General Explanation of the Straight Wire Appliance in the Treatment of Young People and Adults

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Today, our dental patients are asking us to provide them, not only with high quality dental treatment, but also with "esthetic dentistry". More and more, our patients tell us that they are concerned with the way their "smiles" look and are asking us how they can obtain beautiful teeth and attractive smiles. As dentists we can provide them with such alternatives as simple tooth whitening, or this combined with porcelain crowns and veneers to "reshape the smile", and composite fillings or inlays to replace unsightly "black fillings". Missing teeth can be replaced with porcelain bridges or implant work.

But what can you offer to those patients for example, where the teeth are very severely crowded, or where the molars are so severely tipped or super-erupted due to early tooth loss, that because of these things the restorative or esthetic dental treatment result would be badly compromised.

This is a situation where the knowledge of what the orthodontic treatment possibilities are is highly important, and even more important is the ability to use a fixed orthodontic appliance such as the Straight Wire Appliance (SWA). With the SWA, the malocclusion and crooked teeth can be treated first and then it is possible to obtain much more beautiful results as well as optimal occlusions.

These adults see their own unsightly, crooked teeth and bad bites and want to make sure their children don't end up with the same result. And they don't have to, because as a general dentist, you can "guide" your young patients through their years of physical development such that most young patients can have successful orthodontic treatment without extracting teeth. Today, our young patients are treated both orthodontically and orthopaediacally.

I've been asked to describe, "What is the SWA"? To do this, I must briefly compare it to other methods of providing orthodontic treatment. Traditionally, active orthodontic treatment is accomplished using 3 methods: 1.Removable appliances 2. Fixed appliances 3. A combination of both 1 and 2.

Removable appliances traditionally comprise 2 types.

1. A simple palatal or lingual "plate" type, with screws and/or springs that are used to move single teeth or segments of teeth. Biomechanically, the tooth movement here is accomplished solely by what is commonly called "uncontrolled tipping". Because of this the treatment results are very limited and unstable.
2. "Activator" type – called "Removable Functional Appliances" (RFA). There exist many different designs, and they sometimes incorporate a Hyrex Type Screw in the palatal plate to widen the maxillary arch. The RFA work well, in certain cases, to "activate natural growth of the mandible", or less often the maxilla, during the growth phase of a child. There are certain limitations when these RFA are used as the sole method of treatment, and these must be understood: 1. They will not work if they are not in the mouth. 2. Any tooth movement, either desired or undesired, is either tipping or extrusive. 3. With the high treatment standards demanded by patients and parents today, a fully bracketed, fixed appliance on all the teeth is needed in most situations to "finish" the case. 4. They will not work unless there remains substantial growth in the development of the patient. 5. They will not work to "activate growth" in adults, nor can they be efficiently used in "extraction cases". 6. If these are used as the sole treatment medium, a stable "Super CLI occlusion" can rarely be obtained. This is because "bodily tooth movements" such as tooth translation, "bodily rotation" of the tooth and intrusion can't be efficiently accomplished. For example, in most skeletal CLII cases with a horizontal growth pattern, a situation where the RFA would be most effective, the maxillary 1st molars most often start off mesially-lingually rotated and must be distal-buccally rotated around the palatal root in order to have a resulting Super CLI occlusion. This type of movement is not possible with these types of removable appliances. Also any widening of the arch form of the palate, when using an RFA that incorporates a Hyrex type screw, is unstable because only the crowns are tipped buccally and the roots stay behind. If the crowns and their roots are not vertically aligned so that the root apices finish directly over (or under) their crowns (as occurs with a fixed appliance and will be explained), then once the appliance is removed, there will be a rapid relapse of the crowns as they lingually tip again. And it is not possible to have the final "detailed" movements needed to finish a case.

With a fixed appliance the dentist can overcome these above limitations. Fixed appliances work at a different biomechanical level than removable.This is because once the teeth in the arch are aligned (lined-up) and leveled using light and flexible round wires, heavy steel rectangular wires are placed. This is the significant difference, because a rectangular wire in the rectangular slot of the bracket produces a "coupling force" in the bracket that is attached to the tooth, and of course this "coupling force" is transferred to the tooth root as well as the crown. Because of this the root can be moved through the bone in all directions. Also, "bodily movement" or tooth translation (crown and root move the same distance at approximately the same time) is possible. This is important because in order to obtain a more stable result, the crown must be aligned below (or above) the root apex at the end of treatment. But also with the coupling effect, the root can be angulated mesio-distally, torqued buccal-lingually (an very important esthetic consideration also), rotated "bodily" around its center and even intruded or extruded in a controlled manner. Thus, "Three Dimensional" movement is possible. If tooth movement is continuous, and the very lightest forces needed to move the teeth are used, then the teeth move optimally in the bone without damage to the periodontal ligament. We are always searching to find new and efficient ways of providing "optimal forces".

Most fixed appliances are based on the "Edgewise" appliance, which was very popular used in the U.S. from the early 1900's until the 1980's. This appliance uses brackets with rectangular slots designed such that they will receive a rectangular wire, "turned on its edge", into the bracket slot. Thus its name - a wire turned edgewise. In the past, bands for each tooth were fitted and the brackets were soldered to the bands, which

were in turn cemented to the teeth. Today these brackets are bonded to the buccal surface of each tooth, although “molar bands” with brackets (tubes) are still commonly used. These edgewise brackets are “neutral”, thus in order to make the desired tooth movements to position the teeth individually and in the arch form, the dentist had to place bends or even loops in the wires at each bracket site. On the “working wires” the dentist had to place 3 types of bends for each tooth so the wires were not “straight”. In the hands of a great technician, good results could be obtained. But this type of treatment was not for everyone and was mainly for the children of the “well to do”.

Some of the other more popular classic fixed techniques developed earlier are the “ Begg” and “Ricketts”. Like the Edgewise, they are all technically very difficult to learn and are time consuming to practice.

In the 1970’s, Dr. Larry Andrews, an orthodontist from San Diego, California, realized that the very best orthodontic results presented by orthodontic specialists at educational conventions were inconsistent and often far from a ideal. Also, there was no standard goal of treatment. He had an idea: he undertook a study of what he and his colleagues called “Nature’s Best”. These were 120 models, made from the teeth from their own patients, that these dentists had collected over the years and which they felt had “perfect” arch forms and occlusions, and they had never been treated orthodontically – they were “naturally perfect”. He literally dissected and measured the clinical crowns and arch forms of these models, and these scientific measurements were recorded, and the results were named the “6 Keys to Optimal Occlusion” that is the 6 traits one finds in “Nature’s Best”. Later he designed the SWA, which he pre-programmed with these 6 Keys as the goal to treatment. The SWA, along with “straight arch wires”, is designed to get the teeth to these 6 key treatment goals.

In my opinion, Dr. Andrews was a genius to conceive this idea, and then to put it into production and eventually into practice. He revolutionized orthodontic treatment. In my experience, not only is this appliance system 100% easier to learn to use and then to use then the older methods, but also the results are far superior.

What is significant at the social level is that *orthodontics of the highest quality* can now be provided in a more democratic manner to all, and not just to the “well to do”.

In the SWA, each tooth has its own bracket with its own individual “prescription” for its final position in the dental arch. As well, these individual teeth are pre-programmed to align ideally together in the arch form. Instead of the dentist having to make 3 different bends in the rectangular wire <u>for each tooth</u>, the bracket has these effects already pre-programmed in them. What is pre-programmed? The final positions of each tooth as pertains to: The mesio-distal angulation, the bucco-lingual torque, and the “in-and-out” position of each tooth as it relates buccal-lingually to the other teeth in the arch from. The brackets that have been designed by Andrews, if they are correctly positioned on the teeth, will allow optimal results if the diagnosis is correct. Placing them correctly takes some understanding, but it can be mastered very quickly and easily. The brackets can be place “Directly” in the mouth by the dentist, one at a time by bonding them to the teeth using special orthodontic light-cure composite. Or they can be placed “Indirectly”, that is the laboratory positions them ahead of time on a model of the patient, and then a tray, made of silicone, is made around the brackets to hold the brackets in their ideal positions. The tray with the brackets in it are placed in the mouth with the light-cure composite on the bracket base, then the brackets are light cured all at the same time to the teeth. There are obvious advantages and disadvantages to both methods. But at any rate these are not technically difficult procedures once it is practiced a few times. If the brackets are not positioned correctly, there will be unwanted tooth movements. However, the brackets can be removed and repositioned and the tooth position corrected. This happens often and brackets are often repositioned during the finishing phase of treatment.

But how is the prescription “read” so that the teeth can arrive at their final position? This is done using “straight archwires”. Instead of placing multiple bends and loops in the wires to have an effect on the teeth, these continuous, unbent (straight) wires ”read” the pre-programmed information as they provide the force needed to move/guide the teeth to their final positions. The classic wire shapes or forms are also based on the scientific studies of Andrews. These wires are already pre-formed with a “memory” of the ideal arch forms. They guide and power the teeth to an ideal position individually and also as an “arch form”. The maxillary and mandibular arch forms are coordinated so that at the end of treatment, the maxillary arch will contain the mandibular arch in a final “Super CLI” position.

At the beginning of treatment, the crowded, rotated, uneven teeth are aligned and de-rotated, and gradually leveled out in an occlusal-gingival direction by using a series of pre-formed “straight wires”, starting with light, flexible, round wires and replacing them at certain intervals with heavier, more rigid wires. Today, these so called leveling wires are made of “Heat-activated, Nickel-Titanium” (HA NiTi). As compared to steel or other NiTi wires, these confer the lightest force possible in a continuous manner, thus an “optimal force”. Because of their flexibility and memory, we only need 2 or 3 wires to level the arches today. All of these wires have no bends with sharp angles or loops, however sometimes we use the NiTi wires with gentle curves (“Reverse Curve of Spee” or RCS wires) placed in them to help in the bite-opening.

In some early mixed dentition cases, I like to the pre-formed Utility Arch Wire (UAW) as a beginning wire. I adjust these and use them for early molar disto-buccal rotation and expansion, and/or as an “intrusion wire” for incisor intrusion and bite-opening. These do have bends, but they can also be purchased pre-formed so no bending is needed and are very easily fitted and adjusted in a few minutes.

In certain cases that have a very narrow palate, I also like to incorporate along with the basic SWA, a HA NiTi trans-palatal expansion and molar rotator appliance. These are also easy to place and require no adjustment once they are in place. These are usually placed at the time of bracketing and work using a slow, constant HA NiTi type force to slowly widen the palate in about 3 to 4 months. During this time, the wires can be changed and the teeth can be leveled, so that at about the 5th month, the maxillary arch is well leveled and widened, and the molars are distal-buccally rotated.

Eventually, after a certain time during the treatment, all the teeth in each arch are in place and the slots of the brackets (and thus the teeth) are leveled in a line. Also while the teeth are lining up occlusal-gingivally, the arch forms are shaping up transversely so that the upper and lower arches are coordinated and can fit together in a “Super CLI” position. When we get to this stage, we place our “working wires”, that is the

wires we use to do our heavy tooth movements and Skeletal corrections, such as correcting CLII or CLIII dental or skeletal problems into CLI positions, or moving teeth in order to align crowded teeth and to close-up spaces in extraction cases. These types of procedures, which use relatively heavy forces, should never be done on light wires because undesired movements will occur. Today we use only the very rigid and stable 19x25 or 21x25 steel wires as working wires. Once these wires are in place, then the forces are placed to finish correcting skeletal jaw or dental discrepancies. The forces we most often use are CLII or CLIII inter-maxillary elastics. For younger patients, we use these elastics for about 2 to 4 months. If extraction spaces are to be closed, we use CLI elastics or CLI "NiTi closing springs". Sometimes CLII or CLIII elastics are also used to close up spaces. "Sliding mechanics" is the term used to describe moving (sliding) teeth along the working wires, or to close up spaces.

In Europe today and especially in Belgium, most orthodontic treatment is done on young patients. However, I think that in the next 10 years, more and more adults will start with the orthodontic treatment they never had when they were young. The SWA is ideal for all ages and all types of cases.

First I will speak about treatment of younger patients.

The SWA is an *orthodontic* appliance used to position the teeth in an ideal position. I consider it also a "Fixed Functional Appliance" that can be used to *orthopaedically* correct CLII and CLIII jaw discrepancies in growing patients. With the SWA we can obtain for our patients:

-An aesthetic harmony of the lips, jaws and teeth

-Treat most cases without extracting teeth by using "Growth Modification"

-A beautiful, pleasing smile and facial appearance

-An optimal CLI occlusion

For my whole career, I have used an "Esthetic based diagnosis and mechanical treatment planning". I study the models of the teeth, the cephalometric x-ray and analysis, and the face of the patient. I make the final treatment planning decision based on the esthetics of the face.

I feel that by starting a child early, we can work with nature to have as a result an aesthetic harmony of the lips, jaws and teeth along with a beautiful, pleasing smile and facial appearance. Often if a patient, with a CLII div I and a retrognathic mandible, has orthodontic treatment which is started too late, bicuspid extractions are needed to obtain a CLI occlusion. These extractions wouldn't have been needed if the treatment had been started on time. Because the mandible remains in a retrognathic position while the maxillary incisors are retracted distally to obtain the CLI occlusion, the result is often the "orthodontic look". The lips become sunken-in, the nose and chin may look longer, and this "dished-in look" only worsens with age. The only other solution for this situation of "treatment started too late" would be mandibular advancement surgery. CLIII cases involve the same ideas. We can often avoid painful and costly surgery by starting early and working with nature.

When treating mixed-dentition and early adolescent patients, the most common malocclusions (90 to 95%) are CLI and CLII.

CLI skeletal type cases involve crowding in a CLI dentition, but sometimes they have a CLII or CLIII dental situation. Depending on the severity of the crowded teeth, it is best to start these cases around "dental age" 11 to 11.5 years. If the case is properly treated and not rushed to finish, these cases finish in about 24 months. At this age we can work with nature to reshape the form of the alveolar ridges of the dental arches by moving the teeth to ideal position using the SWA and wires. As we move the teeth slowly and steadily using very light forces, the bone moves along with the teeth and it is reshaped. In some instances, early tooth loss of the baby molars has caused a severe loss of space as seen with the mesialization of the 1st permanent molars. If it is too late to "maintain the space", then sometimes the 1st permanent molars need to be distalized so as to push them back into place. Also, inter-maxillary elastics are often needed for a short time to obtain a final bite opening and a Super CLI position. Rare is the case that needs extractions of permanent teeth if a patient is started at the correct time in their developmental growth pattern. However, extractions are needed in certain situations, most often when the patients' treatment is started too late.

CLII and CLIII "Skeletal malocclusions" require a different strategy. Most often CLII malocclusions are exacerbated by soft tissue "functional problems". I prefer to call them *"dysfunctional problems".* These problems mostly originate in early childhood with thumb or finger "sucking habits". Sucking habits incorporate hyper-actions of the soft tissue (the lips, cheeks, and tongue), during swallowing and breathing. A pattern of actions develops which breaks the *normal equilibrium between the soft tissue and the teeth*. Also, the position of the fingers directly against the teeth during these actions, physically push the incisor teeth out of a normal position. We see this in CLII division I closed and open bite cases. If these bad habits continue long term into the "mixed-dentition period", then the vicious cycle of soft tissue dysfunctions and the loss of equilibrium remain, even after the sucking habit has stopped. Every time the child swallows with these soft tissue patterns that are now established, there is an effect on the teeth and the alveolar arches. We often see as a result: a narrow, "V shaped" maxillary arch with the maxillary molars rotated mesial-lingually and the posterior teeth in both arches tipped lingually. This narrow, "V shaped" maxillary arch causes what is commonly called a distal-occlusion, because the maxillary arch form is too narrow to contain the mandibular arch in an anterior position (CLI) without going into cross-bite, thus the lower jaw is "locked" posteriorly. If "habitual mouth breathing" is also part of this pattern, we often see a change for the worse in the maxillary posterior teeth. They are forced downward by the cheek pressure and hyper-develop vertically downward. This is commonly known as "vertical maxillary excess". This contributes to a "long face look" or a "vertical growth pattern". Obviously there are many variations to these, but this is the basic concept.

The overall strategy in these **CLII cases** is to start early enough so that we can *work with nature* to try to solve these problems. The more severe the problems in the child, the earlier the case should be started. Often we start cases at dental age 10 and do a 2-phase treatment.

Using the SWA, we can alter or "modify the existing growth pattern". If we position the teeth (along with their alveolar ridges) and the jaws into ideal positions at an early enough age in a child's development,

then the surrounding soft tissue dysfunctional patterns can be disrupted and hopefully functionally re-educated. We try to obtain proper “lip closure” early.

We must “unlock” the distal occlusion to allow a natural forward/horizontal growth. Often once the distal occlusion is removed as the maxillary arch form is widened and reshaped, the patient automatically moves the mandible forward towards a **CLI position**. Also this allows an early, ideal positioning of the condyles so that they can grow in harmony with the rest of the bony structures and **the face.** This strategy works in most **CLII cases** (90 to 95%), because most of the CLII skeletal problems have a maxilla that is normally positioned in the sagittal sense, while the mandible is retrognathic. Once the maxilla is ideally widened and shaped, natural forward growth of the mandible can occur. Of course there are various degrees of maxillary or mandibular protrusion or retrusion. The growth pattern, whether *horizontal or vertical* is very important when we are deciding on our treatment mechanics.

At this early age, most **CLIII cases** are “pseudo CLIII’s”. We most often see a maxilla, which is “under-developed” sagittally as well as transversely and a prognathic mandible. The truth is the “CLIII Look” is often caused about half and half by a retruded, underdeveloped maxilla and protruded mandible. The prognathic mandible is very often the result of a “forward mandibular slide” due to teeth interferences. These interferences occur during the eruption of the anterior teeth (baby or permanent) and result in an anterior cross-bite position. Every time the mandible functions, it is forced into this anterior and often a lateral CLIII position. We often see the mandible in a CLIII position with a unilateral cross bite and the midline displaced to that side. Because the tongue also tends to rest and to function in a lower position, the lower arch is well shaped and with no crowding, and the maxillary arch is smaller and “under-developed” sagittally and transversely, and has crowding. Often we see an anterior open bite with an out of position tongue.

The strategy here is to disrupt this forward functioning mandible and to “develop” the maxillary arch form so that the teeth can contain in its arch form the mandibular teeth in a CLI position. Again we start by developing the maxillary alveolar ridge and teeth both anterior-posteriorly and transversely by using the SWA and “straight wires”. Usually, after a few weeks of palatal expansion and widening with wires, the cross bites are corrected, thus the interferences that cause the dysfunction of the mandible are removed, and the mandible re-centers naturally and can be contained within the perimeter of the maxilla also resulting in the line-up of the midlines. CLIII elastics are usually needed for a time to obtain a Super CLI occlusion. Also, other combinations of inter-arch elastics, such as “vertical bite-closing elastics”, may be needed in these cases to obtain a proper occlusion.

In all cases, once we have corrected our initial problems and the patient is in a CLI occlusion, we hold this corrected position with “finishing wires” for 3 to 4 months. These finishing wires, 21.5x27 HA NiTi wires, help us to “read” and thus obtain the 6 Keys to Optimal Occlusion”, which are programmed in the SWA. We obtain the final angulations and torque of the crowns and roots. If we take the time for this treatment phase, we will have improved esthetics and a better long-term stability. Also, the final upper and lower arch forms, and the final arch leveling and bite opening are obtained. Any repositioning and detailing of the brackets needs to be evaluated now.

If all looks good after this period, the case is then finished over the next 2 or 3 months by dropping back to smaller HA NiTi wires, and if needed “settling-in” the bite by re-positioning any poorly positioned bracket(s) and/or using “bite settling elastics” (“delta”, “box”) where needed to obtain good intercuspidation. Light “stripping” is used during this period in the lower incisor area to enhance retention.

In all cases, proper retention is needed. Before removing the lower braces, I like to bond a “dead soft wire” to the lingual surface of the 6 or 8 front teeth of the mandibular arch. It is in this area where teeth would start to crowd-up first if the teeth are not retained. Then the braces are removed and impressions are made for “Wrap-around” Hawley retainers for both the upper and lower arches. These are to be worn full-time for 6 months, then at night for 18 more months. If these types of removable retention plates are not used, and only lingual wires are placed, then the Curve of Spee tends to re-establish itself, the bite deepens and stability is lost. Also they help to keep ‘Open Bite” cases closed. After 24 months of retention, the lower wire is removed and the Hawley plates are worn at night until the end of the adolescent growth period. I advise the patients to wear them, as needed, indefinitely if they want to keep their teeth optimally straight.

What I see time and again with this system of “esthetic diagnosis and treatment mechanics” are results with the following:

-An aesthetic harmony of the lips, jaws and teeth
-Treat most cases without extracting teeth by using “Growth Modification”
-A beautiful, pleasing smile and facial appearance
-An optimal CLI occlusion

Orthodontic therapy for adults involves completely different treatment strategies, as compared to young patients, when trying to solve the problems these patients present us with. Personally, I feel that over the next 10 years, the dentists in Belgium will have more and more requests from their “older patients” to solve their problems of crooked teeth, unsightly smiles and severe skeletal jaw discrepancies. One of the big advantages when using the SWA for our adult patients is that the general dentist can offer orthodontics combined with needed restorative treatment and/or with esthetic dentistry. This is ideal in situations where the teeth are very severely crowded, or where the molars are so severely tipped or super-erupted due to early tooth loss, that because of these things the restorative or esthetic dental treatment result would be badly compromised. Another important advantage when using the SWA is that if a patient has a very severe skeletal problem in which jaw surgery is obviously needed for an acceptable result, the SWA is an ideal an fairly easy to use system for aligning the teeth in preparation for orthognathic surgeries such as mandibular advancement or retraction, and/or a surgical maxillary impaction. The SWA is left in place during the surgeries and the hooks on the wires of the SWA are used by the surgeon to help fix the jaws in their new positions.

Many adult cases are treated without extraction. CLI skeletal cases with a favorable facial pattern and minor crowding can usually be treated without extraction. Some cases with a mild CLII and CLIII skeletal/dental relationships and with minor crowding can be treated non-extraction. I feel that a **CLII malocclusion** with up to

about 4mm of overjet and 4mm of skeletal imbalance (Wits = +4) and a favorable "short face, square-jaw mandibular pattern", can be successfully treated non-extraction, especially in younger adults. With the SWA, these are treated basically the same as in our young patients. The teeth are leveled and aligned during a period of months and then CLII elastic therapy is used to obtain a CLI occlusion and to correct any mid-line discrepancies. **CLIII cases** are even more limited in this regard and success could be achieved non-extraction if the case is a very mild CLIII, that is, when at beginning of treatment there is a CLIII with an "end to end" incisor relationship.

"Air-rotor slicing" of the posterior teeth can be used in borderline extraction cases to obtain the necessary millimeters of space to align crooked teeth and/or to correct a mild CLII or CLIII discrepancy without extraction.

In this article, I would like to concentrate on orthodontic treatment with extractions. Why are extractions necessary for some orthodontic cases? After a person has stopped growing, we are unable to use "Growth Modification" (GM) to alter in a large way the shapes of the dental alveolar arches and/or to change the skeletal relationships of the maxilla versus the mandible. So if a patient is skeletally CLI and has moderate to severe tooth crowding, we are obliged to work more within the existing shape of the alveolar ridges in order to straighten the teeth. In young patients, we can reshape and widen narrow arch forms in order to gain enough space to straighten the teeth. In adults we can do this a little, but not as much, so often teeth must be extracted in order to obtain enough space to straighten the teeth and obtain at the end of treatment an acceptable occlusion.

Which teeth are usually extracted? In most cases it is the 1st premolars. However, often we must compromise on this idea because many adults have other missing teeth already, or have certain teeth which are unrestorable and need to be extracted, so in each quadrant, a different tooth type may be extracted (or none may be extracted) in order to obtain an acceptable result. Many adult cases require some compromise, but the result must be acceptable as far as the facial esthetics and the occlusion.

One problem with extraction therapy is that often there is often too much space (premolar extractions provide about 7 to 8 mm of space per quadrant), so that controlling the amount on incisor retraction during space closure is important. Often we are fighting so as to avoid retracting the incisors too far, because If the incisors are retracted too far lingually and/or the incisor buccal crown torque is lost, then the result will be unacceptable esthetically as the mouth will become concave as the lips flatten and the nose and chin appear longer.

"Premolar extraction" provides about 7- 8 mm of space per quadrant and is the accepted way to provide space in order to: *Relieve crowding; Retract incisors that are too protruded; Move the molars mesially.*

Premolar extractions provide space for crowded incisor alignment where, without the extractions, the treatment would create excessive anterior protrusion. And it allows us to be able to "camouflage" moderate CL II or CLIII jaw relationships when "Growth Modification" is no longer available (adult cases).

The important thing is deciding which teeth to extract and then how the spaces are to be closed. Will the incisor teeth be retracted, the posterior teeth be moved mesially or a combination of these?

Let us assume that extraction therapy has been decided upon. We will now discuss the mechanics involved in overjet reduction and space closure of premolar extraction cases**,** using "sliding mechanics" in the level slot line-up of the SWA.

The teeth are aligned and leveled using the same series of wires as we use with our young patients. This can take a few months or many months depending on the amount of crowding. Eventually we place the "working wire", the 19X25 steel wire with soldered brass wire hooks on them in the spaces between the lateral and cuspid brackets. These hooks act as attachments for the **"en mass" space closure** using CLI, CLII or CLIII forces.

When using the SWA, all movement of teeth to close spaces, with or without the extraction of teeth, is accomplished using **"sliding mechanics".** The "working wire" acts like the rail of a train track. The bracket or brackets (with the teeth attached of course) are "slid along" the wire (**"sliding mechanics")** by the use of forces, which are applied with elastics and springs.

The heavy 19x25 steel wire helps resist unwanted tooth movements such as rotations, tippings, and torsional side effects and helps maintain the proper posterior buccal root torque. These wires also apply the *desired* tip and torque forces to the brackets and thus to the teeth. These wires can also be shaped and lightly curved.

We have used various forces over the years, trying to avoid the unwanted side effects of too much "closing force". Today, we have available the nearly constant, light, optimal force of the "HA NiTi closing springs". These provide a measured force (in grams) even if stretched over a distance. Now we know what amount of force we are applying. These force systems can provide gentle, controlled space closure of about 1 – 1,5 mm per month. We can now minimize unwanted anchorage loss, tipping, rotation, and loss of torque during CL I space closure.

Spaces can also be closed using CLI, CLII and CLIII intra-oral elastics. These forces become intermittent if patient compliance is not good. These elastics are worn full-time and must be changed every day. These elastic forces can be measured, but in the case of CLII and CLIII elastic forces, the vertical vector of force is increased as the mouth is opened during eating and speaking.

Thus, elastics can be variable and intermittent, *but are generally reliable and give predictable forces and results if worn full time.* Other systems (steel springs, elastomeric chains) tend to place heavy initial forces that rapidly decline in two to three weeks. These are not recommended for use when there are large spaces to be closed.

Anchorage: To obtain the desired result within the arch, we must control the amount of incisor retraction against molar-bicuspid protraction. After extractions and once the teeth are leveled and aligned, there is usually still some space to close. In most cases, we are not closing the space equally with exactly equal "reciprocal forces", so we must choose a system that provides some kind of "anchorage" (the word anchorage refers to the stability of the posterior teeth).

In orthodontics, we speak of 3 types of anchorage situations; these are:

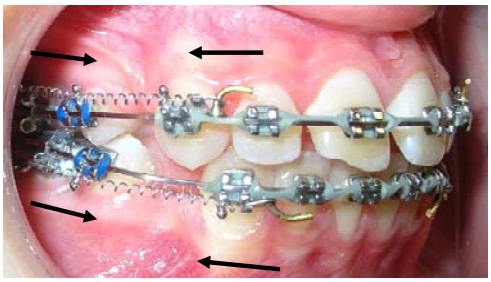
- **Moderate Anchorage**
- **Maximum Anchorage**
- **Minimal Anchorage**

•**Moderate Anchorage** is the most common situation. Once the anterior and posterior teeth are aligned using the extraction spaces, the remaining space must be closed. CLI (intra-maxillary force) NiTi springs or CLI elastics can

be used to close this remaining space “reciprocally” – that is the anterior teeth move distally about the same as the posterior teeth move forward.

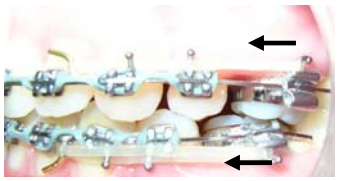
Space closure using a CLI elastic

Space closure using a 200 gram NiTi spring

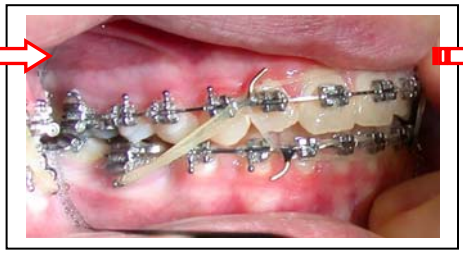


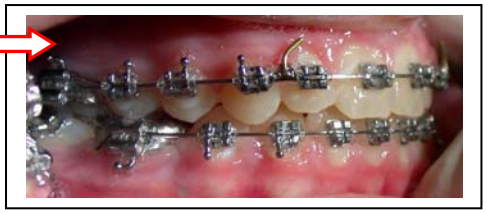
•**Maximum Anchorage:** A case may appear to be similar to the situation as above, but the dentist can visualize on the models that all the available extraction space will be used up during the aligning of the anterior teeth. In these situations, the anchorage force must be 100% so that the posterior segment does not come forward during the distalization of the cuspids and the incisors.

•**Minimal Anchorage:** - No incisor retraction while the space is closed purely by posterior tooth protraction.
In these situations, the final closing of the space after the alignment phase is accomplished by bringing the posterior teeth forward so as to take up 100% of the space. Thus 100% “anterior anchorage” is needed.



Sometimes, especially in the mandibular arch, this is very difficult to achieve and we see the anterior teeth begin to distalize. (see below)

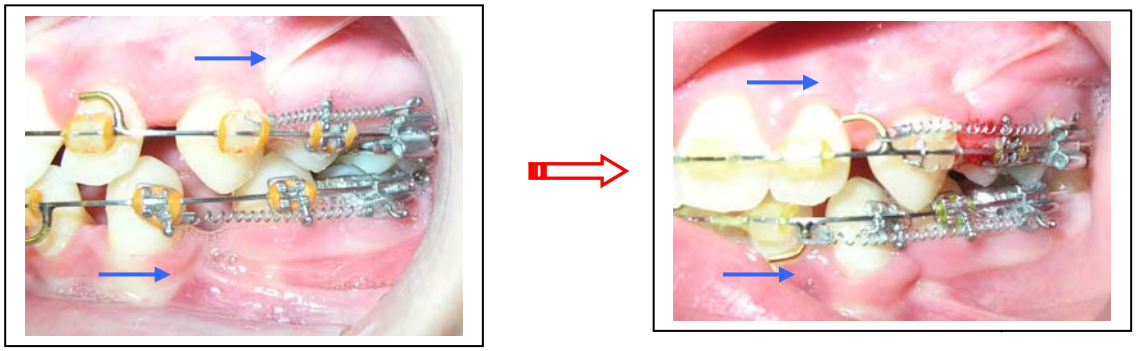




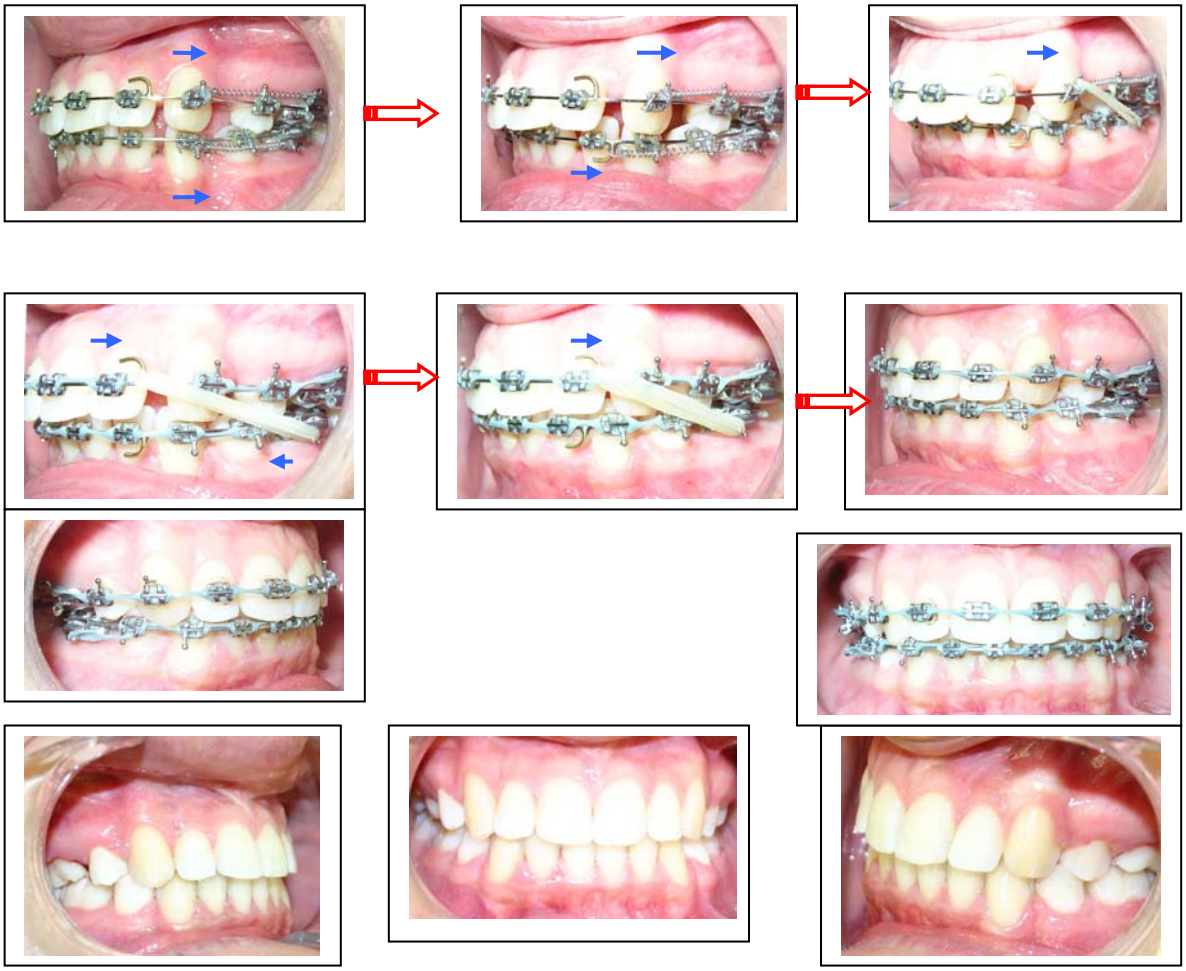
Examples of all the variations of clinical situations, which could occur during space closure, are not possible to discuss within the scope of this article. But clinically, what can happen during the treatment is that a “moderate anchorage situation” can become a “maximum” or “minimum anchorage situation” and the dentist must alter or change the anchorage requirements by **“reinforcing the anchorage”** in the segment where the anchorage needs to be stabilized. This reinforcing can be accomplished simply by adding another tooth to the anchorage segment (such as adding the 2nd molar to the 1st molar and the 2nd premolar). There are other methods such as adding a lingual/palatal arch and/or headgear, adding arch wire torque and/or “wire stops” or “toe-in bends”. Often, when we start space closure using CLI forces, and we don’t want to let the posterior anchorage “slip forward”, instead of using “sliding mechanics” to distalize the 6 anterior teeth in one block **(“en masse”)** by pulling them against the block of posterior teeth, the cuspids are distalized first **(“Cuspid first retaction”)** into the space. In this way we are pulling 2 smaller anterior teeth in the arch (the cuspids) against 4 or 6 larger posterior teeth, thus the posterior segment remains stable and the cuspids slide distally to take up 100% of the space. After the cuspids are back with the other posterior teeth in the posterior segment, thus “reinforcing” the posterior segment, the 4 smaller incisors are then distalized “en masse” using CLI forces. The CLI forces are pulled from the 6 or 8 larger teeth in the posterior segment and attached anteriorly to the wire posts so that the 4 incisors are distalized together “en masse” so as to take up 100% of the space. *This theory of “cuspid first retraction” is the safest way to protect anchorage in anterior overjet reduction and space closure.* This method is recommended, if in doubt about anchorage requirements, until a dentist is more experienced with “en mass closure” of the anterior segment.

"Cuspid first retaction" using CLI forces and sliding mechanics.

Followed by "en masse" spaces closure of the 4 incisors using "sliding mechanics".



One idea that I find very practical is to alternate CLI (intra-maxillary) elastics with CLII and/or CLIII elastics (inter-maxillary). For example, when we are using a CLI elastic or NiTi closing springs to close a space, **CII elastics can be added** at night to increase the force. (see below)



Another example: CLII elastics can be alternated with CLI elastics for anchorage reasons using **"The 10 Hour Force Theory"**. The placement of CLI and CLII elastics can be alternated by the patient so that there is never a force continuously for more than 8 to 10 hours directly on any one posterior tooth. I use this idea frequently in *CLII Camouflage cases where maxillary 1st premolars are extracted and maximum posterior anchorage is needed in the maxillary arch*. To protect the posterior anchorage in the maxilla, I can use the "cuspid first retaction" idea. In addition, the cuspids are distalized by pulling with elastics alternately from the maxillary 1st molars for 8 hours (using CLI elastics) and then from the mandibular 1st and/or 2nd molars for 16 hours with CLII elastics. We will not have maxillary anchorage slippage because we are pulling 1 tooth per side against, alternatively, a reinforced maxillary posterior segment and then the entire mandibular arch. The cuspid has continuous "optimal" force against it, but the forces on the maxillary and mandibular posterior segments are alternated and divided-up. Thus, for 8 hours per day the patient places CLI elastics from the 1st molars to the archwire posts. Then these are removed and other elastics are placed for 16 hours as CLII elastics from the lower 1st molars (and thus the entire lower arch) to the maxillary wire posts. This idea can be taken even further in that the elastics can also be placed alternatively also from the 2nd molars to the wire posts. Thus one can use 4 different posterior teeth per side to pull from so as to lessen the force on any one posterior tooth, thus they remain stable. After the cuspids are retracted and are added to the posterior segments, the same elastic combination can be used to retract the 4 incisors "en masse" into the space.

What happens is that the maxillary anteriors are retracted with “optimal force” while the posterior segment remains stable due to the intermittent/interrupted forces.

“Cuspid First Retraction” is a means of augmenting the posterior anchorage.

Maximum anchorage of a “CLII Camouflage” case – the posterior teeth must remain in place while the anterior teeth are retracted so as to use up the 100% of the extraction spaces.

Once all spaces are closed using these forces, the case is then finished as in non-extraction cases. Traditional CLII elastics are often needed to obtain the final bite opening and a slightly “overcorrected” CLI occlusion. We should be able to see the “6 Keys of Optimal Occlusion” at this point.
Once this final bite opening and overcorrected CLI occlusion is obtained, 21X 25 HA NiTi wires are placed for about 3 months. During this time the original extraction spaces must be tied together. The case is then finished and detailed in the usual manner as in a non-extraction case.

CLI and CLIII cases also use these same theories**.**

Using the SWA, all space closure is accomplished by using “sliding mechanics” and proper “anchorage” set-ups. The biomechanics of these must be understood, but with the SWA, they are very logical and not technically difficult to learn or to use. Most important is that when using this system, what we see as a result at the end of treatment are the following:

-An aesthetic harmony of the lips, jaws and teeth
-A beautiful, pleasing smile and facial appearance
-An optimal occlusion