

Use of Functional Appliances in General Dental Practice

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Abstract

Although most malocclusions pertaining to irregularities of teeth resolve through moving teeth, occasional malocclusions confront us with a disharmonious inter-jaw-relationship owing to faulty size and/ or faulty antero-posterior location of the jaws or dentoalveolar regions. These malocclusions do not always respond favorably to conventional tooth moving appliances and are ideal candidates for appliances that have the capability of molding bones as well as relocating them. Through this article, the authors outline a way that General Dentists can get enough 'food for thought' for treating such cases on their own by using simple removable appliances. Additional reading/training may be needed to get to use the functional appliances with felicity.

Key Words: Skeletal pattern, Growth amount, Growth direction, Construction bite, Appliance manipulation

Introduction

Assuming that one subscribes to the theory that moving teeth is easier than moving bones, it follows that the degree of success in rearranging relationship of jaw bones will be decided by attempting corrective steps well before peak-growth-velocity is over. Thus, late mixed dentition may be the best period for a clinician to aim to start correction of the commonest problem: large overjet (8-10 mm and beyond) often accompanied by deep overbite, narrow maxillary dental arch, recessive chin and a seemingly prognathic or, better still, an almost normal maxillary element.

Such Class II type of cases may be ideal ones for a General Dentist (GD) to familiarize himself with in using Myofunctional Appliances (also referred to as Functional Appliances). Class III cases are as such more

difficult ones to treat and hence should be avoided at least initially.

Though functional appliances are also of a fixed variety, the authors strongly recommend use of the removable type for their minimalistic iatrogenic-damage-potential (operator-induced-damage-potential).

Functional Appliances

These are muscle motivating appliances, often loose fitting, which harness the natural forces of the orofacial musculature that are transmitted to the teeth and alveolar bone through the medium of the appliance. Commonly used Functional Appliances include Andresen's Activator^{12,13} (Fig.1), Balter's Bionator¹⁴

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Fig.1 : Activator

(Fig.2), Frankel Appliance^{16,17} (Fig.3, 4), Clark's Twin Block¹⁰ (Fig.5), etc.

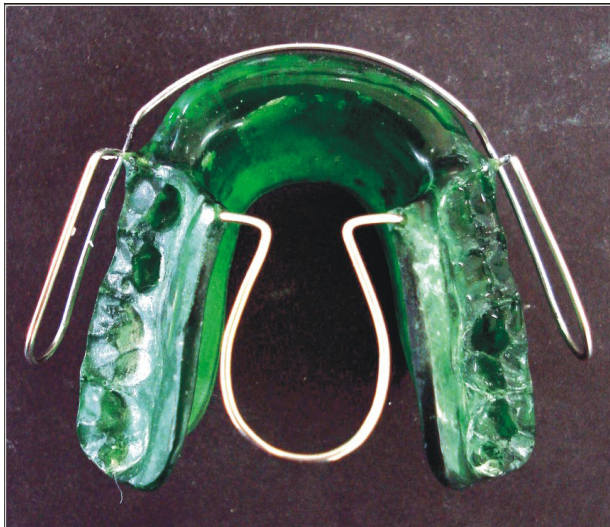


Fig.2 : Bionator



Fig.5 : Twin Block Appliance



Fig.3 : Frankel's Appliance for correction of Class IIs



Fig.6 : Cephalostat, the head holding devise for taking Lateral Cephalograms



Fig.4 : Frankel's Appliance for correction of Class IIIs



Fig.7 : Patient's head positioned in the Cephalostat, Side View

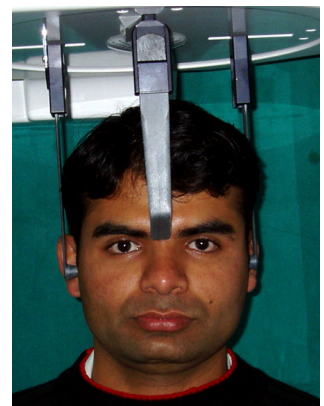


Fig.8 : Position of ear-rods & Fronto-Nasal Rest, Front View

Why Functional:

Irrespective of which functional appliance it is, functional appliances are all based on same basic principles (application, redirection and removal of force), that of using Function Forces & of alternating their direction, strength & duration. All of these appliances are all muscle controlled even if screws & springs are built in.

Development of Functional Appliances:

A major reason was recognition that function had an effect on ultimate morphologic structure of dentofacial complex¹. Moss's Functional Matrix Theory², contributions of Wolff on form & function, studies on response of bone to functional forces by Kock, Benninghof and ideas of Van Der Klauuw all contributed in seeking to change and control the direction of growth of the jaws in correcting imbalance in the skeletal jaw bases.

These studies and several others paved a way in proving that function plays a very important role in controlling size & shape of bones in the membranous bones of craniofacial area and especially more so in regions of the alveolar base of jaws.

Effect of Functional Appliances:

Functional Appliances are unique not solely due to their purported orthopedic effect influencing facial skeleton of growing child in condylar & sutural areas as claimed by several experts. They also exert an orthodontic effect on dentoalveolar area. Unlike conventional appliances which act on teeth using mechanical elements, functional appliances act on dentoalveolar structures by transmitting, eliminating or guiding natural forces produced during various functions e.g. Swallowing, Mastication, etc.

Functional Appliances help to reset the altered equilibrium of the orofacial musculature and often help in elimination of oral habits whilst being an effective post-treatment retention appliance in certain types of cases too.

Case Selection & Issues with Diagnosis & Treatment Planning

Functional Analysis¹¹ is a very important cog, in the wheel of success while using Functional Appliances. The reader is encouraged to be conversant with the nuances involved herein before attempting to treat cases.

Other important issues are:

- The diagnostic criteria used to determine the growth pattern (both antero-posterior and vertical) in a case.
- Status of lower anterior teeth (in terms of proclination or crowding prevalent).

- Judging the efficacy of the expected clinical result (clinical VTO).
- Understanding the principles of, and taking a proper Construction Bite¹².
- Despite being seemingly easy to use, functional appliances need proper case election criteria to be followed and, above all, a cooperative patient to achieve the needed degree of success.

(1) Judging the Skeletal Pattern

The purpose of this step is to determine if a case belongs to the correct type in being treated with a Removable Functional Appliance.

This calls for routine lateral cephalometric skeletal evaluation using suitable simple analysis for judging the skeletal discrepancy between the upper and lower jaws. Any standard textbook in Orthodontics^{3,4,5,7,10,12,13} will help the reader to reacquaint themselves of these basic facts.

If a Cephalostat (Fig.6, 7, and 8) is not available, then, a True Lateral X-ray of the Skull and Mandible taken from the right side with a film-to-focus distance of 5 feet can be made use of.

- (a) **Antero-posterior Dimension:** The normal ANB relationship is about +2° with the plus sign indicating that maxilla is ahead of the mandible.

Ideally, in treating Class II cases with removable functional appliances, the antero-posterior position of maxilla should be more or less normal and the mandible should be retro-positioned in their relationship to the anterior cranial base: thus setting up a large ANB value in the angular measurements.

Thus, all things being equal, cases with a SNA value that is normal or near normal for a child at that age with a concurrent ANB value of upwards of about +5° are ideal (as this indicates that the maxilla is normal and the mandible is retro-positioned) for intervention with a functional appliance.

- (b) **Vertical Dimension:** For easy recall, in lateral cephalometric analysis, this information is divulged by angular measurements FMA, GoGn-SN and Maxillo-Mandibular Plane Angle (Basal Angle). For example, while using FMA values, the normal is 25°. When the face is more oval or long: making the *nose-to-chin-distance* increase substantially, this value increases to well beyond about 30° for the condition to be termed as a High Angle Case. On the other hand, when the *nose-to-chin-distance* shortens this angular value reduces well below 21° or so for the case to be described as a Low Angle Case.

Genesis of a Vertical Problem: Consider the fact that as a child starts to mature in the dento-facial area, the chin position is governed by growth in the dento-alveolar areas of posterior teeth. This is akin to creating *premature contacts* posteriorly, or, as in a situation created by progressive vertical eruption of teeth. Hence, the chin tends to swing downward and backwards: making it assume a retrognathic character. This is counterbalanced by growth in the mandibular condylar area which tends to make the chin go upwards and forwards: making it assume a prognathic character. When the mechanism works well in unison, the result is a normal, balanced face. When growth in posterior alveolar areas radically exceeds that in the condylar region, the result may be a High Angle Case with a longish face. If the roles are reversed, a Low Angle Case may be the outcome.

All things being equal, best cases to start with Functional Appliances are when the FMA value is within the normal range: between 22° to 28° or so.

(2) Status of Lower Incisor Teeth

Since the construction bite is taken in a protrusive mode for Class II cases, there is always a tendency for the lower anterior teeth to be proclined. Hence, in case selection, an important criterion is that the lower anterior teeth should be either 'straight' (sometimes also called as 'upright') or even Retroclined rather than be in a state of proclination. There should also be absence of any lower incisor crowding.

(3) Positive Clinical VTO

VTO stands for Visual Treatment Objective. In essence, this clinical test is an advance indication of the projected/anticipated efficiency of the attained result. Since it is a very accurate way to determine if the treatment result will make a positive effect on the personality change attempted, it is an invaluable clinical advance planning tool in clinical practice: especially since it does not need any specialised equipment.

When a patient with large overjet is to be treated with a functional appliance, the clinician needs to:

- (a) Have the patient sit upright facing the clinician. Patient must be at rest with the lips in their normal unstrained position and the teeth in the Centric Occlusion. If the patient can be relaxed enough to give a physiological rest position, so much the better. Patient is now observed and preferably photographed from the:
 - The Frontal aspect
 - The Profile view

This gives us an accurate depiction of the patient's facial features before treatment.

- (b) Now, the patient is taught/trained to get his Lower Central Incisor teeth in an edge-to-edge relationship with the Upper Central Incisor teeth: a position that he will be made to assume when being treated with the functional appliance. He then holds/maintains the teeth in the same position. Patient is made to drape the lips on the newly positioned teeth with minimum possible strain reflected in them. Photographs are then taken again from the:
 - The Frontal aspect
 - The Profile view

This position reflects the likely *looks* that the patient will exhibit at the end of treatment with Functional Appliance.

- (c) The photographs taken in natural rest position (as in "a") are then compared with those taken in the protrusive (as in "b").
- (d) If the patient's facial features show a marked improvement between the two sets of photographs ("a" v/s "b"), the patient is said to have shown a +^{ve} Clinical VTO and therefore is a good candidate for being treated with a suitable functional appliance.

(4) Construction Bite

The case-attributes that we are contemplating on treating with Functional Appliance shall have a significantly large overjet. This will be attempted to be corrected by following the well laid out principles of registering a Construction Bite¹² using modelling wax.

Although there are several ways and philosophies in the precise way of registering a construction bite, in its simplest form, the same can be broken down into:

- (a) This involves training the patient to achieve the maximal protrusive relationship of the lower incisors, and then staying at least 3 mm *less protrusive* (or, behind/distal) to this maximum protrusive position while registering the Bite on warm roll of horse-shoe-shaped wax. With the construction bite passively in the mouth, the patient's face should look decidedly better (as in when Clinical VTO is taken). If the patient has an overjet that is greater than 6-8 mm, often, it is necessary to advance the mandible in two stages. However, this entirely depends upon a patient's ability of giving a maximal-protrusive-posturing of lower jaw. Sometimes, it may be OK to jump even 10 mm in a one-step-bite.

Care should be taken to ensure that:

- i. Upper and Lower dental midlines coincide/match

- ii. While correcting the midline, there should be no posterior cross-bite created artificially by abnormal posturing of the mandible while taking the construction bite.
 - iii. The vertical separation between molars on left and right sides is equal.
 - iv. The vertical separation in molar region should be at least 3-4 mm.
- (b) This construction bite is then used for the lab to mount the casts on a non-anatomical articulator to fabricate the appliance using self curing acrylic resin with a *salt-and-pepper technique*.

(5) Appliance fabrication pre-requisites:

- a) The impressions taken must be:
 - i. Deep and should register the Labial and Buccal vestibules in totality.
 - ii. The lingual pouch area should also be very well registered.
 - iii. Made in duplicates so that another set of casts are available to check the accuracy of fit of the fabricated appliance, etc.
- b) The casts must be:
 - i. Made out of the impressions at the soonest so that dimensional inaccuracies do not get introduced through syneresis and imbibitions.
 - ii. Made using good quality Dental Stone
 - iii. Without blemishes like air-bubbles or voids.
- c) Undercut Areas, especially on the lingual side should be blocked out with wax prior to acrylisation.

(6) Choice of Myo-functional Appliance

Amongst the commonly used Functional Appliances are Andresen's Activator^{12,13}, Balter's Bionator¹⁴, Frankel Appliance^{16,17}, Clark's Twin Block¹⁰, etc.

Generally, choice of appliance is an operator driven issue rather than it being a case-specific one. Other factors like concurrent need for expansion of dental arches; need to use extra-oral forces in tandem with the functional appliance therapy, availability of lab back-up, patient compliance etc., are some vital issues which determine which appliance is preferred by a clinician.

All in all, the attributes of a typical Class II Division I Case to be treated well before peak growth velocity is reached should be:

- Mixed Dentition Phase: early, mid, or, late (in the same preferential order of chronology). Second permanent molars yet to erupt.
- Normal Maxilla with retro-placed mandible (as confirmed by Lateral Cephalometric Analysis).

- Normal Vertical Growth Pattern.
- Lower Incisors: no proclination, no crowding/rotations.
- Large overjet of upper anteriors.
- 'V' shaped, narrow maxillary dental arch with narrowing in cuspid region.
- A positive Clinical V.T.O.

Mode of Action of Functional Appliances

Several experts^{3,4,5,6,7,8,9} have propagated proper theories with a scientific base: all with significant variation in views to pin down the exact mode of action.

The authors wish to take a very *simplistic model* to explain to a GD the mechanism of Class II correction with Functional Appliances.

Consider a typical case: growing child well before attaining peak-growth-velocity, having a large overjet, narrow maxillary dental arch with distinct constriction in the cuspid-premolar area, deep overbite with an accentuated curve of Spee and a near-normal mandibular dental arch with a non-contracted arch form. The mandible, per say, is normal but is located way behind/posterior to the maxillary unit (distocclusion).

In such a situation, the narrowness of the maxillary dental arch in the cuspid-premolar area does not permit the lower anterior teeth to go forward by translation of the mandible which should be occurring when growth at the mandibular condyle occurs.

This is a bit like person who wears size 10 shoes trying to get into a shoe that is size 4. The wide foot can go only part of the way before the narrowness of the size 4 shoe prevents the foot from going any further. Thus, a lot of the size 4 shoe will be unoccupied by a foot that is normally clad in size 10 shoe. This empty space in size 4 shoe is akin to the large overjet in the narrow maxilla that the wide foot (mandible) is unable to get to occupy due to the narrowness of the shoe's opening (narrow inter-canine-width) in maxillary dental arch.

This results in a Class II occlusion and a retrognathic profile. The lower anterior teeth often become more upright and sometimes even Retroclined as a compensatory effect.

Expansion of the maxillary dental arch is hence needed either before or concurrent to use of functional appliances for the mandible to relocate anteriorly.

Simply put, narrowness of the maxillary arch has to be circumvented for the 'normal' growth potential of the mandible can be given a chance to 'catch-up' with the maxillary growth or, 'jump' ahead to correct the bite (more like releasing the brake of a car on a slope will allow it to move forward at a fast pace). This is often called as 'jumping the bite'.

This circumventing is achieved through the construction bite. The mandibular teeth are made to assume a near edge-to-edge-relationship with the maxillary incisors: thereby taking the posterior teeth out of occlusion. Maxillary teeth are thus now ready to be expanded by a suitable method depending on the type of functional appliance used.

The construction bite when replicated into a fabricated appliance locks the mandible into a more protrusive position. The retractors muscles of the mandible (lateral pterygoids) thus get activated to try to pull the mandible back...however, the appliance does not allow this to happen. The pulling back impetus of the mandible is transferred through the appliance on to the maxilla as a reciprocal effect. At best, the forward and downward growth of maxilla is prevented / retarded. But, the mandibular condyle, owing to having been displaced out of its normal position within the glenoid fossa for the entire time that the appliance is worn then undergoes reorganizational changes.

If the functional appliance is worn for a sufficiently long period (long hours every day and night and doing so continuously in excess of 6-8-10 months), the new protrusive position of the mandible dictated by the appliance then can become the normal position for the patient. It brings about the needed correction in both antero-posterior and vertical dimensions.

The concept is similar to a married lady, on staying at her husband's home, over a period of time, gets to identify and feel comfortable in her new home rather than her parental home ('sasural' and maika' to lapse into colloquial).

Selective grinding (called trimming) of the acrylic of the functional appliance aids the condylar reorganizational changes in allowing/guiding movements in vertical and antero-posterior direction for the teeth.

Care to be taken in using Functional Appliances

When used early in a compliant patient, sometimes the results seem to be attained very quickly: as seen when the clinician asks the patient to take off the appliance. However, when used for a shorter period of time, this apparent correction may be just a transient phase: more due to a dual-bite created rather than a permanent correction.

Therefore, the operator and the patient both need to be patient in getting the appliance to be used for a much longer period (10 months is a good ball-park-figure) for the gains to be of a permanent nature.

In presence of a familial trait/genetic pre-disposition towards unfavorable growth, it is best to keep using the appliance for an even longer period: more like a

retention appliance. This may be done by partial use (about 9 hours daily).

It is impossible to make the reader aware of all intricacies of using a treatment philosophy. The reader should look for avenues to take Continuing Education Programs to hone their skills before embarking on the exciting journey to treat cases with Functional Appliances.

Sometimes, despite the best diagnostic skills, a proper choice of appliance exercised with adhering to all the needed underlying principles, results are inadequate. The reason for that is best described by a simple GAK principle: God Alone Knows!!

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