Injuries and Complications Management with Forsus Appliance

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ABSTRACT

Introduction: Forsus is a useful appliance for non-compliant Class II problems, however various problems can occur when using them.

Objective: To demonstrate a comprehensive series of of critical situations that can occur using the Forsus device and to provide the possible solutions of each complication.

Materials & Method: The clinical management of the Forsus appliance was analyzed for eighty consecutively treated patients. The Forsus was used five months on average and pictures and clinical record were registered each time a patient had a problem or an injury.

Discussion: The most common problem was breakage of the appliance. Breakage could occur as debonding of the lower first premolars or unsoldering of the upper first molar tubes. Lower premolar debonding could be prevented and fixed with an extra layer of flow composite surrounding the bracket base. Lesions of the cheek mucosa were found in several patients. A soft cotton pad used as "wax" was an effective solution to allow soft tissue healing and to prevent spring rubbing against the cheek. Upper molar intrusion occurred mainly when second molars were not included in the upper arch. Some patients experienced disconnection of the spring and the push rod while opening the mouth wide. They were taught to self-adjust the appliance.

Conclusion: The use of the Forsus appliance may lead to relatively frequent problems that the orthodontist can easily prevent and manage.

Keywords: Forsus, Class II, management, problems

INTRODUCTION

Non-compliance appliances to achieve a specific task (such as Class II correction) are becoming increasingly popular because of difficulties in obtaining cooperation from patients and their parents using traditional compliance methods (e.g. elastics, headgear), and mobile functional correctors. Among the several Class II fixed functional correctors, the ForsusTM appliance (3M Unitek, Monrovia, US) is becoming popular. Keim et al reported that it was routinely used by 17% of orthodontists, and occasionally used by 33% in their 2008 survey.[1] This percentage is steadily increasing, reaching 26% for routine use and 35% for occasional use in 2014,[2] making it the most used fixed functional appliance in the United States. Also, patients seem to prefer it to Class II elastics because it is less visible and less demanding, and they do not have to remember to wear it all the time.[3]

As with almost all orthodontic appliances, Forsus can present critical clinical conditions that need to be solved. Many papers have been published on the effects of Forsus, both in the short and the long term.[3,4] Only one paper has reported statistics related to Forsus breakage problems: according to Bowman *et al*[5] 38% of patients using Forsus experienced some sort of major or minor problem.

The aim of this clinical paper is to show a wide range of possible critical situations that can occur using the Forsus device. A thorough list of common and uncommon emergencies is covered, a solution is provided for each clinical situation, together with suggestions on how to prevent and treat the emergency.

MATERIALS AND METHOD

The clinical management of the Forsus appliance to correct Class II dental relationships was analyzed for 80 consecutively treated patients. The Forsus was used 5 months on average (Standard Deviation 2 months). Pictures and clinical records were registered each time a patient had a problem or an injury. Solutions to prevent or fix problems were discussed.

DISCUSSION

1. Lower premolar/canine bracket failure

Lower bracket failure is the most common emergency associated with the Forsus (27%). The use of a fully compressed Forsus and/or repetitive cycles of opening/closing of the mouth can occasionally cause canine/premolar bracket bond failure (Figure 1).

Prevention: Bite guards

Elastomeric ligatures with a bite guard (3M Unitek, Monrovia, CA, US) were originally conceived to prevent debonding of the lower incisor brackets caused by premature contact of the upper against the lower incisors in deep bite patients (Figure 2a-b). They can to be placed under the main working wire (commonly .019x.025 SS wire) around the premolar/canine bracket. The signet part should lean toward the distal side of the bracket to cushion the contact between the Forsus push rod and the canine/premolar bracket.

Prevention: Metallic ligature

If the bracket is a passive self-ligating type with a self-locking door, the retention of the .019x.0125 SS wire will be assured by the door itself. If the bracket is a standard one or an active self-ligating bracket, it is better to tighten a .010 metallic ligature around the bracket to prevent mesial rotation of the tooth (Figure 2a). Mesial rotation may be caused by the distal push on the bracket together with a failure of a standard elastic ligature or opening of the self-ligating active door (Figure 3).

Prevention: Build-up of flowable composite around the bracket

A reinforced adhesion of the target bracket may be obtained by etching the mesial and occlusal surfaces of the canine/premolar bracket and adding a thin extra layer of flowable composite around the base of the bracket (Figure 4). This will make failure of the target bracket a rare event.

Prevention and Repair: Posted or hooks soldered on SS arch

To prevent direct contact of the push rod against the bracket, it is possible to solder/select a presoldered wire the hooks distal to the pushrod target bracket. The same procedure may also serve as an immediate repair solution to give a point of force application to the pushrod, in case of bracket failure, as suggested by Rizwan *et al.*[6] who proposed crimping a crimpable hook on the lower wire, and fixing it with metallic ligatures.

Repair: On the wire re-bonding

Immediate reparation is needed when a lower bracket fails, otherwise the lower push rod will push mesially the debonded bracket against the adjoining mesial. The effectiveness of the spring will thus be reduced. We advise re-bonding on the wire because the wire setup of the lower arch is quite complex and time consuming (metallic ligatures, cushioned elastic ligatures, composite build-up). The debonded bracket is embedded in a thick layer of flowable composite that extends around the bracket base (Figure 5).

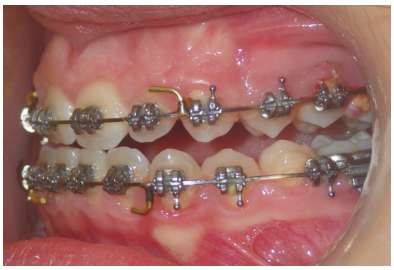

Figure 1: Bracket of second premolar debonded

Figure 2a-b: Bite guard to prevent debonding of the lower incisor brackets

Figure 3: Mesial rotation of first premolar due to failure of standard elastic ligature

Figure 4: Thick composite build-up to rebond first premolar "on the wire" during active Forsus therapy

Figure 5: Build-up of flowable composite on the occlusal and mesial surface of the bracket

2. Upper tube failure

The tube of the upper first molars may also fail in the case of "Forsus on the wire" or the headgear tube of the band may break in the welding area (3%) in case of EZ2 or L-pin insertion of the spring module (Figure 6).

Prevention: For bands- reinforced welding

The headgear tube welding on the band (laser welding) can be reinforced by consolidating the auxiliary tube for the headgear (Figure 7).

Prevention and repair: For tubes- composite build-ups

Flowable composite build-ups may be placed around the upper molars' tube base to reinforce its bonding strength (the same procedure applies for the lower premolar/canine bracket).

3. Lesions of the cheek mucosa

Rubbing of the orthodontic appliance against the cheeks may cause irritation of the cheek mucosa (13%) (Figure 8-11). In four cases, it was necessary to temporarily remove the appliance from the mouth to allow healing.

Prevention: Spring and pushrod protection

"Spring cap anterior and posterior" and "Spring Sleeve" (Comfort Solution Inc., Canada) are plastic devices that fit to the posterior part of the spring or the anterior elbow of the pushrod and prevent the orthodontic device rubbing against the buccal mucosa (Figure 12,13). They were designed specifically for the Forsus appliance.

Prevention and repair: Dental pads or cotton rolls

As classic orthodontic wax does not hold onto the pushrod or the spring, we found it very useful to

Figure 6: Breaking of band tube in the welding area

Figure 7: Welding of the tube reinforced

Figure 8: Lesion on the rear cheek mucosa (due to the back part of the spring)

Figure 9: Lesion on the cheek mucosa (due to the middle part of the spring)

Figure 10: Lesion on the cheek mucosa (due to the middle part of the spring)

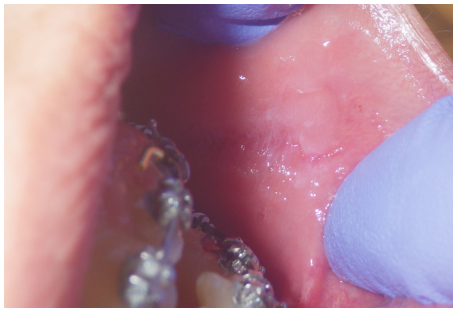

Figure 11: Lesion on the cheek mucosa (due to the middle part of the spring)

Figure 12: Spring Sleeve

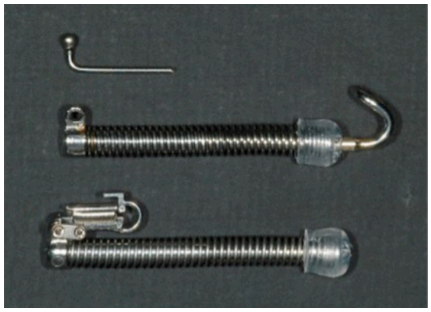

Figure 13: Spring cap anterior and posterior

Figure 14: Tongue'n Cheek dental pads™

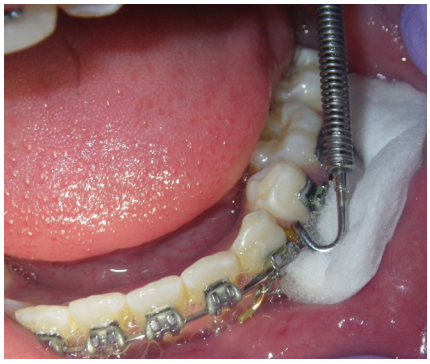

Figure 15: Tongue'n Cheek dental pads absorbing saliva. They cushion the cheek and can serve as ForsusTM "wax"

Figure 16: Vitamin E prophylaxis to increases the turnover of epithelial cells and to act as a lubricant

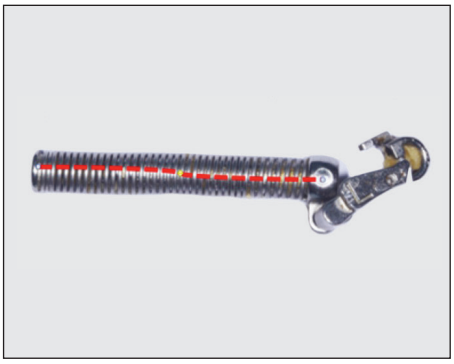

Figure17: Spring bend

Figure 18: First molar intrusion

Figure 19: First molar intrusion

Figure 20: Second molar bonded to extrude the first molar

provide the patient with a set of cotton rolls that should be placed in the vestibular fornix beneath the spring. Cotton rolls keep the cheek mucosa away from the push rod and the spring, thus allowing an initial strengthening of the mucosa, analogous to what happens with wax and standard brackets. Patients are instructed to use the cotton rolls at night (not during the day because they would give a hamster-like appearance) for the first 7-10 days. Cotton rolls are very effective, but are also slightly uncomfortable because they are rigid. We found Tongue'n Cheek Super Absorbent Pads (Hexagon International (GB) Ltd., UK) to be a better alternative (Figure 14). They are soft cotton pads that gain volume when they absorb saliva (Figure 15). They are more comfortable than standard cotton rolls as they are softer. They can also be used to relieve an injured mucosa.

Prevention and repair: Vitamin E

Vitamin E prophylaxis should begin a month before inserting the Forsus and continue during treatment to increases the turnover of epithelial cells and to act as a lubricant[7,8] (Figure 16). Consumers have a choice among gels or sprays.

4. Spring bending

Repetitive cycles of chewing can cause spring bending (2%). Inside the spring, there is a rigid cylindrical soul that may bend and, consequently, the push rod locks. This is rare but may happen (Figure 17).

Repair: New spring

It is recommended to change the spring immediately because the patient's jaw may easily lock and the lower jaw freedom of movement are decreased.

5. Upper first molars: Intrusion and flaring

The Forsus activation generates a force vector that produces intrusion and distalization of upper first molar. The intrusion of the first molar (23%) may sometimes be impressive (Figure 18-19). As the intrusion force is vestibular to the center of resistance of the first molar, it can indirectly induce a torque augmentation, which is caused by the moment generated by the intrusive force.

Prevention and repair: Engage the second molar

It is advisable to engage the second upper molars from the beginning of the treatment to avoid or minimize this condition. With the second molar connected to .019x.025 SS wire, the force is evenly distributed on the molars and specific side effects on

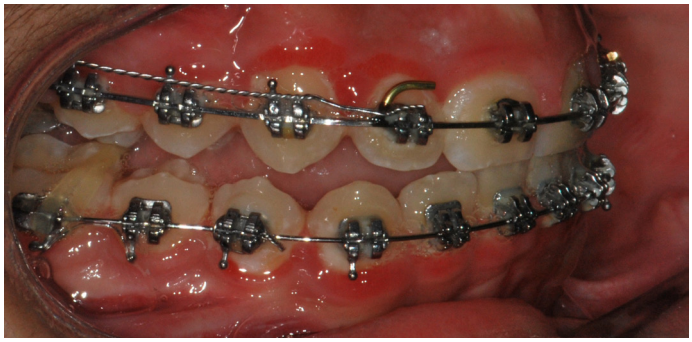

Figure 21: Vestibularization of the lower molars

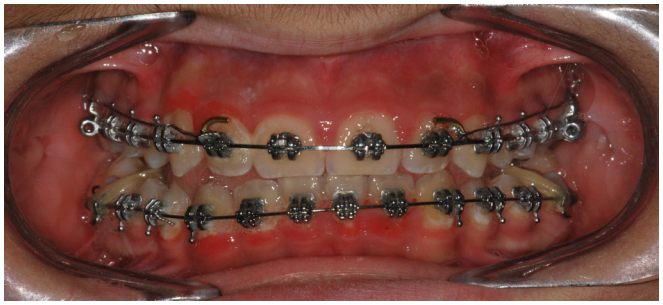

Figure 22a-b: Criss-cross elastics to resolve the vestibularization of the lateral sides of the lower arch

Figure 23: Torque and Intrusion Archwire to prevent excessive palatal inclination of upper incisors

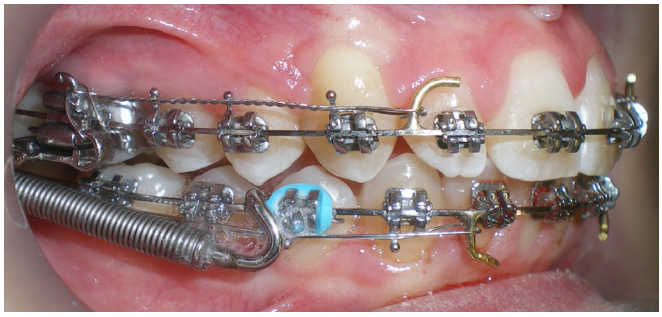

Figure 24: Torque and intrusion archwire

the teeth supporting the spring occurs only rarely. If the upper second molars were not included in the initial bonding, some intrusion on the upper first molars may appear, and it will be more intense for gretaer duration of Forsus use. If intrusion or flaring happens, the orthodontist should finally include the second molars after Forsus removal and use a thin NiTi/CuNiTi wire to allow the upper molars to extrude (Figure 20).

Prevention and repair: Intraoral elastics

The Forsus is used to avoid the use of intraoral elastic to rapidly achieve a Class I occlusion. Incidentally, elastics may be needed to improve intercuspation, after the Forsus removal. They may be used on night time only, thus facilitating patient compliance. In case of upper molar intrusion or vestibular flaring, vertical elastics from the upper first molars to the lower first and/or second molars are very effective.

6. Lower molars: Excessive vestibular torque gain

This is a very rare situation (2%). It is hypothetically due to a convergent inclination of the spring that pushes forward the dental elements against the cortical bone, which opposes resistance to the mesial/forward force. The right and left forces exerted by the pushrods act posteriorly in the lateral side of the arch pushing from backward to forward on the wire, behind the first premolars. The wire is connected to the teeth and they cannot really advance forward as incisor root are embedded into the alveolar bone (they can eventually procline as a consequence of forward forces). The wire is affected by these forces that tend to widen its end, thus causing vestibularization of the lower molars. As a consequence a cross bite in the molar area may be seen (Figure 21).

Repair: Cross bite elastics

The use of crossbite elastic is the solution to decrease the excessive vestibularization of the lower molars and to achieve a correct intercuspation (Figure 22a-b).

7. Upper incisors: Excessive torque loss

As a common consequence of Class II mechanics, the patient may experience a moderate to marked "headgear effect" that may be seen clinically as a torque loss (palatal crown torque) of the upper incisors (4%). The torque loss is advantageous in Class II division 1 with incisors that were excessively flared. In many other cases, an excess of torque loss prevents full correction of overjet/ Class II, due to an excessively reduced overjet.

Prevention: Increased upper incisors torque

An increased torque of the upper incisors may be achieved by selecting high torque values of the upper incisors brackets. When a standard bracket prescription is used, it is possible to achieve a good torque and intrusion control of the upper incisors through a modified posted .019x.025 SS archwire (Figure 23-24).[7]

8. Other minor problems

Other minor problems may occur while using the Forsus, such as crimpable spacer lost (2%), whose solutions are self-evident. In case of frequent spring/push rod disconnection (5%), a bigger size of the pushrod should be selected, and the patient instructed to avoid big yawns. Furthermore, the patient should be instructed to connect the pushrod and the spring, without the need of an emergency appointment.

CONCLUSION

Focusing on prevention may make the Forsus treatment a successful experience, both for the patient and the orthodontist. In particular, preventing rubbing on the cheek mucosa would make it much easier for the patient to accept the Forsus. Flowable composite build-ups around the lower premolars bracket, eventually coupled with bite guards, lower the likelihood of an emergency.

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