

Functional Appliances

Vincent E. Mascia, D.D.S.

Traditional form of treatment



Problem... Facial Esthetics



Answer... Facial Balance



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

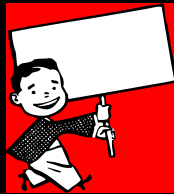


Functional Appliance



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 .



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



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



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



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**

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)



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

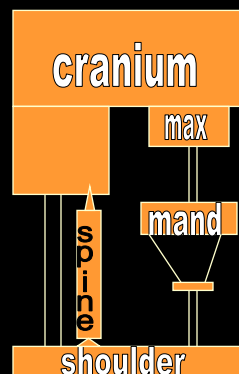


Facial Growth Spurt

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



Bone suspension bridge





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



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



Factors influencing mandibular growth

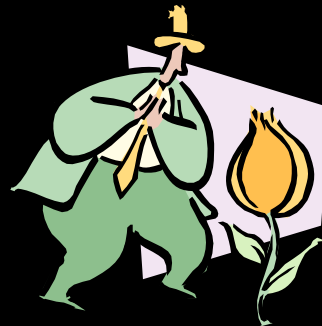
- Cranium positioning
- Condylar cartilage
- Muscles (LPM ?)
- TMJ disc
- STH (Somatomedin)
- Other factors



Does the mandible actually grow?

Sample

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



Problem of controls

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





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**

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



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)



Types of habits

Study by Davidovitch

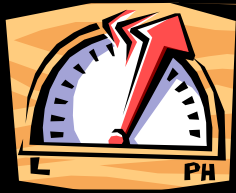
Habits influencing hard tissue when of **long duration**

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



Adult TMD and Bionator

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



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



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



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 Appliance

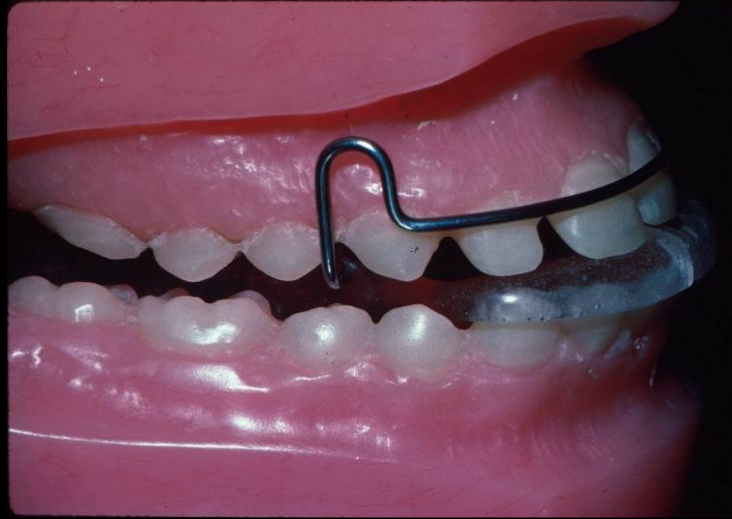
Activator facts

- 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



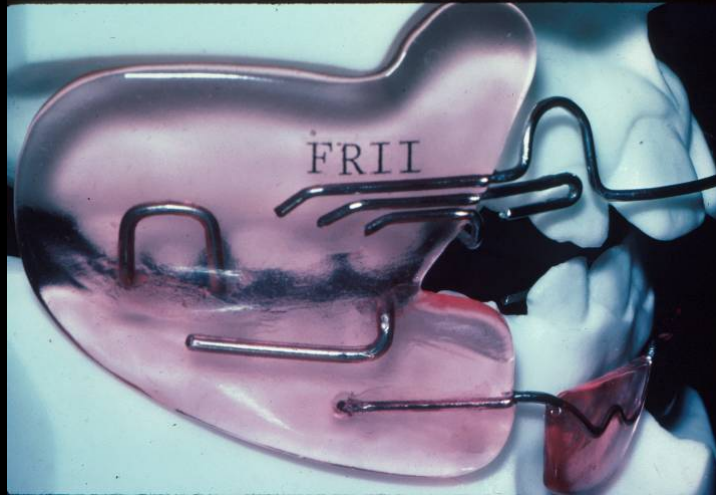
Bionator appliance inserted



Bionator facts

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

Frankel appliance



Frankel facts

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

Herbst appliance



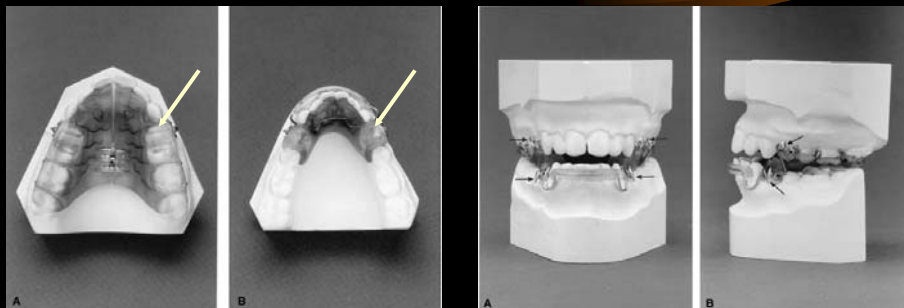
Herbst appliance



Herbst facts

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

Twin Block



From Mills et al, AJO 1998

Twin Block facts

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

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.

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

That's all folks....thanks

