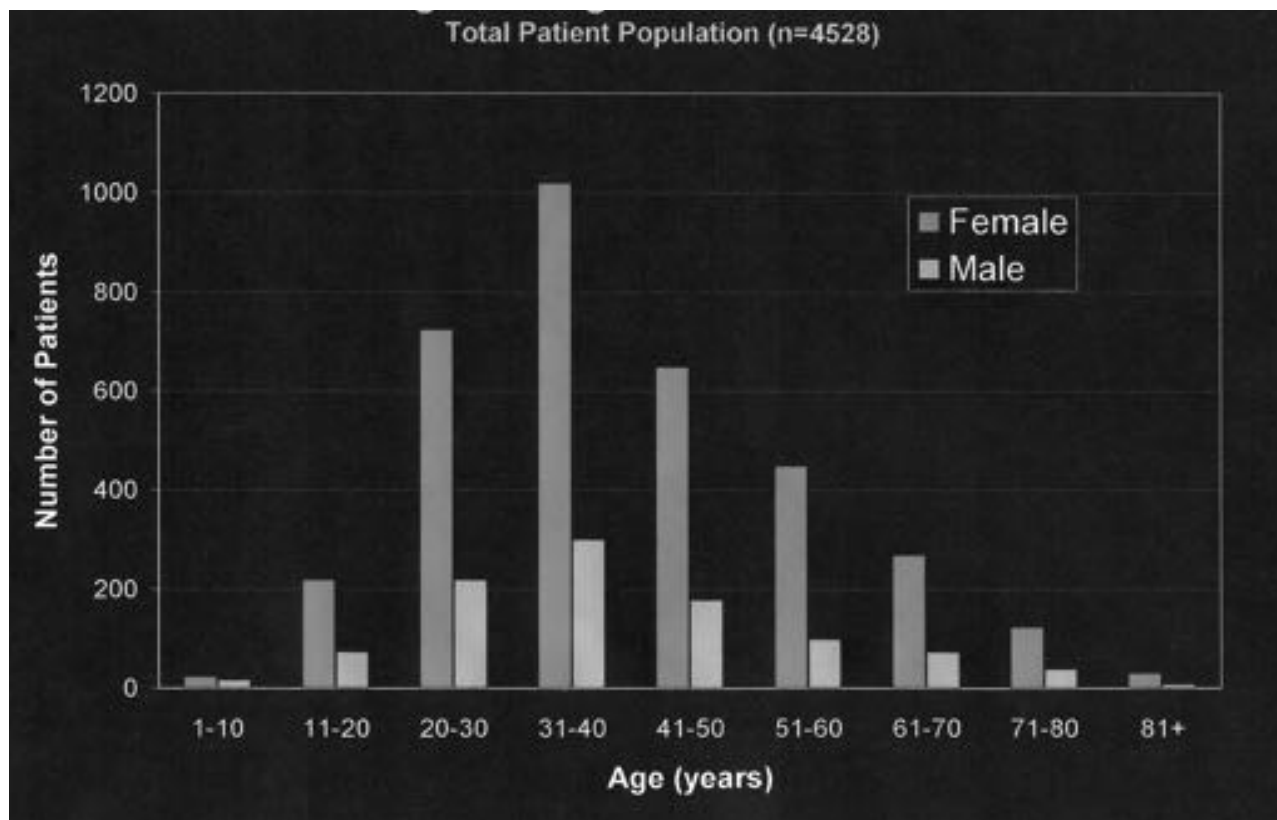
**Age/gender distribution:** The age and gender of the 4,528 subjects studied are shown in **Figure 1**. Prevalence was highest among the 21-50 year olds. Analysis for gender distribution showed that 1,020 of the subjects were males (22.5%) with a mean age of 40 years, and 3,508 were females (77.5%) with a mean age of 41 years. This agrees with reports in the literature<sup>22-25</sup> suggesting that TMD may be more prevalent in females than in males.

**Symptom prevalence:** The symptom prevalence data determined from the questionnaires filled out by all patients are listed in **Table 1**. All 4,528 patients reported symptoms. Of these, only 177 (3.9%) reported no pain symptoms. This is consistent with pain being the symptom most commonly reported as the main reason for patients seeking TMD treatment.<sup>26-37</sup> Pain symptoms in the 4,351 subjects involved consisted of headaches and pain associated with the TMJ, ears, neck, face, back, eyes, and teeth. Prevalence's are shown in **Figure 2a**.

1. **Headaches:** The symptom of headaches was cited by 79.3% of the patients examined. Subcategories included frontal, temple and occipital headache sites. Headaches which patients described as "migraine" or "sinus-type" headaches were less frequent.<sup>38-40</sup>
2. **Otological symptoms:** These symptoms were reported by 82.4% of the entire group of subjects. Included was otalgia (pain in the ear without ear infection), dizziness, muffled ears, tinnitus, decreased hearing and hyperacuity (hypersensitivity to sound).<sup>41-46</sup>
3. **TMJ symptoms:** Of the entire group of subjects, 75.0% experienced joint sounds (clicking or cracking), pain in the TMJ, or limited ability to open one's mouth.
4. **Throat symptoms:** These were experienced by 42.4% of the entire group of subjects. Included were subjects with sore throat without infection and/or who had difficulty in swallowing, or had a feeling of an object in their throats or difficulty engaging in prolonged speech.
5. **Remaining symptoms:** These included facial, cervical or back pain, or pain in or behind the eyes. A sizable number reported that they could not find a *comfortable bite* position for their teeth.<sup>47,48</sup>

**Symptoms per subject prevalence:** The data were also analyzed to determine how many subjects had between the zero and eight pain symptoms considered here to be primary. The distribution is shown in **Figure 2b** where 177 reported none, all the way to 174 showing eight. Between two and five pain symptoms were reported by the largest number of patients. Mean number was 3.5. In **Figure 3**, a comparison is made in the form of pie charts between the prevalence distribution of the various pain symptoms in patients who only reported one symptom and in all patients for the total of all symptoms. The proportion in patients with single symptoms was found to be the same as for all patients.

**Sign prevalence:** Data obtained for prevalence of signs determined by clinical examination are summarized in **Table 2** and shown in **Figure 4a**. Of the total number of subjects involved in this aspect of the study, 4,338 showed one or more clinical signs when examined.



**Figure 1**  
Age and gender distribution of the patient population studied.

Palpated sites that showed pain included the pterygoid and temporalis muscles, as well as TMJ, ear, angle of the mandible, posterior cervical and sternocleidomastoid sites. Some subjects (476) showed no pain sites upon examination.

1. *Extra-oral muscle examination:* This disclosed that 50.0% of the entire group of subjects experienced discomfort on palpation by the examiner of their temporalis muscles. Specifically, the anterior part of the temporalis was more tender than the middle portion and both were more tender than the posterior portion. Posterior cervical muscles were tender to palpation in 32.4% and the sternocleidomastoid (SCM) muscles in 28.0%. The angles of the mandible, through which the internal (medial) pterygoid and posterior digastric muscles and stylomandibular ligaments traverse, were tender to palpation in 49.1% of the subjects and the trapezius muscles in 19.7%. Suprahyoid and infrahyoid muscles in the anterior neck showed only minimal tenderness.
2. *Intra-oral muscle examinations:* When palpation was performed, pterygoid muscle tenderness was

reported by 85.1% of the entire group of subjects examined. Specifically, external (lateral) pterygoid muscles were tender to palpation in 83.3% of the patients; internal (medial) pterygoid muscles were tender in 62.8%.<sup>49</sup> In contrast, masseter muscle tenderness to palpation was minimal.<sup>50</sup>

3. *Temporomandibular joint examination:* This disclosed that 62.4% of the entire subject population reported tenderness or pain upon palpation of the joints with the mouth closed and upon either opening or closing of the mouth. TMJ sounds (clicking or crepitus) were observed on stethoscopic auscultation of the joints in 1/3 of the subjects.<sup>51-58</sup>
4. *Ear pain:* Upon palpation of the anterior wall of the external auditory meatus, ear pain with opening or closing was reported in about one half of the patients. Mandibular condylar heads were palpable by finger pressure against the same anterior wall of the outer ear; these were painful in more than one half of the patients.
5. *Assessment of mandibular movements:* This disclosed limited opening capability (interincisal mea-

**Table 1**  
Prevalence of Different Subjective Symptoms in the 4,528 Patients Studied

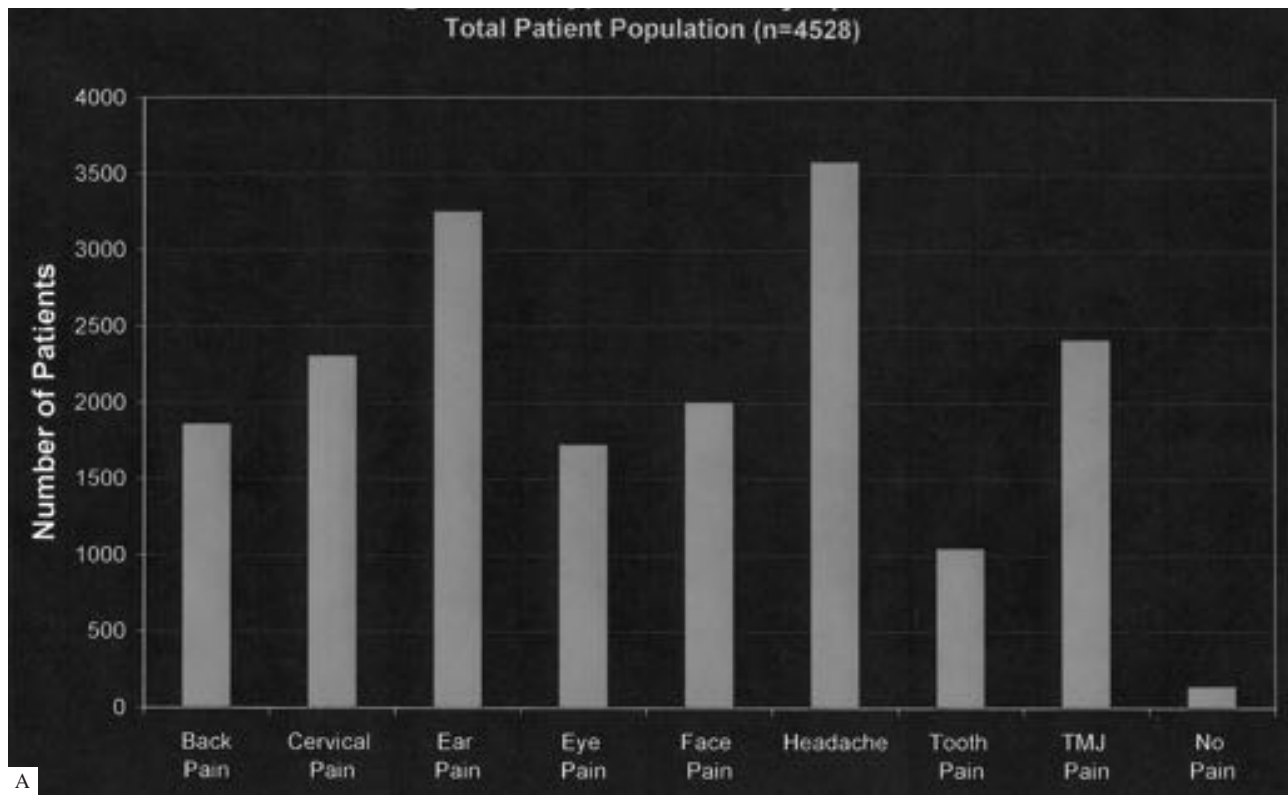
Symptoms	Number of patients with		Percent of patients with	
	each symptom	any symptoms	each symptom	any symptoms
<b>Headaches</b>				
Forehead	1785		39.4	
Temples	2204		48.7	
Occipital	1950		43.1	
Migraine type	1147		25.3	
Sinus type	1496		33.0	
<b>Total</b>	<b>8582</b>	<b>3589</b>		<b>79.3</b>
Mean symptoms/patient	(2.48)			
<b>TMJ</b>				
Limited opening	1267		28.0	
Joint sounds	2291		50.6	
Joint pain	2422		53.5	
<b>Total</b>	<b>5980</b>	<b>3395</b>		<b>75.0</b>
Mean symptoms/patient	(1.77)			
<b>Ear</b>				
Tinnitus	1670		36.9	
Otalgia w/o infection	2355		52.2	
Dizziness	1681		37.1	
Muffled ears	1621		35.8	
Ear pain on airplanes	905		20.0	
Hyperacuity to sound	1060		23.4	
<b>Total</b>	<b>9292</b>	<b>3730</b>		<b>82.4</b>
Mean symptoms/patient	(2.49)			
<b>Other symptoms</b>				
Throat	1920		42.4	
Facial pain	2010		44.6	
Cervical pain	2316		51.3	
Back pain	1867		41.5	
Teeth pain	1052		23.3	
Cannot find comfortable bite	1327		29.3	
Pain behind the eyes	1732		38.5	
<b>Total</b>	<b>12224</b>	<b>3881</b>		<b>85.7</b>
Mean symptoms/patient	(3.16)			

surement less than 35 mm) in only 19.1% of the subjects in the entire group. Lateral deviations on opening or closing movements were observed in about one-third of the subjects. Dyskinesia (irregular movements) or bradykinesia (slow movements) was observed in a similar percentage.<sup>59,60</sup>

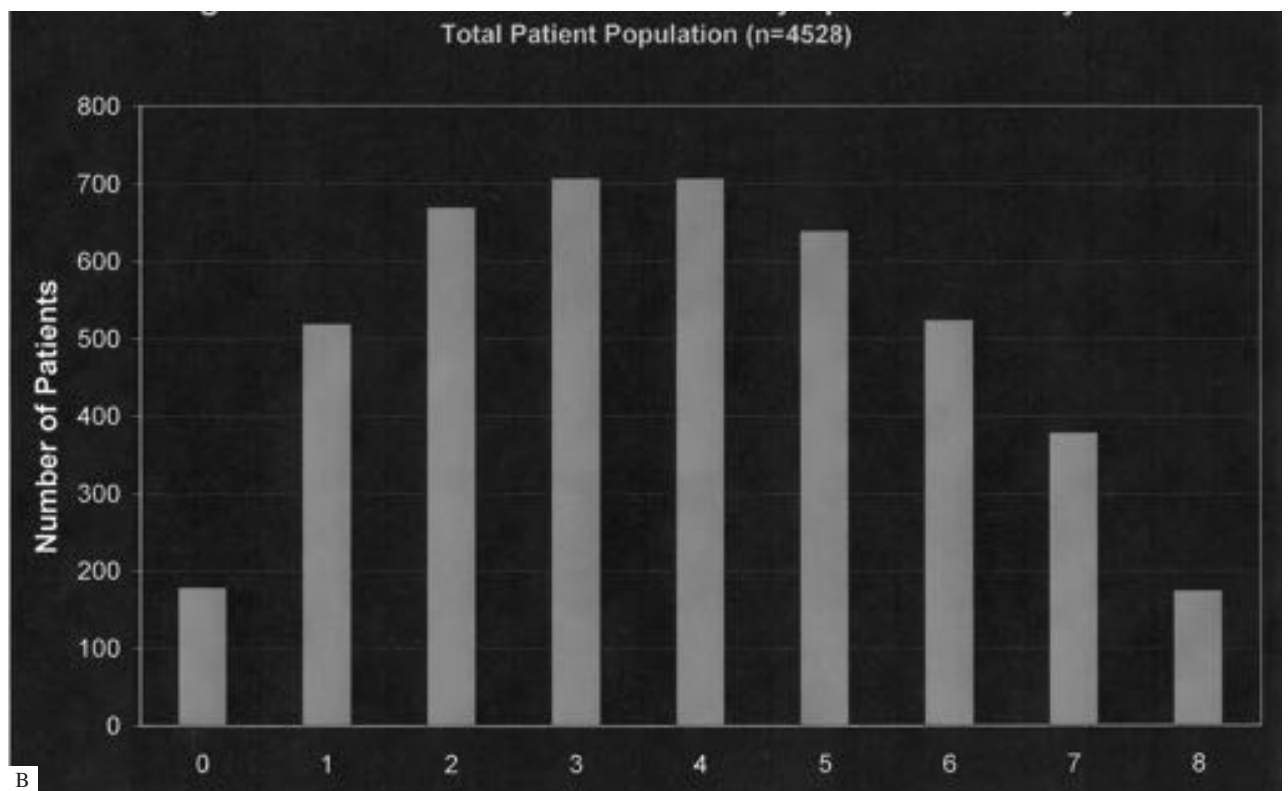
6. *Dental examination:* Worn incisal edges of the anterior teeth were observed in 37.1% of the entire group. Missing posterior occlusion, midline discrepancies, bilevel occlusal planes (anterior teeth higher than posteriors) were seen in less than 10% and severe overjet (horizontal >2 mm) was minimal, whereas,

deep overbite (vertical >2 mm) was seen in about 20% of the subjects. Either worn incisal edges or deep overbite was observed in 46.1% of subjects examined.<sup>61</sup> Overall, 57.6 % of subjects in the entire group showed one or more of the above dental findings.

**Signs per subject prevalence:** When the data were analyzed to determine how many subjects had 0 to 7 sites of pain on palpation, multiple occurrences were common and rather uniform (**Figure 4b**). The largest number of patients had one to five pain sites on palpation with two sites being the most prevalent. Mean number was 3.0.



**Figure 2**  
Distribution of various types of pain symptoms (A above) and pain symptoms per subject in the patient population studied B (below).



**Comparison of pain symptom distributions in single and in all multi-pain symptom patients:** In **Figure 3**, a comparison is made in the form of pie charts, of the prevalence of pain symptoms in single pain symptom patients to the prevalence of the same pain symptoms in the whole patient population. The number of subjects represented by the percentages that appear in the pie charts are provided in **Table 3**. The patterns were very similar. It would be valuable to conduct research to determine whether there is a chronological progression in the number of pain symptoms that are experienced by patients with a change from a simpler to a more complex illness.

**Comparison of pain sign distributions in single and in all multi-sign site patients:** In **Figure 5**, a comparison is made in the form of pie charts of the prevalence of pain signs in single pain on palpation site patients to the prevalence of the same pain signs in the whole patient population. The numbers of subjects represented by the percentages that appear in the pie charts are provided in **Table 4**. This shows a different comparative pattern than that for pain symptoms. Pterygoid pain dominates in the single site group of patients, but pain sign sites were more evenly distributed than in the multi-site patients.

## Discussion

The symptoms most frequently seen in the 4,528 patients seeking treatment for TMD were headaches (79.3%), problems involving the temporomandibular joints (75.0%), and ears (82.4%). Patients with pain symptoms usually had more than one type of pain symptom (see **Figures 2b** and **3**). They commonly had groups or clusters of painful symptoms with the symptoms mainly involving headache, TMJ pain and ear pain (**Figure 2a**).<sup>62-65</sup>

The most common pain sign on palpation included tenderness of the pterygoid muscles (85.1%). This could be a useful marker for examining and carrying out studies and therapies in this area. Less common palpation pain sites are the temporomandibular joints (62.4%), temporalis muscles (50.0%), angle of the mandible (49.1%), ear (49.8%) and palpable condylar heads upon ear examination (53.4%). Less frequently found, though still significant, were lateral deviations of the jaw on opening and closing (36.2%), slow or staggered movements of the jaw (39.1%), posterior cervical (32.4%), and sternocleidomastoid muscle tenderness (28.0%).

One or more of a group of specifically listed dental findings were found in 57.6% of the patients (**Table 2** and **Figures 4a** and **5**). Individual dental findings were not high in prevalence except for worn incisal edges (37.1%) and a deep overbite (19.3%). However, worn incisal

edges or deep overbite was present in 46.1% of the patients in this study.

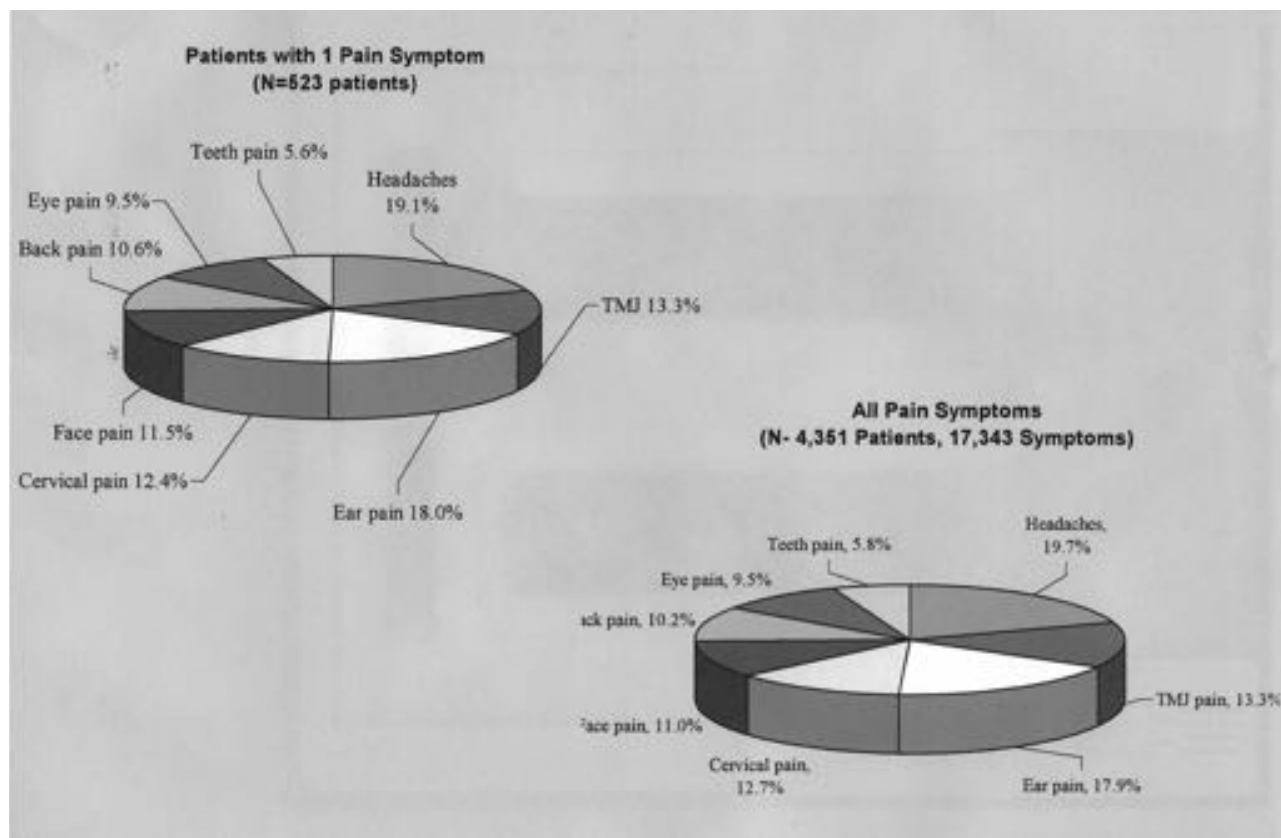
Sites of pain elicited on palpation were further analyzed to determine whether patients had more than one palpation pain site and whether specific clusters or groups of painful sites were so commonly found that their presence could serve as a diagnostic aid. The data showed that there are five commonly occurring groups (clusters) of palpation pain sites in the subjects with 1, 2, 3, 4, and 5 pain sites. The five palpation induced pain sites that occur in almost all of these subject groups include: pterygoid muscles, TMJ, ear, angle of the mandible and temporalis muscles. Cervical pain appears in a number of clusters. Overwhelmingly, pterygoid muscle pain is the most frequently found clinical sign. Together with any of the other frequently found TMD sites (i.e., ear, angle of the mandible and temporalis muscles), a clinical diagnosis of TMD can be made in most but not all cases (**Figures 4a** and **5**).

All symptoms commonly reported by patients with TMD may not result from a TMD problem. Some may be due to other disease/dysfunctional conditions. Symptoms like limited opening of the mouth, pain in the TMJ with or without function and joint sounds are apparently specific to TMD. Others such as headache, otalgia, and dizziness can be indicative of TMD or diseases other than TMD. Clinical examination findings, even though frequently observed, are not all necessarily found in each patient with TMD. Nonetheless, pterygoid pain is ubiquitous and may be a primary indicator.<sup>66-73</sup>

The demonstration that while the elements of TMD seem diffuse, they can at the time of examination manifest TMD dysfunction with single or within groups or clusters of symptom/sign indicators has been valuable. This may indicate in the former case that the indicator is a primary one. The latter may indicate either a primary that has led to other changes, and as the primary has become more intense, slower developing elements reach clinical visibility. That being the case, one cannot help but feel that the variables associated with the masticatory apparatus and related neuromusculature would cause symptoms and signs that would produce at our present level of understanding, the appearance of being complex and highly diffuse.

Several things going wrong at the same time is suggested from the symptom data. On the other hand, the signs data suggest that pterygoid muscles may be affected ahead of other changes. An age study of signs and symptoms might answer these questions. If so, then an entry into this puzzle might become possible.

Subjective symptoms and clinical examination findings have provided the basis of this study, and various



**Figure 3**  
Pie charts comparing proportion of pain symptoms in patients with only a single pain symptom to all the patients with the total of all of their pain symptoms.

types of radiographic imaging of the TMJ are described in the literature.<sup>74-77</sup> Another important aspect and the subject of a second report is the treatment of approximately 1,500 of the patients in this study who demonstrated physiological improvement and significant relief of many of the types of symptoms described here after therapy. The treatment involved creation of a therapeutic neuromuscular occlusion through the fabrication and use of mandibular removable oral orthotic appliances. The neuromuscular occlusal position was determined objectively with electronic measurement devices consisting of surface electromyography (EMG) for evaluation of masticatory muscle function, computerized mandibular scanning/tracking (CMS) of mandibular movements and electrosonography (ESG) of temporomandibular joint sounds.<sup>78-81</sup>

The application of these dynamic measurements both in the analysis of patients with TMD and in the treatment of those patients with comparable pre- and posttreatment physiological data have been published.<sup>82,83</sup> The positive outcome of therapy supported our conclusion in this

study that symptoms and signs in patients seeking TMD care were physically based and not substantially a psychological manifestation as some authors have proposed. An evaluation of the psychological status of the subjects in this study was not performed. The clinical findings of an experienced examiner confirmed a physical basis of many of the subjective symptoms reported by the patients.

Assessment of symptoms and signs in relation to age and chronology as suggested above might indicate which tend to appear earlier and which tend to appear later. It is possible that this could eventually lead to an understanding of how TMD develops and in turn to finding early diagnostic markers and treatment targets. For example, if over-closure is common, then prevention of over-closure or finding its causes might enable a preventive benefit to be added to a curative approach.

## Conclusion

The majority of patients seeking professional treatment for TMD present themselves with symptoms related

**Table 2**  
Prevalence of Different Pain Palpation Sites (Signs) in the 4528 Patients Studied

Signs	Number of patients with each sign	any signs	Percent of patients with each sign	any signs
<b>Extraoral Muscles</b>				
• Temporalis	2169		47.9	
• Posterior cervical	1406		31.1	
• Sternocleidomastoid	1216		26.9	
• Angle of mandible	2128		47.0	
• Trapezius	856		18.9	
• Digastric	183		4.0	
• Superhyoid	159		3.5	
• Infrahyoid	94		2.1	
<b>Total</b>	<b>8211</b>	<b>4344</b>		<b>95.9</b>
Mean signs/patient	(1.89)			
<b>Intraoral muscles</b>				
• External pterygoids	3612*		79.8	
• Internal pterygoids	2723*		60.1	
• Mylohyoids	131		2.9	
• Masseters	433		9.6	
<b>Total</b>	<b>6899</b>	<b>4337</b>		<b>95.8</b>
Mean signs/patient	(1.67)			
<b>TMJ Joints</b>				
• TMJ palpation pain	2705		59.7	
• TMJ sounds	1433		31.6	
<b>Total</b>	<b>4138</b>	<b>4138</b>		<b>91.4</b>
Mean signs/patient	(1.00)			
<b>Ear examination</b>				
• Ear pain on palpation	2159		47.7	
• Palpable condylar heads on closure	2315		51.1	
<b>Total</b>	<b>4474</b>	<b>4342</b>		<b>95.9</b>
Mean signs/patients	(1.03)			
<b>Mandibular movement</b>				
• Lateral deviations on opening and closing	1571		34.7	
• Dyskinesia	1628		36.0	
• Bradykinesia	310		6.8	
• Limited opening	829		18.3	
<b>Total</b>	<b>4338</b>	<b>4342</b>		<b>95.9</b>
Mean signs per/patient	(1.00)			
<b>Dentition</b>				
• Crowded lower anteriors	481		10.6	
• Missing posterior occlusion	349		7.7	
• Open bite	128		2.8	
• Bi-level occlusion	222		4.9	
• Midline discrepancy	400		8.8	
• Deep overbite	875		19.3	
• Worn incisal edges	1678		37.0	
• Severe overjet	359		7.9	
<b>Total</b>	<b>4492</b>	<b>2481</b>		<b>54.8</b>
Mean signs per/patient	(1.81)			

• Pain palation sites

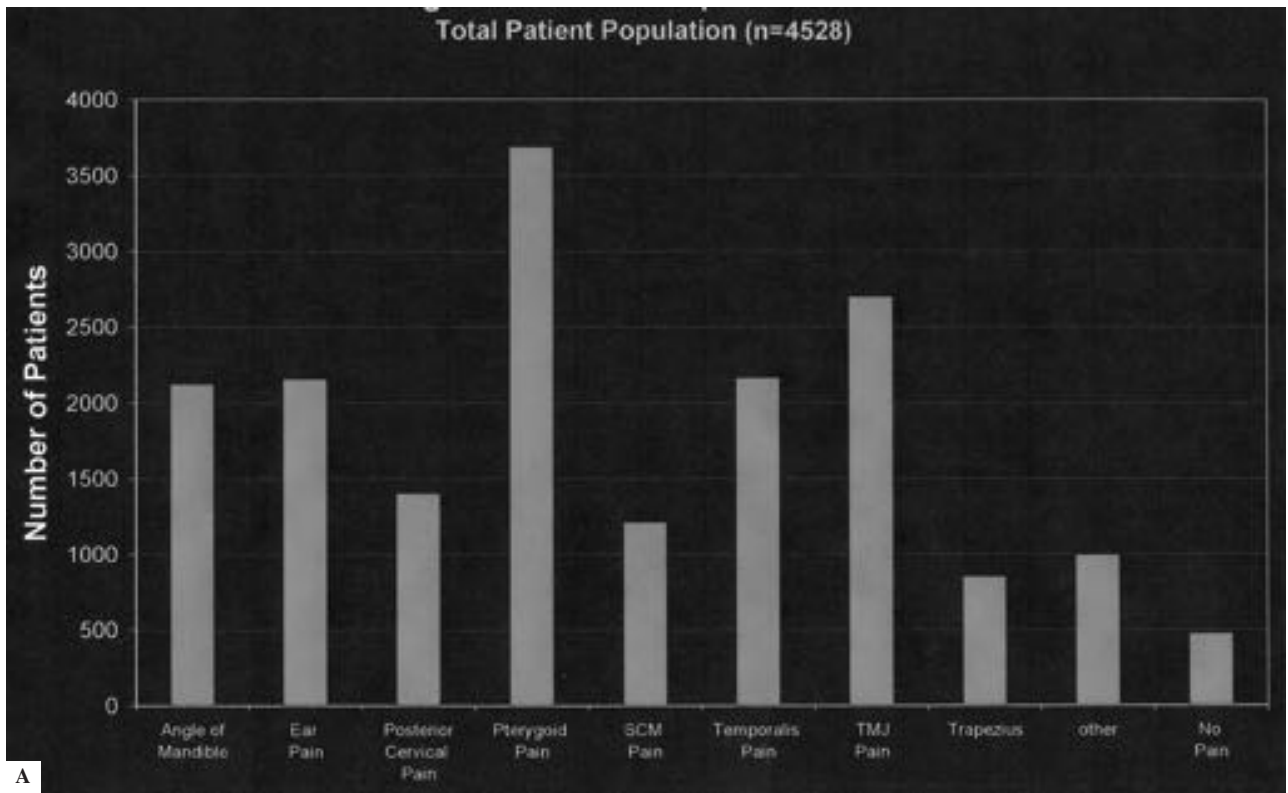
In Figure 4A, external and internal pterygoids above\* are combined in a category of any (i.e., one or more) pterygoid signs (3691 patients).

Note: *Any pterygoids* has been deleted from intraoral muscle section

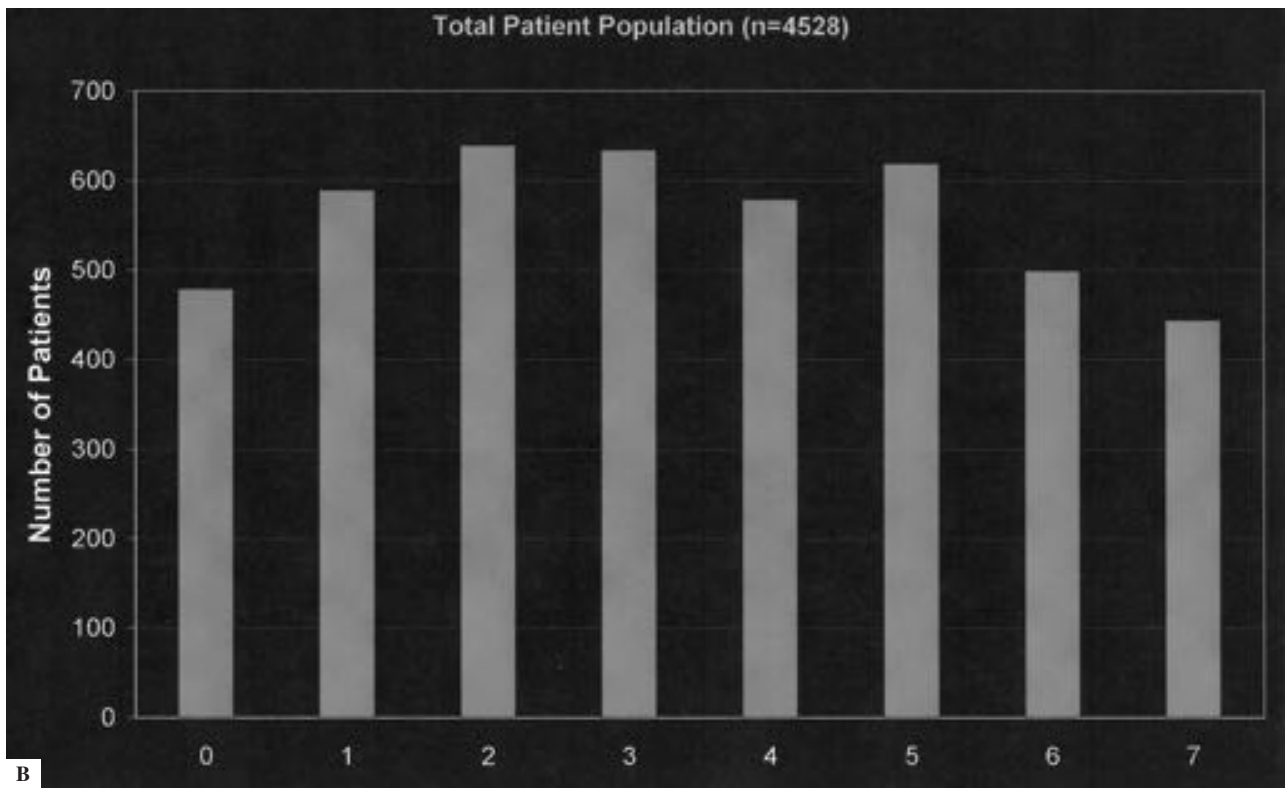
Note: *Dyskinesia or Bradykinesia* has been deleted from mandibular movement section

Note: *Worn incisal or Deep overbite* has been deleted from dentition section





**Figure 4**  
Distribution of various types of pain signs (A above) and pain signs per subject in the patient population studied (B below).

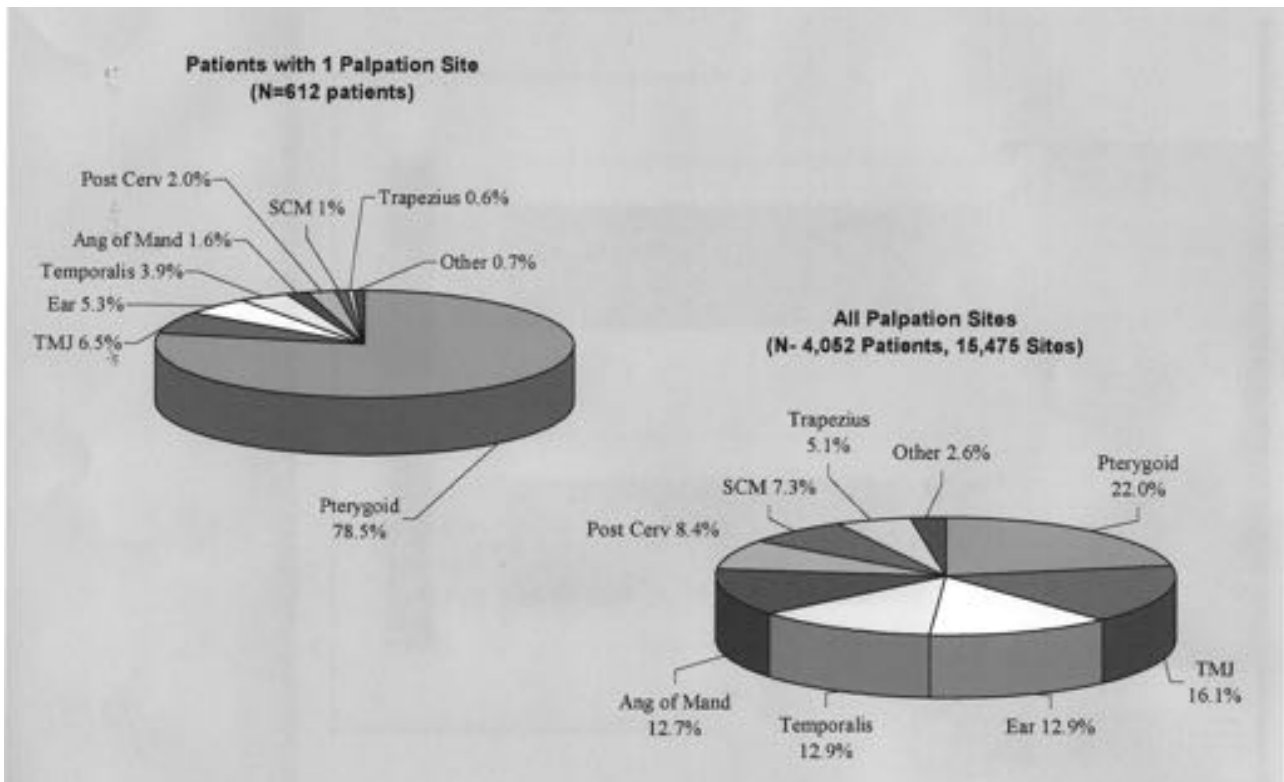


**Table 3**  
Distribution of Pain Symptoms

	Patients with 1 pain symptom (n=523 patients)		All pain symptoms in total study population with pain (n=4,351 patients, n=17,343 symptoms)	
	Number	Percentage	Number	Percentage
Headaches	105	20%	3589	20%
TMJ pain	73	14%	2422	14%
Ear pain	73	14%	2355	14%
Cervical pain	68	13%	2316	13%
Face pain	63	12%	2010	12%
Back pain	58	11%	1867	11%
Eye pain	52	10%	1732	10%
Teeth pain	31	6%	1052	6%

to pain. Nonpain symptoms exist but they appear to be far less prevalent as an incentive for such care seeking action. Some symptoms and signs reported by TMD patients are diagnostically specific while others are not. Most clinical findings characterize a painful and/or dys-

functional state involving mandibular and/or masticatory muscle function. Although all patients presenting for evaluation do not have the same signs and symptoms or the same magnitude (intensity) of each, this study of a large patient population confirms that the most com-



**Figure 5**  
Pie charts comparing proportion of pain palpation sites (signs) in patients with only a single pain sign to all the patients with the total of all of their pain signs.

**Table 4**  
Distribution of Pain on Palpation Sites

	Patients with 1 palpation pain site (n=612 patients)		All palpation pain sites in total subject population (n=4,052 patients, n=15,475 pain sites)	
	Number	Percentage	Number	Percentage
Pterygoid	485	84%	3691	24%
TMJ	40	7%	2705	17%
Ear	33	5%	2159	14%
Temporalis	24	4%	2169	14%
Angle mandible	10	2%	2128	14%
Posterior cervical	14	2%	1406	9%
Sternocleidomastoid	6	1%	1216	8%

monly occurring clinical signs and subjective symptoms of patients seeking treatment for TMD are legitimate with a physical basis.

This study supports the perception of the authors that patients with TMD generally present with a group of symptoms that are characteristic to each patient but can change in the same person over time as changes in the masticatory apparatus occur. Evident is that there are a number of symptoms and clinical signs that occur with sufficient frequency, albeit in variable clusters, that their occurrence should alert the examining dentist or physician of the strong possibility that the presenting patient may have a TMD condition.

Physicians and dentists cognizant of the characteristic constellation of signs and symptoms of TMD can either institute treatment or refer to appropriately trained dental practitioners for timely and effective management.

### Acknowledgement

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