4D Orthodontics
From Morphologic Diagnosis to Time Factor

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Where do we stand now in modern orthodontics?
New methods of orthodontics take great advantage of digital technologies. They do this by preparing an individual treatment plan for the patient, which addresses his/her complex needs. Such a plan factors matters of biocompatibility and sustainability, which might not be exclusively related to his/her orthodontic problems.

Our research in this area has recently been exploring new scientific grounds. The question is: how can we look at the morphologic diagnosis and the maintainability of the results of orthodontic treatments? Let’s see a clinical example of how form and function determine stability.

Orthodontics is gradually evolving towards a more dynamic concept of occlusion, of functional harmony and biologic/mechanic interconnections.

Luckily, the progress from the old “static concept” of Class I occlusion to the present concept of functionally supported occlusions is not completely new to the orthodontists. This is what WJ Thompson wrote in 1979 in his article in Angle Orthodontist entitled “Occlusal Plane and Overbite” (Ref. Angle Orthodontist, 1979 January 49(1):47-55).

Hence, we are not talking of a new concept!

What can these two studies offer to orthodontists? Form and Function, this is what our teachers have taught us to make a correct diagnosis, to set a proper plan of health care and to define the objectives of stability and, above all, the maintainability of the results of our orthodontic treatments.

Let’s see a clinical example of how form and function determine diagnosis and prognosis:

A patient aged 25 was orthodontically treated in the past with fixed orthodontic appliances. He came to our attention due to progressive re-cession of 4.1, increase in sensitivity, and difficulty to maintain proper oral hygiene. The patient has uner-ecently been brought to us for peri-odontal surgery. Upon examination, we discovered severe gingival reces-sion of 4.1 associated with buccal root inclination and traumatic contact with the antagonist for extrusion. It also featured a fixed lower retainer, from 3.2 to 4.2, repeatedly repaired (Figures 1-3).

The old fixed retention previ-ously managed incorrectly has become an active retainer on 4.1 with buccal root torque unchecked. A proper morphologic diagnosis must consid-er the three-dimensional position of the root in the alveolar bone and not just detect the buccal gingival reces-sion, whose single consideration has already led to a treatment failure.

The treatment plan involved: (a) removing the old retainer and fixing a lingual appliance by self-ligating brackets 1 TBF from 3.4 to 4.4 with the purpose of aligning the lower frontal teeth, (b) correcting the root torque of 4.1 and (c) eliminating the occlusal trauma to allow recovery of an adequate periodontal health condition and secure maintain-ability. The required correction has been completed in 8 weeks from the removal of the old retainer and the simultaneous bonding of the lingual orthodontic appliance. The buccal gingival recession of 4.1 has improved significantly, only thanks to its repositioning in an appropri-ate periodontal environment, which has also improved the conditions for maintainability. The lingual appliance, very well tolerated by the patient, is maintained as a fixed re-tainer (Figures 4-8).

In this case, an orthopantomog-raphy had been done before the treatment, which made no apparent morphologic contributions to the clinical diagnosis.

Should a tele-radiography have been useful in this case?

Obviously not! How could we then make any use of tele-radiogra-phy?

In an editorial in the American Journal of Orthodontics of 2008, Da-lid T. Turpin says:

If the intracranial palpation of maxillo-mandibular complex in an 8 year-old child is difficult and there is a reasonable suspicion of a complicated para-digm of occlusion, you should consider doing a tele-radiography!

In the same editorial, we found the following recommendations by the British Orthodontic Society:

- a radiography should be done only after an accurate clinical exami-nation and when it offers an effective diagnostic advantage for the patient;
- generally, the advantages of a radiographic survey exceed the risks;
- the risk level is justified only when the patient has a health advan-tage with the ALARA dose (ALARA: as low as reasonably achievable) (Ref. Am. J. Orthodontist Dentofacial Or-thop. 2008;134:379-387)

A review of relevant literature in the field of orthodontics, published in Progress in Orthodontics in 2013, entitled “Validity of 2D lateral cephalometry in Orthodon-tics: A Systematic Review, reveals:

The literature suggests that the lateral cephalometry has been ap-plied without adequate scientific evidence, irrespective of whether it is mandatory for the diagnosis and without regard to its therapeutic ef-ficacy. (Ref.: Ana R Duran, Piana Pitt-tayapat, Maria Itzev B Rockenbach, Raphael Olzewska, Eun Kyung Seo, Maisong F Fernita and Reinbilde Jacobs. Pro-gress in Orthodontics 2013,14(1):3-10)

This article, as many other publi-cations, recommend that additional research is required on a larger num-ber of patients to clearly better the matter. The message is pretty clear.

The cephalometry has been used in orthodontics for long time for di-gnostic purposes and for training of generations of orthodontists, which helps them understand better the significance of the functional analysis. It does nothing more than express numerically what patients’ maxil-lary and cranial bones morphology provides.

Of course, with study and experi-ence as fundamental grounds, wise orthodontists would likely not need those numbers at all.

Moreover, could we do the ceph-alometry without radiation for a pa-tient who has a health advantage with the ALARA dose in terms of image quality and diagnostic accuracy? (Ref. Am. J. Orthodontist Dentofacial Orthop. 2008;134:379-387)
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By Dentsply Sirona

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To more complex cases requiring morphologic diagnosis, it is possible to superimpose the digital models and the 3D reconstruction of the maxillary bones and the roots obtained from the CBCT. By specific software, one can do a set up that considers the real anatomical limits of the radicular movement, which is named “set up bone safe” (Figures 9-10).

In this case, the virtual tooth of the patient is obtained by mixing the crown derived from the intraoral scan and the root from the CBCT. In this way, the radicular position in the maxillary bones could also be defined during and at the end of the treatment by repeating the intraoral scan, without further exposure to X-rays. It is thus possible to monitor the real progression of the orthodontic treatment, respecting the anatomical limits of the patient, evaluating systematically the match to the set up and, if necessary, restructuring it.

The follow up to our cases is not any longer confined to controls administered after the treatment. It becomes a dynamic concept, where time does not tell us what we have to do with the orthodontic therapy, if we identify the right moment of treatment.

The virtual follow up tells us what is happening today, now, beyond what our eyes see and with maximum care for the patient.

4D Orthodontics introduces a diagnostic fourth dimension, which relates to the time that flows and communicates with us.

References
1. Ortognatodonzia Italiana vol. 14, 1-2007; 13-20

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