

Original Article

Demineralization Preventive Practices among Nigerian Orthodontists—An Evidence-based Approach?

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Received:

14-Jun-2019;

Revision:

24-Oct-2019;

Accepted:

04-Dec-2019;

Published:

04-May-2020.

INTRODUCTION

Fixed orthodontic appliance therapy is one of the treatment options used in the management of malocclusion. A major reported complication associated with it is the development of tooth demineralization lesions.^[1-7] This is the loss of the crystalline structure of the tooth with consequent development of white spot lesions or in severe cases, frank cavitations of the affected teeth.^[1,8] These lesions can occur on any tooth but commonly on the buccal surfaces of anterior

ABSTRACT

Background: The prevalence of white spot lesions/tooth demineralization during orthodontic fixed appliance therapy ranges widely from 2 to 96% of patients. The purpose of this study was to evaluate measures used by orthodontists practicing in Nigeria to manage demineralization during and after fixed orthodontic treatment and how it compares with the available evidence-based information.

Method: Study group comprised of 60 practitioners (21 orthodontists and 39 orthodontic residents) in Nigeria. Self-administered questionnaires were used to obtain information on the measures they use to prevent the occurrence of demineralization at the onset and during orthodontic treatment, as well as the management of its occurrence at treatment completion. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 17.0. Descriptive statistics were used. Level of significance was set at $P < 0.05$.

Results: Responses obtained showed that 96.7% of orthodontic practitioners routinely advised their patients on tooth cleaning methods; the use of manual orthodontic toothbrush (78.3%) and dental floss (51.7%) being popularly recommended methods. However, 51.7% used a specific demineralization preventive protocol at the start of treatment. Oral hygiene instruction was observed to be the most commonly adopted protocol (51.7%), followed by fluoride rinses (41.7%) (considered relatively ineffective). Extraoral hygiene instruction was the most common treatment protocol used when tooth demineralization occurred during and after treatment (56.7% and 73.3% respectively). Approximately 92% of the orthodontists agreed on the need for the development of a basic protocol to prevent demineralization. **Conclusion:** The demineralization preventive measures used by Nigerian orthodontists and orthodontic residents are inconsistent and not based on evidence-based information. The development of standardized demineralization prevention protocol was therefore recommended.

KEYWORDS: Demineralization, oral hygiene, white spot lesions

teeth especially the maxillary teeth, therefore posing an aesthetic concern to the patients at the end of treatment.^[5,6] The aetiology of tooth demineralization lesions during fixed orthodontic treatment stems from plaque and aciduric bacteria accumulation^[1,2] because

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How to cite this article: Umeh OD, Utomi IL, Ndukwe AN, Izuka M. Demineralization preventive practices among Nigerian orthodontists—An evidence-based approach? *Niger J Clin Pract* 2020;23:589-95.

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|---|---|
| Quick Response Code: | Website: www.njcponline.com |
|  | DOI: 10.4103/njcp.njcp_315_19 |

of the complex nature of attachments as well as other component parts of the fixed appliance.^[9] This complicates routine tooth brushing as well as other oral hygiene practices,^[2] encouraging plaque stagnation areas and the onset of the demineralization process. The occurrence of tooth demineralization following orthodontic treatment has been widely reported, with prevalence ranging from as low as 2% to as high as 98%.^[4-7]

A reversal of the demineralization process is possible under favorable conditions.^[1,2,4-6] Some of these conditions include fluoride application in the form of rinses, dentifrices, gels and varnishes,^[2,10-12] chlorhexidine,^[10] and use of xylitol gel,^[13,14] with varied success. Randomized control trial studies and a systematic review have shown fluoride and chlorhexidine varnishes however to be the preferred adjuncts to tooth brushing, in preventing white spot lesions as they are longer lasting and preclude patient compliance.^[15-17] Also affecting the occurrence of these lesions are some patient-related factors e.g. patients oral hygiene, diet, DMFT score, tooth morphology, medical and drug history and genetic susceptibility. With these factors at play, the odds of developing demineralization lesions will vary between patients and so should their preventive protocols.

There is a paucity of data on the measures used by orthodontists worldwide in the prevention and treatment of demineralization/decalcification lesions, despite its significant negative impact on treatment outcome. Two previous studies investigated the protocols used by Dutch orthodontists in the management of white lesions in orthodontic patients.^[2,18] Their findings showed that orthodontists did not use evidence-based knowledge in the management of their patients as most of them recommended fluoride rinses (with little evidence of success) as an adjunct to oral hygiene instructions. To the best knowledge of the authors, there are no studies on prevention practices among orthodontists in Nigeria.

The purpose of this study, therefore, was to evaluate the measures used by orthodontic practitioners in Nigeria in the management of demineralization lesions, assess how it aligns with existing evidence and the need for the development of a standardized protocol.

MATERIALS AND METHOD

This was a questionnaire-based study. The study group consisted of orthodontic fellows and orthodontic residents, who are registered members of the Nigerian Association of Orthodontists and practiced in Nigeria. The questionnaires were distributed and filled by the respondents at their annual general meeting.

The questionnaire had four parts and assessed the orthodontists' demographics and attitude of orthodontists to tooth demineralization during orthodontic treatment. It also assessed the measures utilized by orthodontists in the prevention of white spot lesions at the start of treatment and their treatment protocol during and after orthodontic treatment. The bonding material used by the orthodontists, patients' compliance with oral hygiene instructions during treatment and the need for the development of a standardized protocol was also evaluated.

The study participation was voluntary and ethical approval was obtained from the Lagos University Teaching Hospital Health Research and Ethical Committee before the commencement of the study.

Statistical analysis

Data were analysed using Statistical software for Social Sciences (Version 17.0). Descriptive statistics were used for the subjects' demographics, the attitude of orthodontists to demineralization lesions and measures used in the treatment of demineralization lesions before, during and after orthodontic treatment. The results were presented in figures, charts and frequency tables. The level of significance was set at $P < 0.05$ for all statistical analysis.

RESULTS

A total of 60 respondents (21 orthodontists and 39 orthodontic residents) participated in the study. Questionnaires comprising sets of questions were used to assess demineralization management protocol among orthodontists. The subjects' age ranged from 31–60 years with a male to female ratio of 1:1.2. A majority of the respondents were in public practice setting (76.3%) and had a patient volume of 1–50 (38.3%). The conventional pre-adjusted edgewise system/brackets were the common type of fixed appliance used and the majority of the respondents used the light bond and glass ionomer cement in bonding the brackets and cementing

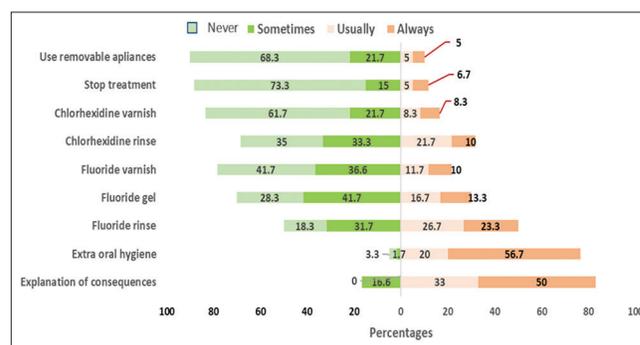


Figure 1: A divergent bar chart showing the management of demineralization during treatment

Table 1: Demographic Characteristics of the Study Population

| Variables (n=60) | Frequency | % |
|--|-----------|------|
| Age Group (Years) | | |
| ≤30 | 10 | 16.6 |
| 31-40 | 25 | 41.7 |
| >40 | 25 | 41.7 |
| Sex | | |
| Female | 37 | 61.7 |
| Male | 23 | 38.3 |
| Years of Practice (Years) | | |
| ≤5 | 18 | 30 |
| 6-10 | 21 | 35 |
| >10 | 21 | 35 |
| Type of Practice | | |
| Public | 47 | 76.3 |
| Private | 13 | 23.7 |
| Current Number of Cases in Practice | | |
| ≤50 | 32 | 53.3 |
| >50 | 28 | 46.7 |
| Type of Bracket Use for Practice | | |
| Conventional | 33 | 55 |
| Self-ligation | 2 | 3.3 |
| Both | 25 | 41.7 |
| What percentage of your patients have demineralization because of orthodontic treatment? | | |
| None | 23 | 38.3 |
| <20 | 23 | 38.3 |
| ≥20 | 14 | 23.3 |
| What percentage have demineralization so the enamel is eroded grouped? | | |
| None | 36 | 60.0 |
| ≤10 | 16 | 26.7 |
| >10 | 8 | 13.3 |
| Uses any specific protocol to prevent demineralization at treatment onset | 32 | 53.3 |
| Uses any extra measures when demineralization occurs and how often? | 48 | 80 |
| Advice patients with fixed appliances on a specific method of cleaning teeth | | |
| Electric Toothbrush | 8 | 13.3 |
| Orthodontic Toothbrush | 47 | 78.3 |
| Interdental Toothbrush | 30 | 50.0 |
| Floss | 31 | 51.7 |
| Chewing Stick | 1 | 1.7 |

Table 2: Attitude of orthodontists to tooth demineralization lesions

| Attitude Toward Demineralization | n (%) | | |
|---|-----------|-----------|-----------|
| | A | N | DA |
| Demineralization is a problem in your practice | 22 (36.6) | 15 (25.0) | 23 (38.4) |
| The orthodontist is responsible when demineralization occurs in a patient | 16 (26.6) | 18 (30.0) | 26 (43.3) |
| The patient is responsible for demineralization lesions | 30 (50.0) | 13 (21.7) | 17 (28.4) |
| On debonding, the patient considers demineralization a problem | 29 (48.3) | 12 (20.0) | 19 (31.7) |
| The protocol should be developed to prevent demineralization | 55 (91.7) | 3 (5.0) | 2 (3.4) |

A=Agree, N=Neutral, DA=Disagree

bands respectively. Most respondents reported less than 20% prevalence of demineralization lesions among their patients at debonding [Table 1].

A set of questions assessed the attitude of the orthodontists and orthodontic residents to demineralization. The responses obtained showed that the occurrence of white spot lesions during fixed appliance therapy posed a problem to many orthodontists in clinical practice (36.7%), with an additional 38.3% and 25% being neutral and disagreeing respectively. More respondents (50%) believed patients were responsible for the occurrence of demineralization lesions during treatment, while 26.7% considered the orthodontist

Table 3: Demineralization protocol in orthodontic patient management

| Specific Protocol to Prevent Demineralization | n (%) | | | |
|---|-----------|-----------|-----------|-----------|
| | A | U | S | N |
| Fluoride Rinse | 7 (11.7) | 8 (13.3) | 10 (16.7) | 35 (58.3) |
| Fluoride Gel Application | 3 (5) | 6 (10) | 15 (25) | 36 (60) |
| Fluoride Vanish Application | 3 (5) | 5 (8.3) | 11 (18.3) | 41 (68.3) |
| Chlorhexidine Rinse | 4 (6.7) | 8 (13.3) | 12 (20.0) | 36 (60) |
| Chlorhexidine Varnish Application | 2 (3.3) | 5 (8.3) | 7 (11.7) | 46 (76.7) |
| Oral Hygiene Instruction | 28 (46.7) | 4 (6.7) | 0 (0) | 28 (46.7) |
| Uses Any Additional Measures When Demineralization Occurs During Treatment | | | | |
| Explanation of Consequences | 30 (50.0) | 20 (33.3) | 10 (16.7) | 0 (0) |
| Extra Oral Hygiene Instruction | 41 (56.7) | 14 (20.0) | 2 (1.7) | 3 (3.3) |
| Fluoride Rinse | 14 (23.3) | 16 (26.7) | 19 (31.7) | 11 (18.3) |
| Fluoride Gel Application | 8 (13.3) | 10 (16.7) | 25 (41.7) | 17 (28.3) |
| Fluoride Varnish Application | 6 (10.0) | 7 (11.7) | 22 (36.6) | 25 (41.7) |
| Chlorhexidine Rinse | 6 (10.0) | 13 (21.7) | 20 (33.3) | 21 (35) |
| Chlorhexidine Varnish Application | 5 (8.3) | 5 (8.3) | 13 (21.7) | 37 (61.7) |
| Stop Orthodontic Treatment | 4 (6.7) | 3 (5.0) | 9 (15.0) | 44 (73.3) |
| Continue Orthodontic Treatment with Removable Appliances | 3 (5.0) | 3 (5.0) | 13 (21.7) | 41 (68.3) |
| Additional Measures Applied After Debonding a Patient with Demineralization | | | | |
| Extra Oral Hygiene Instructions | 44 (73.3) | 10 (16.7) | 6 (10.0) | 0 (0) |
| Fluoride Rinse | 29 (48.3) | 15 (25.0) | 10 (16.7) | 7 (11.7) |
| Fluoride Gel Application | 26 (43.3) | 15 (25.0) | 9 (15.0) | 10 (16.7) |
| Fluoride Varnish Implication | 13 (21.7) | 23 (38.3) | 9 (15.0) | 15 (25.0) |
| Chlorhexidine Rinse | 12 (20.0) | 11 (18.3) | 22 (36.7) | 15 (25.0) |
| Chlorhexidine Varnish Application | 8 (13.4) | 12 (20.0) | 14 (23.3) | 26 (43.3) |
| Referral to a Dentist | 13 (21.6) | 10 (16.7) | 16 (26.7) | 21 (35.0) |
| Polishing of White Spots | 10 (16.7) | 14 (23.3) | 16 (26.7) | 20 (33.3) |

A=Agree, U=Usually, S=Sometimes, N=Never

Table 4: Patient Motivation During Orthodontic Treatment

| Motivation and Cooperation of Patients | n (%) | | | |
|---|-----------|-----------|-----------|---------|
| | A | U | S | N |
| How often do you see patients with fixed appliances with poor oral hygiene? | 4 (6.7) | 30 (50) | 24 (40) | 2 (3.3) |
| How often do they follow the instructions given? | 6 (10.0) | 22 (36.7) | 32 (53.3) | 0 (0) |
| How often does counseling on oral hygiene lead to improvement? | 12 (20.0) | 34 (56.7) | 14 (23.3) | 0 (0) |

A=Agree, U=Usually, S=Sometimes, N=Never

responsible. Approximately 50% of the respondents, however, agreed that demineralization was a significant aesthetic concern to their patients when fixed appliances were removed [Table 2].

Demineralization preventive protocol at the start of treatment

Irrespective of the use of a prevention protocol at the start of treatment, all respondents gave their patients oral hygiene instruction at the start of treatment. Of these, 90% recommended a specific method/cleaning aid, with the use of manual orthodontic tooth brushing is the

most frequently prescribed (78.3%), followed by use of dental floss (51.7%), interdental brushes (50%), electric brush (13.3%) and chewing sticks (1.7%).

Over half (53.3%) of the respondents always prescribed a specific demineralization prevention protocol to their patients at the start of treatment. The oral hygiene instructions were observed to be the most common component of the protocol (46.7%), followed by fluoride rinses. Chlorhexidine varnishes (3.3%) and fluoride varnishes/gels (5%) were observed to be the least recommended components of the protocol [Table 3].

Demineralization protocol frequency during and after treatment

Table 3 and Figure 1 shows the different measures used by orthodontists if demineralization occurred during treatment. Extraoral hygiene instructions and the explanation of the consequences of poor oral hygiene were the common components of the demineralization control protocol. Extraoral hygiene instruction involved emphasizing oral hygiene practices which comprised educating the patient on the need for routine tooth brushing in the morning and at bedtime, and after every meal as well as the use of dental floss for interdental cleaning. Fluoride rinses and gels were recommended

by 23.3%, 13.3% of the orthodontists respectively. Fluoride varnishes and chlorhexidine were infrequently prescribed.

At the end of orthodontic treatment, if demineralization lesions were observed, most orthodontists said they gave their patients extra oral hygiene instructions (emphasizing the frequent practice of oral hygiene). The use of fluoride rinses and gels were recommended by 48.3% and 43.3% of the orthodontists respectively. Chlorhexidine varnishes, fluoride varnishes, referral to the dentist and polishing of white spot lesions were uncommon recommendations to their patients [Table 3].

Patient compliance and co-operation

In response to the set of questions on patient motivation and co-operation, responses obtained showed that most of the patients had poor oral hygiene with moderate compliance rate to oral hygiene instructions. They, however, agreed that compliance was always accompanied by an improvement in oral hygiene [Table 4]. Most of the orthodontists surveyed (91.7%) however agreed on the need for the development of a protocol for the prevention of demineralization for orthodontic patients.

DISCUSSION

The purpose of this study was to evaluate the demineralization preventive and treatment measures used in Nigerian orthodontic practice and how it aligns with evidence-based recommendations.

Tooth demineralization occurs because of a combined effect of an interaction between bacterial plaque, diet and susceptible teeth and can be reduced or prevented if causative factors are modified.^[19] From the responses obtained in the current study, approximately 60% of orthodontic practitioners had patients who developed tooth demineralization during treatment, however, the majority of them never progressed to cavitation lesions. It was also observed that all respondents irrespective of whether a protocol was used or not gave oral hygiene instructions to their patients at the start of treatment with the aim of preventing white spot lesions. This was higher than observed in previous studies,^[2,18] however fewer orthodontic practitioners in this study made use of a specific prevention protocol (51.7%) when compared with previous studies^[2,18] (98% and 81% respectively).

Evaluating the frequently recommended tooth-cleaning aid, it was observed that the manual orthodontic toothbrush was the most frequently recommended. This is in tandem with reports from previous studies.^[2,18] Only 13% of respondents prescribed the use of electric toothbrush in the current study. This is comparable

with previous studies in other populations^[2,18] despite evidence showing that electric toothbrush showed greater efficacy in plaque and gingivitis control than did the manual toothbrush in orthodontic patients.^[20,21] The relatively high cost of electric toothbrushes^[14] and lack of information on its efficacy^[2] have been suggested as possible reasons why they were not frequently recommended. Also important is the concentration of fluoride in the toothpaste recommended to orthodontic patients. A study by Derks *et al.* 2004,^[10] recommended toothpaste with concentrating as high as 1500 ppm in orthodontic patients to prevent demineralization.^[1] This knowledge and practice were however not assessed in this study.

When a basic protocol was used by respondents in this study, oral hygiene instruction was the commonest component of the prevention protocol used (46.7%), followed by the fluoride rinse. This corroborates the findings from other studies.^[2,18]

Fluoride has been reported to be effective in the prevention of tooth demineralization.^[3,11,12,15,16,22-25] Its efficacy, however, is greatly influenced by its mode of administration. Geiger *et al.*^[23] demonstrated the efficacy of fluoride mouth rinse in preventing white spot lesions among orthodontic patients however, a poor compliance rate of 13% was reported. A mode of administration which takes away patients' compliance will, therefore, be preferable if consistent results are to be expected.

Fluoride varnishes have shown greater success because of their higher fluoride concentration and longer adherence to the tooth surface and when compared with other fluoride supplements (dentifrices, rinses and gels).^[26] Fluoride varnish in-office application twice a year was recommended by The American Dental Association's Council on Scientific Affairs for patients on orthodontic treatment and may be increased in patients with poor compliance in home demineralization preventive measures.^[27] Despite the available evidence, the fluoride varnishes were rarely recommended in this study.

Chlorhexidine is an effective adjunct to fluoride therapy, acting by altering the oral microflora in preventing tooth demineralization,^[10] with varnishes found to be more effective than rinses.^[1] However, as previously observed,^[2,18] they were rarely prescribed in this study.

It is difficult from the findings of this study to conclude that the failure to recommend best practices based on evidence is either because of unavailability of the fluoride and chlorhexidine supplements or because of lack of knowledge albeit these are probabilities.

The light bond and glass ionomer cement were most commonly used bonding materials for brackets and cementation of bands, with a majority of respondents agreeing to the use of fluoride-containing bonding agents. Against their diligence in using this is the evidence showing that the use of fluoride-containing bonding agents, however, is of no significance in preventing demineralization, as the fluoride fades away quickly, therefore is not effective on the long term.^[10,28]

This study showed that over 70% of the respondents reported that either none of their patients or less than 20% of them had demineralization at the end of treatment. Furthermore, the fact that about 60% were either neutral or disagreed that demineralization was a burden in their practice may, therefore, be responsible for their failure to adhere to available evidence to prevent white spot lesions/demineralization during orthodontic treatment, as they do not perceive it as a problem.

When demineralization occurred during or after treatment, extra oral hygiene, explanation of not following instructions and use of fluoride rises were followed in that order.

Interesting, on the other hand, is the degree of trust the orthodontists have in recommending oral hygiene instructions as the major component of their protocol, leaving its effectiveness to the compliance of the patient. This may be considered unwise showing the poor level of patient cooperation and motivation reported by the orthodontists in this study [Table 4].

Further reviewing the responses from this study, more respondents considered demineralization lesions as the patients' fault more than it was the orthodontists'. Conversely evaluating the measures used by orthodontists against the available evidence, it may be more correct therefore to assume that when demineralization lesions occurred, both the patient and orthodontist are responsible.

Although this study has some strength and has filled some gaps in orthodontic research, some limitations need to be considered. One limitation was the fact that the study population comprised of orthodontists (fellows) and orthodontic residents. This was done to obtain a significant sample size. However, different levels of orthodontic experience and years in practice may affect principles in patient management.

CONCLUSION

The demineralization preventive measures used by Nigerian orthodontists and orthodontic residents are inconsistent and not based on evidence-based information. The burden of demineralization could not

be objectively ascertained in the study. However, the respondents agreed on the need for the development of standardized demineralization protocol.

RECOMMENDATIONS

1. There is a need to carry out prospective studies to objectively determine the burden of the white spot to orthodontic patients and orthodontist in Nigeria.
2. To formulate a basic demineralization protocol among Orthodontic patients seen in Nigeria, bearing in mind that this may vary among patients.
3. To determine the efficacy of the formulated demineralization protocol developed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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