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Digital impressions in Orthodontics

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Abstract

Digital impressions are a boon to dentistry as well as orthodontics. Unpleasant experiences of taking dental impressions and discomfort caused by them can be avoided, with the advent of digital impressions and scanning. The long been desire of every orthodontist to scan plaster models or teeth directly in the mouth is achieved. The Itero scanner digitally captures the structure and position of teeth and arches, using the latest optical technology. Thus it gives a 3D impression of the teeth and surrounding soft tissues. The benefits of this technology is enormous. This article discusses about the benefits of digital impressions using digital scanners. The Itero scanner digitally captures the structure and position of teeth and arches and it works on the philosophy of optical technology thus giving a 3D impression of the teeth and surrounding soft tissues. The long been desire of every orthodontist to scan plaster model or the teeth directly in the mouth is achieved. The advantage of this system over conventional impression and its use with invisalign system is also discussed.

Keywords: Digital, Conventional, Impressions, Itero scanner.

Introduction

Scanning and creation of digital records allows for convenient and transferable data which can be utilized in years to come, particularly for retention purposes. The taking of dental impression is being replaced by intraoral digital scanning procedures[1], which are new digital impression methods and techniques, that are available in market. These system are being implemented by orthodontists regularly, thus sparing the patients from unpleasant experiences of taking dental impression in dental offices.

The use of plaster models is essential and a routine practice in orthodontics. It has long been every orthodontists desire, to be able to scan plaster models, or even patients teeth directly in the mouth. Avoiding discomfort, speeding up work, improving communication between fellow dentist and labs, and reducing the physical

space needed for storing these models are some of the alleged benefits of thistechnology.

Since the introduction of the first digital impression scanner various dental office scanners have been developed, that are increasingly user friendly and help in producing images with accuracy. The use of these products represents paradigm shift in the way that dental impressions are taken.

This article addresses the technical impacts and applications of digital impressions in routine orthodontics and also explains about Itero scanners, their working principle and advantages compared to conventional impression techniques.

Evolution of Digital Impression Systems

The major goals of digital impression taking process is to establish a proper interocclusal relationship. In orthodontics, the use of accurate plaster models is an essential prerequisite for establishing suitable diagnosis and treatment planning, as well as for monitoring treatment progress.

The techniques used for impression taking with elastomers and creating plaster cast have been in widespread use since 1937. Impregnum, a polyether material introduced by the ESPE company in 1965, was the first polyether material specifically produced for use in dentistry. Many dentists are reluctant to embrace the new technologies because they simply believe elastomeric impression materials and techniques have been in use for so long and work so well that they are irreplaceable or else, that 3D digital scanning technologies are so recent that they are not yet ready for clinical use. Actually impression taking using elastomers, for all its inherent problems, has been used in dentistry for 72years.

Digital impression and scanning systems were introduced in dentistry in the mid 1980s and have evolved to such an extent that some authors predict that in five years most dentists in the US and Europe will be using digital scanners for impression taking[2].

In Orthodontics digital impression taking has been used successfully for several years with systems like Cadent IOC/OrthoCAD, Dentsply/GAC's OrthoPlex, Stratos/OrametrixSureSmile and EMS Rapidform.

Two types of systems are available on the market today: CAD/CAM systems and dedicated three-dimensional digital impression systems(3D). This article reviews the characteristics of dedicated 3D digital impression systems not only because this is the state-of-the-art today but because it shows great promise for the future.

Itero Scanner

Figure 1

The iTero digital impression system(Cadent Inc., USA) entered the market in 2007. It uses a parallel confocal imaging system to perform fast digital scans, capturing 100,000 points of laser light and producing perfect focus images of more than 300 focal depths are spaced no more than 50 micrometers(50um) apart. Parallel confocal digital scanning captures all elements and materials found in the mouth without the need to apply any materials to the teeth, because it features direct scanning and does not require the use of scanning powder, Cadent'siOC scanner provides orthodontists, and their assistants with flexibility in a host of clinical applications. It provides highly accurate orthodontic scanning with real-time viewing in adults and adolescents, in patients with various mouth

openings and in full and partial arches. In addition, iOC's software architecture allows data to be exported and used in integration with other orthodontic office management software such asOrthoCAD.

Itero scanners are already leaders in dental technology. It is constantly refining its intraoral scanning options. Element Itero scanners was introduced in March 2015, and captures6000framespersecond, repto20timesfaster than its predecessor. Its wand is also smaller and lighter, with n built controls for more intrusive operation. Intraoral scanners from this Itero system are renewed for their accuracy, and the increased capture speed is its added feature.

This itero scanner captures images of teeth and surrounding soft tissue of patients and creates three dimensional dental images in minutes[3]. They are very simple to use and operated by one person. Unlike many other scanners, these Itero scanner works on open systems. This feature enables dental professionals to use their digital scan files more flexibly. Intraoral digital scans from Itero scanners can be easily shared with other dental professionals and labs and also with invisalign procedures[4].

Working principle of Itero scanners

Figure 2

These Itero scanner features wand which orthodontist moves around patients teeth and surrounding soft tisues and in latest versions, this wand helps in capturing thousands of frames per second, which are arranged together to create a three dimensional visualization of the patients mouth.

The wands on Itero intraoral scanner are smaller than early intraoral scanners, allowing them to scan molars which were traditionally difficult toreach.

These scanners have screens which display the dental images as they are captured in real time. The screens show whether the scan is good or not before its saved. It act as a good time savers, for the orthodontist in communicating with labs[5]. Unlike many other intraoral scanners patients don't need to cover their teeth in titanium dioxide powder before scanning. This is another advantage ofpresent Itero intraoral scanners. Thus obtained 3D image or model are more accurate than X-ray or traditionalimpressions.

As a result, orthodontist can plan more efficient and stable treatment plan. Precise measurements of tooth size and spaces can be obtained, and it helps in planning a successful treatment from placement of brackets till retainers and aligner trays also if necessary.

Figure 3

The digital itero scanners captures the teeth and surrounding structures using latest optical technology. Once the process is started, orthodontist can stop or start as many times as necessary. Scanning can be done without any radiation. In as little as two to three minutes a digitally perfect 3D impressions areobtained.

Uses of itero scanners

1. Itero scanners are used to obtain pre treatment record.
2. Fabrication of some appliances.
3. Fabrication ofretainers.
4. Used along with Invisaligntreatment.

Advantages of itero scanners

1. Comfort: The 3D scanning is often much more comfortable or patients than traditional impressions, no gag or goop.
2. Quality: Digital impressions limit the margin for error and distortion compared to traditional impressions.
3. Cost effective: 3D scanning costs the same as traditional impression.
4. It is fast and accurate.
5. In case of Invisalign treatments, the treatment time is faster and fit of the aligners is far superior than when made with traditional impressions.
6. These Itero systems come with “Predictive Treatment Scans” which will enable the patient to see their smile after orthodontic treatment look like before the start of treatment itself.

Conventional versus Digital Impressions

Figure 4

No more goop, gagging or discomfort upon using Itero scanners. The most comfortable and accurate digital impressions can be obtained in as little as two to three minutes[6].

Whereas the conventional impression technique is incredibly unpleasant and frequently results in taking many impressions that can be rejected, broken or misplaced.

The Itero scanners ensures a more accurate impression from the start, resulting in improved treatment and a more comfortable patient experience[7]. This system also gives us the ability to view the teeth and jaws instantly in 3D, thus improving communication during the consultation and treatment process[8].

Itero scanner and Invisalign

Figure 5

Invisalign clear aligners are one of the most popular teeth straightening aids which are used today, as they are effective, removable, and virtually undetectable. Unlike many intraoral scanners, iTero intraoral scanners have open architecture which makes them compatible with the invisalign system, including its invisalign outcome stimulator. Orthodontists can scan their patient's mouths with an iTero intraoral scanner, then show them how their invisalign treatment will look. This technology improves the patient's experience because patients can know what to expect and feel more confident in their diagnosis and treatment plan. It also makes the ClinCheck setup three times faster. After setup, speed is still on the iTero intraoral scanner's guide. Itero states ClinCheck treatment plans submitted with its scans are usually posted to the doctor site three times faster than traditional polyvinyl siloxane scans. As a result, invisalign aligners are created and posted back, so that one can start treatment faster. Since the iTero intraoral scanning system is open, orthodontists can also send the scan files to any laboratory. Orthodontists can also create better invisalign treatment plans for their patients using iTero intraoral scans. Align Technology research showed orthodontists who used the scans have 10 times fewer rejections and seven times fewer issues with the fit of the invisalign aligners. These results may be because iTero intraoral scanners help orthodontists track their patient's progress. Regular scans throughout invisalign treatment can help orthodontist compare expected outcomes with results. If results are not as expected, orthodontist can use the scans to educate their patients about their treatment and the importance of complying with theirrecommendations.

Discussion

The use of digital models in orthodontics has proven an excellent technique and possibly the future[9] method of choice. Rheude et al[10] compared the use of digital models with plaster models in orthodontic diagnosis and treatment planning. They concluded that in most cases digital models can be successfully used as part of the orthodontic records. It is noteworthy that the more the examiner used digital models the more the diagnoses resembled those of conventional models. This indicates a modest learning curve before digital models can be compared to conventional models. Leifert et al[11] took space measurements in conventional plaster models and in digital models (OrthoCad system, Cadent, USA) and concluded that the accuracy of software for space analysis in digital models is just as clinically acceptable and reproducible as in conventional plaster models. Incorporating digital scanning in daily practice does not require any additional processes or procedures to be learned by either orthodontists or their assistants. Consultations for obtaining orthodontic records remain virtually unchanged in terms of time and goals, with the added benefit that patient satisfaction is significantly

enhanced. In Timm C. Schott et al[12] study, about students perspectives on the use of digital versus conventional dental impression techniques in orthodontics the students reported a preference for the digital impression technique over the conventional impressions, stressing the fact that digital impression techniques must be implemented among undergraduate level to familiarize students with the procedure at an early stage in order to be able to practice it in modernorthodontics.

Conclusion

Digital impression taking given its undesirable benefits, will transform digital intraoral scanning into a routine procedure in most dental offices in the coming years.

Furthermore, they lead to reduce repeated visits and retreatments while increasing treatment effectiveness. Patients will be benefitted with more comfort and a much more pleasant experience. These digital solutions are now being integrated into many dental procedures with the usage of this system in orthodontics for impression making and digital models one can confidently predict that in coming years we will witness a true digital revolution in the dental office. A revolution that will benefit patients terms of more efficient treatment planning and treatment efficiency and reduces discomfort.

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