ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 03 | March - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

SOFTWARES IN ORTHODONTICS- A REVIEW

Orthodontology

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ABSTRACT

There has been a huge advancement in the orthodontic technology that enables an orthodontist to plan the treatment precisely and this digitalization has also made the communication easier with the patient and other clinicians as they can also understand and visualize the treatment plan. It is now much easier to achieve a straighter and healthier smile because of digital orthodontics. Hence this review is mainly based on the softwares which are currently available for orthodontic purposes.

KEYWORDS

INTRODUCTION

In many areas of health care, there is a shift toward digitization of patient information and data.[1] Even in dentistry, various softwares have been invented and are being used in order to save time and to eradicate the human errors. Orthodontics is no exception.[1] In the branch of Orthodontics, numerous softwares have been developed to analyze, interpret before landing to a particular diagnosis and then plan the treatment consequently.

Software programs have been presented in various attributes of orthodontic practice such as lateral cephalogram interpretation, study model analysis, photographic analysis, treatment planning and even for clinical procedures like, precise bracket positioning. Therefore, it is essential to understand and utilize the technology available for a successful orthodontic practice.

This review article considers the various softwares that are available and majorly used in the field of orthodontics and its applications.

Various Softwares for model analysis[2]:

- **OrthoAnalyz®**
- **Digimodel®**
- **O3DM®**
- **Rapidform®**
- **BibliocastCecile3®**
- **Emodel®**
- **OraMetrix®**
- **OrthoCAD®**
- **AnatoModels®**
- **Ivoris@Analyze3D®**
- **MatLab®**
- **Meshlab®**
- **O3D®**
- **Ortho3D®**
- **OrthoInsight**
- **Pixform®**

Digital study models were introduced commercially in 1999 by OrthoCad (Cadent, Carlstadt, NJ, USA) and in 2001 (emodel; GeoDigm, Chanhassen, MN, USA). The technology used to generate digital study models varies considerably. Emodels scans the surface of a complete plaster model, whereas OrthoCad uses destructive scanning with multiple scans of a model in thin slices.[3]. Rapid prototyping (RP) systems, such as stereolithography, generate 3D models from a digital file through incremental layering of photo-curable polymers[4]. Direct scanning of impressions to generate digital models is also possible (Digimodel; Orthoproof, Albuquerque, NM, USA), obviating the requirement for plaster models.[3]

Costalos et al 2005[5] conducted a study in which they compared orthodontic post-treatment (24 plaster models and 24 digital OrthoCAD models, Cadent Inc, Carlstadt, NJ) models of 24 patients were assembled from the postgraduate orthodontic clinic at Columbia University School of Dental and Oral Surgery. To conclude, the use of digital models is advantageous for clinical practice and has great potential if the models are reliable and easy to use.

Keating et al 2008[4] did a study in which they compared plaster, digital and reconstructed study model accuracy. Each model was captured three-dimensionally, using a commercially available Minolta VIVID 900 non-contact 3D surface laser scanner (Konica Minolta Inc., Tokyo, Japan), a rotary stage and Easy3DScan integrating software (TowerGraphics, Lucca, Italy). Linear measurements were recorded between landmarks, directly on each of the plaster models and indirectly on the 3D digital surface models. Finally, they concluded that The Minolta VIVID 900 digitizer is a reliable device for capturing the surface detail of plaster study models three-dimensionally in a digital format but physical models of appropriate detail and accuracy cannot be reproduced from scanned data using the Rapid-prototyping technique described.

Various Softwares for cephalometric analysis:[6-9]

- **Viewbox**
- **OnyxCeph**
- **OrisCeph**
- **Facad**
- **Winceph**
- **Nemoceph**
- **Vistadent**
- **Dolphin**
- **Autoceph**
- **JOE (Rocky Mountain Orthodontics)**

Cephalometric radiography is an essential tool in clinical orthodontics. With standardized radiographs, the orientation of various anatomical structures can be studied by means of angular and linear measurements.[7]

Manual analysis is performed by tracing radiographic landmarks on acetate overlays and using these landmarks to measure the desired linear and angular values. This process can be time-consuming and the linear and angular cephalometric measurements obtained manually with a ruler and a protractor may be prone to error.[6]Technical advances in computer science have made it possible to perform cephalometric tracing both through the use of digitizers and directly on screen-displayed digitalimages.[7]

Segura et al 2014 conducted a study to compare the reliability of the measures of the computerized cephalometric program Nemoceph Nx, with the tracing done manually with digital lateral cephalograms and concluded that there was no significant difference in the manual or digital measurement of the linear and angular cephalometric measures, however the layout with the program Nemoceph Nx is more accurate .[8] Sangroula et al 2018[9] evaluated the reliability and accuracy of linear and angular cephalometric measurements obtained from two computerized cephalometric analysis software programs, namely

AutoCEPH© (version 2.1.1) and Dolphin® (version 11.9) as compared to manual tracings in posteroanterior cephalogram and found that the reliability and reproducibility of measurements obtained from two computerized cephalometric analysis softwares, namely AutoCEPH© and Dolphin® imaging software were high with each other and to gold standard hand tracing.

Various softwares for smile analysis and smile design[10-14]

- **Sure smile**
- **Smile Analyzer**
- **Digital Smile Design**
- **Adobe photoshop CS2**
- **Easy Smile analysis**

Orthodontic diagnosis and treatment should carefully consider the patient's facial appearance and esthetics. In case of sacrificing esthetics for the sake of good occlusion, the patient will not be satisfied with the treatment outcome, even if all the functional goals have been achieved[11], hence analysis of all smile and esthetic parameters is mandatory.

The SureSmile (OraMetrix, Dallas, Tex) process begins with a direct 3-dimensional scan of the patient's dentition using the OraScanner (OraMetrix), a light-based imaging device that projects a precisely patterned grid onto the teeth. The Windows-based software allows the operator to diagnose, plan treatment, and simulate the result. The software is the interface by which the 3-dimensional model of the dentition can be viewed from preselected perspectives, such as frontal, lateral, posterior, or occlusal views.[10]

The "Smile Analyzer" software was designed using VisualBasic.NET and the ADO.NET was used for developing its Microsoft Access database. The "Smile Analyzer" runs on Microsoft Windows. The program can also be improved so that the database is accessible over a network.[11]

The Digital Smile Design (DSD), developed by Dr. Christian Coachman4 or VEP5 (Oral Laboratory Esthetics, Didier and Hélène Crescenzo) are essential reference tools (generally led by the practitioner in charge of esthetic rehabilitation) to understand, plan, communicate, and share therapeutic projects with the team and avoid pitfalls or possible unanticipated compromises.[13]

"ESA," which is an easy-to-use computer-based smile analysis for evaluating the smile proportions by using the PowerPoint software. It also can be used on computer, photograph, dental study models, or chairside with bare minimum armamentarium.[14]

Softwares for bracket positioning[15,16]:

- **Ortho Analyzer**
- **Ortho CAD**
- **Sure Smile process[10]**

Redmond et al 2004 conducted a study in which they described the OrthoCAD Bracket Placement solution (Cadent, Carlstadt, NJ) that can help the clinicians in accurate and quicker positioning of brackets according to a digitally defined setup.[15]

Layman 2019[16] conducted a study in which he gave a procedure for digital bracket placement through indirect bonding using Ortho Analyzer software. To conclude he said that this technique allows the practitioner to benefit from the chairside efficiencies of indirect bonding while drastically reducing lab time. Moreover, the ability to efficiently fabricate indirect bonding trays can expand practice capacity and create a real return on investment for your digital equipment.

Balut et al 2020[17] published a case report in which he explained that digital planning with indirect bonding make orthodontist more efficient and accurate in terms of saving chair side time, having clear vision toward treatment progress and improving patient consults.

Softwares for treatment planning:

- **Orthodontic treatment planning software**
- **Advanced Visualization System Inc, Waltham ,USA**
- **Sure Smile process[10]**
- **Digital Smile Design[13]**

Noorazi 2006[18] conducted a study in which the new orthodontic treatment planning software had been discussed. He explained that the concepts of ***fuzzy logic*** enable the computer program to work with nominal variables. The reason is that, even after determining the numeric parameters, we are accustomed to interpreting them as nominal variables. Finally, he concluded that the software suggests treatment plans for routine patients. There might be teeth with special conditions (missing, previously extracted, nonerupted, fractured). The software deals with these situations appropriately[18]

Motohashi and Kuroda 1999[19] , conducted a study in which they developed 3D computer aided design for diagnostic set up of casts in orthodontic diagnosis and treatment planning. The system comprised a measuring unit which obtained 3D information from the dental model using laser scanning and a personal computer to generate the 3D graphics. The software to automatically align the individual teeth was AVS (Advanced Visualization Systems Inc.;USA). To conclude, the computed diagnostic cast has advantages such as high speed processing and quantitative evaluation on the amount of 3D movement of the individual tooth relative to the craniofacial plane.

CONCLUSION

With the declaration of "Digital India" concept, India has come a long way but yet to cover a long mile particularly in the field of dentistry. With the advancement of newer technologies and softwares the ability of an orthodontist is improvising and is much more beneficial to the patient.

New opportunities for improved treatment coupled with shorter and more comfortable patient experiences are now possible through the use of these digital paradigms[20].

To conclude, the use of softwares has been proven to be a boon for an orthodontist, patient and also in the field of clinical and non-clinical dentistry

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