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

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.

TYPES OF MATERIALS USED

<table>
<thead>
<tr>
<th>THICKNESS</th>
<th>PRODUCT NAME</th>
<th>COMPONENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 mm</td>
<td>Bioplast</td>
<td>Ethylenevinyl acetate copolymer</td>
</tr>
<tr>
<td>1.0 mm</td>
<td>Copyplast</td>
<td>Ethylenevinyl acetate copolymer</td>
</tr>
<tr>
<td>1.0 mm</td>
<td>Duran</td>
<td>Polymethylene terephthalate glycol</td>
</tr>
<tr>
<td>0.8 mm</td>
<td>Hardcast</td>
<td>Polypropylene</td>
</tr>
<tr>
<td>0.75 mm</td>
<td>Imprelon “S”</td>
<td>Polypropylene</td>
</tr>
<tr>
<td>0.040 in.</td>
<td>Essix A+</td>
<td>Copolyester</td>
</tr>
<tr>
<td>0.040 in.</td>
<td>Essix C+</td>
<td>Polypropylene/ethylene copolymer (&gt;95%), stabilizers (&lt;5%)</td>
</tr>
<tr>
<td>0.030 in.</td>
<td>Invisalign</td>
<td>Polyurethane from methylene diphenyl disocyanate and 1,6-hexanediol, Additives</td>
</tr>
</tbody>
</table>

Principles of Clear Aligner Therapy

Creating Space

Force/Pressure Application

1. 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.

2. Aging: Micro-cracks, delaminated areas, calcified biofilm deposits, loss of transparency, decline in residual stresses, increased water absorption are reported with use over time.

3. Stainability: Colours changes are seen in aligners when exposed to coffee, black tea, red wine.
GINGIVAL MARGIN DESIGN: 3 types
Scalloped
Straight cut at Gingival Zenith
Straight cut 2mm above the Gingival Zenith (Most retentive)

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