

Aligners- The science of Clear Orthodontics



INTRODUCTION: The active clear plastic trays fitting snugly onto the teeth, each worn for 2 weeks on an average, and changed sequentially to accomplish the incorporated tooth movements.

ORIGIN STORY:

The chronology of clear aligners leading up to their present-day use dates back to 1945 when Dr. Harold D. Kesling first advocated a rubber appliance for moving teeth. Nahoum and Sheridan developed their appliances using the same concepts. Later in 1997, Zia Chishti and Kelsey Wirth developed a clear aligner system called Invisalign®, which was launched by Align Technology® (Santa Clara, CA) and is credited with bringing a comfortable alternative to braces to mainstream orthodontics. An onslaught of clear aligner systems have since followed that are being used to correct minor to complex malocclusions.

BENEFITS

- Aesthetics
- Comfort
- Improved oral hygiene and periodontal health
- No food restrictions
- Predictable treatment time
- Decreased dental office visits
- Minimal emergencies
- Possible to include teeth with structural anomalies and difficult-to-bond surfaces.

LIMITATIONS

- Dependency on patient compliance
- Limited extent of tooth movements by aligners alone
- Higher cost.
- Initial slurring of speech
- Breakages
- Chances of losing the aligners
- Inconvenience

Principles of Clear Aligner Therapy

Creating Space

Force/Pressure Application



BIOMECHANICS

Force driven system- Pressure points and attachments are incorporated into aligners that apply the forces required for planned movements.

Displacement driven system- Controls tipping and minor rotations. Aligners are fabricated as per next staged position; the tooth continues to move till the aligner becomes passive

PROPERTIES

- Mechanical:** Force delivery depends on amount of activation, type of material, thickness of material and size and shape of adjacent teeth. Wear resistance is directly proportional to the hardness of material.
- Aging:** Micro-cracks, delaminated areas, calcified biofilm deposits, loss of transparency, decline in residual stresses, increased water absorption are reported with use over time.
- Stainability:** Colours changes are seen in aligners when exposed to coffee, black tea, red wine.

TYPES OF MATERIALS USED

THICKNESS	PRODUCT NAME	COMPONENTS
1.0 mm	Bioplast	Ethylenevinyl acetate copolymer
1.0 mm	Copyplast	Ethylenevinyl acetate copolymer
1.0 mm	Duran	Polyethylene terephthalate glycol
0.8 mm	Hardcast	Polypropylene
0.75 mm	Imprelon "S"	Polypropylene
0.040 in.	Essix A+	Copolyester
0.040 in.	Essix C+	Polypropylene/ ethylene copolymer (>95%), stabilizers (<5%)
0.030 in.	Invisalign	Polyurethane from methylene diphenyl diisocyanate and 1,6-hexanedial, Additives

GINGIVAL MARGIN DESIGN: 3 types

Scalloped



Straight cut at Gingival



Straight cut 2mm above the Gingival Zenith (*Most retentive*)



**IDEAL WEAR TIME
OF ALIGNERS:**
22 hours per day
for 2 weeks

DIGITAL PROCESS OF ALIGNERS FABRICATION

Digital Impressions (Scans)

Scans uploaded to the
software

Virtual treatment planning

Digital Teeth Sectioning

Interproximal reduction
planned

Treatment plan sent for
review

Teeth moved digitally for
alignment

Incorporation of
attachments/auxillaries for
aiding tooth movement

Sequence of aligners
fabricated

DenToGo – a device for
remote monitoring of clear
aligner patients which
helps with:

- Efficient scheduling
- Increased compliance
- Personalized messages



CONCLUSION

Clear aligner treatment has flourished since its introduction into orthodontics. Continued developments on the technological front are being adapted to improve its efficiency, especially in complex cases. Being a removable appliance, patient compliance is the foremost criteria for success of treatment with aligners and patient motivation is indispensable to avail the planned treatment outcomes. Arrays of companies are manufacturing aligners today, accounting for the increased demand by patients seeking orthodontic treatment, with the number increasing every year.

REFERENCES

1. [https://support.ClearCorrect\(ClearCorrect, Round Rock, TX, USA\).com/hc/en-us/articles/115006636087-2-basic-principles-for-clear-aligner-treatment](https://support.ClearCorrect(ClearCorrect, Round Rock, TX, USA).com/hc/en-us/articles/115006636087-2-basic-principles-for-clear-aligner-treatment)
2. Tamer İ, Öztaş E, Marşan G. Orthodontic Treatment with Clear Aligners and The Scientific Reality Behind Their Marketing: A Literature Review. *Türk J Orthod.* 2019; 32(4): 241-6.
3. Drake CT, McGorray SP, Dolce C, Nair M, Wheeler TT. Orthodontic Tooth Movement with Clear Aligners. *ISRN Dent.* 2012; 2012:657973. doi: 10.5402/2012/657973.
4. Ryokawa H, Miyazaki Y, Fujishima A, Miyazaki T, Maki K. The mechanical properties of dental thermoplastic materials in a simulated intraoral environment. *Orthodontic Waves.* 2006 Jun 1;65 (2):64-72.
5. Andreason *et al.* Orthodontic aligner fabrication by overlay method. United States. US9,345,557B7. May 24, 2016.
6. Cowley DP, Mah J, O'Toole B. The effect of gingival-margin design on the retention of thermoformed aligners. *J Clin Orthod.* 2012; 46(11):697-705.