

# Aligners- Their Properties and Disposal

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## Abstract

In this ever-evolving world, with an increase in demand for aesthetics, Thermoplastic aligners have become the current trending and adaptive orthodontic treatment modality. However, with an increase in usage of thermoplastic aligners, there has been a constant surge of non -biodegradable plastic waste with each passing year, which in turn is making the world disease prone and unfriendly to the environment. So, to avoid environmental issues, we as an orthodontist should come up and work towards reducing plastic waste. Therefore, this SOP aims to provide guidelines to discard aligners in a systematic way to reduce biohazards.

**Keywords:** aligners, discard, non-biodegradable, Orthodontics, plastics

## INTRODUCTION

Orthodontics is now approaching a fancy and aesthetic tomorrow since it began as a specialty of dentistry in the early 1900s.<sup>1</sup> From metal ring cemented to the tooth to the bondable metal brackets to the monocrystalline ceramic brackets to clear aligners.<sup>2,3</sup> This amazing technological leap represents a revolution.<sup>2</sup>

Towards the end of the last century, and in the first decade of this century, the first aligners for orthodontic purposes appeared.<sup>4</sup> This innovative development was driven primarily by patient demand for a more aesthetic, comfortable, and unobtrusive orthodontic treatment. Since it was introduced as an orthodontic treatment option, aligners have become very popular and the number of patients receiving orthodontic treatment with aligners is steadily increasing. The use of aligners in orthodontics has created a paradigm shift in orthodontics and encourages people of all ages, including the elderly, to seek treatment for a malocclusion.

Due to its aesthetic properties, global markets have seen a surge in aligner demand. The clear aligners market size was estimated at USD 4.7 billion in 2021, globally and from 2022 to 2030 is assumed to grow at a compound annual growth rate (CAGR) of 29.5%.<sup>5</sup> With such an exponential increase in the use of aligners, one also needs to consider the biomedical waste generated by aligners, which would also increase substantially.<sup>6</sup>

We must keep in mind how villainous discarded aligners can be for our environment as they are made up of nonbiodegradable plastics. These plastics can take up to centuries to decompose and has the potential to cause a threat to our environment.<sup>7</sup>

Therefore, their disposal must be given due care. Management of Biomedical waste (BMW) in terms of aligner disposal is important. WHO has confirmed that the government needs to allocate a portion of the budget to establish, support & maintain an efficient waste management system. This consists of modern and complex methods/devices to lessen the quantity and toxicity of clinical waste. Non-governmental businesses want to put in force applications and ventures that make contributions to this incentive.<sup>8</sup>

## DISCUSSION

The emergence of the orthodontic aligner treatment protocols has improved social attitudes and has played a major role in the patient's acceptance of orthodontic treatment, especially among adults. Clear aligners are available in a variety of thickness, ranging from 0.50 mm to 1.5 mm.<sup>9</sup> Varying thickness of the aligners have an impact on their mechanical properties and, as a result, their performance. The stability and transparency of the orthodontic clear aligners need to be dimensionally stable and maintain their transparency in the oral environment.<sup>10</sup>

According to the literature, Polyethylene Terephthalate Glycol (PET G) is most commonly used by aligner manufacturers, but with a variety of polypropylene, polycarbonate (PC), thermoplastic polyurethane (TPU), ethylene

vinyl acetate, etc.<sup>10</sup> The aligner material must have good light transmission and be able to transmit 80% of visible light. Polyurethane, polyester, polyvinyl chloride, polysulfone, and polycarbonate are some of the polymer materials with excellent optical properties suitable for the manufacture of aligners.<sup>11</sup>

Aligners are constantly exposed to saliva at body temperature and can adversely affect the chemical composition of the polymer. Certain polyesters, such as polycarbonate and polyamide, can undergo irreversible hydrolysis that can degrade the polymer structure. Thus, the polymer that is used to make aligners must be resistant to hydrolysis and water degradation.<sup>11</sup>

The surface roughness of the clear aligner helps in the retention of the aligner over a tooth surface, surface roughness reduces after one week of usage and continues to decrease after the next few weeks of wear. Deterioration of roughness parameters and mechanical properties have an undesired effect on the retention and orthodontic pressure during aligner treatment.<sup>12</sup> A 14-day tray regimen was followed to overcome this issue of retention due to a decrease in surface roughness. However, studies have now shown that the 7-day protocol of aligner tray is more efficient in tooth movement as compared to the 14-day protocol. The total number of aligner trays in each case will vary greatly as it depends on the type of malocclusion, frequency of change, and the number of revision aligners.<sup>13</sup> With the increase in the popularity and demand for clear aligner treatment, we need to introspect the environmental risks posed by discarded aligners. Aligners are made up of non-biodegradable thermoplastic material especially, Polyethylene Terephthalate which is highly resistant to decomposition.<sup>14</sup> In addition, toxic gases released during combustion like Polychlorinated biphenyls, dioxins, etc. pose a threat to all living organisms when released into the atmosphere.<sup>15</sup> Studies published by the Environmental Health Perspective have found that even a trace amount of these particles in the environment pose a hazard and have the potential to cause diseases such as immune system changes, prostate enlargement, diabetes, hyperactivity, infertility, obesity, precocious puberty, and breast cancer.<sup>16</sup> Therefore, the need of the hour is to develop standard protocols for the proper disposal of aligners.<sup>17-20</sup> Different authors have prescribed various methods for aligner disposal. Keeping in mind the work done by Mithun et al<sup>17</sup>, Gautam et al<sup>18</sup>, and Saini et al<sup>19</sup>, the following Standard Operating Procedures (SOP) for the disposal of aligners have been devised (Figure 1).

“Figure 1: Protocol for Discarding Used Aligners “



Mechanical or secondary recycling is a viable alternative and consists of turning post-consumed plastic waste into granules (pallets) that can be reused in the production of other materials. This recycling produces products made

from a single type of plastic or a mixture of different plastics. It is estimated that only 9% of the world's post-consumption plastic waste is mechanically recycled.<sup>21</sup>

## CONCLUSION

With the current increasing trend of aligners, we need to be aware of the basic properties of aligners, the plastic burden and hazards caused by aligners, and their systematic disposal or recycling, which would help us save the environment without hampering progress in the field of Orthodontics.

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