

Digital diagnosis records in orthodontics. An overview

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ABSTRACT

Digital technology is becoming day by day a more important procedure in most of the clinic activities and, thus, orthodontists are increasingly adding digital technology to their orthodontics records.

In this article we want to outline the advantages and disadvantages of the use of digital photography, digital radiography as well as one of the latest developments: the digital study stone casts.

We will also present the state of the art related to dentists that use these digital records routinely in our country.

Key words: *Digital photography, digital radiography, digital dental casts.*

RESUMEN

Actualmente la tecnología digital es una realidad que cada vez se impone más en todos los ámbitos clínicos y, por tanto, existe una incorporación también de los ortodoncistas a la digitalización de los registros ortodóncicos diagnósticos.

En este trabajo queremos hacer una valoración sobre las ventajas y desventajas, del uso de la radiografía digital, la fotografía digital así como de la última incorporación, los modelos de estudio digitalizados.

Basados en encuestas previas, mostraremos la situación actual en nuestro país en cuanto al número de profesionales que utilizan estos registros digitales de manera sistemática.

Palabras clave: *Fotografía digital, radiografía digital, modelo de estudio digital.*

INTRODUCTION

Orthodontic records have always been very important in Orthodontics since they are a basic diagnosis tool which tells us about the patient occlusion. This information will be very useful to make and plan a right diagnosis and orthodontic treatment.

These records can be divided in three main groups; radiographs photographs and study dental casts. These records must be taken like before, sometimes during and after every orthodontic treatment.

Intraoral and extraoral photographs, study dental casts, panoramic and lateral radiography are the most useful orthodontic records as it was showed in a recent survey between Spanish Orthodontists (1) and with similar results to another survey in the USA (2).

Traditionally, conventional radiographs and photographs were made of regular photographic or radiographic paper, while study dental casts were made of stone material.

But nowadays, there is a big move towards digital orthodontic records.

DIGITAL PHOTOGRAPHY

Digital photography has been the first orthodontic digital record changing from the traditional photos into digital ones. Digital images have enjoyed enormous technological advancements in the past five years where digital camera's sales have been greater than traditional ones (3).

Digital orthodontic extraoral and intraoral photos can also be instantly integrated into the practice's software and have them all together in the same screen. (Figure 1)

ADVANTAGES OF DIGITAL PHOTOGRAPHY

The advantages of digital photography to traditional photography are enumerated (3-6).

- Ability to view the image as soon as it has been taken both in the camera screen or in the PC, allowing the doctor or operator to rectify it, repeat it or show it to the patients in order to motivate them.
- The absence of film, slides or processing cost is very well welcome for everybody.
- The ability to store records electronically is useful since after a number of years working, the space needed to store a large number of pictures records is significant.
- Image copies can be made automatically and easily with no economic cost.
- Digital photos are suited for immediate data transmission automatically everywhere to a colleague with the advantage of keeping original ones.
- There is not dust, scratch or damage of slides with time, even though it is necessary to make security copies very often.
- Digital records allow complete more confidentiality as the number of people involved in the processing and storage procedure is reduced.
- Digital records are easily and automatically introduced in main lectures, oral communications or PC presentations for teaching purposes.
- Any competent assistant can be trained to take digital photos,

thus saving time for the orthodontist.

39 per cent of the responders to a Spanish survey's (1) uses digital camera, another 39 per cent still uses traditional one, while 23 per cent uses both, digital and traditional cameras. In the United States (2), 28 per cent uses digital camera while 48 per cent still uses traditional one.

Before acquiring a digital camera, we describe some options to orthodontists ready to incorporate digital photography into their practices (7,8).

- In orthodontics, if you expect very high quality image, a top-end camera will be necessary.
- If you have an analogical photographic system, it is better to change just the body of the camera instead of buying a new one.
- If you don't have any experience at all in digital photography, it is better to buy a mid-range camera and not a very sophisticated one.
- Since digital technology is advancing substantially and decreasing in price everyday, it is better to buy a mid-range price camera.
- Consult Internet and have good references in order to be aware of all new things in digital photography.

DISADVANTAGES OF DIGITAL PHOTOGRAPHY

Digital photography has several disadvantages to keep in mind (3):

- Cameras prices are still high but they are decreasing in prices everyday (3,4).
- Digital image can be retouched and won't be useful for medico-legal requirements as the traditional negative (3).
- Since digital quality and technology are advancing, actual digital cameras will be absolute in a few years (3).

DIGITAL RADIOGRAPHY

As digital photography, there is a slow but steady move towards digital radiography which supposes a big quality improvement.

ADVANTAGES OF DIGITAL RADIOGRAPHY

Respect digital radiography, the advantages are discussed:

- Using digital radiography, the image is instantly obtained, thus saving time and allowing the professional to diagnosis immediately.
- Digital images are now of more than adequate quality and are certainly to conventionally obtained radiographs.
- Easy use by the operator.
- The reduction in radiation is like 70%.
- No chemicals or film needed for digital radiography.
- The brightness, contrast and saturation can be altered on the radiography which can make identification of anatomic tissues easier by the professional.
- We can use software for managing these radiographs and localize and place cephalometric points easily and automatically (Figure 2).

51,4 per cent of the Spanish responders (1), uses a cephalometric program for orthodontic diagnosis while 28 per cent of the

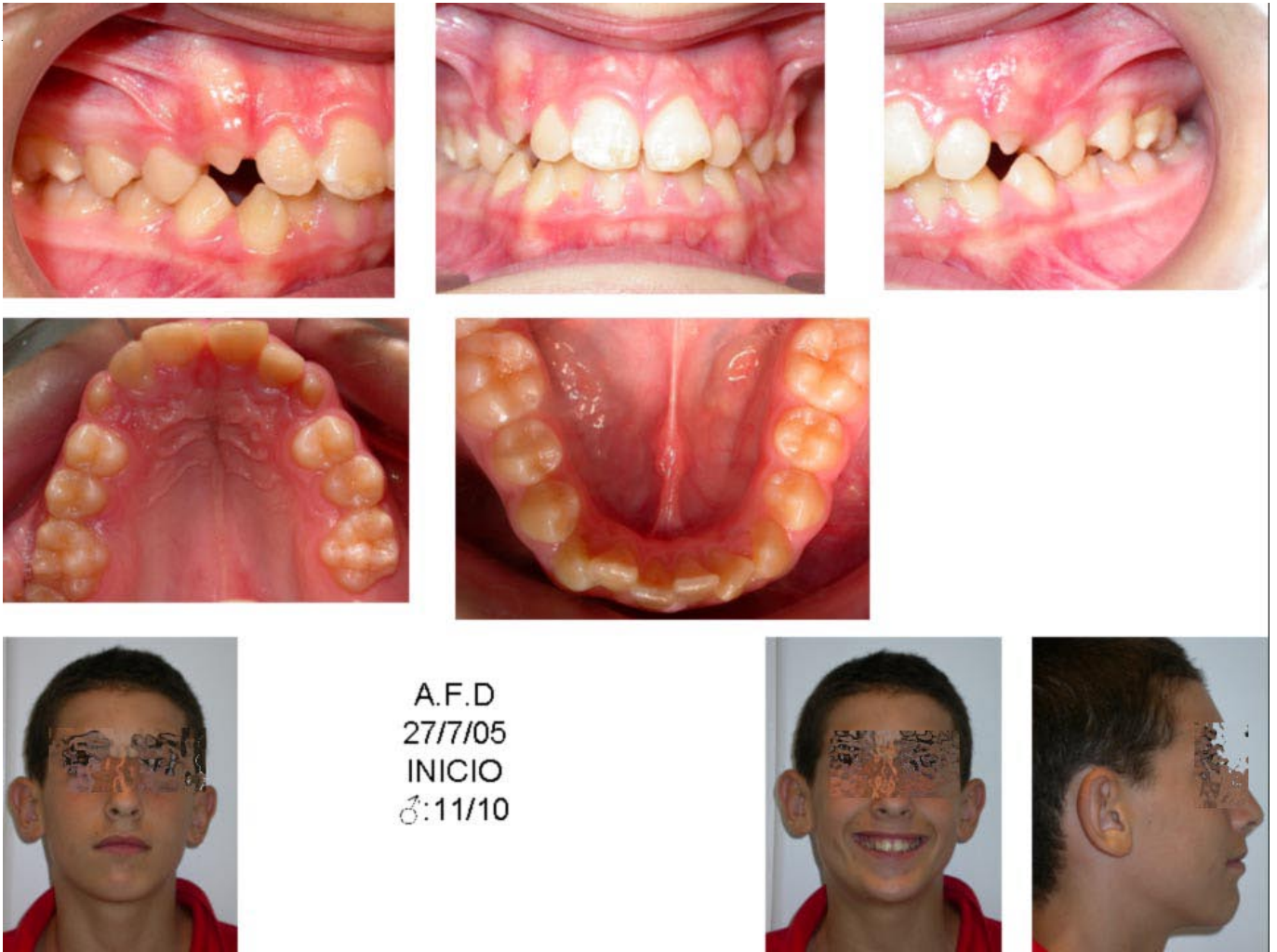


Fig. 1. Extraoral and intraoral digital photography of an orthodontic patient.

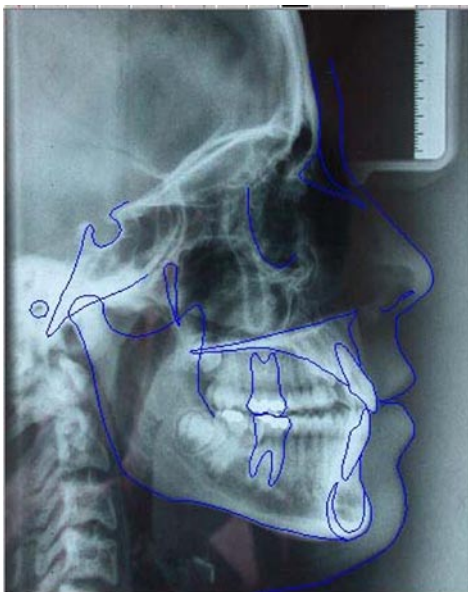


Fig. 2. Digital Lateral measured radiography.



Fig. 3. A dental cast been digitalized with a conventional scanner.

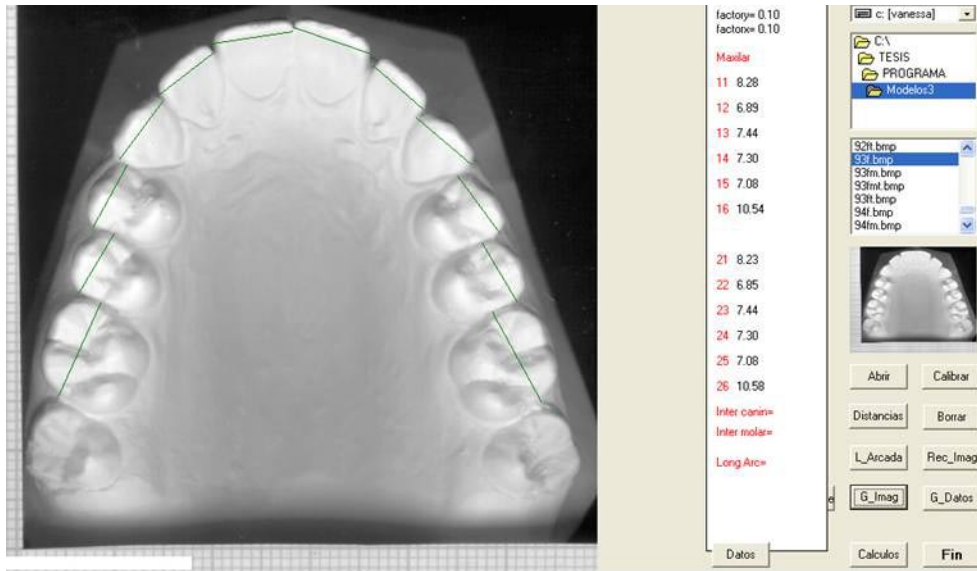


Fig. 4. Upper dental cast image digitalized inside the Digital program.

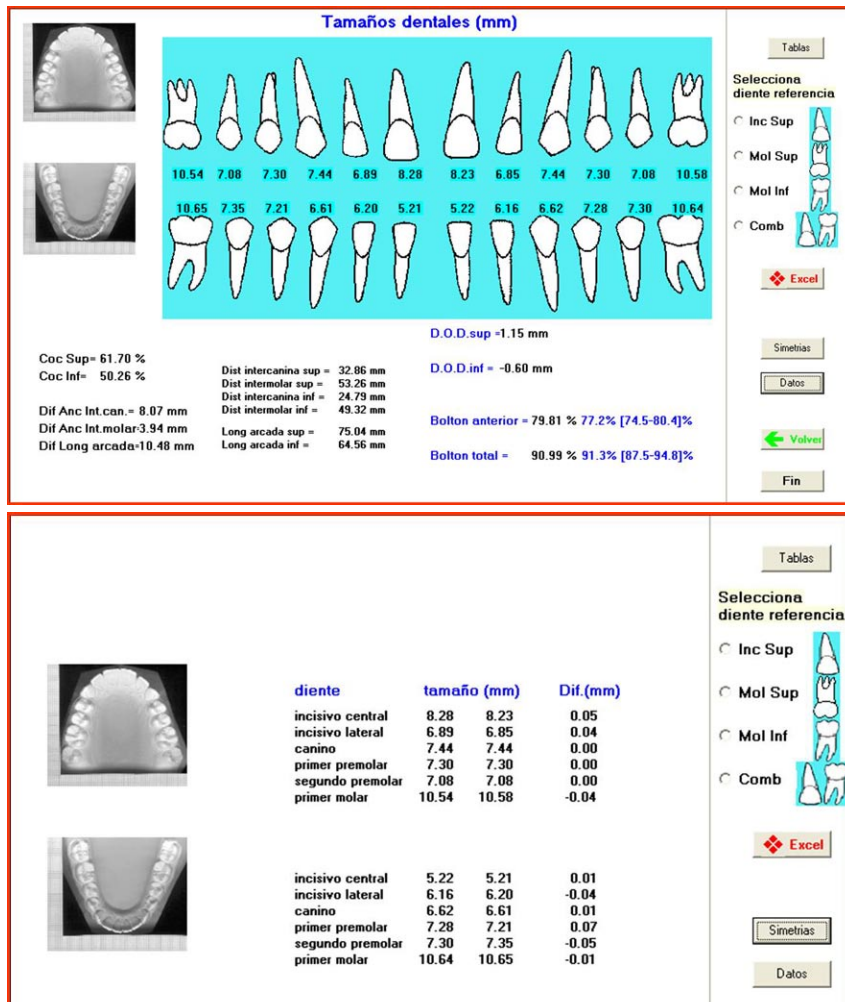


Fig. 5. A and B: Dental casts indirect and direct teeth measurements with the digital program.

DIGITAL STUDY MODELS

Any Orthodontist who has been in practice for a number of years, experiences a problem about storage space in his office besides it is a consuming time procedure. For this reason, the additional advantage of saving space of digital models is a welcome advance (9-11).

Begole (12) was one of the first authors introducing a computer program to aid the direct analysis of study models as a clinical diagnostic and using dental cast photos.

Rudge (13) devised another computer system using an electronic X-Y reader in order to relate changes in dentition as a result of orthodontic treatment.

At the same time, Yen (14) proposed a simple computer program using a study model photocopy. This program predicts "required space" and compares it to "available space". This analysis also includes Bolton ratios, intercanine distances, intermolar distances, arch length and arch discrepancy.

The introduction of digital image in our society and especially in orthodontics permits the use of, either a regular scanner, or a digital camera, to digitalize stone dental casts and to measure several measurements as mesiodistal tooth size, arch length, intercanine distance or intermolar distance by a computer program prepared to use these obtained digital images in 2D.

Rivero et al (15), used a regular scanner to digitalize dental stone casts while Carter et al (16), introduced another new digital method to measure tooth-arch width, length and perimeter and to evaluate longitudinal arch changes with age.

Gouvianaski et al (17) were one of the first authors using a digital camera linked to a computer program to photograph and measure stone dental casts while Trankmann et al (18) measured dental models by digitalizing tables.

Ho and Freer (19), designed a computer program that permits direct input of tooth-width measurements per patient from study casts using digital calipers instead of traditional ones.

Mok and Cooke (20) compared the reproducibility of mesiodistal total tooth widths and arch perimeter values, on plaster casts, given by sonic digitization and by digital calipers.

Redmond (9,10) introduced a new computerized system in which impressions are sent to the company where they are scanned and e-mailed to the Orthodontist back. This new system allows five simultaneous views of the model in 3D, can be incorporated into computer patient records and eliminating the need for model storage.

Tomassetti (21) compared three digital measuring methods with the traditional method for calculating the Bolton Index and concluded that digital methods were much quicker.

Garino (22) also compared dental arch measurements between stone and digital casts concluding that digital program were as easy and accurate as traditional ones with the additional advantage of saving storage space.

In McKeown's study (23) tooth dimensions were compared between index patients with severe hypodontia, their relatives with a full complement of teeth and a control group. All formed teeth were imaged buccally and occlusally from study models with a digital camera linked to a computer. The camera was mounted horizontally above the model on an adjustable rod

with the lens focused parallel to the tooth surface and parallel to the long axis of the clinical crown for occlusal views.

Tran (24) compared Little index results with traditional calipers and a digital program concluding that the digital system was a very good option for this measurement.

But most of the digital programs reviewed, give teeth measurement information as a group and not individually.

In the present study, we introduce a new, fast and accurate 2D computerized-aid system, already introduced and proved by us (25), to measure mesio-distal tooth size, intercanine and intermolar distance, arch perimeter and calculate Overall and Anterior Bolton ratios, arch discrepancy and teeth asymmetries automatically.

All the study casts were digitized with a conventional scanner (Figure 3). But before making any measurement, it is important to use an accurate and easy calibration system to obtain dental casts tooth real dimensions in millimetres.

With the aid of the mouse as a user interface of the digital method, we marked the points of the mesiodistal size of each permanent tooth on the image of the casts. The software designed for this purpose, which we have tested and found accurate and reliable (25) determines dental measurements in millimetres automatically. From this data, we were able to predict the rest of teeth measurements (Figure 4, 5A and 5B).

ADVANTAGES OF DIGITAL STUDY MODELS

- These virtual casts can be kept in digital format and also eliminating the storage problem with study models in our offices.
- Digital images can be made bigger and localizing anatomic points easily.
- Digital photos are suited for immediate data transmission for instance to a colleague by Internet for an orthodontic diagnosis.
- Digital study casts can be showed to patients in order to motivate them in their treatments.
- Measurements can be made on digital casts in an easy, accurate and automatic way.
- Digital casts and their measurements can be accessed at any time and at any distance for diagnostic, clinical and information purposes.

In Spain, an orthodontics survey (1) reported that digital programs for dental casts are just used by 10%.

DISADVANTAGES OF DIGITAL STUDY MODELS

- If we have poor dental casts, digitalized images can be altered during digitalizing even if a good calibration system is made.
- Sometimes, some dental images in mixed dentition are difficult to recognize and measure.
- Digitalizing dental casts is a laborious process that has always to be made under the same conditions.

Nowadays, digital study models can be viewed from any angle, turned through 360° in all planes of space and even opened to allow upper and lower models to be viewed separately. Measurements can be carried out to allow space analyses to be conducted (26-28).

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