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-Ismael 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**

Voudaurus 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

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**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, Pancerz 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 facts**

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

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**Twin Block**

From Mills et al, AJO 1998
**Twin Block facts**

- Removeble
- 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’Brien 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