ORIGINAL ARTICLE

A survey on German dentists regarding the management of craniomandibular disorders

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Abstract The purpose of the present investigation was to identify the most frequent therapies and, in particular, the prescription patterns for occlusal splints for the management of craniomandibular disorders (CMDs) used by German general dentists and specialists. Additionally, the knowledge and opinion of the practising dentists were examined. All active members of the statutory dental insurance providers of the German North Rhine (n=5,500)and the Westphalia-Lippe area (n=4,984) were surveyed with a questionnaire by mail. Results indicated that occlusal splints were the first-choice therapy followed by physiotherapy and occlusal equilibration. In the preceding year, both general dentists and specialists made 30 occlusal splints on average. With regard to high-quality evidencebased recommendations, some statistically significant discrepancies between general dentists and specialists were detected. On the basis of the present data, it seems useful to consider intensifying the topic of CMDs and orofacial pain in future undergraduate dental curricula and in postgraduate training.

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Department of Operative Dentistry and Periodontology, Faculty of Medicine, University of Rostock, Rostock, Germany Keywords Craniomandibular disorders · Survey · Dental general practises · Management · Occlusal splints · Dentists knowledge

Introduction

In Germany, as in most Western countries, the topic of craniomandibular disorders (CMDs) is part of dentists' undergraduate curricula at dental schools. As defined by the American Academy of Orofacial Pain, the terms CMDs and temporomandibular disorders (TMDs) are used synonymously and comprise a number of clinical problems involving the masticatory musculature, the temporomandibular joints and associated structures, or both [2]. In the past two decades research has generated extensive knowledge concerning the aetiology, diagnosis and management of CMDs [3, 4, 9-13, 22-24, 32, 43, 46]. For instance, among CMD researchers there is a consensus that in virtually all cases the management should be conservative and reversible [25]. In this context, it is of major interest how practising dentists view CMDs. So, efforts were made to evaluate the transfer of knowledge from researchers to front-line care givers. To gain information on the knowledge and opinions of practising dentists and the therapies prescribed for CMD patients, several surveys have been performed [18, 20, 21, 26, 34, 40]. Some of them indicate discrepancies between expert-knowledge in the field of CMDs and what is understood by practising dentists [18, 20, 21, 26]. For example, a survey of 10,000 members of the American Dental Association revealed that splints, occlusal equilibration, relaxation techniques and stress management as the most frequently applied management approaches for CMD were used in 68%, 30%, 27% and 25% of the patients, respectively [21]. Thus, in contrast to

the consensus among CMD experts these findings show that practising dentists apply both conservative, reversible techniques and irreversible ones to their CMD patients. However, nearly all of these investigations have been performed on US dentists. A recent study surveyed Swedish dentists in the Public Dental Service regarding their knowledge of TMDs in children and adolescents [40]. In this study, Tegelberg and colleagues found, collectively, wide consensus in TMD knowledge amongst TMD specialists except for the statements in the domain 'diagnostics and classification'.

At present, there is little information on the most frequently used therapies and, in particular, the occlusal splint prescription patterns of German general dental practitioners. Even less information is available on what German practising dentists actually know and believe about CMDs. Therefore, the purpose of the present investigation was to identify the most frequent therapies and, in particular, the prescription patterns for occlusal splints used by German general dentists and specialists for the management of CMDs. Additionally, the knowledge and opinion of practising dentists were examined. The hypothesis of this study was that there is a difference between general dentists and dental specialists regarding the most frequently applied therapies and, in particularly, regarding the most commonly used occlusal splint types. Furthermore, it was assumed that in some fields both general dentists and specialists diverge from high-quality evidence-based recommendations.

Material and methods

Questionnaire

A three-page questionnaire, consisting of three sections was developed. The first section of this questionnaire aimed at recording sociodemographic and descriptive information on the respondents such as age, gender, number of years in professional life, membership in the respective statutory dental insurance provider, specialty and additional qualification. Furthermore, respondents were asked to estimate the proportion of patients diagnosed with CMD in their own practise and the percentage of these patients needing and getting therapy. The last question of the first section intended to identify whether respondents primarily referred their CMD patients to either other practitioners or universitybased care centres. Respondents who treated CMD patients themselves were asked to continue the questionnaire.

The second section of the questionnaire focused on rating the percentage of various therapeutic modalities applied, the types and distributions of occlusal splints used for the management of these patients and the number of occlusal splints made for the management of CMD patients. With respect to the prescription patterns of occlusal splints, respondents were additionally asked to reveal some details, i.e. indicate their most frequent recommendations for the application time for each type of occlusal splint.

To assess practising dentists' knowledge and opinion of CMDs, the third section of the questionnaire included five statements derived from a mail survey that had been designed at the University of Washington and fielded in the Seattle area [26] and the Kansas City area [18]. With respect to the complexity of the present questionnaire, the statements were extracted from only three instead of originally four domains: statement 1, derived from the psychophysiological domain; statement 2, derived from the psychiatric disorders domain; and statement 3, 4, and 5, derived from the pathophysiological domain. Each statement was arranged on an 11-point scale in which 0 represented "strongly disagree", 10 "strongly agree" and 5 was a "neutral" standpoint. In the original Seattle study [26], statements have been verified by two panels of experts that formed the expert group. Similar to the Kansas City survey [18], the expert responses used in the Seattle study were applied to the present investigation. A statement was defined as "expert consensus" if more than 75% of the experts in the designated group endorsed either an "agree" (scores 7-10) or a "disagree" response (scores 0-3).

Sample

The questionnaire was mailed along with a cover letter requesting assistance and participation, and a stamped, self-addressed envelope. All active members of the statutory dental insurance providers of the German North Rhine (n= 5,500; 2006 roster) and the Westphalia-Lippe area (n= 4,984; 2006 roster) received the questionnaire. To provide the anonymity of the respondents, both statutory dental insurance providers took care of the dispatch and sent the questionnaires together with a routine quarterly newsletter. The survey was carried out between February and June 2006. There was no financial incentive for responding to the survey.

Statistical analysis

The statistical analysis was performed using the statistical software "SPSS" Version 15.0. Normal distribution was tested using the Kolmogorov–Smirnov test along with an assessment of histograms. If data consisted of frequencies in discrete categories, the chi-square test was applied to determine the significance of differences between two independent groups. For all quantitative variables that were not normally distributed, differences were evaluated by means of the non-parametric Mann–Whitney *U* test. For all statistical analyses, an α -error probability of *P*<0.05 was defined as the statistically significant level.

Results

Nine hundred and forty-two (8.98%) of the 10,484 forms were returned. Of the returned questionnaires, 52.4% were from members of the statutory dental insurance providers of the German North Rhine and 47.6% from members of the Westphalia-Lippe area. Significantly more men than women returned the questionnaire (699=74.2% vs. 239= 25.4%), four respondents failed to report their gender (P <0.01). This respondent distribution is consistent with the approximate gender distribution of the practising dentists in both areas of the statutory dental insurance providers (30.0% and 29.0% women) and is, thus, representative for the dentist population of the former West German federal states [5]. Six hundred and eighty (72.4%) respondents provided complete data, 12 (1.3%) filled in only the first section of the questionnaire and in 247 cases (26.3%) the questionnaire was missing at least one item. Some demographic and descriptive characteristics of the respondents, classified as 'general dentists' and 'specialists', are shown in Table 1. Eight hundred and eleven (86.4%) of the respondents were practising general dentists and 128 (13.6%) were specialists. Orthodontists represented the largest proportion of specialists (33.6%), followed by dentists with postgraduate qualification in oral implantology (18.8%)and oral surgeons (14.8%). The largest proportion of participants (39.9%) had 11 to 20 years of professional work experience.

The ten most frequently applied therapies for CMD management are shown in Table 2. Occlusal splints were by

far most frequent, followed by physiotherapy, occlusal equilibration, prosthodontic reconstruction and relaxation techniques. In the preceding year, a general dentist made 30.03 occlusal splints on average (SD=35.53; range, 0 to 300) while a specialist made 30.21 occlusal splints on average (SD=36.73; range, 0 to 200) (P=n. s.). Table 3 gives the average percentage of patients treated by general dentists and specialists with different types of occlusal splints. The most frequently used splint types are occlusal stabilisation splints with canine guidance, followed by occlusal splints with group function and hard plates. To give an impression of the differences in the therapeutic approaches among the different dental specialties, information on the most frequently applied therapies and, in particular, on the different types of occlusal splints used by different specialists' groups is shown in Table 4 and Table 5, respectively. For a better overview, only those two specialty groups that treated least or most of their patients with the respective therapy or the respective splint type are listed. As was to be expected, along with the individual professional focus certain preferences are observable regarding the therapies most frequently applied by the respective specialty group.

Table 6 presents details on splint application recommendations: the percentage of respondents who recommend splint application for 24 h, the use only at night, the use if required, or various combinations of application times for the respective type of occlusal splint. The listed data indicate that there is a wide variance as to the prescribed application times. For the various types of occlusal splints, the responding dentists most frequently recommended the

Table 1	Demographic	and practise	characteristics	of the	respondents
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	General dentists	Specialists	P value
Age (n=929)	45.95±8.55	45.57±8.82	n. s. ^a
Male (<i>n</i> =935)	603 (74.5%)	95 (75.4%)	n. s. ^b
Number of years in professional life $(n=922)$	18.33 ± 8.77	17.75 ± 8.61	n. s. ^a
Percentage of patients diagnosed with CMD $(n=932)$	10.30 ± 13.09	10.94 ± 14.30	n. s. ^a
Percentage of CMD patients needing and getting therapy $(n=933)$	37.69 ± 37.41	39.22 ± 40.55	n. s. ^a
Do you predominantly treat CMD patients on your own? $(n=931)$			< 0.001 ^b
Yes	737 (91.6%)	100 (79.4%)	
No, predominantly referred out to other practises	18 (2.2%)	16 (12.7%)	
No, predominantly referred out to university-based care centres	9 (1.1%)	4 (3.2%)	
No, referred out to other practises or university-based care centres	3 (0.4%)	1 (0.8%)	
Yes, or referred out to other practises	12 (1.5%)	2 (1.6%)	
Yes, or referred out to university-based care centres	15 (1.9%)	1 (0.8%)	
Yes, or referred out to other practises or to university-based care centres	6 (0.7%)	0 (0%)	
I usually do not act in any way	5 (0.6%)	2 (1.6%)	

Respondents are divided into general dentists and specialists

^a Mann–Whitney U test; data are presented as mean±standard deviation (SD)

^b Chi-square test

Table 2 Average percentage of patients treated by the respond-		General dentists (%)	Specialists (%)	P value
frequent therapies for CMDs	Occlusal splints (n=904)	75.0	56.97	< 0.001
	Physiotherapy (n=909)	15.90	25.30	< 0.05
	Occlusal equilibration $(n=907)$	15.86	8.60	< 0.001
	Prosthodontic reconstruction ($n=911$)	12.43	9.43	< 0.001
	Orthodontics (n=915)	1.68	11.78	< 0.001
	Relaxation techniques $(n=915)$	10.22	11.74	n. s.
	Thermal packs $(n=916)$	7.78	8.84	n. s.
Demondente en divided inte	Medications (n=917)	4.78	4.78	n. s.
general dentists and specialists.	Diet counselling $(n=918)$	2.53	3.58	n. s.
Mann-Whitney U test used to	Psychotherapy $(n=917)$	2.25	2.73	n. s.
assess differences between general dentists and specialists	Miscellaneous (n=907)	3.36	6.06	n. s.

use at night. The only exception to this is the repositioning splint which most respondents recommended to use for 24 h.

In Table 7, the opinion of general practising dentists and specialists is compared with experts (referring to the five statements mentioned above). In four of the five statements the specialists' opinion was closer to the expert response than was that of the general dentists. To provide further information, the responses of the practising dentists in the Kansas City study [18] are also given.

Discussion

The most important result of this study is that a considerable number of practising dentists still applies irreversible techniques for the management of CMDs, such as occlusal adjustment, prosthodontic reconstruction or orthodontics. For instance, as derived from our survey, general dentists use occlusal equilibration in approximately 16% of their CMD patients. In this context it should be underlined that on the basis of the scientific literature of the past decade [7, 8, 10, 15, 20, 21, 23, 24, 42, 44, 45] none of the important institutions, such as the National Institutes of Health Technology [29], the German Association for Functional Diagnostics and Treatment/the German Society of Dentistry and Oral Medicine [1] or the European Academy of Craniomandibular Disorders [10], recommends the application of irreversible techniques for the management of CMDs. After pain and dysfunction has been managed by reversible therapy, the patient should be regarded as any other regular patients. In case the dental treatment plan requires prosthodontic reconstruction or orthodontics, it should preferably be performed only after the symptoms of pain and dysfunction have subsided [10, 16]. Conversely, considering the most frequently applied dental therapies for the management of CMDs, the data of our survey clearly demonstrate that for both general dentists and specialists, occlusal splints are the first-choice therapy, followed by physiotherapeutic procedures. These findings underline a consensus of most practising dentists with CMD experts emphasising that the management of CMDs should predominantly be conservative and reversible [22].

As derived from the present investigation, the stabilisation splint with canine guidance is the occlusal splint type of choice, but other types of splints are also frequently being applied. Although various authors have reported on the efficacy of occlusal stabilisation splints, the obtained clinical results were not better than those of other splint types [21, 35, 44]. Moreover, scientific evidence is still equivocal that improvement of pain symptoms after incorporation of an intraoral appliance is caused by a specific effect of the splint [44]. Thus, several theories have been proposed to

Table 3 Average percentage of patients treated by the respondents with various occlusal splint types

	General dentists (%)	Specialists (%)	P value
Stabilisation splint with canine protected articulation $(n=907)$	45.13	40.20	n. s.
Occlusal splint with group function $(n=910)$	18.89	12.21	< 0.05
Hard plate $(n=912)$	9.53	7.55	< 0.05
Repositioning splint $(n=913)$	6.51	9.00	n. s.
Soft splint (n=912)	5.60	1.96	< 0.05
Reflex splint with anterior plateau $(n=914)$	2.82	5.60	n. s.

Respondents are divided into general dentists and specialists. Mann-Whitney U test used to assess differences between general dentists and specialists

	Minimum	Maximum	P value
Occlusal splints (n=123)	35.9% (orthodontists)	81.4% (periodontists)	< 0.01
Physiotherapy $(n=123)$	3.3% (prosthodontists)	75.0% (endodontists)	n. s.
Occlusal equilibration $(n=123)$	2,1 % (orthodontists)	35.0 % (specialists in preventive and restorative dentistry)	< 0.001
Prosthodontic reconstruction ($n=123$)	1.4% (orthodontists)%	19.7% (implantologists)	< 0.001
Orthodontics (n=124)	0.5% (maxillofacial surgeons)	28.8% (orthodontists)	< 0.01
Relaxation techniques $(n=124)$	6.8% (orthodontists)%	45.0% (endodontists)	< 0.05
Thermal packs (n=126)	2.1% (periodontists)	40.0% (specialists in preventive and restorative dentistry)	n. s.
Medications $(n=126)$	0.4% (periodontists)	35.0% (specialists in preventive and restorative dentistry)	< 0.05
Diet counselling $(n=126)$	0.4% (oral surgeons)	15.8% (maxillofacial surgeons)	n. s.
Psychotherapy $(n=125)$	0.3% (prosthodontists)	8.6% (oral surgeons)	n. s.
Miscellaneous ($n=127$)	0.1% (periodontists)	20.0% (endodontists)	n. s.

Table 4 Average percentage of patients treated by specialists with the following most frequent therapies for CMDs

Specialists are divided into the respective specialty groups. Kruskal-Wallis test used to assess differences between the specialty groups

explain the effects of dental splint therapy, such as the occlusal disengagement theory, the vertical dimension theory, the maxillomandibular realignment theory, the temporomandibular joint repositioning theory and the cognitive awareness theory [6, 14]. However, the underlying causes explaining the obvious success of occlusal splint therapies have not clearly been identified [34]. In sum, the outcome of our study largely reflects the current view of dental experts except for the use of soft splints. Regardless of the experimental study by *Okeson* in 1987, which indicated an increased parafunctional activity following a soft splint therapy, our survey shows that general dentists use this type of splint in 5.6% of their CMD patients [33].

For the assessment of the knowledge and opinions of practising dentists regarding CMDs, the present study evaluated five statements derived from the Seattle survey [26]. Although the applied statements had been developed in 1993, their validity has been proven once again by a panel of experts in 2007 [40] and in various scientific publications [1, 19, 28, 36, 42, 45]. According to our survey, in four of the five statements the specialists' opinion was closer to the expert response than that of the general dentists. Considering the observed agreement with the experts on parafunctional habits, it seems that both general dentists

and specialists view parafunctional activities as an important contributing factor to CMDs. Conversely, for the three statements on the role of depression and occlusion, the agreement between general dentists, specialists and experts was low. Yet, it should be noted that about 30% of the practising dentists had a neutral opinion. These findings might rather be interpreted as a tacit uncertainty than an open disagreement with the expert opinion. This might be due to either a lack of knowledge or to knowledge of convincing arguments on both sides of the issue and, consequently, an ambiguous opinion.

The present investigation comprises some limitations that need to be carefully regarded when interpreting data. Firstly, in comparison with previous surveys in the USA, the response rate in the present survey was low and, thus, it is possible that response bias might have influenced the outcome of our investigation. Though, the lack of gender differences between general dentists and specialists and the close approximation of the respondents' gender distribution to that of the study sample and the former West German federal states dentist population [5] support the validity of the data. Furthermore, the present study provides data similar to previous surveys performed on US dentists 12–17 years ago [18, 20, 21, 26, 34]. A possible explanation

Table 5 Average percentage of patients treated by specialists with various occlusal splint types

Type of occlusal splint	Minimum	Maximum	P value
Stabilisation splint with canine protected articulation $(n=121)$	2.5% (endodontists)	65.0% (specialists in preventive and restorative dentistry)	n. s.
Occlusal splint with group function $(n=124)$	1.8% (miscellaneous specialists)	30.9% (periodontists)	n. s.
Hard plate $(n=124)$	3.2% (orthodontists)	42.5% (endodontists)	n. s.
Repositioning splint (n=123)	1.43% (periodontists)	25.0% (endodontists)	n. s.
Soft splint (n=124)	1.4% (periodontists)	6.54% (maxillofacial surgeons)	< 0.01
Reflex splint with anterior plateau $(n=123)$	3.2% (orthodontists)	14.3% (periodontists)	n. s.

Specialists are divided into the respective specialty groups. Kruskal-Wallis test used to assess differences between the specialty groups

Table 6 Percentage of respondents who recommend various at	pplication d	lurations for t	he different occlus	sal splint types					
	General de	ntists			Specialists				P value
Type of occlusal splint	24h (%) /	At night (%)	If required (%) I	Diverse combinations (9	24h (%) A	: night (%)	If required (%)	Diverse combinations (%)	
Stabilisation splint with canine protected articulation $(n=593)$	22.1	61.7	3.8	12.3	36.1	47.2	4.2	12.5	n.s
Occlusal splint with group function $(n=330)$	18.0	64.7	4.7	12.7	26.7	60.0	10.0	3.3	n.s
Hard plate $(n=237)$	13.4	71.0	9.7	6.0	15.0	55.0	25.0	5.0	n.s
Repositioning splint $(n=277)$	50.4	38.4	4.5	6.6	64.7	20.6	5.9	8.7	n.s
Soft splint $(n=175)$	17.7	57.0	20.3	5.0	0	81.3	18.8	0	n.s
Reflex splint with anterior plateau $(n=142)$	25.0	56.7	10.8	7.5	22.7	50.0	27.3	0	n.s
ltem			Expert response (Le Resche et al	. [26]) (Gla	tising dentists ros et al. [18]) (%) dentis	onding general sts (%)	Responding specialists (%)	P value
Item Oral parafunctional habits are often significant in the developm Clinical depression is rare in chronic CMD patients (n =875) Balancing interferences are commonly related to CMD (n =902 Occlusal equilibration is a useful early therapy for CMD (n =91	aent of CM () 14)	D $(n=913)$	Expert response (Le Resche et al Agree: (85%) Disagree: (100% Disagree: (85%) Disagree: (85%)	Prac (Gla	tising dentists ros et al. [18]) (82 69.0 10.0 26.0	Resp %) denti	onding general sts (%) 76.9 44.5 9.6 41.8	Responding specialists (%) 71.7 56.1 22.7 52.5	<i>P</i> value n. s. <0.05 <0.001 n. s.
	a uiciapy	(77 <i>6</i> - <i>u</i>)	Disagree: (100%	0	0.06		04.0	0.01	п. s.

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Respondents are divided into general dentists and specialists. Chi-square test was used for comparison of general dentists vs. specialists

for the low response rate might be the complexity of the questionnaire, because it included three sections that addressed various problems. Yet another reason might be that in contrast to US dentists, German dentists are less trained and familiar with surveys and, above all, this was the first survey on CMDs. Apart from that, in the USA the general interest in data collection has a certain tradition and the respective willingness to participate is, per se, much higher than it is in Germany. This assumption is supported by the fact that other German surveys in the field of endodontics reveal significantly lower response rates than do surveys on US dentists [30, 41]. Moreover, our investigation has been performed anonymously and, accordingly, we neither had the chance to remind non-respondents via telephone interview (as reported in other surveys) nor did participants receive any financial incentives.

Secondly, it should be noted that within this survey, some numbers do not sum up to 100%. This results from the effect of rounding and the fact that some respondents failed to answer all questions of the survey.

In conclusion, the outlined discrepancies challenge the efficacy of the transfer of knowledge from the researcher to the clinician. For a prompter bridging of this gap, improvement strategies should aim at different targets: traditionally, clinical decisions were based on knowledge gained through training, individual past experiences, well-established practise traditions and the opinions of approved authorities [40]. Nowadays, most postgraduates receive science-based recommendations from scientific journals. To promptly reach a considerable number of practising dentists for keeping practitioners' understanding up to date, further reviews of CMD research findings may be needed [38]—particularly in the general dental literature. This could help reducing the time delay between scientific advances in this area and the acceptance of new scientifically verified principles in dental practise. Moreover, it would be desirable to keep practising dentists up to date by means of routine participation in postgraduate training courses and to renew and update undergraduate curricula at regular intervals [40]. With respect to the latter two aspects, efforts have already been made to harmonise and renew programmes of various dental schools in the USA and Europe [17, 27, 31, 37, 39]. The data of our study derived from a survey on German practising dentists advocate such endeavours and again underpin the need for extending the topic of CMDs and orofacial pain in future undergraduate dental curricula and postgraduate courses.

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Conflict of interest The authors declare that they have no conflict of interest.

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