

# Feature

## The Bionator: Sleeping Giant

*This article has been peer reviewed.*

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***“I really do not see the signal.”***

(putting the telescope to his blind eye)

Horatio Nelson 1758-1805

English Admiral

If you understand the Bionator, chances are you possess a good understanding of orthodontics. If you do not understand the Bionator, or more correctly if you do not understand the various treatment principles it symbolizes, you will have a difficult time claiming you have a true grasp of orthodontics and its companion discipline, the treatment of temporomandibular joint pain-dysfunction problems. Sound like bold statements? Permit me to explain.

For the sake of brevity and clarity the reader is asked to indulge the use of simplified metaphor and sweeping generalization as such methods facilitate a quick elucidation of an extensive and complex subject matter.

The world of orthodontics has been dominated for almost a century in this country by fixed appliances. General dentists were trained in the use of space maintainers, simple lingual holding arches and possibly the use of a Hawley retainer with a labial bow and/or finger springs to shift or tip a tooth here and there, but for all intents and purposes most general dentists were only taught enough “full mouth” orthodontics so as to be able to know when to refer. The implementation of fully banded “strap-ups” was a privilege usually reserved for the orthodontic specialist. Those generalists who did advance their knowledge and skills to the point where they were treating major malocclusions with fully banded fixed appliances often had to proverbially pull themselves up by their own orthodontic boot straps, usually under the suspicious and sometimes less than approving watchful eye of nearby specialists. In their efforts to properly diagnose patient treatment needs, one of the big questions facing everybody that practiced orthodontics, be they specialist or generalist, (other than what was the best way to fight relapse)<sup>1-3</sup> was what criteria to use to decide whether to extract bicuspids or not! This, of course, was only after all the dust had settled after the first big series of fights between the early extractionists like Dewey, Case, Tweed etc. and the non-extraction oriented followers of “old father Angle.” It was a copasetic little environment with the

orthodontic specialists reigning supreme and unchallenged in their opinions as far as what actually constituted the appropriate standard of orthodontic care. The specialists did most of the ortho while the generalists for the most part kept their place. Braces were braces. Techniques varied, but they all concentrated pretty much on the same thing: moving teeth. All seemed well with the world.

But then something happened that threatened all that. Over an extended period of decades, a new orthodontic approach was developed, based on European techniques involving removable devices called “functional appliances.” As a result a new treatment methodology evolved. A new way was found. It revealed the short falls of the traditional orthodontic methods. It rocked the orthodontic establishment down to its very core and turned that cozy little clinical world totally upside down. Things were not what they seemed. Merely aligning teeth wasn’t always enough. Someone had discovered the truth! There was more to orthodontics than just moving teeth.<sup>4-7</sup>

Gradually, over the first half of the century certain leading European orthodontic clinicians had strikingly discovered that correct orthodontic treatment involved more than just moving teeth with fixed appliances, more than just relieving crowding via bicuspid extraction, more than merely rearranging the teeth (and often shrinking the dental arches in the process) to fit the pre-existing jaw to jaw horizontal and vertical relationships. They discovered how to completely realign mandibular skeletal Class II retrusive relationships out to a full and esthetically pleasing skeletal Class I relationship. They discovered how to alter the jaw-deforming “Class II neuromuscular sling” that was actually a muscular mal-adaptation that once corrected myofunctionally would in turn, due to redirected peri-oral and inter-oral muscle forces, deliver a deficient Skeletal Class II mandible more forward back out to a normal skeletal Class I relationship where it belongs.<sup>8-14</sup> They not only discovered how to develop a stunted, dentally crammed skeletal Class II mandible down and forward in concert with the natural grain of growth, the complete opposite of what the traditional fixed appliances school of thought often tried to do, but also came to observe that these endeavors once completed provided enormous relief to painful, damaged, headache producing internally deranged temporomandibu-



Figure 1-A



Figure 1-B



Figure 1-C



Figure 1-D

Figure 1-A: Traditional Bionator, a modification of an earlier design of Dr. Wilhelm Balters of Germany.

Figures 1-B, C, D: Bionator inserted on display models, various views

lar joints in the process.<sup>15-16</sup> And the clarion functional appliance that stood as the initial hallmark technique that accomplished all of these wondrous and revolutionary results was the Bionator! That's why it is so important to not only understand what it does but also what it signifies.

Actually, the Bionator is more than just a functional appliance. In certain circumstances it can be used in other capacities as an active plate and even a myofunctional and dental retainer. Three for one. What a deal! Let us look at how this can be.

### The Bionator as a Functional Appliance

In more recent times, newer devices such as the Clark Twin Block series of removable appliances have eclipsed the humble Bionator somewhat for the center stage spot in the wave of popularity that has sprung up over mandibular advancement procedures that employ various types of functional appliances. But just because it was one of the earliest functional appliances to be developed, never underestimate the value of the traditional Bionator or its abilities to accomplish truly incredible feats of orthodontic, orthopedic and

myofunctional mechanotherapy. It must be remembered that for nearly a century the fixed appliance devotees insisted that you could not therapeutically "grow mandibles." Orthognathic surgery was considered the only true way out of the large skeletal Class II overjet mess. Yet eliminating 7, 8 or even 10 or 11 millimeter skeletal Class II mandibular retrusions that are compounded in the pretreatment state by 100% or greater overbites forms the theater of operations where the Bionator truly shines. This is the area of treatment for which it was originally designed and the type of malocclusive problem it solves best. That is why when the early Bionators, or even their first primary ancestral prototypes which were called "Activators," were first introduced to the European orthodontic community they were referred to as the "miracle appliances." They seemingly miraculously "grew" Class I mandibles out of retrusive skeletal Class II malocclusions, something the fixed appliance school had never been able to do, not because it couldn't be done, just that because it couldn't be done with fixed appliances. They were the wrong appliances for the skeletal Class II mandibular retrusion problem. Functional appliances where needed here.

One of the big secrets to the most efficient use of a Bionator is treatment timing. It has been observed that when treating skeletal Class II, deep bite cases with the Bionator, dramatic and timely treatment flow occurs as the pubertal growth spurt ensues, a time generally coinciding with the stage in dental development when the deciduous second molars are near exfoliation and /or the permanent second bicuspids are just starting to erupt. This is the time when a Bionator is most efficient.

Another absolutely critical component of the correct deployment of the Bionator is archform. Jumbled, crowded, over-lapped teeth, narrow arch forms, deep curves of Spee, and upper arch to lower arch transverse dimension discrepancies must all be corrected and/or eliminated prior to the insertion of the Bionator. This means that the individual dental arches can be treated one at a time independently of each other in order to attain proper and compatible arch form with teeth positioned within the normal window of cephalometric parameters irrespective of their intra-arch alignment. The intra-arch alignment, both horizontal and vertical, is the job of the Bionator. It has been stated that, "The Bionator is an arch aligning appliance." If you don't have reasonably properly shaped arches you're not ready for a Bionator. Overlapped teeth, crowded teeth, rotated teeth, or displaced teeth, Division 2 retroclined upper teeth, blocked out cuspids, jumbled lower anteriors and all sorts of other dental alignment irregularities, do not constitute good arch form. Get the arch form right, then you'll be able to get the Bionator right.

One of the things that makes the Bionator so stellar as a functional appliance is that it is directly aimed at one of the most pernicious and nebulous of etiological factors in the development of the skeletal Class II malocclusion, that mysterious entity referred to as the Class II neuromuscular sling. It is the musculature that is aberrant in the skeletal Class II case and these untoward muscle forces can act to retard normal development of not only the mandible but also sometimes the entire stomatognathic system itself. Whether this muscular maladaptation is primary or only secondary, whether it is an adaptation to airway obstruction, whether it is nutritional in nature, genetic, or due to other developmental aberrations is unclear, and frankly unimportant. Once it is there, it's there, and it won't go away by itself, it won't go away due to treatment with fixed appliances and Class II elastics, it won't go away with headgear, it won't go away until it is addressed with a technique specifically designed to attack and correct it. Since a serious percentage of the children needing orthodontics exhibit some form of retrusive skeletal Class II, deep overbite malocclusion (or skeletal Class II effect), this all becomes very important. Not being able to address a problem this pervasive leaves a clinician's orthodontic treatment capabilities seriously compromised. Emotion driven denial can't change this simple scientific fact. When maxillo-mandibular verti-

cal and horizontal relationships, and the musculature that surrounds them are "off" fixed appliances do little to change them.

In a skeletal Class II, deep bite situation, if you cannot deliver the mandible more forward to skeletal Class I, (which you can't if you're restricted to using only fixed appliances) the only alternative left open to you in many cases is to somehow crank the maxillary incisors back far enough and tip the lower anteriors forward enough in an effort to obtain incisor coupling and close up the huge horizontal overjets. Past that, the only alternative, if the remaining overjet is still too big, is to cut the mandible in half and wire the front half far enough forward so as to bring its mandibular incisors into contact with the dome of the upper incisors until the sectioned bone heals. But that was before the advent of functional appliances. Now there are better options. If it's a matter of the choice between a high risk, high expense, sagittal sliding mandibular osteotomy vs. the simple use of the humble little Bionator to accomplish the same final effect, let's face it, not much of a contest!

Muscle function is a key player. Incorrect and major manifestations of the peri-oral and/or intra-oral muscle function in concert act as the offensive, attacking player. Let improper oral muscle function have its way and both the patient and the treating clinician lose the orthodontic game. Correct or redirected muscle function is the winning defensive payer enlisted by the Bionator. The structural design of the appliance forces both the extra-oral and intra-oral surrounding muscle environment of the jaws to change from a cumulative force of persistent destructive activity to one of persistent constructive activity. And as we have learned, due to the bio-plastic nature of the entire maxilla, and alveolar process of the mandible, as well as the functional responsiveness of the condylar head and neck during growth and development of the stomatognathic system, as the muscle goes, so go the bones. Speech and deglutition are both muscle functions. The calculated obstacle represented by the design of the Bionator, better than anything else, forces that cadre of repetitive muscle functions to go the right way, "the bone-correcting" way. And the bones oblige. Sure, it takes time, but so what! It only takes 2 hours in the O.R. to cut a child's jaw in half. But sometimes the complications of such a procedure last for life.

The fact that the Bionator (and its philosophical treatment concept) are directly muscle and bone oriented is demonstrated by the manner in which this simple appliance is subject to the "rules of the muscle kingdom." The "First Rule" in any muscle environment is that muscles need time to adapt to that which is being demanded of them. Try jogging 4 miles non-stop if you're out of shape. The next day your leg muscles will let you know they're not happy. But start gradually, a little bit everyday, and in just a month you can probably do it, nonstop, without being sore the next day. This principle is the first cardinal rule of Functional

Jaw Orthopedics. If you will forgive a little levity for the sake of clarity, this rule concerning advancement of retruded skeletal Class II mandibles can be stated, "You can't yank em' too far forward too fast!" In the old days when Bionators were first being introduced to the orthodontic world it was discovered that if a child had a skeletal Class II, deep bite retrusive mandibular situation, with a large overjet in the 10-12 mm range, bringing the mandible all the way forward all at once with a single Bionator would result in painful muscle spasms in the masticatory elevators. This problem was initially solved by first building a Bionator that would only bring the mandible part of the way forward as a result of being made with a construction bite (wax inter-occlusal record) that produced say only 5-6 mm mandibular protrusion, i.e. a distance only about half the total needed. Then, after about 6 months, when the mandible and its musculature had easily adapted to that partially advanced position, a second Bionator would be constructed that delivered the mandible the rest of the way to full skeletal Class I.

The need to address this principle is also reflected in the genius of Dr. John Witzig. He developed the Orthopedic Corrector I appliance (the more sophisticated, sister appliance to the Bionator) that employs those little side appliance expansion screws that permit the employment of slightly less than fully protrusive construction bites. Dr. Witzig's invention of the use of these little side screws in his Orthopedic Corrector I (OCI) technique allowed the use of wax construction bites for appliance construction that brought the mandible near, but not all the way, to the desired finishing position. Once the muscles had adapted to that location, the little side screws could be activated (and the lower IPA's or interproximal projections of acrylic could be eliminated as per standard Orthopedic Corrector I technique) and with the screws opened 2-3 mm or so, thus advancing the lower incisor appliance cap area, the mandible was forced further forward, sequentially as desired, to the final, fully corrective finishing position. This obviated the bothersome and expensive construction of that entire second or even third appliance. It's a simple trick, but very clever. Not only does it reflect the clinical skills of John Witzig, it also pays homage to the rules of muscles.

However, for their seemingly sometimes functional obstinacy, muscles can also be very tolerant. This in turn is reflected in the principles of the proper registration of wax construction bites for Bionators also. In a case where the mandible needs to be advanced by a distance represented by X, the wax construction bite for the treatment Bionator needs to be taken in a protrusive position represented by the distance X + Y where Y is 2-3 mm past the actual desired finishing position. This of course is only once the mandible is within 5-6mm or so of such a position either naturally in the pretreatment state or after having been brought to that range by an initial "preparatory" phase of

Bionator treatment out of a deeper retrusion, with a less aggressive construction bite. The vertical distance between upper and lower incisors when the appliance is in the mouth is usually 2-4 mm open in the incisor area and is occupied by the thickness of the anterior incisor cap. Such combinations compensate for the tolerance of the jaw muscles to slight changes in the natural occlusion. The ideal construction bite in the ideal Bionator case (2-4mm open interincisally, 1-3 mm past end to end insicallly) causes the muscles to change because this degree of protrusion and increased vertical has been shown to be enough to bring them outside their range of acceptability while at the same time not violating their outer limits of tolerance in both horizontal and vertical dimensions. Given good arch form, adequate patient compliance and proper appliance management and adjustment, the case then gradually and gracefully changes from a skeletal and dental Class II deep overbite mandibular retrusion to a full dental and skeletal Class I jaw alignment, with proper ranges of incisor overjet and overbite relationship. With the naturally programmed passive eruption of the posteriors, the teeth fill in the vertical gap between the posteriors as the case turns into a full dental Class I. It is natural, it is correct, it is beautiful. Most importantly it is how Nature wants it. This often makes for a fuller more attractive face, it helps in the "posttreatment stability wars," and makes for a happy, healthy, unstrained, pain-free temporomandibular joint. Mild A-P skeletal discrepancies in the 1-3mm range and minimal overbites of a similar nature may well be the domain of the fixed appliances. But the "galloping" skeletal/dental Class II retrusive mandible with the deep overbite, retruded lower facial profile, weak chin and sunken in facial appearance are the realm of the Bionator, Orthopedic Corrector I or other mandibular advancement type functional appliances of their league. How could you conceive otherwise?

### The Bionator in Orthopedic Retention

As previously stated, since the Bionator or Orthopedic Corrector I's are described as mandibular advancing, arch aligning appliances, a certain qualifying amount of preliminary arch modification (correction) is implied prior to the use of such appliances. Again oversimplifying for the sake of brevity, this essentially entails the preparation of the arches, if need be, by varieties of active plate and or fixed appliance techniques. This might involve lateral development of the upper arch, although usually not to some predetermined trans-arch width according to traditional tables such as Pont's (Linder-Horth Corrected) or Schwarz, (although these can be helpful at times), but rather to a trans-arch width just wide enough to adequately house an uprighted, decrowded, ideal (or not so ideal) mandibular arch in the finishing advanced position. Treating to an upper arch width just wide enough to house the decrowded lower arch is an effort to make peace with the muscle envi-

ronment as quickly as possible. Obtaining proper arch form prior to Bionator use might also involve forward development of "Div 2" retroclined upper incisors with maxillary Sagittal II active plates and/or even various fixed appliances. It might also involve posterior quadrant distalization techniques combined, where appropriate, with the blessings of second molar extraction techniques, (one of the few arch preparation techniques inherently stable). In the lower arch, often molar distalization and arch perimeter development techniques rely on fixed appliances that merely upright lingually tipped posterior quadrants giving the illusion of widened and elongated decrowded arches due to the forgiveness of the dermally originated alveolar bone that sits atop the solid, unchangeable mandibular apical base of mesodermally originated chondral bone. (This is in contrast to the maxilla which is entirely ectodermally originated dermal bone; alveolar process, apical base and all.)

The point is, all this orthodontic arch preparation, prior to myofunctional and orthopedic arch realignment and opening of the deep overbite, involves procedures (except for the aforementioned posterior quadrant distalization techniques performed in conjunction with second molar extraction), that are fraught with relapse potential. Fortunately, as we shall see presently, the Bionator has some services to offer in certain cases here too!

For over a century the complete and long term retention of orthodontic treatment results has been an "Achilles heel" of the orthodontic discipline, regardless of which particular technique was used to treat a given case nor which treatment philosophy spawned its methods. Yes, there are some cases that appear on the surface to remain orthodontically stable, preserving the beautiful results effected by the treating clinician's efforts without exhibiting even the most minuscule posttreatment changes in tooth position. There are cases that seem to defy the unrelenting tug of transeptal fibers, the elastic memory of alveolar bone, and the merciless pounding of nocturnal parafunctional activity. There are in fact a certain modicum of cases that can withstand all the "thousand natural shocks that flesh is heir to," and gloriously continue to remain in their pristine posttreatment state of "Board qualifying," "Andrew's 6-Key-fulfilling," "lecture-slide-starring" condition of orthodontic obsessive/compulsive perfection, serenely capable of satisfying the pedagogues in our profession. Yes, there are some cases that exhibit such legendary stability. But only some. Most don't. In many cases diastemas reappear, extraction sites creep open, root angulations nudge unfavorably, vertical dimension of occlusion withers, pernicious occlusal relations clandestinely hint at returning to their former ways, arch form alters, crossbites reoccur, and incisors tip, torque and blatantly even re-overlap in a muted, nose-thumbing rebuke of sacred and vaulted orthodontic treatment mechanics dogma. Orthodontic specialists know it. Pedodontic specialists know it. General dentists certainly know it. They are the ones that

see the patients year after year over the decades. Sooner or later, (and most likely sooner) every clinician that practices major orthodontic treatment of "full blown" malocclusions will be forced to confront this enigma. And in the past it was all blamed by some on the fact that such cases were merely treated with fixed appliances only, thereby leaving myofunctional and major orthopedic (i.e. TMJ) aspects of some cases seriously unresolved. But guess what? The Functional Jaw Orthopedics people fared little better. They had their own problems!

Being that the "fixed-appliance-only" school of traditional orthodontics: 1) flirted with serious attempts at arresting DNA-directed growth inhibition (as if headgear can overcome genetics) 2) and since their treatments at times moved teeth entirely out of their genetic beds, often against the grain of growth by means of the deceptively logical principle of bicuspid extraction and 3) since their total overall treatment philosophy, regardless of subset type (e.g. Begg, Edgewise, Roth, Bioprogressive, Andrews, etc.) did not even include the most wistful allusions to the extremely demanding principles of the biomechanics of the temporomandibular joints, their stately and time-honored position in the orthodontic world left them as no match against the thunderously crushing blows of the FJO-camp with its orthopedic and TMJ correcting myofunctional principles. However, that latter philosophy has entirely redirected the scope of modern day treatments of malocclusion in both children and adults to the point where now those who by skill and/or training are limited to the deliverance of care by the mere use of fixed appliances alone remain perched on a methodological precipice of medicolegal disaster. But the specter of the problems of "retention" with all the new connotations of the word, still prowls the newly re-defined myofunctional, TMJ-driven clinical world of functional orthodontics albeit in a modernized somewhat altered aegis.

The two principles that the FJO camp brought to the discipline of orthodontics that helped immeasurably in the battle for posttreatment stability were the weapons of 1) the confluence of treatment techniques with myofunctional growth directions and 2) the use of second molar extraction techniques. The former allows for, among other things, the restructuring (retraining) of the Class II neuromuscular sling (a technique that represents the myofunctional heart and soul of the FJO philosophy), and the latter, with all its important stability-enhancing prowess, has been adequately covered in numerous other sources and is common knowledge to most devotees of the FJO approach. Nevertheless, the myofunctional camp never said it wouldn't ever have to enlist traditional fixed appliances to level, align, and rotate teeth. And when it comes to the relapse aspects of the "teeth portion" of the conceptual "Teeth, Bone, Muscle, Maxillofacial Triangle" of malocclusion, all of the old standard principles of orthodontics for addressing those types



Figure 2-A

Figures 2-A, 2-B: Lateral view of IPA's (interproximal projections of acrylic)



Figure 2-B

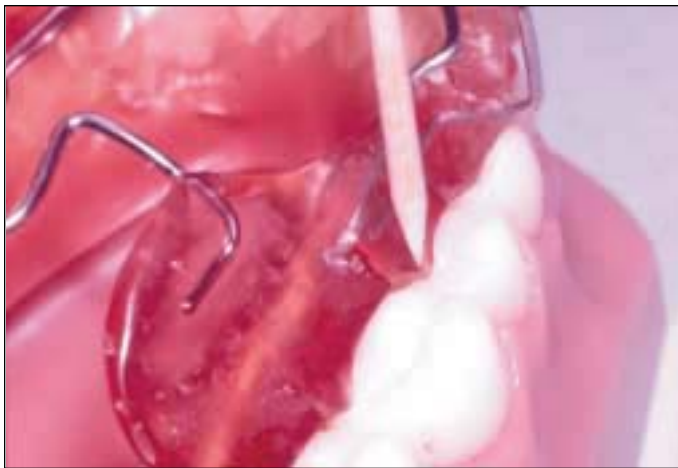


Figure 2-C

Figures 2-C, 2-D: IPA's must be reduced after 3-4 months of treatment to allow passive eruption of the posteriors: only the IPA mesial to upper 1st molars is left unadjusted as it anchors the whole appliance against the maxillary arch

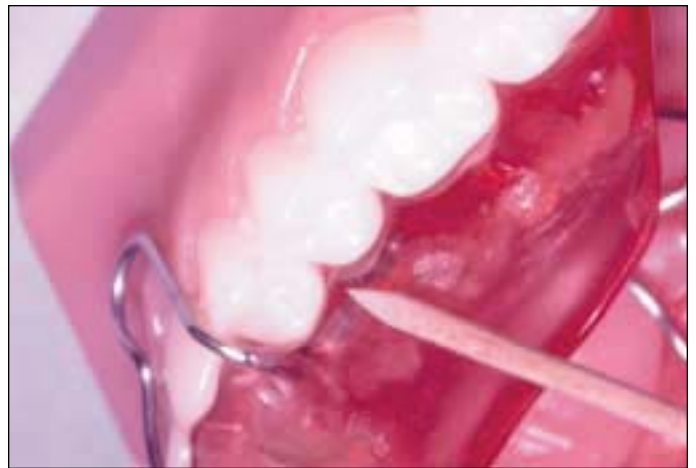


Figure 2-D

preventing distal drift of the appliance.

of problems still apply whether functional techniques are used as part of the treatment plan or not.

Root torque is still root torque, plain and simple. A rotation still remains as sinister as ever.

Yet for all the enhancements of long term stability associated with the upgrading of orthodontic/TMJ care represented by FJO methods, the problems of posttreatment retention of the "Bone" and "Muscle" portions of the triangle are treatment aspects with which the FJO camp in turn must additionally wrestle. Those may be defined in terms first of the nebulous concepts of "Correction vs. Development," and secondly in terms of the elastic memory of the "class II neuromuscular sling." Let us look at each briefly here.

Purely orthodontic tooth position "correction" implies the orthodontic movement of a tooth or group of teeth back to their original alveolar locations in which they initially erupted into the mouth, but away from which they have been subsequently moved by some extraneous force. Orthodontic correction of an upper central incisor caught

by inclined plane action behind a lower incisor as it erupts, or the appliance-effected distalization of entire posterior quadrants, sans second molars, initially shoved forward by the combined thrust of the 2nd and 3rd molars, are prime examples of the principle of correction. Correction is usually characterized by high levels of posttreatment stability.

Orthopedic arch form "development" on the other hand, consists of moving a group of teeth and their alveolar processes to a new location, into a new perioral muscle environment heretofore which they have never yet occupied. Development of the dental arches laterally, or A-P movement of the retroclined maxillary anteriors in Division 2 situations are prime examples. Development is always characterized by high levels of posttreatment instability, less so in children, more so in adolescents, much more so in adults. Arch developments, whether laterally or A-P, is often a requirement for proper subsequent housing of the mandible in a sufficiently forward position to decompress and/or protect the joints, the value of which is now becoming well substantiated in the literature. Fortunately the

inherent penchant for relapse of arch development can be dealt with, but not without a price. In cases of adult arch "development" that price can be formidable.

In the treatment of malocclusion in children and early adolescents, things usually go pretty well posttreatment-stability-wise. Mandibles advanced out of skeletal Class II retrusion stay put, naturally achieved vertical dimension of the occlusion holds, 2nd molar-relieved arch forms stay reasonably jumble free. Should inobtrusive amounts of arch widening, or premaxillary "Division 2" type forward development of maxillary anteriors be performed on the growing child as a requirement of the treatment plan, traditional retentive techniques (e.g. slight over correction, enlisting more correction and less development where possible, prolonged periods of active retention, and elimination of 2nd molar thrust where indicated) usually serve doctor and patient well and posttreatment stability is usually not much of a problem. Things well fitted during the growth and development years generally abide.

But the greater the development effected in a case, either A-P, laterally, or both, and the older the patient at the time of initial treatment, the more the posttreatment picture begins to change. It varies from individual to individual, but the more the notion of development is involved, and the older the malocclusion is at the time of treatment, the more protracted active efforts at retention must be enlisted "pari passu." When major arch development in fully adult patients is required, the picture changes yet again, and this time even more dramatically, especially when compromised TM joints are involved.

The Bionator, and its first born offspring the more "A-P construction-bite-tolerant" Orthopedic Corrector I (OCI), are capable of dramatic conversion of true skeletal Class II deep bite malocclusions into Class I occlusions with fully developed vertical, provided the diagnosis is correct (a big provision) and the appliances are constructed, used and adjusted properly. Even with the recent popularity of Dr. William Clark's magnificent series of Twin Block appliance techniques, the Bionator/OCI still remains one of the signature appliances of the FJO methodology, especially now that its uses can be appreciated in the posttreatment management of the adult TMJ patient.

The Bionator/OCI serves as an excellent posttreatment nighttime retainer for any patient who has been previously treated with FJO based techniques and has suffered from malocclusion –spawned TMJ headache, pain-dysfunction and internal derangement troubles of the NRDM/SPDC type (neuromuscular reflexive displacement of the mandible causing superior posterior displacement of the condyle at full occlusion). In the treatment of a growing child, the enhancement of the eruption of the posterior teeth to increase the vertical brought about the prolonged daily and nightly wearing of the Bionator/OCI (16-20 hours per day) is predicated on proper adjustment or clearing out of the

IPA's, (interproximal projections of acrylic) that arc out over the occluso-lingual line angles and interproximal contacts of the posterior teeth. During the first 4-5 months of treatment with the Bionator/OCI these IPA's are left in full contact with the occluso-lingual and interproximal portions of the posterior teeth to help the mandible remain in the propulsed treatment position which stretches out and retrains the Class II neuromuscular sling (which along with maxillary arch width deficiency serves as one of the chief culprits that interfere with proper forward and vertical mandibular growth). Once muscular readaption (liberation) takes place and the mandible is muscularly repositioned forward (freeing up its latent DNA-directed natural orthopedic growth potential) and the retrusive elastic memory of the oral musculature that at first wants to pull the mandible back is eliminated; the arch anchoring IPA's of the Bionator/OCI can then be ground away free and clear of the occluso-lingual surfaces of the teeth (all but the appliance anchoring IPAs mesial to the maxillary first molars) to permit the posterior teeth and their supportive alveolar processes in turn to have their chance at expressing their appliance-simulated natural vertical growth. This is standard Bionator/OCI appliance adjustment technique. Being dermal bone in origin, the alveolar processes are "orthopedic whimps" in exerting themselves and any form of mechanical or muscular interference that is exerted on or over them, and/or their cradled teeth, can easily retard their vertical growth. Hence, adjusting the IPA's must be periodically attended to and even then one can't be in a hurry to see rapid and robust posterior molar and bicuspid eruption. Often 9-12 months is required to effect such forms of passive posterior eruption even when "surfing in" on the height of the crest of the growth curve wave under the most ideal circumstances in the growing child. Yet since it is a form of modified correction, the results obtained by these passive eruption techniques are extremely stable. However, once the flower of childhood growth has wilted in the young adult, even under the best of circumstances, such passive eruption may take several years. Under the worst of circumstances in the fully matured adult with a deep curve of Spee it often won't even occur at all. That's why there are things like SSV's (Spahl Split Vertical Eruption Acceleration Appliance Systems).

Even though the condyle/disc assembly in the TMJ patient can be reasonably refurbished by lengthy proper treatment that permanently places the condyle somewhere in the Gelb 4/7 vicinity (off-center, slightly down and forward in the glenoid fossa at full occlusion), such properly treated joints, though truly "healed," whether the condyle functions on the original disc or on a surrogate fibrous connective tissue pseudo-disc, are often times still not quite the same nor as sturdy as the original anatomy. Now although condylar rotation movements, or "hinge axis rotations" of the condyle in the fossa, are nearly always innocuous with

respect to damaged TMJ's, the two types of condylar activity that do prove universally hard on posttreatment TM joints are 1) functional sideways or lateral excursive motion and 2) retrograde motion. Both can occur as a result of nocturnal parafunctional activity. Here in these circumstances is where the Bionator/OCI can be of enormous help, not so much for what it does but for what it can prevent.

In general, once the mandible has been advanced in TMJ treatment, thereby effecting proper and permanent condyle/fossa functional relationships (healing), the corresponding finishing of the occlusion, which usually consists of closing up the advancement-effected posterior open bite, can usually be accomplished in one of three ways: orthodontically, prosthodontically, or by artificial occlusal enhancements (crowns, onlays, composite build-ups). Each method can benefit from the use of the Bionator/OCI as a nighttime retainer.

In the event that the posterior open bite was closed with an SSV (Spahl Split Vertical), Biofinisher, Riconator, or other type orthodontic technique, the Bionator/OCI acts as an excellent retainer to not only protect the joints from the harmful effects of nocturnal parafunctional retrograde movements, lateral excursive movements, clenching and bruxism, but it also can be adjusted or relieved in conventional style in the area of the IPA's to act as a reinforcing influence that nightly whispers mild and continuing eruptive messages to the recently actively verticalized posteriors, thus protecting them from occlusion forced re-intrusion. The fact that the anterior incisors are the only teeth that are in contact in the Bionator/OCI is what protects the actively erupted posteriors from the re-intrusive forces of nocturnal occlusion. The distance between the occlusal surfaces of the back teeth is a combined product of the thickness of the appliance cap plus the distance of the natural incisor overbite and this collective interocclusal distance posteriorly encourages the molars and bicuspid to at least stay put if not subtly hint at vague efforts to continue eruption vertically. The point is it helps preserve the treatment-effected vertical without over-erupting the posteriors as in that regard using the Bionator at night only is not enough.

If for the sake of expediency or other reasons, occlusal composites or cast restorations are used in case finishing, the Bionator/OCI retainer, again by virtue of combined values of thickness of the anterior cap plus natural incisor overbite, provides sufficient separation of the occlusal surfaces of the posterior teeth to protect them from the ravages of nocturnal clenching and bruxism which has been known to splint not only many a porcelain crown or cast composite-based onlay but even unrestored natural teeth! This type of occlusal protection is an obvious plus!

Overlay partials used to closed post-advancement posterior open bites, although acceptable as functional diurnal prostheses, fail to protect the joint from nocturnal lateral excursive or retrograde condylar thrusts and therefore are as

ineffective in protecting joints from such abuse as are mere generic acrylic flat plane splints and/or elastic flat plant anti-bruxism orthotics (single arch soft splints).

It must also be remembered that the nocturnal use of the Bionator/OCI as a retainer to protect the joints and reinforce the new myofunctional Class I engram in fact actually precludes the increased vertical augmentation of the posterior vertical in adults and adolescents when such is the intention of the clinician since the IPA's can then be left intact, unadjusted and unrelieved, in full contact with the occluso-lingual line angles of the teeth. Should, for any reason, concern exist as to the possibility of the occurrence of unwanted eruption (a dim possibility), a simple instruction should be sent to the lab on the lab slip that during appliance construction a little extra acrylic should be left curled over the occluso-lingual surfaces of the teeth. This insures the elimination of any chance, regardless of how remote, of vertical eruption. Passive eruption is somewhat slow even in the growing child and needs every form of encouragement to express itself. The very limited time of wear at night during sleep of the Bionator/OCI acting as a retention appliance is, as previously mentioned, simply not enough to cause any vertical response in the posteriors, especially with the IPA's of the Bionator/OCI in contact with the teeth. This gives the appliance great versatility as an orthotic for night (sleep only) use as per the needs of the case.

The Bionator/OCI acts as a joint protective device for use during sleep that preserves posterior occlusal vertical and keeps the upper and lower dental arches juxtaposed in a zone of safety relative to one another thereby helping to prevent damage to recently healed intra-capsular joint tissues by restricting untoward condylar movement in the fossa. It also most importantly preserves and reinforces the correction of the Class II neuromuscular sling to a Class I neuromuscular sling with a resting and functional arch to arch relationship that in turn reinforces the reconstructed, joint-protecting occlusion. Yet the construction of the Bionator/OCI as a retention appliance follows slightly different rules than the construction of a Bionator/OCI treatment appliance.

The first thing to remember in the deployment of the Bionator/OCI as an h.s. (hours of sleep) post-TMJ-treatment retainer is that the construction bite taken for this retention appliance is slightly different than that registered for the treatment appliance. Bionators work on a principle of hyperpropulsion of the mandible (hence over-stretching of the musculature) past the actual treatment finishing position. This is done so as to directly address and/or counteract things like 1) the elastic memory of the Class II neuromuscular sling, and 2) intracapsular ligament and condyle/fossa stereoscopic tolerance, or for want of a better description (and please forgive the crude terminology) something that may be described as "slop" in the joint (as in a worn transmission). At the conclusion of treatment,



once the mandible has been satisfactorily advanced, such hyperpropulsion has no purpose since the mandible is already in proper Class I position. Too aggressive of a construction bite for a Bionator/OCI retainer for an individual with a mandible in proper position would result in a retainer that leaves the patient slightly muscularly hyperpropulsed for a short while every morning upon rising. Under such circumstances patients will complain of minor problems like being unable to occlude their back teeth quite fully together until the musculature presently readapts to the appliance being out, a period of time that may range from a minute or two to half an hour. It resolves itself down to a matter of a bit too much of a good thing. End to end construction bites about 2-3mm open between the incisors usually does best for h.s. Bionator/OCI retainer appliances. The forward pull of an appliance constructed with this type of bite registration is usually too minimal to be registered adaptively by intra-capsular structures due to the aforementioned tolerance or "slop" in the joint and therefore is not enough to change anything overnight as far as permanent mandibular position is concerned.

Another thing to remember is that the large midline active expansion screw processed into the appliance behind the lower anteriors and the little Orthopedic Corrector I side screws, although useful at times during treatment, have no purpose in the retainer form of the appliance. Hence, once treatment is complete, regardless of the means, when a new Bionator retainer appliance is constructed, for the sake of patient comfort these screws may be eliminated, unless uncertainty exists as to the completeness of the retraining of the Class II neuromuscular sling (usually in the adult). In such cases the conventional incisor end to end construction bite is still used but conventional Orthopedic Corrector I side screws are processed into the appliance to allow the clinician to "fiddle" with various mandibular propulsive positions past end to end incisally until long term satisfaction is achieved. Sometimes slight changes in the amount of propulsion effected by the appliance are necessary to find just the right condylar or muscular position for maximum comfort. Of course, if the screws are activated and the incisal cap advanced to provide more mandibular propulsion, IPA's between the lower teeth and any other overhanging acrylic must be cleared away from the lingual surface contact with the lower posteriors as per conventional OCI technique. Nevertheless, eruption is still not a problem as the minimal time of appliance use nocturnally is still too limited to elicit a response in the posterior teeth, especially in the mandible. It is better to be a little short in the construction bite and have the option of being able to open the appliance side screws to gain the desired tension with respect to the musculature than to make a nocturnal TMJ retention appliance too propulsed from the start. You can always turn the side screws of this type and then make the appliance bigger and increase its propulsive aspects, but

once it is initially constructed too big you can't make it smaller. So if the clinician is sure that end to end incisally will be the satisfactory mandibular position for retentive/protective purposes, leave all the screws out for the sake of tongue comfort. If uncertainty exists that incisal end to end maxillomandibular position will prove adequate, construct the appliance with Orthopedic Corrector I side screws for incremental advancement options.

Another critical issue that must be faced by the FJO camp is that of the retention of the oft needed arch development. Many skeletal Class II cases require a certain amount of lateral development of the maxillary arch in order to subsequently house the mandible, arch to arch, in the final advanced position. In other instances such as Class II Division 2 type malocclusion (or its equivalent), the maxillary incisors must be developed forward, out of the way of the future "big MAC" (mandibular arc of closure) so that the mandible can be housed far enough forward by the occlusion to keep the condyles in the physiologically acceptable position. Both situations exhibit a high risk relapse potential that must be aggressively addressed, especially in adult TMJ patients. Lateral arch development in late adolescents and young adults represents a particular area of considerable concern and requires careful clinical management. Lateral development in more mature adults can be a particularly difficult endeavor to both effect and especially maintain. (Here is where surgical augmentation of arch width by means of various techniques of maxillary corticotomy proves to be a viable treatment option.) When used in tandem with simple Hawley type retainers diurnally, the Bionator/OCI as an h.s. retainer is capable of helping keep laterally developed arches at their proper width due to the large palatal surface area represented by the vertical wings of the Bionator appliance. Hawley retainers, or their equivalents, are great for intra-arch orthodontic retention. Bionators are great for inter-arch orthopedic and myofunctional retention as well as joint protection. Sometimes you need both. That means sensible alternation of retainer usage. It isn't hard to figure out.

However, with respect to retention of "Division 2" retroclined upper anteriors that have been moved or torqued forward prior to subsequent mandibular advancement, we face an entirely different situation. As for keeping adult maxillary anteriors sufficiently forward against the persistent lingually directed forces of the transeptal fibers and the unrelenting force of the orbicularis oris musculature, in spite of presence of the "cinched-up" lingual wire of the Bionator/OCI h.s. appliance as a safeguard, Bionators, often, if not always, prove inadequate for the prevention of lingual relapse of such forward developed adult maxillary anteriors. In these cases a little extra help is needed. The combined use of either a bonded wire retainer of some sort (usually bonded to the lingual surface of the upper cuspids and laterals), or the alternate diurnal use of a simple

Hawley retainer, with or without a labial bow, in conjunction with the nocturnal use of the Bionator/OCI is usually very effective. Of course with the bonded lingual wire retainer the lingual wire of the Bionator becomes redundant and need not be processed in to the appliance, thus making it even more streamlined and comfortable for the patient.

In the more extreme cases of mandatory adult arch development, 2-4 years of diurnal/nocturnal alternation of Hawley/Bionator retainers is common. As the advanced (corrected) mandibular position becomes progressively, albeit slowly, more stable, the patient may be allowed to taper off with respect to the intensity of active retention with the removable Hawley/Bionator combo to the point of wearing the Hawley h.s. one night, and Bionator h.s. the next night and neither one during the day. Eventually with even more time, as the joints go from being "soft healed" to being "hard healed," the Bionator can usually be dispensed with altogether. But the h.s. use of the Hawley to prevent subtle lingual drift of the upper anteriors should be continued and monitored carefully and may even prove in some cases to be a lifetime requirement. Patients seldom complain. In fact, after several years of treatment that has proven successful in eliminating chronic recurrent headaches, most patients feel nervous without some sort of retainer in their mouth during sleep. As the great orthodontist Dr. Grant Bowbeer quipped, they may be thought of as "Pajamas for the teeth," an easy thing to become accustomed to for most anyone. People wear eye glasses, hearing aids, partial dentures, pacemakers, insulin pumps and artificial health related prostheses of every kind every day. Wearing little removable, streamlined, highly polished intra-oral retention devices of various kinds during sleep means little. Having a headache free life means plenty!

In spite of the progress in treatment represented by the techniques of Functional Jaw Orthopedics, the old nemesis of relapse in its various clandestine forms is still a problem that every treating clinician must confront. Fortunately, for addressing certain aspects of the retention problem, things like the Bionator/OCI h.s. retainer must be enlisted to help. Sometimes treatment success demands a concerted effort. But then, what is the alternative?

### The Bionator as Active Plate

Although the original Bionator was designed purely as a functional appliance, modifications to the appliance that have become popular over the years have allowed it to also, under certain circumstances, qualify as part active plate. The difference between these two main families of removable appliances is in the source of energy they each employ in order to achieve their ends. A true functional appliance enlists the patient's own muscle forces to provide the energy to do the work prescribed by the treatment intention. They accomplish this in a variety of ways, as per the design of

the appliance, often times acting as a muscle stimulator or a calculated intra-oral obstacle that re-directs muscle forces. These forces on the jaws are what, in the final analysis, provide the energy to reshape and/or realign the jaws.

An active plate, on the other hand, is a removable appliance that uses a spring, orthodontic screw, a wire, or some other externally applied mechanical source of energy to provide the power within the appliance to do work (that is "work" in the sense of classical Newtonian Physics, i.e. force times distance).

The common placement of an orthodontic expansion screw at the midline of the lingual aspect of the Bionator, along with the presence of the Coffin spring in the palatal vault area make the appliance part active plate. With activation of the midline screw (no more often than one weekly 90 degree turn equalling 1/4 mm) and commensurate expansion of the Coffin spring's omega loop (with required compensatory bends placed at the 90 degree bends to prevent acrylic fracture at the points where the wire enters the acrylic side wings) results in incremental lateral expansion of the upper and lower dental arches simultaneously. Modest amounts of lateral arch development can be achieved in this way, usually consisting of merely uprighting lingually tilted posterior quadrants. This also aids in stimulating posterior vertical eruption. That is why in many cases such dual adjustment of the midline screw and Coffin spring of about 1.0 mm or so are employed over the first 4-6 weeks of Bionator treatment merely to impress the IPA's (interproximal projection of acrylic) into the interdental spaces to nudge the teeth laterally just enough to biologically "wake them up" and help thereby stimulate eruption in deep bite situations.

As stated earlier, the Orthopedic Corrector I side screws are associated with advancing the anterior third of the appliance (the cap area) when necessary to increase the pull of the appliance on the mandible in order to gain progressively increased degrees of advancement and as such have nothing to do with the concept of making the OCI part active plate. Those side screws are directed strictly at altering the soft tissue masticatory muscle environment, not the hard tissue dental arch form environment.

Varieties of other appliance adjustments and management techniques allow the Bionator family of appliances to advance Skeletal Class II restrusive mandibles forward to full skeletal and dental Class I, they can increase vertical dimensions of occlusion, retract maxillary anterior incisors by proper adjustment of the labial bow, procline lingually tipped lower incisors, closed down anterior open bites, develop dental arches laterally, retrain deviant tongue thrust and swallowing patterns, resize the foreshortened Class II neuromuscular sling, relieve strain on damaged and painful temporomandibular joints, and even preserve and protect those joints once posteriorly displaced condyles have been properly repositioned and damaged bilaminar zones healed.

The Bionator can also greatly enhance facial appearance by virtue of its ability to permanently reposition retrusive mandibles more correctly forward thereby correcting vertical, sagittal and skeletal disharmonies. That is why it has been stated the “The Bionator is a face maker as well as a mouth maker.” Although minor individual tooth movements can be effected with the appliance with given specific design modifications, generally ideal, or near ideal arch form is invariably effected prior to insertion of the Bionator, and often this arch form is initially obtained via fixed appliances and/or active plates.

Yes, the Bionator is in fact an “arch aligning appliance.” To understand what an arch is, to understand what proper arch alignment is, with all its orthopedic, myofunctional, and temporomandibular joint implications, is to understand what a Bionator really is. And that is a good understanding of orthodontics.

Hopefully, this will stimulate those unfamiliar with Bionator/OCI technique to seek further knowledge as to the “ins and outs” of these and other functional appliances that occupy a strong position in the FJO methodology and that have been thoroughly described in other sources. To fail to do so is to remain at risk.

*“Education has for its object the formation of character.”*

Herbert Spencer 1820-1902  
English Philosopher

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