



Clear Aligners: A Narrative Review

Dr. Swati Mrinal, 2nd year PG, Department of Orthodontics and Dentofacial Orthopaedics,
Awadh Dental College and Hospital, Jamshedpur

Dr. Pragya Trivedy, 3rd year PG, Department of Orthodontics and Dentofacial Orthopaedics,
Awadh Dental College and Hospital, Jamshedpur

Dr. Sourav Agarwal, 3rd year PG, Department of Orthodontics and Dentofacial Orthopaedics,
NIMS Dental College and Hospital, Jaipur

Dr. Navjeet Dhillon, 3rd year PG, Department of Orthodontics and Dentofacial Orthopaedics,
NIMS Dental College and Hospital, Jaipur

Dr. Mrinal Kumar Nandi, Reader, Department of Orthodontics and Dentofacial Orthopaedics,
Awadh Dental College and Hospital Jamshedpur

Corresponding author: Dr. Swati Mrinal, 2nd year PG, Department of Orthodontics and
Dentofacial Orthopaedics, Awadh Dental College and Hospital, Jamshedpur

Abstract: A major consideration for people seeking orthodontic treatment is aesthetics, which is also a top priority. Researchers have developed a range of alternatives, including ceramic or composite braces, lingual orthodontics, and transparent aligners, to satisfy the growing aesthetic need for a traditional brace substitute. A set of transparent dental appliances that are specifically designed to suit a patient's teeth are used in the procedure known as clear aligner therapy. Alternatives to conventional braces that are used to straighten teeth include clear aligners. Similar to braces, clear aligners use a progressive force to control tooth movement, but they do it without the need of metal wires or brackets. The objective of present review literature is to discuss clear aligner therapy in detail.

Keywords: Clear aligner, Orthodontic treatment, Aligner, CAT

Introduction: Clear plastic aligners are an alternative to dental braces for straightening teeth. The clear aligner technique (CAT) has recently gained popularity as an alternative to conventional fixed orthodontic equipment in the orthodontic community due to the rising

expectations for aesthetic and comfort among patients seeking orthodontic treatment. The initial purpose of clear aligners was to fix modest gaps and treat mild to moderate tooth crowding. CAT can be used to repair more complicated malocclusions, including extraction cases, as proven by the various papers and expert experiences available today.¹ In today's world, fixed appliance therapy and aligners are at a crossroads. Initially aligner service provided by licensed orthodontists only, aligners are now being delivered by general practitioners as well. Today, people may receive aligners at their door without having to travel to a dental office thanks to firms like Direct Smile.²⁻⁴ This in-depth narrative review will give readers a thorough knowledge about clear aligner therapy.

Table 1: Evolution of Clear Aligner⁵

Generation	Specification
1st generation (2000)	Displacement-driven i.e. solely dependent upon aligners shape for results and no attachments were involved
2nd generation (2009)	Invisalign introduced Smart Force attachments like, for extrusions and rotations which are patient specific and tooth specific and which continuously deliver forces to teeth
3rd generation (2010)	G3 Precision Cuts for Class II/III inter maxillary elastics
4 th generation (2011)	G4 attachments were introduced to enhance the clinical outcomes in Open Bites cases
5 th generation (2013)	G5 Smart Track aligner material, highlights of this material are greater and constant force delivery, chemical stability and precise fit. G5 attachments for correction of deep bite were introduced to level the curve of spee by controlled premolar extrusion and anterior intrusion
6th generation (2014)	G6 for first premolar extraction: Optimized retraction attachments were introduced for bodily movement of canine which would eliminate unwanted tipping and anterior extrusion with or without elastics.
7 th generation (2016)	G7 delivers better upper lateral control, improved root control, and

	features to address prevention of posterior open bites
8 th generation (2020)	G8 attachments for crowding and crossbite cases

Clear aligner production process: Patients who use invisible aligners get the same standard examination and diagnosis methods as other patients, including clinical and laboratory testing (X-rays and study models). Models can be created using impression materials such as polyvinyl silicone, with silicone bite material being utilised to record the maximum inter-cuspatation. A 3D scanner is also a viable option for capturing the details. The chosen aligner maker will subsequently receive the recorded diagnostic information for further processing.⁶

3-D model are prepared at lab and send to the concerned orthodontist, with the results being elaborated after each stage of aligner use. The concerned orthodontist requests any alterations to the method, which the maker of the aligners incorporates (if practical) into the treatment protocol. Before beginning any procedure of fabricating the aligners, all such disagreements are reconfirmed with the appropriate orthodontist.^{6,7}

Several thermoplastic polymers, like as polyvinyl chloride, polyurethane, polyethylene terephthalate, and polyethylene terephthalate glycol, are used for thermoforming transparent aligners. For each aligner to be thermoformed and finally trimmed, a physical model (created using 3D printing, stereolithography, or material jetting) is required.¹

Small tooth-colored structures called attachments are affixed to the teeth either before or after aligner therapy. They let the aligner's forces to be transferred from the aligner to the teeth.¹ It is advised to schedule a follow-up appointment after switching from one set of aligners to the next in order to evaluate the patient's comfort and usability as well as to address any problems or concerns they may be having. To evaluate the effectiveness of the treatment, a reassessment is advised every four weeks, with a change in aligner therapy being advised every two weeks.⁸

Table 2: Indication and Contraindication of Clear Aligner⁹⁻¹¹	
Indication	Contraindication
Problems with mildly crowded and misaligned areas (1–5 mm). Maxillary molar distalization	Severe spacing over 5 mm Severe crowding requiring extraction Skeletal discrepancies >2 mm

Deep bite correction with intrusion Arch expansion Spacing problems of teeth of about 1-5 mm Deep overbite in terms of Class II div 2 cases Patients with narrow arch Distally tipped molars Malaligned teeth Lower incisor extraction in case of severe crowding cases	Teeth which are rotated Extrusion – requires more force Short clinical crowns Multiple missing teeth.
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Table 3: Advantage and Disadvantage of Clear Aligner Therapy^{10,12-15}	
Advantage	Disadvantage
More esthetic appealing Acceptable to patient Better oral hygiene Technically much easier than lingual appliances Ideal for retreatment Facilitate excellent dental hygiene Easy to use Less chairside time Extractions can be avoided Faster and predictable results	All clear aligner cases needs patient compliance Not cost-effective Availability There is possibility of misplacing the appliance Though exceedingly rare, allergic and toxic responses to the aligner material may occur

Discussion: With clear aligner therapy, the patient wears a series of removable, clear aligners that are individually made to progressively move the teeth into the desired position. Depending on how severe the malocclusion is, a different number of aligners may be required. Because of their invisibility, which is a result of their optical qualities, clear aligners are superior.¹⁶ Adult patients select clear aligner treatment despite the escalated cost and orthodontists practice clear aligners despite its biomechanical limitations because of the aesthetics it offers. The optical

properties of the different clear aligners vary because of the composition of the materials used in manufacturing.¹⁷

The optimal material characteristics for a transparent aligner would include a large spring back, high stored energy, tolerance to the oral environment, biocompatibility, and low surface roughness. The thermoplastic material used to make the aligners has mechanical qualities that are essential for delivering consistent orthodontic forces that can yield the desired results. Orthodontic thermoplastic materials should have desirable attributes including transparency, which is defined by optical properties, decreased hardness, greater elasticity and resilience, and ageing resistance.¹⁸

There are several different thicknesses of clear aligners, ranging from 0.50 mm to 1.5 mm. This may affect their mechanical characteristics and, consequently, their performance, much like the building material did.¹⁹

With their permanent teeth fully erupted, adults or teenagers should use CAT. There is debate concerning the treatment indications for these aligners, despite the fact that it is generally acknowledged that CAT is not the best option for many orthodontic issues. Some say they should be used on people with modest dental crowding, but others say they can be utilised in cases of more complicated orthodontics.²⁰

In general, mild crowding (1-5 mm), spacing issues (1-5 mm), deep overbites (Class II, div 2), narrow arches requiring expansion, absolute intrusion (one or two teeth), severe crowding with lower incisor extraction, and molars needing distal tipping are indications for CAT. The following are the contraindications: Open bite cases, cases requiring teeth extrusion, cases with multiple missing teeth, cases with crowding or spacing problems of more than 5 mm, anteroposterior skeletal problems of more than 2 mm, centric relation and centric occlusion discrepancies, severely rotated and severely tipped teeth, and teeth with short clinical crowns.²⁰

Conclusion: A more aesthetically beautiful and practical alternative to conventional fixed mechanics is clear aligners. In cases of mild to moderate crowding, clear aligners can be used, but complex cases should be treated cautiously. The risk of root resorption associated with orthodontic treatment is still present in aligner therapy, such as with fixed appliances.

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