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3D DENTAL MICROSCOPY

THE NEXT LEVEL IN ERGONOMICS AND BIO-SAFETY

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Abstract

The anatomic areas dentists have to work on are exceedingly small. The precision needed by the operator depends on several factors, such as light, visualization of the oral cavity structures and working posture; repetitive movements, poor work habits and the need of good visibility are among the main factors related to the musculoskeletal disorders reported by dentists. The addition of magnification devices to clinical practice has been associated with decreasing the rate of musculoskeletal disorders as well as working as in conjunction with newer biosafety protocols. Currently, the novel Coronavirus disease is defining new risks for all dental practitioners and the use of 3D microscopy allows the practitioner to comfortably wear the personal protective equipment while adopting ergonomic working positions at the largest possible distance from patient's face. This will reduce the risk of direct contamination with oral fluids.

Introduction

The introduction of the dental operating microscope triggered a rapid transition from conventional dentistry to the precise and detailed world of micro-dentistry (1, 2). However, not all clinicians are willing to invest the time needed to overcome the learning curve to use the microscope in the most effective way (3). The 3D surgical microscope is an alternative to the operating microscopes that have been present in the dentistry since 1977 when Baumann proposed their use in dentistry (3, 4). The 3D microscopic magnification is a relatively new technology that offers crystal clear imaging in a high definition monitor, personalized ergonomic positions, longest possible distance between patient's and Dr's faces. This has the possibility reduce the risk of direct contamination with blood, saliva, aerosol, etc. These advantages, among

others, may help motivate the transition from regular dentistry to micro-dentistry, frustration-free and enjoyable. The main objective of this article is to highlight and describe the characteristics of the 3D surgical microscope that can contribute to enhanced biosafety in clinical practice, reduced stress and to avoid the very common neck and back pain in dental practitioners that may decrease the ability to practice dentistry and earn a living (5, 6).

Magnification devices in dentistry, Benefits and Applications

The anatomical structures that dentists have to work on, are exceedingly small and at times microscopic, and the precision needed by the operator depends many factors, such as light, clear visualization of the oral cavity structures and working posture (7, 8). Most of the time, in the solution to these kinds of challenges, the clinician will benefit from the operative microscope and what it has to offer, such as versatility, optimal degree of magnification, luminosity, digital documentation, ergonomics and depth of field especially in 3D microscopy.

While the introduction of the dental operating microscope in 1977 arrived with the objective of enhancing visual accuracy, it triggered a transition from conventional dentistry to the precise and detailed world of micro-dentistry (1-3). There are several factors influencing the visual accuracy, such as age, ophthalmological disorders, visual acuity, working distance, illumination, magnification tools, etc. Having these multiple factors in mind, dentists should be aware of their own visual performance and the available methods to improve their precision, such as loupes and microscopes (9). Many dentists are not aware of their visual handicaps and the repercussion this may have on the art of dentistry that is based on the precision of every procedural

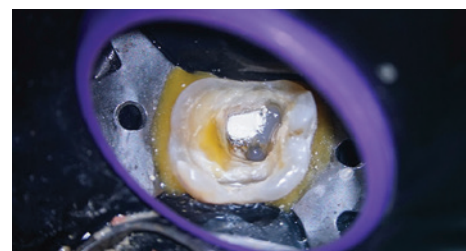


Fig. 1. Pulp chamber perforation repair with a high consistency calcium silicate material, this procedure requires high precision, magnification and proper illumination to accomplish a good result.

step (Fig. 1). The human eye is capable to provide good details, but it is not comparable to what can be accomplished when an image is sharpened and enlarged with the microscope (Fig. 2) (2). The benefits of using optical aids are many, to mention some: better diagnostic capability, enhanced quality of therapy, ergonomic benefits, and improved patient-dentist communication. (10, 11).

The American Dental Association adopted the use of the microscope as a requirement in the graduate endodontic programs and with time the microscope has become more user friendly. As a result, we are witnessing more acceptance in almost all areas of dentistry. For example, the diagnostic analysis of patient symptoms can more detailed. Fractures or



Fig. 2. Picture on the left was taken with the lowest magnification offered by the Seiler Promise Vision Surgical Microscope, while the picture on the right shows the same image at highest magnification, more small details are visible at higher magnifications, nevertheless the depth of field will decrease.

marginal leakage are relatively undetectable with normal vision, however, with the help of microscopes these findings are very common in the daily clinical practice(12). In restorative dentistry, an area where precision is crucial to success, particularly in marginal accuracy where even a minor discrepancy can result in the loss of gingival integrity, leakage, and complete failure of the restoration. In periodontics the success of a periodontal treatment is based on the elimination of even the minutest particles of biofilm (13). Last but not least, endodontics is probably the most important area for the microscope to be applied, because the treatment of the pulpo-dental complex and the root canal system requires an increased level of precision, achievable only at high magnification and illumination levels (2).

The 3D microscope offers new possibilities in the magnification world, the experience can be even more ergonomic since it does not have a binocular head. Instead, it has an optical pod that can be rotated and positioned in any orientation without affecting the heads-up posture of the operator. These characteristics make it very convenient to practice surgical, prosthetic, and operative procedures in a comfortable manner. Our 3D microscope provides 6 steps of magnification and depth of field greater than 51mm, so it provides more realistic images to work on without eye fatigue while allowing peripheral vision of the clinical environment (Fig. 3). The 3D high definition screen is located just in front of the dentist, positioned at the optimum distance to offer the best quality of 3D images. The on screen display will follow all the movements performed by the dentist, eliminating the need to twist the spine and neck during the treatment. The dental assistant will see exactly the same view as the dentist is seeing which will potentially optimize the clinical workflow.

Biosafety and 3D-Microscopy:

The novel Coronavirus disease is defining new risks for all dental practitioners. Some of the common transmission ways of COVID-19 are contaminated droplets in the air by eye, nose and mouth exposure (14). As healthcare



Fig. 3. Heads upright working position using the Promise Vision Surgical Microscope, as the microscope does not have binoculars, the clinician can have full sense of the clinical environment by aid of peripheral vision.

professionals, dentists have direct contact with saliva and blood, placing them at higher risk of infection.

Conventional protective measures such as wearing a regular surgical mask, surgical cap and isolation clothing are sometimes not sufficient(15). The American Dental Association (ADA) recommends the use of face-shields, goggles, and to increase the working distance in addition to the traditional biosafety measurements. This might turn the dentistry we knew, into a completely different, complex dental practice (16). The PPE can complicate positioning of the eyes with the binoculars. When using the 3D microscope, the PPE does not create any interference between the clinician and the device. It also allows the practitioner to adopt the largest possible distance between patient's and Dr's faces, which will reduce the risk of direct contamination with blood, saliva, aerosol, etc. (Fig. 4).

Musculoskeletal Disorders in Dentistry

It has been demonstrated that work related physical disorders might reduce productivity in economic activities, about 150 million people are affected by these problems worldwide (5, 17). Dental practitioners are a population of workers highly affected by musculoskeletal disorders, and sadly, most of symptoms tend to be ignored until they lead to chronic injury that can cause irreversible damage (18). Re-

petitive movements, poor work habits, need of good visibility and bad working postures are among the main factors related to the fact that 82% of dental students report musculoskeletal pain even in early stages of their dental training (5, 18, 19). Neck (47%) and lower back (35%) are the most reported areas to be affected, most of the cases due to prolonged, static, and non-ergonomic positions adopted during the pursuit of good visibility.(6) Adding magnification devices have been associated with decreased lower back and neck pain, as they allow operators to work in more healthy and relaxed positions for shoulders, elbows and lower back (19-21).

The 3D dental microscope, a relatively recent introduction into modern dental therapy, with complementary accessories (such as variofocus, recording system, motorized positioning of the high definition screen, 3 axis motion of the optical head, etc.) allows new possibilities to the ergonomic imperatives of the dental profession. The ideal working posture can be attained with a combination of the dentist/patient position and the capability of placing the microscope in ideal angulation for every treatment without affecting the most ergonomic posture of the practitioner (Fig 4)



Fig. 4. Ergonomically working positions, long working distance and use of personal protective equipment without interfering with the clinical working posture and use of the Promise Vision 3D Surgical microscope are shown in this picture.

(22). The 3D dental microscope can offer a multilevel focusing by the help of variofocus, without the necessity of moving the optical head up and down and multiple angulation postures to have a proper visualization in all intra-oral areas. In this way, the 3D microscopy might be a great clinical aid to avoid the so common musculoskeletal disorders.

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