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 of how new technologies could effectively change the way we diagnose and plan the corresponding treatment. A new player is emerging in the third-dimensional era, the 4D technology!

What does it mean? Can we talk of a new revolution in appliance technology?


This means that the correct timing of the treatment could be a major prerequisite to accomplish its main objectives. The “timing requirement” is by far a very clear concept but it can be further enhanced by adding an extra degree of dynamicity. Let’s see how!

To do this we have to go back in time… looking for studies on the same subject matter.

In 1996, Harold D. Kesling, in an article published in the American Journal of Orthodontics, entitled “The Diagnostic Setup with Consideration of the Third Dimension”, said:

Good orthodontic casts not only provide exact duplicates of every tooth in the mouth, but they also give a fairly accurate pattern of the apical base. Since neither the apical base nor the tooth sizes can be altered materially, some intelligent rearrangements of the plaster teeth, as it appears on the model, can remove confusion arising from pure speculation by replacing it with concrete objective manipulation. In short, he has just invented the morphologic diagnosis and the diagnostic setup.

Harold D. Kesling further noted, “Without dissecting the teeth from the orthodontic models and rearranging them in the most desirable sequence on the available model bases, the orthodontist can only speculate on available options and limitations of the treatment” (Ref. Am. J. Orthodontics, October 1996, vol.113, no. 5, pages 701-710).

Dynamics is the branch of mechanics interested in studying bodies’ motion and its causes or, more clearly, the circumstances that determine or modify it. Orthodontics is gradually evolving towards a more dynamic concept of occlusion, of functional harmony and biologic/mechanic interconnection.

Fortunately, 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 W.J. Thompson wrote in 1995 in his article in Angle Orthodontist entitled “Occlusal Plane and Overbite” (Ref. Angle Orthodontist, 1995, 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 recession of 4.1, increase in sensitivity, and difficulty to maintain proper oral hygiene. The patient has unre- latively been brought to us for periodontal surgery. Upon examination, we discovered severe gingival recessions 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 previously managed incorrectly has become an active retainer on 4.1 with buccal root torque unchecked. A proper morphologic diagnosis must consider the three-dimensional position of the root in the alveolar bone and not just detect the buccal gingival recession, 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 TTR from 3.4 to 4.4 with the purpose of aligning the lower front 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 maintainability. 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 appropriate periodontal environment, which has also improved the conditions for maintainability. The lingual appliance, very well tolerated by the patient, is maintained as a fixed retainer (Figures 4-8).

In this case, an orthopantomography 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-radiography?

In an editorial in the American Journal of Orthodontics of 2008, Davide I. Turpin says:

If the intracranial pulsation of maxillary sinus is difficult and there is a reasonable suspicion of a complicated eruption, you should consider doing a tele-radiography!

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

- a radiography should be done only after an accurate clinical examination 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 advantage with the ALARA dose (ALARA, as low as reasonably achievable) (Ref. Am. J. Orthodontist Dentofacial Orthop. 2008;134:37-47).

A review of relevant literature in the University of Oporto, Portugal, published in Progress in Orthodontics in 2013, entitled “Validity of 2D- vs. 2D- and 2D- vs. 3D- radiographs in Orthodontics; a Systematic Review, reveals The literature suggests that the lateral cephalometry has been applied without adequate scientific evidence, irrespective of whether it is mandatory for the diagnosis and without regard to its therapeutic efficacy (Ref. Ana R Durão, Puiha Pittayapat, Matta Iyer et al. 2013, a review of 2013). This article, as many other publications, recommend that additional research is required on a larger number of patients to clarify better the matter. The message is pretty clear. The cephalometry has been used in orthodontics for long time for diagnostic purposes and for training of generations of orthodontists, which helps them understand better the significance of angle measurement. It does nothing more than express numerically what patients’ maxillary and cranial bones morphology provides.

Of course, with study and experience as fundamental grounds, wise orthodontists would likely not need those numbers at all. Moreover, could we do the cephalometry without radiation for a patient?
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CEREC Zirconia: Valued material can now be used chairside

By Dentsply Sirona

Full contour zirconia has become a very popular material in dental offices due to its high flexural strength, biocompatibility and tissue conserving preparation. Dentsply Sirona CAD/CAM has introduced a world class technology to make the impossible possible. Thanks to an outstanding innovative workflow CEREC allows dentists to process and totally modify the previous model. Christensen, it is the best way to do so because when digital instruments do the innovation, the result is much better.

From 3D to 4D

Starting by the intraoral digital scanning of the dental arches, we can obtain virtual models and the occlusal details of a patient can be analysed and measured, without resorting to stone models. This technology was not conceivable at all some years ago.

A digital set up of orthodontic movements can be performed on such virtual models to simulate and define treatment objectives, to project appliances and to develop skills how to apply it.

During the treatment, new virtual models can be obtained by further digital scans of the dental arches, which may be superimposed on the initial ones, if desirable. In this way, it is possible also to monitor the progression of the therapy.

In 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 anatomic 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 tells us what is happening today, now, beyond what our eyes see and with maximum care for the patient.

CEREC Zirconia introduces a diagnostic fourth dimension, which relates to the time that flows and communicates with us.

References

Fig. 1: CEREC Zirconia can be dry milled with the CEREC milling and grinding unit.

Fig. 2: The new sintering furnace CEREC SpeedFire needs 20-35 minutes for crowns.

Fig. 3: The product family for the chairside production of CEREC Zirconia in the practice (from right): CEREC AC with Omnicam, the new CEREC SpeedFire sintering furnace as well as the CEREC milling and grinding unit.

Fig. 4: Crown made from CEREC Zirconia after sintering.

Fig. 5: The CEREC SpeedFire sintering furnace is the smallest of its kind on the market and really saves time with a sintering process that takes 10-15 minutes for each crown.

Fig. 6: Furnace CEREC SpeedFire needs 20-35 minutes for crowns.

Fig. 7: Follow up after two years

Fig. 8: Follow up after two years: note the presence of healthy gingiva

Fig. 9: In red the ideal set up of 3.3 without considering the real anatomical limits: the root is outside the bone

Fig. 10: In blue the lower arch set up considering the bone limits of the patient
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Our Speakers

Elzaan Booysen
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MBA in General Management

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Has many publications & lectures in Hygiene topics.

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Fig. 7: The CEREC SpeedGlaze spray quickly gives the restoration its high gloss. Spray on, fire for about 10-15 minutes and it’s ready.

Fig. 8: The CEREC SW 4.4.1 turns fabricating a restoration into a simple workflow which users can control intuitively.

It is obvious that advanced technologies in automobiles, computers and smartphones make our daily lives easier. CEREC is also a technology that further develops a dental practice and can make it well positioned for the future. Especially now, as the system is highly flexible, it enables dentists to expand their offering in implant dentistry and orthodontics.

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