#### This article has been peer reviewed.

# FEATURE

# Customized Orthodontics: The Insignia System

By Alessandro Perri, DDS; Antonio Gracco DDS; Laura Siviero, DDS; Serena Incerti Parenti, DDS; Daniela Rita Ippolito DDS

Abstract: Customized treatment systems offer both patient and clinician numerous advantages, first and foremost the possibility of viewing a computerized rendering of the dentition in three dimensions. This allows the orthodontist to perform accurate measurements, analyses and simulations, and for both to be able to view the end result on screen. Thus, computerized technology consents optimization of not only the diagnostic phase, by means of extremely accurate three-dimensional imaging systems, but also the operative phase, by supplying individualized appliances with little or no correction while the treatment is in progress. In this article we present a customized orthodontic system called Insignia and how it works through two different clinical cases.

Keywords: customized orthodontic appliance, Insignia, 3D technology.

ntroduction

Orthodontics, like the other dentistry disciplines has recently benefited from the influx of technological innovations. These innovations have

principally involved the means and procedures of diagnosis, with new developments being introduced in the field

of photography, tomography and optical and laser scanning. More recently, innovative systems able to construct orthodontic appliances customized for the patients have been introduced to the market. (1-5)

The majority of these systems involve three principal procedural phases.

The first phase involves the collection of diagnostic information. In addition to extra- and intraoral photographs of the patient, it is necessary to gather very precise information regarding the patient's occlusion and the coronal morphology of their teeth. Some systems require that this information be acquired by means of precision impressions, while others rely on intra-oral scans of the teeth or volumetric tomography of the dental arches.

The second phase of these systems involves the use of the acquired data on the patient's teeth and occlusion for digital replication of the dental arcades using reverse engineering processes. This consents acquisition of digital models of the arches, in which each tooth is defined as a CAD-CAM object, whose position can therefore be altered in three-dimensional space for virtual simulation of an ideal occlusion.

The third and final phase of these systems involves the construction of orthodontic appliances customized for the patient. This customization can be performed on three different components of the appliance; the bracket can be individualized, compensation bends can be added to the orthodontic archwires, and personalized jigs can be fabricated for precise positioning of the brackets on the teeth. (6-15) The Insignia System (Ormco, Glendora, Calif.) is one of the most advanced computerized systems for obtaining personalized appliances for patients. This system relies on precision impressions of the patient's teeth, which are subsequently used to obtain digital models of the dental arches directly via scanning of corresponding plaster models, or indirectly through a tomography of the impressions themselves. A digital setup is then performed on these digital models in order to obtain ideal alignment and levelling of the arches.

These stages are performed by the expert technicians at the Insignia headquarters at Glendora, USA. However, once the virtual set-up is complete, each case is forwarded to the clinician so that any necessary adjustments to the treatment plan in order to perfect the final occlusion can be made.

Indeed, using the Approver software, the orthodontists are able to modify every aspect of the digital setup directly from their computer. In fact, this software allows modification of the form of the arch, within its anatomical limits (Figure 1) ; the three-dimensional position of each single tooth (Figure 2); the smile arch (Figure 3) and the points of contact between the teeth in centric occlusion(Figure 4).

Once the clinician has defined the ideal setup for the patient, it is possible to proceed to the construction of customized orthodontic appliances.

Unlike many other systems, in which personalization entails the modification of the thickness of the composite used to adhere the bracket base to the tooth crown, in this system the brackets themselves are milled to the correct specifications.

These tailored modifications are possible with the Insignia twin brackets, whose slots can be milled to suit the case (milled in face), or self-ligating Damon SL brackets, whose bases can be customized.(Figure 5) It is, however, not possible to mill aesthetic twin or self-ligating brackets.



Figure 1: Mandibular archform and cortical limits. It is possible to make transversal modifcations within the bone limits.



Figure 2: Insignia digital set-up; virtual compass on right first molar to change the threedimensional position of the tooth.



view of the digital setup with underlined dots and lines that make possible smile arch modifcations.

Figure 3: Frontal





The Insignia system also permits personalization of metallic archwires with first-order compensation bends; this can be done to all wires required to complete the treatment, whether made of CuNiTi, stainless steel or TMA. Furthermore, application the brackets to the teeth is rendered extremely accurate and reliable, thanks to the production of transfer jigs; these are also obtained by precision milling of a spongy material to accurately fit the occlusal surface of the teeth.

# **Case Report 1**

A 14-year-old female presented with an occlusal sagittal molar relationship of Angle Class II, the upper median line was deviated 4 mm to the right, and ectopic maxillary canines were present high in the vestibule. The patient presented a hyperdivergent skeletal pattern. Due to the skeletal characteristics of the patient and the lack of space for the upper and lower canines, it was decided to plan customized orthodontic treatment using Insignia featuring extraction of the first premolars. (Figures 6- 12)

Twin Insignia attachments customized by means of slot milling were selected.

The archwire sequence employed was: 014 CuNiTi, .14 x .25 CuNiTi, .18 x .25 CuNiTi and .19 x .25 SS, followed by .19 x .25 TMA. In order to complete the correction of the molar Class on the right side, it was necessary to use a Vector orthodontic miniscrew (diameter 1.4 mm and length 6 mm), applied between the roots of teeth 43 and 45, and an elastic chain for mesializing tooth 46.

To improve intercuspidation, the finishing phase was performed by means of a TMA archwire.

The patient was seen 13 times over a total treatment time of 19 months. During that time no bracket bond failure occurred and no repositioning was necessary. (Figures 13 - 20)

## **Case Report 2**

A 25-year-old female presented with an occlusal sagittal molar relationship of slight Class II molar and canine relationships on the right, and a slight Class III canine relationship on the left, she had also an anterior open-bite. The left upper first molar had been extracted in the past and the second molar was inclined mesially. The patient presented a hyperdivergent skeletal pattern (Figures 21 - 27).

In this case it was decided to utilize Insignia customized appliances with Damon Q self-ligating brackets. It was decided to proceed to extraction of the 28 and consequent uprighting of the left upper second molar, in order to create space for the subsequent insertion of an implant at the first-molar site.



Figure 4: Dental contacts in the final centric occlusion (white dots).

Customized Damon Q brackets (Insignia SL) and molar tubes (TIB: Torque in base tubes), arches with first order compensation

IJO ■ VOL. 25 ■ NO. 4 ■ WINTER 2014







Figures 13-17: Post-treatment photographs. Canine and molar Class I occlusion, midline centred.



Figures 18-19: Post-treatment radiographs: OPT and teleradiograms.



Figure 20: Cephalometric Superimpositions before (green) and after (black).







Figures 21-27: Intraoral pictures, initial radiographs: OPT and teleradiography. The archwire sequence employed was: 014 CuNiTi, .14 x .25 CuNiTi, .18 x .25 CuNiTi and .19 x .25 SS, followed by .19 x .25 TMA.

Correction of the molar and canine Class and closure of the anterior open bite was achieved by means of intermaxillary elastics.

The patient was seen 13 times over a total treatment time of 18 months. During that time no bracket bond failure occurred and no repositioning was necessary. (Figures 28 - 35)

### Discussion

The Insignia system consents orthodontic treatment to be planned via computerized simulation of the patient's arches. The orthodontist is therefore in a position to view both the initial malocclusion and its final correction on screen. This three-dimensional video representation of the mouth is particularly useful as the treatment plan can be easily shared with both the patient and any colleagues involved in a multi-disciplinary approach. It is also possible to measure the modifications in the arch form, to alter the line of the smile arch in function of the facial expressions of the patient, and to view the occlusal contacts of the arches in centric occlusion.

Before defining the final ideal occlusion, and prior to fabrication of the orthodontic appliances, the clinician may modify the three-dimensional position of each single tooth at any moment, by altering values of torque, tip and in-out etc.

Moreover, this system permits online storage of not only 3D simulations, but also photographs and x-rays, thereby providing a useful and easy-to-access patient-specific archive. Moreover, the Approver software is intuitive and easy to use, and consents the set-up to be planned at any place and at any time, as long as an internet connection is available.

However, one important limitation of this system is the lack of information available regarding the roots of the teeth, which explains why it is sometimes necessary to add small corrective bends in the archwires during the finishing phase. Nevertheless, it will be possible in future to incorporate DICOM tomography files, thereby making all necessary threedimensional information about the teeth available.

IJO ■ VOL. 25 ■ NO. 4 ■ WINTER 2014









Figures 33-35: Post-treatment radiographs: OPT and teleradiograms. Cephalometric Superimpositions before (green) and after (black).

#### References

- Keim RG, Gottlieb EL, Nelson AH, Vogels DS: 2002 JCO study of orthodontic diagnosis and treatment procedures. Part 1. Results and trends, J Clin Orthod 36:553-68, 2002.
- Redmond WJ, Redmond MJ, Redmond WR: The OrthoCAD bracket placement solution. *Am J Orthod Dentofacial Orthop.* 125:645-6, 2004.
- Mayhew MJ: Computer-aided bracket placement for indirect bonding. J Clin Orthod. 39:653-60, 2005.
- Okunami TR, Kusnoto B, BeGole E, Evans CA, Sadowsky C, Fadavi S: Assessing the American Board of Orthodontics objective grading system: digital vs plaster dental casts. *Am J Orthod Dentofacial Orthop.* 131:51-6, 2007.
- Costalos PA, Sarraf K, Cangialosi TJ, Efstratiadis S: Evaluation of the accuracy of digital model analysis for the American Board of Orthodontics objective grading system for dental casts. *Am J Orthod Dentofacial Orthop*.128:624-9, 2005.
- Saxe AK, Louie LJ, Mah J. Efficiency and effectiveness of Sure-Smile. World J Orthod 2010;11:16-22.
- Sachdeva R.: SureSmile technology in a patient-centered orthodontic practice, J. Clin. Orthod. 35:245-253, 2001.
- Mah J, Sachdeva, R.: Computer-assisted orthodontic treatment: The SureSmile process, Am. J. Orthod. 120:85-87, 2001.
- 9. Sameshima, G.: Treatment time, Orthod. Prod., June 2004, p.22.

- Vassura G, Vassura M, Bazzacchi A, Gracco A. A shift of force vector from arm to brain: 3D computer technology in orthodontic treatment management. *Int Orthod.* 2010 Mar;8(1):46-63. Epub 2010 Mar 4.
- Scholz RP, Sarver DM. Interview with an Insignia doctor: David M. Sarver. Am J Orthod Dentofacial Orthop. 2009 Dec;136(6):853-6.
- Mavreas D, Athanasiou AE. Factors affecting the duration of orthodontic treatment: a systematic review. *Eur J Orthod.* 2008 Aug; 30(4):386-95.
- Fink DF, Smith RJ. The duration of orthodontic treatment. Am J Orthod Dentofacial Orthop. 1992 Jul;102(1):45-51.
- Vu CQ, Roberts WE, Hartsfield JK Jr, Ofner S. Treatment complexity index for assessing the relationship of treatment duration and outcomes in a graduate orthodontics clinic. *Am J Orthod Dentofacial Orthop.* 2008 Jan;133(1):9.e1-13.
- 15. Lin Ed. Technology case report. Class I with deep bite and crowding treated with lingual, i-Cat and Sure Smile. *Orthotown* December 2010, 29-31.



Dr. Alessandro Perri graduated in dentistry at University of Padova, Padova; Graduated in the Post-Graduated School of Orthodontics, University of Ferrara, Ferrara; Private Practitioner in Padova.



Dr. Laura Siviero graduated in Dentistry at University of Ferrara, Ferrara. Resident at Post Graduated School of Orthodontics of Ferrara, Ferrara.







Dr. Ippolito Daniela Rita graduated in Dentistry from the University of Bologna, where she is a resident, Unit of Orthodontics, Department of Biomedical and Neuromotor Sciences, University of Bologna, Bologna, Italy.



Dr. Anotino Gracco earned his degree in Dentistry and Dental Prosthetics from the University of Padova, Padova. He completed his post-graduate specialization in Orthognathodontics at the University of Ferrara, Ferrara. He was awarded a research grant in 2005-2010 for the project 'Three-dimensional Diagnosis in Orthodontics' at the University of Ferrara, Department of Medical

and Surgical Disciplines. He is a lecturer and Professor at the University of Ferrara Department of Orthognathodontics, responsible for teaching techniques such as skeletal anchorage, 3D technologies and the Customized appliances. He is a researcher at the University of Padova, Padova, Italy.