

Range of contemporary orthodontic treatment

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19/6/2026

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Objectives

- Explain the range of contemporary orthodontic treatment modalities
- Understand the advantages and disadvantages of these treatments

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Aligners

- The term 'orthodontic aligner' most commonly refers to clear, removable, plastic appliances that can produce small tooth movements
- Clear aligners are an aesthetic alternative to fixed appliances and have come a long way since their conception as a 'tooth positioner,' in the 1940s.
- In 1946, Kesling stated that a series of these positioners could be used to achieve more ambitious tooth movements when used as an adjunct to conventional treatment.



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- In 1999, Align technology introduced Invisalign, which used CAM and design principles to avoid the need for multiple impressions.
- As a result, more dentists utilised this form of orthodontics.
- Currently, Invisalign and other major clear aligner systems can use specific force delivery via composite precision attachments, generating force vectors to permit a range of specific tooth movements.
- Previously thought to be limited to tipping movements only, aligners have developed into a system that can propose to deliver most movements achieved with fixed appliances.



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Thermoplastic aligners

- Initially aligners were used in cases where one or two teeth for small amounts of movement.
- These aligners were referred to as 'positioners'.
- The Hilliard thermoforming pliers were later developed to enable tooth-moving forces to be added to the aligner by the clinician at the chair-side.
- The pliers were used to create a projection in the appliance which then applied force to the tooth as the plastic returned to its original state.



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Spring aligners



- Spring aligners were developed as an alternative method for aligning anterior teeth.
- These appliances employ two opposing nickel-titanium sprung bows, which straighten teeth by applying reciprocal force labially and palatally.
- The appliances are designed to provide a short course of treatment (usually less than 4 months) and are limited to mild crowding of rotated or labiolingually displaced incisors.
- Most common types is Inman aligner

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Contemporary aligners

- Contemporary orthodontic aligner treatment has been driven by research developed from the Invisalign system.
- Invisalign is an orthodontic technique that uses sequential computer-generated plastic aligners to deliver a course of orthodontic treatment.



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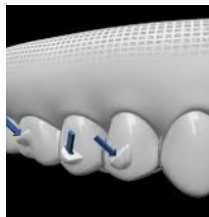
Tooth movement with aligners

- Application of force to achieve tooth movement with aligners is different to other orthodontic appliances.
- For aligners, the plastic enclosing the tooth has two functions: application of force for tooth movement and retention of the appliance.
- Tooth movement is achieved by elastic deformation of the aligner and the composition of the plastic is therefore important.
- The material needs to be stiff enough to deliver the correct level of force, but also highly elastic so it will return to its original shape when stretched, moving the tooth with it.
- Retention for the appliance is usually provided by the natural undercuts of the tooth, however, in some cases the functions of retention and elastic deformation can compete, for example, displacement of the aligner when trying to extrude teeth.

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Scope of tooth movement with aligners

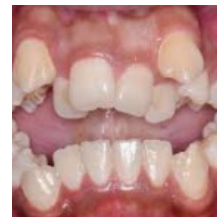
- Advances in understanding of tooth movement mechanics have enabled the development of a range of different shaped attachments that are placed on teeth to increase engagement between the aligner and tooth.
- These attachments have been carefully designed using biomechanical knowledge to allow the aligner to exert a range of force vectors.
- Attachments, in conjunction with advanced plastic aligner materials, enable more difficult tooth movements to be achieved, such as de-rotation of round teeth (canines and premolars), relative intrusion/extrusion of one or multiple teeth, and root torque.
- With appropriate understanding, planning, and use of modern aligner technologies it is possible to achieve a scope of tooth movement with aligners that is comparable to fixed appliances.



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Clinical stages in aligner treatment

- Case selection
- When deciding whether alignment treatment is a viable option, it is important to understand the patient's key concerns and establish treatment goals.
- If significant tooth movement is required or there is an underlying skeletal discrepancy that requires correction, other forms of treatment may be preferable.
- It is essential that treatment objectives are measured against the scope of the appliance to deliver the necessary tooth movements and any biological limitations posed by the malocclusion



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Clear Aligner Therapy (CAT)

- Treatment planning
- A prescription is sent by the clinician with the records to the manufacturer to allow the technician to deliver a preliminary sequence of tooth movements.
- In the prescription, the clinician specifies the aims of treatment, including which aspects of malocclusion are to be corrected or accepted.
- The manufacturer will usually produce a virtual set-up that reflects the desired outcome described in the prescription.
- The virtual set-up can often be viewed in a software program, such as the Invisalign ClinCheck



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Advantages and disadvantages

- The most commonly proposed advantages of aligners include:
- more aesthetic appliance
- improved dental health in terms of periodontal health and reduced risk of decalcification
- a reduction in chair-side time, overall treatment time, pain experience, and root resorption.
- The current body of evidence for orthodontic aligners is insufficient to conclusively support or refute these claims although future high-quality randomized trials are planned

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- It is generally acknowledged that aligners are more aesthetic than metal buccal fixed appliances but not as inconspicuous as lingual fixed appliances.
- The appearance of aligners compared to ceramic fixed appliances is more difficult to judge and depends on the particular systems in use and personal preference.
- The ability to remove aligners for cleaning and eating might be expected to reduce the risk of periodontal problems and decalcification

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Clear Aligner Therapy (CAT)

Issues:

- Compliance
- Use of intra-oral elastics
- Need for attachments and IPR



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CAT issues

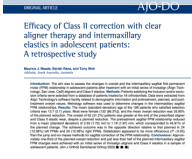
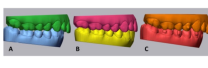
- Kravitz et al. (2009) reported 41% accuracy of projected tooth movement which improved to 50% in 2020.
- CAT performs less effectively compared to fixed appliances with certain tooth movements:
 - Buccolingual inclination
 - Overjet reduction
 - Extraction space closure
 - Arch expansion



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CAT for Class II in adolescent patients

- Australian Aligner Research Database
- 17,500 patients
- 199 patients included
- Outcomes
 - End of treatment: 45.2% had an overjet >4.1mm
 - Only 33.6% of planned overjet reduction was achieved
 - 31% showed an increased overjet despite a reduction in overjet planned?

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Lingual appliances

- They were first described in Japan in 1968.
- Lingual appliance systems were introduced in the USA in the 1970's
- After much attention in the early 1980s, their popularity fell, partly due to the introduction of ceramic brackets, but also due to a number of problems with the appliance.
- However, in Europe and Asia considerable interest remained and over several decades a number of systems were developed, including fully customised lingual appliances which provide a similar level of 3-D control as labial brackets.



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Advantages

- Lingual orthodontics offers a number of advantages:
- Aesthetics
- No risk to the labial enamel through decalcification
- Position of the teeth can be seen more accurately as not obscured by the appliance.

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Advantages

- Some lingual brackets create a bite-plane effect on the upper incisors and canines, making these types of brackets useful for treating deep overbites.
- Force vector in close relation to the centre of resistance of the tooth to provide further advantages for both patient and orthodontist

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Disadvantages

- Lingual orthodontics also has some potential disadvantages:
- Speech alteration
- Discomfort to the patient's tongue
- Masticatory difficulties
- More technically demanding for the operator, which increases the chair-time.

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Disadvantages

- Reduced inter-bracket span and bracket width can make rotational control difficult
- Operator proficiency in indirect bonding is required for customized appliances and rebonding failed brackets can be difficult.
- More difficult to clean.
- Increased cost.

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- Majority of tongue discomfort in lower arch, therefore patients choose to have a lingual appliance in upper and labial appliance in lower
- CAD/CAM has allowed the production of fully customized appliances, with individualized production of brackets and wires.

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- CAD/CAM can improve the fit of the appliances, increasing the finishing control, as well as reducing speech problems and tongue irritation.
- If the customized brackets debond during treatment they can be rebonded directly, as the bracket base-to-tooth fit is so good that incorrect positioning is unlikely.
- Lingual appliances are more expensive and more technically difficult than labial appliances, so it remains to be seen if further developments in this field will lead to more widespread use of lingual orthodontics.

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Bracket height determined by presence of prominent cingulum plateau



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- Upper labial and lower lingual
- Avoid occlusal interference with increased overbite



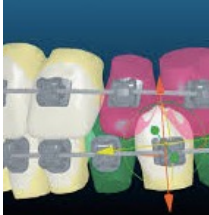
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Fully customized fixed appliances

- Preadjusted edgewise appliance revolutionized orthodontic treatment as it eliminated need for complex archwire bends
- However, one size does not fit all due to individual variations in the labial face of the teeth, inaccuracies in bracket positioning and failure of the bracket to deliver its full prescription.
- CAD CAM technology and refined milling techniques have allowed the development of fully customized fixed braces

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- From a scanned model, teeth are set in an ideal post treatment position and from this brackets are designed and milled with a prescription unique to the individual patient
- The brackets are then indirectly bonded to eliminate errors of bracket placement
- Studies have shown that fully customized appliances are accurate at delivering the planned tooth position and efficient in doing so.
- Increased costs compared to conventional fixed appliances



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Indirect bonding

- Brackets are first bonded to a replica of the patient's teeth (a model) in a laboratory setting, then transferred to the patient's mouth using a custom tray.

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How Indirect Bonding Works:

- 1. Impression/Scan:**
An impression or digital scan of the patient's teeth is taken to create a replica.
- 2. Bracket Bonding on Model:**
The orthodontist or a technician bonds the brackets to the model at precise locations.
- 3. Transfer Tray Fabrication:**
A custom tray is made to fit over the teeth, holding the brackets in their desired positions.
- 4. Transfer to Patient's Mouth:**
The tray with the bonded brackets is placed in the patient's mouth, and the brackets are securely bonded to the teeth.



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Advantages of Indirect Bonding:

- **Improved Accuracy:**
Indirect bonding allows for precise bracket placement as it is done in a controlled laboratory setting without the interference of saliva or soft tissues.
- **Reduced Chair Time:**
By bonding all brackets at once, the procedure in the patient's mouth is significantly faster compared to direct bonding.
- **Enhanced Patient Comfort:**
Less chair time and a more predictable procedure can lead to a more comfortable experience for the patient.
- **Fewer Wire Bends:**
Accurate bracket placement may reduce the need for wire adjustments during treatment.

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Disadvantages of Indirect Bonding:

- **Increased Lab Time:**
 - Indirect bonding requires additional time and effort in the laboratory for bracket placement on the model.
- **Potential for Bond Failure During Transfer:**
 - There's a slight risk of brackets detaching from the transfer tray during placement, although this is minimized with proper techniques and materials.
- **Adhesive Flash:**
 - Minimizing flash (excess adhesive) can be more challenging with indirect bonding.

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Questions?

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