

# DECISION SUPPORT SYSTEMS AND TECHNOLOGIES USED IN PERIODONTOLOGY

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**Keywords:** Periodontology, Periodontal disease, Decision support systems.

**Abstract:** The use of computer systems to aid clinical decision making is growing. Besides clinical practice, computer applications, decision support systems or technologies can be used during dentistry and periodontology learning. A research was made using 30 searching expressions, based on MeSH Terms. A total of 17 articles were selected from the initial 249. Dental Students' Ability to Assess Gingival Health Status Software (DAAGS) and Virtual Learning Environment (VLE) are two examples of computer programs used in Periodontology learning. 3D technologies, electronic devices and image analysis systems are tools used during periodontal diagnosis. Dental informatics and periodontology are extremely connected, because, many systems, technologies or electronic devices could be used during diagnose, treatment or pre-operative phase. Computer applications could also be used to improve learning skills during pre-clinical and clinical stages, and at same time other technologies as 3D can present more detailed data to clinician, leading to a correct decision.

## 1 INTRODUCTION

Clinical dentistry has seen a slew of informatics and Information Technologies innovations, such as computerized charting, digital radiology, the Florida Probe (electronic periodontal probing system), Oral CDX (computer-assisted, brush biopsy, test for detection of oral cancer), computer-based shade matching, and CEREC (a modular computer-aided design/manufacturing system for creating ceramic restorations) (Schleyer, T.K., 2003). Besides clinical practice, computer programs are also used during dentistry learning (Wenzel, A., 2002). Periodontal disease can be defined as the presence of gingival inflammation at sites where there has been a pathological detachment of collagen fibres from the cementum and the junctional epithelium has migrated apically, that would lead to the resorption of coronal portions of tooth supporting alveolar bone. (Savage, A., et al., 2009) Evaluation of patient's periodontal status requires obtaining a relevant medical and dental history and conducting a thorough clinical and radiographic examination with evaluation of extraoral and intraoral (AAP, 2000),

and a sequence of interrelated steps is inherent to effective periodontal treatment: early and accurate diagnosis, comprehensive treatment, and continued periodontal maintenance and monitoring. The treatment of patients with periodontal disease is best accomplished within the structure of a uniform and consistent Periodontal Treatment Protocol. Such a protocol would reinforce accurate and timely diagnosis, treatment needs based on a specific diagnosis, and continual assessment and monitoring of outcomes. All effective treatment protocols begin with a thorough and timely diagnosis. Although advancements in periodontal therapy, periodontal diseases remain the most common cause of adult tooth loss (Sweeting, L., et al., 2008). Diagnosis and treatment of periodontitis continue to present significant challenges to all practitioners regardless of experience level (Sweeting, L., et al., 2008). The aim of this paper is to know how decision support systems can help dentists and periodontologists during diagnosis and clinical practice, and at same time evaluate the relationship between dental informatics and periodontology, identify in published bibliography Decision Support Systems

for diagnosis in Periodontology, know if Decision Support Systems are frequently used in periodontology practice and describe computer examples of computer-based learning in Periodontology.

## 2 METHODS

A research was performed between October' 2009 and December' 2009 in two databases – PubMed and European Federation of Periodontology – Journal of Clinical Periodontology, using 30 searching expressions based on MeSH Terms. All used articles were selected using title, abstract and full reading filtering. They must have been published after January 1st, 2000, and have the full text available. From the 249 articles initially selected, 230 were excluded based on title and abstract, and after full text analysis 17 were selected to use in the review.

## 3 RESULTS

A total of 17 articles were selected and included in this investigation. Health Informatics and Dental Informatics are the Investigation Areas with more articles, (n=4) each one. The geographically distribution shows that USA (n=7) and Europe (n=8) (UK, Switzerland and Germany with n=2, Sweden and Denmark with n=1).

Decision Support Systems, software applications and technologies are used in to help during periodontology learning stage and during clinical stage.

### 3.1 Decision Support Systems/Technologies used during Learning Stage

On learning stage those applications help students during their pre-clinical or clinical training, Dental Students' Ability to Assess Gingival Health Status Software (DAAGS) and Virtual Learning Environment are two examples of computer programs used in Priodontology learning. DAAGS was used to improve dentists', dental students' at different levels of education (Basic, Preclinic and Clinic), and dental hygienists' ability to assess the gingival health level while using the Oral Rating Index (ORI). The study was carried out at Ankara University in Turkey in 2003. and was made by this way, after explained to the students the ORI scoring and criteria (the gold standard), a set of standard

color photos was presented using an LCD projector set automatically (15 seconds per photo) at the beginning of each test. Then, the students were asked to judge each photo according to ORI criteria. Three tests were made, test 1 and 2 same day and test 3 after two weeks. The study performed using DAAGS had a positive outcome, results revealed that, without any training, there was an increase in the number of correct answers and reproducibility and a decrease in irrelevant answers with the students' increasing clinical experience, after three application Tests. Also important is the fact that Basic group showed a significant improvement which indicates that the DAAGS software can be considered an instructive tool for education. Authors concluded that DAAGS would be useful to dental students before clinical training and also an helpful tool for calibration of dental employees (Camgoz, M., et al., 2008).

Other application used on periodontoly learning stage is the Virtual Learning Environment (VLE), a web-based database application, divided into 6 sections (history taking, clinical examination, Xrays, diagnosis, treatment planning and prognosis, and log) where the learner uses free text communication on the screen to interact with patient data. After reviewing the patient information, the student proposes therapy and makes prognostic evaluations of the case in free text with simple design. Study had positive results. Students were randomly assigned to two groups. The experimental group (E) worked with the virtual patient for 1 week prior to their first patient contact whilst the control group (C) was first allowed to use the virtual patient after their first patient contact. Results indicated that students who practiced with the virtual patient prior to their first patient encounter behave more knowledgeably and professionally compared with C group. Authors also concluded that the use of the virtual patient and the process of writing questions in working with the virtual patient stimulate students to organize their knowledge and result in more confident behavior towards the patient (Janda, M.S., et al., 2004).

### 3.2 Decision Support Systems/Technologies used during Clinical Stage

On clinical stage, those technologies can help clinician during diagnosis and treatment phases, before intervention phase or after treatment or invasive involvement. Nowadays 3D tools are useful in Periodontology.

### 3.2.1 3D Technologies

Walter et al in 2009, demonstrated that findings from a 3D Cone Beam Computed Tomography (CBCT) add substantial information about the root form and proximity, furcation involvement (FI) and the presence of mineralized connective tissue at maxillary molar teeth. This study compared CBCT data with x-ray (periapical) in 12 patients with generalized chronic periodontitis, and showed that application of dental CBCT enables a distinct and more detailed assessment of FI in maxillary molars compared with conventional clinical measurements and periapical x-rays. The main conclusion of this study is that CBCT images of maxillary molars may provide detailed information of FI and a reliable basis for treatment decision. CBCT was also used by Park et al in 2007, where concluded that CBCT provide effective 3-D visualization and image analysis of the bone-tooth interface that complement periodontal. This information is also present in a study made by Grimard et al published in 2009, where authors used same technology to compare the measurements of bone defects from digital intraoral radiographs (IR) and CBVT images with direct surgical measurements for the evaluation of regenerative treatment outcomes, like CBVT is an equivalent substitution for direct surgical measurements of bony changes occurring after bone replacement graft procedures, especially defect fill and defect resolution and help clinicians to measure the volume changes of interdental papilla region after surgical and non-surgical treatment in periodontology.

CAD/CAM 3D are an easy-to-use chair-side method to document changes in soft tissues. CAD/CAM method can adequately measure at chair-side soft tissue changes of the interdental papilla region under clinical conditions. With this procedure it is possible to assess different surgical and non-surgical treatments in terms of interdental soft tissue preservation during active and maintenance periodontal therapy or implantology procedures in the esthetic zone. (Strebel et al, 2009).

These technologies was also used by Park et al in 2007, in a study where they concluded that 3D Micro-Computed Tomography provide effective 3-D visualization and image analysis of the bone-tooth interface that complement periodontal.

### 3.2.2 Image Analysis System

Other example used in Periodontology is a method based on image analysis that aims to quantify dental plaque, published in 2001 by Smith et al. It measures

the plaque quantity using digital images taken in a standardized illumination, head and camera positioning. After plaque disclosure with erythrosine, a picture was taken, then image were analyzed and plaque area was selected, and copy to a new image which was converted to grey levels, all those phases were made in Adobe Photoshop. Then with Image Pro Plus measure to real scale size of plaque area was made. Authors concluded that the system provides an improved method of quantifying both simple and complex dental plaque areas with increased accuracy without the need for a clinician.

### 3.2.3 Electronic Devices

Clinical practice is helped by electronic devices, such as electronic probes, instrument that automating the recording method and controlling the probing pressure (Silva-Boghossian, C.M., et al., 2008). Another example of electronic devices is an instrument that combines a fuzzy set with an ultrasonic scaler, which automatic recognize tooth surfaces using a piezoceramic dental ultrasonic scaler as an oscillatory excitation and sensor system, combined with special pattern recognition software based on a fuzzy classifying algorithm. Calculus, cementum and tooth surface are automatic recognized, which reduce the amount of tooth substance removed and consequently decrease dentin hypersensitivity after periodontal treatment (Kocher et al, 2000). Other example is one based on a conventional piezoceramic ultrasonic scaler which detects automatically subgingival calculus based on surface stimulation to oscillate the instruments tip. The frequency is dependent on the substrate characteristics, cementum or calculus. The detection device may reduce the risk to overtreat cementum with adhering biofilm and without calculus, because the power setting should only be high if the insert encounters calculus and low if there is only biofilm (Meissner et al 2008).

## 4 DISCUSSION

This investigation shows that decision Support Systems/Technologies in Periodontology are used in two different ways: learning and clinical stage which help students during their pre-clinical or clinical training. DAAGS Software and VLE are two examples of computer programs used in Priodontology learning. On clinical practice help clinician during diagnosis and treatment phases.

3D technologies are important partners in perio-

dentology treatment, diagnosis or treatment planning phases. Imaging analysis systems allows identification of dental plaque. Electronic probes, help probing during diagnosis, and ultrasonic devices, identify hard dental tissues or subgingival calculus help clinicians during treatment and diagnosis phases improving diagnosis accuracy and precision.

Also showed that decision support systems and technologies in periodontology are useful to make correct decisions and select better treatment based on a correct diagnose. This work also summarized data and showed it in a simplest way, useful technologies, computer applications and software used in periodontology and demonstrated that informatics is an important helper and valuable partner in periodontology practice. The data offered on this review presents a few of systems or electronic devices used actually.

More research must be done in this area, because this review was based on 30 searching expressions and free full text papers, that means that many other articles with important information couldn't be used. This review showed how diagnosis moment is important in Periodontology and how new technologies could can help clinicians during these stage. A correct and timely diagnose leads to a correct and benefic treatment approach or option to patient periodontal pathology. Dental informatics is a new research area which is helping periodontology, because many systems, technologies or electronic devices could be used during diagnose, treatment or pre-operative phases. Computer applications in periodontology could also be used to improve learning skills during pre-clinical and clinical stages, and lead to a correct decision. More research must be done, however this investigation confirm that implementation of dental informatics into Periodontology is a reality and with these small steps a huge walking is being done.

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