

Orthodontists' instructions for oral hygiene in patients with removable and fixed orthodontic appliances

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Abstract

Introduction: The aim of this questionnaire-based survey was to evaluate information on frequencies, instructions and products relating to oral hygiene (OH) in orthodontic practices.

Methods: Using a computer-generated randomization list, 1000 orthodontists were selected and sent a questionnaire. The size and number of inhabitants of the federal states of Germany were considered. The federal states with the highest return rate (Baden-Wuerttemberg [BW], Bavaria [B], Hesse [H], Lower Saxony [LS], Nordrhein-Westphalia [NRW]) were considered and differences between the 16 federal states were divided into North, South, East and Central Germany.

Results: The response rate of the questionnaires was 52.4%. The majority (53.8%) worked in one practice alone. Most (59.1%) have been orthodontists for 5–25 years. For vestibular multibracket appliances (MBA) in BW, B, H and LS over 90% recommended interdental brushes (IDB). In NRW 91.4% recommend fluoride gel. In B and H more than 80% chose electric toothbrush (ETB), in BW, LS and NRW more than 80% manual toothbrush (MTB). For lingual MBA (LMBA) in BW, H, LS and NRW with approximately 50% each fluoride gel, IDB and MTB were chosen. In B fluoride gel, IDB and ETB. For removable apparatus (RA), five federal states recommended MTB (>80%) and ETB (BW, B, H > 80%; NRW > 70%; LS > 60%).

Conclusion: Electric toothbrushes are recommended for the use with all appliances, only with removable appliances manual toothbrushes are favoured. For vestibular MBA it is strongly advised to use IDB additionally.

KEYWORDS

Electric toothbrush, interdental brushes, multibracket appliances, oral hygiene, questionnaire study, removable appliances, white spot lesions

1 | INTRODUCTION

The risk of white spot lesions (WSL) in orthodontically treated patients is significantly higher than in patients who have never undergone such treatment,¹ which also increases the risk of developing

gingivitis or periodontal diseases. Many patients with MBA experience at least one lesion in a mild form.² Depending on the depth of the lesion, these can still be visible years after the end of therapy.^{3–5} On the other hand, complete remineralization,⁶ is also possible for lesions less than 100 µm deep in the enamel.⁷ However, the lesions

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caused by orthodontic treatments are usually several 100µm deep. No complete remineralization can take place here.⁸ Since the saliva germ counts and thus the risk of the formation of WSL's do not completely normalize until approximately 3 months after removal of the orthodontic appliance,^{9,10} optimal oral hygiene, close monitoring appointments and various fluoride-containing preparations make sense.¹¹ This can stop the formation of WSL's.^{2,11} Ways to reduce the risk of demineralization include, for example, optimal oral hygiene, regular professional dental cleaning (PDC), the right tooth brushing method and the appropriate products.

1.1 | Population

Germany has around 80.5 million inhabitants.¹² Particularly NRW (~17.64 million inhabitants), B, BW, LS and H are among the most populous of the 16 German federal states.¹³ Around 3.000 orthodontists have their own practice, additionally nearly 600 work as employed orthodontists. NRW, B and BW are the federal states with the largest populations and the federal states with the most orthodontists in private practices.¹⁴

1.2 | Toothbrushes

Both MTB and ETB are suitable for mechanical biofilm removal according to Geurtsen et al.¹⁵ ETB¹⁶⁻¹⁹ and other studies in which no difference has been proven.²⁰⁻²⁴

MTBs with different brush head designs are still used most frequently today.^{25,26} Despite extensive research, only one study could be found that could prove the superiority of a manual toothbrush over various electric toothbrushes.²⁷

ETBs often have the advantage that their brush head is small enough to clean areas that cannot be reached by toothbrushes with larger heads.²⁸ Furthermore, ETBs are recommended especially for patients with manual limitations or poor oral hygiene compliance. Using an ETB is easier for many people to learn than using a MTB.^{25,29}

Interdental Brushes (IDB) are small brushes for cleaning the interdental space or the space between brackets, when instructed in between them, consisting of a wire core with nylon bristles arranged at an angle of 90°. IDBs with large diameters are particularly suitable for cleaning MBA.²⁵ Some authors were also able to demonstrate that IDBs can significantly reduce the plaque index during MBA treatment.^{30,31} Geurtsen et al. could not provide clear evidence that these actually reduce proximal caries.³² In general, however, other scientists were able to show a connection between complete plaque removal and the reduction of caries.³³

1.3 | Fluoride-containing products

Fluorides prevent caries and protect tooth enamel. They are deposited pre-eruptively and post-eruptively in the enamel, whereby the

post-eruptive effect plays the decisive role in caries reduction.³⁴ At the same time, demineralization is reduced, and remineralization is promoted.^{25,30}

As demineralization and WSL may occur during orthodontic treatments with MBA, the preventive effect of fluoride gels was tested and confirmed that the application provides effective protection against demineralization.^{35,36}

Daily use of a sodium fluoride (NaF⁻) irrigation solution can reduce caries and demineralization during orthodontic treatment.^{4,17,37-40}

This study aims to evaluate information on frequencies, instructions and products relating to oral hygiene in orthodontic practices throughout Germany. As the findings provide an understanding of the orthodontists' favoured oral hygiene products, they are of clinical relevance to dental hygienists and orthodontists wishing to compare their own view on the products with their colleague's opinions.

2 | METHODS

2.1 | Study population and methodology

This cross-sectional study was conducted in cooperation with the Institute of Medical Biostatistics, Epidemiology and Informatics (IMBEI), Mainz, in 2012. The questionnaires were sent out by post to 1.000 orthodontists randomly selected in January 2012. The participants were picked from the membership list of the German Society of Orthodontists (DGKFO) using a computer-generated randomization list taking size and number of inhabitants of each respective German federal state into consideration. The orthodontists sent their filled-out questionnaires back to Mainz by May 2012. Stratified sampling was used.

The questionnaire was sent out with a cover letter informing the participant about the anonymity of their answers and assuring them that the provided data would be recorded and evaluated exclusively by employees of IMBEI. Thus, the participants were made aware that their data would be pseudonymously stored for 10 years.

The questionnaires were locked in closets and saved on computers that only the principal investigator and data manager had access to. All study stuff involved are subject to a confidentiality agreement.

Only completely filled-out questionnaires were evaluated.

Pretesting of the questionnaire was conducted as an internal testrun by letting eight postgrad students fill it out and giving feedback. It was concluded that the questionnaire was easy to understand and to fill out. Thus, the testrun suggested that erroneous answers were unlikely. A sample of 10% of entered questionnaires was source-verified.

The questionnaire consisted of five sections inquiring about the orthodontist's preferred instructions concerning oral care they tend their patients as well as their methods of checking their patient's oral care. Participants could express their feedback in another section and choose to receive information about the study's results. Some of the 22 questions had multiple answers.

2.2 | Demographic classification

The practice locations could be assigned to the respective federal state with the postal code. The federal states with the highest return rate (BW, B, H, LS and NRW) were examined and differences between the 16 federal states were divided into North, South, East and Central on the one hand (Table 1) and East and West on the other hand (Table 2). This classification was made in coordination with the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR, Bonn, Germany).

2.3 | Data analysis

The data were evaluated using the SPSS Statistics 23 statistics program (IBM, Armonk, USA) and/or the Excel 2010 program (Microsoft, Redmond, USA). Absolute and relative frequencies were presented in cross tables and compared between the individual federal states, northern, eastern, southern and central Germany as well as western and eastern Germany using a chi-square test. As this is an exploratory study, *p*-values were not corrected after multiple tests and should, therefore, be interpreted purely descriptively.

3 | RESULTS

The response rate of the questionnaires was 52.4%. Of the 524 returned questionnaires, 128 (24.4%) came from NRW, 90 (17.2%) from B, 87 (16.6%) from BW, 51 (9.7%) from H and 45 (8.6%) from LS. Based on the demographic division into North, Central, South and East, 201 (38.4%) of the questionnaires came from the South. A total

TABLE 1 Demographic classification of the German federal states in north, central, south and east according to BBSR.

North	Bremen
	Hamburg
	Lower Saxony
	Schleswig-Holstein
Central	Hesse
	North Rhine-Westphalia
	Saarland
South	Baden-Wuerttemberg
	Bavaria
	Rhineland-Palatine
East	Berlin
	Brandenburg
	Mecklenburg-West-Pomerania
	Saxony
	Saxony-Anhalt
	Thuringia

of 186 (35.5%) questionnaires came from Central, 69 (13.2%) from Eastern and 68 (13.0%) from Northern Germany.

A comparison of the three tables (Tables 3–5) shows the popularity of both MTB and ETB in all three appliances, regardless of the use of fixed vestibular (82.7% and 77.1%), lingual (45.7% and 40.3%) or removable appliances (88.7% and 75.2%). The sonic toothbrush was significantly less recommended. IDB were frequently mentioned for fixed appliances, whereby the percentages for vestibular MBA (92.3%) were significantly higher than for lingual MBA (48.5%). Interdental brushes were not recommended for removable appliances.

The fluoride gel was indicated more frequently for vestibular MBA (81.5%) and removable appliances (69.5%) than for cleaning lingual MBA (44.9%). In contrast to the values for vestibular MBA and removable devices, the data showed no clear decision for a specific product. The mouth rinse solution was not specified very frequently for all three devices.

A comparison of the results for the five federal states with the most returns shows that the information here was similar to the recommendations for the whole of Germany. MTB and ETB were generally recommended in almost equal percentages for all three appliances. Fluoride gel was also recommended for all appliances. The use of sonic toothbrushes has been significantly reduced. In contrast to fixed appliances with a strong tendency towards IDB, there were significantly fewer recommendations for removable appliances. For vestibular MBA, mouth rinses were recommended on average with approx. 60%. For lingual MBA and removable appliances, each recommended only about 40%.

4 | DISCUSSION

There are many studies that describe and test the effectiveness of various aids and products necessary for optimal oral hygiene. The authors have partially different results. The study situation agrees that the use of products containing fluoride reduces the risk of caries.^{15,25,30,34,39,41–43} Fluoride-containing products are available in various applications: fluoride gel,^{25,34,36} toothpaste,^{42,44} mouthwash,^{4,17,40,45–47} sealant,^{48–52} sodium, amine or tin fluoride.^{39,42} However, which method actually works best is controversial.^{42,53,54} The effectiveness of various ETB and MTB^{16–24} is also described differently, whereas the use of IDB is undisputed.

Various tooth brushing techniques are described in the literature as the method of choice.^{55–63} In the promotion of oral health and maintaining the general and dental health of the patients, the role of the dental hygienist (DH) needs to be emphasized.^{64,65} The active partaking and amount of responsibility are critical in the treatment to maintain dental and oral health.⁶⁶ The regular performance of professional tooth cleaning^{67–71} and the need for oral hygiene instructions and guidance^{17,20,72–76} are undisputed.

In the present study, a total of 1000 members were randomly selected from the DGKFO (German Society for Orthodontics e.V.) directory received a questionnaire with 22 questions that was sent to them by mail. The response rate was 52.4%. Eichenauer et al.⁷⁷

Ost	Brandenburg	West	Bremen
	Mecklenburg-West-Pomerania		Hamburg
	Saxony		Lower Saxony
	Saxony-Anhalt		Schleswig-Holstein
	Thuringia		Hesse
	Former East Berlin		North Rhine-Westphalia
			Saarland
			Baden-Wuerttemberg
			Bavaria
			Rhineland-Palatine
			Former West Berlin

TABLE 2 Demographic classification of the German federal states in East and West Germany according to BBSR.

TABLE 3 Frequency of responses to vestibular MBA in per cent in relation to the whole of Germany.

Regions	Manual toothbrush	Electric toothbrush	Sonic toothbrush	Interdental brushes	Fluoride gel	Mouth rinse
North	88.2%	75.0%	26.5%	89.7%	83.8%	48.5%
Central	79.6%	78.5%	28.0%	89.2%	90.9%	62.9%
South	83.1%	81.1%	33.3%	94.5%	83.1%	70.1%
East	79.7%	73.9%	33.3%	95.7%	68.1%	68.1%
Mean	82.7%	77.1%	30.3%	92.3%	81.5%	62.4%

TABLE 4 Frequency of responses to lingual MBA in per cent in relation to the whole of Germany.

Regions	Manual toothbrush	Electric toothbrush	Sonic toothbrush	Interdental brushes	Fluoride gel	Mouth rinse
North	50.0%	44.1%	17.6%	55.8%	47.1%	32.4%
Central	51.6%	46.8%	17.7%	57%	52.7%	39.2%
South	49.3%	45.8%	20.9%	50.7%	49.8%	41.8%
East	31.9%	24.6%	17.4%	30.4%	30.4%	33.3%
Mean	45.7%	40.3%	18.4%	48.5%	44.9%	36.8%

TABLE 5 Frequency of responses for removable appliances in per cent in relation to the whole of Germany.

Regions	Manual toothbrush	Electric toothbrush	Sonic toothbrush	Interdental brushes	Fluoride gel	Mouth rinse
North	94.1%	67.6%	19.1%	23.5%	76.5%	30.9%
Central	85.5%	78%	21.5%	23.1%	70.4%	34.9%
South	85.1%	84.1%	32.3%	22.4%	67.7%	42.8%
East	89.9%	71%	27.5%	13%	63.3%	42%
Mean	88.7%	75.2%	25.1%	20.5%	69.5%	37.7%

achieved a response rate of 99.5% in their telephone survey. This suggests that a personal interview is more likely to encourage orthodontists to participate in such a study than a little personal questionnaire that requires additional work to complete and return. However, a telephone survey with a number of 20 questions, some of which had several possible answers, would have been very difficult. This would have taken a lot of time and might have led other orthodontists not to participate. Accordingly, the questionnaire study, which was sent by post and could be completed by hand at any time, was the right decision.

An online survey published by Rosenstiel et al.⁷⁸ shows that sending the questionnaire by email does not provide better results. Here the response rate was 6.3%, despite an additional reminder of the answer to the questionnaire. Suzuki et al. were able to achieve significantly better results with their online than Rosenstiel.⁷⁹

The use of a questionnaire makes it relatively easy to obtain a large amount of information. Many other scientists also used this method of information retrieval.⁷⁸⁻⁸² Additionally for this study, a questionnaire was a good possibility to ask many orthodontists about different topics.

4.1 | Recommendations on oral hygiene products for vestibular and lingual appliances

The literature on manual and electric toothbrushes shows different results with regard to the effectiveness of the two toothbrushes: 'Manual toothbrush is more effective',²⁷ 'Rotary oscillating is more effective',^{16,28,83-85} 'No difference between the two brushes'.^{24,86} This could explain why no clear decision was made for one of the two brushes. One explanation for the low figures for the sonic toothbrush could be that it is less known than the rotating oscillating and manual brush and the studies are very different: 'No difference between sonic and manual toothbrush',^{23,87} 'No difference between sonic and rotating oscillating brush',^{86,88} 'Sonic toothbrush more effective than manual toothbrush',⁸⁴ 'Sonic toothbrush more effective than rotating oscillating brush',⁸⁹ 'Rotating oscillating brush more effective than sonic toothbrush'.^{87,90} Furthermore, more mistakes are proven when using a sonic toothbrush.^{23,25,88,91-94}

The recommendations of the orthodontists in this study on IDB agree with the recommendations in the literature. Several studies have shown that toothbrushes alone are not sufficient for MBA.^{23,26,88} Several authors recommend IDB's^{25,30,31,95} for optimal cleaning of the areas underneath as they are shown to be more effective in removing plaque than brushing alone.⁹⁶

The fluoride gel was indicated for vestibular and lingual MBA almost all over Germany with more than 80%. Different authors came to similar results: The regular use of fluoride gels can protect against demineralization during treatment with MBA.^{35,36} The repeated application of low-concentrated gel provides effective protection against white spots. Additionally, fluoride gels achieve better results when it comes to remineralization than mouth rinses.⁹⁷

The fluoride-containing mouth rinse solution was recommended in this study by most of the orthodontists surveyed. Here, too, several studies have shown the positive effect of fluoride-containing rinsing solution.^{4,17,37-40} These mouth rinse solutions reduce the increase in caries noticeably and their effects are independent from other fluoride-containing oral hygiene products. Because of these reasons, fluoride-containing mouth rinse solution is recommended especially for patients with limited cleaning ability under MBA treatment and with increased caries risk.³⁴

4.2 | Recommendations on oral hygiene products for removable appliances

The MTB was indicated most frequently, followed by the ETB. All (100%) of the orthodontists surveyed in LS indicated the manual toothbrush. Here the difference to the ETB (66.7%) was greatest. In the study by Eichenauer et al.⁷⁷ mechanical cleaning with a toothbrush was with 99.8% named as the most frequent recommendation for cleaning removable orthodontic appliances. The authors speculated, based on the conducted interviews, that choosing toothbrushes over chemical cleaning additives might have been considered a more affordable option. On the subject of oral hygiene in removable appliances, only a few results have been found in the

literature. Here only the cleaning of the RA is usually discussed. In this particular study, the cleaning of the RA is recommended, but it is not specified which kind of toothbrush participants should use.

Sonic toothbrush and IDB were hardly mentioned here. The sonic toothbrush was given very rarely, as was the case for cleaning in MBA patients. This goes along with the results of various studies on the effectiveness of the sonic toothbrush^{23,25,84,86-92} described above, stating that using the sonic toothbrush does only offer small improvements on teeth without brackets compared to manual toothbrushes.

The fluoride gel was recommended with over 60% for cleaning in patients with RA, with the presumed intent of application in the oral cavity to reduce demineralization and White Spot Lesions as described by Knösel et al. as well as Landry and Shannon.^{35,36}

The mouth rinse solution was rather less stated. This was most frequently mentioned in southern and eastern Germany with about 42%. The 5 federal states with the most returned questionnaires also had percentages below 40%. Only the orthodontists in B indicated the mouth rinsing solution with over 50%. These values are contrary to the data of the children in the study of Krupinska-Nanys et al.⁹⁸ In the study by Eichenauer et al.,⁷⁷ cleaning of the RA with a standard rinsing solution was one of the least recommended (2.4%).

Abbate et al.⁹⁹ investigated OH in patients with aligners and MBA. In the group with the removable aligners, plaque index, probing depth and bleeding index were significantly lower than in the group with the MBA carriers. As an explanation, these authors cited the simpler oral hygiene of removable appliances, as all obstacles of an MBA are eliminated, and the aligners can be removed during meals.

4.3 | Limitations and suggestions for future research

This study was limited by multiple factors. Almost half (47.6%) of the selected orthodontists did not return the questionnaires. Furthermore, orthodontists from different parts of Germany tended to prefer different oral hygiene products. The demographic differences cannot be explained solely by the evaluation of this study and extensive literature research. A further study could be conceivable, for example, looking at the doctrine of the various universities in the federal states. Additionally, the findings do not indicate whether patients implement their orthodontists' oral health recommendations and, if so, which. A study investigating this question would provide a great opportunity to improve the quality of today's oral health advice. It is important to note that this study is representative for Germany, but not necessarily for other countries with different oral hygiene instructions. Marketing and production of oral hygiene products might differ greatly as well.

5 | CONCLUSION

MTB and ETB are strongly recommended for vestibular, lingual, fixed or removable appliances. IDB was frequently mentioned for fixed appliances as well, whereby the percentages for vestibular MBA were significantly higher than for lingual MBA. Interdental brushes

were not recommended for removable appliances. The fluoride gel was indicated more frequently for vestibular MBA and removable appliances than for cleaning lingual MBA.

6 | CLINICAL RELEVANCE

Orthodontically treated patients have a significantly higher risk of developing white spot lesions, as oral hygiene is more difficult to maintain. This questionnaire-based survey inquired about the recommended frequency of oral hygiene routines, products used and instructions given to patients in orthodontic practices. Focusing on the recommendations for fixed and removable appliances, manual and electric toothbrushes, interdental brushes as well as fluoride gel and mouth rinse solutions are evaluated. Dental education and health care reform are essential in the further development of innovative applications and standardization of procedures regarding the significant prevalence of individuals with WSL.

AUTHOR CONTRIBUTIONS

CB, DO and CE prepared and conducted the research, designed the research project and supervised the research. IS and CB performed the statistical analysis together. CE, CB, DO and HW drafted the manuscript. CE, DO, CB, PFP, HW and IS finalized the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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