**International Journal of Contemporary Dental Research (IJCDR)**
Vol. 01, Issue. 4, Oct 2023, pp. 18~20
ISSN –2584-0274 DOI: https//doi.org/10.62175/apdch2321 

# Microplastics in Orthodontics

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**Article Info**

***Article history:***

**Received:**08/02/2023
**Revised:** 09/14/2023
**Accepted:** 10/18/2023

***Keywords:***

MICROPLASTICS,
TOOTH PASTE,
RETAINERS ,
ALIGNERS,
RESIN-BASED COMPOSITE,
RUBBER BAND.

**ABSTRACT**

**Introduction :**The role of microplastics in the environment have become a major concern over the years .the leaching of microplastics from the materials used in the orthodontics has been increased .primary and secondary microplastics are leached from the materials such as tooth paste, retainers , resin-based composite and aligners. Microplastics and nano plastics are small plastic fragments of <5 mm and <1000 nm, respectively. Most commonly, MPs are defined as synthetic polymer particles or fibers with a diameter of 1–5000 μm , even though the lower limit has been extended down to 100 nm by the European Food and Safety Authority (EFSA). Their ingestion could cause oxidative stress and inflammatory lesions. Thus, it is important to enhance the understanding of microplastics to minimise the potential risks.



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## 1. INTRODUCTION

In recent years, environmental microplastics have raised concerns about public health. The two main dental items that are responsible for the environmental contamination caused by microplastics are toothpaste and composite restoration materials. Clear orthodontic aligners have recently seen increasing popularity. Even though it is well recognised that plastic items can degrade mechanically and environmentally, releasing microplastics (MPs), thermoplastic materials offer a number of benefits. Currently, we still have very limited knowledge on the emerging contamination, not only in terms of the source but also about the exposure, pathway, fate, transportation, and toxicity. Regarding the source, for example, microplastics and nano plastics can be formed through fragmentation or breakdown of big plastic items due to physical factors such as scratch and cutting. Microplastics and nano plastics are small plastic fragments of <5 mm and <1000 nm, respectively. Many of these items are used in our daily lives and even can come into contact with the mouth, such as feeding bottles and silicone-rubber baby teats, leading to the risk of microplastics and nano plastic ingestion. It is thus important to enhance our understanding of these plastic items before measures can be taken to minimize the potential risks[1].

## II. TYPES OF MICRO PLASTICS

Depending on the origin we differentiate them into

- Primary microplastics

They are manufactured as microbeads, capsules, fibres or pellets. Examples include microbeads used in cosmetics and personal care products, industrial scrubbers used for abrasive blast cleaning and microfibers

used in textiles. Primary microplastic can also come from the run-off/effluent of plastic product fabrication or manufacturing facilities.

- Secondary microplastics

They are the result of larger pieces of plastic breaking down into smaller pieces. When plastic waste is exposed to sunlight, it starts to deteriorate and break apart. It is generated by the fragmentation of larger plastic items by UV radiation, physical abrasion and microbial processes[2].

## III. FROM TOOTH PASTE

In terms of dental origin, toothpaste containing plastic particles <5 mm, forms the source of primary microplastics. In addition, the general public knows very little about the presence of microplastics in personal care products. Tooth enamel and dentine abrasion can result from using toothpaste containing microbeads for extended periods of time. The microbeads can get entrapped in the gingival sulcus leading to gingivitis and periodontitis[3].

## IV. FROM ALIGNERS

The growing demand for “invisible” orthodontic treatments among both child and adult patients, led to an upsurge in the development of esthetic and comfortable alternatives to conventional fixed appliances The first digitally designed and manufactured removable polyurethane aligners, based on the Invisalign® system, were launched in 1998 by Align Technology©. Patients should wear each aligner for up to 22 h/day for 7–14 days, according to the manufacturer's protocol; the number of prescribed aligners depends on the amount of dental crowding and case complexity[4]. The thermoplastic materials used by aligner manufacturers mainly include polyethylene terephthalate (PET), polypropylene, polycarbonate, and polyurethanes (PU). These polymers are vulnerable to a number of mechanical and environmental conditions that can break them down into fragments known as secondary microplastics. In actuality, small plastic fragments are referred to as "microplastics" (MPs), a term that was first used in 20045.[5]. Most commonly, MPs are defined as synthetic polymer particles or fibers with a diameter of 1–5000 μm , even though the lower limit has been extended down to 100 nm by the European Food and Safety Authority (EFSA)[2]. Their ingestion could cause oxidative stress and inflammatory lesions.[1]

## V. FROM RUBBER BANDS

Most teenagers experience orthodontic treatment , but we do not know the possible adverse effects of the released microplastics and nano particles that are recently categorised as emerging contaminants. During the treatment process, many plastic items are involved, such as rubber bands that are generally employed to improve the biting. The “rubber band” might be made of latex (a natural polymer), EPDM, polyisoprene, or silicone. However, the use of rubber bands raises concerns about the possible release of microplastics and even nano plastics into our mouths directly. Particularly, this kind of exposure to teenagers should be well studied, given that they are young and their bodies are still in the growing process. Unfortunately, there is a rare report so far, perhaps the reason is that the detection of microplastics is still difficult, even more difficult for nano plastics.

## VI. FROM RESIN-BASED COMPOSITES

Resin-based composites used in CADCAM milling, pit and fissure sealants, and direct restorative products have the potential to release monomers like Bisphenol A-glycidyl methacrylate (Bis-GMA), which poses a serious environmental risk when disposed of in landfills. Secondary microplastics are formed from the resin-based composite restorative materials which degrade within the oral cavity or may be released during the process of finishing and polishing of restorations. Studies have confirmed the damage to aquatic life caused by microplastics which can lead to the extinction of various aquatic species in future. Additionally, they absorb biotoxins by adsorption, and via bioaccumulation, they make their way up the food chain. A few nations have passed laws restricting the use of microplastics in health care products. Many, nevertheless, do not have such stringent rules. Therefore, an educational and regulatory approach toward the use of microplastics is mandatory to control the emerging threat of microplastics to the environment[6]

## VII. FROM RETAINERS

Quantifiable amounts of leached BPA were observed from a thermoformed orthodontic retainer material (7.63 µg/g of material) and an orthodontic adhesive (2.75 µg/g of material). BPA leaching was only observed within the first 3 days of artificial saliva immersion[7].

## EFFECTS OF MICROPLASTICS

Many different orthodontic products are used routinely during and after orthodontic treatment, including but not limited to, brackets, adhesives, cements, ligatures, clear aligners, and retainers. In the manufacturing process of some of these products, BPA is utilized as a starting material. Intraorally, these materials are exposed to extreme thermal changes, mechanical wear, pH changes, and enzymatic degradation from bacterial and salivary enzymes, which can cause microplastic leaching. Moreover, the inability of the immune system to remove these synthetic particles may lead to chronic inflammation and increase risk of neoplasia[8]. In general, the potential toxicity of microparticles depends on their shape, chemical composition, and size. Size is a crucial factor for the uptake, intended as the penetration into either cells or tissues beyond the epithelial surface; it has been observed that very small particles are able to passively cross cell membranes, while larger ones require active endocytosis[9]. Generally, processes facilitating active uptake into tissues appear to work on particles up to 1 µm[10] . As regards the shape, it influences the toxicity modifying interactions with cells and tissues: it has been demonstrated that microfibers interact with cells and tissues differently than microspheres, fragments, or films[11]. The detached small polymer fragments can be considered as secondary MPs and their ingestion could cause oxidative and inflammatory processes in orthodontic patients.[7]

## CONCLUSION

Millions of microplastics and even nano plastics might be released daily into the mouth of a teenager from the rubber bands, retainers ,resin-based composite and aligners used for orthodontic treatment, which might be a big concern. The characterization of microplastics and nano plastics is still a challenge. With the advancements in the past few years, we currently can test most of them, but the accuracy and certainty should be further improved and research is needed to address risk assessment.

## REFERENCES

[1] Quinzi V, Orilisi G, Vitiello F, Notarstefano V, Marzo G, Orsini G. A spectroscopic study on orthodontic aligners: First evidence of secondary microplastic detachment after seven days of artificial saliva exposure. Sci Total Environ. 2023;866:161356.
[2] Cole M, Lindeque P, Halsband C, Galloway TS. Microplastics as contaminants in the marine environment: a review. Mar Pollut Bull. 2011;62(12):2588–97.
[3] da Costa JP, Santos PS, Duarte AC, Rocha-Santos T. (Nano) plastics in the environment–sources, fates and effects. Sci Total Environ. 2016;566:15–26.
[4] Al-Nadawi M, Kravitz ND, Hansa I, Makki L, Ferguson DJ, Vaid NR. Effect of clear aligner wear protocol on the efficacy of tooth movement: A randomized clinical trial. Angle Orthod. 2021;91(2):157–63.
[5] Frias JP, Nash R. Microplastics: Finding a consensus on the definition. Mar Pollut Bull. 2019;138:145–7.
[6] Chandran T, Vishnu U, Warrier AK. Microplastics in Dentistry—A Review. In: Muthu SS, editor. Microplastic Pollution [Internet]. Singapore: Springer Singapore; 2021 [cited 2024 Feb 11]. p. 157–74. (Sustainable Textiles: Production, Processing, Manufacturing & Chemistry). Available from: http://link.springer.com/10.1007/978-981-16-0297-9_6
[7] Kotyk MW, Wiltshire WA. An investigation into bisphenol-A leaching from orthodontic materials. Angle Orthod. 2014;84(3):516–20.
[8] Prata JC. Airborne microplastics: consequences to human health? Environ Pollut. 2018;234:115–26.
[9] Triebskorn R, Braunbeck T, Grummt T, Hanslik L, Huppertsberg S, Jekel M, et al. Relevance of nano-and microplastics for freshwater ecosystems: a critical review. TrAC Trends Anal Chem. 2019;110:375–92.
[10] Kuo E, Miller RJ. Automated custom-manufacturing technology in orthodontics. Am J Orthod Dentofacial Orthop. 2003;123(5):578–81.
Allegri M, Bianchi MG, Chiu M, Varet J, Costa AL, Ortelli S, et al. Shape-related toxicity of titanium dioxide nanofibres. PLoS One. 2016;11(3):e0151365.