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ALIGNER INSIGHTS: SMART PLASTICS, SMARTER SMILES

Dr. Kavya Umesh[1], Dr. Shwetha G S[2], Dr. Mohan S O[3], Dr. Lokesh N K[4]

[1] PG student Rajarajeswari Dental College and Hospital
[2] Professor Rajarajeswari Dental College and Hospital
[3] PG student Rajarajeswari Dental College and Hospital
[4] Professor Rajarajeswari Dental College and Hospital

ABSTRACT:

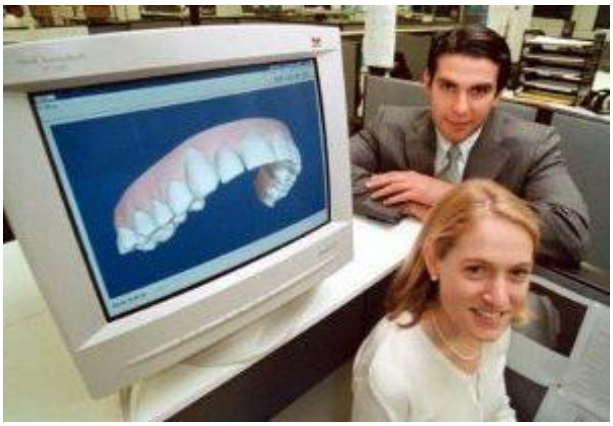
Orthodontics is at a crossroads where digital methods are gradually replacing the production of traditional analog appliances through the use of 3D technology. This transition has primarily been driven by the advent and integration of computers. The incorporation of computers, computer-aided design (CAD) software, computerized machinery, and innovative materials has facilitated this shift in a relatively brief period within the fields of dentistry and orthodontics. The catalyst for this change is the capability to scan the oral cavity digitally. While CAD software and 3D printers were already available, it took several years to adopt these technologies in orthodontics and implement them consistently in clinical settings.

Traditionally, orthodontic treatment has relied on fixed appliances, but recently, thermoformed aligners have emerged as an alternative when a more discreet treatment option is desired. Clear aligner therapy utilizes thermoformed aligners. A newly developed aligner resin now enables the direct printing of aligners. Directly printed aligners offer numerous benefits over thermoformed versions. Research has commenced to explore all facets of the workflow and the results of aligner printing. Further investigations are necessary to examine the various characteristics of directly printed aligners.

INTRODUCTION:

The only branch of dentistry and medicine that uses force to shift teeth and other body parts is orthodontics. There has been much research done on the biology of tooth movement, and numerous features of this movement have been the subject of theories. Orthodontic issues are resolved by utilising the special ability of our teeth to shift continuously throughout our lives. Since Angle created the edgewise appliance, fixed appliances have become the primary method of moving teeth.
A bright mind named Dr. Kesling created the tooth positioner, a plastic device, in 1945 to shift teeth without the need for fixed appliances. Made of rubber, the positioner was used right away in a dental setup.[1]

Later, Nahoum developed a two-block appliance for the upper and lower dental arches, and Sheridan et al. introduced the Essix appliance in 1993 to address minor orthodontic issues in conjunction with the interproximal reduction initially employed by ML Ballard in 1944.[2,3]
Four years later, the next significant step was taken when Zia Christi and Kelsey Wirth established the Invisalign aligner system (Align Technology, Santa Clara, California, USA). While direct-to-consumer aligners were released in the previous few years, other businesses later adopted that strategy.



The first orthodontic aligners came in the last decade of the previous century and the first decade of the current one. Patients' demands for more pleasant and non-intrusive care were the primary force behind this ground-breaking advancement.

Aligners have, in fact, been quite popular since they were first offered as a treatment option in orthodontics, and the number of patients receiving aligner therapy has only grown.

Different types of malocclusion have a detrimental effect on periodontal health and dental cleanliness in addition to compromising dental aesthetics and a pleasant smile. Patients seek orthodontic treatment for a variety of reasons, such as health or dental issues, the enhancement of their looks and to increase confidence and self-worth.[4,5]

An increasing number of doctors and patients are opting for aligner-based orthodontic treatment since it is not only efficient but also does not negatively

impact their everyday lives. This contrasts with traditional orthodontic therapy, which uses fixed orthodontic devices like brackets and an archwire to shift teeth into the proper position by applying corrective forces. These devices are unsightly and cause irritation to the lips.

ALIGNERS AVAILABLE:

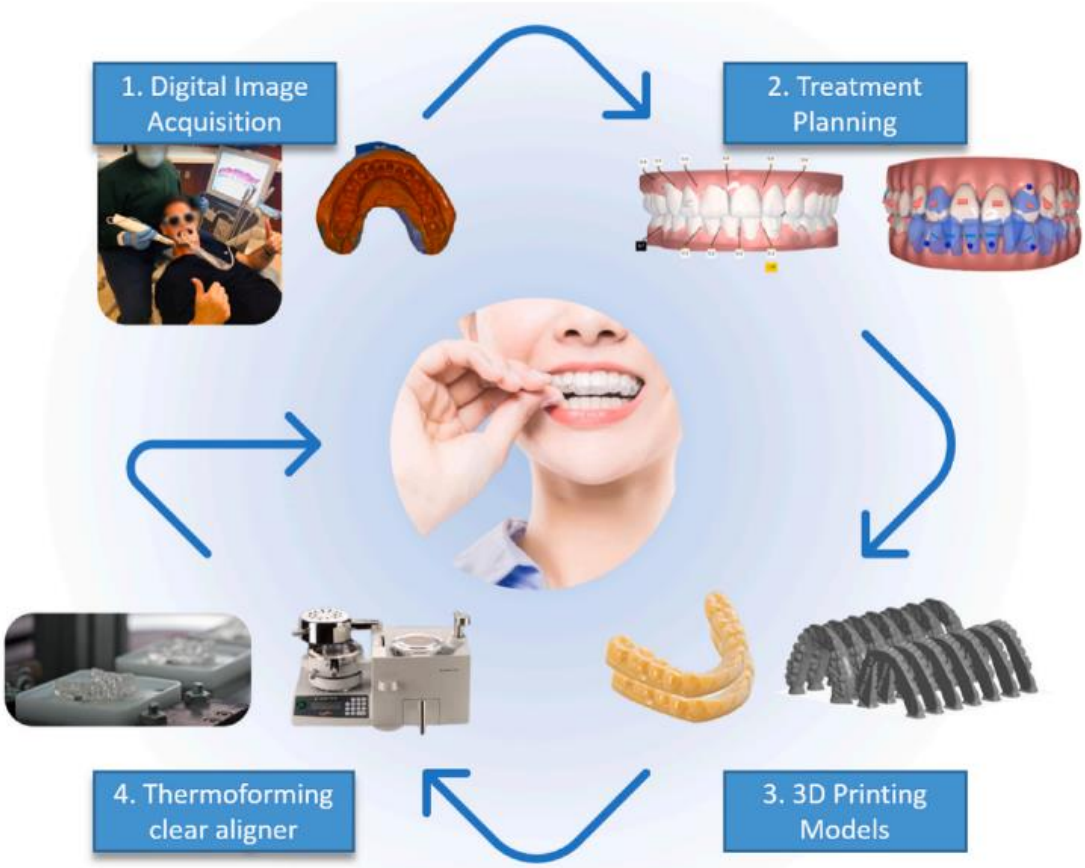
Product Name	Manufacturer	Description	Use	Material
Invisalign Full, Invisalign Teen, Invisalign Assist, Invisalign Express 10, Invisalign Express 5	Align Technology, Inc.	Number of aligners dependent on treatment; simultaneous tooth movement of all teeth; SmartForce features (attachments, torque, bite opening)	Range from minor anterior tooth movement to complex treatment of all teeth	SmartTrack: Multilayer polyurethane and copolyester proprietary material (released in 2013)
Insignia: Clearguide Express	Ormco AOA	Up to 10 aligners/arch Move tooth up to 2.5 mm/tooth (0.25 mm/aligner) Monitor movement with "Heat N Bite"	Alignment of U/L anterior teeth	No information
Vivid Aligners	ODL	Sets of 3–5 aligners ; move tooth up to 0.5 mm/tooth		Zendura: rigid polyurethane
ClearCorrect	ClearCorrect	Aligners created in phases; models included to fabricate replacement aligners	Range from minor anterior tooth movement to treatment of all teeth	Zendura: rigid polyurethane
Minor Alignment Correction	Digi3DWorks	Return model with teeth moved for aligner to be made in office; will make aligner if desired	Alignment of U/L anterior teeth	Raintree Essix ACE: Copolyester proprietary
Clarus Clear Aligners	Clarus (Egypt)	Use attachments, buttons, and elastics Standard aligner: 4 aligners/mo, each worn for 1 wk, movement 0.5–0.7 mm/mo Smart aligner: 2 aligners/mo, each worn for 2 wks, movement 1.0 mm/mo	Range from minor anterior tooth movement to treatment of all teeth	Standard clear aligner material unknown; Smart clear aligner material unknown
AIRAligner	Nivol (Italy)	AIR One (one arch treatment); AIR Light (treatment of both arches <22 aligners); AIR Complete of (treatment both arches	Move all teeth	No information

Materials for Thermoformed Aligners

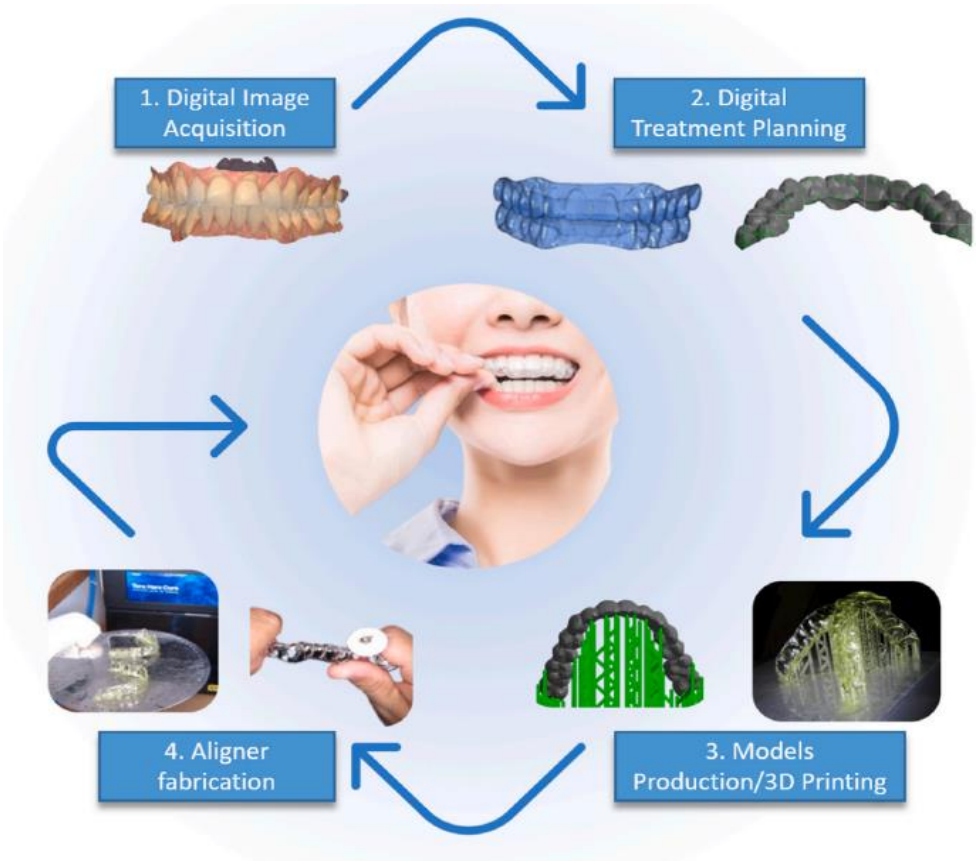
Because of their superior qualities, a variety of thermoplastic materials—or combinations of materials—are being used for production. These consist of polyethylene terephthalate, polyurethane, polyvinyl chloride, and polyethylene terephthalate glycol. At the moment, the process of making a set of clear aligners begins with a digital 3D intraoral scan of the dentition or virtual planning software utilising the first plaster impression, which is scanned in three dimensions.

Each aligner in the treatment set requires a physical 3D model, which is created using material jetting, stereolithography, or 3D printing. The clear material is then molded (either vacuum-formed or thermoformed) over the patient's 3D model of teeth to create the aligners, which are subsequently cut. The procedure is time-consuming, expensive, and labour-intensive.[6,7,8]

WORKFLOW IN FABRICATION OF CLEAR ALIGNERS (INDIRECT PRINTING)



WORKFLOW IN FABRICATION OF CLEAR ALIGNERS (DIRECT PRINTING)



Advantages and Disadvantages of DIRECT Printed Aligners

- All of humanity is concerned about the environmental burden. Non-recyclable materials harm the environment and cause issues for all life on Earth. Every year, the world witnesses a steady, silent accumulation of millions of nonrecyclable printed dental models from the time they are created until 3D printing. Since printed aligners don't require dental models, they might be the answer. A printed aligner should ideally be recyclable. In this sense, this can be an additional benefit over a thermoformed one.

- Direct aligner printing is a quicker process because it does not include the model printing and thermoforming phases, aligner removal, and cutting. For example, printing in a horizontal orientation would enable the patient to receive the aligner or aligners quickly in situations where the orthodontist wishes to send them right away.

- The aligner is taken out of the dental model using units (handpieces) during the thermoforming process.
  Furthermore, their extremities need to have the aligner polished.
  All of this activity produces a dust cloud that not only makes the office dirty but also poses risks to the operational staff. The production of printed aligners takes place in a dust-free atmosphere, which benefits staff and the office.

- The capacity to manufacture aligner with consistent thickness is a significant benefit of printed aligners. The benefit of homogeneous thickness is that it applies consistent forces to every tooth. A study by Koenig et al found that thermoformed aligners significantly decreased in thickness, whereas printed aligners thickened by 12%. According to a different study, thermoformed aligners are thinner after the thermoforming process than the original plastic foil.

- Thermoforming foils are available in a particular thickness.
  They cannot, therefore, be purposefully changed. Compared to thermoformed aligners, printed aligners are more adaptable since they can have their thickness increased in particular places.

- ✓ New technology typically have some drawbacks as well, albeit they eventually diminish. One significant drawback, for instance, is that the entire printing and post-printing process is erratic and requires several phases. A mistake in one step can cause issues in other steps. This is why a scientific evidence-based process should be carried out through in-depth study, enabling a reliable and superior result. The relatively greater equipment cost in comparison to the production of thermoformed aligners is another drawback.

- ✓ A printer and a UV curing unit should be bought together in addition to the software that comes with both types of aligners. Naturally, it is important to remember that a piece of thermoforming equipment that costs as much as a decent 3D printer is not necessary. It's also important to figure out how many aligners can be printed per milliliter and how much each thermoformed aligner will cost. This ought to cover the cost of the required 3D-printed model and the plastic foil.

Overview of steps in clear aligner treatment

1. Case records and case selection
2. High-quality impressions or intraoral scans
3. 3D virtual set-up and treatment progress stages
4. Approval of treatment steps on the web
5. Construction of aligners' delivery to treating doctor
6. Issue of aligners and review
7. Finishing and retention

CONCLUSION:

Aligners, also known as clear aligners, are a modern orthodontic treatment designed to straighten teeth without the need for traditional metal braces. They work through a series of custom-made, clear plastic trays that gradually move teeth into the desired position.

The in-office concept is here to stay. Nevertheless, orthodontic and dental associations should create protocols and guidelines for digital laboratory installments in orthodontic offices. The observed uncontrolled installation of 3D printers, post-printing units, and toxic and irritating materials in orthodontic offices should be controlled through protocols that will be applied and often checked by dental associations. Scientific studies should be conducted before the release of new materials and technologies resembling the medicine way.

Orthodontics has definitely entered into a new additive era.

REFERENCES:

1. Kesling HD. The philosophy of the tooth positioning appliance. Am J Orthod. 1945;31(6):29-304. [CrossRef]
2. Nahoum, H. The vacuum formed dental contour appliance. NY State Dent J. 1964;9:385-390. [CrossRef]
3. Sheridan JJ, LeDoux W, McMinn R. Essix retainers: fabrication and supervision for permanent retention. J Clin Orthod. 1993;27(1):37- 45. [CrossRef]
4. Sheridan JJ. Air-rotor stripping. J Clin Orthod. 1985;19(1):43-59. [CrossRef]
5. 5.Kaur, S.; Singh, R.; Soni, S.; Garg, V.; Kaur, M. Esthetic orthodontic appliances-A review. Ann. Geriatr. Educ. Med. Sci. 2008, 5, 11–14.
6. Leonardi, R. Cone-beam computed tomography and three-dimensional orthodontics. Where we are and future perspectives. J Orthod. 2019, 46, 45–48. [CrossRef]
7. Bollen, A.M. Effects of malocclusions and orthodontics on periodontal health: evidence from a systematic review. J. Dent. Educ. 2008, 72, 912–918. [CrossRef]
8. Weir, T. Clear aligners in orthodontic treatment. Aust. Dent. J. 2017, 62 (Suppl. 1), 58–62. [CrossRef]
9. Martorelli, M.; Gerbino, S.; Giudice, M.; Ausiello, P. A comparison between customized clear and removable orthodontic appliances manufactured using RP and CNC techniques. Dent. Mater. 2013, 29, e1–e10. [CrossRef]
10. 10.Can E, Panayi N, Polychronis G, et al. In-house 3D-printed aligners: effect of in vivo ageing on mechanical properties. Eur J Orthod. 2022;44(1):51-55. [CrossRef]
11. 11. Papadopoulou AK, Cantele A, Polychronis G, Zinelis S, Eliades T. Changes in Roughness and Mechanical Properties of Invisalign® Appliances after One- and Two-Weeks Use. Materials (Basel). 2019;12(15):2406. [CrossRef]
12. 12. Zinelis S, Panayi N, Polychronis G, Papageorgiou SN, Eliades T. Comparative analysis of mechanical properties of orthodontic aligners produced by different contemporary 3D printers. Orthod Craniofac Res. 2022;25(3):336-341. [CrossRef]
13. 13. Koenig N, Choi JY, McCray J, Hayes A, Schneider P, Kim KB. Comparison of dimensional accuracy between direct-printed and thermoformed aligners. Korean J Orthod. 2022;52(4):249-257. [CrossRef]
14. 14. Pratsinis H, Papageorgiou SN, Panayi N, Iliadi A, Eliades T, Kletsas D. Cytotoxicity and estrogenicity of a novel 3-dimensional printed orthodontic aligner. Am J Orthod Dentofacial Orthop. 2022;162(3):e116-e122