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An updated review of FORSUS fatigue resistant device a fixed functional appliance.

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Abstract

Functional appliances play an important role in treating skeletal discrepancy in young growing patients. Various removable and fixed functional appliances have been used by orthodontists extensively for improvement of dental and skeletal growth pattern. Forsus is one such fixed functional appliance which is very effective in Class II correction in patients having retrognathic mandible. it can control overbite, modify dental eruption, result in a good soft tissue profile of face, effective constant force delivery system that reduces overall treatment time and is break resistant. The prime objective of our investigation is to update the Forsus fatigue resistant device.

Keyword: Forsus, Class II treatment, Fixed functional appliance.

Introduction

Growth modification using functional appliances (removable and fixed functional) is the best way to correct a jaw discrepancy in young growing patients.[1] Functional appliances alters the posture of mandible and transmits the force created by the resulting stretch of the muscle and soft tissue and change of neuromuscular environment to the dental and skeletal tissues to produce movement of the teeth and modification of growth. Functional orthopedic treatment seeks to correct malocclusions and harmonize the shape of the dental arch and oro-facial functions.

Earlier removable appliances were bulkier and inconvenient resulting in reduced patient co-operation.[2] With appliance in place it was difficult to carry out functions like speaking and mastication. Further intermittent wear does not allow continuous muscle activity, which is very essential for promoting the skeletal change.[3] Fixed functional systems have few benefits over removable systems like they are used full day, implying continuous forces for mandibular growth. They are compact in size allowing better adaptation to perform functions like swallowing, mastication, speech and inhalation. These appliances reduce the need for patient compliance thus placing treatment outcome under the control of orthodontist. With fixed functional appliances, the treatment duration was reduced to around 6 months. Beside this faster result, it became possible to use the advantage of growth modification treatment in patients who were near the completion of growth. Wide variety of fixed functional appliances are available nowadays. Among these appliance selection is based primarily on the status of the dental and skeletal tissues of the patient, the type of dental response desired, the rate and amount of skeletal growth remaining and the degree of co-operation anticipated from the patients. Thus to reap the benefits of functional appliance and to eliminate the non-compliance and other disadvantage fixed functional appliances have been developed. These appliances have been improved to the present state by the pioneers of this field who rightly deserve rich accolades. Here is the brief review through the history of development of these appliances.

Historical Perspective

Various fixed functional appliances have gained popularity in recent years to achieve better results in skeletal discrepancy patients of growing age group. Fixed Functional Appliance was first introduced in dentistry by Dr. Emil Herbst in 1909.[4] Later in 1934, Herbst presented a series of article sharing his experience with the appliance. In 1979 Pancherz et al investigated the effect of Herbst appliance on masticatory muscle activity using EMG records.[5] In 1987 James J. Jasper introduced a flexible, fixed tooth borne functional appliance that allowed free lateral movements too.[6] Clements and Jacobson in 1982 introduced the MARS (Mandibular Advancing Repositioning Splint) which is attached to the archwires of a multibanded orthodontic appliance. McNamara Jr in 1995 described the use of a flexible force module (like Jasper Jumper appliance) incorporated into existing rigid fixed functional appliance, according to him the flexible spring module provides greater freedom of mandibular movement than the more rigid Herbst appliance.[7] In 1995 Weiland and Bantleon gave a report of treatment of class II malocclusion with the Jasper Jumper. In 1999 Ritto described a miniaturised telescopic device the Ritto appliance.[8] Almeida et al in 2005 described the short term treatment effects produced by the Herbst appliance during treatment of mixed dentition patients with Class II division 1 malocclusion. In 2006 FORSUS spring was given by an American orthodontist William Vogt. This is flexible fixed type of functional appliance with innovative three telescopic appliance with a coil spring in its exterior part.[9] Various studies based on the outcomes obtained by these fixed functional appliance shows that correction of Class II malocclusion consists of combination of dentoalveolar (60-70%) and orthopedic (30-40%) effects.

Classification Of Fixed Functional Appliances: Here is the classification given by Ritto A Korrodi[10] in the year 2001. Here is an updated classification with certain new appliances included, alongwith name of introducer and year in which these appliances were introduced.

Rigid Fixed functional appliances (RFFA)

1. Herbst Appliance (Emil Herbst in 1979)
   a. Banded Herbst appliance[5] (Pancherz in 1979)
   b. Cap Splint Herbst (Pancherz in 1997)
   c. Bonded Herbst appliance[11] (Raymond P Howe in 1982)
   d. Acrylic splint Herbst appliance[12] (James A. McNamara in 1988)
   e. Integrated Herbst appliance[13] (Paul Haegglund and Staffan Segerdall in 1997)
   f. Mandibular advancement locking unit (MALU) Herbst appliance (TP Orthodontics)
   g. Flip lock Herbst appliance(Miller in 1996)
   h. Mandibular advancing repositioning splint
   i. (MARS)[14] (Clements & Jacobson in 1982)
1. Functional orthopaedic magnetic Appliance (FOMA)[15] (Vardimon et al in 1989)
2. Cantilever Bite Jumper (Mayes in 1996)
3. Rick-A-Nator[16] (Rondeau B.H in 1990)
4. Ventral Telescope (The Professional positioners)
5. Magnetic Telescopic Device (A K Ritto)
6. Mandibular Protraction Appliance (MPA)[17] (Coelho Filho in 1995)
7. Universal Bite Jumper[18] (Xavier Calvez in 1998)
8. Biopedic Appliance (Designed by Collins J and marketed by GAC in 1997)
9. Mandibular Anterior Repositionin
10. Appliance (MARA)[19] (Douglas Toll in 1991
11. Intraoral snoring therapy appliance (IST) (Hinz)
12. Ritto Appliance[8] (A K Ritto in 1999)

Flexible Fixed Functional Appliances (FFFA)

1. Jasper Jumper[6] (Jasper in 1987)
2. Amoric Torsion Coils (Amoric in 1994)
3. Adjustable Bite Corrector[20] (Dr. Richard West in 1995)
4. Scandee Tubular Jumper (Saga dental AS, Norway)
5. Klapper Super Spring[21] (Lewis Klapper in 1999
6. Bite Fixer (Ormco in 1999)
7. Churro Jumper[22] (Castanon in 1998)
8. Flex developer (Winsauer in 2002)

Hybrid Appliances

1. Calibrated Force Module (The Cor Mar Inc. in 1988)
2. Eureka Spring (John DeVincenzo in 1997)
3. Twin Force Bite Corrector (Corbett and Molina in 2001
4. Forsus – Fatigue Resistant Device[23] (Introduced by William Vogt marketed by 3M Unitek in 2006)
5. Alpern Class II Closers (GAC International Inc.)
6. Power Scope (Introduced by Andy Hayes marketed by American Orthodontics)

Moschos A. Papadopoulos [24] further classified fixed functional appliances into four categories depending upon features of force system used to advance the mandible. Perhaps both the classifications, one by Ritto A. Koroddi and other by Moschos A. Papadopoulos were almost similar but the later kept appliances like Caliberated force modules and Alpern Class II correctors separately in "Appliances acting as substitute for elastics."

1. Rigid Intermaxillary Appliances (RIMA)
2. Flexible Intermaxillay Appliances (FIMA)
3. Hybrid appliances (combination of RIMA and FIMA)
4. Appliances acting as substitute for elastics.

Forsus Fatigue Resistant Device

FORSUS™ spring was given by an American orthodontist of Philadelphia **WILLIAM VOGT**. It is an innovative three telescopic appliance with a coil spring in its exterior part which resembles some flexible functional appliances. The Forsus (FRD) (Figure 1) can be used instead of Class II elastics in mild cases and instead of Herbst appliances in severe cases.

Figure 1: FORSUS (Fatigue resistant device)

Forsus springs work best in any Class II cases with convex profiles, except those with normal mandibles and prognathic maxilla, or with protrusive or overly large mandibles relative to the other skeletal structures. In comparison with other appliances its great advantage lies in its NiTi coil spring providing resistance to breaking. It is available in different spring length sizes like 28 mm, 31 mm, 34 mm and 37 mm for left and right side. Its bent ends helps the spring to attach to bands and archwires of the previously placed fixed orthodontic appliances. There is no interference with continuous arches used during the treatment, which offers wide application independently of the method applied. The appliance slides along the arch and facilitates opening of the mouth and lateral movements and thus allowing the patient to open and move their jaw freely. Its availability in different sizes, various attachments and stops gives an orthodontist the power to control the amount of force. To select the length of coil spring to be used, measurements are made in habitual occlusion from mesial of headgear tube of the upper first molar to distal of the lower canine bracket. 12 mm is added to this measurement (4 mm play, 4 mm headgear tube, 4 mm activation) and this gives the length of the module to be used. The assembly has a ball pin and a ball stop, the earlier one serves to attach it to headgear tube whereas the later one acts as a stop for the appliance on mandibular arch (with a bayonet bend distal to canine) distal to mandibular canine bracket. The lower first premolar bracket should be removed so that the spring can slide along the whole archwire.

Installation and instructions to use the appliance:

Insert 'L' ball pin into spring module's distal end pin hole and pull it through headgear tube from distal to mesial end (Figure 2).

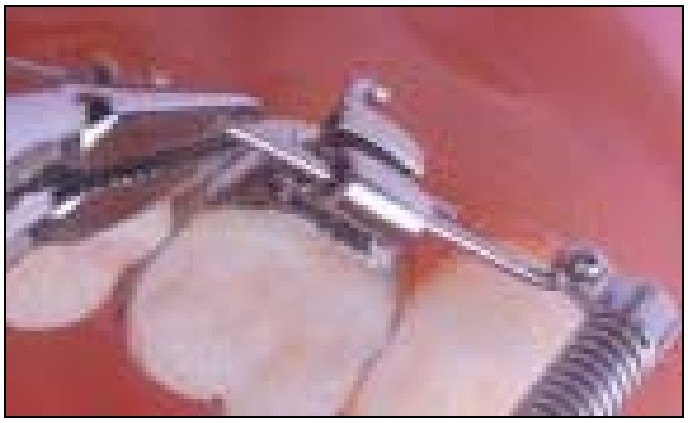

Figure 2: L ball pin inserted from distal to mesial in headgear tube

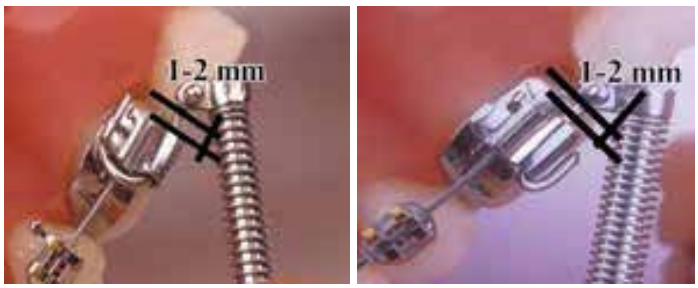

Figure 3: L ball pin bent keeping 1-2 mm distance from headgear tube

L pin is bent either occlusaly or gingivaly keeping 1 to 2 mm clearance between distal end of tube and pin ball (Figure 3) as it will allow unrestricted movements. Both the arches should be ligated with full size rectangular stainless steel archwires using stainless steel ligatures. To increase the anchorage, lower arch should be bonded till second molars. High force levels of the appliance can debond the canine brackets, so to avoid direct contact of appliance with mandibular canine bracket placing a Gurin lock (Figure 4) or adding bayonet bend in archwires can

help. Appropriate length of push rod should be selected with FORSUS guide scale (Figure 5). Push rod loop is to be placed between canine and first premolar, have patient open mouth, compress spring and insert the push rod through it.

Figure 4: Gurin lock

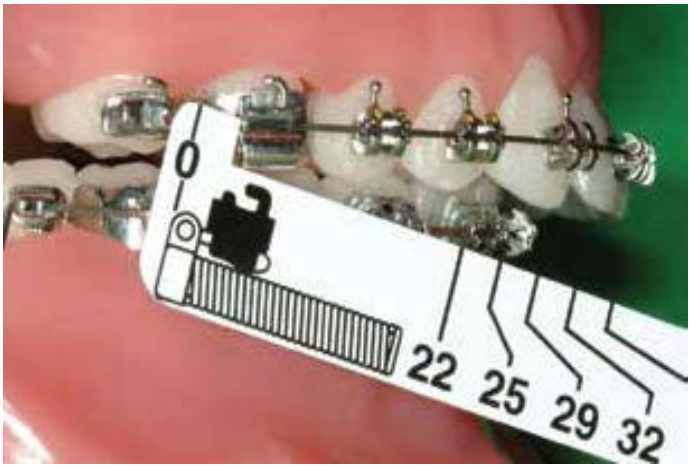

Figure 5: Forsus guide scale

Make sure that after proper activation it should be tightly crimped around the archwire (Figure 6). If patient bites on spring assembly, adjust "L" ball pin or entire assembly with a buccal offset. Reactivation of appliance can be done by crimping split ring bushings on push rod distal of stopper by compressing the spring as needed (usually 2 or 3 mm at a time to achieve midline correction and advancement)(Figure 7). An overactivated push rod will always protrude distally (Figure 8) out of spring module in centric occlusion ,that's how we can check the proper activation of appliance. Very often orthodontist may encounter some problems in patient undergoing treatment with FORSUS appliance, like mesial rotation of mandibular canines, proclined lower anterior segment & debonded canine brackets. It occurs due to constant force exerted by the push rods. So to overcome these problems, rotation wedges can be used. These rotation wedges (Figure 9) are to be tied on the distal tie wings of the lower canine brackets prior to placement of archwire and FORSUS modules. These wedges prevent the push rod to contact directly with the canine brackets and their shock absorber effect helps avid undesirable tooth movement like canine rotations and bracket debonding. To avoid proclination of lower anteriors, MBT prescription should be chosen over any other precription as they have increased lower incisor lingual torque values.

Figure 6: Insertion and crimping of push rod loop between canine and first premolar

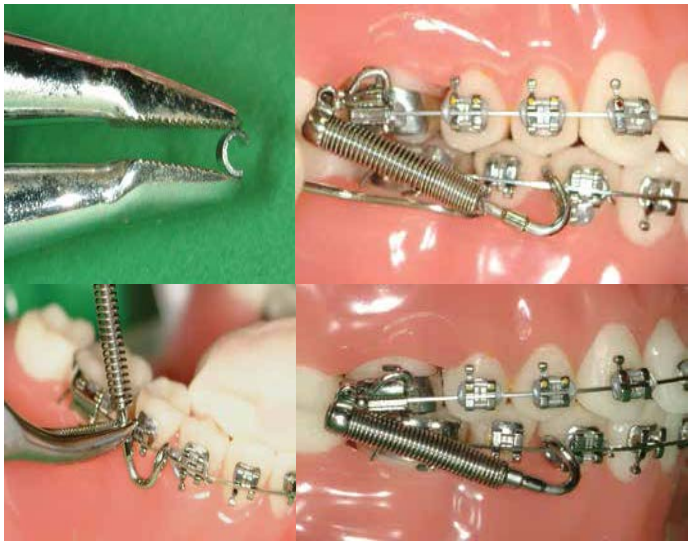

Figure 7: Reactivation of appliance

Figure 8:Overactivation results in push rod being pushed beyond the spring on centric occlusion

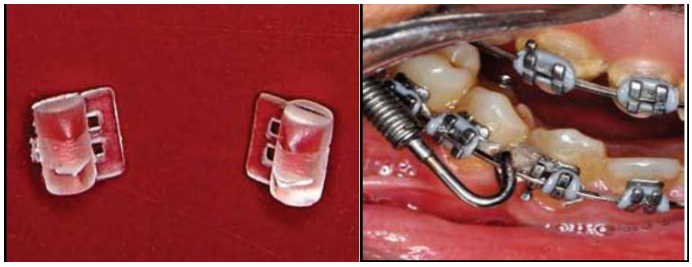

Figure 9: Rotational wedges and their placement

Forsus^{tm} Nitinol Flat Spring

Instead of the NiTi coil spring, this appliance has a Nitinol flat spring and its flat surface is more esthetically accepetable and more comfortable too. It requires no lab set-up, making chairside installation easy and quick. It is also available in different sizes alongwith 3 different bypass designs. This appliance has increased flexibility and is more sleek in design due to the presence of super elastic Nitinol flat spring. These Nitinol flat spring applies a constant force levels from the initial set up till its time of removal resulting in shorter treatment durations.

Summary and Conclusion

Removable functional appliances are effective but this treatment always demands a lot of patient cooperation. Results vary as patient cooperation is variable and is not always forthcoming. Patient faces difficulty while performing normal functions like speech and mastication with these appliances in place. But with the invent of fixed functional appliances many of these drawbacks have been overcome. With these appliances patient cooperation is no longer a stumbling block, the fixed functional appliance have rapidly endeared themselves to the clinician in achieving result and they should not considered at last resort appliances. Nowadays orthodontist do have a wide variety of appliance selection option that can be used to posture the mandible forward for the correction of Class II skeletal discrepancies. FORSUS (Fatigue resistant device) by 3M Unitek over runs many other appliances of this era due to its numerous advantages as shown in various studies. It has better design, more constant force delivery system, its break resistant design, better tolerance by patient and its easy installation are few of the advantages over other. However, fixed bite jumping appliance have definite indication and contraindication, which should not be neglected. Newer innovations have come into this field, and it is up to the clinician to decide as to when, where and how to apply it. Finally, it is not the appliance but the clinician behind the appliance who can make the difference between success and failure.

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