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EDITORIAL

*Raffaele Schiavoni*
Editor-in-Chief

# *Is a New Era on the Horizon?*

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*I remember witnessing a discussion between two distinguished colleagues at an American Association of Orthodontists (AAO) meeting that sounded more or less as follows:*
*"I have the* heart*", vehemently stated one of the two, "to dismiss a 7–8-year-old patient with a severe Class II malocclusion in mixed dentition because with my* hands *I can treat him when he's 12–13 years old with a full permanent dentition after the eruption of the second molars".*
*The other colleague replied in an equally passionate tone:*
*"...you may have the* hands *to treat him in permanent dentition, but I've the* head *to start treating him when he's a 7–8-year-old in mixed dentition!"*
*It was the time of the 'one-phase vs two-phase treatment in Class II malocclusion' and 'early vs late treatment' controversies that have perhaps never subsided.*
*Perhaps that's why in the June AJO-DO editorial, Editor-in-Chief Rolf Behrents, discussing the topic, brilliantly quotes Buridan's paradox*: "a mule that is both hungry and thirsty is placed at equal distances from a pile of hay and a bucket of water. The paradox assumes that the mule will be drawn to whichever is closer, and because of the equal distances, it will stand in place motionless and eventually die of both hunger and thirst, since it cannot decide to choose one direction or the other"*[1]*.*
*Behrents further states "strategies of treatment... must be dictated by the nature of the patient's problems" and thus "treatments need to be designed to fit the patient's problem, rather than patient's problem fitting the treatment".*
*Probably after years of heated discussions and controversies that have not always produced major scientific evidence, the time for softer tones has finally come: it is the dawn of a new era promoting useful scientific research.*
*This refers not only to the abovementioned 'one-phase vs two-phase-treatment' controversy but to many others.*
*Inevitably, the future will see more and more 'customization' of treatment and thus adjustment of the available scientific evidence to the needs of the individual.*
*This new awareness shall be attained through calm and serene discussions.*

**Jean Buridan, 14th century French philosopher*

**REFERENCE LIST**

1. Behrents RG. One phase or two, and Buridan's paradox. *AJO-DO* 2016;**149**:775–776.

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# Guided Orthodontic Regeneration: a New Approach in Ortho-Periodontal Regenerative Treatment

*Maria Giacinta Paolone*
Private practice in Orthodontics, Rome, Italy

*Roberto Kaitsas*
Private practice in Oral Surgery, Rome, Italy

Correspondence:
e-mail: paolone.mg@gmail.com

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## Abstract

Guided orthodontic regeneration (GOR) procedures can be used to achieve orthodontic movement in perio-restorative patients and can be considered to be part of periodontal treatment. GOR techniques include modelling and regeneration with guided orthodontic 'soft tissue' regeneration and guided orthodontic 'bone' regeneration. The increased amount of soft tissue obtained with orthodontic movement can be used for subsequent periodontal regenerative techniques. This strategy can also improve primary implant stability in the bone and, eventually, simplify guided tissue regeneration of soft tissues, restore a tooth with external resorption in a sensitive aesthetic area or extract a tooth to create new hard-soft tissue for adjacent teeth.

**Keywords**
Orthodontic extrusion, orthodontic extraction, forced eruption, implant site development, lingual orthodontics, osseous regeneration, guided orthodontic regeneration, guided bone regeneration, guided tissue regeneration

doi:10.12889/2016_C00258

## INTRODUCTION

Various surgical procedures standardized over the years are used to treat periodontal and implant patients. Orthodontic movement is also employed to modify and regenerate hard and soft tissue through an approach called 'guided orthodontic regeneration' (GOR). Orthodontic treatment has an important role in perio-implant patients by encouraging space redistribution, levelling bone, and, most importantly, developing and regenerating osseous and soft tissue. Orthodontics can be used to modify and improve the periodontal anatomy of hard and soft tissues in periodontally damaged or fractured teeth[1-7]. The preservation of alveolar dimensions is important in order to reduce the severity of further surgical procedures[8]. The thin vestibular cortical plate in aesthetic regions is susceptible to easy resorption following periodontal and periapical infections and to external resorption, which can complicate implant and prosthetic rehabilitation of this challenging area.

Vestibular, lingual and interproximal periodontal defects can be morphologically altered with orthodontic movement. External resorption, which is a perio-endodontic problem, can be treated using orthodontic solutions. And if this can be accomplished with vestibular techniques[9-12], then it can also be accomplished using lingual appliances.

The main element of the GOR approach is orthodontic extrusion. GOR can be divided into:

- Modelling
  - slow extrusion (teeth);
  - extraction (hard-soft tissue creation)
- Regeneration
  - guided orthodontic bone regeneration (GObR);
  - guided orthodontic soft tissue regeneration (GotR).

According to the amount of the extrusive movement and of tissue regeneration, we can classify GOR into:

- Tooth recovery (slow extrusion);
- tooth extraction without implant insertion;
- tooth extraction with implant insertion and implant site development (GObR and GotR).

The aim of this work is to describe regenerative and periodontal treatment using GOR, its relationship with guided bone regeneration (GBR) and guided tissue regeneration (GTR), and to explain how orthodontics can modify and improve tissue morphology. This aim is attained by discussing clinical cases and the different approaches used.

## TISSUE MODELLING

The first application is the use of GOR for modelling tissue where slow extrusion was employed to recover the dental structure of a tooth and an orthodontic extraction was used to create hard and soft tissue available for adjacent teeth. The following two cases will explain these two applications.

*Figure 1: Pretreatment appearance of the 1.2 with cervical resorption.*

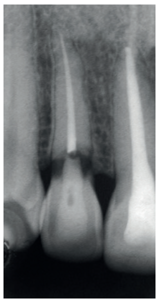

*Figure 2: X-ray showing external resorption.*

*Figure 3: 0.016" TMA wire extrusion bend.*

*Figure 4: The extrusion.*

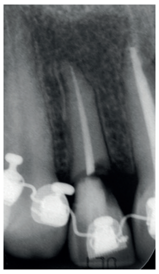

*Figure 5: Radiographic control of the extrusion.*

*Figure 6: The fibrotomy.*

*Figure 7: Appearance of the tooth at the end of extrusion.*

*Figure 8: The dental dam after flap elevation.*

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*Figure 9: The laminate veneer and the tooth at time of luting.*

*Figure 10: X-ray control.*

*Figure 11: 1-year follow-up.*

*Figure 12: Pretreatment and lingual bonding.*


*Figure 13: Clinical (lingual aspect) sequences of orthodontic extrusion.*

## TOOTH RECOVERY (SLOW EXTRUSION)

A 42-year-old woman presented for cervical restoration on 12 *(Fig. 1)*. The tooth had external resorption in a root canal-treated upper lateral incisor which had been subject to trauma many years before when the patient was 16 years old *(Fig. 2)*. We decided not to place an implant but to restore the tooth because dental structure was adequate[4,5]. Restoration of the tooth required exposure of the resorption margins. The conventional surgical procedure of crown lengthening was not suitable due to the depth of the lesion in an aesthetic region of the mouth. We therefore decided to first perform a slow extrusion[6] without fibrotomy in order to level and increase the soft tissues and then a quicker extrusion with fibrotomy to extrude only the root without soft tissue margin repositioning. This was performed employing lingual orthodontics.

### Mechanics

The patient underwent lingual (7th generation Ormco, Orange, CA, USA) full mouth bonding with indirect bonding with an extrusive set-up on 12 *(Fig. 3)*. A 0.016" CuNiTi wire was used first, followed by a 0.016" TMA wire to obtain controlled slow extrusion *(Figs. 4 and 5)*. At the beginning, slow extrusion was carried out to overextrude 12 and obtain a more incisal position of the vestibular gingival margin to prevent apical relapse of soft tissue. The second part of the extrusion was quicker and supported by a fibrotomy *(Fig. 6)* to expose the margins of the lesion.

### Restoration

At the end of orthodontic extrusion *(Fig. 7)*, a flap was elevated to expose the margins to allow a rubber dental dam to be placed *(Fig. 8)*. The tooth was restored with a fibre post system (Enapost; Micerium, Avegno, Italy) luted with a dual cement (Enacem; Micerium). After core reconstruction, final restoration was performed using a laminate porcelain veneer *(Figs. 9–11)*.

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*Figure 14: Clinical (vestibular aspect) sequences of orthodontic extrusion.*

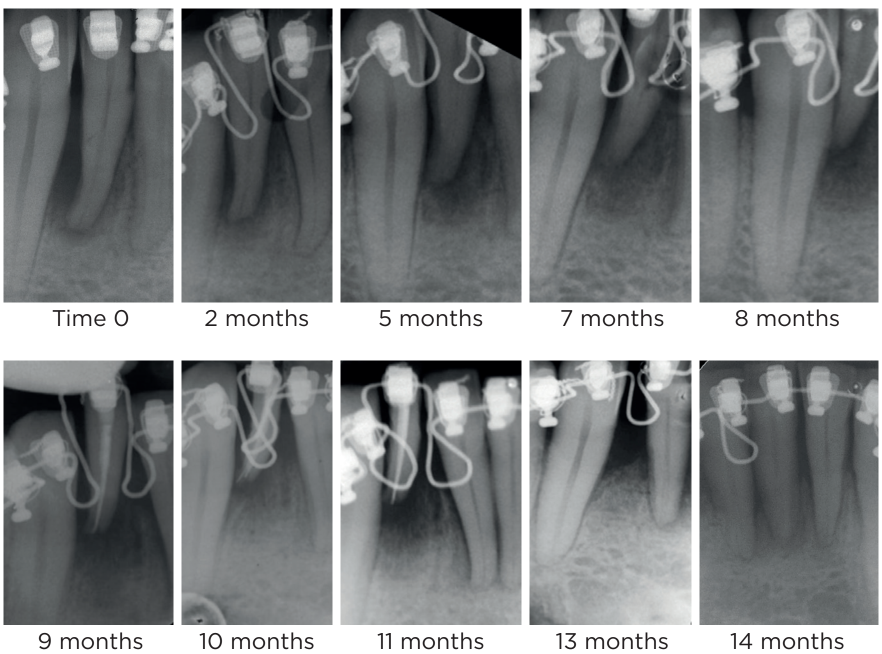


*Figure 15: X-ray controls of the sequences of orthodontic extrusion.*

*Figure 16: Clinical aspect of the tissue.*

*Figure 17: Pretreatment aspect of the 2.1 with the displaced crown.*

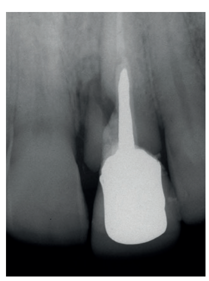

*Figure 18: X-ray of the metal post with the fractured fragment.*

## TOOTH EXTRACTION (ORTHODONTIC EXTRACTION)

A patient presented to our office for recurrent abscesses on the site of 43–42. Tooth 42 had a two-wall infraosseous defect with a distal probing of 9 mm *(Fig. 12)*. Probing on 43 mesial showed a reduced but sufficient level of attachment. The patient requested that the abscess problem be solved and the lower teeth aligned. We decided not to perform GTR to maintain the tooth but to use 42 to perform an orthodontic extraction using extrusion in order to remodel morphology due to bone loss and to increase hard and soft tissues, thus avoiding an unaesthetic cleft in the extraction site due to the collapse of already compromised tissues. The tissue was squeezed by other teeth to create an acceptable interproximal space. The patient underwent lingual (7$^{th}$ generation Ormco) bonding. We first extruded 42 and 43 to extrude and level the interproximal bony defect on mesial 43. Then 42 was slowly extracted with slow extrusion. Tooth 42 was torqued with a vestibular root torque to increase the alveolar ridge and reduce the risk of soft tissue collapse and a subsequent vestibular cleft often present during extraction in thin cortical plates. Use of a 0.016” TMA wire followed by a 0.017”×0.017” TMA wire with loops facilitated these precise movements *(Figs. 13–16)*.

## TISSUE REGENERATING

The second application of GOR is for implant site development in order to regenerate bone (GObR) or/and soft tissue (GOtR).

## GObR

The patient was a 57-year-old caucasian man with multiple traumas to an upper left central incisor *(Figs. 17 and 18)*. Probing revealed a mesiovestibular defect of 9 mm on the mesial and 5 mm on the vestibular aspect. Radiographic examination confirmed the presence of a fracture with a displaced root fragment below the bone level and the osseous defect. Crown lengthening was not suitable for aesthetic reasons and a forced eruption followed by prosthetic restoration could not be realized due to a poor crown-root ratio.

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### Orthodontic phase

A lingual appliance (7th generation Ormco) was applied only on the upper anterior teeth including the first premolars in order to perform an orthodontic extraction of the upper incisor. The crown of the incisor was etched with hydrofluoric acid and pretreated with a silane. The incisor bracket was bonded apically to the other brackets.

The lingual wire conventional sequence (0.016" CuNiTi, 0.016" TMA, then 0.017"×0.017" TMA) allowed controlled extrusion *(Fig. 19)* and prevented from radicular vestibular torque which could have destroyed the thin cortical plate[13].

The bracket on the incisor was re-bonded more apically. Then, when it was no longer possible to use the crown for bracket bonding because the greater part of the crown had been reduced and the appearance was no longer acceptable, a multi-disciplinary device was employed combining endodontic retention with a composite resin 12-11-X-22 veneer pontic *(Fig. 20)*. A post (Parapost; Coltène Whaledent, Cuyahoga Falls, OH, USA) was prepared with a hole for anchorage and was luted in the root canal with ossiphosphate zinc cement (DeTrey Zinc; Dentspy, Weybridge, UK). A 2-2 composite veneer pontic was bonded on the vestibular face of the remaining three incisors *(Fig. 21)*.

A red patch was observed confirming evertion of the non-keratinized sulcular epithelium. Once overcorrection and overextrusion had been obtained, the tooth was stabilized before extraction and implant substitution for 6 months with a 0.017"×0.022" SS wire in order to reduce relapse and obtain maturation of the soft tissue and alveolar bone *(Figs. 22 and 23)*.

### Surgical phase

After the stabilization period, a FRIALIT-2 4.5/15 mm (FRIADENT, Dentsply) root-form fixture was placed in the fresh extraction socket *(Fig. 24)*. After 6 months, the second surgical phase was initiated *(Fig. 25)*. At the same time a vestibular connective tissue graft was realized to increase the width of the vestibular tissue for use during the prosthetic phase[14,15].

### Prosthetic phase

After 4 months, a temporary crown was cemented using a customized titanium abutment to guide tissue maturation[16,17]. The crown was recontoured during the following 8 months[18,19]. Definitive restoration was obtained using a customized zirconia abutment and an all-ceramic crown (CeraBase, FRIADENT) *(Figs. 26–29)*.

*Figure 19: 0.016" TMA wire sequence of extrusion.*

*Figure 20: Composite veneer 2-2 for aesthetics and anchorage inside.*

*Figure 21: Parapost insertion and its anchorage on the veneer.*

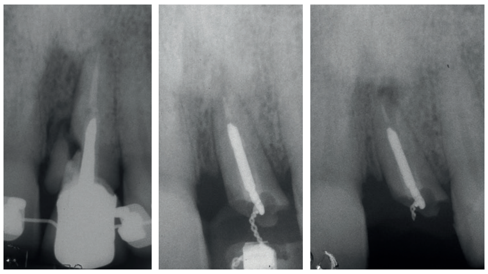

*Figure 22: Radiological control of extrusion (baseline to implant insertion).*

*Figure 23: The tissue at the time of fixture insertion time with the red patch.*

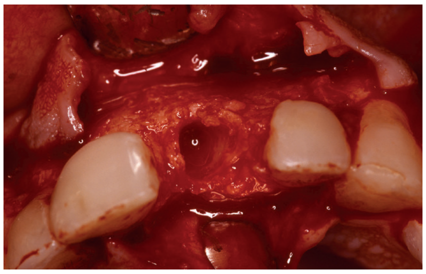

*Figure 24: The postextraction socket with mesiovestibular osseous regeneration.*

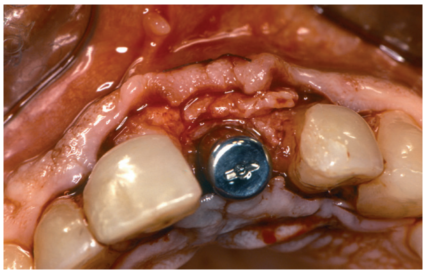

*Figure 25: Second stage surgery with the connective tissue graft.*



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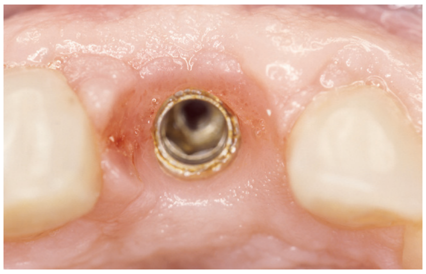

*Figure 26: Soft tissues at final luting.*

*Figure 27: Customized zirconia abutment and the all-ceramic crown.*

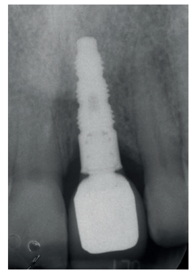

*Figure 28: X-ray 4-year follow-up.*

*Figure 29: 4-year follow-up.*

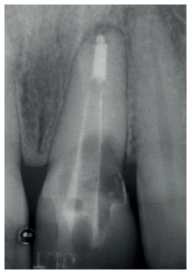

*Figure 30: X-ray showing external resorption.*

*Figure 31: Pretreatment appearance of the 2.1 with the sinus tract.*

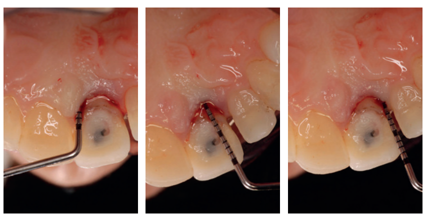

*Figure 32: Palatal periodontal probing of the osseous defects.*

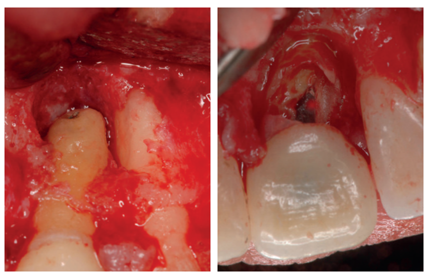

*Figure 33: Vestibular and palatal aspects of the dental and osseous defects.*

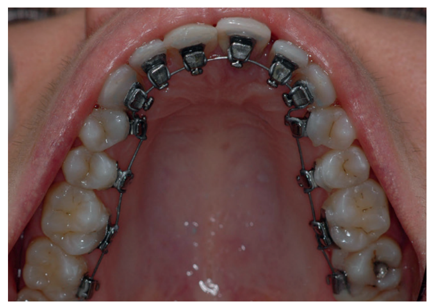

*Figure 34: Orthodontic lingual appliance.*

## GOtR

A 41-year-old woman presented with bone loss on the central left incisor due to several traumas and consequent external resorption *(Figs. 30 and 31)* confirmed by increased palatal probing *(Fig. 32)*.

The bone lesion complicated the implant treatment and obliged to a GBR technique *(Fig. 33)*. In order to perform a regenerative technique a great amount of soft tissue was needed to cover the membrane so a regenerative technique could be performed, an orthodontic extrusion was performed although contraindicated by the endodontic lesion.

## Orthodontic extrusion

The patient was treated with a lingual technique for aesthetic reasons. We used full mouth bonding on the upper teeth with lingual brackets ($7^{th}$ generation Ormco) and a sectional set-up with indirect lingual bonding and an extrusive position of the brackets on 21. The first arch wire was a 0.016” CuNiTi wire. Extrusion was then performed with a 0.016” TMA wire, and then with a 0.017”×0.017” TMA wire *(Figs. 34–37)*.

The first stage was pure extrusion along the long axis of the tooth. However, the surgeon requested the presence of interproximal bone peaks so that a GBR on the implant and a GTR on the lateral incisor could be performed, so the tooth was tipped first distally, to overcorrect the mesial peak, and then mesially to elevate the distal peak. In this approach, GObR achieved a classic extrusion to obtain the bone peaks for bone regeneration.

A radicular vestibular torque was then applied and included compensatory lingual bending to lingually torque the crown. The quantity of extrusion was determined not by the soft tissue increment but by the final hard tissue enhancement as the periodontist had requested a large amount of soft tissue to allow future surgical regenerative procedures using GOtR.

A 0.017”×0.022” SS wire was used to stabilize the tooth before implant surgery.

A removable Essix appliance was used to cover the redundant soft tissue while the surgeon worked behind the teeth in lingual *(Fig. 38)* to enhance aesthetics during the entire ortho-periodontic treatment.

## Surgical phase

After the stabilization period *(Fig. 39)*, the fragment was extracted

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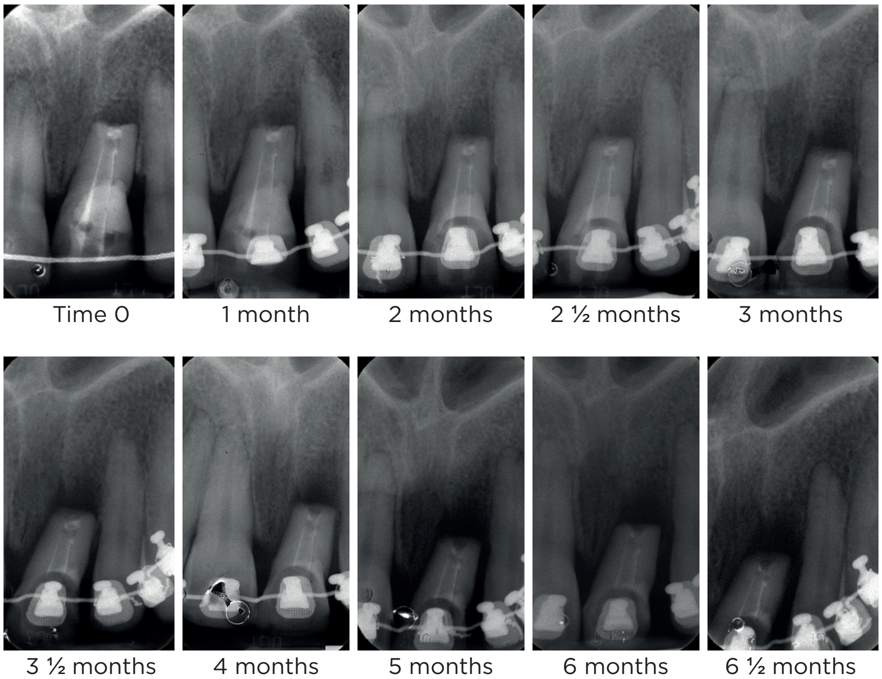


*Figure 35: Radiographic sequences showing orthodontic extrusion.*


*Figure 36: Clinical (lingual aspect) sequences of orthodontic extrusion.*

revealing a large osseous defect and dehiscence on the 2.2 root surface *(Fig. 40)*. A vestibular trapezoidal full-thickness flap was elevated with two oblique 'hockey-stick'[20] releasing incisions. After insertion of a 4.5/15 mm FRIALIT-2 implant (FRIADENT, Dentsply) *(Fig. 41)*, the osseous defect was filled with autologous particulated bone (Safescraper; META, Correggio, Italy) and the 2.2 root dehiscence was treated *(Fig. 42)*. The graft was covered with a non-resorbable titanium-reinforced e-PTFE membrane (Gore-TEX, W. L. Gore & Associates, Newark, DE, USA) previously adapted and fixed with a single titanium pin (FRIADENT, Dentsply) *(Fig. 43)* which also covered the root surface of the 2.2 in order to achieve deep tissue regeneration. After 12 months the membrane was removed and a vestibular graft was performed using the palatal pedicle of the flap *(Figs. 44–46)*. The pedicle was disepithelialized to create a roll-flap that was vestibulary packed to increase the thickness of the vestibular soft tissue *(Fig. 47)*.

### Prosthetic phase

After a healing period of 4 months, a temporary crown was cemented using the same protocol as in the previous case[16,17] to obtain papillae maturation before definitive restoration *(Figs. 48 and 49)*.

## DISCUSSION

The rehabilitation of teeth with periodontal damage and of perio-implants requires an interdisciplinary and multidisciplinary approach from diagnosis to treatment. Orthodontic movements are used non-surgically to increase the amount of available alveolar bone and soft tissue for implant site development and fixture placement[21,22], and to extract teeth while squeezing the resulting regenerated tissues or to recover enough dental structure so teeth can be restored. Periodontal ligaments can be used for distraction osteogenesis. The fibres of the periodontal ligament are inserted into the periosteum of the alveolar bone. When tension is applied, new bone is deposited, so periodontal morphology can be modified and improved provided the force applied, speed and inflammation are under control. Thus stimulation of the periodontal ligament with traction and extrusive forces can enhance the regenerative potential of periodontal surgery (including guided regeneration techniques) by modifying the morphology of an intraosseous defect, raising a vertically reduced alveolar ridge deformity[22] and increasing the amount of soft tissue. Consequently, a non-restorable tooth must not be extracted as first choice but should be utilized to improve the osseous and soft tissue anatomy of adjacent teeth for better and more predictable



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surgery with an improved aesthetic result[23-26].
Orthodontists are valuable members of the team treating challenging cases. and make a large contribution to aesthetics during treatment and to the final appearance. Lingual orthodontics used to achieve orthodontic extrusion can help develop and improve periodontal


*Figure 37: Clinical (vestibular aspect) sequences of orthodontic extrusion.*

*Figure 38: The Essix appliance in situ to maintain aesthetic appearance.*

*Figure 39: Soft tissue at the end of extrusion at time of implant surgery.*

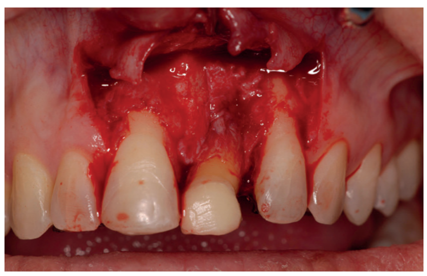

*Figure 40: The extruded fragment with the neo-generated attached tissue.*

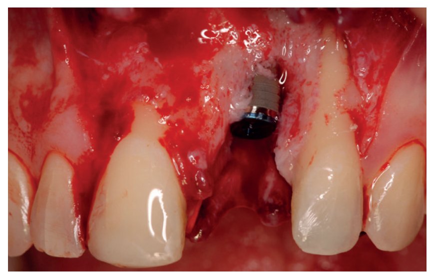

*Figure 41: Fixture insertion with the defect and dehiscence of the root of 2.2.*

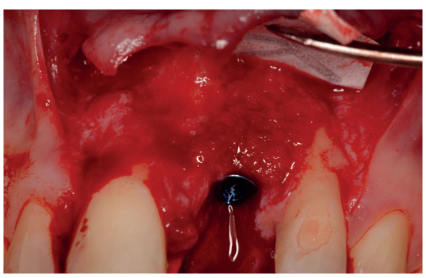

*Figure 42: Autologous particulated bone placed on implant and root.*

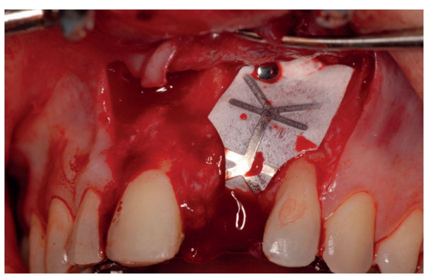

*Figure 43: Fixation of the non-resorbable membrane.*

*Figure 44: Soft tissue at the second stage of surgery.*

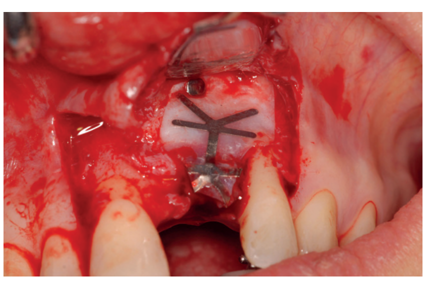

*Figure 45: Second surgical phase flap elevated to allow access to the membrane.*

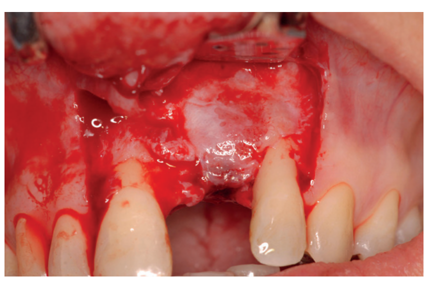

*Figure 46: Regenerated bone on the implant (GBR) and on the root (GTR).*

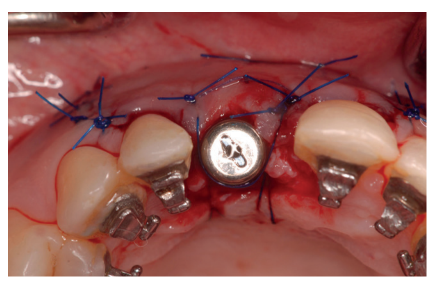

*Figure 47: Occlusal aspect of the sutured flap with vestibular soft tissue augmentation.*

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*Figure 48: 3-year follow-up.*

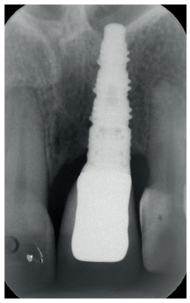

*Figure 49: Radiographic 3-year follow-up.*

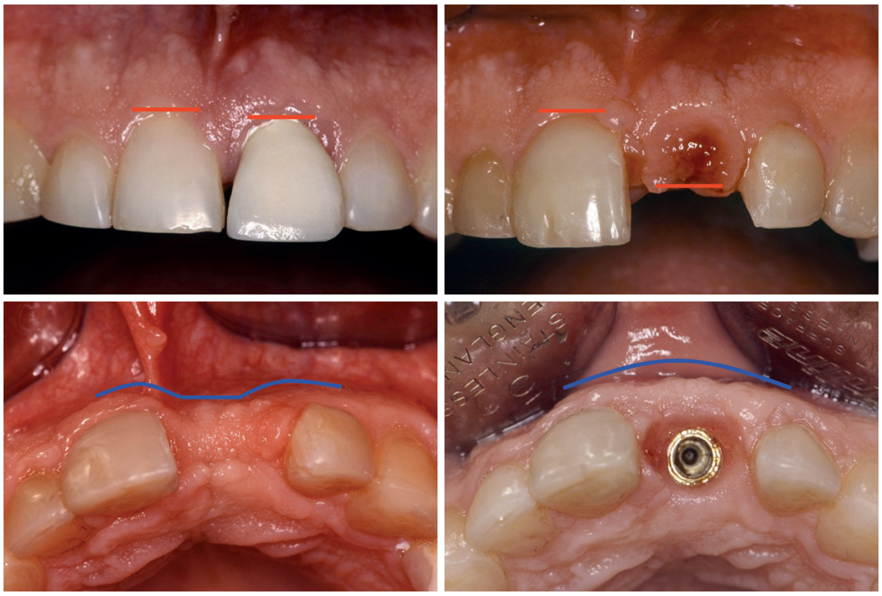

*Figure 50: Tissue augmentation after the extrusion movement and the connective graft.*

morphology or the final implant site, its bone[27] and its soft tissues[28] while allowing a pleasing appearance be maintained. A lingual appliance can preserve aesthetics throughout the entire orthodontic treatment. If aesthetics are compromised by soft tissue enhancement, a removable Essix appliance can preserve the integrity of the smile and minimize the effect of the extruded tooth which can be just a root or an abnormal quantity of gingival tissue.

When an adequate amount of soft tissue has been achieved through GOR, it is possible to simultaneously apply GBR to an implant and GTR to teeth at the same surgical site, as shown in the last case described above. The use of orthodontics to regenerate hard and soft tissue has many advantages compared to other purely regenerative therapies. First, non-restorable teeth can be used to help whole mouth rehabilitation. Second, orthodontic appliances (and lingual ones in particular) can, during bone distraction and development, simultaneously solve orthodontic aesthetic problems. Lingual appliances also allow the use of combined removable vestibular aesthetic appliances to conceal missing teeth and tissue modification. The use of GOR allows more complex regenerative techniques (such as complex vertical GBR, edentulous ridge expansion and osseous graft) to be reduced or eliminated and avoids the aesthetic defects caused by tissue collapse after extraction. It permits the recovery of fractured or resorbed roots, thus avoiding implant treatment. Last but not least, GOR makes subsequent surgical technique such as fixture insertion (GObR) and mucogingival correction (GOtR) much easier *(Fig. 50)*.

Therefore we can consider GOR as a modelling and regenerating (implant site development) approach. The modelling approach encompasses tooth extrusion to maintain and restore the tooth (external resorption in 1.2) and tooth extraction to slowly regenerate lost tissues after the extraction (osseous defect in 4.2). The regenerating approach can be used for implant site development (GObR, the classic approach to orthodontic extrusion[27], and GOtR for improving soft tissue to be used for other regenerative techniques[28]).

Some disadvantages must be considered, in particular the lengthy period of treatment due to the non-resorbable membranes and the orthodontic extrusion. However, the use of the lingual approach and external vestibular Essix appliances to improve aesthetics during orthodontic treatment, can help patients accept and manage their treatment.



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## REFERENCE LIST

1. Ingber JS. Forced eruption. Part I. A method for treating nonrestorable teeth. *J Periodontol* 1976;**45**:199–206.
2. Ingber JS. Forced eruption. Part II. A method for treating nonrestorable teeth. Periodontal and restorative considerations. *J Periodontol* 1976;**47**:203–216.
3. Delivanis P, Delivanis H, Kuftinec MM. Endodontic-orthodontic management of fractured anterior teeth. *J Am Dent Assoc* 1978;**97**:483–485.
4. Simon JH, Kelly WH, Gordon DG, Ericksen GW. Extrusion of endodontically treated teeth. *J Am Dent Assoc* 1978;**97**:17–23.
5. Stern N, Becker A. Forced eruption: biological and clinical considerations. *J Oral Rehabil* 1980;**7**:395–402.
6. Shiloah J. Clinical crown lengthening by vertical root movement. *J Prosthet Dent* 1981;**45**:602–605.
7. Cronin RJ, Wardle WL. Prosthodontic management of vertical root extrusion. *J Prosthet Dent* 1981;**46**:498–504.
8. Lambert F, Vincent K, Vanhoutte V, Seidel L, Lecloux G, Rompen E. A methodological approach to assessing alveolar ridge preservation procedures in humans: hard tissue profile. *J Clin Periodontol* 2012;**39**:887–894.
9. Chaushu S, Zahavi T, Becker A. Forced eruption of maxillary incisor teeth from the lingual side. *Quintessence Int* 2004;**35**:431–436.
10. Geron S, Ziskind D. Lingual forced eruption orthodontic technique: clinical considerations for patient selection and clinical report. *J Prosthet Dent* 2002;**87**:125–128.
11. Uddin M, Mosheshvili N, Segelnick SL. A new appliance for forced eruption. *N Y State Dent J* 2006;**72**:46–50.
12. Nozawa T, Sugiyama T, Yamaguchi S, Ramos T, Komatsu S, Enomoto H, Ito K. Buccal and coronal bone augmentation using forced eruption and buccal root torque: a case report. *Int J Periodontics Restorative Dent* 2003;**23**:585–591.
13. Hinds KF. Alveolar ridge development with forced eruption and distraction of retained natural dentition. *Oral Maxillof Surg Clin N Am* 2004;**16**:75–89.
14. Price RB, Price DE. Esthetic restoration of a single-tooth dental implant using a subepithelial connective tissue graft: a case report with 3-year follow-up. *Int J Periodontics Restorative Dent* 1999;**19**:92–101.
15. Evian CI, al-Maseeh J, Symeonides E. Soft tissue augmentation for implant dentistry. *Compend Contin Educ Dent* 2003;**24**:195–198, 200–202, 204–206; quiz 208.
16. Chee WW, Donovan T. Use of provisional restorations to enhance soft-tissue contours for implant restorations. *Compend Contin Educ Dent* 1998;**19**:481–486, 488–489; quiz 490.
17. Bichacho N, Landsberg CJ. Single implant restorations: prosthetically induced soft tissue topography. *Pract Periodontics Aesthet Dent* 1997;**9**:745–752; quiz 754.
18. Stumpel LJ, Haechler W, Bedrossian E. Customized abutments to shape and transfer peri-implant soft-tissue contours. *J Calif Dent Assoc* 2000;**28**:301–309.
19. Touati B, Guez G, Saadoun A. Aesthetic soft tissue integration and optimized emergence profile: provisionalization and customized impression coping. *Pract Periodontics Aesthet Dent* 1999;**11**:305–314; quiz 316.
20. Kaitsas R. Lembi e suture, in Barone A, Bianchi A (eds.) *Manuale di Chirurgia Orale*. Italy, Elsevier Masson, 2011, pp. 213–269.
21. Mantzikos T, Shamus I. Forced eruption and implant site development: an ostheophysiologic response. *Am J Orthod Dentofacial Orthop* 1999;**115**:583–591.
22. Ostojic S, Sieber R, Borer K, Lambrecht JT. Controlled orthodontic extrusion with subsequent implantation. *Schweiz Monatsschr Zahnmed* 2005;**115**:222–231.
23. Ogihara S, Marks MH. Enhancing the regenerative potential of guided tissue regeneration to treat an intrabony defect and adjacent ridge deformity by orthodontic extrusive force. *J Periodontol* 2006;**77**:2093–2100.
24. Salama H, Salama M. The role of orthodontic extrusive remodeling in the enhancement of soft and hard tissue profiles prior to implant placement: a systematic approach to the management of extraction site defects. *Int J Periodontics Restorative Dent* 1993;**13**:312–333.
25. Yeo AB, Cheok CB. Management strategies of the unsalvageable tooth. *Dent Update* 2006;**33**:7–12.
26. Schwartz-Arad D, Levin L, Ashkenazi M. Treatment options of untreatable traumatized anterior maxillary teeth for future use of dental implantation. *Implant Dent* 2004;**13**:120–128.
27. Paolone MG, Kaitsas R, Paolone G, Kaitsas V. Lingual orthodontics and forced eruption: a means for osseous and tissue regeneration. *Prog Orthod* 2008;**9**:46–57.
28. Kaitsas R, Paolone MG, Paolone G. Guided orthodontic regeneration: a tool to enhance conventional regenerative techniques in implant surgery. *Int Orthod* 2015;**13**:539–554.

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CLINICAL ARTICLE

# *Skeletal Class III Malocclusion Camouflage Treatment using NiTi Heat Activated Wire: A Clinical Case Using the Anterior Reverse Loca-System*

*Michele Ceschi*
Department of Medical, Surgical and Health Sciences, University of Trieste, Italy

*Luca Contardo*
Department of Medical, Surgical and Health Sciences, University of Trieste, Italy

*Ranieri Locatelli*
Department of Medical, Surgical and Health Sciences, University of Trieste, Italy

*Riccardo Riatti*
Department of Medical, Surgical and Health Sciences, University of Trieste, Italy

*Giuseppe Perinetti*
Department of Medical, Surgical and Health Sciences, University of Trieste, Italy

Correspondence:
e-mail: ceschimichele@tiscali.it

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The authors declare that they have no conflicts of interest related to this research.

## *Abstract*

*Objectives:* Skeletal Class III malocclusion can be treated according to several procedures depending on the amount of skeletal discrepancy and the growth phase of the patient. One of the camouflage treatment options, the Anterior Reverse Loca-System (ARLS), is described here.

*Materials and methods:* The ARLS was applied to correct a Class III malocclusion. The ARLS employs an upper F100 0.018”×0.025” heat activated NiTi (NiTi-HA) archwire after full-mouth fixed bonding. Bilateral loops on the NiTi-HA archwire are responsible for the anterior movement of the maxillary frontal teeth, while full-time intraoral Class III elastics are used to control lower incisor proclination.

*Result:* Despite the underlying Class III skeletal and dental relationship, the patient achieved a Class I dental relationship with normal overjet and overbite after 14 months of treatment.

*Conclusion:* The ARLS is a simple alternative treatment and may be considered for borderline cases of Class III malocclusion if the patient refuses to undergo combined orthodontic-surgical treatment.

**Keywords**
Class III, camouflage, NiTi archwire, ARLS

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## INTRODUCTION

Skeletal Class III malocclusion may be treated according to different protocols mainly depending on the amount of sagittal and vertical basal bone discrepancies and skeletal maturity attained by the patient. The treatment of post-pubertal patients with little or absent mandibular growth may be challenging when a combined orthodontic-surgical approach is refused[1-7]. In such cases, camouflage treatment is the only alternative.

Over the past decade, non-surgical therapies for the correction of mild Class III malocclusions have become more popular. For mild-to-moderate skeletal Class III discrepancies these therapies include bonded brackets with Class III elastics, extractions and miniscrew/miniplate systems[8-13].

In the present clinical case, a new, simple and effective method called the Anterior Reverse Loca-System (ARLS) was used to correct a Class III malocclusion by applying a bilateral continuous anterior force on the maxillary frontal teeth.

## APPLIANCE DESIGN

The ARLS is a simple system consisting of a F100 0.018"×0.025" heat activated NiTi wire (NiTi-HA; Neo-Sentalloy, Thomy Inc., Tokyo, Japan) applied to full-mouth fixed brackets.

The procedure is as follows. The upper NiTi-HA wire is marked on both distal ends in correspondence with the distal aspect of the maxillary first molar tubes. A crimpable arch stop is then applied on either mark, and the archwire is cut, leaving about 1 cm distally to the stops *(Fig. 1a)*[14,15].

The terminal archwire portions (distal to the stops) are inserted into the maxillary first molar tubes, so that the stops are in close contact with the mesial aspect of the molar tubes. The archwire is then engaged into the braces and ligated, with the exception of the canines, where a couple of bends (loops) are formed since the inter-stop archwire length is generally 8–10 mm longer than the corresponding full-arch length *(Fig. 1b)*. During treatment, these loops will tend to straighten, producing an approximately 100 g force with anterior direction on the maxillary frontal teeth.

Class III correction is therefore achieved by applying a light continuous force through loop deactivation. The anchorage counteracting the distalizing force of the loops to the molar region is finally provided by full-time application of intra-oral Class III elastics of about 150 g force *(Fig. 2)*.

## BIOMECHANICS

The ARLS is designed to achieve a Class I molar and canine relationship. The simplicity of the system allows it to be used in conjunction with any fixed technique (and bracket prescription) according to the orthodontist's preferences.

The biomechanical objectives of the appliance are as follows:

- to produce a mesial symmetrical (or asymmetrical, in case of middle line deviation) movement of the maxillary frontal teeth (generally canine to canines);
- to significantly reduce archwire substitution procedures, thus reducing chairside working time and any possible, though small, relapse of the achieved tooth movement;
- to reduce treatment time as the NiTi-HA archwire may be used as the initial wire and kept until a dental Class I relationship is achieved.

## CLINICAL CASE

A 15-year-old female patient presented with Class III malocclusion. The parents of the patient signed a consent form for the release of her pictures. The patient showed a concave profile with an open nasolabial angle and good facial symmetry. Intraoral examination revealed the absence of upper crowding, a V-shaped upper arch and a U-shaped lower arch, with a bilateral Class III molar relationship and an edge-to-edge incisor relationship *(Fig. 3)*.

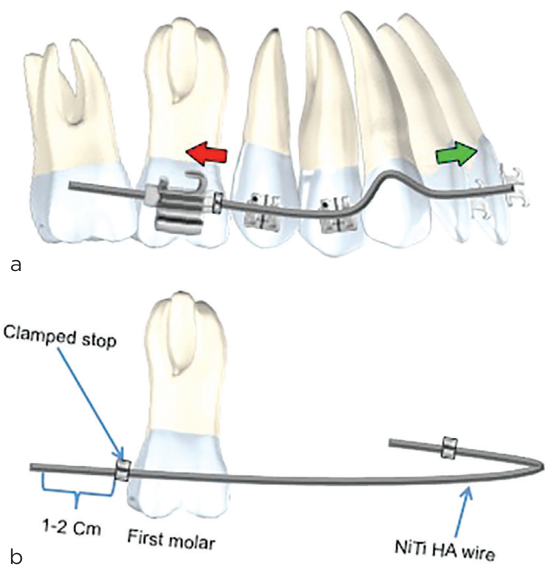


*Figure 1: The Anterior Reverse Loca-System (a) and function (b).*

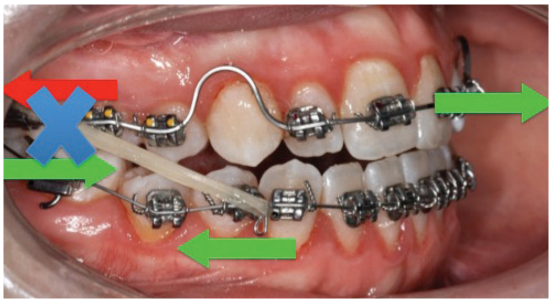

*Figure 2: Clinical application of the Anterior Reverse Loca-System.*

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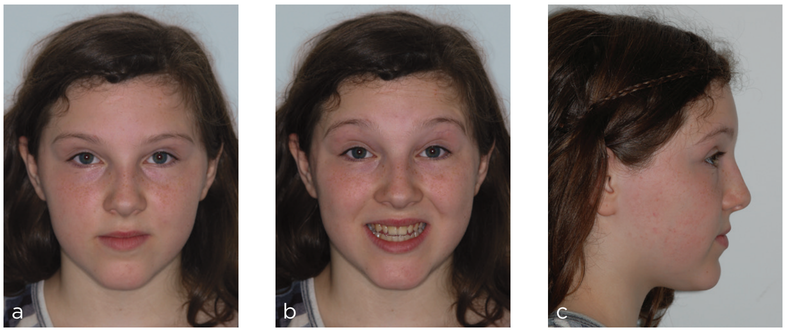

*Figure 3: The 15-year-old female Class III patient before treatment (a-i). Detail: third middle phalanx film denoting post-pubertal stage MPS6 (l).*

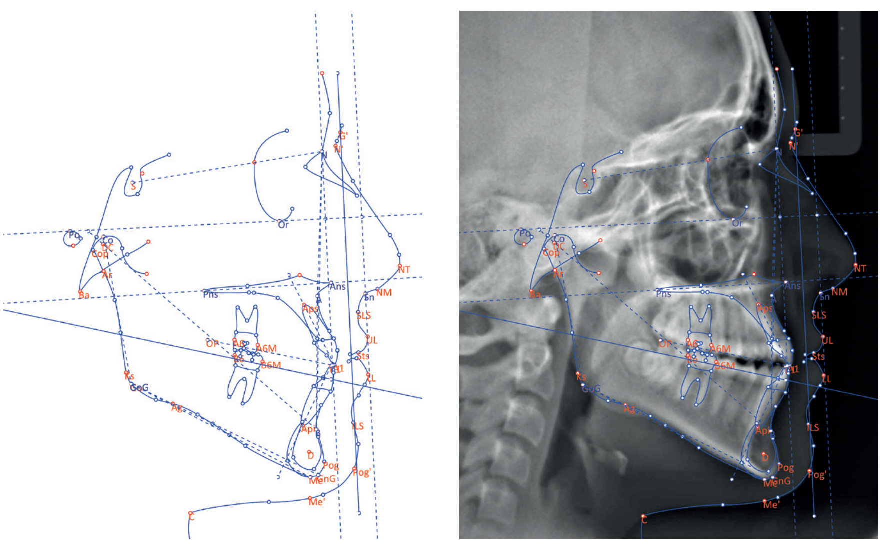

*Figure 4: Pre-treatment cephalometric tracings.*

| | Norm | Pre-treatment | Post-treatment |
|---|---|---|---|
| **SNA** | 82 | 76,5 | 77,6 |
| **SNB** | 80 | 78,5 | 76,7 |
| **ANB** | 2 | -2 | 09 |
| **WITS** | 0-1 | -5,9 | -2,7 |
| **SN-MP** | 32 | 43 | 45 |
| **PP-U1** | 110 | 111 | 115 |
| **MP-L1** | 90 | 89 | 88 |

*Table 1: Pre-treatment and post-treatment cephalometric values.*



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According to middle phalanx maturation, the patient was in post-pubertal growth phase MPS6 *(Fig. 3l)*[16]. Cephalometric analysis *(Table 1, Fig. 4)* showed a skeletal Class III discrepancy with moderate maxillary retrusion (SNA angle 76.5°, SNB 78.5°), a negative ANB angle of 2°, a negative WITS appraisal of 5.9 mm, and a hyperdivergent pattern with a mandibular plane angle on the SN plane of 43°. The patient showed mild dental compensation, with normal proclination of the upper incisors (PP-U1, 110°) and a mild lingual inclination of the lower incisors (MP–L1, 89°) *(Table 1)*. The patient was thus a borderline Class III surgical-orthodontic case.

Due to the refusal of the patient and her parents of a combined orthodontic-surgical approach, camouflage non-extraction treatment was agreed on. Treatment objectives were: a) to level both arches, b) establish a bilateral molar and canine Class I relationship, and c) improve the facial profile by protraction of the maxillary frontal teeth.

Bi-dimensional pre-adjusted brackets (Victory, 3M Unitek Orthodontic Solutions, Monrovia, CA, USA) were bonded on both dental arches with the exception of the maxillary canines, and the ARLS was applied as described above.

The ARLS was placed at the beginning of the treatment, while in the mandibular arch the alignment started with a 0.016" NiTi round wire. Moreover, 120 g force Class III elastics (GAC International Inc., Bohemia, NY,


*Figure 5: Patient at the first appointment with the Anterior Reverse Loca-System.*

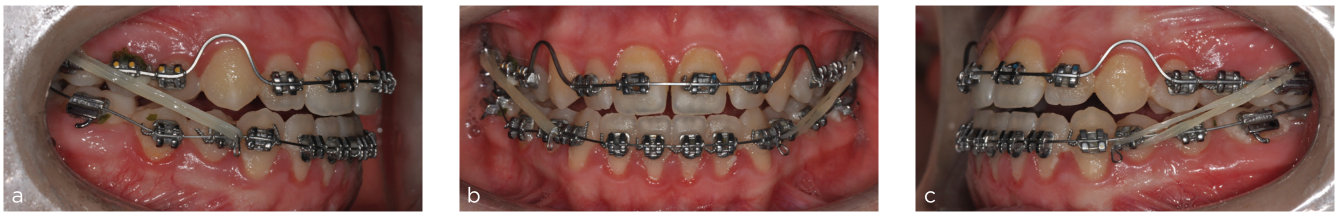


*Figure 6: After 2 months of treatment with the Anterior Reverse Loca-System. Note the increase in overjet and the interincisal diastema.*

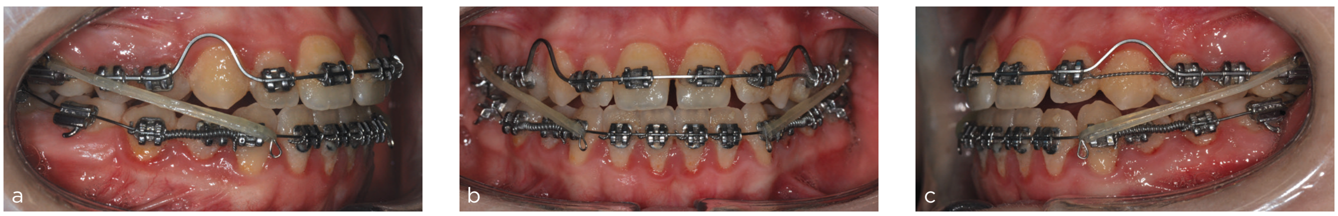


*Figure 7: After 3 months, the left loop was ligated, resulting in an asymmetrical force.*


*Figure 8: Blocking of the loops.*

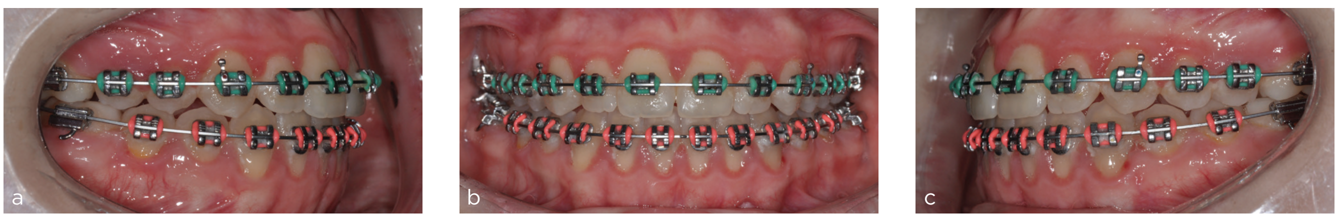


*Figure 9: The Anterior Reverse Loca-System removed and finishing with continuous arches.*

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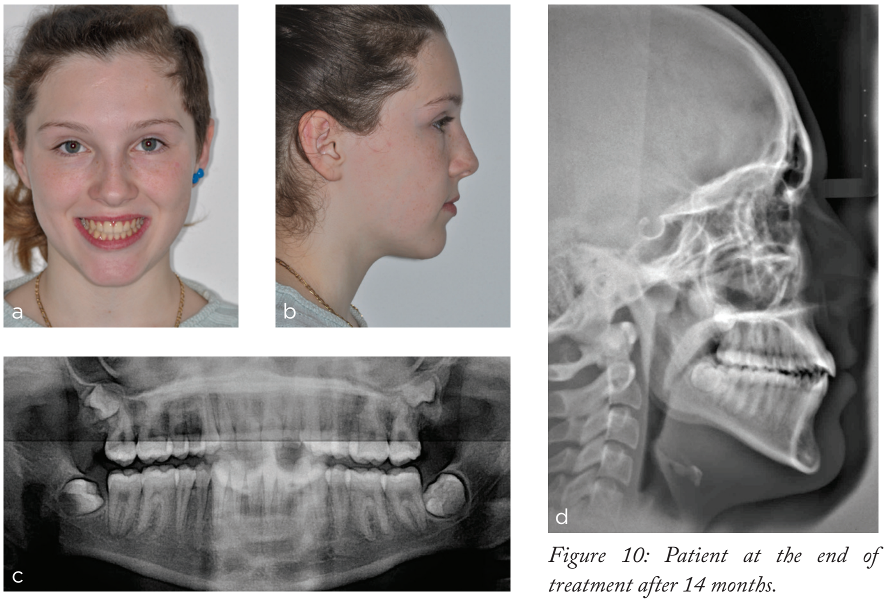


*Figure 10: Patient at the end of treatment after 14 months.*

USA) were used from the beginning of treatment *(Fig. 5)* to control the position of the maxillary molars and proclination of the mandibular incisors. After 2 months of treatment, an upper diastema with an increased overjet appeared as the ARLS loop height reduced *(Fig. 6)*. In the mandibular arch, levelling and alignment proceeded according to classical progression of the NiTi archwire from round to 0.016×0.016" and then 18×25 NiTi archwires used for the ARLS, which was maintained until the canines achieved a Class I relationship. Metallic ligatures were used from the beginning of treatment to the end of ARLS treatment.

Due to a slight discrepancy between the left and right sides, after 3 months of treatment, the left loop was blocked using a stainless-steel ligature wire *(Fig. 7)*. In contrast, the right loop was left active, allowing the median lines to be centred. As soon as the midlines were centred, the right loop was also blocked *(Fig. 8)*. Class III elastics were used during the entire treatment.

After 3 months of ARLS treatment, a normal overjet and Class I canine and molar relationships were achieved. Subsequently, NiTi superelastic and stainless steel finishing archwires were placed on both maxillary and mandibular arches *(Fig. 9)*. The appliance was debonded 12 months later *(Fig. 10)* and removable retainers were fitted.

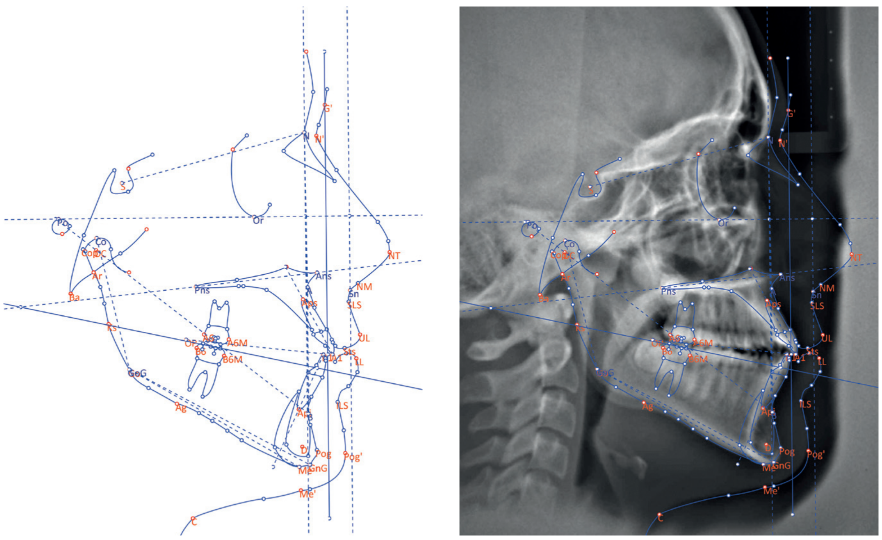

*Figure 11: Post-treatment cephalometric tracings.*

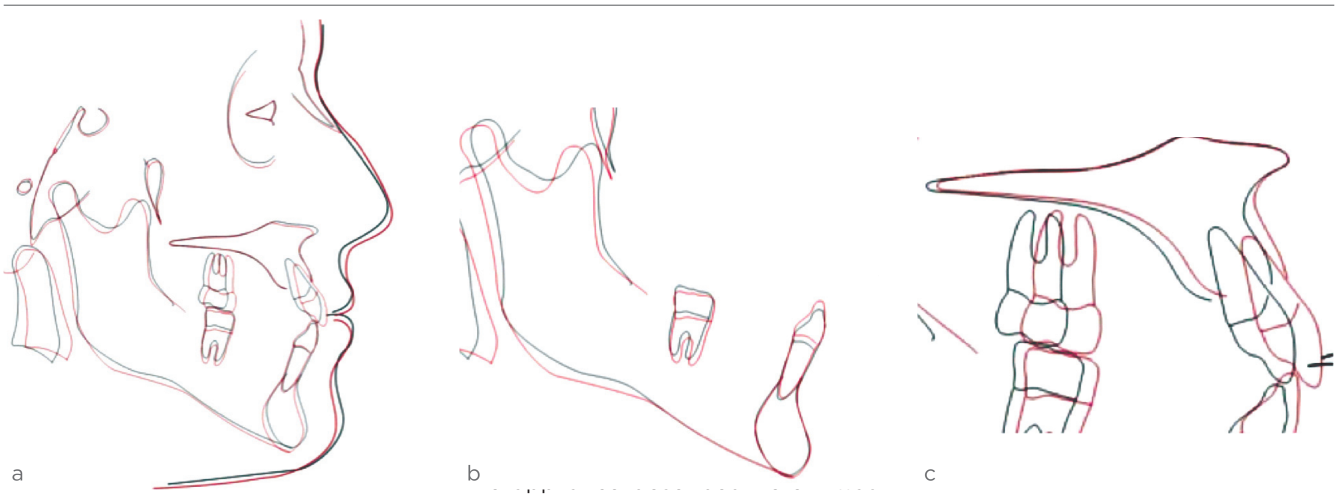


*Figure 12: Superimposition of pre and post-treatment cephalometric tracings.*



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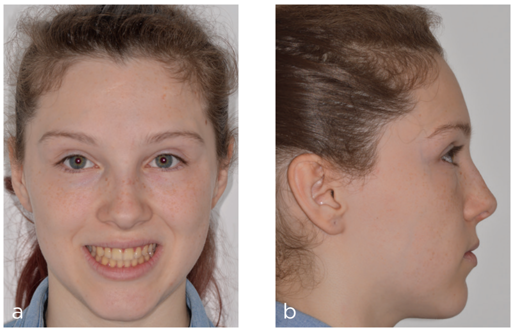


*Figure 13: Patient at 3-year follow-up.*


Despite the underlying skeletal and dental Class III relationships, the patient attained a Class I dental relationship with normal overjet and overbite, along with coincident midlines after 12 months of treatment *(Figs. 10 and 11)*. The patient's profile also improved, with a slight forward movement of the upper lip *(Fig. 12)*. The maxillary incisor proclination increased by a few degrees (final PP-U1, 115°) lengthening the maxillary arch. The proclination of the lower incisors had also been controlled properly (final MP-L1, 88°) *(Table 1)*. Finally, 3-year follow-up *(Fig. 13)* showed good stability of the treatment results along with a harmonic soft tissue profile.

## CONCLUSIONS

The appliance described herein was biomechanically efficient and cost effective, minimising treatment time and patient discomfort. In only 14 months, this orthodontic treatment yielded a Class III camouflage, with a good facial profile, a normal Class I occlusion and coincident midlines, without premolar extractions or surgery.

The ARLS alternative treatment approach may be considered in borderline cases of Class III malocclusion if the patient refuses to undergo combined orthodontic-surgical treatment.

## REFERENCE LIST


1. Proffit WR, Ackerman JL. A systematic approach to orthodontic diagnosis and treatment planning, in Graber TM, Swain BF (eds.) *Current Orthodontic Concepts and Techniques*, 3rd ed. St. Louis, MO: C.V. Mosby, 1985, pp. 714-718.
2. Liu X, Yang Z. Orthodontic camouflage treatment of an adult skeletal Class III malocclusion. *J Clin Orthod 2010*;**44**:57–63.
3 Ngan P, Wilmes B, Drescher D, Martin C, Weaver B, Gunel E. Comparison of two maxillary protraction protocols: tooth-borne versus bone anchored protraction facemask treatment. *Prog Orthod* 2015;**16**:26.
4 Moon W, Wu KW, MacGinnis M, Sung J, Chu H, Youssef G, Machado A. The efficacy of maxillary protraction protocols with the micro-implant-assisted rapid palatal expander (MARPE) and the novel N2 mini-implant–a finite element study. *Prog Orthod* 2015;**16**:16.
5 Ngan P, Moon W. Evolution of Class III treatment in orthodontics. *Am J Orthod Dentofacial Orthop* 2015;**148**:22–36.
6 Seo YJ, Chung KR, Kim SH, Nelson G. Camouflage treatment of skeletal class III malocclusion with asymmetry using a bone-borne rapid maxillary expander. *Angle Orthod* 2015;**85**:322–334.
7. Lin J, Gu Y. Preliminary investigation of nonsurgical treatment of severe skeletal Class III malocclusion in the permanent dentition. *Angle Orthod* 2003;**73**:401–410.
8. Janson G, de Souza JEP, Alves FA, Andrade P Jr., Nakamura A, de Freitas MR, Henriques JFC. Extreme dentoalveolar compensation in the treatment of Class III malocclusion. *Am J Orthod Dentofacial Orthop* 2005;**128**:787–794.
9. Faerovig E, Zachrisson BU. Effects of mandibular incisor extraction on anterior occlusion in adults with Class III malocclusion and reduced overbite. *Am J Orthod Dentofacial Orthop* 1999;**115**:113–124.
10. Costa A, Raffaini M, Melsen B. Miniscrews as orthodontic anchorage: a preliminary report. *Int J Adult Orthod Orthog Surg* 1998;**13**:201–209.
11. Sherwood KH, Burch JG. Skeletally based miniplate supported orthodontic anchorage. *J Oral Maxillofac Surg* 2005;**63**:279–284.
12. Moullas AT, Palomo JM, Gass JR, Amberman BD, White J, Gustovich D. Nonsurgical treatment of a patient with a Class III malocclusion. *Am J Orthod Dentofacial Orthop* 2006;**129**:S111–S118.
13. Baek SH, Yang IH, Kim KW, Ahn HW. Treatment of Class III malocclusions using miniplate and mini-implant anchorage. *Semin Orthod* 2011;**17**:98–107.
14. Locatelli R, Bednar J, Dietz VS, Gianelly AA. Molar distalization with superelastic NiTi wires. *J Clin Orthod* 1992;**26**:277–279.
15. Miura F, Mogi M, Ohura Y, Hamanaka H. The super-elastic property of the Japanese NiTi alloy wire for use in orthodontics. *Am J Orthod Dentofacial Orthop* 1986;**90**:1–10.
16. Perinetti G, Perillo L, Franchi L, Di Lenarda R, Contardo L. Maturation of the middle phalanx of the third finger and cervical vertebrae: a comparative and diagnostic agreement study. *Orthod Craniofac Res* 2014;**17**:270–279.


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CLINICAL ARTICLE

# Treatment of Skeletal Class II Malocclusion in Growing Young Patient using Forsus™ Appliance


*Harshal Ashok Patil*
Department of Orthodontics
ACPM Dental College Dhule
Maharashtra, India

*Veerendra V. Kerudi*
Department of Orthodontics
ACPM Dental College Dhule
Maharashtra, India

*Amit Maheshwari*
Department of Orthodontics
ACPM Dental College Dhule
Maharashtra, India

*Neeraj Patil*
Department of Orthodontics
ACPM Dental College Dhule
Maharashtra, India

*Jitendra S. Sharan*
Department of Orthodontics and Dentofacial Deformities, Centre for Dental Education and Research AIIMS, Ansari Nagar, New Delhi, India

*Pawankumar D. Tekale*
Department of Orthodontics,
Dr Rajesh Ramdasji Kambe Dental College and Hospital, Akola,
Maharashtra, India

Correspondence:
e-mail: drharshalortho111@gmail.com



## *Abstract*

This case report outlines the treatment of a 13-year old female with Class II division 1 malocclusion with mandibular retrusion, proclined maxillary anterior teeth, severe deep bite, and convex facial profile. The Forsus™ fatigue resistance device (FRD) was used for this patient and it was a very effective tool in correcting both skeletal and dental parameters. FRD application with appropriate treatment time can result in prominent changes in the facial profile and dentition thus enhancing quality of life.



**Keywords**
Fixed functional Appliance, Class II Correctors, FRD

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## INTRODUCTION

Class II division 1 malocclusion is one of the most common pattern of malocclusion an orthodontist comes across in his/ her orthodontic practice. Depending on the stage at which a patient visits the orthodontist for correction of their skeletal or dental Class II/1 related problems, an orthodontist has to use his diagnostic and clinical skills for optimal management of the problems. Sometime this might challenge and test the skills of even a highly experienced orthodontist. Skeletal Class II malocclusion is either due to prognathic maxilla, retrognathic mandible or a combination of both. *McNamara* reported mandibular retrusion as the most common characteristic Class II malocclusion[1].
Depending on the development status of the patient, several removable or fixed functional appliances can be used for the treatment of Class II division 1 malocclusions with mandibular deficiency in order to stimulate mandibular growth by forward positioning of the mandible. Unlike removable functional appliances, fixed functional devices are less dependent on patient compliance, and they can also be used concurrently with fixed mechanotherapy, thereby reducing treatment duration[2]. Fixed functional appliances are considered to be noncompliant Class II correctors, and include appliances such as the Herbst, Jasper Jumper, Twin Force BiteCorrector, Forsus™ etc. Among all Class II correctors, the Forsus™ has proven to be the most comfortable to a patient, right from installation. The Forsus™ corrector exerts milder forces in comparison to the Herbst appliance, thus allowing gradual overpowering of the patient's oral musculature and dental changes[3,4].
The FRD is a three-piece, semi-rigid telescoping system incorporating a superelastic nickel-titanium coil spring that can be assembled chair-side in a relatively short amount of time. It is compatible with most of the fixed orthodontic appliances and can be incorporated into preexisting appliances. The FRD attaches at the first maxillary molar and onto the mandibular archwire, distal to either the canine or first premolar bracket. As the coil is compressed, opposing forces are transmitted to the sites of attachment[5,6]. This article reports on non-extraction treatment of a skeletal Class II patient using the Forsus™ appliance which resulted in good occlusion and facial profile.

## CASE REPORT

A 13-year-old patient presented with the chief complaint of forwardly placed upper front teeth. On clinical examination, extraorally, she exhibited a convex profile, acute nasolabial

*Figure 1: Pre-treatment photographs.*

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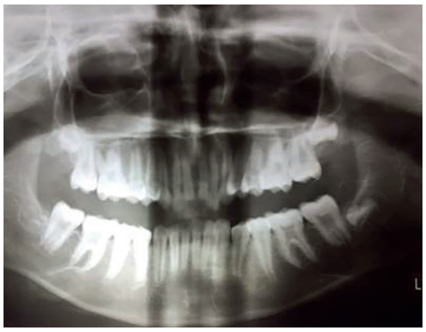

*Figure 2: Pre-treatment panoramic radiograph and lateral cephalogram.*

angle, recessive chin, protrusion of the upper lip and average growth pattern *(Fig. 1)*. Intraoral examination revealed Class II molar relation, proclined maxillary anterior teeth with an overjet of 8 mm, an overbite of 5 mm and a pronounced curve of Spee.

In the cephalometric assessment, the increased ANB (5°) and Wits appraisal (+6 mm) confirmed that the patient had a Class II skeletal pattern. The upper incisors were proclined, whereas the lower incisors were retroclined *(Fig. 2 and Table 1)*.

The diagnosis was Class II division 1 malocclusion associated with a retrognathic mandible and proclined maxillary anterior teeth. Pretreatment

*Figure 3: Intra-oral photographs with Forsus™ appliance.*

| Cephalometric Parameter | Pre-Treatment | Post-Treatment |
|---|---|---|
| SNA | 87° | 85° |
| SNB | 82° | 84° |
| ANB | 5° | 1° |
| Wits appraisal (mm) | 6 | 3 |
| Go-Gn-SN | 27° | 26° |
| Basal Plane Angle | 28° | 27° |
| Jaraback Ratio | 63% | 64% |
| FMA | 29° | 27° |
| Maxillary Length (Harvold Analysis) | 88° | 88° |
| Mandibular Length (Harvold Analysis) | 109° | 112° |
| U1-NA (°) | 37° | 29° |
| U1-NA (mm) | 10mm | 5mm |
| U1-SN | 124° | 112° |
| U1-Palatal Plane | 122° | 112° |
| IMPA | 87° | 90° |
| L1-NB (°) | 18° | 21° |
| L1-NB (NN) | 3mm | 4mm |
| Interincisal Angle | 119° | 129° |
| Nasolabial Angle | 92° | 102° |

*Table 1: Cephalometric Analysis.*

cephalometric values confirmed a class II skeletal relationship with a ANB of 5°, FMA of 29°, and SN-Go Gn of 27°.

## Treatment Objectives

- Obtain a symmetrical Class I occlusion without extractions.
- Improve facial appearance by inhibiting forward vertical growth of the maxilla and stimulating growth of the mandible.
- Correction of Class II molar relationship.
- Correction of skeletal Class II pattern to orthognathic profile.

## Treatment Plan

Considering the diagnosis, non-extraction fixed mechanotherapy was planned using a MBT 0.022" slot pre-adjusted appliance. Along with a fixed functional appliance, this expected to advance the mandible into a Class I relationship. The Forsus™ FRD (Forsus™ Fatigue Resistant Device; 3M Unitek, Monrovia, Calif) was one of the preferred option, as it does not require patient compliance.

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*Figure 4: Post-treatment photographs.*

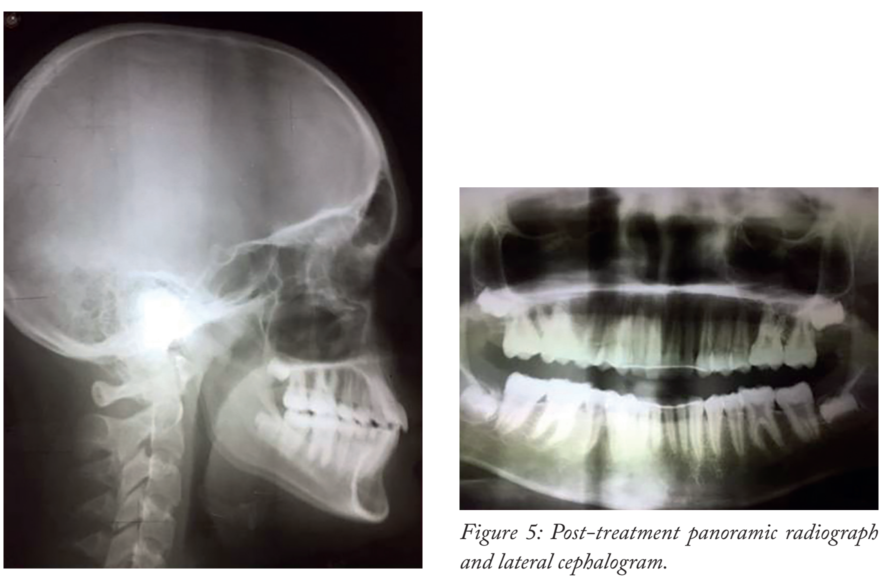

*Figure 5: Post-treatment panoramic radiograph and lateral cephalogram.*

## Treatment Progress

The molars were banded, and the remaining teeth were bonded with 0.022” preadjusted edgewise appliance (MBT prescription, American Orthodontics mini master series). A transpalatal arch was placed on the upper first molars to counter the buccal flaring of the molars.

Treatment was started using 0.016” NiTi in both arches, which was followed by 0.018” NiTi 0.019”×0.025” NiTi. Finally, a 0.019”×0.025” stainless steel wire was placed as a working arch wire. Leveling and alignment were achieved in 4 months. This was followed by mandibular advancement using the Forsus™ FRD *(Fig. 3)*. A 29 mm length of push rod was selected. 0.019”×0.025” SS in the lower arch was given 10° labial root torque to prevent the flaring of the lower anteriors due to the Forsus™. Molar correction and canine Class I relationship was achieved within 6 months of use of the Forsus™ appliance. Settling of the occlusion was carried out on 0.016” stainless steel in the upper and lower arches with settling elastics over a period of 3 months. The total active treatment time was 13 months.

Most of the treatment objectives outlined for this patient were achieved. The post-treatment facial

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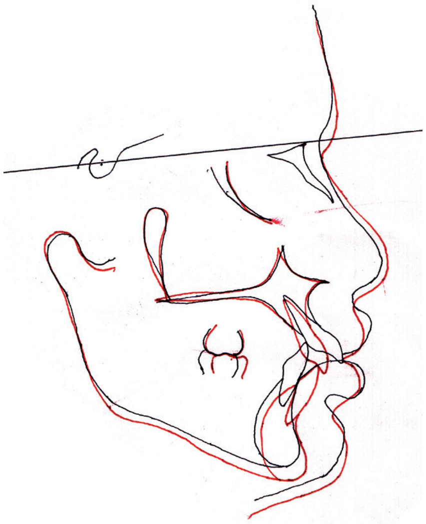

*Figure 6: Superimposition of pre-treatment, and post-treatment cephalometric tracings (black line: before treatment and red line: post-treatment).*

profile of the patient demonstrated noticeable improvement with good facial esthetics, straight facial profile *(Fig. 4 and 5)*. A good Class I molar relationship was achieved along with Class I canine relationship with normal overjet and overbite. A maxillary removable Begg's wrap-around retainer with anterior inclined plane to hold the corrected jaw relation was used for six months, along with permanent bonded maxillary and mandibular canine to canine lingual retainer.

## DISCUSSION

Class II malocclusions resulting from orthognathic maxilla and retrognathic mandible are usually treated with functional orthopedic appliances that create orthopedic forces directed at the mandibular structures. These appliances affect the jaws with remodeling of the mandibular condyle, remodeling of the glenoid fossa, repositioning the mandibular condyle in the glenoid fossa, and autorotation of the mandibular bone. Amongst the fixed functional appliances available, the Forsus™ FRD has long proven to be one of the best treatment modality for mild to moderate Class II malocclusion.

The case reported in this article is a young female patient at the late stage of puberty with skeletal Class II malocclusion due to mandibular retrusion. It has been shown that fixed functional appliances enhance mandibular growth. In this case report the post-treatment measurements showed favorable sagittal skeletal changes: SNA angle decreased by 2°, SNB angle showed increase from 82° to 84°, 4° reduction was seen in ANB angle, Wits reduction of 2 mm was seen and Harvold maxillary length was unchanged in maxilla and increased by 3 mm in mandible. The dento-alveolar changes showed that maxillary incisors were retracted significantly by 5 mm linear and 14° angular while mandibular incisors changed by 1 mm linear and 3° angular *(Table 1)*. The soft tissue improvement was seen with a trend towards orthognathic profile *(Fig. 4)*. The lateral cephalometric pre-treatment and post-treatment were compared using superimposition *(Fig. 6)*. Superimposition demonstrated an increase in mandibular length and improvement in soft tissue profile.

Labial flaring of mandibular incisors have been reported to be one of the major disadvantages of fixed functional appliances[7,8]. This can, however, be prevented with the use of the Forsus™ FRD by use of a sectional arch, using a pre-torqued wire prior to insertion of the Forsus™ or using brackets with built-in labial root torque[6]. MBT appliance was used for this case, with -6º torque in the lower incisor brackets. The lower archwire was securely cinched distal to lower second molars. This helped to counteract the protrusive effect of the Forsus™ on mandibular incisors. IMPA showed a mild increase from 87° to 90°. IMPA up to 90° is acceptable and stable. Another significant effect of the Forsus™ is the distal tipping effect on the maxillary incisors and molars. Even though the attachment to maxilla is at the molar tubes, the effect is seen on the incisors as well, since the entire maxillary arch is consolidated with a multi-bracket appliance[6].

## CONCLUSION

The Forsus™ fatigue-resistant device (FRD), is less dependent on patient compliance as the appliance is fixed, and the remaining growth after the pubertal growth spurt can be managed effectively. The Forsus™ FRD is not as rigid as previous fixed functional appliances and hence is comfortable for the patients.

## REFERENCE LIST


1. McNamara JA. Components of Class II malocclusion in children 8-10 years of age. *Angle Orthod* 1981;**51**:177-202.
2. O'Brien K, Wright J, Conboy F, et al. Effectiveness of treatment for Class II malocclusion with the Herbst or Twinblock appliances: a randomized, controlled trial. *Am J Orthod Dentofacial Orthop* 2003;**124**:128-137.
3. Kucukkeles N, Ilhan I, Orgun IA. Treatment efficiency in skeletal Class II patients treated with the Jasper Jumper. *Angle Orthod* 2007;**77**:449–456.
4. Franchi L, Alvetro L, Giuntini V, et al. Effectiveness of comprehensive fixed appliance treatment used with the forsus fatigue resistant device in class II patients. *Angle Orthod* 2011;**81**:678–683.
5. Vogt W. The forsus fatigue resistant device. *J Clin Orthod* 2006;**40**:368-77;quiz 358.
6. Jones G, Buschang PH, Kim KB, Oliver DR. Class II non-extraction patients treated with the Forsus Fatigue Resistant Device versus intermaxillary elastics. *Angle Orthod* 2008;**78**:332-8.
7. Jones G, Buschang PH, Kim KB, Oliver DR. Class II non-extraction patients treated with the Forsus fatigue resistant device versus intermaxillary elastics. *Angle Orthod* 2008;**78**:332-8.
8. Oztoprak MO, Nalbantgil D, Uyanlar A, Arun T. A cephalometric comparative study of Class II correction with Sabbagh Universal Spring (SUS (2)) and forsus FRD appliances. *Eur J Dent* 2012;**6**:302-10.


 

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clinical TIPS

# An Uprighting Auxiliary for Correction of Impacted Mandibular Second Molars


*Dinesh Ram Raja*
Department of Orthodontics and Dentofacial Orthopedics
Meenakshi Ammal Dental College and Hospital, Chennai, India

*Ratna Parameswaran*
Department of Orthodontics and Dentofacial Orthopedics
Meenakshi Ammal Dental College and Hospital, Chennai, India

*Devaki Vijayalakshmi*
Department of Orthodontics and Dentofacial Orthopedics
Meenakshi Ammal Dental College and Hospital, Chennai, India

Correspondence:
e-mail: avdineshramraja@gmail.com



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## Abstract

Impaction of the lower second molar is rare[1] and often requires a multidisciplinary treatment approach, which can prove challenging for both orthodontists and oral surgeons. Partial or total impaction of the mandibular second molar occurs in only 0.3% of the general population and 2-3% of orthodontic patients[2,3]. The usual age at presentation is between 11 and 13 years, and although some cases undoubtedly self-correct, it is equally true that many do not[4].



**Keywords**
Disimpaction, impaction, mandibular molar, vertical impaction, second molar


Three major factors complicate treatment of an impacted molar:

- biomechanically unfavourable position of the centre of rotation of the molar;
- horizontal inclination of the molar;
- difficulties in bonding to an impacted tooth[5].

To overcome these difficulties, we have developed an auxiliary spring fabricated using AJ Wilcock 0.014 wire.

## APPLIANCE DESIGN

The auxiliary spring is constructed using AJ Wilcock 0.014 wire. It consists of a retentive arm, U loop, horizontal arm and distal driving arm *(Fig. 1)*.
The retentive arm is engaged into the 1st molar buccal tube. The U loop is positioned distal to the 1st molar tube which acts as a stop and aids in the flexibility of the spring. The horizontal arm is positioned at the 1st molar

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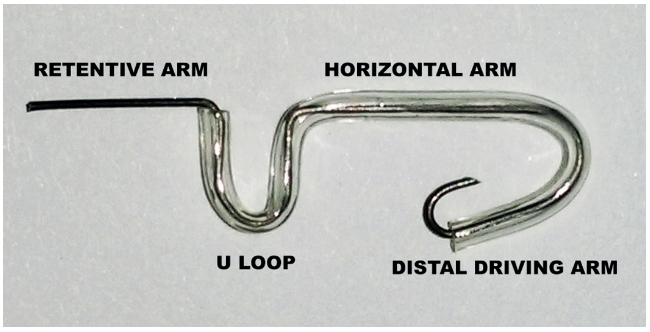


*Figure 1: Parts of uprighting spring.*

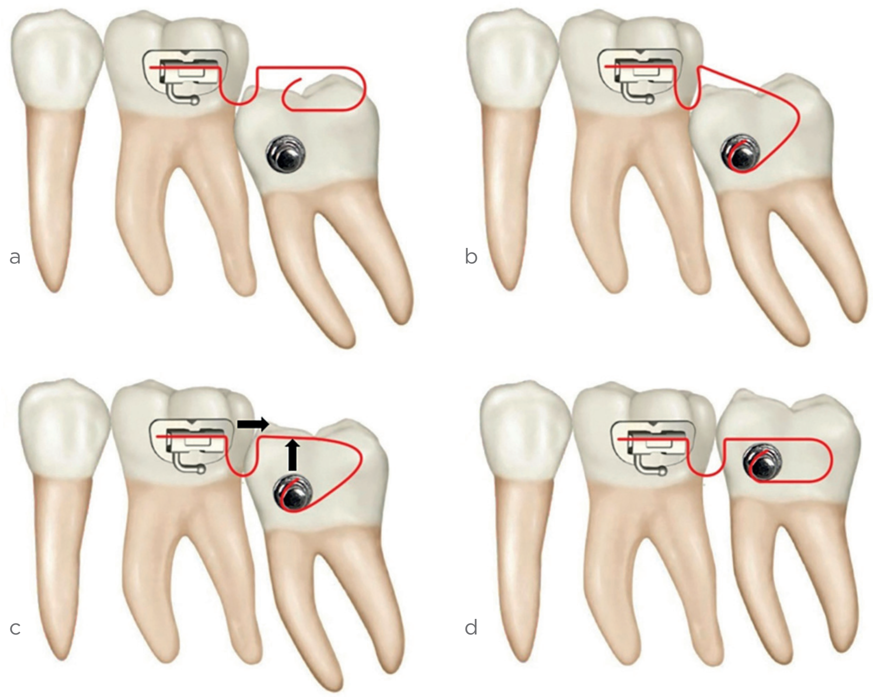


*Figure 2: Pictorial representation of spring action. a) engagement of spring into 1st molar buccal tube, b) engagement of distal driving arm to the button placed towards mesiobuccal cusp of vertically impacted 2nd molar, c) action of spring causing a simultaneous distal driving force and vertical extrusive force in 2nd molar, d) second molar brought to occlusion.*

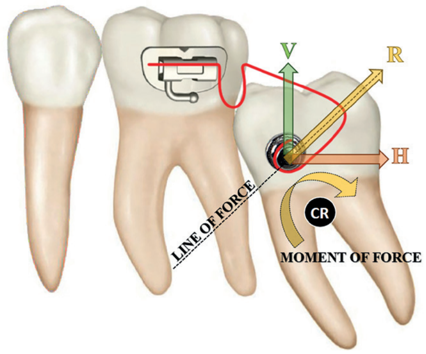


*Figure 3: Force system for uprighting vertically impacted second molar. Direction of line of force is favourable for simultaneous uprighting with distal driving force. The moment created by the activated distal arm helps in unlocking of second molar from the distal cervical bulge of first molar. (V- Vertical force; H- Horizontal force; R- Resultant force; CR- Center of resistance).*

buccal tube level. The distal driving arm is engaged to the button which is positioned on the clinically visible area that has been surgically exposed, preferably towards the mesiobuccal cusp of the impacted 2nd molar *(Fig. 2)*. The tubing inserted from the U loop to the distal driving arm prevents wire impingement on soft tissue and the double back in the distal driving arm which engages to the lingual button prevents the rolling of wire in the molar tube and aids in patient comfort. The use of a round wire over a rectangular wire eases fabrication and delivery of light force over a prolonged period of time. Moreover there is no torque expressed from the use of a rectangular wire since it has been engaged to a lingual button in a double back fashion. The activation force from the hook of the distal driving arm measured by Dontrix Gauge amounts to 60 gms.

Common clinical scenario for vertically impacted mandibular second molar is due to the obstruction caused by erupting third molar *(Fig. 4)*. Minor surgical procedure was performed for removal of the impacted 38 and uncovering of the buccal aspect of the impacted 37. Bonding of lingual button on exposed surface on the second molar with Transbond XT adhesive (3M UNITEK) facilitated the attachment for the distal driving arm of the disimpaction spring *(Fig. 5)*. The initial change in inclination was noticed 4 weeks after the application of the device *(Fig. 6)*. Two months after the commencement of treatment, a satisfactory lower second molar inclination was achieved. A corrected position of the impacted molar was achieved at the sixth month *(Fig. 7 and Fig. 8)*.

## Notable advantages

- The technique provides a simultaneous distal driving force and vertical extrusive force *(Fig. 9)*.
- Distal driving force can be increased by increasing the length of horizontal arm *(Fig.10a)* and reducing the length of distal driving arm during fabrication *(Fig.10b)* or intraoral activation by opening the U loop *(Fig. 10c)*.
- Vertical eruptive force can be increased by compressing the

 

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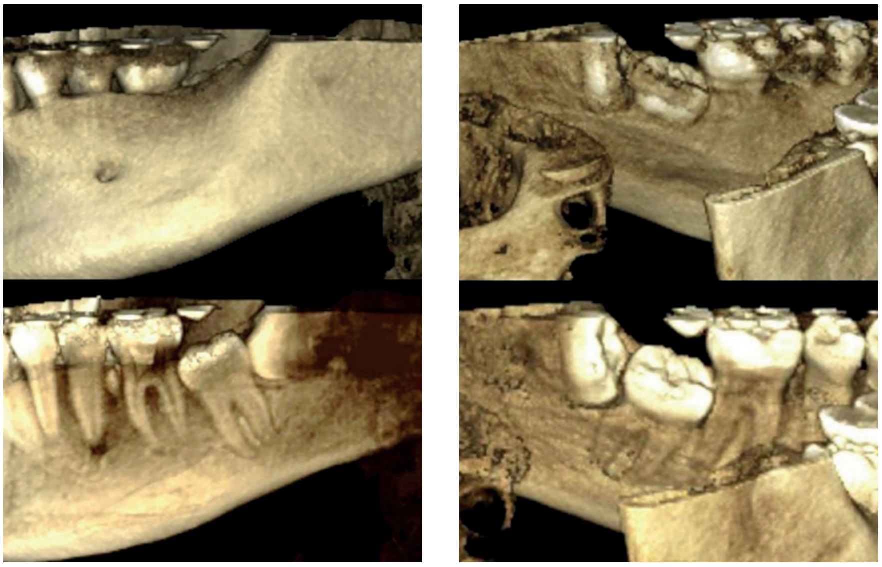

*Figure 4: CBCT revealed a vivid representation of level of impaction in all three planes of space.*

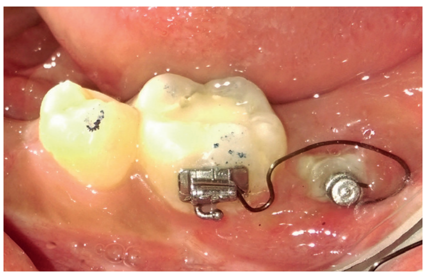

*Figure 5: Initial application of disimpaction spring.*

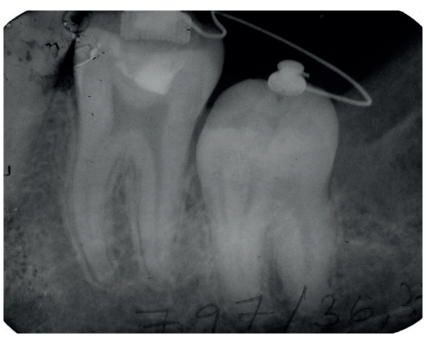

*Figure 6: 4 weeks after the application of disimpaction spring.*

loop between the horizontal arm and distal driving arm *(Fig.11)*.

- Does not accumulate food debris and does not require adequate vestibular height.
- Mechanical advantage of the spring is that the force exerted on the impacted tooth is proportional to its depth of impaction.

### Limitations

- It requires a surgical exposure site large enough to place a lingual button.
- The use of this spring is limited to a mesioangular, vertical and distoangular impacted mandibular molar.

The position of the lingual button is decided based on the degree of inclination of the tooth. The placement of the lingual button for a mesiangular and a vertically impacted tooth is at the mesiobuccal cusp and the buccal groove respectively *(Fig. 12)*. Distoangular impaction of mandibular second molars is generally rare and the placement of the lingual button is at the distobuccal cusp.

## CONCLUSION

Second molar impaction is a very challenging clinical scenario that requires proper clinical, radiological, and biomechanical evaluation and a good appliance selection for successful treatment results.

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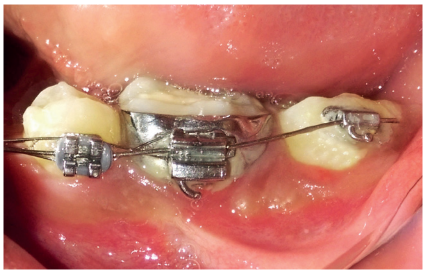

Figure 7: Post disimpaction clinical picture showing 37 in the level of occlusal plane.

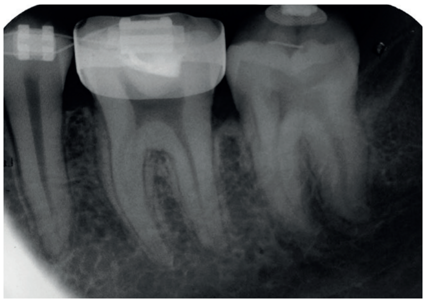

Figure 8: Post disimpaction IOPA showing upright 37 at the level of occlusal plane. Mandibular occlusal X-ray showing 37 in the arch.

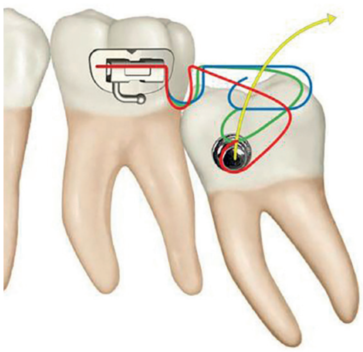

Figure 9: Illustration of spring action showing simultaneous distal driving force and vertical extrusive force.

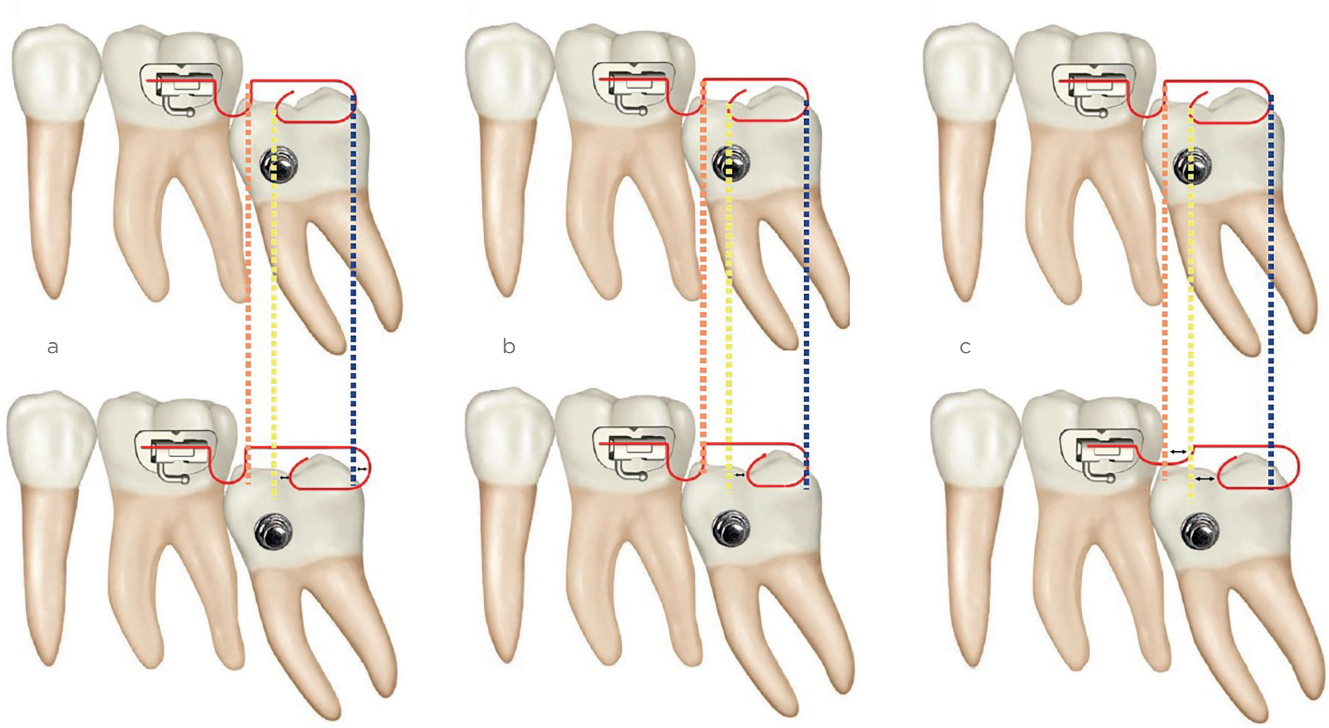


Figure 10: Distal driving force can be increased by: a) increasing the length of horizontal arm, b) reducing the length of distal driving arm during fabrication or c) intraoral activation by opening the U loop.



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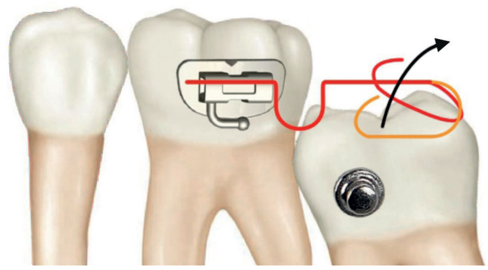

*Figure 11: Vertical eruptive force can be increased by compressing the loop between the horizontal arm and distal driving arm.*

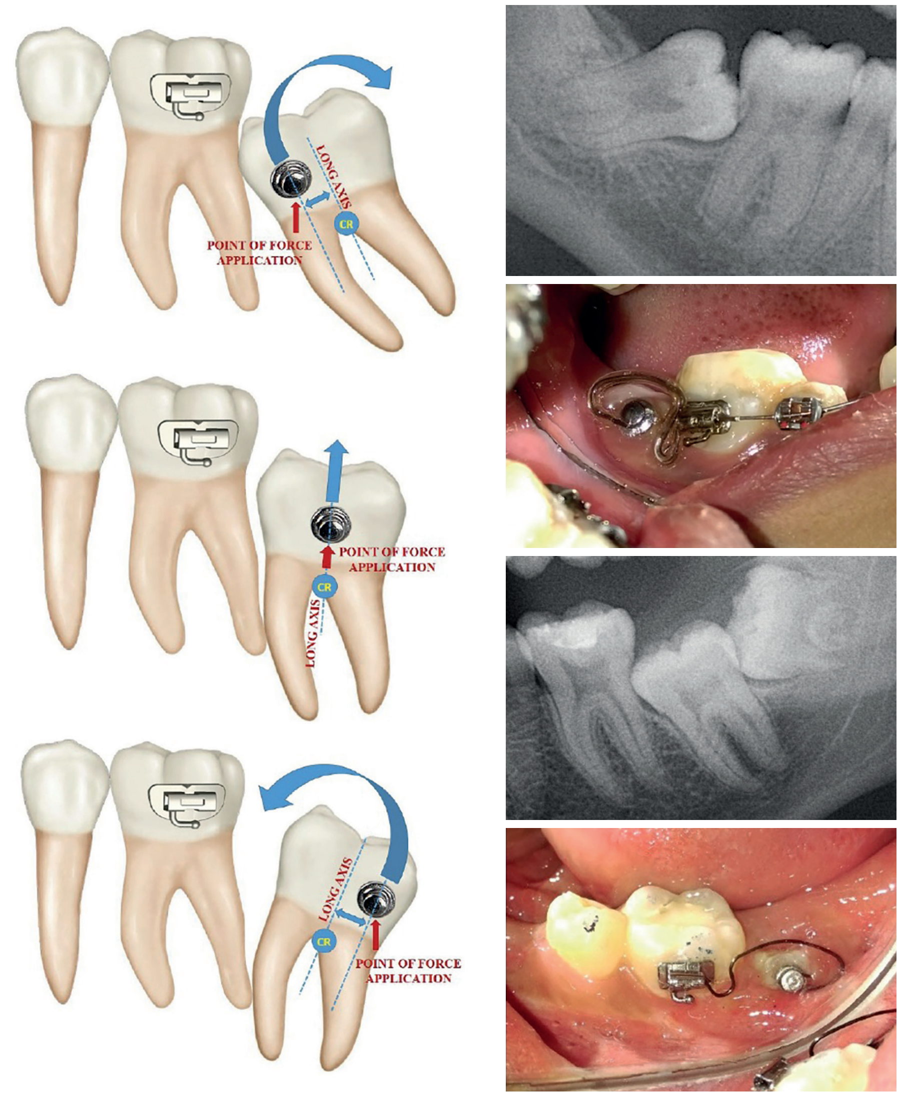


*Figure 12: Positioning of lingual button in a mesioangular, vertical and distoangular impacted second molar.*

## REFERENCE LIST


1. Sawickaa M, Racka-Pilszaka B, Rosnowska-Mazurkiewiczb A. Uprighting Partially Impacted Permanent Second Molars. *Angle Orthod* 2007;**77**:148-154.
2. Grover PS, Lorton L. The incidence of unerupted permanent teeth and related clinical cases. *Oral Surg Oral Med Oral Pathol* 1985;**59**:420-425.
3. Wellfelt B, Varpio M. Disturbed eruption of the permanent lower second molar: Treatment and results, *ASDCJ Dent Child* 1988;**55**:183-189.
4. Pogrel MA. The surgical uprighting of mandibular second molars, *AJODO* 1995;**108**:180-3.
5. Giancotti A, Greco G. An uprighting auxiliary for deeply impacted mandibular molars. *JCO* 2013;**47**:255-259.


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clinical TIPS

# A Simple Method for Rotating Teeth During Finishing

*Ayman El Nigoumi*
Department of Orthodontics and Dentofacial Orthopaedics, Cairo University, Cairo, Egypt

*Sakha Ahil*
Department of Orthodontics and Dentofacial Orthopaedics, Cairo University, Cairo, Egypt

Correspondence:
e-mail: aymanelnigoumi@gmail.com

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## Abstract

The aim of this clinical aid is to help correct the minor rotations encountered prior to debonding utilizing a Kobayashi ligature wire.

**Keywords**
Finishing, rotation, Kobayashi, lateral incisor

During the last stage of orthodontic treatment, minor corrections are required to achieve perfect finishing. Teeth, especially lateral incisors, usually require additional first-order correction during this stage *(Fig. 1)*, given that 80% of alignment errors during finishing occur in lateral incisors and second molars[1]. These errors are routinely corrected with a first-order bend, bracket repositioning or a rotational wedge. Here a simple method utilizing a Kobayashi ligature is proposed for correcting minor rotations before debonding.

*Figure 1: A maxillary left lateral incisor with a distal-out relation to the maxillary canine (mesial-in).*



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## PROCEDURE

1. A 0.014” Kobayashi ligature is ligated around the base of the bracket on the tooth that requires correction. The ligature is bent 90 degrees and rests on the side that requires a distal-in correction *(Fig. 2)*.

2. The height of the ascending arm with the loop determines the amount of distal-in correction applied *(Fig. 2)*.

3. The loop should be aligned vertically with the bracket’s slot line.

4. The single bracket wings are ligated away from the loop (the mesial wings are ligated in this example).

*Figure 2.*

## RESULTS

Follow up at 2 weeks shows correction of the lateral incisor’s relation to the canine *(Fig. 3)*. Adjustments are made by modifying the ascending arm of the Kobayashi ligature. Wire deflection can be clearly seen, but overcorrection was intended in this case.

*Figure 3.*

Follow-up at 4 weeks shows a slightly overcorrected (required in this case) maxillary lateral incisor *(Fig. 4)*.

*Figure 4.*


### REFERENCE LIST

1. American Board of Orthodontics. Objective grading system for dental casts and panoramic radiographs. *Am J Orthod* 1998;**114**:589-599.


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# Cohort study

*Bruno Oliva*
Catholic University of Sacred Heart, Rome, Italy
Private Orthodontic Practice, Brindisi, Italy

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Cohort studies are observational studies[1,2] that analyze the association between exposure to risk factors and disease or condition (outcome).
This definition is similar to that of case-control studies[3]. What is the difference? The difference is the direction of the study.
In cohort studies the investigators select subjects from a given population that are exposed to a specific risk factor and subjects that are not exposed to a specific risk factor. The subjects are followed over time and data about the outcome of interest are collected.
The direction of the cohort study is always prospective[4]. The investigators select subjects who, at the onset of study, are free of the outcome (disease) of interest but vary in their exposure to risk factor, and then follow them over time.
Another exposure can be orthodontic treatment, and in this case the difference between cohort studies and clinical trials is minimal. In cohort studies, the investigator does not intervene; in clinical trials, the investigator allocates the patients to treatment groups.
For example, investigators select subjects exposed and unexposed to orthodontic treatment. Then, they follow the subjects over time to assess whether subjects who had orthodontic treatment develop the outcome or multiple outcomes – e.g. periodontal disease, temporomandibular joint disorders, root resorptions.
The direction of a cohort study is prospective, but cohort study can be retrospective (or historical cohort study) if the data are collected from pre-existing sources in the past – e.g. patient records[5].
This study design assesses the development of outcome/disease over a specific period of time, then it measures the rate of new cases or the incidence in exposed and unexposed subjects.
Cohort studies are used for rare exposure and common disease.

**Example:** we are interested in evaluating the association between mouth breathing (exposure) and maxillary contraction (outcome). In a representative sample of the population (children at an early stage of growth) we select subjects with mouth breathing (exposed) and those without mouth breathing (unexposed). Subsequently, we follow the subjects for a set period of time and we collect information from the exposed and the unexposed on the presence of maxillary contraction. If we observe a greater incidence of maxillary contraction in the exposed group, then an association between mouth breathing and maxillary contraction might be supposed.

| Population of interest | |
|---|---|
| Exposed (mouth breathers) | Maxillary contraction |
| | Correct transverse diameter |
| Unexposed (nose breathers) | Maxillary contraction |
| | Correct transverse diameter |
| time → | |

*Table 1: A cohort study assessing the association between mouth breathing and maxillary contraction.*

## REFERENCE LIST

1. Oliva B. Introduction to Clinical Studies, *EJCO* 2014;**2**:63.
2. Grimes DA, Schulz KF. An overview of clinical research: the lay of the land. *Lancet* 2002;**359**:57-61.
3. Oliva B. Case-control study. *EJCO* 2016;**4**:31.
4. Levin KA. Study design IV. Cohort studies. *Evidence-Based Dentistry* 2003;**7**:51-52.
5. Pandis N. Cohort studies: Part 1. *Am J Orthod Dentofacial Orthop* 2014; **146**:534-5.

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