

Benefits of using magnification in dental specialties - a narrative review



DENTAL MEDICINE

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Abstract

An increased number of clinicians are using magnification to facilitate their vision when carrying out dental examinations and treatments. The best instrument for this purpose is the microscope, which has proven to enhance quality, longevity and outcome of clinical work. Its use in some dental specialties (such as endodontics) is now well established, but there is also a role for this equipment in other branches of dentistry.

To anticipate the contribution of magnification to dentistry in general, recent research and experimental data on the importance of magnification devices will be considered, from the perspectives of optical issues, diagnosing methods and treatment options. It will be shown that, while the microscope is vital to certain specialties (such as endodontics, periodontics, restorative dentistry and prosthodontics), it has little effect on others (orthodontics, for example). This synthesis of current research attempts to shed light on the optimal magnification used in certain clinical situations, the distinctive benefits of loupes and microscopes for each dental branch, as well as their drawbacks.

Keywords: magnification, microscope, restorative dentistry

Introduction

Throughout their rich history, magnification devices were viewed with reluctance, they generated curiosity and created heated controversy. At present, magnification devices are widely used in numerous medical branches, due to the marked improvements they bring to both the ability to diagnose certain diseases and their treatment. The modern aim of conserving as much healthy tissue as possible can only be done with the use of magnification [1].

In terms of dentistry, the Dental Operating Microscope and loupes were received with enthusiasm especially in performing endodontic treatments. Endodontics has developed new techniques for root canal treatment, to enhance the visualization of the surgical field [2,3]. The small size of the operating field, insufficient lighting and inadequate working positions were the

fuel for the technological development of magnification. In recent years, there has been an increased interest in magnification devices among practitioners of other specialties, along with the success of minimally invasive dentistry principles.

In order to be a good professional, a dentist must possess two qualities: fine motor skills and a high visual acuity [4]. Controlled and very fine movements are not innate, but learned: they can be perfected through hard work and constant exercise. As for visual acuity, it is an intrinsic feature of each and every eyeball. Dentists should be aware of their own visual ability and of the various methods available to compensate for their visual deficiencies [5].

The human eye has the ability to differentiate between two distinct entities if they are at least 0.2 mm apart from one another. Using the Dental Operating Microscope presents a great advantage:

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one is able to distinguish these entities if there is a distance of merely 0.006 mm between them [6]. In other words, the resolution of the human eye increases significantly.

Dental practitioners often carry out treatments which require a greater resolution than the healthy eye can provide. The use of magnification makes possible the visualization of microscopic details of the operating field and has a positive influence on the ability to diagnose and restore dental lesions. The most frequent procedures performed with the aid of magnification devices include placing the margins of a restoration, treating radicular furcations and bone grafting [7].

Endodontics

Saying “Magnification brings great benefits to dentistry” may prove to be true, but it’s somehow incomplete. There is no ideal level of magnification. It has to be adjusted according to a multitude of factors, such as the nature and the purpose of a clinical procedure.

Uses of various magnifications are as follows:

- Low magnification (3-8 x) is used for the examination of tooth, orientation and positioning of bur or ultrasonic tip. The wide field of view permits comparisons of the adjacent anatomic landmarks. It is usually encountered in dental loupes [8];

- Medium magnification (8-16 x) is used in surgical and non-surgical endodontic procedures as it provides an acceptable field of view and depth of field. It is used for performing complex procedures like perforation repairs and separated instrument retrieval [2];

- High magnification (16-30 x) is used on rare occasions, such as examinations of minute anatomies like calcified canal orifices and minute cracks. Apart from having a reduced field of view, immediate loss of focus may occur with minor movements.

The specialization that has benefited from the advantages of magnification devices since their appearance is endodontics. In conventional endodontics, improving visual acuity and illumination facilitates:

- The identification and subsequent access of accessory anatomy [9];

- The negotiation of sclerosed canals;

- The identification and removal of dystrophic calcifications, such as pulpal stones [10];

- Improved quality of canal obturation and so ensuring the creation of an effective coronal seal;

- The identification and subsequent repair of perforations and restorative defects;

- The retrieval of separated endodontic instruments and fractured posts.

The operating microscope is already used by many clinicians during periradicular [11,12] and periodontal surgery [13]. Microsurgical techniques allow the soft tissues to be handled and replaced more accurately, which is associated with reduced surgical morbidity [14].

Consequently, as well as less scarring, less post-operative pain and more rapid healing will result.

In addition, the microsurgical approach allows the practitioner to perform interventions involving small-scale osteotomies, examinations of resealed root surfaces, retrograde fillings and the application of materials with high accuracy [15].

Restorative dentistry

The diagnosis of periodontal disease or carious lesions is carried out mainly by inspection, to which radiographic examinations may be associated, for certainty. Literature data support the fact that the sense of touch does not significantly influence the accuracy of the diagnosis of caries [16]. These lesions should be treated at an early stage, ideally before the appearance of cavities in the enamel [17]. The treatment options include remineralization techniques that avoid excessive sacrifice of dental tissues.

According to studies that detected a statistically significant difference between making a diagnosis using the microscope and under direct vision, it is best to choose a low or moderate level of magnification. A reduced magnification is considered optimal for this clinical step, as it allows a good visualization of the surgical field, but it does not excessively compromise the depth of the field of view [18].

The benefits of magnification in restorative dentistry treatments are important in the following situations [19]:

- Identification of areas where the enamel tissue is demineralized;

- Identification and minimally invasive removal of old restorations;

- Inspection of caries borders and remaining carious tissue;

- Identification of enamel cracks and fissures;

- Checking on the sectional matrix adaptation and controlled application of liner;

- Minimally invasive preparation of small Class III cavities;

- Evaluation of the marginal gaps of the restorations;

- Gaps or impurities in restorative materials;

- Removal of excess composite materials;

- Management of small, accidental pulp chamber openings without mechanical injury to the pulp.

Prosthodontics

In prosthodontics practice using a microscope or a magnification device with the capacity to enhance the surgical field 6-8x simplifies many technically difficult tasks [20].

Magnification, along with co-axial illumination, helps detect a preliminary path of placement for an arch for removable partial dentures and reduce long-term damage to abutment teeth [21].

In fixed prosthodontics, the horizontal and vertical marginal fit between dental prosthesis and abutments affect

the prognosis, longevity and esthetics of the restorations.

The use of microscope-level magnification allows a dentist to see microscopic amounts of elevation of marginal ridges or microscopic amounts of elevation of the FPD margin above the abutment margin [22] and to identify which adjustments result in microscopic incremental improvements in seating the indirect restorations [23].

The optimal horizontal marginal gap between dental prostheses and abutments is 0 μm . This is easily achieved with the use of magnification devices, precise laboratory techniques and training. On the other hand, the optimal vertical margin fit is 50 μm . Tooth preparations, impression materials and techniques all influence the size of the vertical gap.

The bacteria that cause tooth decay are smaller than 1 μm in size. However, caries is the result of bacterial aggregations, rather than a single bacterium. Minimizing the marginal gap between the dental prostheses and abutments should result in a considerable reduction in the incidence of marginal caries [24] and an increase in the patients' comfort. The proprioception of teeth and tongue allows for the observation of small differences in thickness or roughness on a scale of less than 20 μm [25]. Obtaining smooth surfaces through correct placement and thorough polishing of the fixed prosthetic devices is essential for the health and comfort of the patient [26].

Periodontics

Numerous aspects of the treatments of periodontal pathology require a meticulous diagnosis. The magnification devices and microsurgical instruments, in association with minimally invasive techniques, offer the best results.

The Dental Operating Microscope allows for the thorough and effective identification of any irritative factor such as dental calculus or enamel pearls that could explain the attachment loss in a particular area [27]. The use of the microscope is particularly beneficial in areas with difficult access, such as radicular furcations, due to its high level of magnification and proper lighting.

In recent years, numerous microsurgical techniques have been developed, with good results and high patient satisfaction [28]. Among the benefits of periodontal microsurgery are included [29]:

- Achieving predictable results
- Performing minimally invasive procedures with minimal discomfort
- Rapid healing
- Improved esthetics
- High patient compliance.

Microsurgical techniques and principles are frequently used when creating gingival flaps and making sutures because they allow the dentist to exercise high control over soft tissues without further traumatizing them by stretching, distorting or tearing them [30]. Microsurgical nodes differ from conventional ones by the existence of a

lumen that compensates for the change in volume caused by post-interventional edema. As a result, healing is achieved faster, less painful and with reduced scar tissue compared to techniques that do not benefit from magnification [10]. Consequently, as well as less scarring, less post-operative pain and more rapid healing may result.

Surgery

The use of magnification, laparoscopic and endoscopic devices result in reduced morbidity associated with surgery by avoiding large incisions. When respecting the principles of minimally invasive surgery, the complications associated with the fractures' treatment are greatly reduced by making small incisions that only expose a small amount of subcutaneous tissue [31].

In addition, minimally invasive approaches have evolved through the development of surgical microscopes which, being equipped with digital cameras, help obtain images during maxillofacial surgery procedures.

Surgical interventions on the maxillary sinus, salivary glands or temporo-mandibular joint are usually performed with the help of the endoscope, an instrument of great value in this field [32]. The microscope plays an important part as well: it is used for the anastomosis of blood vessels and nerve structures in the aftermath of tumor resections.

In oral surgery, the Dental Operating Microscope is used when performing tooth extractions [33]. It is also successfully used to examine sockets for the presence of retained roots or for the presence of oro-antral communication intra-operatively.

Orthodontics

The Dental Operating Microscope has been little used in this specialty so far, and more detailed research is necessary.

However, it has been proven that the use of a magnification system improves the quality of debonding and clean-up procedures in a significant way. Comparisons of the results of four techniques used show that regardless of the tools and finishing technique chosen, the use of the magnification device greatly influenced the results.

The magnification of the smallest details is an especially important factor to consider during the debonding procedure, in order to save as much enamel tissue as possible during adhesive removal [34].

Conclusion

The incorporation of magnification into dental practice presents a multitude of advantages and it will surely become the standard of care in dentistry in the near future. The practice of clinical dentistry, regardless of specialty, can be challenging, but being able to see clearly and being comfortable at the chairside improves the clinical experience for both the operator and the patient.

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