Intraoral scanner in dentistry

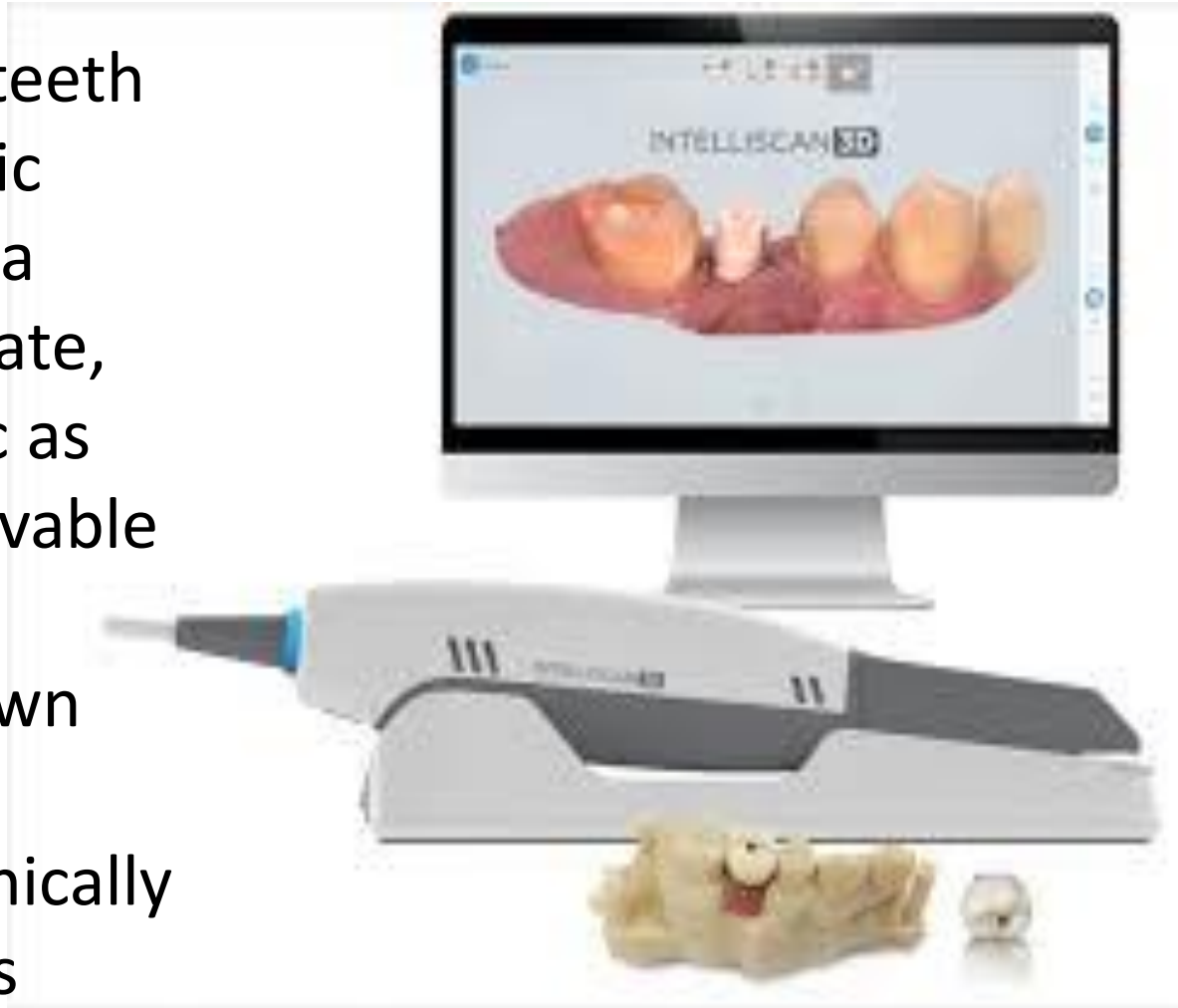
What's the intraoral Scan?

- IOS is a medical device composed of a handheld camera (hardware), a computer, and a software. The goal of IOS is to record with precision the three-dimensional geometry of an object. The most widely used digital format is the open STL (Standard Tessellation Language) or locked STL-like. However, other file formats have been developed to record color, transparency, or texture of dental tissues (such as Polygon File Format, PLY files). Irrespective of the type of imaging technology employed by IOS, all cameras require the projection of light that is then recorded as individual images or video and compiled by the software after recognition of the POI (points of interest). And then calculated depending on the distance to object technologies of each camera.

What is the intraoral scanner used for?

- Smile designs DSD
- in orthodontic treatments, thus generating retainers and palatal appliances. Allowing to observe imperfections in real time that need correction-alignment.
- In treatments of unknown lingual brackets and invisible aligners, such as Invisalign aligners.
- Partial prostheses and obturators.

- In prostheses, IOS are used to make impressions of preparations of natural teeth for fabricating a wide range of prosthetic restorations: resin inlays/onlays, zirconia copings , single crowns in lithium disilicate, zirconia , metal-ceramic and all-ceramic as well as frameworks and fixed and removable partial and complete dentures. Several studies and literature reviews have shown that the marginal gap of ceramic single crowns made from intraoral scans is clinically acceptable and similar to that in crowns produced from conventional impressions.



How does an intraoral scanner work?

- An intraoral scanner can capture optical impressions directly on the patient's jaws, we must pass the pencil or intraoral camera over the gums and teeth of the patient, it emits a light source (which can be laser or structured). Next, you will be able to observe the model recreating itself on the touch screen in a three-dimensional image.

Intraoral scanners can be of two types, so how they work will depend on what type it is:

- Photographic technology scanners are those that capture individual images of the areas to be scanned, ie individual images are taken that the system merges to form the digital 3D model.
- Unlike the previous type, Video technology scanners work in a very similar way to a video camera, so the scanned areas are recorded.

How can the intraoral scanner help your dental clinic?

- Until now, the traditional system to represent the patient's oral cavity was by making dental impressions with materials such as alginate or silicones, which caused discomfort to the patient (gag reflex, bad taste ...), required more work time, caused errors or instability of the impression, lacerations on the margins and the emptying of the impression with plaster.

- Nowadays, the digital workflow in the clinics has become more and more noticeable and the use of the intraoral scanner has simplified the design of models, therefore, the realization of prosthetic or orthodontic treatments require less work time (compared to the traditional model of taking impressions).

Advantages that the intraoral scanner offers to your dental clinic:

1. **Say goodbye to Alginate, or plaster**: With the use of the intraoral scanner you will avoid the cumbersome use of alginate, in a matter of two or three minutes you will obtain a 3D printing model to work on it.

2. **Avoid discomfort to your patients**: in line with the previous point, you can obtain the images without bothering the patient with the taking of physical impressions, so you can forget about the gag reflex, complaints about the taste or smell of alginate or silicones that are so annoying for patients (adults and children). The process will therefore be faster, more pleasant and more comfortable for the patient. Probably this is one of the advantages that favours the patient very much, they will thank you for more efficient processes that reduce the minutes of waiting.

3. **Get high fidelity models**: If there is one thing that stands out, it is the precision and fidelity of obtaining the models, because there are no inconveniences such as bubbles, setting, wrinkles or cracks or tears. So the errors are reduced to the maximum and the measurements consist of an incredible precision. The scanners are so accurate that models of both natural teeth and implants can be captured.

4. **Corrects defects instantly**: If for some reason an image has been distorted, just by reviewing the area, scanning it again you will be able to rectify it without any problem.
5. **Create 3D files:** The ability to access 3D digital files whenever you want is possible. You will be able to create them and locate them easily, favouring the saving of space for shelter of plaster or plaster models.

6. **Save on shipping costs:** You will save the money you used previously in shipments to laboratory, these will be sent to the laboratory through the management software with your user. You will not have to send the models in physical under any circumstances.
7. **Use it also as a Marketing tool:** You will differentiate yourself from the competition, through the use of technology as one of the fundamental pillars of your dental clinic. In addition, the patient will be able to visualize the evolution of their treatment, they will feel that they are actively part of the process. It will also allow you to show the state of caries, fractured teeth, presence of calculus and the current position of their teeth, offering them an easier to understand knowledge of their mouth.
8. **It simplifies the process:** it facilitates diagnosis, simplifies the process of obtaining models and improves the effectiveness of the results.

- **The disadvantage of the IOS** Difficulty detecting deep margin lines of prepared teeth One of the most frequent problems encountered with IOS and with optical impressions is difficulty in detecting deep marginal lines on prepared teeth or in the case of bleeding In some cases and especially in aesthetic areas where it is important for the clinician to place the prosthetic margins subgingival, it may be more difficult for the light to correctly detect the entire finishing line In fact, unlike the conventional impression materials, light cannot physically detach the gum and therefore cannot register ‘non-visible’ areas. Similar problems can also blood may obscure the prosthetic.

appropriate strategies for highlighting the preparation line (insertion of a single or double retraction cord), and avoiding bleeding (excellent oral hygiene and Provisionals with correct emergency profile).

What are the main intraoral scanners currently on the market?

- There are several models of intraoral scanners in the digital dentistry market: the Medit 500, TRIOS 4, iTero Element 5D, Primescan, Esmeralda S, CS300 among others. In this article we will comment on the evolution of those that we consider most important in the current market.

- **iTero** was introduced to the market at the beginning of 2007, after many years of research and trial-error tests, Align Technology has managed to evolve, reaching devices like the CEREC Omnicam, does not need to use powder to reflect light. In addition, the scanning sequence is indicated to the operator by the computer itself, meaning that he can remove the scanner head from the patient's mouth at any time, as the images are assembled to capture all the details of the oral structures.

Medit started in digital dentistry in 2013 with Blue Identica, which was the first intraoral scanner with blue light on the market, after two years launched the Hybrid. Last year they introduced their first intraoral scanner the Medit i500, and then the Medit i700, to date they have been perfecting their software and other functions based on user feedback.

- **CEREC Primescan:** The various sales companies have been developing and improving the design, use and software of intraoral scanners since the appearance of Sirona's CEREC in the 1980s. The CEREC systems have evolved and improved models have been introduced, which are simpler to use and faster, without the need for dust.

- **3Shape TRIOS**: 3Shape presented the TRIOS scanner at the 2011 International Dental Show. Currently, the market includes the 3Shape TRIOS 3 Basic intraoral scanner, the 3Shape TRIOS 3 and the 3Shape TRIOS 4. The latter, which is wireless, allows wireless scanning for comfortable and easy work. the latter has notable improvements such as: aid in the diagnosis of caries and also the shade of the teeth .

Are optical impressions as accurate as conventional impressions?

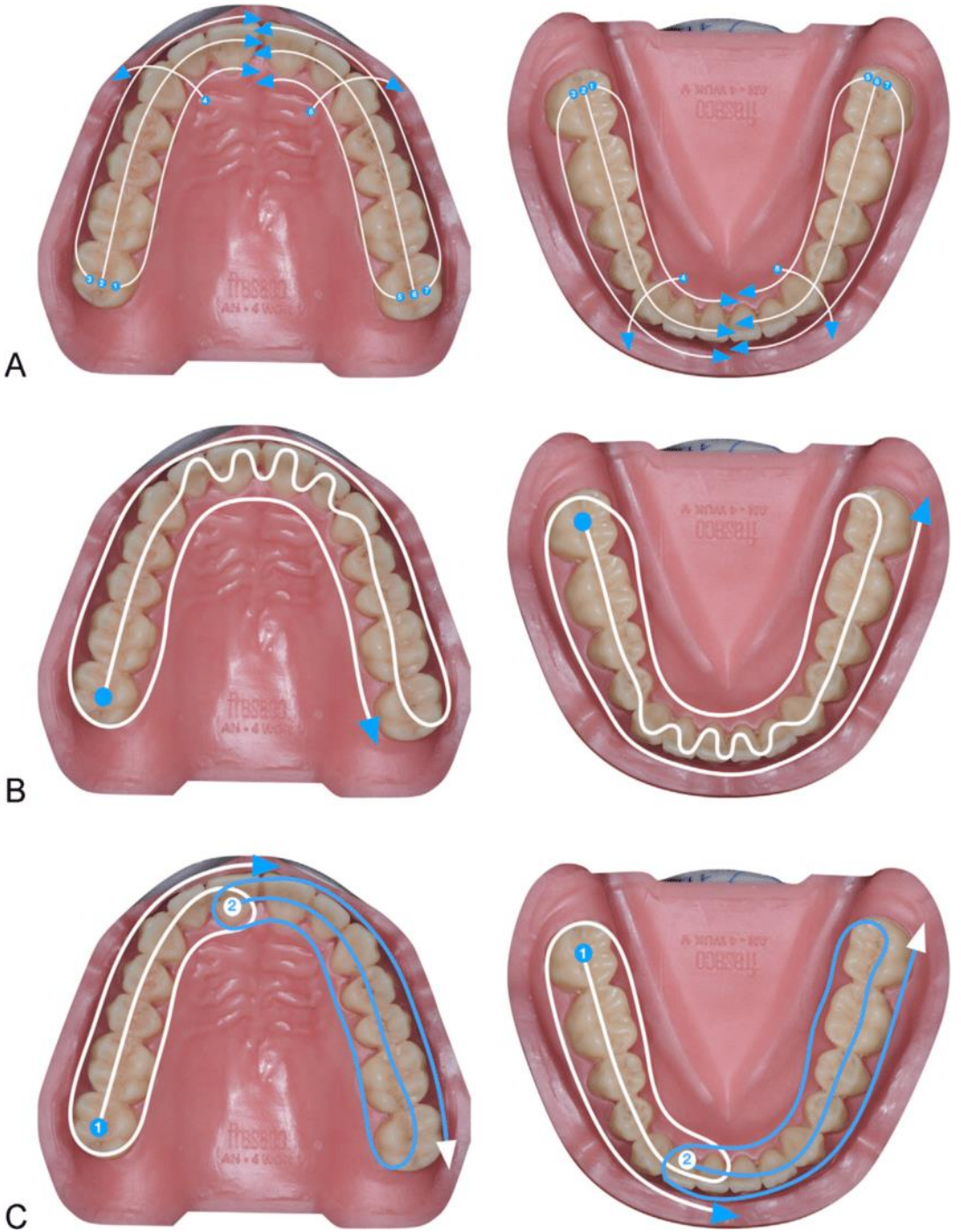
The main feature an IOS should have is accuracy: a scanner should be able to detect an accurate impression, accuracy is defined as the ‘closeness, of agreement between a measured quantity value and a true quantity value of a measured objects ’ Ultimately, accuracy is the sum of trueness and precision .Trueness, is the ‘closeness of agreement between the expectation of a test result or a measurement result and a true value. Precision is defined as the ‘closeness of agreement between indications or measured quantity values obtained by replicate measurements on the same objects under specified conditions. Ideally, an IOS should have high trueness (it should be able to match reality as closely as possible). that is, be able to detect any impression detail and permit the establishment of a virtual model as similar as possible to the actual model, and that little or nothing deviates from reality.

Precision and Trueness of IOS Files

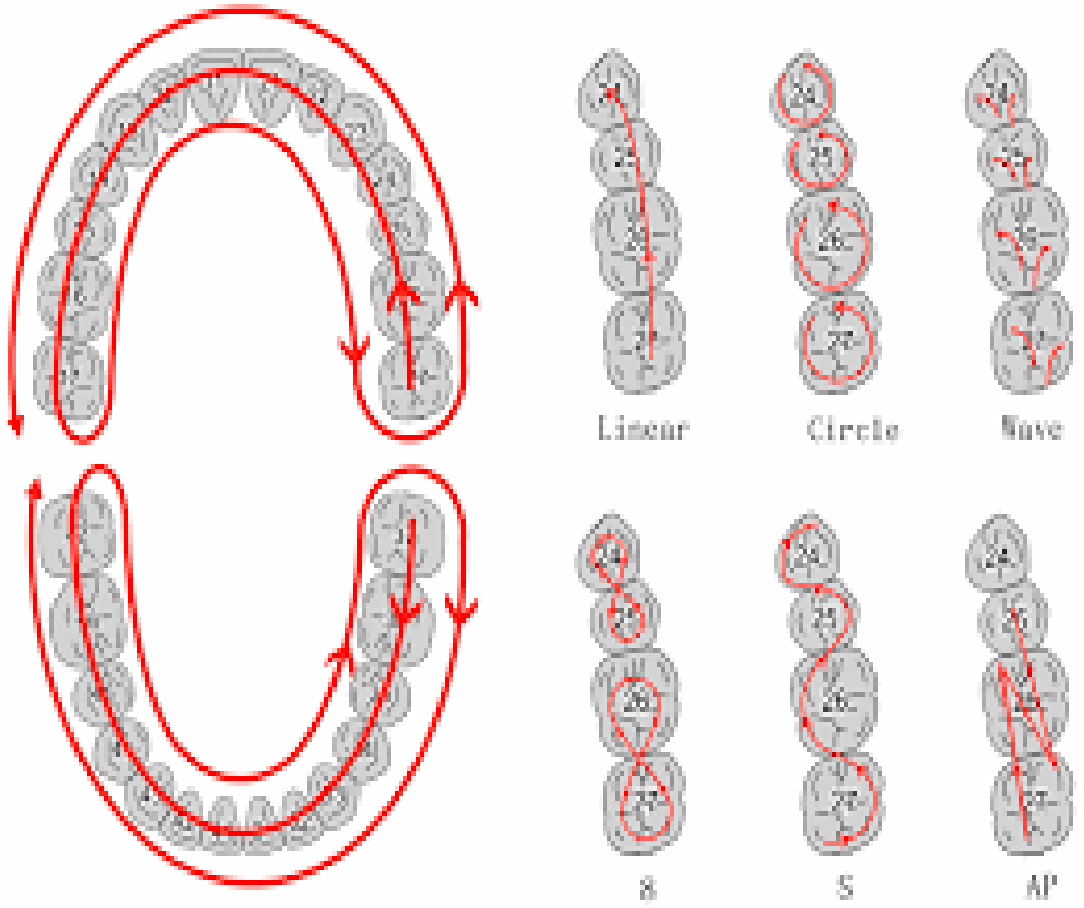
- Trueness and precision mainly depend on the scanner acquisition/processing software, which performs the most difficult task: ‘building’ the 3D virtual models. The resolution of acquisition, that is, the minimum difference an instrument is capable of measuring (i.e. sensitivity of the instrument) is also important; however, it depends on the cameras inside the scanner, which are generally very powerful. Many papers have reported clinically valuable precision and trueness of current IOS, both in vitro and in vivo For example, Ender et al. have reported that the mean trueness of various IOS technologies is between 20 and 48 µm and the precision is between 4 and 16 µm, when compared to conventional impression. The conclusion of these reports is that current IOS devices are clinically adapted for common practice, with at least similar accuracy to conventional impression taking.

Scanning Paths

Scan path means that the intraoral scanner must be used according to a specific movement to increase accuracy of the virtual model . Recent studies have shown the influence of the scan path on the accuracy of data captured using confocal scanners, both in vitro and in vivo . The scanned object should be positioned at the centre of an acquisition area to describe an optimal sphere around the object. Practitioners also have to maintain a fluid movement, always preserving a steady distance and the tooth cantered during recording. The camera should be held in a range of between 5 and 30 mm of the scanned surface depending on the scanners and technologies.



- Another procedure consists of making an S sweep on vestibular, occlusal, and lingual faces of each tooth successively . The first strategy seems to limit spatial distortion by finishing the capture at the initial position, and so avoiding an overall one-way error, but linear or rough movement of vestibular scans could be imprecise on interproximal areas. This technical observation leads practitioners to adapt their clinical protocol in difficult areas such as interproximal zones, tooth preparation, high curvatures of central incisive, and change of axis around canines.



Finally, an IOS should be able to fit in an ‘open’ workflow and should have an affordable purchase and management price. Ideally, an IOS should have two outputs: a proprietary file with legal value, and an open-format file (e.g.. STL,. OBJ,. PLY). Open-format files can be immediately opened and used by all CAD prosthetic systems In such cases, the literature generally refers to an ‘open system’ .The advantage of these systems is versatility, together with a potential reduction of costs (there is no need to buy specific CAD licenses or to pay to unlock the files); however, a certain degree of experience may be required, initially, to interface the different software and milling machines .This problem does not arise in the case of IOS within a ‘closed system’. Such scanners have as output only the reference proprietary (closed) file, which can be opened and processed only by a CAD software from the same manufacturing company. The inability to freely dispose of. STL files, or the need to pay fees to unlock them, certainly represents the main limits of closed systems


Any
Questions

Thanks for listening