

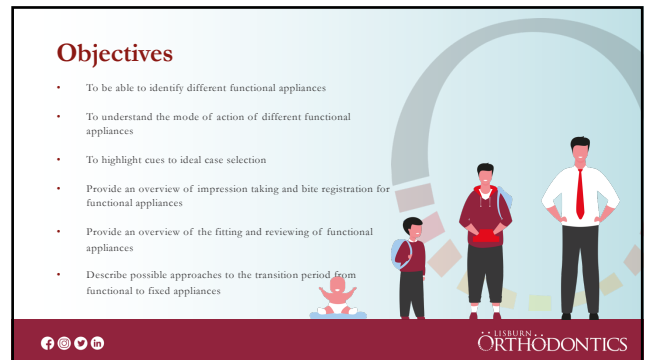


Functional Appliances

Appliance types, case selection and mode of action

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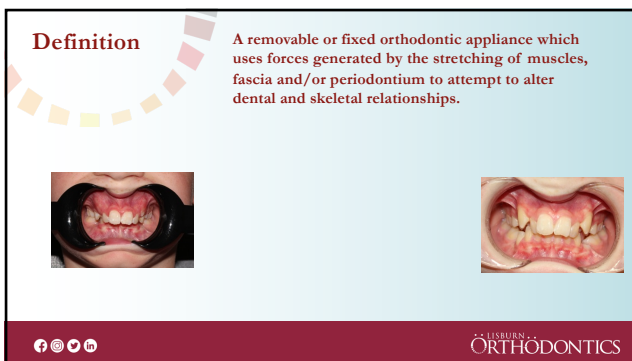


Objectives

- To be able to identify different functional appliances
- To understand the mode of action of different functional appliances
- To highlight cues to ideal case selection
- Provide an overview of impression taking and bite registration for functional appliances
- Provide an overview of the fitting and reviewing of functional appliances
- Describe possible approaches to the transition period from functional to fixed appliances

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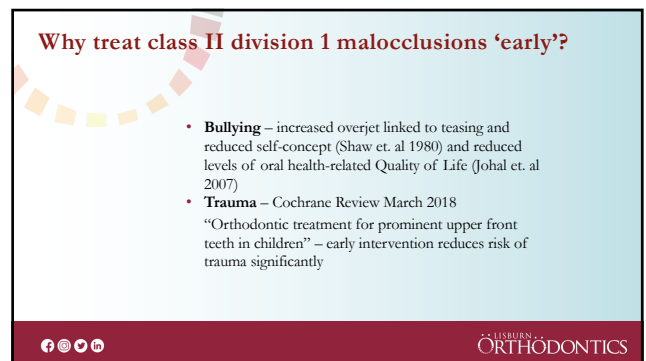


Definition

A removable or fixed orthodontic appliance which uses forces generated by the stretching of muscles, fascia and/or periodontium to attempt to alter dental and skeletal relationships.

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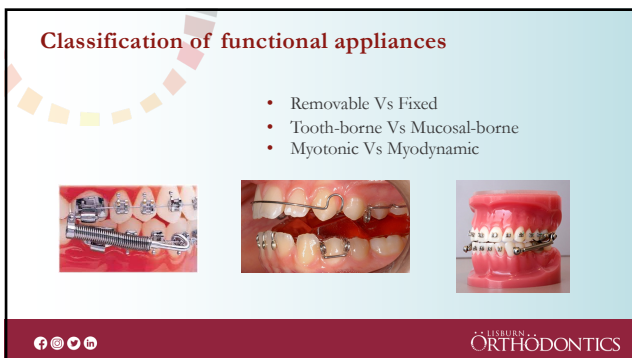


Why treat class II division 1 malocclusions 'early'?

- Bullying** – increased overjet linked to teasing and reduced self-concept (Shaw et. al 1980) and reduced levels of oral health-related Quality of Life (Johal et. al 2007)
- Trauma** – Cochrane Review March 2018
“Orthodontic treatment for prominent upper front teeth in children” – early intervention reduces risk of trauma significantly

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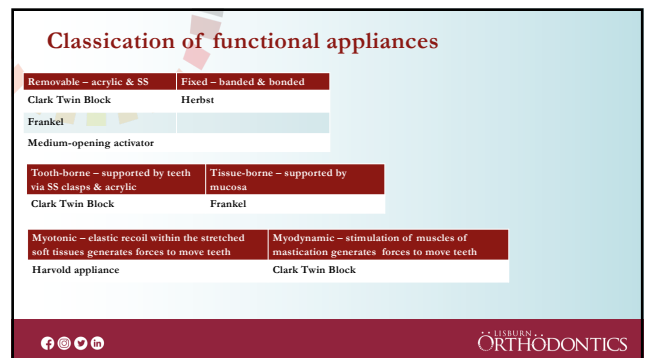


Classification of functional appliances

- Removable Vs Fixed
- Tooth-borne Vs Mucosal-borne
- Myotonic Vs Myodynamic

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Classification of functional appliances

Removable – acrylic & SS	Fixed – banded & bonded
Clark Twin Block	Herbst
Frankel	
Medium-opening activator	
Tooth-borne – supported by teeth via SS clasps & acrylic Clark Twin Block	Tissue-borne – supported by mucosa Frankel
Myotonic – elastic recoil within the stretched soft tissues generates forces to move teeth Harvold appliance	Myodynamic – stimulation of muscles of mastication generates forces to move teeth Clark Twin Block

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Aims of Functional Appliances

- Overjet reduction
- Correct buccal segment relationship
- Change soft tissue environment
- Build posterior anchorage before extractions and fixed appliances



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Specific Functional Appliances

Modified Clark Twin Block

- Removable, tooth-borne, myodynamic
- Most common functional for class II correction
- Good compliance
- Can be modified
- Easily adjusted
- Cheap
- Oral hygiene



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Specific Functional Appliances

Andresen Activator

- Removable, tooth-borne, myodynamic
- Single appliance
- Loose fitting
- Facets cut into acrylic posteriorly to guide mesial eruption of the lower molars



Andresen
Activator
AA



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Specific Functional Appliances

Harvold Appliance

- Removable, tooth-borne, *myotonic*
- Single appliance
- Postures mandible forwards and props mouth open 5-6mm beyond the freeway space to activate elastic recoil of soft tissues
- Appliance is trimmed to allow eruption of lower molars while occlusal shelves prevent eruption of upper molars to correct class II
- Compliance can be difficult
- Used to be dyed black to show calculus to prove patient was wearing appliance



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Specific Functional Appliances

Bionator

- Removable, tooth-borne, myodynamic
- Single appliance – hard to reactivate
- Less acrylic than Andresen
- Palatal coffin spring sits clear of palate – forces tongue anteriorly and stabilises appliance
- Buccal wire shields hold cheeks away from teeth to allow passive expansion of arches



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Specific Functional Appliances

Medium-Opening Activator

- Removable, tooth-borne, myodynamic
- Single appliance – hard to reactivate
- Adams clasps improve retention
- Mandibular protrusion with lingual flanges
- Lower molars free to erupt – good for simultaneous deep bite correction



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Specific Functional Appliances

Teuscher Appliance/ Activator

- Removable, tooth-borne, myodynamic
- Single appliance – hard to reactivate
- Headgear tubes incorporated into design
- Torquing spurs present on the upper incisors provide palatal root and prevent retroclination
- Labial pads can be incorporated into lower labial segment to hold away soft tissues and facial musculature



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Specific Functional Appliances

Fränkel FR2

- Removable, tissue-borne, myodynamic
- Fränkel was advocate of *functional matrix theory* – bony growth driven by form and function of the soft tissues appliance – hard to reactivate
- Labial acrylic pads and buccal acrylic shields
- Passive expansion of arches, prevents mentalis muscle activity and stretches periosteum to produce bony apposition



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Specific Functional Appliances

Dynamax appliance

- Removable, tooth-borne, myodynamic
- Upper removable appliance with vertical hangers that contact arms on a lower lingual arch to posture the mandible
- Lower fixed appliance may be in place simultaneously
- Frequent breakages



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Specific Functional Appliances

Newport functional appliance

- Digital twin block
- Tooth-borne
- Variety of designs
- Difficult fabrication
- Unable to eat/drink with appliance in
- Limitation to dental tipping movements – potentially more skeletal change



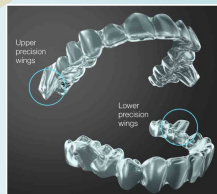
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Specific Functional Appliances

Invisalign Mandibular Advancement appliance

- Digital twin block
- Tooth-borne
- Aligners incorporating precision wings to advance mandible whilst aligning arches
- Expensive
- Less bite opening effect



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Specific Functional Appliances

Herbst appliance

- Fixed, tooth-borne
- Banded or bonded onto maxillary molars and lower anterior teeth
- Bilateral telescope apparatus that postures mandible forwards as the patient closes their mouth
- Non-compliance dependent
- Expensive, difficult to tolerate, prone to breakages
- Uses a compressive inter-maxillary force with a class III vector



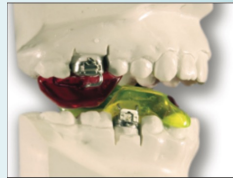
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Specific Functional Appliances

Clip Over Fixed Functional

- Fixed 'twin block'
- Bands on first molars with acrylic blocks
- Clips over fixed appliances
- Prone to breakages



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Specific Functional Appliances

Forsus appliance

- Fixed class II corrector with fatigue resistant spring modules and push rods
- Molar bands with occlusal headgear tubes to limit vertical force vector
- Decide on extractions before using appliance
- Ligate I3s with ligatures to limit rotation
- Can be used in non-growing patients
- Uses a compressive inter-maxillary force with a class III vector



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Forsus appliance installation video

<https://www.youtube.com/watch?v=1z24CQ47doY>



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Specific Functional Appliances

Carriere appliance

- Fixed class II corrector
- Arm bonded from upper molars to canines with ball joint on the molar to allow movement of the canine
- Lower essix must be worn at the same time as elastic – 'no elastic, no plastic'
- Heavy elastic wear producing a tensile, inter-maxillary force with class II vector
- Use lower arch as anchorage unit to tip canines distally – will also result in canine extrusion



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Indications for Functional Appliances

- Increased overjet
- Mandibular retrognathia
- Growing patient, utilise growth/adaptive potential
- Motivated patient
- Class II buccal segments
- Increased overbite
- Lower or average vertical proportions (FMPA, LFA)
- Retroclined lower incisors and/or proclined upper incisors



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Contra-indications for Functional Appliances

- Non-growing patient (generally over 12 yrs)
- Increased vertical proportions/high angle
- Backwards mandibular growth rotation
- AOB cases
- Proclined lower incisors (unless planning extractions later)
- Poor compliance eg. Sensory issues



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Mode of Action

Muscles of mastication

- Posturing the mandible alters activity within the masticatory muscles, with the force being transmitted to the teeth

Dentition

- Intermaxillary class II force transmitted onto the teeth resulting in tipping

Remodelling at the condyle

- Condylar cartilage is secondary cartilage. Stimulation of the local functional environment can have a positive effect on cell division and growth, with remodelling of the condyle at the glenoid fossa (controversial, limited evidence)



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Mode of Action

73% of effect is dento-alveolar change, 27% skeletal:

- Retroclination of maxillary incisors
- Proclination of mandibular incisors
- Distal tipping of upper teeth
- Mesial tipping of lower teeth
- Restraint of forward maxillary growth
- 1mm of additional forward mandibular growth

*Backward and downward rotation of maxilla, with increase in lower anterior face height – not favourable in high angle class II malocclusions

*Care with class II division 2 malocclusions with prognathic chin

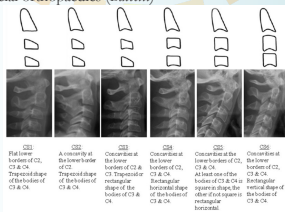


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Timing of treatment

Cervical Vertebral Maturation (CVM) Method for the assessment of optimal treatment timing in dentofacial orthopaedics (Baccetti)



Functional appliances work best in growing patients, during pubertal growth spurt

Peak mandibular growth occurs between C53 – C54



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Record taking for functional appliances

- Clinical photographs
- Radiographs – OPT and/or ceph
- Impressions or digital scan – palatal coverage important
- Functional bite registration



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Record taking for functional appliances

Impressions for functional appliances

- Record all teeth, soft tissues and the adjacent anatomical structures eg frenal attachments
- No alterations or distortions.
- Choose a suitably-sized impression tray (that is therefore unlikely to displace the tissues), or a custom impression tray.



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Record taking for functional appliances

Functional bite registration

- Ask patient to practice 'advanced position of mandible' beforehand. **Always check centrelines in advanced position.**
- Full strip of wax, wide enough to cover the whole of the upper arch from the upper incisors to at least the first permanent molars on both sides of the arch - at least 8–10 mm thickness (lateral open bites as incisors come forwards)
- Soften wax with hot water. Mould up into the palate and push against the upper teeth to ensure there are sufficient indentation marks in the wax from upper incisors to the molar region which will allow the technician to accurately locate the study models
- Ask patient to close in postured position slowly to ensure accuracy
- Check on study models (if available) and also re-try in patient's mouth to ensure patient postures into same position



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Record taking for functional appliances

Using bite recorder



<https://www.youtube.com/watch?v=qyAwhoGLULs>



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Designing a functional appliance

Key elements:

- Sufficient retention (Adams & ball-ended clasps)
- Edge to edge incisor relationship (if possible)
- 70 degree inclined bite blocks
- 7-8mm separation in the premolar regions
- Mid-line expansion screw
- Labial bow on the upper appliance will limit upper incisor retroination

Modifications to design:

- Wire stops on occlusal surface of 7's
- Incorporation of headgear tubes into the upper block (band selection before impression)
- Use of Z or T springs to procline upper incisors if starting with class II div 2 incisor relationship (generally used fixed)



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Fitting a functional appliance

Ideally, the appliance should be fitted no more than **2 weeks** after the impressions are taken to ensure good fit

- The patient should be shown the appliance and informed how it works
- Allow time for the patient to practice insertion and removal
- Adjust clasps as required
- Provide full instructions on wear/maintenance and charges - aim for FULL TIME except OH/contact sports, swimming or horse riding/mealtimes
- Review the patient 2-4 weeks after fitting. If no problems, appointments can then be every 8 weeks for progress review if compliance is good



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Reviewing a functional appliance

What do we need to record at subsequent appointments?

1. Overjet
2. Canine relationships
3. Molar relationships
4. Centrelines
5. Reverse overjet



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Transition from functional to fixed appliances

The next phase of treatment after overjet correction may include:

1. No further treatment
2. Progression to fixed appliances:
 - Night time only wear - to allow settling of lateral open bites
 - Trimming of the upper block to allow eruption of the lower molars
 - Use of a steep and deep bite plane along with upper and lower fixed appliances
 - Fixed appliances and class II elastic support



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Post-functional records

What do we need to record after the overjet is reduced?

1. Photos – intra-oral and extra-oral
2. Impressions/scan
3. Lateral ceph to assess for changes in incisor inclinations during functional phase



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Functional Appliances





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References

- O'Brien et al. 2003 - transient improvement in self concept with early treatment
- O'Brien et al. 2009 - accelerated skeletal growth is not maintained in the medium - long term
- Lund and Sandler 1998 - average changes in incisor inclination with twin block are 10.8 degree upper incisor retroclination and 7.9 degree lower incisor proclination
- Banks et al. 2004 - little difference in skeletal or dental outcome with maximum protrusion vs. Incremental advancement of the mandible
- Patekh et al. 2019 - there was no difference in the dental and skeletal changes between full and part time wear
- Trenouth 2012 - use of southend clasps on the upper and lower incisors produced significantly less dental tipping, enhancing the skeletal correction (age range 9-30 years!)
- Shah and Sandler 2008 - How to...take a wax bite for a Twin Block appliance



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Thank You.

Any questions?
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