

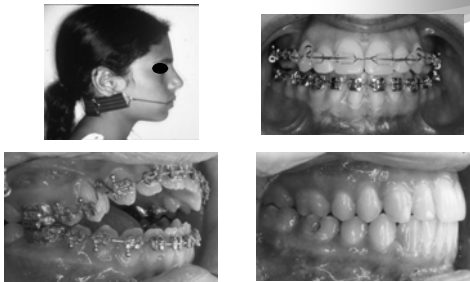
Functional Appliances

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Answer... Facial Balance



Traditional form of treatment



Wouldn't it be nice if we could...

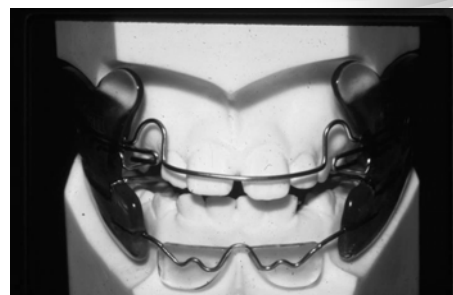
- Influence growth
- Had a simple appliance to use
- One that is hygienic
- Possibly avoid surgery
- Influence occlusion
- Influence facial esthetics
- Economical to use



Problem... Facial Esthetics



Functional Appliance



Working definition

- Functional Appliance - a device that alters a patient's functional environment in an attempt to influence and permanently change the surrounding hard tissue .



Why treat malocclusion?

- Possible pre-disposition to disease
- May lead to jaw dysfunction (TMD,Speech,Mastication)
- Facial esthetics with psychological implications
- Single or multiple tooth damage

Percentage of malocclusions in early mixed dentitions

Study by Keski-Nisula et al Dec 03

- 92.7 % some disharmony present
- 67.7% malocclusion
- 52.4% Class II type
- 1.5% Class III type
- 30.1% Asymmetrical Bite



History of development of functional appliances

- Robin 1902- monobloc
- Andresen 1908- Activator
- Herbst 1934- Herbst
- Balters 1960- Bionator
- Bimler 1964 – Bimler
- Frankel 1967- Frankel
- Clark 1977-Twin Block

Percentage of malocclusions

Study by U.S.P.H.S. 1970

- 75% some disharmony present
- 40% malocclusion
- 20% Class II type
- 5% Class III type
- 4% Open Bite



Historical biases of Europe and America on functional appliances

European

- Functional approach most biocompatible
- Mechanical force deemed unbiologic



American

- European social system excluded extensive fixed appliance therapy
- Question of precision of results

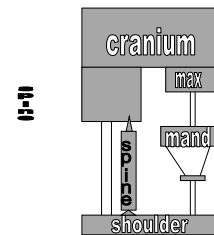


Potential advantages of functional appliances

- Enlarge transverse width of arches to relieve crowding
- Diminish adverse fixed appliance problems (gingival proliferation, TMD, decalcification, extractions-Ismail AJO 2002)
- Reduced time with braces? (Profit-AJO, June 2002)
- Reduce or eliminate dysfunctional habits
- Tx of TMD? (Pancherz AJO Aug 1999)



Bone suspension bridge



Growth Hypothesis

- His 1874- Physiology of the plasticity of bone (biologic structures may be altered)
- Moss 1960,1962,1997- Regional and local factors play a role in cranio-facial morphogenesis-Functional Matrix Theory
- Voudouris 2000- Factors of displacement, viscoelasticity, transduction-Growth Relativity
- Mao & Nah 2004- Growth and development is the net result of environmental modulation of genetic inheritance



Role of muscles

Study by McNamara with primates 1975

- Masticatory muscles and appropriate orthopedic appliances can modify the rate and amount of condylar growth

- LPM activity may induce condylar deposition

Study by Voudouris- AJO March 2000

Growth Relativity Hypothesis- Three factors of displacement, several direct viscoelastic connections, and transduction of forces



Facial Growth Spurt

- Beginning of puberty or menstruation
- Evaluated by age, tooth eruption, height, ossification of hand/wrist bones on x-ray



Role of glenoid fossa

Voudauris 1988

- Fossa is altered and brought forward by mandibular advancement

Ruf et al- AJO 1999

- The increase in mandibular prognathism to be a result of condylar and glenoid fossa remodeling

Rabie et al -AJO 2002

- Forward mandibular positioning causes significant increases in vascularization and new bone formation in the glenoid fossa

Factors influencing maxillary growth

- Maxillary sutures
- Subperiosteal bone deposition
- Nasal septum
- STH (Somatomedin)
- Ligaments and muscles



Problem of controls

- Varied response of children
- Individual basis
- All factors not predictable
- Role of “Evidence Based Research”



Factors influencing mandibular growth

- Cranium positioning
- Condylar cartilage
- Muscles (LPM ?)
- TMJ disc
- STH (Somatomedin)
- Other factors



Advancement stability

Study with rats

Functional advancements at different ages and occlusions

Stable Results

- Treatment continues until growth stops
- Continued growth possible with locked-in occlusion

Unstable Results

Continued growth with imprecise occlusion

Does the mandible actually grow?

Sample

- Panchez-changes direction
- Stutman-yes
- Mills,Janson-no



Extrapolation of studies to clinical experience

- Treatment with young patients- correct and hold
- Treatment with older growers- establish a class I in permanent dentition to lock-in
- Treatment with non growers-not rec





Arch width stability

Study by Sillman, Baume, Moorrees

- Lower canine most stable
- 2-5 mm change in maxillary molar width post-eruption
- Premolars vary



Adult TMD and Bionator

- Night time wear
- Reduces bruxism and clenching
- Relaxes LPM during sleep
- Long term use needed



Optimum timing

- Increase of STH (Somatomedin)
 - Increase of sex hormone
 - High growth rate
 - 8-10 years for removable type
 - 11-13 years fixed type
- Note- Most efficient in permanent dentition-
(Profit, Pancherz AJO 2002)



Indications for functional appliances

- Well aligned dental arches
- Posterior positioned mandible
- Non severe skeletal discrepancy
- Lingual tipping of mandibular incisors
- Proper patient selection

Barton- AJO Sept 1997



Types of habits

Study by Davidovitch

Habits influencing hard tissue when of long duration

- Finger sucking
- Soft tissue rests on teeth
- Tongue posturing
- Head position



Contraindications

- Class II skeletal by maxillary prognathism
- Vertically directed grower
- Labial tipping of lower incisors
- crowding

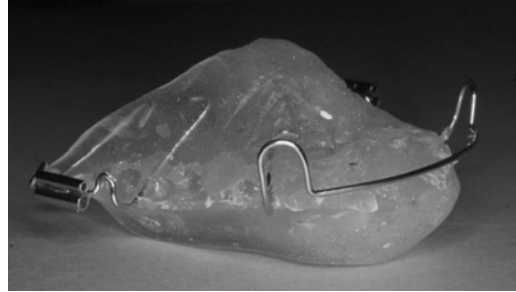


Conclusions on efficacy

According to Woodside

- Removable functionals do not work well part-time
- Large vertical changes in construction bite redirects maxilla
- Apical base width change possible with Frankel
- Bionator and Frankel work similarly on LPM activity
- Glenoid fossa changes stable
- Stepwise progression of advancement best

Activator Appliance



Informed consent

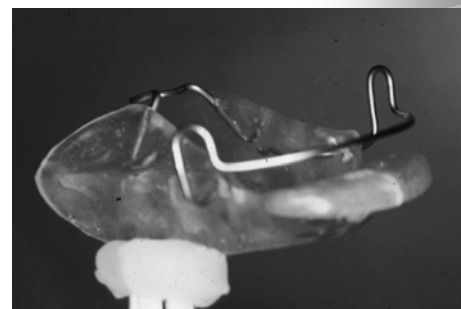
- Diagnosis- presented and understood by pt
- Comprehensive tx plan
- Overview of reasonable alternatives
- Discussion of probable sequella of non-tx
- Potential risks
- Predicted outcome and probability of success

Activator facts

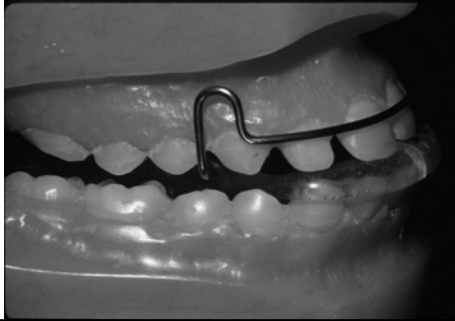
- Original design worn at night
- Large one piece of acrylic
- Teeth could be redirected during eruption
- Large vertical opening construction bite
- Could not speak or eat when worn
- Advances mandibular jaw



Bionator appliance



Bionator appliance inserted



Frankel facts

- Exoskeleton of metal and acrylic
- Restrains muscles and lips
- Exerciser
- Expands apical base
- Worn day and night
- Speaking possible, yet difficult

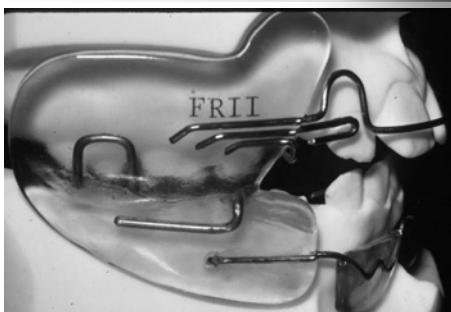
Bionator facts

- Prototype of less bulky activator
- Worn day and night
- Allows more tongue action
- Mandibular advancement
- Speaking possible, yet difficult

Herbst appliance



Frankel appliance



Herbst appliance



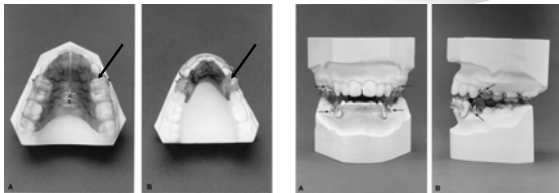
Herbst facts

- Fixed to teeth
- Patient compliance not required
- Works 24 hours
- Less airway blockage
- Most popular type at present time in U.S.

Latest Findings- the challenges

- **June 2004** AJODO by Tullock et al
 - 1 phase of fixed orthodontics is more efficient than 2 phases with functional/fixed appliances.
- **September 2003** AJODO by O'Brian et al
 - Fully randomized study demonstrated clinically significant dento-alveolar changes with Twin Block. Effective at overbite/overjet reduction.

Twin Block



From Mills et al, AJO 1998

Latest Findings (con't)

- **July 2003** EJO by Basciftci et al
 - the activator appliance can produce both skeletal and dental effects in the growing dentofacial complex.
- **January 2003** AJODO by Laecken et al
 - Retroactive study suggests that both skeletal and dental changes contribute to Class II treatment with the Herbst appliance with fossa remodeling

Twin Block facts

- Removeble
- Separate upper/lower plates
- Patient compliance required
- Less airway blockage
- Improved speech
- Most popular removable type at present

That's all folks....thanks

