Medicon Dental Sciences
Volume 2 Issue 2 November 2022
Perspective

Digital Orthodontics A New Perspective

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Received: November 02, 2022; **Published:** November 12, 2022

Introduction

Digital orthodontics has been there around a decade, but the recent advancements in technology and the inherent desire of orthodontist to go paperless has dramatically turned the tables in favour of digitalizing the practice. Beginning from the initial patient communication, to record keeping, photographs, radiographs, treatment planning and outcomes, everything under the practice of orthodontics can be digitalized. The heart of any good orthodontic treatment lies in its diagnosis and treatment planning. Incorporation of three-dimensional digital technology for radiographic imaging, 3D reconstruction of face, fabrication of study models, construction of 3D stereolithographic models, prediction of treatment outcome, virtual surgical planning and artificial intelligence has lead to correct diagnosis and better clinical outcomes. All this begins with the collection of digital data and this trend will continue to dominate the practice of orthodontics in coming future.

Digital Dental Models

They are obtained by indirect method which need transport of plaster casts or impressions for laser or computed tomography (CT) scanning to the specialized company. Cone beam computer tomography (CBCT) is the direct method to capture the dentition for dental analysis, but CBCT is not indicated for imaging dentition alone because of its radiation dose.

Accuracy of Digital Dental Models

Fleming PS et al. (2011) conducted a systematic review to assess the tooth size, arch length, irregularity index, arch width and crowding with the use of digital models versus measurements on plaster models with digital callipers in patients with and without malocclusion. Digital measurements were comparable to that obtained from plaster models. Digital models offered a high degree of validity when compared to direct measurement on plaster models. Many studies have assessed the accuracy and reliability of digital dental models using various methods and software, which limits the ability to compare the outcomes. Reference point varies between examiners and directly affects the measurement. Direct measurement on plaster casts or digital model varies even while points are described precisely. Identification of points in digital models are more accurate because it can be enlarged and segmented for a better view. Superimposition of digital dental models with software (Geomagic, Maxillim) compares the size and volume of the dentition and the alveolar bone.

Digital videography captures patient's smile, speech, oral and pharyngeal function, at the same moment. The camera captures 30 frames per second and produces a 5 second clip for a total of 150 frames captured. Then the smile image is opened in a software called Smile Mesh. The Smile Mesh software was designed by TDG Computing (Jon Coopersmith and Greg Cassileth) for Dr. James and Marc Ackerman that measures 15 attributes of smile. It was initially used manually by Hulsey and modified and computerized by James and Marc Ackerman. With digital technology, the patients dynamic anterior tooth display can be evaluated. Picturization and assessment of smile dynamics is a two-stage process. First is the clinical examination (measurement of lip - tooth relationships) and second is record taking using digital photography, videography, radiography, and plaster study cast that records the smile both dynamically and statically. A frontal and oblique view is taken to assess the characteristics of smile three dimensionally. To record, assess and plan the treatment of smile it is evaluated in 4 dimensions - frontal, oblique, sagittal and time (maturation and aging of soft tissues). Latest technologies have developed the ability to view the patients more dynamically and enable quantification and communication of newer concepts of function and appearance. Schabel et al. compared the smiles of the subjects obtained by clinical photography vs smiles from digital video clips (Smile Mesh) after orthodontic treatment. The results of the study concluded that there is a positive correlation between Smile Mesh measurements obtained from the smiles captured by clinical photography and digital video clips. The standard digital photograph can be immediately viewed and is considered a valid tool in the post treatment smile analysis whereas the digital video clips offer more information for the dynamic analysis of the smile.

Virtual Setup

The segmented dentition on the CBCT radiographs will be used to simulate the dental movement which is required to correct the malocclusion using the virtual repositioning software and a setup of the dentition can then be made. File transfer protocol (FTP) allows easy and protected uploading of the files by the orthodontic labs. Dental setup has been established as a valuable diagnostic tool in orthodontics and surgical treatments to approve, alter or reject the planned treatment. Initially Kesling's diagnostic setup in which the crown of the teeth ideally positioned with wax was used to plan the orthodontic treatment. The limitations of this setup were that the cast had to be copied and was a time-consuming procedure. As software programs are available now, a virtual setup can be made faster with the digital models without the need for dental casts. For a digital setup, the dental crown must be segmented in the digital dental models.

Virtual Segmentation

With the help of software like Insignia, an instant virtual segmentation is done on the digital dental model. A reference plane is marked for the dentition and alveolar bone. In some setup, occlusal plane and palatal midline are taken as reference. After the segmentation, virtual roots are added to the dental crown according to the planned root movement.

Technologies of 3D Printing

1. Fused deposition modelling (FDM).
2. Selective laser melting (SLM) and Selective laser sintering (SLS).
3. Electron beam melting (EBM).
4. Stereolithography (SLA).
5. Inkjet 3D printing.
6. Digital light processing (DLP).
7. Laminated object manufacturing (LOM).

Artificial Intelligence (Ai) And Machine Learning (Ml) In Orthodontics

The buzz word of AI and ML has made its presence felt in the speciality of orthodontics too. Artificial Intelligence (AI) is the ability of computer programs to perceive data information and convert it into reasonable and intelligent actions. Machine Learning (ML) is an application of AI commonly used in dental and medical fields. In orthodontics, AI and ML can be used for diagnosis and treatment planning, growth assessment and prediction of treatment outcomes. Artificial Neural Networks (ANNs) can be used to predict extraction decision, extraction patterns and anchorage requirements in fixed orthodontics.ML can be used for landmark identification and cephalometric analysis on digital cephalograms. ANNs can estimate the dental age and can predict canine impaction from panoramic radiographs.AI can also be utilized to predict the post-treatment soft-tissue changes such as lip position in extraction vs non-extraction cases. AI can also be used to quantify facial attractiveness, predict post-treatment peer assessment rating (PAR) index and treatment outcome in untreated Class III orthodontic cases.AI and ML in orthodontics can play a substantial role in eliminating subjectivity, reduce variability and practice more efficiently. The drawback of this technology lies in the fact that the algorithms are based on assumptions thereby leading to misleading information. Hence is it prudent for an orthodontist to not substitute their orthodontic knowledge, judgement and experience for such non-human software-backed programs.

Role of Robots in Orthodontics

Robotic technology in medical field has been extensively researched in developed countries. Robots in dentistry can be employed to bring convenience, improve accuracy and provide economic growth. Although in a nascent stage, robots in orthodontics can be used for inserting a mini-implant with precise insertion depth, insertion angle, proper torque and achieving primary stability. Robots have also been employed to bend arch-wire and is known as Sure Smile arch-wire bending robot. They provide with customized arch-wire and brackets allowing simulation of different treatment plans and detailed treatment planning. The scope of robotic technology in vast and unlimited but will require extensive research to promise practical clinical benefit in this field.

Conclusion

Data is the new currency in today's digital world. Large chunks of data acquired from any source can create opportunities for unending technological advancement in the field of dentistry and orthodontics. It is a duty and collectively responsibility of the orthodontic community to harness the power of this big data to improvise the clinical outcome and refine personalized care for our patients. The collaborative efforts of the government, corporates and dental researchers can dramatically shape the future of orthodontics. Moving towards a fully dedicated digital orthodontic practice can be a daunting task initially both in terms of finance and psychology. In the long run, the merits of the practice are positively effected exponentially. Average treatment times are reduced, appointments are streamlined, treatment outcomes are better leading to enhanced patient experiences. Overall, progressing towards a digital orthodontic practice will only generate more revenue, increase profession liking amongst peers and bring an immense sense of satisfaction to the orthodontist.

Reference

1. Redmond WR, Redmond WJ and Redmond MJ. "Clinical implications of digital orthodontics". Am J Orthod Dentofacial Orthop 117.2 (2000): 240-1.
2. Taneva E, Kusnoto B and Evans CA. "3D scanning, imaging and printing in orthodontics". Issues in Contemporary Orthodontics 148.5 (2015): 862-7.
3. Breuning KH and Kau CH. "Digital planning and custom orthodontic treatment". John Wiley & Sons (2017).
4. Kau CH, Olim S and Nguyen JT. "The future of orthodontic diagnostic records". Seminars in Orthodontics 17.1 (2011): 39-45.
5. Jacox LA., et al. "Understanding technology adoption by orthodontists: a qualitative study". Am J Orthod Dentofacial Orthop 155.3 (2019): 432-42.
6. Christensen LR. "Digital workflows in contemporary orthodontics". APOS Trends in Orthodontics 7.1 (2017): 12-8.
7. Fleming PS, Marinho V and Johal A. "Orthodontic measurements on digital study models compared with plaster models: a systematic review". Orthod Craniofac Res 14.1 (2011): 1-6.
8. Ackerman MB and Ackerman JL. "Smile analysis and design in the digital era". Journal of Clinical Orthodontics 36.4 (2002): 221-36.
9. Sarver DM, Ackerman MB. "Dynamic smile visualization and quantification: part 1. Evolution of the concept and dynamic records for smile capture". Am J Orthod Dentofacial Orthop 124.1 (2003): 4-12.

Volume 2 Issue 2 November 2022