EUROPEAN JOURNAL OF CLINICAL ORTHODONTICS
International Journal supported by the Italian Society of Orthodontics (SIDO)
Volume 4, Issue 1

Contents

Cover image: Figure 6, Mansour E. et al. Molar Uprighting using a Simplified Technique (MUST). Page 5

Print ISSN 2283-7272
Online Edition www-ejco-journal.com ISSN 2283-9208

Registered at *Registro Stampa at Tribunale Civile e Penale di Milano* n.69 on 18/03/2013.
N. Repertorio ROC: 972244

Silvia Allegrini
2016 SIDO President

SIDO International Spring Meeting

Dearest Members,

2016 is the year of simplification and participation at SIDO.
With your help and a Board focused on governing the Society as one in a long-term perspective, the perception, use and implementation of member services can become agile and more efficient.
In the spirit of the words of our first SIDO woman President: "Acknowledging the past, living the present, envisioning the future," we are implementing the rapid pace of modernization of our website www.sido.it in structure and content, increasing a spending review to allow investments in the image of Orthodontics, of SIDO members and for SIDO member activities, stimulating our curiosity through cultural events with a highly interactive orientation.
I am delighted to inform you of the decision to keep our membership fees unchanged and to offer you further benefits. In particular we have launched an all-inclusive, long-term package of 50 CME credits directly obtainable at the close of the International Congress in autumn.
The scientific program introduces courses held in SIDO, tutoring in becoming Ordinary and/or Active SIDO Member with the use of new technologies, together with a Spring Meeting and a Congress that continue the opening of SIDO on the international scene, with a scientific structure particularly articulated and with an absolute international breadth.
You will be able to appreciate the strong interactivity and use of new technologies already at the Spring Meeting. The Spring Meeting is a multidisciplinary event with the scientific contribution of AIOP. The Congress sees the Tweed Foundation among its most valued patrons in the pre-congress courses, 4 parallel congress sessions on the Friday with a SIDO-ORTEC session, and 4 sessions on the Saturday with a session in cooperation with AIOP. Please look at the program online at www.sido.it. Two dedicated newsletters will follow shortly. The advantage for the SIDO member is to have two major international events directly at home, here at SIDO.

Live in and be proud of SIDO in 2016.
With great affection

EDITORIAL

100 years of AJO-DO

Raffaele Schiavoni
Editor-in-Chief

How to cite this article:
Schiavoni R. 100 years AJO-DO. *EJCO* 2016;**4**:1

2015 was the centenary year of AJO-DO. To celebrate this, the "Centennial Supplement. Honoring our Past. Building Our Future" was published to accompany the May 2015 issue and it is a great start for the readers!

It is difficult to convey just how exciting it is for me to read this issue. I only hope I can encourage all of you who have not read it yet to read it as soon as possible.

"100 Years of Publishing, 100 People of Influence": 16 judges have recognized some of the people who have most influenced the developing specialty of orthodontics over the last 100 years. So many of these have been a support for our own professional growth, directly and indirectly, with many coming to feel at home in our country and befriending us personally and as colleagues. Examples that spring immediately to mind are Anthony A. Gianelly, Robert M. Ricketts, Ronald H. Roth, Vincent G. Kokich and Lennart Wieslander. I still remember this last who, when passing through Rome, accepted my invitation to my home and examine with me patient tracings and discuss the results obtained.

Over time the Journal has changed its name, reflecting the evolution of our profession, with its present name "American Journal of Orthodontics and Dentofacial Orthopaedics (1986)" amounting to an acknowledgement of the scientific value of functional therapies developed in Europe.

Our eyes scan the images of Charles Tweed, a master to all of us. Who among us has not entered in hallowed awe that temple of orthodontics, the Tweed Foundation?

The article "What Do the Teeth Say?" is another foundation stone for our specialisation, where Raymond Begg, starting out as a "humble sheep farmer" learnt so much from his extraordinary studies on native Australians.

From the past to the future with the article by Lucia Cevidanes on 3-D and its almost infinite potential.

The relationship between orthodontics and surgery is examined in the article: "Who Does What, When and Why" and all the challenges that these questions give rise to.

The paper by Jeffrey P. Okeson is of fundamental importance: "Evolution of Occlusion and Temporomandibular Disorder in Orthodontics: Past, Present and Future". His conclusions succeed in my view in clearing some of the haze that has for years bedeviled some certain aspects of orthodontic treatment: "Treatment goals directed towards establishing orthopedic stability in the masticatory structures should be a routine part of all orthodontic therapy. Achieving these goals will most likely reduce the patient's risk factors for developing TMD". This statement is all the more significant in the context of where it is published.

Our friend Ravindra Nanda makes a remarkable contribution to the Supplement with "Reflections on Mentorship" where "Now more than ever, we need highly accomplished and effective mentors who can motivate and mold young orthodontists into truth-seeking educators, innovative researchers, and excellent clinicians... we must set the bar high to bring our specialty to a new level".

The article by Peter M. Greco "A Proud Tradition of Ethics in a Proud Specialty" encourages to think hard about issues that I believe are more relevant today than ever.

In his conclusions, the Author quotes a statement by the 1977 AAO President in, Dr. Eugene Blair "The specialty's image is a composite of the images projected by individual orthodontists". Dr Blair, says Greco, "Challenged each reader to initiate a self-assessment of his or her ethical awareness via the exploration of several timeless questions" ...amongst which the following seems to be particularly relevant today: "Are we, as orthodontists, perceived to improve society and teach others to do so - or are we seen merely as sportsmen and world travelers as afforded by our affluence?".

The Journal's first editor Martin Dewey challenged our specialization to remain thoroughly professional, a challenge that remains pertinent almost a century after his first editorial was published in the International Journal of Orthodontia.

This is in short an extraordinary issue that is filled with both professional and human talking points. The EJCO is in its infancy and it is essential that it should grow in line with these guidelines and bear fruit for the whole orthodontic community. The words: ethics, professionalism and mentorship should be the leitmotiv for all of us who wish to contribute to this end.

It is our mission for this to be a journal "by the clinician for the clinician" from the very outset. A question remains as to what extent is professional practice separate from research work? What we need is an osmotic exchange between the real needs of the clinician and the 'research based' guidelines for the greatest benefits for our patients. Where the happy patient outcome is our true mission!

To conclude I feel I really must quote Thomas J. Cangialosi: "...I do not believe that the "golden age of orthodontics" is over by any means. In many ways, I think it is just beginning. In short, there is so much left to do. What an exciting time this is to be an orthodontist!"

doi:10.12889/2016_A00247

Molar Uprighting using a Simplified Technique (MUST)

Eslam Mansour
MOrth Program, Future University in Egypt, New Cairo, Egypt

Ayman Kodaih
MOrth Program, Future University in Egypt, New Cairo Egypt

Amr Ragab El-Beialy
Department of Orthodontics and Dentofacial Orthopedics, Cairo University, Egypt.
Instructor MOrth Programs, Cairo University and Future University, Cairo, Egypt

Yehya Ahmed Mostafa
Department of Orthodontics and Dentofacial Orthopedics, Cairo University, Egypt.
Program Director, MOrth Programs, Cairo University and Future University, Cairo, Egypt

Correspondence:
e-mail: amr.elbeialy@dentistry.cu.edu.eg

Article history:
Received: 04/09/2015
Accepted: 21/09/2015
Published online: 17/12/2015

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

How to cite this article:
Mansour E, Kodaih A, El-Beialy AR, Mostafa YA. Molar uprighting using a simplified technique (MUST). *EJCO* 2016;**4**:2-6

Acknowledgements:
The authors would like to express their sincere gratitude to Dr. Ahmed Mostafa Heider, Associate Professor, Department of Orthodontics and Dentofacial Orthopedics, Faculty of Oral and Dental Medicine, Cairo University, for his valuable assistance in editing this article.

Abstract

The effectiveness of the mechanics presented in the orthodontic literature for uprighting a mesially tipped last molar is swinging between either simple but incompetent techniques of leveling arch wires and open coil springs, to the more sophisticated handy craft but successful techniques of uprighting springs and peculiar loop designs. Unfortunately, the issue of molar uprighting is further complicated by the absence of a more distal molar. The technique described here within this article adds one more tool for molar uprighting. It comprises the simple use of double tubes bonded to the last molars and flexible archwires to upright tipped last molars with minimal maneuver, no sophisticated loop designs and a non-technique sensitive procedure.

Keywords
Orthodontics, biomechanics, molar uprighting, double tubes, superflexible archwires

doi:10.12889/2015_C00242

INTRODUCTION

Uprighting the last molar is of considerable interest to the orthodontic community; indeed, the literature describes many different techniques for uprighting the most distal molars. These methods range from the simple but inefficient techniques of levelling arch wires[1,2,3] and open coil springs, to the more efficient, but labour-intensive and time-consuming techniques of uprighting springs[1,4-10] piggybacking[12,13] and unusual loop designs[14-17]. Recently, although uprighting on temporary anchorage devices (TADs) was shown to be efficient and satisfactory[18-21], it incurs additional cost, requires a considerable inventory, is technique sensitive, and TAD insertion is sometimes complicated by the thick and flabby soft tissues in the retromolar region.

Moreover, the orthodontic mechanics for uprighting a tipped last molar are complicated by the absence of a more distal anchor tooth. The lack of control over the arch wire posterior to the tooth to be uprighted is a problem. Furthermore, the reaction forces resulting from the various uprighting techniques, such as extrusion of the uprighted molar, intrusion of the anterior segment and protraction of the dental segment mesial to the tipped molar, further complicate the mechanics and force system.

OBJECTIVES

This article describes a simple, yet efficient method for uprighting and aligning severely tipped last molars. The technique is expected to overcome the problem of the absence of a more distal anchor tooth or the presence of a third molar in close proximity.

MATERIALS AND METHODS

The technique consists of bonding a double tube to the tipped last molar, a single tube to the first molar, and the use of a super-elastic levelling arch wire. The arch wire emerging at the distal end of the second molar tube is looped back again through the distal opening of the auxiliary tube of the second molar, and then back into the premolars to be ligated *(Fig. 1)*.

The use of a super-elastic levelling arch wire is fundamental to maintain the arch wire's flexibility and elasticity despite the sharp distal bend. The size of the initial arch wire will vary according to the degree of molar tilting and the angle at which the molar tube was bonded. Usually, 0.012 or 0.014-inch super-elastic arch wires are suitable for severely tipped molars. The wire should be changed (activated) frequently (every 1-3 weeks) because the sharp bend might cause permanent wire deformation.

For more control over the free wire and hence the tipped molar, the first molar could be bonded or banded with a double tube. The flexible levelling arch wire is inserted into the main tubes of the first and second molars, and then looped back through the distal opening of the second and first molars' auxiliary tubes. This modification reduces the free wire span between the second molar and the first premolar, which in turn increases the deflection of the wire, and hence produces a better couple effect on the tipped molar *(Fig. 2)*.

The direction of wire engagement into the double tubes of the first and then the second molars (the main tube of the first molar and then into the main tube of the second molar versus the main tube of the first molar and then the auxiliary tube of the second molar) alters the deflection angle of the wire and accordingly changes the magnitude of the couple delivered. In some cases, a distal molar starts to erupt in a mesial tipping direction at the end of treatment, while in others, the uprighting in the middle of treatment of a mandibular last molar is planned. In such cases, the orthodontist needs to sustain a rigid arch wire on the rest of the arch for other mechanics (space closure, inter-arch elastics, etc.).

The technique proposed in this article is efficient provided that the first molar is bonded or banded with a double tube, with the main rigid arch wire occupying the main tube. An overlay flexible arch wire starts at the premolars, is inserted into the auxiliary tube of the first molar and then into the auxiliary tube of the second molar, and then looped back into the main tube of the second molar, bypassing the first molar, and is finally ligated over the premolar brackets *(Fig. 3)*.

An additional strength of this technique is the possibility of distalizing the tipped molar with space

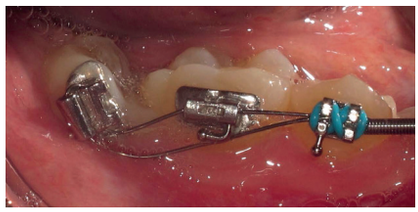


Figure 1: The basic technique: wire spanning the single tube on the first molar and the double tube is bonded to the tipped molar.

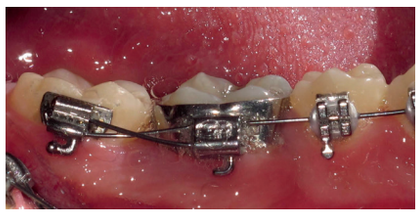


Figure 2: Flexible arch wire inserted into the double tubes of both molars.

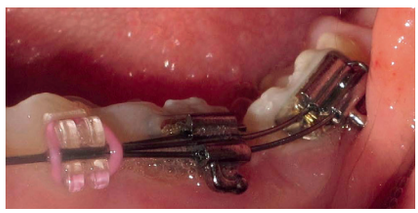


Figure 3: The main arch wire occupies the main tube of the first molar, while a flexible arch wire spans the auxiliary tube of the first molar and the double tubes of the tipped molar.

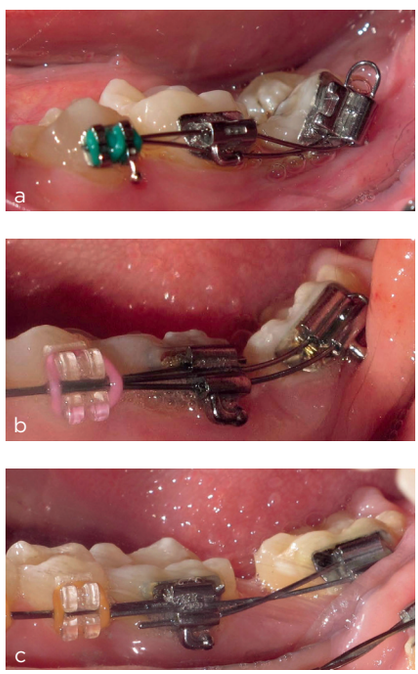


Figure 4: The wire is looped at a distance from the distal end of the tipped tooth to allow for uprighting and distalization: (a) installation, (b) uprighting in progress, (c) uprighting with distallization.

doi:10.12889/2015_C00242

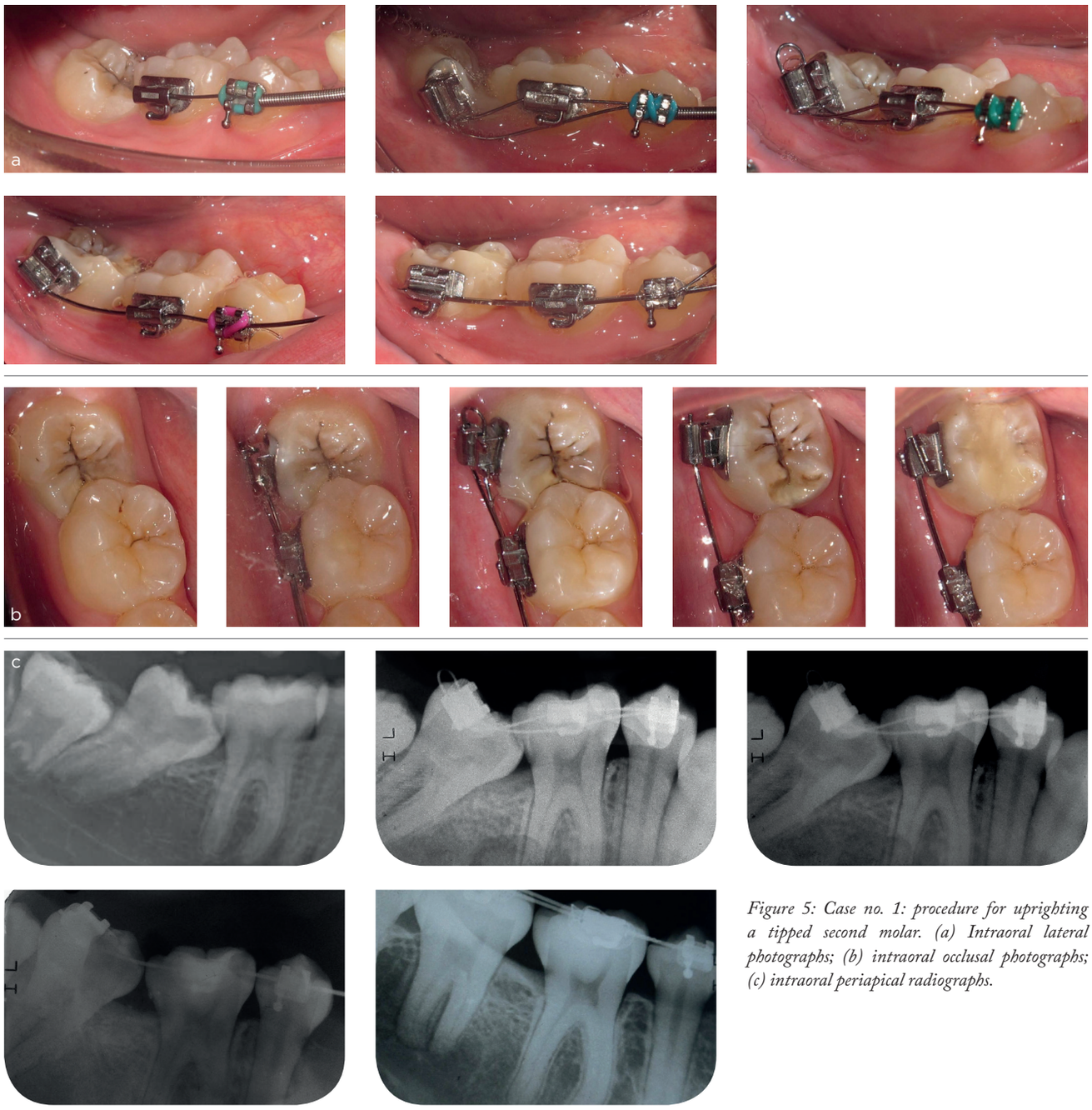


Figure 5: Case no. 1: procedure for uprighting a tipped second molar. (a) Intraoral lateral photographs; (b) intraoral occlusal photographs; (c) intraoral periapical radiographs.

opening as required. In such cases, the wire is looped at a distance from the distal end of the tube of the tipped tooth. This allows for uprighting at the expense of distal crown movement, and results in space opening (distalization), with roots upright and parallel to the mesial tooth *(Fig. 4a-c)*.

DISCUSSION

The technique described in this article allows efficient uprighting of tipped lower molars with no observable extrusion, and with the possibility of distalization as needed. The use of levelling arch wires allows simultaneous levelling and uprighting of mesially tipped molars.

The versatility and ease of application of this technique in a wide range of clinical situations with mesially tipped molars adds to its merits. Using levelling arch wires to upright tipped distal molars simultaneously with anterior and posterior levelling and alignment might save a considerable amount of treatment time. In addition, an extra procedure for uprighting the molars is not required. The average time required for uprighting tipped molars using this technique varies considerably depending on the degree of molar tilting. The least time required for uprighting the molars shown in the figures was around 2 months.

doi:10.12889/2015_C00242

Springs, loops and TADs are not needed in this technique, thereby reducing both patient discomfort and costs. Moreover, it avoids dependence on the presence of a more distal anchor tooth to achieve efficient molar uprighting. It is not technique sensitive but does have the drawback of the tiresome looping back of the wire in the tipped molar's tubes.

The three cases in *Figs. 5-7* show the clinical application of this technique.

CONCLUSION

The technique described here provides another tool for molar uprighting. It comprises the simple use of double tubes bonded to the last molars and flexible arch wires to upright tipped last molars without extrusion. It is not sensitive to technique, requires minimal manoeuvres, and does not need sophisticated loop designs.

LEARNING POINTS

- We use simple mechanics to upright a mesially tipped last molar.
- The only devices needed are bondable double tubes and flexible arch wires.
- No side effects on the adjacent teeth were seen.
- The technique can be manipulated to achieve distalization of the tipped molar.

Figure 6: Case no. 2: procedure for uprighting a tipped second molar. (a) Intraoral lateral photographs; (b) intraoral occlusal photographs; (c) intraoral periapical radiographs.

doi:10.12889/2015_C00242

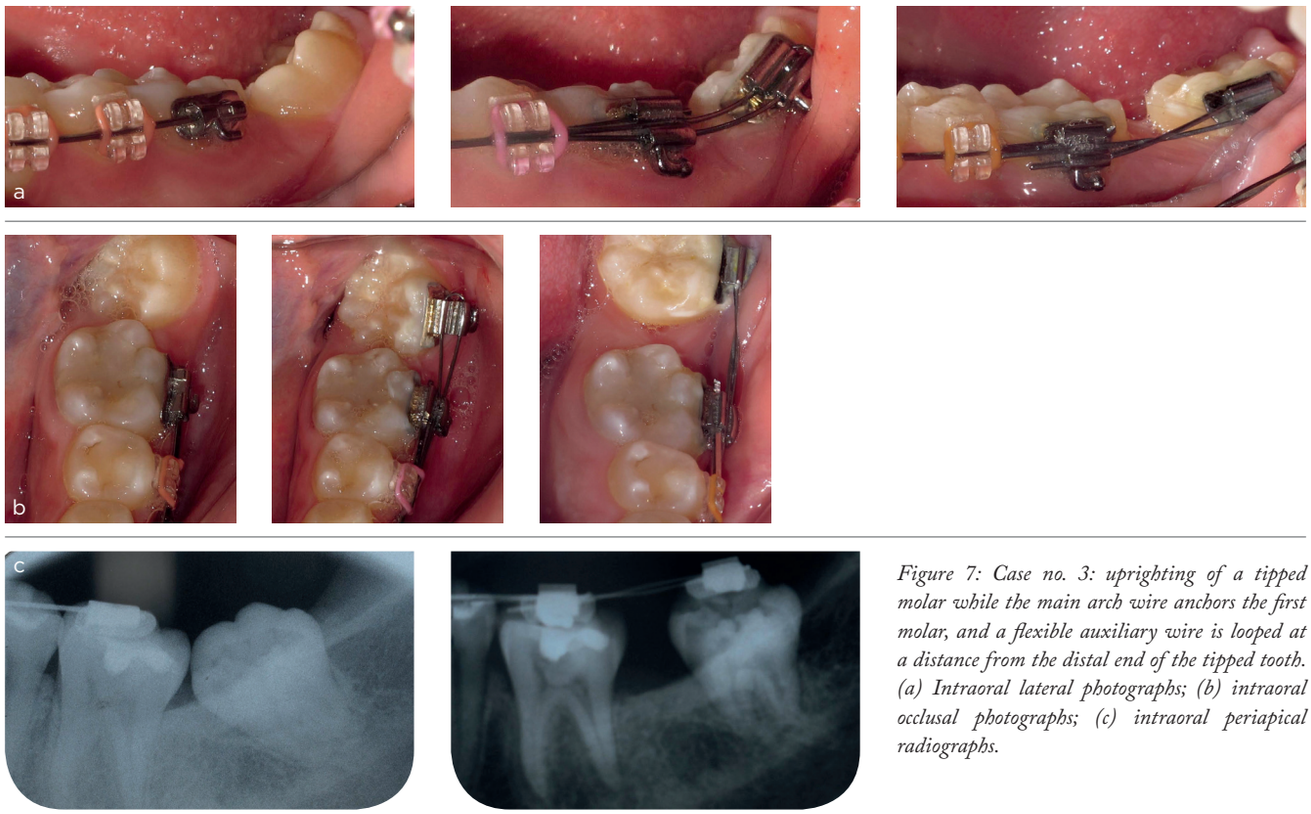


Figure 7: Case no. 3: uprighting of a tipped molar while the main arch wire anchors the first molar, and a flexible auxiliary wire is looped at a distance from the distal end of the tipped tooth. (a) Intraoral lateral photographs; (b) intraoral occlusal photographs; (c) intraoral periapical radiographs.

REFERENCE LIST

1. Proffit WR, Fields HW, Sarver DM. *Contemporary Orthodontics*. St. Louis, MO: Mosby Elsevier, 2007.
2. Kim M, Kim M, Chun Y. Molar uprighting by a nickel-titanium spring based on a setup model. *Am J Orthod Dentofac Orthop* 2014;**146**:119–123.
3. Lai Y, Chu MP, Vijayaraghavan TV. Uprighting molars with twisted superelastic nickel titanium wires. *J Clin Orthod* 2001;**35**:100.
4. Sawicka M, Racka-Pilszak B, Rosnowska-Mazurkiewicz A. Uprighting partially impacted permanent second molars. *Angle Orthod* 2007;**77**:1.
5. Zachrisson BU, Bantleon H. Optimal mechanics for mandibular molar uprighting. *World J Orthod* 2005;**6**:80–87.
6. Fu PS, Lai CH, Wu YM, et al. Uprighting impacted mandibular permanent second molars with the tip-back cantilever technique–case report. *J Dent Sci* 2008;**3**:174–180.
7. Doshi J, Trivedi K, Traulatha S. Management of partially impacted mandibular second molars with an Australian uprighting spring. *Orthod Cyber J* 2009;**November**:1–22.
8. Curtis A, Aebdesj T. Uprighting impacted lower second molars with a stopped Earl's pearls. PCSO Bullettin 2010:**69**:46–47.
9. Simon RL. Rationale and practical technique for uprighting mesially inclined molars. *J Prosthet Dent* 1984;**52**:256–259.
10. Majourau A, Norton LA. Uprighting impacted second molars with segmented springs. *Am J Orthod Dentofac Orthop* 1995;**107**:235–238.
11. Shapira Y, Kuftinec M. Uprighting mesially impacted mandibular permanent second molars. *Angle Orthod* 1998;**68**:173–178.
12 Kogod M, Kogod HS. Molar uprighting with the piggyback buccal sectional arch wire technique. *Am J Orthod Dentofac Orthop* 1991;**99**:276–280.
13. Gupta S, Sriganganagar R. A simple and rapid method of molar uprighting: case report. Orthocj.com. 2014. Accessed July 29.
14. Norton LA, Lopes I. Specific mechanics for abutment uprighting. *Aust Dent J* 1980;**25**:273–278.
15. Miao YQ, Zhong H. Uprighting appliance for impacted mandibular second and third molars. *J Clin Orthod* 2006;**40**:110–116.
16. De Oliveira AC, Pithon MM, Dos Santos RL. Miniscrew-supported coil spring for molar uprighting: description. *Dental Press J Orthod* 2013;**18**:45–49.
17. Raghav S, Vinod P, Shashikala KV. The Neoslider appliance for uprighting mesially impacted mandibular second molars. *J Clin Orthod* 2013;**47**:553–557.
18. Park HS, Kyung HM, Sung JH. A simple method of molar uprighting with micro-implant anchorage. *J Clin Orthod* 2002;**36**:592–596.
19. Nienkemper M. Preprosthetic molar uprighting using skeletal anchorage. *J Clin Orthod* 2013;**7**:433–437.
20. Lee KJ, Park YC, Hwang WS, Seong EH. Second molars with direct miniscrew anchorage. *J Clin Orthod* 2007;**10**:627–635.
21. Gracco A, Lombardo L. Mandibular second molars with a modified uprighter jet. *J Clin Orthod* 2007;**5**:281–284

doi:10.12889/2015_C00242

Sectional Cable Method in a High Anchorage Demand Case: A Case Report

Mohammed Almuzian
Glasgow Dental Hospital & School, Glasgow, Scotland, UK

Philip Benington
Glasgow Dental Hospital & School, Glasgow, Scotland, UK

Lubna Al Muzian
University of Manchester, Manchester, England, UK

Correspondence:
e-mail: dr_muzian@hotmail.com

Article history:
Received: 04/05/2015
Accepted: 25/05/2015
Published online: 03/07/2015

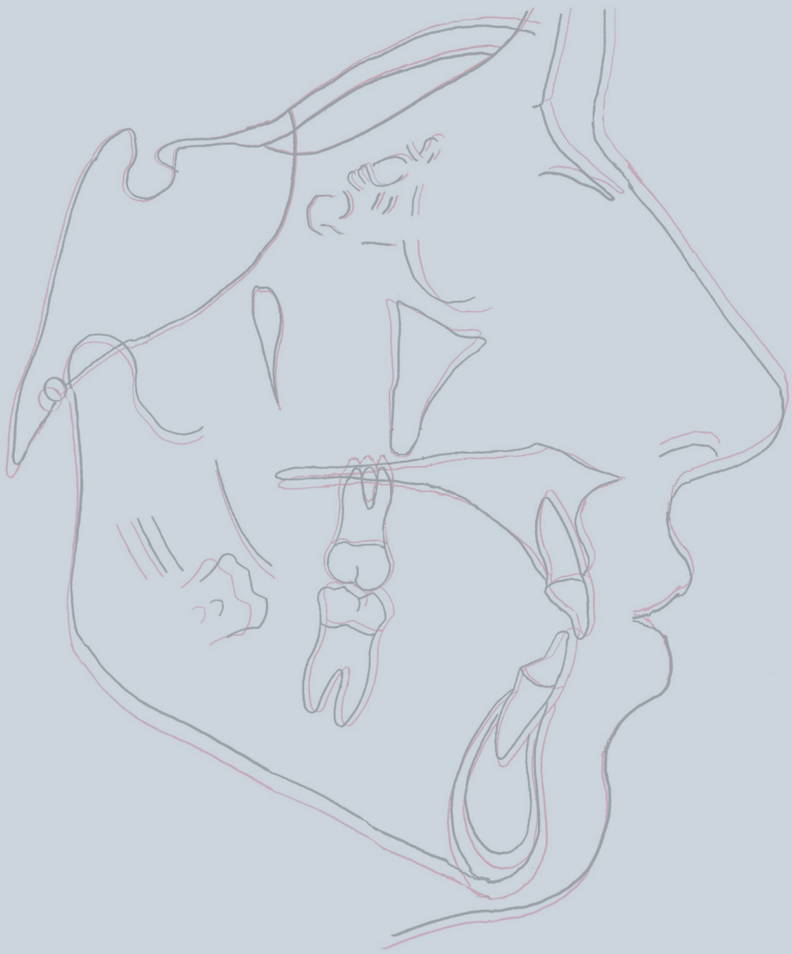
Conflict of interest:
The authors declare that they have no conflicts of interest related to this research.

How to cite this article:
Almuzian M, Benington P, Al Muzian L. Sectional cable method in a high anchorage demand case: a case report. *EJCO* 2016;**4**:7-15

Acknowledgements:
The author would like to thank the patient for his permission to use his photographs.

Abstract

The use of skeletal anchorage through miniscrews has broadened the range of orthodontic treatment options. This case report describes the use of a modified double cable technique for retraction of teeth in conjunction with palatal miniscrews/ transpalatal arch in a high anchorage demand case.



Keywords
Cable technique, transpalatal arch, palatal miniscrews

doi:10.12889/2015_C00236

INTRODUCTION

Orthodontic anchorage refers to the use of sites that provide resistance in order to control unwanted tooth movement in response to the reactive forces generated on activation of any orthodontic appliance[1]. Anchorage can be classified, depending on the percentage of movement of the anchorage unit into the extraction space, as minimum (>75%), moderate (50%) and maximum (<25%)[2]. Maximum anchorage can be delivered using extra-oral headgear appliances (EOAs) or miniscrews (temporary anchorage devices, TADs).

In general, orthodontic treatment is associated with iatrogenic effects such as white spot lesions (WSLs) and soft tissue irritation. WSLs are more common on the labial than lingual surfaces, and arise after the orthodontic appliance is fitted, which changes the microflora and increases food stagnation[3-5]. Factors predictive for the development of WSL include lengthy treatment times and a history of high caries risk suggesting poor oral hygiene and/or poor diet control[4,6]. Many reports describe mechanical soft tissue irritation and even lip entrapment onto orthodontic brackets during contact sport activities[7,8].

The present case was treated in two phases: the first involved the combined use of TADs and a transpalatal appliance (TPA) to maximise anchorage. This was in conjunction with asectional modified double cable (SMDC) approach to increase appliance acceptance and reduce the risk of WSLs and the chance of mechanical soft tissue injury/irritation in a competitive athletic patient. The second stage involved shortened use of a conventional fixed appliance approach to fine-tune the occlusion.

CASE PRESENTATION

A 15¾-year-old Caucasian male actively involved in contact sports presented with concern about the appearance of his front teeth. His medical history was otherwise unremarkable.

EXTRA-ORAL ASSESSMENT

Extra-orally, he presented with a mild Class II skeletal base, a high Frankfort mandibular plane angle and increased lower anterior facial height. There was acceptable facial symmetry. Soft tissue examination revealed potentially competent lips, and average nasolabial and labiomental angles *(Fig. 1)*.

INTRA-ORAL ASSESSMENT

Intra-oral examination revealed full permanent dentition except for the lower second premolars (L5s) and all third molars. The upper second premolars (U5s), and upper and lower right first permanent molars (UR6 and LR6) were heavily restored *(Fig. 2)*.

The mandibular and maxillary arch forms were oval-shaped with average incisor inclination and severe crowding. On occlusion, the incisor relationship was Class I with an overjet of 2 mm. There was a slightly reduced overbite of 1.5 mm which was complete to teeth. The upper and lower centrelines were

Figure 1: Pre-treatment extra-oral photographs.

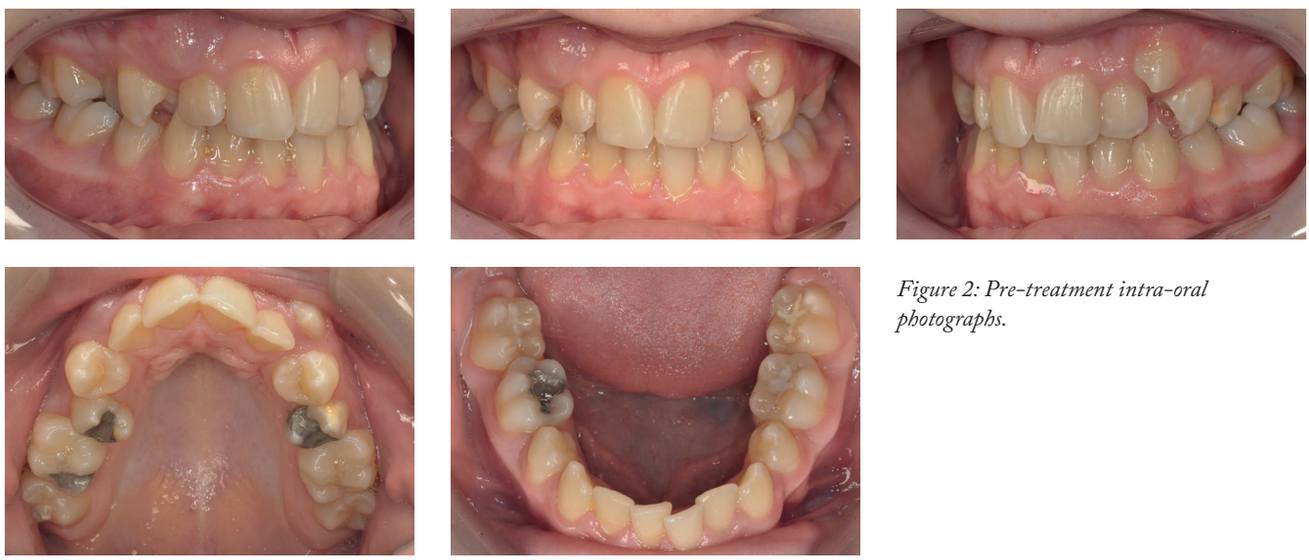


Figure 2: Pre-treatment intra-oral photographs.

doi:10.12889/2015_C00236

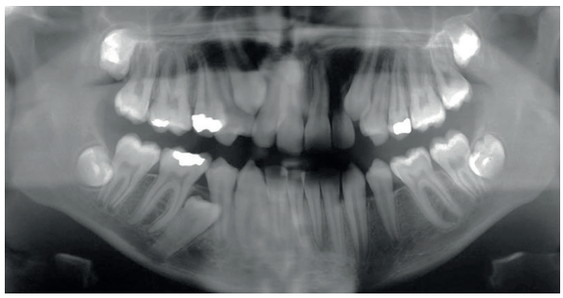


Figure 3: Pre-treatment OPT.

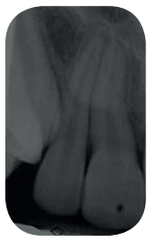


Figure 4: Pre-treatment periapical radiograph of the UR2.

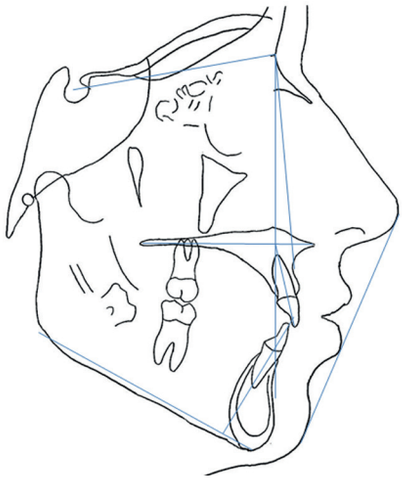


Figure 5: Pre-treatment lateral cephalogram and its tracing.

Figure 6: The transpalatal appliance (TPA)/ temporary anchorage devices (TADs) combination. The TPA included two parallel welded H-shaped attachments for the TADs to slot into, in order to provide secure engagement and ligation between the TADs and TPA.

Variable	Pre-treatment	Post-treatment	Normal 8, 9
SNA	81	82	82° ± 3°
SNB	77	78	79° ± 3°
ANB	*4*	*4* (EC=3.5)	3° ± 1°
SN to maxillary plane	8	9	8°± 3°
Wits appraisal	+2	+1	0 mm
Upper incisor to maxillary plane angle	112	114	108° ± 5°
Lower incisor to mandibular plane angle	94	92	92° ± 5°
Interincisal angle	128	130	133° ± 10°
Maxillary mandibular planes angle	*30*	*31*	27° ± 5°
Upper anterior face height	52	53	56 ± 4 mm[Q31]
Lower anterior face height	73	75	70.5 ± 4.5 mm
Face/height ratio	*58.4*	58.5	55%
Lower incisor to APo line	3	2	0–2 mm
Lower lip to Ricketts' E plane	−1	1	−2 mm
Naso-labial angle	93	92	95° ± 10

Italics denote values outside the normal range, EC: Eastman correction for AND angle

Table 1: Pre- and post-treatment cephalometric analysis.

coincident with each other and with the facial midline. The buccal segment relationship on the left side was a ¼ unit Class III molar and ¾ unit Class II canine relationship, while the buccal segment relationship on the right side was a Class I molar relationship. There was a normal transverse relationship of the buccal segments on closure without displacement.

RADIOGRAPHIC ASSESSMENT

The pre-treatment panoramic radiograph combined with patient dental history and clinical examination confirmed the following *(Fig. 3)*:

- Developmental absence of the lower left second premolar (LL5)
- Buccal impaction of the upper right canine (UR3)
- Vertical impaction of the lower right second premolar (LR5)
- Favourable position of the developing L8s.

Periapical radiographs of the upper right permanent lateral incisor (UR2) through vertical parallax re-confirmed the buccal impaction of the UR3 and demonstrated no evidence of pathology or abnormal root morphology *(Fig. 4)*. Cephalometric findings confirmed the clinical findings of a mild Class II skeletal base relationship, increased vertical proportions and average inclination of upper and lower incisors *(Fig. 5, Table 1)*.

DIAGNOSTIC SUMMARY

In summary, this case report describes a 15-year-old male patient, actively involved in contact sports, with no relevant medical history and with permanent dentition, who presented with a Class I incisor relationship on a mild Class II skeletal base relationship with increased vertical proportions, no obvious transverse asymmetry and potentially competent lips. The malocclusion was complicated by a buccally ectopic UL3, a buccally impacted UR3, vertical impaction of LR5, a developmentally missing LL5, reduced overbite, and severe upper and lower arch crowding. The U5s were heavily restored and hypoplastic. The possible aetiologies of this malocclusion are:

- Skeletal factor: Class II base
- Dentoalveolar factor: dentoalveolar discrepancy with crowding and

doi:10.12889/2015_C00236

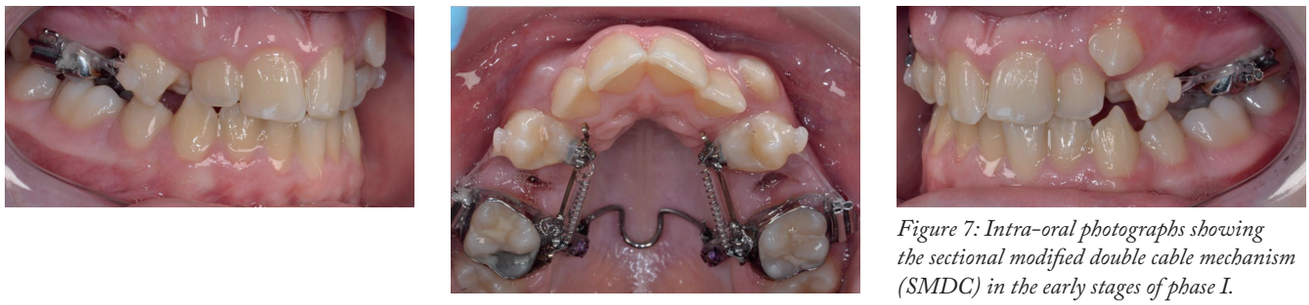


Figure 7: Intra-oral photographs showing the sectional modified double cable mechanism (SMDC) in the early stages of phase I.

Figure 8: Intra-oral photographs during the late stages of phase I.

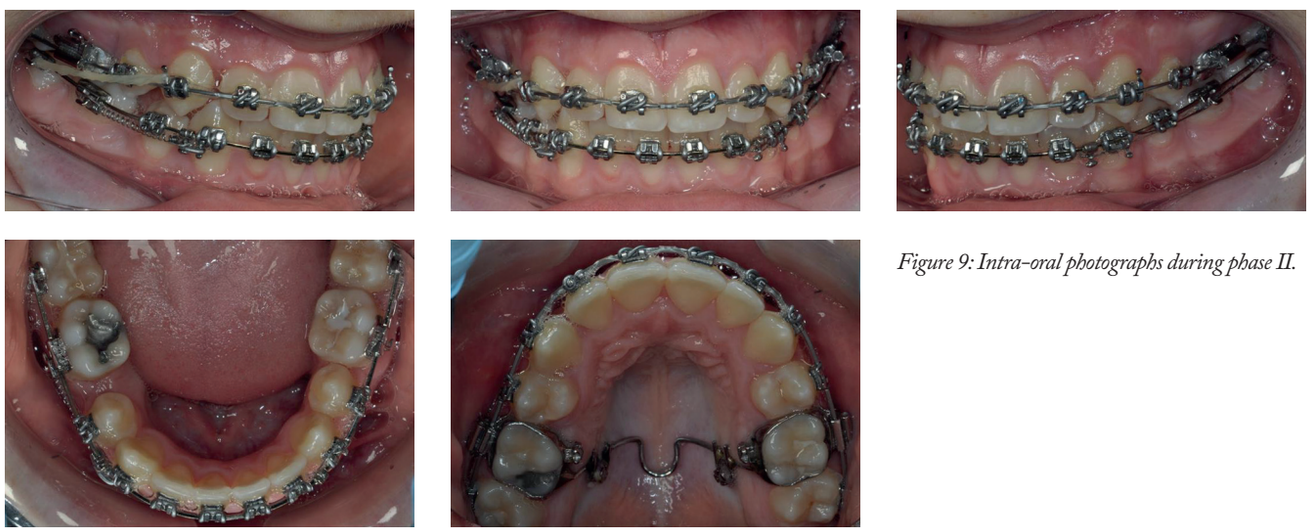


Figure 9: Intra-oral photographs during phase II.

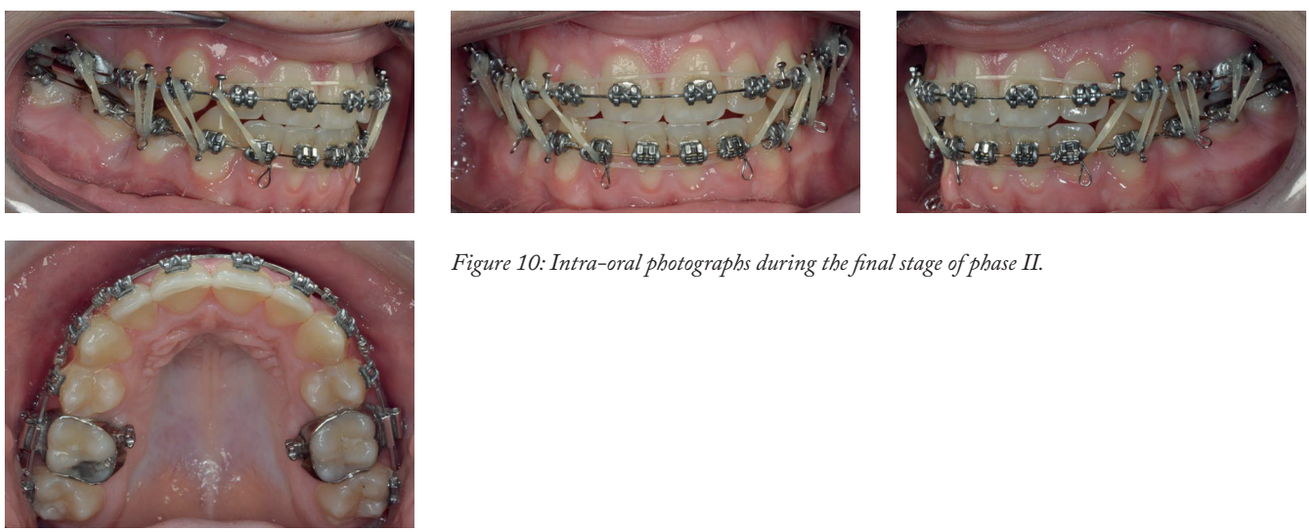


Figure 10: Intra-oral photographs during the final stage of phase II.

doi:10.12889/2015_C00236

Figure 11: Post-treatment extra-oral and intra-oral photographs after debonding.

Figure 12: Post-treatment intra-oral photographs with retainers in place.

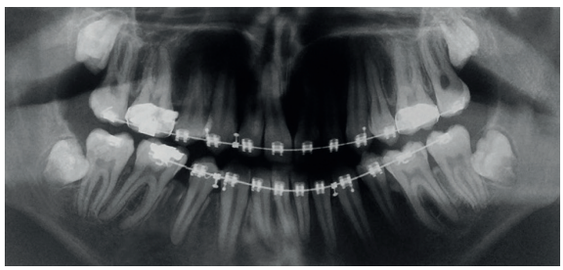


Figure 13: OPT towards the end of treatment.

missing LL5
- Other factors: possibility of some early loss of primary teeth
- Any combination of the above.

TREATMENT NEEDS

The patient expressed great concern regarding the appearance of his teeth with a high need for orthodontic treatment based on the Index of Orthodontic Treatment Need (IOTN) with a Dental Health Component of 5i and an Aesthetic Component of 6.

AIMS AND OBJECTIVES OF TREATMENT

The aims and objectives of treatment were to:

- Secure and maintain optimum oral hygiene and dental health throughout treatment
- Accept the underlying Class II skeletal pattern
- Relieve crowding
- Align and level arches
- Normalise the overbite and overjet
- Achieve a Class I molar and canine relationship
- Monitor eruption of the unerupted teeth
- Retain the final orthodontic result.

doi:10.12889/2015_C00236

TREATMENT PLAN AND ALTERNATIVES

Although extraction of the buccally excluded U3 in the severely crowded upper arch could rapidly achieve treatment objectives, this option was excluded because the U5s were hypoplastic and heavily restored, and therefore their prognosis was unpredictable. The use of an EOA to reinforce anchorage was not acceptable to either the patient or the clinician due to the aesthetic/social impact and the potential of sport injuries, respectively. Additionally, the success of anchorage support depends entirely on patient compliance, which has been reported to be reduced in males[9].

A treatment plan to meet all treatment objectives was formulated and involved two phases:

A. The first stage involved extraction of the U5s and impacted LR5. The appliance used in this phase consisted of a custom-made, modified TPA/TADs combination and SMDC mechanics. The aims of the first phase were to:
   - Maintain a high level of anchorage support in three planes of space
   - Retract the U4s into the position of the U5s
   - Start initial alignment of the U3s after their spontaneous eruption or surgical exposure, if required
   - Reduce the full fixed appliance wearing time.
B. The second phase involved bonding upper and lower pre-adjusted edgewise fixed appliances (0.022" × 0.028" slot) with MBT prescription in order to:
   - Complete levelling and alignment
   - Close residual space.

Index	Parameter	Value
IOTN		
Dental Health Component	Start	4i
	Finish	2g
Aesthetic Component	Start	6
	Finish	1
PAR		
	Start	55
	Finish	2
	Change	53
	% Change	96.4%

IOTN: Index of Orthodontic Treatment Need; PAR: Peer Assessment Rating.

Table 2: Occlusal indices.

This was followed by the use of upper and lower pressure-formed retainers (PFRs) during the night.

TREATMENT

Treatment effectively started after improvement of oral hygiene and extraction of the U5s and LR5. At this stage, 0.2% chlorhexidine mouthwash for 30 sec was prescribed before two self-drilling TADs (1.8 mm length/2 mm diameter; Forestadent, St. Louis, MO, USA) were placed to reduce risk of failure[10]. TADs were placed palatally between the upper first and second permanent molars (U6s and U7s) bilaterally under local anaesthesia using a contra-angle hand-piece (HP). A slow HP was adjusted to a torque of 128:1 and 60 rounds per minute (rpm). An oblique rather than horizontal insertion was used to minimise the risk of root trauma[11]. Force loading and application on TADs was delayed for 6 weeks (healing period) to allow bone remodelling[12]. During this period, a modified TPA was designed, constructed and cemented using glass ionomer cement (GIC). The TPA included two parallel welded H-shaped attachments for the TAD to slot into, in order to provide secure engagement and ligation between the TADs and TPA *(Fig. 6)*. At the end of the healing period, the TADs

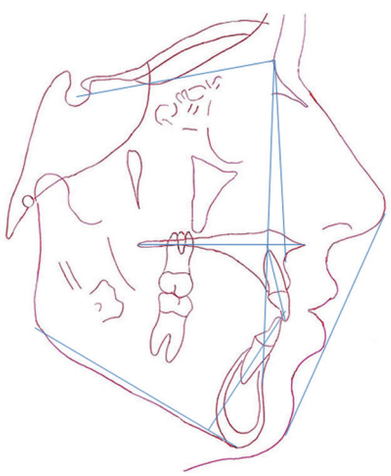


Figure 14: Cephalogram and its tracing towards the end of treatment.

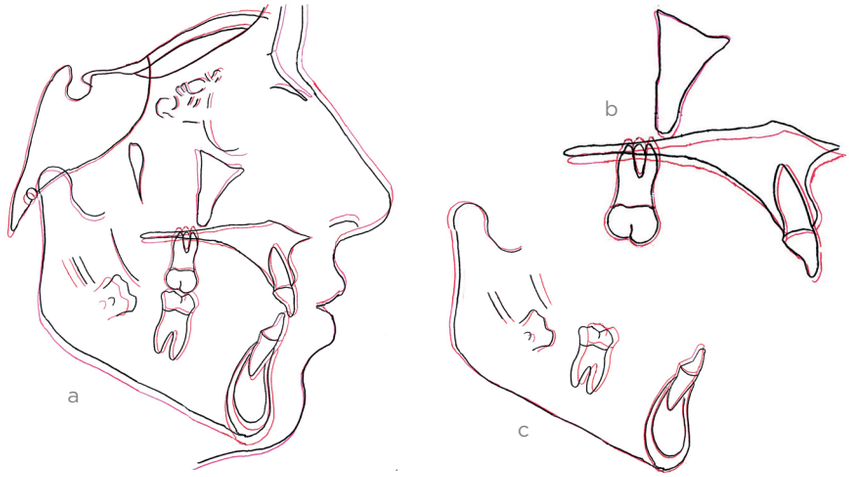


Figure 15: Cephalometric superimposition registered on: (a) the cranial base, and (b) maxillary and (c) mandibular Bjork's stable structures.

doi:10.12889/2015_C00236

Space requirements	Lower	Upper
Crowding and spacing	−10	−14 mm
Levelling occlusal curve	0 mm	0 mm
Arch width change	0 mm	0 mm
Incisor anterioposterior change	0 mm	0 mm
Angulation/inclination change	0 mm	0 mm
Total	−10 mm	−14 mm
Space creation/utilization		
Tooth reduction/enlargement	0 mm	0 mm
Extractions	+14 mm	+14 mm
Space opening for prosthetic replacement	0 mm	0 mm
Molar distal movement	−3 mm	0 mm
Molar mesial movement	−1 mm	0 mm
Total	+10 mm	+14 mm
Residue	0 mm	0 mm

+ indicates space available or gained; − indicates space required or lost.

Table 3: Royal London Hospital Space Analysis/orthodontic space planning.

were deemed stable and the SMDC mechanism was applied. The SMDC mechanism consisted of:

1. A custom-made buccal composite button on the U4s
2. Swapped and inverted self-ligating premolar brackets (Damon MX brackets; Ormco, Orange, CA, USA) bonded palatally on the U4s
3. Swapped and inverted self-ligating molar tubes (Damon MX brackets; Ormco) laser-welded on the middle of the palatal surface of the U6s bands
4. A buccal force component consisting of power chain elastics from the buccal hooks of the U6s band to the composite button of the U4s
5. A palatal force component consisting of a 6 mm nickel titanium (NiTi) spring from the U6s tubes to the U4s self-ligating brackets.

Custom-made buttons were constructed using elastic separators as a template where their lumen was filled with composite and bonded on the etched buccal surface of the U4s. The level and position of the U4s brackets (bonded palatally) were guided using transfer wires (TWs) which acted in a similar way to transfer jigs. TWs were made of sections of straight 0.019" × 0.025" stainless steel (SS) wire which were inserted into the palatally welded tubes on the U6s and therefore guided the positioning of the U4s brackets to eliminate the levelling phase and allow immediate sliding movement of the U4s *(Fig. 7)*.

The SMDC mechanics continued until the U4s were completely retracted, which took around 5 months. At that stage, the U3s erupted spontaneously following this space provision. Sectional titanium molybdenum alloy (TMA) 0.019" × 0.025" archwires were used to aid initial alignment and extrusion of the U3s *(Fig. 8)*.

The aims of the first phase were accomplished 8 months after active treatment was started and the active components of the SMDC appliance were removed, leaving the TPA/TADs combination passively in place for anchorage support. This was followed by bonding an upper/lower pre-adjusted fixed appliance in position. The chosen third order prescription of the U3s was (+7°) and L5s brackets were bonded on the lower first premolars (L4s). The archwire sequence in both arches progressed from 0.014" NiTi, to 0.016" × 0.022" NiTi and then to a 0.019" × 0.025" SS customised and co-ordinated working archwire. Residual space closure commenced using a NiTi spring on the lower right side supported with Class II elastics for night-time wear (¼", 3.5 oz; TP Orthodontics, LaPorte, IN, USA) *(Fig. 9)*. Once space closure was complete, the TPA/TADs combination was removed, conventional buccal U6 and lower second permanent molar (L7s) tubes were bonded and treatment moved to the final stage.

The final stage involved the use of bilateral settling zig-zag and anterior box elastics (3/8", 3.5 oz) on an upper 0.019" × 0.025" SS and lower 0.014" SS archwire *(Fig. 10)*. At debonding, a mere 7 months following placement of the full conventional fixed appliance, upper and lower PFR retainers were provided for night-time use only *(Figs. 11 and 12)*.

TREATMENT CHANGES

The patient was successfully treated using a two-phase approach over a period of 15 months. Satisfactory orthodontic outcomes were achieved, as reflected in the post-treatment IOTN and Peer Assessment Rating[13] scores *(Table 2)*.

Towards the end of treatment, OPT and cephalometric analysis demonstrated very mild dental and skeletal changes as a result of treatment, growth changes and/or tracing error *(Table 1, Figs. 13–15)*. Superimposition on Bjork's stable maxillary structures revealed a mild proclination and extrusion of the upper incisors, possibly due to the effect of the settling elastics, whereas the upper molars were almost stable due to the use of the TPA/TADs combination. The mandibular superimposition confirmed that the lower incisors were slightly retroclined and extruded, while the lower molars had moved mesially and extruded.

PROGNOSIS

The prognosis for the stability of the occlusion was good, although it was anticipated that there would be some future growth, particularly vertically, which might reduce the overbite. Long-term wear of the upper and lower PFRs during the night was advocated if the patient wished to maintain archform as well as the alignment of the teeth. Although an upper bonded retainer might be preferable, the limited incisor clearance and consequently probable increased bonding failure led to its exclusion from the treatment plan.

doi:10.12889/2015_C00236

TREATMENT RATIONALE

As the patient's Class II skeletal base discrepancy was mild, the orthodontic camouflage approach was considered appropriate. In view of Royal London Space Analysis[14,15], the lower and upper arches were treated on an extraction basis *(Table 3)*. Selection of the U5s was based primarily on their poor prognosis.

From a biomechanical point of view, the TPA/TAD combination helped to maintain the anchorage and overbite. Concerning bracket prescription and set-up, self-ligating brackets were selected because of clinician convenience due to ease of ligation and patient comfort due to absence of wire ligatures palatally. Additionally, swapping and inverting the palatally bonded U4 self-ligation brackets controlled the second and third order (tip and torque) of the U4s. One might argue that the effect of a similar set-up on the welded U6s tube had been excluded though the use of a rigid TPA, but this manoeuvre was planned to provide consistency with the tip and torque of the U4 brackets during the first phase of treatment. The increased palatal root torque prescription of the U3s brackets (+7˚, +7˚) controlled the roots of the U3s as they were buccally positioned. In the lower arch, bonding the L5 brackets on the L4s avoided significant torque progression between these teeth after space closure. Finally, the L7s were bonded and aligned at a late stage with the view that this may avoid molar extrusion and worsening of the overbite.

DISCUSSION

This case was classified as a maximum anchorage demand case which required either an EOA or TADs. The use of headgear involves many inherent complications such as a high failure rate due to lack of compliance (5% for females and 25% for males)[9], low patient perception[16], nickel allergy[17] and the risk of intra/extra-oral injuries[18–20]. Additionally, it has been proven that TADs are more efficient than an EOA in maintaining anchorage[21,22] and even possibly provide more anchorage in TAD-treated cases[23]. Accordingly, TADs were selected for use with a TPA to provide anchorage, which in turn would control the overbite and facilitate the SMDC mechanism.

History and clinical examination revealed that the patient was considered to have a high risk of caries. Although there is a weak correlation between lengthy treatment and WSL lesions[4,6], it was seen to be beneficial to initially use the sectional lingual approach in order to reduce the period of labial appliance wear and minimise this potential risk. Moreover, a lingual approach is associated with better patient acceptance[24,25]. Another consideration was the fact that the patient was a professional football player engaged in contact sport activities. Therefore, the SMDC approach was considered ideal for avoiding traumatic soft tissue injury by the orthodontic appliance[7,8].

Furthermore, evidence has shown that the visibility of orthodontic appliances is associated with reduced appliance acceptance and lack of confidence[26]. The two-phase approach used here aided acceptance of the orthodontic treatment as an invisible and aesthetic appliance was used before conventional labial fixed appliance treatment was commenced, resulting in shorter treatment time.

CONCLUSION

Although clinical and radiographical examination is crucial in orthodontic planning, the treatment approach and mechanics should be tailored to meet the aesthetic and social prerequisites of the patient. Moreover, an appropriate orthodontic treatment should afford beneficial outcomes that outweigh its potential risks.

doi:10.12889/2015_C00236

REFERENCE LIST

1. Mitchell L. An Introduction to Orthodontics. Oxford: Oxford University Press, 2013.
2. Nanda R, Kapila S. Current therapy in orthodontics. *Orthod J* 2010;**26**:97.
3. Banks P, Chadwick S, Asher-McDade C, Wright J. Fluoride-releasing elastomerics–a prospective controlled clinical trial. *Eur J Orthod* 2000;**22**:401–407.
4. Gorelick L, Geiger AM, Gwinnett AJ. Incidence of white spot formation after bonding and banding. *Am J Orthod* 1982;**81**:93–98.
5. Zachrisson BU, Zachrisson S. Caries incidence and oral hygiene during orthodontic treatment. *Eur J Oral Sci* 1971;**79**:394–401.
6. Al Mulla AH, Kharsa SA, Kjellberg H, Birkhed D. Caries risk profiles in orthodontic patients at follow-up using Cariogram. *Angle Orthod* 2009;**79**:323–330.
7. Ellis PE, Benson PE. Potential hazards of orthodontic treatment–what your patient should know. *Dent Update* 2002;**29**:492–496.
8. Ngeow W, Kon L. Entrapped lip following sport injury. *Dent Update* 1997;**24**:285–286.
9. Ghafaria J, Shoferb F, Jacobsson-Hunta U, Markowitzc D, Lasterb L. Headgear versus function regulator in the early treatment of class II, division 1 malocclusion: a randomized clinical trial. *Am J Orthod* Dentofac Orthop 1998;**113**:51–61.
10. Baek S-H, Kim B-M, Kyung S-H, Lim JK, Kim YH. Success rate and risk factors associated with mini-implants reinstalled in the maxilla. *Angle Orthod* 2008;**78**:895–901.
11. Cousley RR. A clinical strategy for maxillary molar intrusion using orthodontic mini implants and a customized palatal arch. *J Orthod* 2010;**37**:202–208.
12. Ohashi E, Pecho OE, Moron M, Lagravere MO. Implant vs screw loading protocols in orthodontics: a systematic review. *Angle Orthod* 2006;**76**:721–727.
13. Parbatani R, Williams A, Ireland A, Sandy J. The process of orthognathic care in an NHS region. *Annals RCS Eng* 2010;**92**:34.
14. Kirschen RH, O'Higgins EA, Lee RT. The Royal London Space Planning: an integration of space analysis and treatment planning: Part I: Assessing the space required to meet treatment objectives. *Am J Orthod Dentofac Orthop* 2000;**118**:448–455.
15. Kirschen RH, O'Higgins EA, Lee RT. The Royal London Space Planning: an integration of space analysis and treatment planning: Part II: The effect of other treatment procedures on space. *Am J Orthod Dentofac Orthop* 2000;**118**:456–461.
16. Sandler J. A comparison of the effectiveness of three methods of anchorage reinforcement in the treatment of maximum anchorage patients–a randomised clinical trial. PhD thesis, University of Sheffield, 2014.
17. Rahilly G, Price N. Current products and practice: nickel allergy and orthodontics. *J Orthod* 2003;**30**:171–174.
18. Booth-Mason S, Birnie D. Penetrating eye injury from orthodontic headgear–a case report. *Eur J Orthod* 1988;**10**:111–114.
19. Holland GN, Wallace DA, Mondino BJ, Cole SH, Ryan SJ. Severe ocular injuries from orthodontic headgear. *Arch Ophthalmol* 1985;**103**:649–651.
20. Samuels RH, Jones ML. Orthodontic facebow injuries and safety equipment. *Eur J Orthod* 1994;**16**:385–394.
21. Feldmann I, Bondemark L. Orthodontic anchorage: a systematic review. *Angle Orthod* 2006;**76**:493–501.
22. Ma J, Wang L, Zhang W, Chen W, Zhao C, Smales RJ. Comparative evaluation of micro-implant and headgear anchorage used with a pre-adjusted appliance system. *Eur J Orthod* 2008;**30**:283–287.
23. Al-Sibaie S, Hajeer MY. Assessment of changes following en-masse retraction with mini-implants anchorage compared to two-step retraction with conventional anchorage in patients with class II division 1 malocclusion: a randomized controlled trial. *Eur J Orthod* 2014;**36**:275–283.
24. Fritz U, Diedrich P, Wiechmann D. Lingual technique–patients' characteristics, motivation and acceptance. Interpretation of a retrospective survey. *J Orofac Orthop* 2002;**63**:227–233.
25. Romano R. Lingual Orthodontics. Hamilton: B.C. Decker, 1998.
26. Sergl HG, Klages U, Zentner A. Functional and social discomfort during orthodontic treatment–effects on compliance and prediction of patients' adaptation by personality variables. *Eur J Orthod* 2000;**22**:307–315.

doi:10.12889/2015_C00236

The Use of the Sander Bite-Jumping Appliance in the Correction of Class II Division 1 Malocclusion in Hypodivergent Patients with a Deep Overbite

Roberto Martina
Section of Orthodontics, Department of Neuroscience, Reproductive Science and Oral Science, University of Naples "Federico II", Italy

Roberto Uomo
Division of Dentistry, Department of Pediatric Surgery, "Bambino Gesù" Children Hospital, Rome, Italy.
Section of Orthodontics, Department of Neuroscience, Reproductive Science and Oral Science, University of Naples "Federico II", Italy

Simona Baldares
Section of Orthodontics, Department of Neuroscience, Reproductive Science and Oral Science, University of Naples "Federico II", Italy

Angela Galeotti
Division of Dentistry, Department of Pediatric Surgery, "Bambino Gesù" Children Hospital, Rome, Italy

Vincenzo D'Antò
Section of Orthodontics, Department of Neuroscience, Reproductive Science and Oral Science, University of Naples "Federico II", Italy

Correspondence:
e-mail: robertouomo@gmail.com

Article history:
Received: 23/09/2015
Accepted: 27/10/2015
Published online: 10/02/2016

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

How to cite this article:
Martina R, Uomo R, Baladares S, Galeotti A, D'Antò V. The use of the sander bite-jumping appliance in the correction of class I malocclusion in hypoadivergent patients with a deep overbite. *EJCO* 2016;**4**:16-22

Abstract

Objectives: The Sander bite-jumping appliance (BJA) has been reported to be effective in promoting supplementary mandibular growth in young Class II division 1 individuals with mandibular retrusion. In hypodivergent Class II patients with increased overbite, it is necessary to increase face height and correct the deep bite in order to allow the mandible to move forwards and obtain proper mandibular advancement. The aim of this clinical report is to describe the biomechanical advantages and clinical efficiency of the modified BJA for hypodivergent patients.
Materials and methods: The present article analyzes the biomechanics and the clinical rationale of a modified version of the BJA. Moreover, the clinical effects of the use of the modified BJA in the treatment of Class II division 1 malocclusion in hypodivergent patients with deep overbite are shown by presentation of the case an 11-year-old child with 4-year post-treatment follow-up.
Results and conclusions: The modified Sander BJA could be successfully used in the correction of Class II division 1 malocclusion in hypodivergent patients with a deep bite because of the favourable combination of vertical and sagittal effects.

Keywords
Invisalign®; Class III malocclusion; orthodontic-surgical treatment.

doi:10.12889/2015_C00244

INTRODUCTION

Class II malocclusion occurs in more than a third of the general population and is considered to be one of the most common orthodontic problems[1-3]. The treatment of Class II dental and skeletal disharmonies can be facilitated by the use of a wide range of fixed and removable orthodontic functional appliances.

In the 1950's, M. Schwarz introduced the removable double plate appliance[4], which was later modified by F.G. Sander to produce the bite-jumping appliance (BJA). Sander reported the correction of Class II malocclusions by combined activator and headgear effects on the jaws[5].

The BJA has been demonstrated to be effective in achieving supplementary mandibular growth in young Class II division 1 individuals with mandibular retrusion[6]. Moreover, it has been reported that the side effects of the appliance, such as clockwise rotation of the jaws, sagittal upper jaw growth control and proclination of the lower incisors, are minimal[6].

The original design of the BJA consists of an upper and a lower acrylic plate. The core of the appliance contains an expansion screw (Sander® II expansion screw, Forestadent, Pforzheim, Germany; www.forestadent.com) moulded to two 15 mm long robust prongs, which are embedded in the upper plate and form an angle of 60° with the occlusal plane. The mid-portion of the lower plate has an acrylic inclined plane, which touches the upper prongs when the mouth closes, so that the patient is forced to move the mandible forwards. The stability and retention of both plates are mainly obtained by means of Adams clamps, and are further increased by the use of a labial bow or torque springs in the upper plate and by acrylic covering of the lower incisors for half of their crown length *(Fig. 1)*.

In our clinical protocol, the initial working bite is taken with 4 mm of mandibular advancement. Subsequent reactivations of the appliance are obtained chairside by adding a 2 mm thick acrylic layer to the inclined plane of the lower plate.

For optimal results, the BJA should be worn at least 14 hours per day, including night-time.

DEEP BITE HYPODIVERGENT CLASS II MALOCCLUSION AND RATIONALE FOR MOLAR EXTRUSION

In Class II division 1 subjects, deep bite is mainly related to greater vertical dentoalveolar growth in the lower incisor region and extrusion of these teeth[7,8].

Some authors reported that a deep overbite is negatively correlated with the Go-Me, Ar-Pog and SNB measurements in Class II division 1 children, suggesting that the more pronounced the overbite, the less mandibular growth will occur[9]. The increased overbite, in fact, could represent an obstacle to horizontal mandibular growth.

In hypodivergent subjects, counter-clockwise mandibular rotation could increase deep bite severity and mandibular growth restriction.

Moreover, in hypodivergent Class II patients with a short face, mandibular retrusion and deep bite, the contact between the incisor edge of the lower front teeth and the cervical palatal surface of the upper teeth prevents the mandible from moving forwards to obtain proper mandibular advancement. In such cases, the goal is to increase face height and correct the deep bite in order to obtain an 'anterior leeway space' for mandibular advancement *(Fig. 2)*.

According to Proffit, this aim could be achieved by controlling eruption of the upper posterior teeth and enhancing eruption of the lower posterior teeth, along with inhibition of lower incisor extrusion[10].

In fact, allowing the vertical and mesial eruption of the lower molars while the upper teeth are prohibited from erupting, may improve the molar relationship and lead the occlusal plane to rotate up posteriorly in a direction that facilitates Class II correction *(Fig. 3)*[11].

MODIFIED BJA FOR HYPODIVERGENT CLASS II MALOCCLUSION: CLINICAL APPLICATION

Molar banding is mandatory in order to achieve efficient lower first molar extrusion.

Before alginate impressions are taken, lower molar bands with a welded vestibular tube should be fitted and

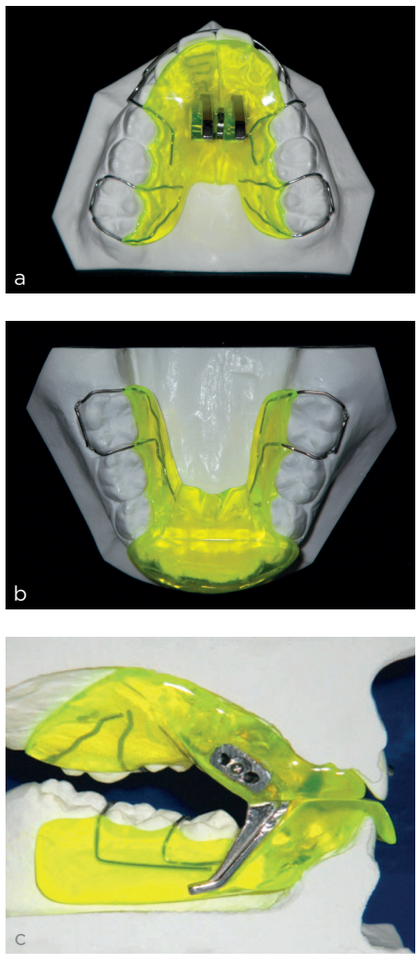


Figure 1: The Sander bite-jumping appliance: different views of the upper and lower plates. The prongs of the upper plate determine mandibular advancement through leaning on the inclined plane of the lower plate (a-c).

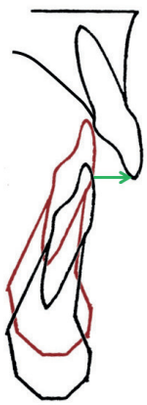


Figure 2: In deep-bite hypodivergent patients, the increased overbite could represent an obstacle to horizontal mandibular growth. In order to achieve mandibular advancement, it is necessary to increase face height and correct the deep bite, obtaining an 'anterior leeway space'.

doi:10.12889/2015_C00244

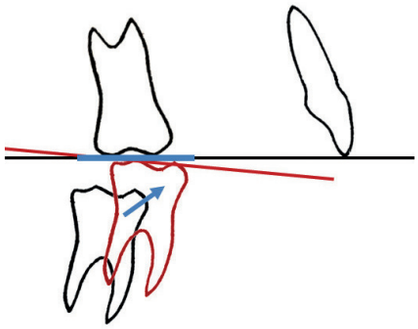


Figure 3: Extrusion of the lower molars aids correction of the Class II relationship through the mesially directed molar eruption.

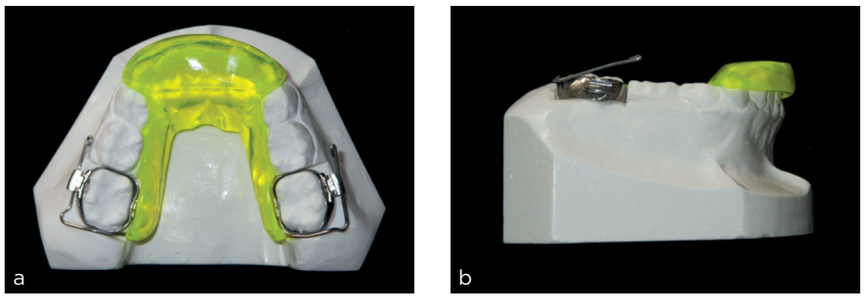
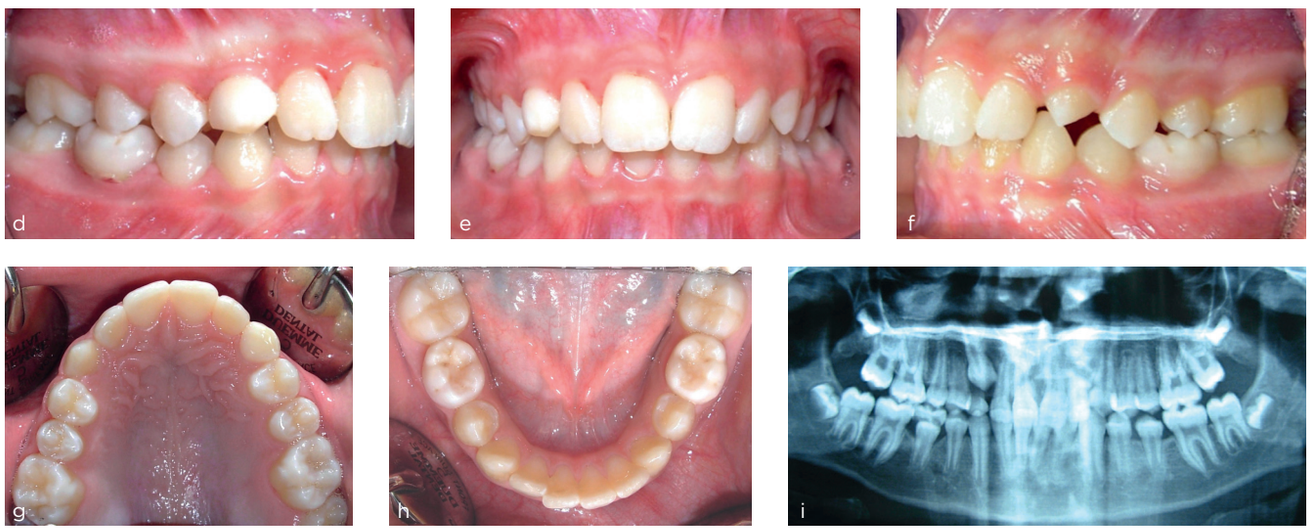


Figure 4: Modified bite-jumping appliance for hypodivergent patients, lower plate. Extrusion of the lower first molars is achieved by vertical and buccal activation of the modified posterior hooks inserted under the molar tubes (a-b).

Figure 5: The patient showed a Class II division 1 malocclusion with mandibular retrusion and a hypodivergent growth pattern (a-c). Intraoral photographs revealed a bilateral Class II molar relationship with increased overjet and overbite (d-h). Panoramic radiograph at the start of treatment (i).



sent to the laboratory along with the alginate impressions of both arches and the working bite, as described previously.

Smooth bands on the lingual side are recommended; if present, any seating lug or lingual welded supplement must be removed before band fitting.

On the lower first molars, Adams hooks should be replaced with Dominique-like hooks made of 0.7 mm chrome-cobalt wire with the horizontal portion inserted under the molar tubes *(Fig. 4a)*.

The use of this type of hook consistently increases lower plate retention.

Extrusion of the lower first molars is accomplished by vertical activation of posterior hooks inserted under the molar tubes *(Fig. 4b)*. The vertical activation should be 1.5 mm on each side.

Since the point of force application is located vestibular to the centre of resistance of the lower molars, slight vestibular activation is suggested in order to avoid lingual molar tipping during extrusion.

CASE PRESENTATION

An 11-year-old boy *(Fig. 5)* presented for orthodontic treatment with skeletal Class II division 1 malocclusion, a

doi:10.12889/2015_C00244

bilateral full cusp Class II molar relationship, and increased overjet (OVJ) and overbite (OVB). His medical history was not contributory. Soft tissue profile and cephalometric radiography suggested mandibular retrusion and a hypodivergent growth pattern.

Treatment planning involved a first treatment phase with the modified BJA, followed by full multibracket therapy.

Torque springs were used in the upper plate of the BJA in order to maintain upper incisor torque; Adams and ball hooks were used for retention. Lower incisor and canine edges were covered with acrylic in the lower plate and extrusion hooks were adapted to fit under the first lower molar bands *(Fig. 6)*.

After 10 months of functional orthodontic treatment, a clear improvement in facial profile was seen, a Class I molar relationship was achieved on both sides, and the OVJ and OVB had improved considerably *(Fig. 7)*.

Since the permanent dentition was fully erupted at the end of the functional treatment, the patient immediately started the second phase of fixed orthodontic treatment with an MBT straight-wire multibracket appliance. At the end of 14 months of fixed appliance therapy, he showed a bilateral Class I molar relationship, his OVJ and OVB were normalized, and facial aesthetics had dramatically changed, with correction of the convex profile *(Fig 8)*. As the patient presented impacted lower third molars *(Fig. 8i)*, with marked mesial inclination of their crowns, he was referred for extraction but refused to undergo surgery.

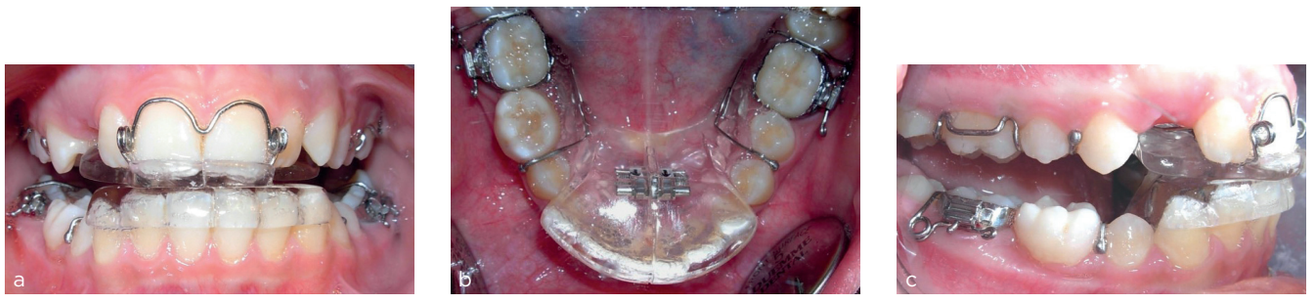


Figure 6: Characteristics of the appliance used: torque springs and acrylic covering were applied in order to control the upper and lower incisor positions, respectively (a–b). Modified posterior hooks were applied on the lower first molars to achieve proper extrusion (c).

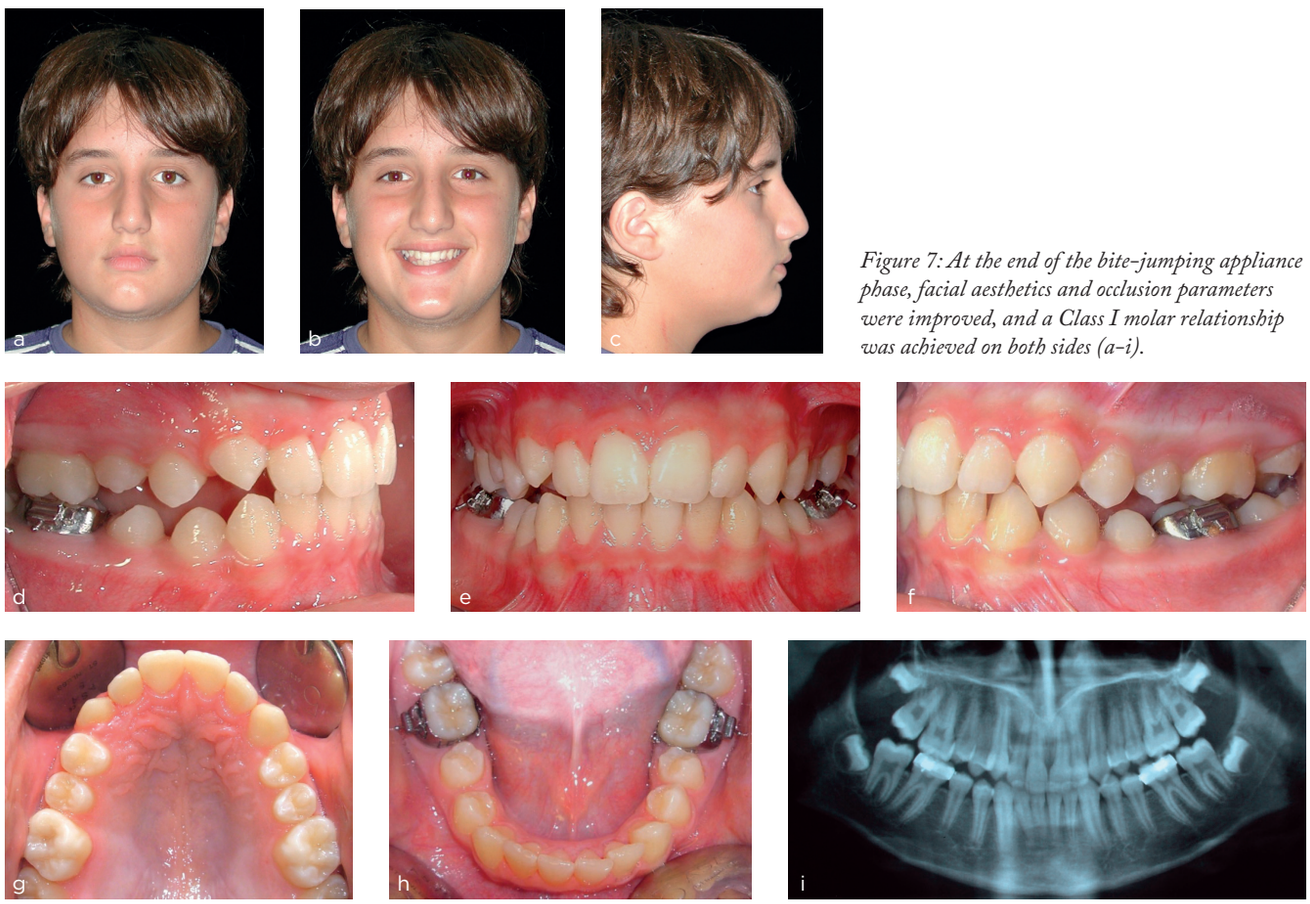


Figure 7: At the end of the bite-jumping appliance phase, facial aesthetics and occlusion parameters were improved, and a Class I molar relationship was achieved on both sides (a–i).

doi:10.12889/2015_C00244

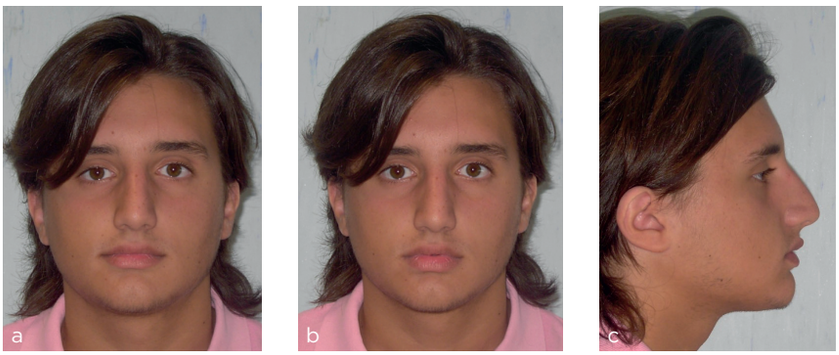
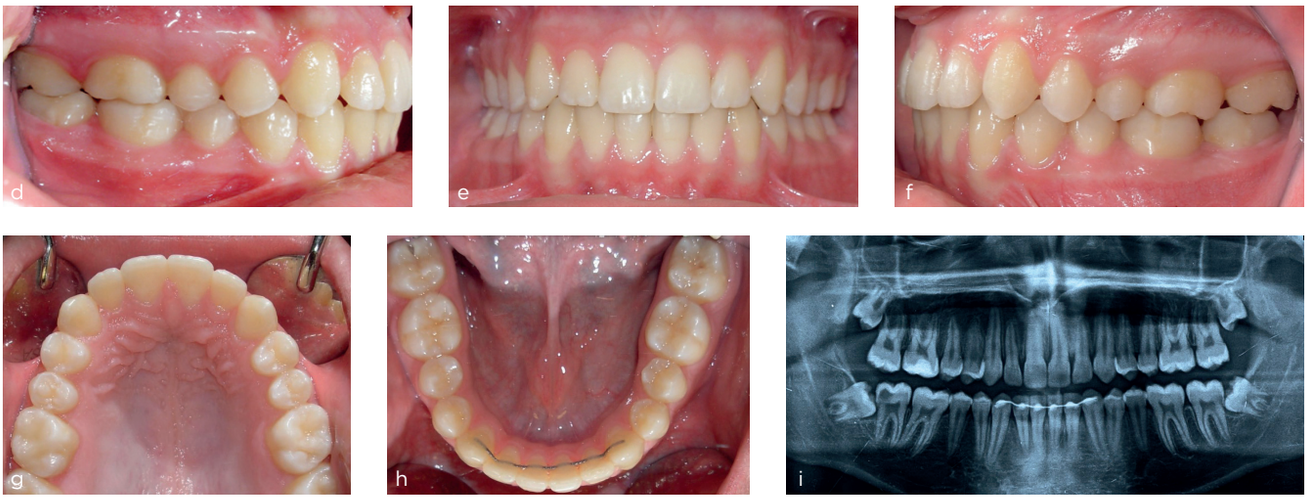


Figure 8: After multibracket therapy, vertical and sagittal maxillo-mandibular relationships were corrected, with significant improvement in facial and profile aesthetics (a-c). The patient showed a bilateral Class I molar relationship and normal overjet and overbite (d-h). A panoramic radiograph showed acceptable root parallelism (i).



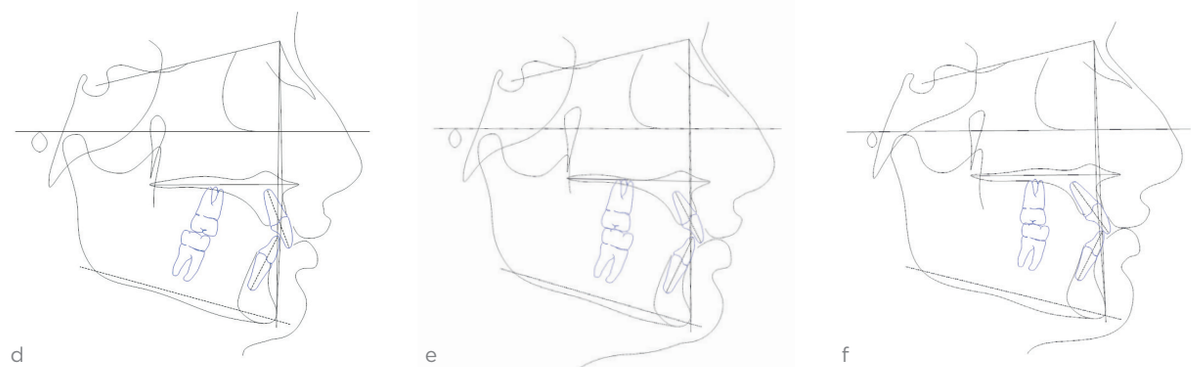


Figure 9: Comparison between cephalograms and tracings at the start of treatment (a,d), at the end of functional treatment (b,e) and at the end of fixed orthodontic treatment (c,f).

doi:10.12889/2015_C00244

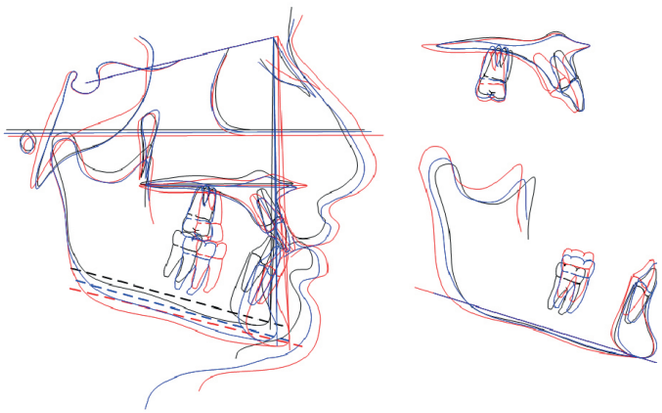


Figure 10: Superimposition of cephalometric tracings before (black) and after functional treatment (blue), and at the end of fixed treatment (red). The images demonstrate a significant improvement in the sagittal jaw relationship due to mandibular advancement, with a marked changed in the vertical position of the lower first molar.

Comparison of cephalometric data before and after functional treatment showed an increase in lower facial height and a significant correction of sagittal discrepancy *(Figs. 9 and 10; Table 1)*. Tracing superimpositions highlight the amount of molar vertical movement; on the other hand, restricted movement of the lower incisor could be seen, indicating that OVJ correction was due to mandibular growth and advancement rather than incisor proclination *(Fig. 10; Table 1)*.

The 4-year follow-up showed that the results achieved at the end of treatment were stable. The occlusal relationship and dental alignment were kept stable *(Fig. 11)*. Normal OVJ and OVB were preserved and the lower fixed retention was still in place. In particular, facial aesthetics seem to have further improvement, which could be the consequence of a gradual adaptation of soft tissues to dental and bone changes, which usually takes longer to occur.

DISCUSSION AND CONCLUSION

The modified Sander BJA could be successfully used in the correction of Class II division 1 malocclusion in hypodivergent patients with a deep bite because of the combination of vertical and sagittal effects.

Functional appliances force the mandible to occlude anteriorly. The forced anterior position of the mandible usually associates with neuromuscular adaptation with the new position[12].

It has been suggested that Class II orthopaedic correction may be influenced by vertical craniofacial features[13]. In Class II hypodivergent patients, bite opening is necessary in order to eliminate contact between the upper and lower incisors, and avoids the proprioceptive input that forces the mandible back.

In a previous study, the BJA was reported to induce mandibular clockwise rotation compared to the twin block appliance[14]. Although this result is in contrast to a previous randomized controlled trial[6] that showed no effects on the vertical dimension, the increase in vertical facial height could represent one of the main treatment goals in the correction of Class II malocclusion in hypodivergent patient with a deep bite and short face.

In the modified version of the BJA, the use of molar extrusion hooks, determining the vertical and mesial eruption of the lower molars, is able to reduce a deep bite and allow mandibular advancement in a direction that facilitates Class II correction, obtaining an anterior leeway space.

The simple clinical management and the high comfort level of the modified Sander BJA can reduce chairside time and the need for patient compliance. Moreover, the combined improvement in the sagittal and vertical dimensions achieved during the functional phase of the orthodontic treatment, can simplify correction during multibracket fixed treatment.

	Pre-treatment	After functional treatment	After fixed treatment
Sagittal skeletal relationships			
S-N-A	77.3°	77.5°	76.9°
S-N-B	73.6°	75.2°	76°
A-N-B	3.7°	2.3°	0.9°
Vertical skeletal relationships			
S-N/ANS-PNS	10.7°	12.6°	13.5°
S-N/Go-Gn	28.3°	31.9°	30.7°
ANS-PNS/Go-Gn	17.6°	19.3º	17.2°
Dento-basal relationships			
1 - ANS-PNS	110.4°	118.4°	125.4°
1 - Go-Gn	101.7°	99.7º	102.6°
1 - A-Pg (mm)	–0.9	0.8	2.4
Dental relationships			
Overjet (mm)	4.8	3.6	2.6
Overbite (mm)	4	1.3	0.7
Interincisal angle (1/1)	132.1°	126.9°	117.4°

Table 1: Comparison of cephalometric measurements before treatment, after functional treatment and after fixed orthodontic treatment with the modified bite-jumping appliance.

doi:10.12889/2015_C00244

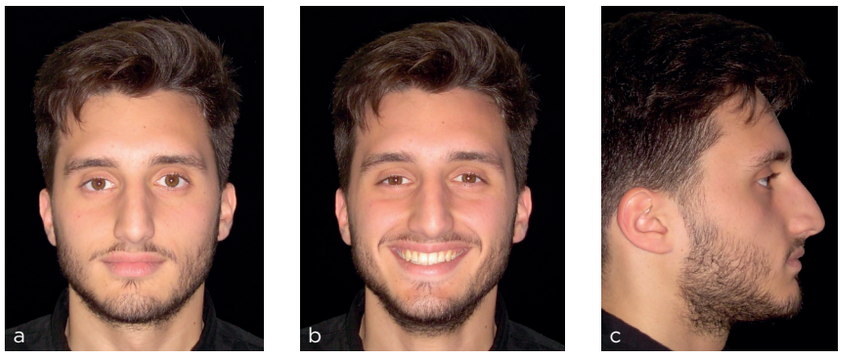
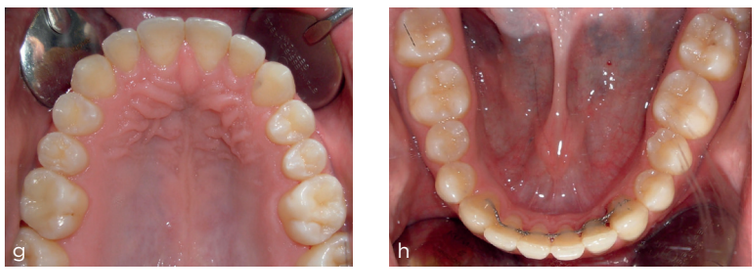


Figure 11: After 4-year follow-up, the patent showed a stable Class I occlusion, resulting in a good mandibular position and an improved, balanced profile (a–h).



REFERENCE LIST

1. Proffit WR, Fields HW, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the N-HANES III survey. *Int J Adult Orthod Orthog Surg* 1998;**13**:97–106.
2. Lauc T. Orofacial analysis on the Adriatic islands: an epidemiological study of malocclusions on Hvar Island. *Eur J Orthod* 2003;**25**:273–278.
3. Laganà G, Masucci C, Fabi F, Bollero P, Cozza P. Prevalence of malocclusions, oral habits and orthodontic treatment need in a 7- to 15-year-old schoolchildren population in Tirana. *Prog Orthod* 2013;**14**:12.
4. Graber TM, Neuman B. The activator: use and modifications, in *Removable Orthodontic Appliances*, 2nd ed. Philadelphia: W.B. Saunders, 1984, pp. 198–243.
5. Sander FG, Weinreich A. The bite-jumping-appliance. *Dtsch Stomatol* 1991;**41**:195–198.
6. Martina R, Cioffi I, Galeotti A, Tagliaferri R, Cimino R, Michelotti A, et al. Efficacy of the Sander bite-jumping appliance in growing patients with mandibular retrusion: a randomized controlled trial. *Orthod Craniofac Res* 2013;**16**:116–126.
7. Martina R, Farella M, Tagliaferri R, Michelotti A, Quaremba G, van Eijden TM. The relationship between molar dentoalveolar and craniofacial heights. *Angle Orthod* 2005;**75**:974–979.
8. Samuelson G, Garner LD, Potter R. Tooth movements associated with deep overbite correction in Class II division 1 malocclusions. *Int J Orthod* 1989;**27**:3–8.
9. Marques LS, Armond MC, Ramos-Jorge ML, Andrade RG, Bolognese AM. Correlations between dentoskeletal variables and deep bite in Class II Division 1 individuals. *Braz Oral Res* 2011;**25**:56–62.
10. Proffit WR, Fields HW, Sarver DM. Orthodontic treatment planning: limitations, controversies and special problems, in *Contemporary Orthodontics*, 4th ed. St Louis: Mosby Elsevier, 2007, pp. 292–293.
11. Proffit WR, Fields HW, Sarver DM. Treatment of skeletal problems in children, in *Contemporary Orthodontics*, 4th ed. St Louis: Mosby Elsevier, 2007, p. 512.
12. Amit S, Toshniwal N. A clinical, cephalometric, electromyographic and ultrasonographic evaluation of Twin-Block appliance. *J Ind Orthod Soc* 2010;**44**:5–16.
13. Mills C, McCulloch K. Treatment effects of the Twin-Block appliance: a cephalometric study. *Am J Orthod* 1998;**114**:15–24.
14. Burhan AS, Nawaya FR. Dentoskeletal effects of the Bite-Jumping Appliance and the Twin-Block Appliance in the treatment of skeletal Class II malocclusion: a randomized controlled trial. *Eur J Orthod* 2015;**37**:330–337.

doi:10.12889/2015_C00244

Non-Surgical Orthodontic/Orthopedic Treatment of a Young Adult Class III Patient

Małgorzata Kuc-Michalska
Private practice at NZOZ Poradnia Ortodontyczno-Stomatologiczna w Zabrzu, Poland

Aneta Karska
Private practice at NZOZ Poradnia Ortodontyczno-Stomatologiczna w Zabrzu, Poland

Peter Ngan
Department of Orthodontics, West Virginia University, Morgantown, West Virginia, USA

Correspondence:
e-mail: kucmichalska041968@gmail.com

Article history:
Received: 03/08/2015
Accepted: 11/01/2016
Published online: 12/02/2016

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

How to cite this article:
Kuc-Michalska M, Karska A, Ngan P. Non-surgical orthodontic/orthopedic treatment of young adult class III patient. *EJCO* 2016;**4**:23-30

Acknowledgements:
The Authors would like to dedicate this manuscript to Tiziano Baccetti who was the initiator of the paper. We also would like to thank Lorenzo Franchi, from the Department of Surgery and Translational Medicine, University of Florence, for his help with the initial revision of the text.

doi: 10.12889/2016_C00245

Abstract

Objective: To report and evaluate the outcomes of nonsurgical orthodontic treatment of a young adult female patient with Class III malocclusion and hyperdivergent growth pattern.
Material and Methods: The 15-year-old patient with moderate skeletal Class III malocclusion and hyperdivergent growth pattern was treated by the Authors (M K-M and AK). The treatment started after growth completion (CS6 in cervical vertebral maturation) and consisted of the combined use of a face mask, Haas-type expansion appliance, a lower fixed appliance and Class III elastics for the first phase of treatment followed by full fixed appliance. Lateral cephalometric radiographs were taken at the beginning (T1) and at the end (T2) of treatment. Selected cephalometric analyses and superimpositions were used to evaluate dental, skeletal and facial changes with treatment. The patient was followed for 7 years to document the stability of non-surgical orthodontic/orthopedic treatment.
Results: Patient treatment improved the skeletal relationship, dental relationship and visible enhancement in the appearance of the midface, lip profile and the position of the chin. Improvement in the anteroposterior skeletal relationship was demonstrated by an improvement in the ANB angle and Wits appraisal. The vertical dimension was maintained with an improvement of the overbite. Upper and lower incisors were uprighted to a more correct position. Treatment results were stable for 7 years.
Conclusion: Successful non-surgical orthodontic treatment can be achieved in young adult Class III patient with a hyperdivergent growth pattern with a combination of orthopedic and fixed appliances. It can be an alternative treatment for patients who decline the option of surgical treatment.

Keywords
Hyperdivergent Class III malocclusion, nonsurgical Class III treatment, orthopedic face mask treatment, expansion with acrylic Haas appliance

INTRODUCTION

Treatment of patients with Class III malocclusion remains a challenge to practicing orthodontists. The etiology of Class III malocclusion includes the following factors:

1) genetic which can lead to skeletal disharmony;
2) functional or muscular which can lead to forward positioning of the mandible;
3) dysfunctional or mouth breathing which can lead to maxillary deficiency[1].

The differential contribution of these factors results in various combinations of dentoalveolar and skeletal discrepancies in one or both jaws in Class III patients.

Successful treatment of young patients with Class III malocclusion and midface deficiency has been reported in the literature[2-6]. The long-term success of early treatment depends however on growth potential after treatment[2,7,8]. Despite the fact that many researchers have attempted to find the best formula for predicting the outcome of Class III therapy in patients with excessive mandibular growth, it remains unpredictable[2,9-16]. During the pubertal growth spurt, one out of 3 patients with early Class III treatment shows relapse while others develop a Class III relationship for the first time[3,7,8,17,18]. The anteroposterior discrepancy between the maxilla and the mandible has been attributed to a larger growth of the mandible, a longer pubertal growth period of Class III malocclusion compared to Class I individuals, and a smaller maxilla[7,8,18].

Nonsurgical treatment of adult patients with Class III skeletal problems is an option which has not received sufficient attention in the literature. For many years the best choice of treatment for such patients has been to wait for the completion of facial growth and then to treat subjects with orthodontics combined with orthognatic surgery[19]. There have been only a few reports on non-surgical treatment of skeletal Class III malocclusion in the available literature[20-25]. The use of Haas expansion appliance for correcting mild to moderate Class III malocclusions has been reported as early as the 1960s[26-29]. However, until now the use of expansion appliances in older patients has been considered a controversial method despite the fact that the appliance can induce maxillary dentoalveolar expansion at any developmental stage and enable forward maxillary traction[3,17,29]. Furthermore, the risks and costs related to surgical treatment are not always accepted by patients or their parents. Alternative treatment methods related to the correction of this skeletal discrepancy therefore warrants further investigation. The aim of the paper was to report and evaluate the outcomes of nonsurgical orthodontic treatment of a patient with Class III hyperdivergent malocclusion.

MATERIALS AND METHODS

A 15-year-old female patient presented with growth maturation CS6 according to the Cervical Vertebral Maturation (CVM) method[2] skeletal Class III malocclusion and a hyperdivergent growth pattern *(Fig. 1, 2)*.

The option of orthodontic/orthognathic surgery had been offered to the patient due to the severity of the skeletal deformity and skeletal maturation. The patient declined the surgical option and accepted the combined orthodontic-orthopedic treatment protocol described below.

Figure 1: A 15-year-old female patient with dental and skeletal Class III malocclusion with deviation of mandibular dental midline before the orthopedic/orthodontic treatment (a-g).

doi: 10.12889/2016_C00245

The non-surgical treatment consisted of two stages. The first stage, which lasted over a period of 6 months, consisted of a Haas-type expander on acrylic splints, a face mask and a lower fixed appliance, combined with intraoral long Class III elastics worn full time to enhance the forward maxillary traction[21]. The acrylic splints of the appliance were formed higher in its posterior part in order to induce a mandibular clockwise rotation simultaneously with intrusion of lower molars and the change in the mandibular plane angle to minimize the elongation of lower face height. The patient was asked to turn the screw of the expander once a day in the late evening until the desired transverse width was achieved (28 turns) and then was immobilized. After the tenth turn the patient was instructed to begin wearing the face mask with pads fitted at the chin and forehead. Extraoral elastics were stretched from the posterior hooks on the expander to the support bar of the face mask in a downward and forward vector. The patient was advised to wear the face mask for 14 hours daily (from 7 pm to 7 am and 2 hours during daytime), five days a week and the whole day at weekends. The elastic force applied from the posterior hooks on the Haas appliance to the face mask was 450-550 g per side. At the same time, long Class III elastics were applied to the posterior hooks on the Haas appliance (placed between second premolars and first molars) and the hooks on the lower canine brackets. These were stretched with an initial force of 200 g per side. The patient was instructed to wear the intraoral elastics full time.

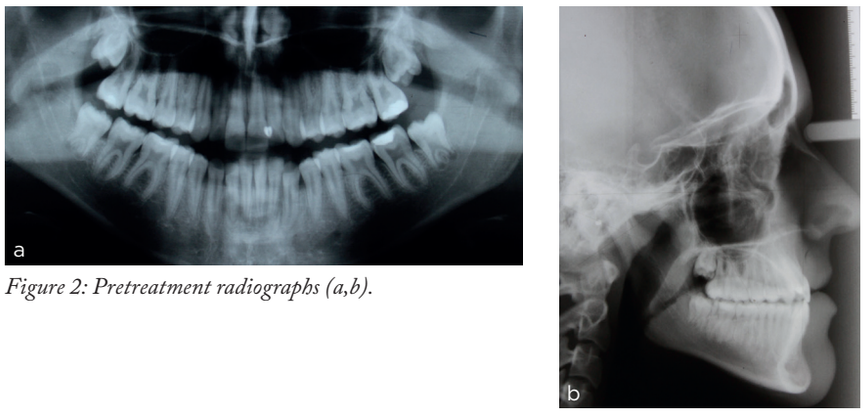


Figure 2: Pretreatment radiographs (a,b).

After correction of the anterior crossbite and overcorrection of the molars to a more Class I and Class II canine relationship, the Haas-type expander was removed and replaced by an upper fixed appliance and a palatal expander used in the second stage of orthodontic treatment[21]. The final bite adjustment was then made by means of short and long Class III and Class I elastics worn 24 hours daily with the initial force of 200 g per side. The treatment objective was to eliminate the anterior crossbite and achieve a

Figure 3: Intraoral and facial photographs 1 month after the removal of acrylic Haas appliance and the placement of upper fixed appliance. Dental and skeletal improvement in the sagittal plane, still visible mandibular dental midline left-side deviation (a-g).

doi: 10.12889/2016_C00245

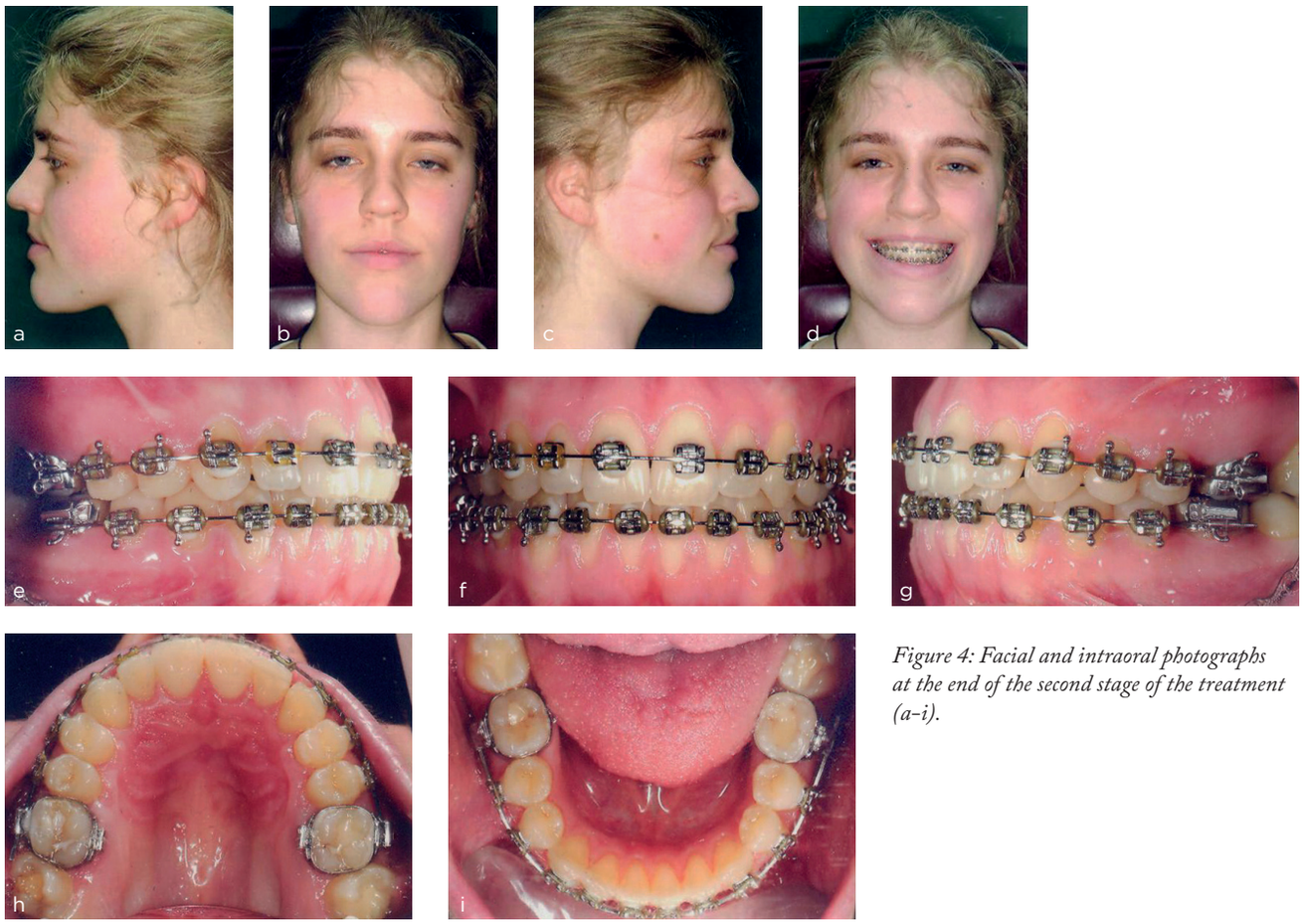


Figure 4: Facial and intraoral photographs at the end of the second stage of the treatment (a–i).

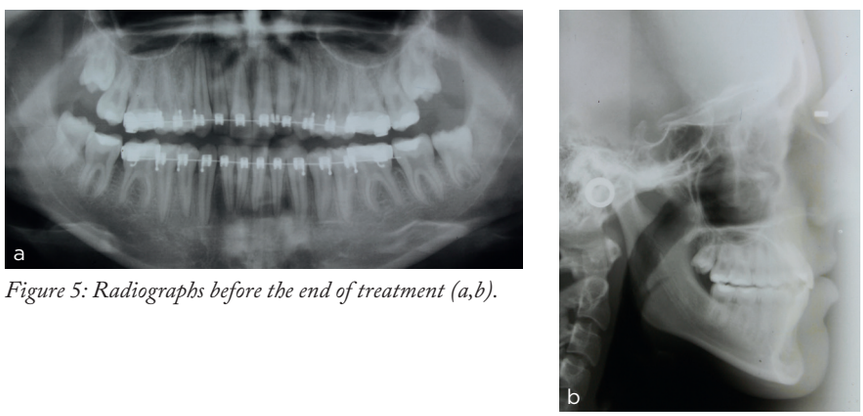


Figure 5: Radiographs before the end of treatment (a,b).

proper Class I dental relationship. The second objective was to minimize the skeletal discrepancy by inducing a forward/downward movement of the maxilla and downward/backward rotation of the chin.

RESULTS

The first stage of treatment was completed within 6 months with the anterior crossbite corrected and achieved a more Class I molar relationship and intrusion of lower first molars *(Fig. 3)*. The soft tissue profile also improved significantly after the initial phase of treatment *(Fig. 3)*.

In the second stage the Haas appliance was removed and replaced with upper fixed appliance and palatal expander to control vertical position of upper first molars. The completion of the second stage of treatment with the full fixed appliance and Class III elastics on the right side and Class II elastics on the left side took 10 months *(Fig. 4, 5)*.

The full fixed appliance was then left for an additional 5 months with triangular elastics stretched between upper first premolars and lower first and second premolars to stabilize the treatment results. The patient was compliant and lower third molars were extracted at the end of the treatment. *Figure 6* shows the final result after the second phase of orthodontic treatment. The patient achieved a better skeletal and dental relationship. The soft tissue profile improved significantly due to forward movement of the midface (infraorbital ridge, cheeks, nose and the upper lip were moved forward). The chin moved backward and slightly downward.

Cephalometric evaluation made before and after active treatment showed a considerable improvement in the Wits appraisal (5 mm); the SNA

doi: 10.12889/2016_C00245

	Case 1		
Cephalometric values	T1	T2	T1-T2
Age and treatment duration	15y 2m	16y 11m	21m
CS	6	6	
SNA (deg)	**74,5**	**75,5**	**+1**
SNB (deg)	76,5	75,5	-1
SNPg (deg)	77,5	76,5	-1
ANB (deg)	-2	0	+2
ANPg (deg)	-3	-1	+2
Wits (mm)	**-5**	**0**	**+5**
Co-A (mm)	**91**	**95**	**+4**
Co-Gn (mm)	129	129	0
SN to Palatal Plane (deg)	7	7	0
SN to Mand. Plane (deg)	37	37	0
Palatal Plane to Mand. Plane (deg)	30	30	0
Co-Go-Me (deg)	128,5	124,5	-4
ANS-Me (mm)	**76**	**79**	**+3**
Upper Inc. to Palatal Plane (deg)	107	111	+4
Lower Inc. to Mand. Plane (deg)	86	89	+3

Abbreviations: *T1:* beginning of the treatment; *T2:* end of the treatment; *CS:* Cervical stage; *deg:* degrees; *y:* years; *m:* months; *Mand. Plane:* Mandibular Plane; *Co:* Condylion; *Gn:* gnathion; *Me:* Menton; *ANS:* Anterior Nasal Spine; *Upper Inc.:* Upper incisor; *Lower Inc.:* Lower incisor

Table 1: Values of the cephalometric variables before (T1) and after treatment (T2).

angle (1 degree); and the ANB angle (2 degrees). SNB and SNPg angles were decreased by 1 degree *(Table 1)*.
Superimposition of the pre- and post-treatment radiographs *(Fig. 7)* revealed a slight elongation of the lower face and some chin retraction due to a downward displacement of the maxilla, extrusion of lower molars and a clockwise rotation of the mandible (greater ANS-Me 3 mm). The patient showed proclination of the upper incisors (4 degrees) to an almost ideal position and proclination of lower incisors (3 deegres) to a more correct position *(Table 1)*.
The patient was re-evaluated every 6 months after active treatment for 2 years and then once a year for the next 5 years and retained good dental relationship and continuous improvement in facial appearance *(Fig. 8, 9)*.
The patient did not develop temporomandibular disorder during or after treatment.

DISCUSSION

Twenty years ago orthognatic surgery was considered to be "the only viable option" for Class III patients after the completion of growth[19]. The use of maxillary expansion in conjunction with face mask therapy was limited to the deciduous or early mixed dentition[2-4,17]. The use of miniplates may be used for orthopedic treatment in Class III patients up to early adolescence[5,6]. However, after this age, the changes in a skeletal position of the maxilla were insignificant with orthopedic treatment[3] and surgical procedure was considered the main solution to adult skeletal Class III patients[19,30].
Significant movements of the upper and/or lower jaws with orthognathic surgery and associated with problems of stability[31]. These problems are associated with difficulties in neuromuscular adaptation and the stretch of the surrounding soft tissues[30-32]. The orthodontic-orthopedic treatment proposed in the present case report can produce modifications in the position of both jaws over a long period (6-9 months), thereby making these changes acceptable to the neuromuscular system and providing time for adaptation to a new skeletal environment. Moreover, from what is known and observed in clinical settings, most Class III patients have their individual functional adaptations to dental discrepancies, which leads to a forward functional shift of the lower jaw. Thus the use of elastics can alter the spatial position of the lower jaw.
In 1997, it was reported that maxillary protraction is possible with good results up to 12 years of age in the Chinese population[33]. The fact that maxillary protraction is possible in young adults may be related to the latest findings relevant to spheno-occipital synchondrosis (SOS) using computed tomography[34]. Growth at the SOS translates the maxilla upward and forward relative to the mandible. Current research has shown that rapid maxillary expansion has significant effects on the SOS length and an increase in posterior cranial base length (Ba-SOS) in young individuals[34,35]. The variation of the timing of SOS fusion between and within populations is broad, with reports of complete fusion in individuals aged 11 and non-fusion in adults well before 25 years of age[36-38]. If fusion of SOS is not complete in young adults, it can be assumed that antero-posterior traction of the maxillary complex can still change the spatial position of the maxilla in adults and the use of the Haas expander appliance may enable this movement.
The force of Class III elastics of about 200 grams per side applied to the dental arches in our treatment is similar to that applied to the miniplates used in younger patients[5,6]. The 400-600 gram force of elastics per side exerted from the Haas appliance to the face mask is also similar to the recommendations reported in the literature[1-5,33]. In the present case report, the A-point advancement of 4.0 mm in the patient is smaller than the results obtained by combining skeletal anchorage and face mask therapy (7.0mm) in a younger patient[39]. However, it was better than the average results obtained by rapid

doi: 10.12889/2016_C00245

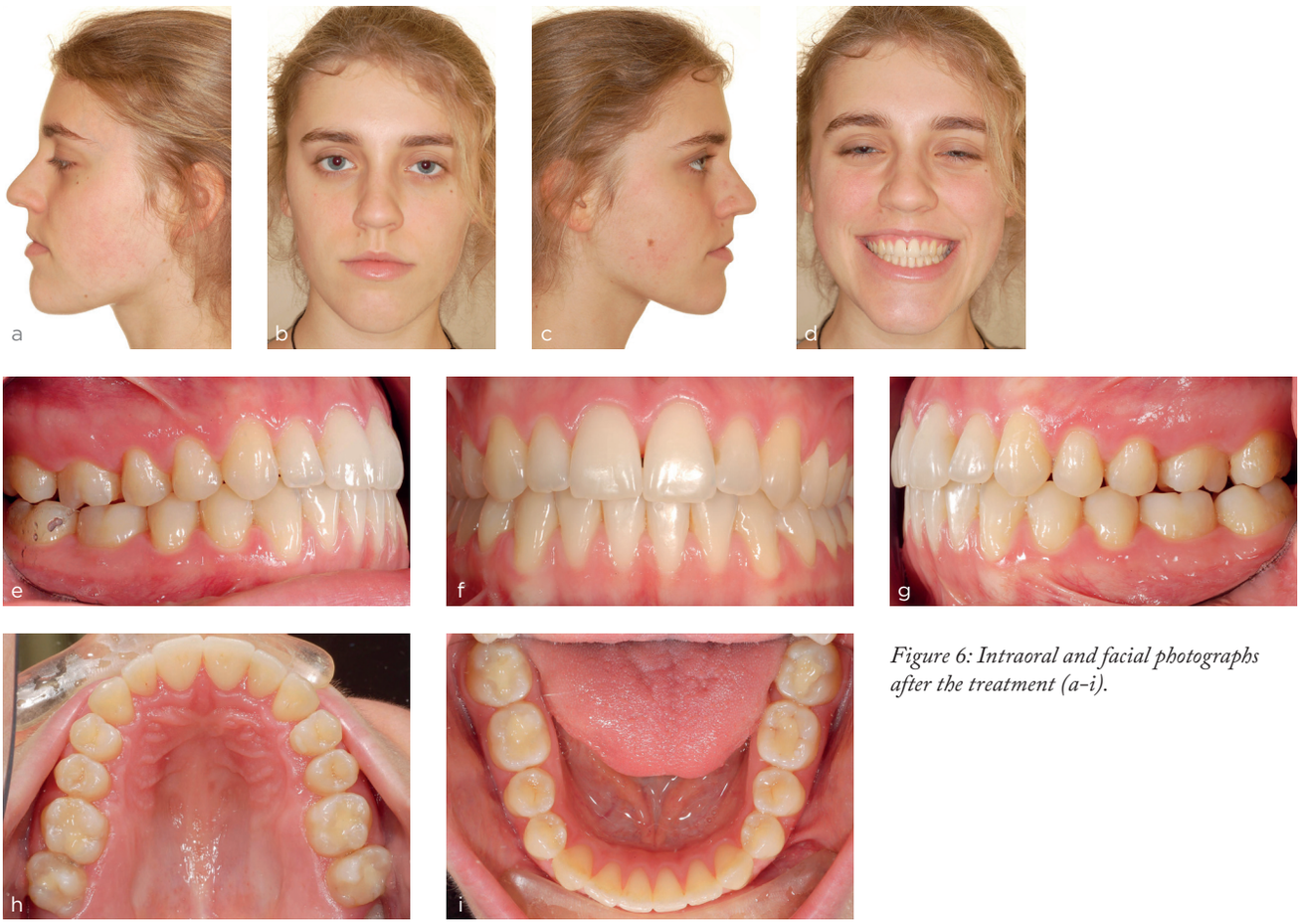


Figure 6: Intraoral and facial photographs after the treatment (a–i).

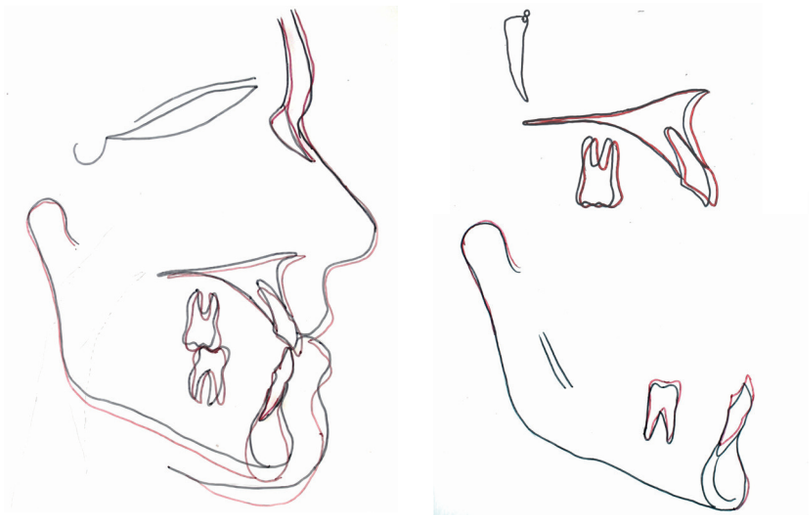


Figure 7: Superimpositions of pretreatment (black) and posttreatment (red) cephalometric tracings show skeletal maxillary advancement and slight forward displacement of maxillary dentition.

maxillary expansion and face mask (2.4 mm) and smaller (1.3 mm) than those reported in the bone-anchored maxillary protraction protocol in prepubertal patients[3,5,6].

It should be noted that the success of orthopedic treatment in young adults relies on patient compliance in wearing the elastics full time to thereby deliver a continuous force on the cranial sutures, including the SOS. The study on the effectiveness of forces on sutures demonstrates that a continuous force ensures ~ 65% more favorable results as compared with intermittent forces[40]. When patients use a face mask for 14 hours daily, together with full-day use of Class III elastics, a force is exerted 24 hours a day on the circumaxillary sutures, temporomandibular joints and the lower jaw[19,26,27,30,33]. The improvement in facial appearance, which was visible after the first month of the therapy, resulted in very good patient compliance.

The most visible change during the treatment regimen described above was emphasized by the comparison of the Wits measurement before and after treatment (+5mm). Treatment duration was relatively short, lasting 21 months. It can therefore be concluded that an improvement in the skeletal and dental relationships was achieved

doi: 10.12889/2016_C00245

Figure 8: Intraoral and facial photographs 7 years after treatment (a–i).
The occlusion and skeletal changes were stable. The patient wore Essex retainers on both arches for 2 years.

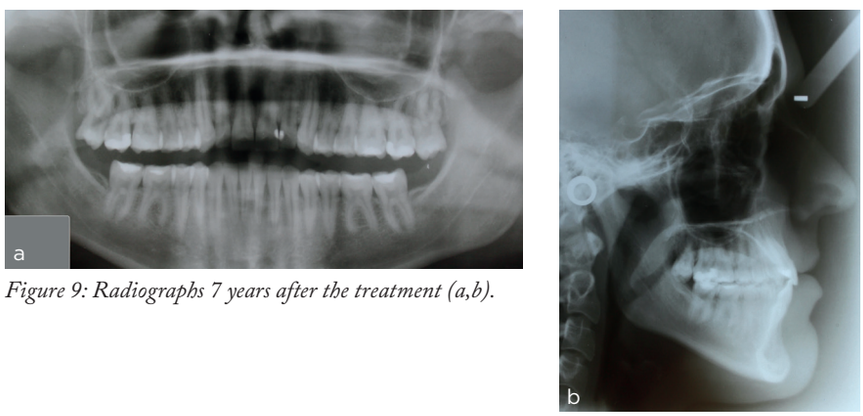


Figure 9: Radiographs 7 years after the treatment (a,b).

faster and, more importantly, remained stable in young adult Class III patient because continuing growth did not impinge on the positive outcome of the treatment, as usually happens in the case of patients treated in earlier stages of growth.

In summary, the final outcomes of the treatment described here consisted of positive changes in three different components:

1) dentoalveolar compensation in both jaws;
2) favorable skeletal changes consisting in the forward displacement of the midface and a subsequent mandibular clockwise rotation;
3) a backward functional shift of the mandible facilitated by the disarticulation of the majority of teeth on the acrylic splints of the Haas appliance.

These results need however to be confirmed with a larger sample with a long observation period.

CONCLUSIONS

Combined orthodontic treatment of our patient using the Haas expansion appliance, face mask, fixed appliances and Class III elastics worn full time, resulted in a correct dental relationship, better skeletal relationship and an improved facial appearance in the patient with moderate skeletal Class III malocclusion. Such treatment may be useful in young adult patients, even in hyperdivergent patients and may be an alternative to combined surgical-orthodontic therapy. Patient compliance remains one of the main factors for successful outcome.

doi: 10.12889/2016_C00245

REFERENCE LIST

1. Proffit W, Fields HW. The etiology of orthodontic problems. In Proffit W, Fields HW. Contemporary Orthodontics. Mosby Year Book, 2012.
2. Baccetti T, Franchi L, McNamara JA. Cephalometric variables predicting the long–term success or failure of combined rapid maxillary expansion and facial mask therapy. *Am J Orthod Dentofacial Orthop* 2004;**126**:16-22.
3. Baccetti T, Franchi L, McNamara Jr JA. The Cervical Vertebral Maturation (CVM) Method for the assessment of optimal treatment timing in dentofacial orthopedics. *SeminOrthod* 2005;**11**:119-129.
4. Baccetti T, Mc Gill JS, Franchi L, Mc Namara Jr JA, Tollaro J. Skeletal effects of early treatment of Class III malocclusion with maxillary expansion and face mask therapy. *Am J Orthod Dentofacial Orthop* 1998;**318**:533-43.
5. Cevidanes L Baccetti T, Franchi L, McNamara Jr JA, De Clerck H. Comparison of two protocols for maxillary protraction: bone anchors versus face mask with rapid maxillary expansion. *Angle Orthod* 2010;**80**:799-806.
6. De Clerck HJ, Cevidanes L, Heymann G, Tulloch C. Orthopedic traction of the maxilla with miniplates: a new perspective for treatment of midface deficiency. *J Oral Maxillofac Surg* 2009; **67**:2123-2129.
7. Baccetti T, Franchi L, and McNamara, JA Jr. Growth in the Untreated Class III Subjects. *Semin Orthod* 2007;**13**:130-142.
8. Wolfe SM, Araujo E, Behrents RG, Buschang PH. Craniofacial growth of Class III subjects six to sixteen years of age. *Angle Orthod* 2011;**81**:211–216.
9. Fudalej P. Prognosis on the Orthodontics management of Class III malocclusion – review of literature. *Czas Stomatol* 2007;**12**:806-814.
10. Moon YM, Ahn SJ, Chang YI. Cephalometric predictors of long-term stability in the early treatment of Class III malocclusion. *Angle Orthod* 2005;**75**:747-753.
11. Sugawara J, Mitani H. Facial growth of skeletal Class III malocclusion and the effects, limitation and long-term dentofacial adaptations to chin-cup therapy. *Semin Orthod* 1997;**3**:244-254.
12. Baumrid S, Korn E I, West E E. Prediction of mandibular rotation, An empirical test of clinician performance. *Am J Orthod Dentofacial* Orthop 1984;**86**:371-385.
13. Björk A. Prediction of mandibular growth rotation. *Am J Orthod* 1969;**55**:585-599.
14. Björk A, Skieler V. Normal and abnormal growth of mandible: a synthesis of longitudinal Cephalometric implant studies over a period of 25 years. *Eur J Orthod* 1983;**5**:1-46.
15. Ghiz MA, Ngan P, Gunel E. Cephalometric variables to predict future success of early orthopedic Class III treatment. *Am J Orthod Dentofacial Orthop* 2005;**127**:301-306.
16. Ko YI, Baek SH, Mah J, Zang WS. Determinant of successful chincup therapy in skeletal Class III malocclusion. *Am J Orthod Dentofacial Orthop* 2004;**126**:33-41.
17. Baccetti T, Cameron Ch G, Franchi L, Mc Namara JA. Treatment timing for rapid maxillary expansion, *Angle Orthod 2001*;**71**:343-350.
18. Kuc-Michalska M, Baccetti T. Duration of the pubertal growth peak in skeletal Class I and III subjects. *Angle Orthod* 2010;**80**:54-57.
19. Fields HW, Proffit WR. Treatment of skeletal problems in preadolescent children. In Proffit WR, Fields HW. Contemporary Orthodontics. Mosby Year Book, 1993.
20. Baydas B, Yavuz I, Usiu H, Dagsuyu IM, Ceylan I. Nonsurgical rapid maxillary expansion effects on craniofacial structures in young adult females. *Angle Orthod* 2006;**5**:759-767.
21. Garcia B Coco. Class III non-surgical treatment: breaking the barrier. *Int J of Orthod* 2007;**18**:35-36.
22. Jiuxiang L Yan Gu. Preliminary investigation of nonsurgical treatment of severe skeletal Class III malocclusion in the permanent dentition. *Angle Orthod* 2003;**73**:401-410.
23. Daher W, Caron J, Wechsler M. Nonsurgical treatment of an adult with a Class III malocclusion. *Am J Orthod Dentofacial Orthop* 2007;**32**:243-51.
24. Masataka H, Choo-ryung J, Chung, Kunimichi S. Nonsurgical correction of skeletal Class III malocclusion with lateral shift in an adult. *Am J Orthod Dentofacial Orthop* 2007;**131**:797-804.
25. Kuc-Michalska M. Nonsurgical treatment of adult Class III female patient with left-side lateral mandibular shift. *Clinical Orthodontics* 2015;**1**:21-39.
26. Haas AJ. Rapid expansion of the maxillary dental arch and nasal cavity by opening the midpalatal suture. *Angle Orthod* 1961;**31**:73-90.
27. Haas AJ. Palatal expansion: just the beginning of dentofacial orthopedics. *Am J Orthod* 1970;**57**:219-225.
28. Haas AJ. Long-term posttreatment evaluation of rapid palatal expansion. *Angle Orthod* 1980;**3**:189-217.
29. Handelman ChS. Nonsurgical rapid maxillary alveolar expansion in adults: a clinical evaluation. *Angle Orthod* 1997;**67**:291-308.
30. Meikle MC. Remodeling the dentofacial skeleton; The biological basis of orthodontics and dentofacial orthopedics. *J Dent Res* 2007;**86**:12-24.
31. Mucedero M, Coviello A, Baccetti T, Franchi L, Cozza P. Stability Factors After Double-Jaw Surgery in Class III Malocclusion. *Angle Orthod* 2008;**78**:1141-1152.
32. Sinclair PM, Thomas PM, Proffit WR. Combined surgical and orthodontic treatment. In Proffit W, Fields HW. Contemporary Orthodontics. Mosby Year Book 1993
33. Mervin D, Ngan P, Haag U and co. Timing for effective application of anteriorly directed orthopedic force to the maxilla. *Am J Orthod Dentofac Orthop* 1997;**112**:292-299.
34. Leonardi R, Cutrera A, Barbato E. Rapid maxillary expansion affects the spheno-occipital synchondrosis in youngsters. A study with low-dose computed tomography. *Angle Orthod* 2010;**80**:106–10.
35. Silvestrini-Biavati A, Angiero F, Gambino A, Ugolini A. Do changes in spheno-occipital synchondrosis after rapid maxillary expansion affect the maxillomandibular complex? *Eur J Peaediatr Dent* 2013;**14**:63-67.
36. Franklin D, Flavel A. Brief communication: timing of spheno-occipital closure in modern Western Australians. *Am J Phys Antropol* 2014;**153**:132-8.
37. Shirley NR, Jantz RL. Spheno-occipital synchondrosis fusion in modern Americans. *J Forensic Sci* 2011;**56**:580-5.
38. Krishan K, Kanchan T. Evaluation of spheno-occipital synchondrosis: A review of literature and considerations from forensic anthropologic point of view. *J Forensic Dent Sci* 2013;**5**:72–76.
39. Kircelli BH, Pectas ZO. Midfacial protraction with skeletally anchored face mask therapy: A novel approach and preliminary results. *Am J Orthod Dentofacial Orthop* 2008;**33**:440.
40. Shih- Yao Liu S, Kyung H-M, Buschang P. Continuous forces are more effective than intermittent forces in expanding sutures. *Eur J Orthod* 2010;**32**:371-380.

doi: 10.12889/2016_C00245

Case-control Study

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

How to cite this article:
Oliva B. Case-control study. *EJCO* 2016;**4**:31

Case-control studies are observational studies[1,2] that analyze association between exposure to risk factors and disease or condition (outcome of interest).
They are retrospective studies[3] because they look back in time. The investigators select from a given population subjects with specific condition/disease (cases) and subjects without specific condition/disease (controls). Data on exposure to risk factors are then collected retrospectively by interview, medical records or other sources.
If the investigators observe a greater number of exposed subjects in the cases group they might suppose association between risk factor and outcome.
Great care should be taken in the definition of disease and risk factors and in the selection of the cases and especially of the controls in order to limit bias[4].
The cases and controls should be similar in terms of some important characteristics (this technique is defined matching)[5], e.g. similar distribution of age and sex. Individual matching means that each case is matched to 1 or more controls.
The case-control study design is cheap and quick. It is often used in the study of rare disease/condition or of disease with a long latent period because prospective design should enroll a large numbers of subjects or should follow the subjects for a long period.
In the next article I will discuss the analysis of data and bias in case-control studies.

Example: we are interested in evaluating the association between mouth breathing (exposure) and maxillary contraction (outcome). In a representative sample of the population we select the subjects with maxillary contraction (cases) and those without maxillary contraction (controls).
Subsequently, we collect information from the cases and the controls on the past presence of mouth breathing. If we observe a greater number of mouth breathers in the group of cases, then an association between mouth breathing and maxillary contraction might be supposed.

	Population of interest
Exposed (mouth breathers)	Cases (maxillary contraction)
Unexposed (nose breathers)	
Exposed (mouth breathers)	Controls (correct transverse diameter)
Unexposed (nose breathers)	
← time	

Table 1: Example.

REFERENCE LIST

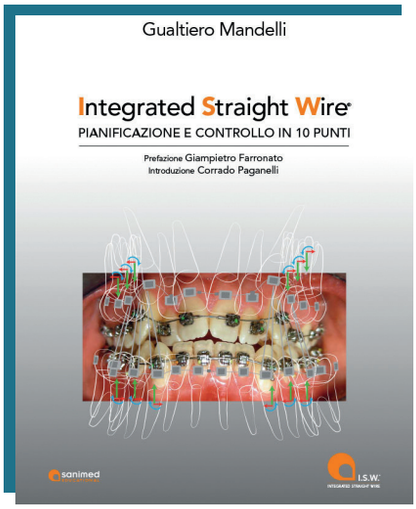
1. Oliva B. Introduction to Clinical Studies, *EJCO* 2014;**2**:63.
2. Grimes DA, Schulz KF. An overview of clinical research: the lay of the land. *Lancet* 2002;**359**:57-61.
3. Schulz KF, Grimes DA. Case-control studies: Research in reverse. *Lancet* 2002;**359**:431-4.
4. Levin KA. Study design V. Case-control studies. *Evid Based Dent* 2003;**7**:83-84.
5. Pandis N. Case-control studies: Part 1. *Am J Orthod Dentofacial Orthop.* 2014;**146**:266-7.

doi: 10.12889/2016_D00246

Integrated Straight Wire

Raffaele Schiavoni
Editor in-chief.

Gualtiero Mandelli's book "Integrated Straight Wire - Pianificazione e controllo in 10 punti" published by Sanimed Educational Srls arose from the author's desire to make the Damon technique (Damon System, Ormco) not so much "manually" as "culturally" dependent.
Thus, in the first part of his book, the Author divides the therapeutic approach into ten parts: from the "problem list" through to retention. In the second section the author analyses what he calls "phase auxiliaries" with one-by-one steps, i.e. occlusal buildups and elastics and so on.
The book ends with 10 clinical cases that present a range of levels of difficulty. Lastly there is an extremely useful 13-page summary, with no images, of the 10 ISW technique points, the goals and the therapeutic means provided by the Damon System and the challenges that are faced.
The task the Author sets himself is not an easy one but the result is an admirable endeavour that will be appreciated by those new to the technique as it will greatly simplify their journey.
The chapter on occlusal buildups for example is, in my opinion, particularly successful, offering both exhaustive artwork and detailed text.
If I may offer a suggestion to my friend Gualtiero Mandelli: why not make an English version?



Author
Gualtiero Mandelli

Contact information
Visit: http://www.sanimededucational.it/isw-manual/