

The Forsus™ Fatigue Resistant Device : Better Than Elastics for Class II

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He has a private practice in Colomiers, France on the outskirts of Toulouse. Dr. Pascal Baron is diplomat member of the European College of Orthodontics. He published in various professional journals and he delivered presentations nationally and internationally. He has a variety of research subjects mainly including Class III, ortho-magnetic tooth disimpaction, scan 3D imaging, Level Anchorage™ System and adult treatments.

Dr. Pascal Baron has used the Forsus™ Corrector system since it was introduced on the European market in 2002. Clinical trials are in progress.

There have been few significant changes with fixed appliance techniques since it was invented. In a previous issue of the *Orthodontic Perspectives*, Dr. G. L. Weinberger¹ presented the SmartClip™ Self-Ligating Bracket, as a real technological innovation, in the same category as the arrival of the twin-bracket and the straight wire. We should remember, however, that innovations offered by manufacturers of orthodontic materials have, essentially, been improvements to existing devices. These days, any progress in the design of brackets, adhesives, alloys and cosmetic materials are made by R&D departments.

Conversely, therapeutic concepts remain the prerogative of the clinicians. Although we should pay homage to Edward H. Angle for his invention of the edgewise appliance, the honors should also go to Charles H. Tweed for having created the foundations of modern orthodontics². Extractions, the position of the incisors, integration of the vertical direction and anchorage preparation are essential contributions to the individualization, reproducibility and stability of our treatments. Others then played their part by studying the effects of orthodontic mechanics and, within a few decades, it was all over. If we look back we can see that the fundamental knowledge required for treatment success has been in place since the first half of the 1970s. Subsequent events, with the growth of various schools of thought and many straight wire techniques, are merely capturing market share.

The most recent revolution was, once again, the work of teams of clinicians. The use of screwed anchorages, mini-screws, micro-screws or plates³⁻⁶, has opened up a broad range of options by offering the orthodontist reliable intrabuccal anchorage that needs no cooperation.

Similarly, the suppliers have played their part by concentrating on the thorny problem of replacement of the intermaxillary elastics, a potential source of loss of compliance as some patients say they are difficult to wear. The first of these devices to appear

was the Jasper Jumper™ (AO), then several other intermaxillary devices such as the BiteFixer (Ormco), the Eureka Spring (GAC) and the TurboSpring (RMO) appeared. Unfortunately, as we orthodontists soon found, however seductive these might sound the reality was less appealing as they had a number of weaknesses. So we abandoned all these new devices, and returned to the task of remotivating our patients to wear their intermaxillary elastic tractions as in the good old days of Dr. Tweed.

When 3M Unitek came up with the Forsus™ Fatigue Resistant Device system, we tried it without any great expectations, thinking that it too would have no future. The fact that you are reading this article at all means that things turned out very differently from the way we had expected. The Forsus Appliance is now fully integrated into the range of treatment options in our daily practice.

Unlike the other Class II correction procedures, the Forsus Appliance system offers many more advantages than disadvantages. Its long term reliability and patient acceptability has made it the alternative of choice when compared with a conventional mechanism using elastic tractions. I have found the system will correct a full Class II in 4 to 5 months, can be installed and removed in 5 minutes, and is activated in 30 seconds.

It can be indicated in cases where the patient refuses to wear rubber bands or will not wear intermaxillary elastics long enough. After the first few hours it is well tolerated and when the patient returns for his next appointment he generally clearly prefers this system to the inconvenience of wearing elastics. It is very comforting for orthodontists to know that they have a successful back-up solution when faced with treating a patient with wavering compliance.

However, because of its mode of action, the Forsus system has specific indications. We prefer to use them from the start as a response to specific Class II clinical situations, providing the best

treatment option straightaway. The patient can be told during his pre-treatment consultation that he will not be wearing any, or very few, elastics but will have a more effective and less visible fixed system.

Practical considerations:

Each Forsus Appliance comprises a piston spring which is fixed to the upper arch from the extraoral force tube from the first molar by a fixation pin. The mandible rod is placed directly on the lower archwire distally to the canine bracket and will slide in the interior of the telescopic piston tube. When the mouth closes the ring of the rod comes into direct contact with the piston edge and compresses it on the spring. A recoil force is thus delivered to the two application points: to the upper molar tube and on the lower canine bracket. With a bit of practice installation can be done without removing the lower archwire; it just takes a few minutes to install and adjust. It is advisable to check that there are no blockages of the system when the jaw moves. It is also important to use the gauge supplied so that you choose the correct length of lower rods. The lengths can be different for the left and right side if the arches relationship is asymmetrical. In most cases we make a W-shaped palate bar in .036 steel which is inserted in the palatal tube of the molar bands and will stop any undesirable torque movements (Fig. 1A). As the Forsus Appliance performs its function the W lets us adjust the vertical position of the bar easily, when required.

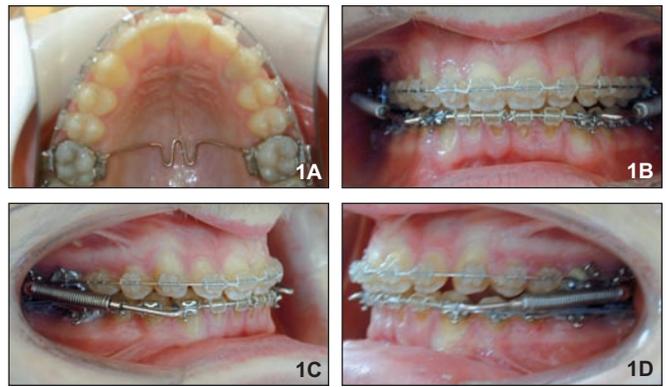
During the next appointment one or more rings can be added to the sliding rod (Fig. 2A-B) to activate the appliance. Another way of doing this is to shorten the fixation pin at the level of the molar tube, if the initial adjustment allows for this.

A new fixation device is planned by 3M Unitek (Fig. 3). It will be even easier to fit but will not give this freedom of activation.

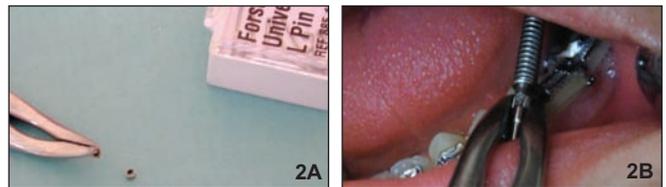
Biomechanical considerations:

The Forsus Appliance is well tolerated by patients and simple to fit, but the major strategic advantage is found in its method of action. The Forsus does not behave in exactly the same way as intermaxillary elastics. Its biomechanical superiority to elastics is obvious in several areas :

- it is worn continuously, including during meal times which is when most jaw movement happens,
- the maximum force delivered is in the order of 2000N with the mouth closed and this decreases very little over time (the system's susceptibility to mechanical fatigue is negligible compared with that of elastics, whose period of action is only a few hours),
- the force applied on the arches is proportional and progressive as the mouth closes,
- it increases in resistance to the powerful levator muscles while the elastics traction works by opposing the much less active depressor muscles,



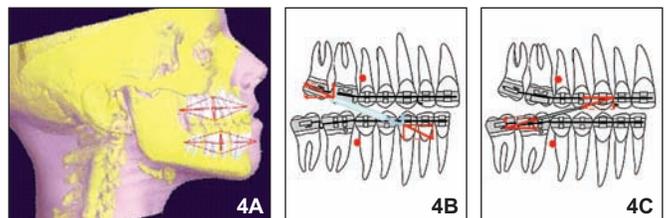
Figures 1A-D: Forsus Appliance on the prepared arches. W shaped palate bar.



Figures 2A-B: Split rings and fitting.



Figure 3: New snap clip on the molar tube.



Figures 4A-C: Biomechanical factors. A, Centres of resistance of each arch by 3D reconstruction. B, Forces and moments exerted by the Forsus Corrector. C, Forces and moments exerted by Class II elastics traction.

- although the anteroposterior action of the Forsus Appliance and the elastics can be comparable, this is not true in the vertical direction: the Forsus Appliance have a depressive action on the upper arch while the intermaxillary elastics traction has an extrusive action on the two arches.

If we assume that the forces applied are equivalent in intensity we see that the mode of action is different. An assessment of the forces and moments must be done taking into account the latest anchorage results, in particular the results we obtained with a 3D reconstruction⁷. In the case of complete arches, the centres of resistance are situated on the median sagittal plane, approximately at the level of the first third of the root, between the second premolars and the first molars (Fig. 4A-C).

If we simplify the problem to a single plane and only two directions, if the forces are equal the moments generated by horizontal forces are more or less equivalent. However, in the vertical direction, the moment/force ratio is clearly reduced with the Forsus Appliance. In theory, a particularly valuable ingressive effect on the upper arch is provided by the system of forces.

Clinical considerations:

So, given these effects, we can see that the Forsus system can be used when a Class II mechanic is indicated. In open bite cases these specific effects will be a determining factor in the choice of a Forsus system, as the considerable correction mechanics required are always tricky to perform. With fewer unknown factors, the Forsus system will also be indicated for normal and deep bite cases in a good number of Class II occlusal situations.

The correction of a residual bilateral Class II in a case of non-extraction is the first indication which comes naturally to mind, but there are other reasons for prescribing a Forsus system.

They can be installed on one side in the case of a unilateral malocclusion, for example. This will effectively solve a Class II subdivision (Fig. 5A-C).

They can also be used with reciprocal space closure appliances. They provide excellent anterior-inferior anchorage which is useful for mesialisation of the posterior teeth. In the upper arch it is the posterior anchorage which will be strengthened and this will facilitate Class II corrections (Fig. 6A-C).

In case of agenesis of the second premolars, or microdentition, or when the lower arch has numerous diastemata, considerable mesialisation of the arch is required. This can be a tricky procedure when the inferior incisor does not require repositioning. Here, too, the Forsus Appliance provides a noteworthy solution as it allows mesial movement tooth by tooth. It deals with the canines bilaterally then can be shifted onto the first premolars to give anterior anchorage providing mesial movement of the remaining lateral sectors (Fig. 7A-C).

A similar procedure, but in the opposite direction and at the molar extremity of the Forsus this time, it is possible to perform easy segmental distalization at the upper arch (Fig. 8A-D). This mechanism will be beneficial for the treatment of certain complex Class II where patient compliance can be too difficult if we do not use this type of appliance. However, Class II correction will be longer than in a straightforward case, as it then requires a phase for space closure.

Other indications for the Forsus Appliance are mesial positioning of the upper molars, unilaterally activated on asymmetric arches cases or, as we have already mentioned, refusal to wear the intermaxillary elastics. Similarly, intermaxillary elastics are contraindicated for some disabled patients or patients who are allergic to latex.



Figures 5A-C: Left unilateral action treatment for correction of a Class II subdivision.



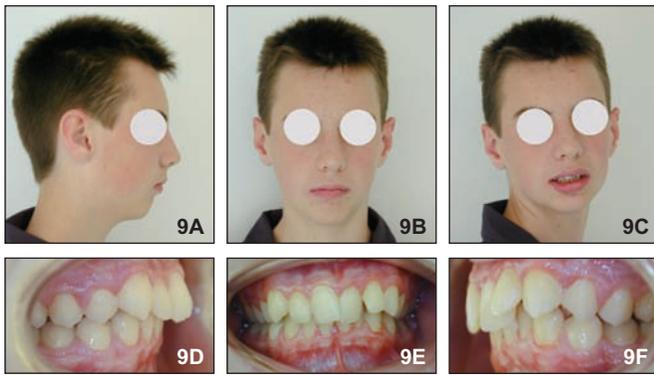
Figures 6A-C: Reciprocal space closure using Forsus™ Fatigue Resistant Device.



Figures 7A-C: Forced loss of lower anchorage. The sliding rod is placed distally to the premolar.



Figures 8A-D: Segmental distalization : posterior spaces will appear in the upper arch as the Class II is corrected in the lateral sectors.



Figures 9A-F: Pre-treatment views.

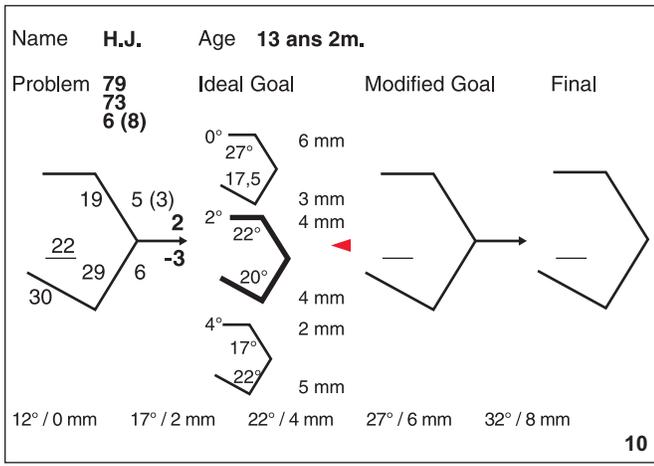
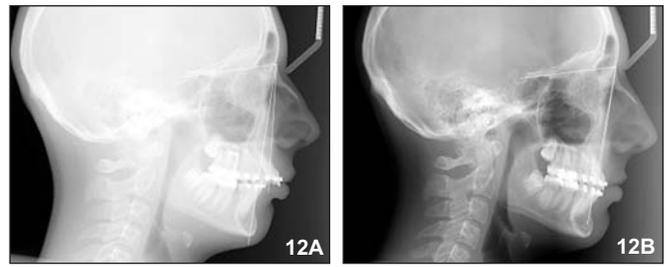


Figure 10: Céphalométric goal.

CHARTING THE ANCHORAGE PROBLEM		+	-
1. Depth of curve of Spee in mm (-)			2
2. M M discrepancy (-) or space (+) in lower arch			3
3. M M to upright $\bar{1}$			4
4. Molar anchorage loss while retracting $\bar{3}\bar{3}$ (-)			1
5. ANB change: regular = 1.5 mm/°, major = 1 mm / ° (-)		R	2
6. Mandibular plane 8° high (-1), 8° low (+1)			
7. Use palatal bar. (+1) if used at least one year.		1	
8. Delay extraction of $\bar{4}\bar{4}$		1	
9. Extraction Values	14-24-35-45	15	5
10.	TOTAL	17	23
11.	NET		\emptyset
12. Use Class III elastics. (+1) per month			
13. Use high-pull headgear. (+1) per six months			

Figure 11: Anchorage chart: T.L. Root analysis.



Figures 12A-B: A, Teleradiography before the Forsus™ Appliance and extraction of 14, 24. B, End of the phase.

This review of the possible uses of the Forsus system clearly shows that it is much more than just a simple device for replacing intermaxillary traction. We evaluated its contribution to our treatment options in terms of anchorage on the one hand and obviating the need for compliance on the other hand. This led us to include it in our therapeutic analysis by considering certain lines of the Terrell L. Root Chart⁸ that we use. Combined with the Level Anchorage™ System concept, the Forsus Appliance opens up new possibilities and allows us to achieve optimum treatment goals more easily and with better control, even in borderline cases.

Clinical case:

The following clinical case illustrates one of the possible indications. A 13-year-old boy presented with facial imbalance due to a strong retrognathic of the lower jaw. The occlusal relationship indicated a full Class II with a curve of Spee of 2 and lower crowding of 4mm. Cephalometric radiography showed a skeletal Class II with an ANB pattern of 6° and SNB of 73°. There were few vertical problems with just a skeletal deepbite tendency (FMA = 22°) and protrusion of the lower incisor (FMIA = 52° and I/NB = 6mm and 31°). The prognosis for a facial improvement was rather poor without surgery (Fig. 9-10).

Our objective was to correct the skeletal and dental Class II as far as possible by improving the lower jaw. The ROOT analysis gave the anchorage assessment (Fig. 11). The treatment plan was extraction of 14, 24, 35, 45 and use of regular anchorage to the lower arch and delaying extraction of the upper premolars.

Once the arches were prepared, 18 months after the start of treatment, the Class II was still as severe with little improvement in the growth of the lower jaw (Fig. 12A). Following extraction of the first upper premolars, a reciprocal space closure mechanic was installed jointly with the Forsus Appliance (Fig. 13A-B), see page 19. Six months later there was effective correction. Teleradiography (Fig. 12B) shows that the position of the lower incisor has been controlled and the skeletal ratios are normalized. The SNB changed from 74° to 76° before and after, respectively. The finishing touches could then be made to ensure good intercuspitation (Fig. 13C-D).

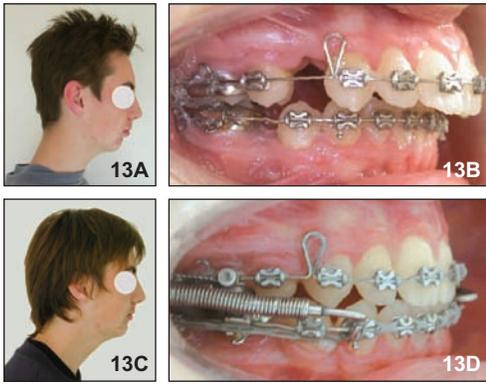


Figure 13A-D: A and B, Before Forsus™ Fatigue Resistant Device and space closure. C and D, End of the phase.

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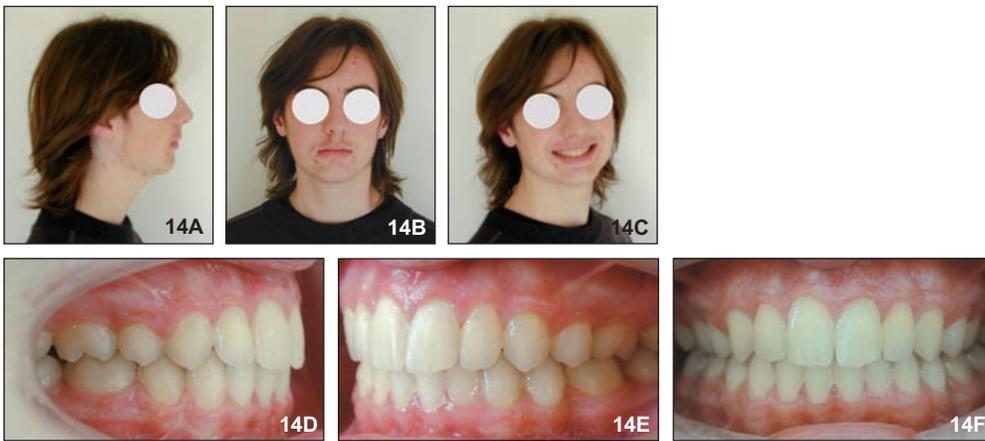


Figure 14A-F: Post-treatment views.