

Dental caries during orthodontic treatment: a review of the literature

Abstract

Background: Dental caries is a dynamic, non-transmissible and multifactorial disease caused by the acid generated by bacterial plaque. It is a very common pathology in the population, which in turn presents various risk factors that are often difficult to identify.

Objective: The objective of this research is to provide a broader view of dental caries during orthodontic treatment, not as specific clinical signs, but in a more comprehensive way, including all the associated factors involved.

Methods: A database search was conducted to obtain appropriate articles. The following databases were consulted: Pubmed, Medline, and The Cochrane Library, from 2010 to 2022.

Results: The results showed that there is an association between caries disease and the use of orthodontics, where the risk of presenting caries lesions increases in those who use orthodontic appliances and also have a higher risk of developing white spot lesions than those who do not use orthodontic appliances. It is also noted that the preventive use of different remineralizing agents could be useful in reducing the incidence of white spot lesions.

Conclusión: We can conclude that there is an association between the use of orthodontics and the presence of dental caries, with the white spot being the most studied sign of this. More studies are required with a methodology focused on caries as a complex and multifactorial phenomenon.

Keywords: dental caries, orthodontic treatment, bacterial plaque

Introduction

Dental caries is a dynamic, non-communicable, multifactorial disease mediated by biofilm and modulated by diet.^{1,2} It is the most prevalent disease in humans³ and accounts for 50% of all children in the world.⁴ It is a pathological process that causes cavitation in the teeth, a process that takes weeks or even years to be carried out, the first manifestation of this disease is usually the accumulation of biofilm on the tooth surface. The main and immediate cause is the acid produced by this film, but what should give us greater concern is the medium in which this acid is formed, which causes the subsequent dissolution of the teeth.⁵ In this medium, the most relevant acidogenic-aciduric bacterial species known to date are Streptococcus mutans, bifidobacteria and lactobacilli. While streptococcus mutans are initiators, bifidobacteria and lactobacilli are more enhancers of progression.⁶

The diagnosis of dental caries is composed of a set of clinical and radiographic signs and symptoms based on scientific knowledge of the physiology of the disease and clinical manifestation,⁷ so visual observation and intraoral radiographs are of utmost importance in the detection of caries, however, the latter may present suboptimal sensitivity in early caries lesions.⁸ "The introduction of the International Caries Detection and Assessment System (ICDAS) and the International Caries Classification and Management System (ICCMST™) provided an evidence-based method for comprehensive caries classification and management for dentists and teachers."⁹ It has been proposed that ICDAS, unlike many other methods and tools for caries detection, gives us greater accuracy and sensitivity with respect to the detection of occlusal caries lesions.¹⁰ There are different risk factors for it, and therefore, recognizing these factors and applying them has been one of the main tasks carried out by researchers.¹¹

"With over 700 species of microorganisms and some 19,000 phylotypes comprising dental biofilm, and with so many other factors

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that are associated with the progression or delay of disease processes (such as individual and cultural behaviors, variations in oral hygiene, variations in diet, salivary secretion, host immune responses, etc.) it is not possible to state precisely what exactly is happening at any given time at the interface between biofilm and hard tissues (enamel and dentin)."³

Dental caries can be controlled and its progression stopped most of the time by non-invasive and non-surgical interventions, as long as they have not infected the pulp.³ At the same time, orthodontics as a treatment for dental malposition and crowding is nowadays one of the most widely used options worldwide.¹² Orthodontic treatment provides many benefits of which esthetics is the main reason why patients undergo this type of treatment. However, it could be assumed that the malocclusion and alignment of the teeth may hinder oral hygiene, causing an accumulation of bacterial plaque and thus causing dental caries. There are several studies that report a positive correlation between dentomaxillary anomalies and the accumulation of bacterial plaque, although previous research has failed to directly confirm a relationship between dental malalignment and dental caries.¹³

In this respect, a multitude of randomized clinical studies, systematic reviews and meta-analyses have been meta-analyses have been performed to recognize their risk factors and treatment.^{14,15} Even so, the scientific literature has focused on this specific type of condition, probably because of its aesthetic impact, but no similar treatment for caries as a disease in itself is found in the literature, rather, it has been limited to registering, analyzing and treating a symptom of this disease: the white spot lesion. This review is intended to give a general overview of the caries phenomenon that occurs when orthodontic appliances begin to be used on the patient, and therefore, we will not be concerned so much with a specific sign of the disease (color changes, cavitations, etc.) as with the origin of these symptoms.

Materials and methods

In order to obtain updated data on the relationship between the use of braces and the incidence of dental caries, a bibliographic search was carried out, which is detailed below.

Literature search

A database search was performed in order to obtain appropriate articles. The following databases were consulted: Pubmed, Medline and The Cochrane Library, from 2010 to 2022.

Inclusion criteria

Articles were included according to the following inclusion criteria: 1. Only reviews, randomized clinical trials and cross-sectional studies were included. 2. The population in study are people who wear fixed metal, ceramic or sapphire orthodontics. 3. Only studies written in English were included.

Exclusion criteria

Of the selected studies, they were excluded in the following order: 1. Studies whose title was not related to the use of brackets and the study of caries. 2. Articles focused on specific populations such as people with motor dysfunctions and others were excluded.

Information synthesis method

The literature review showed different types of methodologies to assess the risk of caries, its prevention and the use of brackets. The studies were classified according to their type (RCT, reviews and cross-sectional studies), to their results and to the different risk factors that were considered to evaluate caries risk apart from the use of brackets. The results were analyzed according to these 3 variables.

Results

The total number of articles found was 3624, filtering by type 162 articles were obtained. Of these articles 14 were related to our research. Out of these 14 articles, 7 were reviews, 1 a cross-sectional study, and 6 clinical trials.

Association between caries disease and use of braces

5 of the articles directly evaluated the association between dental caries and the use of orthodontic appliances, and all were found to

Table I

Study authors	year	Type of study	Compared groups	Risk factors evaluated in addition to braces	Evaluated indicator	Results
Alice Pinto, Luana Severo Alves, Marisa Maltzb, Cristiano Susinc, Julio Zenkner. ¹⁶	2018	transversal	Without orthodontics vs. with braces treatment at different times	Age gender education oral hygiene family income	caries prevalence	chi2 test, significant
Ana Zilda Nazar Bergamo, atherina Morant Holanda de Oliveiraa. M'irian Aiko Nakane Matsumotob, a'ssio do Nascimento, Fa'bio Louren et al. ¹⁷	2019	prospective clinical study	Before and after braces installation	Dental hygiene previous gum disease	microbial flora	non-parametric test, significant
M Wishney ¹⁵	2017	review	Without orthodontics vs with orthodontics	-	white spot incidence	without test

Table Continued...

Study authors	year	Type of study	Compared groups	Risk factors evaluated in addition to braces	Evaluated indicator	Results
Yunlei Wang, Danchen Qin, Feiyang Guo, Colin Levey,b Greg Huang, Peter Ngan, et al. ²²	2019	review	different white spot lesion treatments	oral hygiene caries experience	white spot incidence	without test
Federico Perrini, Luca Lombardo, Angela Arreghini, Silvia Medori, Giuseppe Sicilianie. ²³ (1111 R R)	2016	prospective clinical study	Fluor varnish vs no fluor varnish	oral hygiene	white spot incidence	chi2 test, significant
Maria Contaldo, Alberta Lucchese, Carlo Lajolo, Cosimo Rupe, Dario Di Stasio, AntonioRomano et al. ¹⁸	2021	review	without orthodontics vs with orthodontics	-	microbial flora	without test
1111 R RCT2						
Hanna Enerback, € a Peter Lingstrom, € b Marie Moller, € c Cathrine Nylen, c Cecilia Odman Bresin, € c Ingrid Ostman Ros, € c and Anna Westerlunda ¹⁹	2022	randomized clinical trial	different uses of fluoride in caries prevention	home fluoride	cavitated caries	kruskal wallis test, mixed results
Huimin Hu, Chong Feng, Zhaowei Jiang, Lufei Wang, Sonu Shrestha, Xiaoming Su4, Yu Shu, Long Ge6, Wenli Lai, Fang Hua and Hu Long ²⁰	2019	systematic review with meta-analysis	control group vs group with orthodontics and remineralizing agents	age sex ethnicity	incidence and severity of white spot lesions	chi2 test, significant
van der Veen MH, Attin R, Schwestka-Polly R, Wiechmann D ²⁴	2010	prospective clinical study	buccal braces vs lingual braces	use of fluoride varnish	white spot incidence	t test for paired samples, significant
Tasios Thomas, Papageorgiou Spyridon N, Papadopoulos Moschos A, Tsapas et al. ²⁵	2019	review with meta-analysis	Efficacy of different treatments against the development of white spot lesions	-	white spot incidence	I2 test T2 test
1111 R SRM 2						
Divesh Sardana, Jingyang Zhang, Manikandan Ekambaram, Yanqi Yanga, Colman P. McGrath, Cynthia K.Y.Yiu ²⁶	2019	review with meta-analysis	Fluoride effectiveness against white spot lesions during orthodontic treatment Fluoride	prevention and reversal of white spot lesions	random effect inverse variance method for meta-analysis, Mantel Haenszel fixed-effect method y chi2 test	sealants: RR=0.77; 95% CI=0.63 to 0.95; P=0.01; I2=50% fluoride varnish: MD=-0.32 mm2; 95% CI=-0.44 to -0.21 mm2; P<0.001; I2=0%

Table Continued...

Study authors	year	Type of study	Compared groups	Risk factors evaluated in addition to braces	Evaluated indicator	Results
 R SRM 4						
Anas H Al Mulla, Saad Al Kharsa, and Dowen Birkhed ²⁷	2010	randomized clinical trial	effectiveness of oral hygiene instruction vs. conventional oral hygiene instruction	oral hygiene	cavitated caries	RR= 0.26 - 0.59 (0.95) for fluoride varnish I ² = 81.2 test - t
Fadi Ata-Ali, Javier Ata-Ali, Marcela Ferrer-Molina, Teresa Cobo, Felix De Carlos, and Juan Cobo ²⁸	2015	review with meta-analysis	lingual and buccal orthodontics	-	Cavitated and non-cavitated caries (among others)	inverse-variance method of Der Simonian and Laird, not significant
Esma J Doğramacı, David S Brennan ²¹	2018	non-concurrent prospective	without orthodontics vs with orthodontics	Socio-demographic factor oral hygiene	Influence of Orthodontics on dental caries	negative binomial regression, not significant
 RCT						

Discussion

There is abundant literature regarding the link between orthodontic treatment and the phenomenon of dental caries. Most of the studies found suggest that there is a relationship between its use and the prevalence and incidence of caries. Even so, there are methodological variables that reduce the internal validity of some studies and that must be interpreted with caution.

The phenomenon of dental caries is multifactorial, so when it is studied in relation to its risk factors, these should be adjusted for those that are known to influence its development. In this regard, the study carried out by Alice et al.¹⁶ is the most complete since it was adjusted for age, gender, education, hygiene and family income. All independent risk factors for the phenomenon of dental caries, even so, due to the nature of the study, it cannot be classified as more than low-quality evidence. At the same time, the use of the chi-square test does not provide measures of association, so we cannot weigh the strength of this association, we only know that it exists.

Other studies such as those by Wang et al.²² Perrini et al.,²³ Huimin et al.²⁰ adjust their measurements only for oral hygiene and use of fluoride. Special mention should be made of the social determinants in health that are absent in most of the comparisons but that have been strongly associated with the phenomenon under study. Thus, the comparison of a group without braces with another group that has braces could be distorted if household income is uneven, even when age, gender, and fluoride use have been considered.

Another discretion that must be taken is that most of the articles deal with a specific type of caries, that is, the white spot. They approach the phenomenon of caries from this perspective even when there are other signs that could account for a higher incidence or prevalence of the pathology. In several articles, the methodology to evaluate the presence of caries is visual inspection, but without an Rx complement. We know that this lowers the sensitivity of the technique, which could bias the study. Perhaps the most important problem is the lack of integration in caries evaluation of the complexity of factors that affect it. Thus, the measurement of the change in the oral bioflora may be an indication that helps to link the phenomenon of caries with the use of braces, but in no way proves that there is an association or causality between caries and the orthodontic treatment. In the same way, the absence of adjustment for the different risk factors generates caries

studies that do not account for the real complexity of the phenomenon, and that deliver apparently significant results.

Conclusions

Considering the studies carried out, we can conclude with a medium level of evidence that there is an association between the use of braces and the presence of the caries phenomenon, with the white spot being the most studied sign of this. Even so, more studies with a methodology focused on caries as a complex and multifactorial phenomenon are required to reach a more reliable conclusion. At the same time, in addition to performing the analysis adjusted for risk factors, it is necessary to evaluate the incidence of caries with all the available signs associated with it.

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None

Conflicts of interest

The author declares no conflict of interest.

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