



Cihan University
College of Dentistry

Clear Aligners

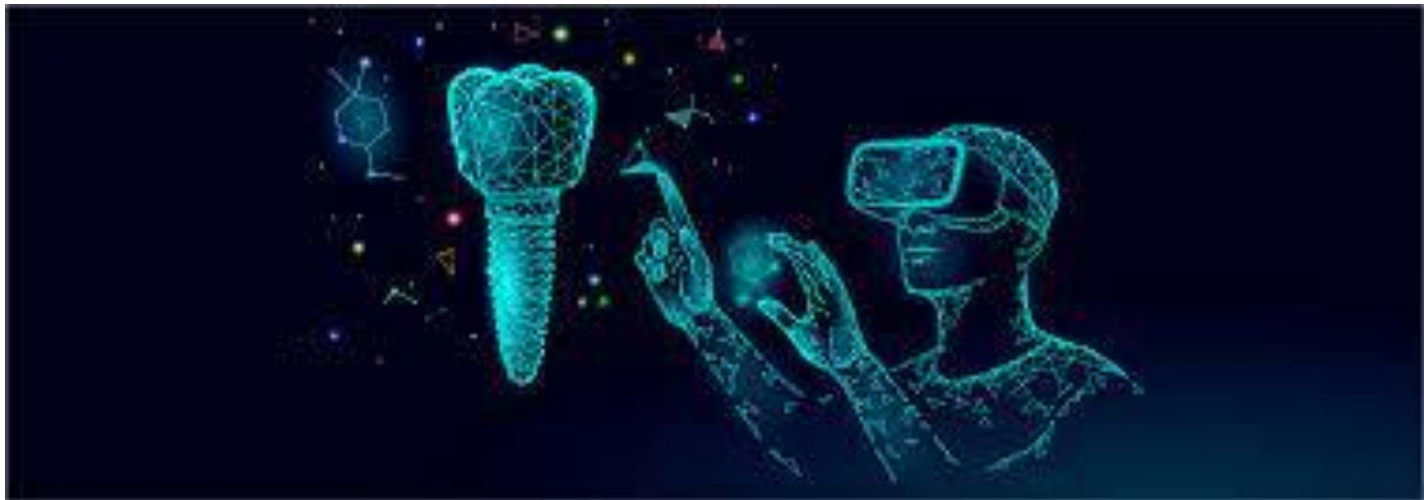
The modern way for teeth movement



Prepared by: **Dr. Ranj Azad**

Introduction

- **Digital technologies** can be used in all aspects of dentistry, including diagnosis, treatment planning, and restoration.
- **Digital dentistry** has transformed the field of dentistry, improving the precision, accuracy, and efficiency of dental procedure.
- Allowing for greater precision, efficiency, and accessibility.



Introduction

- **Orthodontics** is the branch of dentistry concerned with facial growth, development of the dentition, occlusion, & treatment of occlusal anomalies.
- An ideal occlusion is an **anatomically perfect** arrangement of the teeth.
- **Malocclusion** is not in itself a disease; rather, it describes variation around the ideal.



Clear aligners

- Decision to pursue orthodontic treatment is influenced by the desire to look **attractive**, **self-esteem**, **gender**, **age** & **peer-group norms**.
- **Benefits Tx:** improvement of physical function, prevention of tissue damage & correction of aesthetic components.
- Most patients that are seeking orthodontics treatment, **aesthetics** is a major **downside** to initiate treatment.



Abu Alhaija, E.S.J., Al-Nimri, K.S., Al-Khateeb, S.N., 2005. Self-perception of malocclusion among north jordanian school children. Eur. J. Orthod. 27, 292–295

Varma, R., Jayanthi, M., Mahesh Kumar, P., Joseph, T., 2005. Oral health status of 5 years and 12 years school going children in Chennai city - An epidemiological study. J. Indian Soc. Pedod. Prev. Dent. 23, 17

Clear aligners

- To meet the patient's **aesthetic** desire for an alternative to traditional braces:
 1. Lingual orthodontics,
 2. Ceramic braces,
 3. Clear aligners.



Clear aligners

- Transparent aligner therapy is a treatment that consists of a set of **plastic, clear**, appliance custom-made to fit the contour of a patient's teeth.

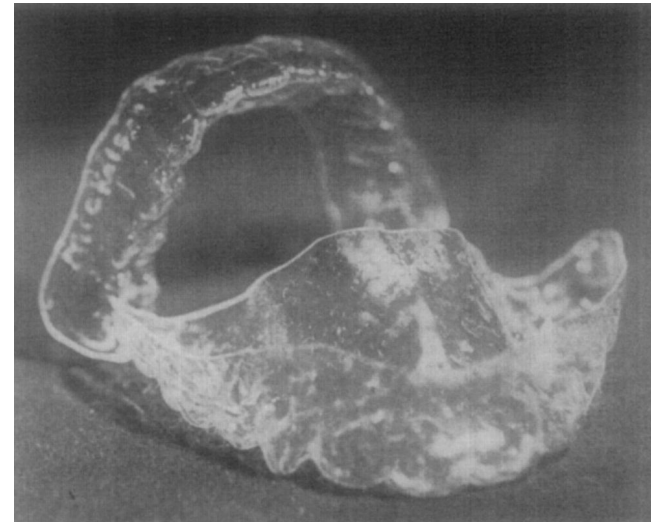


Shetty, S., Pitti, V., Satish Babu, C.L., Surendra Kumar, G.P., Deepthi, B.C., 2010. Bruxism: A Literature Review. *J. Indian Prosthodont. Soc.* 10, 141–148.

Varma, R., Jayanthi, M., Mahesh Kumar, P., Joseph, T., 2005. Oral health status of 5 years and 12 years school going children in Chennai city - An epidemiological study. *J. Indian Soc. Pedod. Prev. Dent.* 23, 17

Clear aligners

- In **1945**, **Dr. Kesling** first described application of flexible tooth positioners to simulate teeth movements.
- That was made form *rubber & wrapped* upper & lower tooth surfaces to permit active movement.
- Used for Tx: **moderate relapse** as well as a **retainer**.
- In **1971**, **Ponitz** recognised these thin thermoplastic devices as **invisible retainers**.

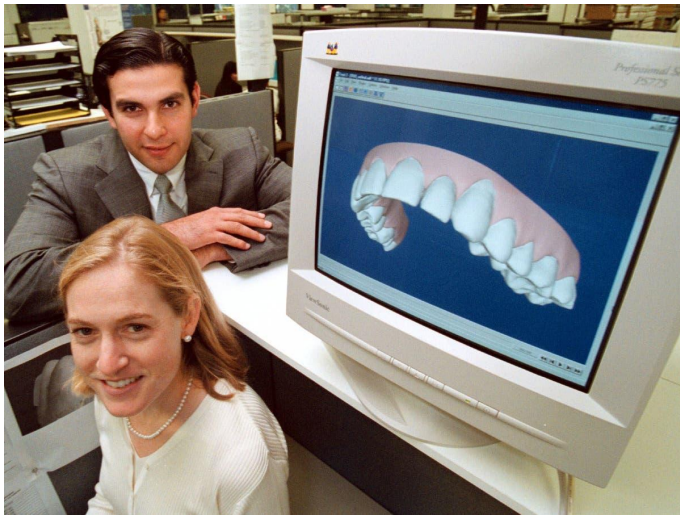


Kesling, H.D., 1945. The philosophy of the tooth positioning appliance. Am. J. Orthod. Oral Surg. 31, 297–304.

Ponitz, R.J., 1971. Invisible retainers. Am. J. Orthod. 59, 266–272.

Clear aligners

- **Kelsey Wirth** & **Zia Chishti** had a background in Computer Science from *Stanford University*, invented the initial technology of transparent aligner.
- They invented a 3D design tools, software programming that fabricated "**incremental retainers.**"
- Align Technology received FDA clearance for **Invisalign, 1998**
- Term derived from the words "**invisible**" & "**aligners**"



Ke, Y., Zhu, Y., Zhu, M., 2019. A comparison of treatment effectiveness between clear aligner and fixed appliance therapies. BMC Oral Health 19, 24.

Shetty, S., Shaikh, N., 2021. Clear aligner therapy – A review. J. Dent. Spec. 9, 46–52.

Clear aligners

- 1st clear aligner system for complete orthodontic treatment, Invisalign, was released in **1999** by **Align Technology**.
- Company started to development of novel aligner **materials**, tooth **attachments**, **tooth movement staging** & **interproximal reduction** to address a broader spectrum of malocclusions.

Djeu, G., Shelton, C., Maganzini, A., 2005. Outcome assessment of Invisalign and traditional orthodontic treatment compared with the American Board of Orthodontics objective grading system. *Am. J. Orthod. Dentofacial Orthop.* 128, 292–298.

McNamara, J.A., Brudon, W.L., Kokich, V.G., 2001. *Orthodontics and dentofacial orthopedics*. Needham Press Ann Arbor.

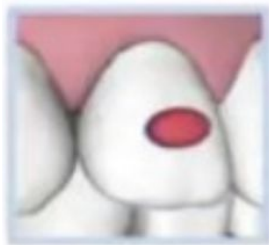
Clear aligners

- Invisalign appliance is currently recommended for **adults** & for **adolescents** with fully erupted **permanent teeth**
- Mandatory to wear appliance for a minimum of **20 to 22** hours a day.
- TX **mild** orthodontic cases
- There are reports of complex orthodontic cases Tx with Invisalign appliance, a *recent study* demonstrated the successful closure of a **4-mm anterior open bite** by extrusion of the anterior teeth using a series of **35 Invisalign** aligners.



Clear aligners

- **Attachments** were engineered by Align Technology to achieve predictable tooth movements
- **Ellipsoid, Rectangle & bevelled** attachment
- Function Attachments
 1. Increase *retention*,
 2. *Transmit* desirable force to the teeth,
 3. Support auxiliary functions such as placement of elastics.



Ellipsoid



Rectangular



Beveled



Simon, M., Keilig, L., Schwarze, J., Jung, B.A., Bourauel, C., 2014. Treatment outcome and efficacy of an aligner technique – regarding incisor torque, premolar derotation and molar distalization. BMC Oral Health 14, 68.

Khosravi, R., Cohanim, B., Hujuel, P., Daher, S., Neal, M., Liu, W., Huang, G., 2017. Management of overbite with the Invisalign appliance. Am. J. Orthod. Dentofacial Orthop. 151, 691–699

Clear aligners

- Factors that can contribute to tooth movement is the **thickness** of the clear aligners.
- Increasing the **thickness** of aligners will also increase the area of **force** applied to the **tooth** structure & **roots**.
- Thicknesses of **0.5**, **0.75** & **0.85 mm** can transfer enough pressure to the PDL for orthodontic treatment.
- Once the **0.95 mm** force exerted to crown was **too large** & must be used with caution.
- Thickness of **1.05 & 1.15 mm** force exerted to the crown can cause **damage** to the dental crown & **root resorption**.

CA Clear Aligner		
SOFT	.020"	0.5 mm
MEDIUM	.025"	0.625 mm
HARD	.030"	0.75 mm
RETENTION	.040"	1 mm



Seo, J.-H., Eghan-Acquah, E., Kim, M.-S., Lee, J.-H., Jeong, 2021. Comparative analysis of stress in the periodontal ligament and center of rotation in the tooth after orthodontic treatment depending on clear aligner thickness—finite element analysis study. *Materials* 14, 324.

Alhasyimi, A.A., Ayub, A., Farmasyanti, C.A., 2023. Effectiveness of the Attachment Design and Thickness of Clear Aligners during Orthodontic Anterior Retraction: Finite Element Analysis. *Eur. J. Dent.*

Clear aligners

A **study** compared the **stability** of Tx outcome with clear aligners to conventional brackets.

- Patients treated with **Invisalign relapsed more** than those treated with conventional fixed appliances.
- **Invisalign group** inserted new aligners introducing new forces every 2 weeks.
- **Braces group**, was adjusted usually every 4-6 weeks.
- **Activating** an appliance too frequently can produce **damage** to the **teeth** or **bone** by cutting short the repair process.
- **2-week** interval of aligners in the Invisalign system is **too short** it will lead to poor bone formation & more relapse.

Kuncio, D., Maganzini, A., Shelton, C., Freeman, K., 2007. Invisalign and traditional orthodontic treatment postretention outcomes compared using the American Board of Orthodontics objective grading system. *Angle Orthod.* 77, 864–869.

Zheng, M., Liu, R., Ni, Z., 2017. Efficiency, effectiveness and treatment stability of clear aligners: A systematic review and meta-analysis. *Orthod. Craniofac. Res.* 20, 127–133.

Clear aligners

Software

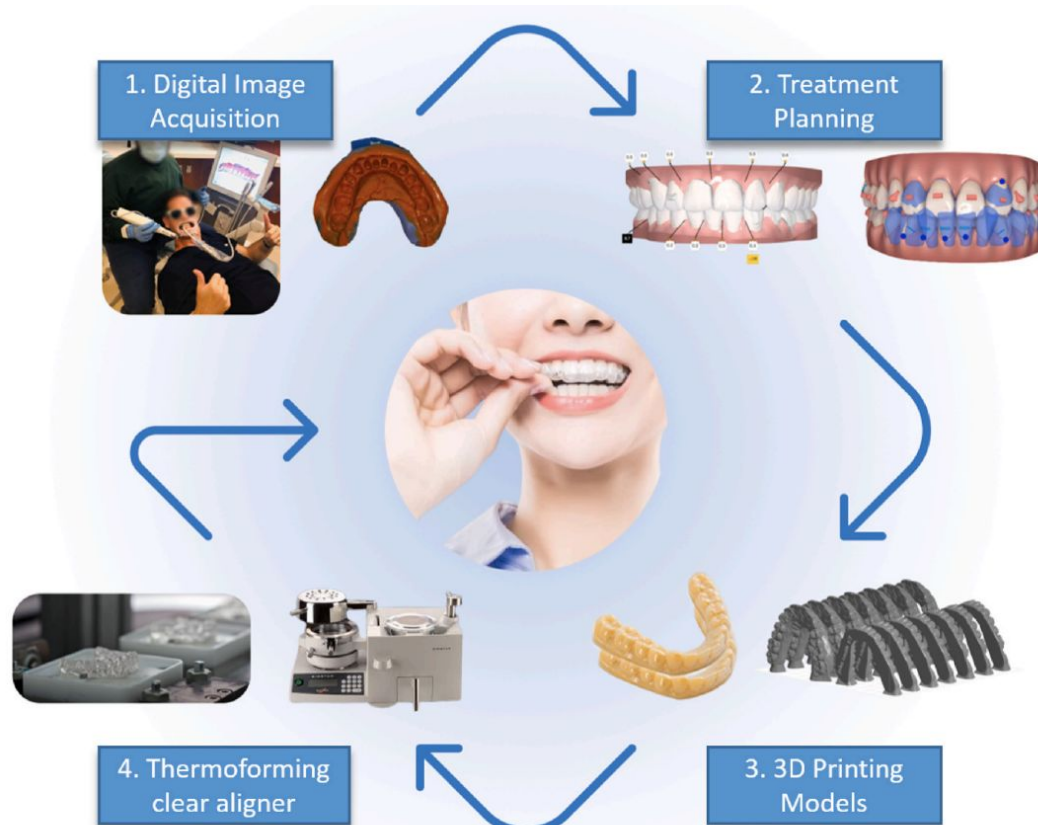
- There are **statistically significant** differences in **extrusion/intrusion** & translation **buccal/lingual** movements between software packages when progressing from the same initial malocclusion to the same final outcome.
- Similarly, the **number** of **aligners** & number of attachments differed significantly when implementing the same virtual setup on the software packages.

Clear aligners

Conventional method of vacuum thermoforming with thermoplastic material moulding on physical models

Thermoplastic polymers

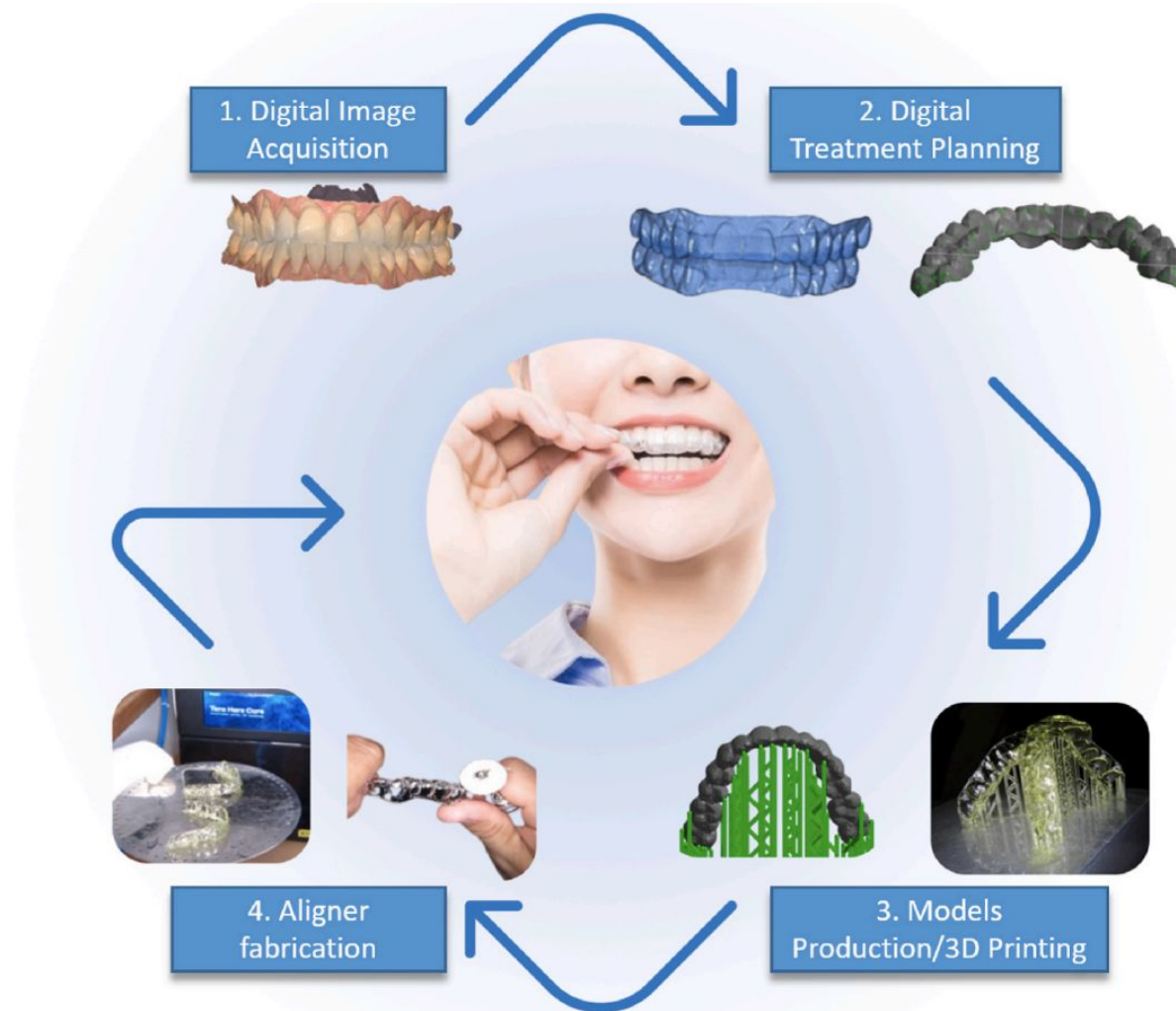
- Polyethylene terephthalate (PET)
- Polyethylene terephthalate glycol (PETG)



Clear aligners

Direct 3D printing without physical models

- **Photocurable resin TC-85**



Clear aligners

3D printed aligner

- Direct 3D printing will provide a better:
 1. Esthetic characteristics of the material
 2. Better geometric accuracy
 3. Better fit
 4. Higher efficacy

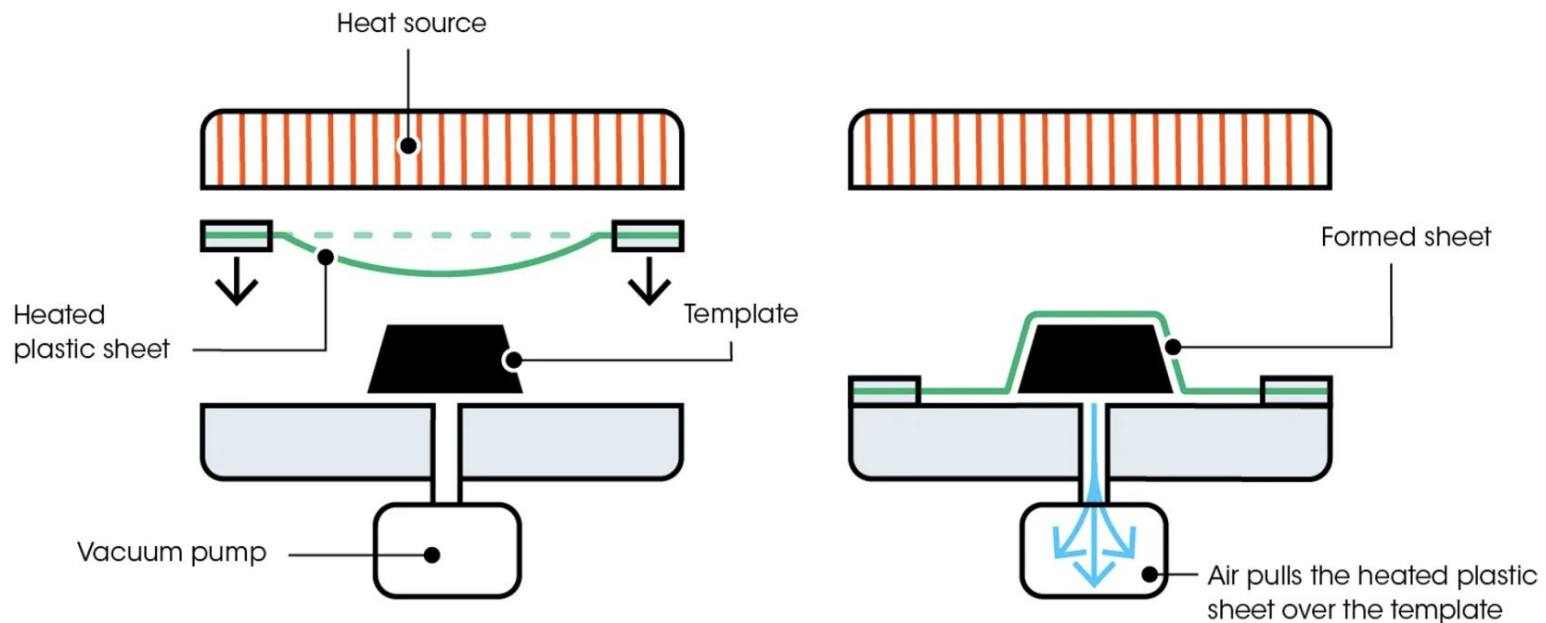


Clear aligners

Clear aligners

Pressure Forming vs. Vacuum Forming

- **Vacuum forming** is the oldest method of thermoforming.
- Use a **vacuum** to **remove** the **air** between heated plastic material & template.



Clear aligners

Pressure Forming vs. Vacuum Forming

- **Pressure forming** refers to the process of using air pressure on a heated plastic sheet to create a mold
- Able to create parts **high** degrees of **details** & **texture**.
- Plastic sheet is heated from above.
- Once the proper temperature is reached, pressurized air pushes the plastic sheet over the template.
- An **air vent** removes any access air.

