

The application of microscopic surgery in dentistry

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ABSTRACT

The use of the microscope as a tool for practising Medicine, especially in surgical specialisations, has been established for decades. The microscope was first used in OdontologyDentistry back to the 1970s and 1980s, and was introduced more widely (although it was still far from being in general use) during 1990s.

The purpose of this article is to describe the main applications of the microscope in OdontologyDentistry today, as well as providing odontologists and stomatologists, whether specialists or in general practice, with information about microscopic OdontologyDentistry for better patient care. This work also gives particular importance to matters needed to achieve the necessary manual dexterity to work in a magnified operating field using a surgical microscope (SM).

Key words: *Microscope, microscopic surgery, new technologies, OdontologyDentistry.*

RESUMEN

El microscopio como herramienta en la práctica de la Medicina, y sobre todo en las especialidades quirúrgicas se ha establecido como un hecho hace ya décadas. Las incorporaciones más tempranas del microscopio a la práctica odontológica debemos buscarla en los años 70 y 80, si bien la incorporación de una forma más amplia (aunque todavía lejos de ser generalizada) ocurre en la década final del siglo pasado.

El objetivo del presente artículo es describir las principales aplicaciones del microscopio a la Odontología actual, a la vez que informar y acercar la Odontología realizada bajo microscopia al odontólogo o estomatólogo, ya sea especialista o de práctica general, para lograr una mejor asistencia a sus pacientes. En este trabajo también se trata con especial importancia todos aquellos conceptos necesarios para la consecución de las destrezas manuales necesarias en el uso de la magnificación del campo operatorio por medio del microscopio operatorio (MO).

Palabras clave: *Microscopio, microscopio quirúrgico, nuevas tecnologías, Odontología.*

INTRODUCTION

Nowadays, the introduction of the microscope into precision dental practice is one of the greatest advances seen in modern OdontologyDentistry. Today's greatest challenge is to bring this improvement to new generations of trainee dentists, and to provide those who have been in practice for a longer period of time with the abilities and skills they need to provide offer better odontological dentistry care, as well as cutting down on the initial effort and stress involved when introducing visual magnification to odontological dentistry practice.

The aim of this article is to describe, inform and bring microscopic OdontologyDentistry to specialist and general practitioner dentists to improve care and to explain the necessary aspects for achieving the manual skills needed when operating with a magnified field using a surgical microscope (SM).

HISTORICAL BACKGROUND OF THE USE OF THE MICROSCOPE IN ODONTOLOGYDENTISTRY

Microsurgery in OdontologyDentistry field has benefited from the advances and application of microsurgical procedures and technologies in Medicine. The first articles (1-4) about using a microscope in OdontologyDentistry were published during the late 1970s and the 1980s. However, it was not until the 1990s when systematic use of surgical microscopes started and was applied by the different odontological dentistry specialities (5), such as Periodontal Surgery (6). In the Oral Surgery field, Leblanc JP and Van Boven RW (7), laid the foundations and used nerve microsuturing nerve repair techniques to treat traumatic injuries to the lower dental nerve. Nevertheless, reference material on the field of microsurgery in OdontologyDentistry has long been lacking, and is mainly anecdotal in nature (8).

THE SURGICAL OR OPERATING MICROSCOPE IN ODONTOLOGYDENTISTRY

All surgical microscopes used in Medicine and OdontologyDentistry share the common characteristics of stereoscopic vision and coaxial lighting, which, together with the magnification, make it more convenient to perform clinical work since there is an increased range of vision thanks to the improved ability to see they provide. Furthermore, using an Operating Microscope means we are obliged to work in a correct position, leading to more increased physical comfort, and less tiredness, as well as and avoidsavoiding, in the long-term problems with the spinal column.

The microscope's ability to magnify the image depends mostly on the quality of the optics and the focal distance of the lens. The shorter this is, the greater the magnification achieved.

Consequently, a low magnification level is considered to be between 2.5 and 8, and is used to guide us in a large working area. It is important to point out regarding these magnifications, that the lowest (from 2.5 to 4), can be achieved

by using magnifying lenses integrated into the operator's glasses. It is highly recommended for professionals to start using these to magnify the visual field as they make it much easier to learn and become accustomed to working with a certain depth of field, diminishing the problems associated with such a radical change in clinical practice. The average increase is between eight and 16 and is used for working with greater precision in OdontologyDentistry. The more powerful magnifications, more than 16x (and in some cases as much 32x 40x), are used to examine very fine details, for diagnostics and intrasurgical examinations, and to locate difficult-to-detect findings. It must be recognised that at these great levels of magnification the working field in focus is significantly decreased (lower depth of field), which can be inconvenient and cause considerable eye fatigue.

Microscopic surgical work requires not only knowledge of the specific techniques of each speciality, but also prior training in keeping a steady hand, working in an appropriate position and an in-depth knowledge and understanding of all the instruments necessary for performing microsurgery, in this way, getting the best out of the equipment for optimum results. Although using and manoeuvring this type of instrument can be difficult and complicated at first, we should not let this make us stop us trying too soon. Nevertheless, we must be aware that this technique and working philosophy take some time and considerable experience require a level of training depending on the skills of each professional before having sufficient experience to ensure we can be sure of providing continuity and positive results for our patients in clinical practice.

THE ADVANTAGES OF USING A MICROSCOPE IN ODONTOLOGYDENTISTRY

During the years since microscopic techniques were introduced into our daily working clinical practice, it is true to say that in addition to the traditional microsurgical triad (better light, sharper images and improved surgical abilities), there are a multitude of additional advantages, which can be classified into postural, procedural, psychological and educational (table 1).

BASIC ASPECTS OF INTRODUCING THE MICROSCOPE INTO CLINICAL PRACTICE

1.- INSTALLING THE MICROSCOPE

Most operators prefer a ceiling or wall-mounted microscope, as this option causes the fewest restrictions when it comes to moving around the microscope and its mounting. Sometimes, depending on the size, equipment and the way the operating theatre and clinic are "decorated", a floor- or wheel-mounted microscope may be recommended.

2.- TREMBLE CONTROL

Tremble control (9) is one of the most important preparatory steps in the learning period and is very valuable when using microsurgical techniques, which is assessed and measured in tens of a millimetre when we are working with large magnifications. When trembling cannot be controlled it usually has catastrophic results, which, in general, lead to

Table 1. The advantages of using a microscope in Dentistry.

Postural	Procedural	Psychological	Educational
<ul style="list-style-type: none"> • Posture should be perfect, so as not to cause discomfort to the back and neck, protecting the spinal column from future problems. • The microscope forces us to work at the same distance from the object at all times, avoiding tiring the eyes, as there is no need make constant adjustments. • There is not need for the dentist to wear his or her prescription spectacles. If the eyes are different, all microscopical binoculars have corrective mechanisms to compensate for this. 	<ul style="list-style-type: none"> • Considerably improves manual abilities as the operating field is magnified. • Lighting is magnificent, as it is always in the right place, without shadows. • Collateral vision decreases, e.g. the area surrounding the visual field is dark as it is in the cinema, removing unnecessary visual information and improvement sharpness of vision. • We can switch from one level of magnification to another (there are different scales ranging from 2x to 32x) very easily, without changing the position of the microscope. • Recording operations means we can assess the techniques followed and detect procedural errors or problems, 	<ul style="list-style-type: none"> • Decreases occupational, physical and postural stress. • Increases personal, professional satisfaction when the improved quality of our surgical treatments is seen. • Improves clinical results, with less post-operative discomfort for the patient. • Can be a significant internal marketing tool, as it gives the patient the idea of a high degree of professional qualification, as well as the impression of being very up to date with new optical, digital and computerised technological applications in Odontology/Dentistry. • The patient feels more confident. 	<ul style="list-style-type: none"> • Makes it easy for us to gather clinical images to file, clinical photographs, as a camera can be incorporated. • Easier to make reports, whether these are reports made by referring dentists, legal assessment reports or damage valuation reports for insurance companies. • Makes it very much easier to record diagnostic sequences and treatment in video format (if the microscope has a built-in video camera) and shows a magnified image of the operating field on the monitor for the assistant or auxiliary worker. Allows this to be recorded on disc or tape. • Allows clinical videos of interventions or techniques to be recorded and presented at conferences, symposia, or orally during speeches and conferences, or as part of specialised post-graduate training.

Table 2. Basic recommendations for controlling trembling.

Avoid feeling desperate and useless. Don't get discouraged, breathe deeply and relax.
Don't get bad tempered or irritated.
Don't try and go too fast. Complete each step well before going on to the next. If you come up against a problem, stop and think.
Feel confident.
Concentrate.
Try to get enough sleep and avoid heavy physical tasks.
Avoid smoking, coffee, alcohol and other bad influences.
Work for a reasonable period of time.
Appropriate handling and position to achieve better support and manoeuvrability.
Do not acquire bad habits.

Table 3. Initial exercises to improve movement coordination in microsurgery.

Position yourself correctly.
Move your hands together under the microscope, touching the tips of the fingers together.
Do the same as above, but using two Adson tissue forceps.
Pass objects from one set of forceps to the other.
Cut out letters from paper or flexible materials.

discouragement and demoralisation. Some basic but very significant recommendations for controlling trembling are set out in Table 2.

3.- POSTURE CONTROL

The operator's head must be slightly bent (approximately 30°), the dental chair should be in such a position that the operator and assistant's backs are vertical and straight, the operator's arms should fall relaxed and parallel to the vertical axis of the microscope, and the forearms should be parallel to the floor (Figure 1). The length and angle of the chair's headrest should be adapted to position of the patient's head in the appropriate occlusal plane. There are some simple exercises we should do until our movements are harmonious and precise (Table 3).

4.- WORKING POSITIONS FOR DENTISTRY

It is absolutely impossible to give a complete list of all the working positions we might possibly need when performing microsurgical procedures in the different areas of the oral cavity. Our ultimate goal is to learn how to adjust the position of both patient and microscope, and for the surgeon and assistant to find the most comfortable, least tiring and fatiguing positions (10), while being able to see all possible areas of the mouth.

Generally, the operator is situated at between nine and twelve o'clock, and there is a greater distance between the operator and the patient being greater. Usually, the first steps in the majority of procedures are performed at low levels of magnification, and higher magnification is used for observing the details. A lot of the time it is better to move the patient's head, the chair or to use a dental mirror, rather than needing to continually adjust the microscope (11).

Working on the upper jaw maxillary is usually easier to master than the on the lower. The patient in the chair should be lying in the supine position, the head tilting backwards with the chin slightly raised. The view of the vestibular surface of the teeth and alveolar maxillary procedures are carried out in direct view without the need of a mirror. Nevertheless, when working on the palatine areas indirect vision can be recommended with the help of a dental mirror or a mirror for palatine photographs. The mirror is placed at a distance at which the end of the instrument or the handle are within the operating field and do not interfere with the operator's view. If we wish to avoid using indirect vision we will need to tilt lift the patient's head further back, hyperextending it and tilting it to the side into a position that allows us to see. Access to the vestibular and palatine areas of a quadrant during the intervention itself requires constant changes in the position of both patient and microscope, which tires patient and makes the operation take longer.

Mandibular work is usually more complex. The antero-inferior teeth can be seen very easily from the 12 o'clock position. A dental mirror is recommended to see the lingual face of these teeth. It is also possible to see the vestibular and lingual surfaces of the premolars and molars with a mirror. To do this the microscope is directed in a perpendicular line to the vestibular surface. The most problematic area is the view of the occlusal face of the lower back teeth, because of

the soft tissues of the upper lip, especially when patients can only open their mouths to a limited or diminished extent.

APPLICATIONS FOR MICROSCOPIC SURGERY IN ODONTOLOGICAL SPECIALITIES

1.- ENDODONTICS

Endodontists were the first Odontological Dentistry professionals to find applications for the microscope in everyday practice, both for conventional and surgical endodontics (1, 5, 12).

For specialists in Endodontics the term Microscopic surgery is incorrect, as most of the procedures during which they use microscopes are not surgical. Endodontics is not surgical, therefore they believe it is more appropriate to call it an Operating Microscope (13). A survey carried out by the American Association of Endodontists (AAE) showed that the indications for using a microscope in Endodontics in different clinical situations was were, in order of most to least frequent, removing broken instruments from the canals, preparing the retrograde obturation cavity, obturating of the back cavity, permeabilising of calcified channels and locating the pulpar chamber canals, and also placed special emphasis on the time in training needed to correctly use a microscope in endodontics (14).

In short, as the most frequent decisive factor in the majority of endodontic errors and endodontic surgery is microfiltration, using an operating microscope and microsurgical techniques permits the complex system of canals to be managed and identified in a safe, precise manner, and makes it easier to resolve cases which would, in the past, without magnification, been impossible (13).

2.- PERIAPICAL OR ENDODONTIC SURGERY

Periapical or endodontic surgery is a reliable method of treating teeth with periapical lesions that do not respond to conventional canal treatment. On many occasions, when endodontic re-treatment is performed by the orthograde route, or in cases where there is no other alternative possible, it is usually the final therapeutic option for preserving the natural tooth before exodonty exodontics (Figures 2 and 3) (15).

The successful results described in the literature range from 45 to 80% according to the different authors and the different pathologies presented by the teeth in question (16-21) at the time of the surgical intervention. During recent years these success rates have improved because of the use of more precise procedures and new technologies and as the application of ultrasound for performing retrograde cavity obturation, or the use of superior obturation materials, and of course, and of course, and as well as because of the use of equipment to magnify the surgical field such as magnifying glasses or the surgical microscope (22).

3.- PERIODONTICS AND PERIODONTAL SURGERY

It is completely accepted in the literature that to treat Periodontal Disease, effective plaque and calculus removal from the radicular root surface is a determining factor for the success of the treatment and the control of the disease (23).



Fig. 1. Correct positions for working with a microscope in OdontologyDentistry.

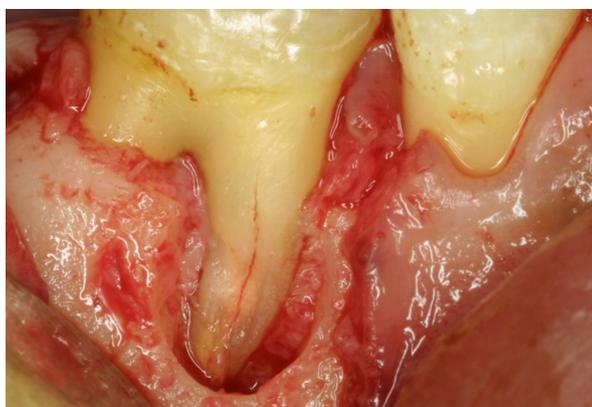


Fig. 2. Magnification allows otherwise-invisible radicularroot fractures to be identified, avoiding treatment failures.



Fig. 3. X-rays taken immediately before carrying out an apicoectomy in a first upper left premolar. When there are no contraindications for surgical-endodontics, the microscope allows us to work very precisely and to optimum standards in a small operating area.

As a result, any new techniques or technologies such as spectacles, magnifying glasses, frontal cold light, etc., that make us more able to see and see more clearly during scaling and radicular isolationroot planning manoeuvres will be useful. Naturally, the surgical microscope is an ideal instrument for this, as it combines stereoscopic vision, magnification and illumination.

Perhaps the routine use of the microscope during basic periodontal treatment (scaling and isolatingplanning) is not sufficiently ergonomic to justify its generalised use, but this is not the case in surgical indications. Reference material shows that surgical visual access substantially improves the operator's ability to remove the calculus (24, 25). In this way, the application of microsurgical techniques in Periodontics has provided a new, more precise and reliable approach to the most commonplace surgical procedures such as access surgery and pocket removal, regenerative periodontal surgery and mucogingival surgery (6., 26). A surgical microscope makes the operator's view sharper (8) and provides:

- The ability to perform the surgery with greater precision, making more precise incisions and the ability to use smaller instruments that cause less trauma and faster post-operative healing.
- Precise tissue restructuring with smaller needles and stitches.
- A better view of the radicularroot surface, leading to easier radicularroot instrumentation, in turn leading to more effective removal of calculus and radicularroot isolationplanning.

4.- ORAL SURGERY

Oral and Maxilofacial Surgery, an eminently surgical speciality, also benefits from the clinical and operating advantages of microsurgery. The use and application of magnification in therapeutic procedures is very beneficial when the operator's increased ability to see sharply is vital to achieving the best clinical results.

Consequently, this technique is particularly important for use in all surgical procedures for treating included or impacted teeth (27), and in particular for surgical salvage cases where mucogingival surgical procedures are being used to provide keratinised gum for teeth erupting through the vestibular plane (apical repositioning flaps, lateral displacement flaps, flaps in combination with soft tissue grafts).

Also recent, (7, 28, 29) but no less important, is the use of the microscope in the surgical treatment of injuries and lesions to the sensitive nerves of the mouth area. These include the lingual nerve and the lower dental nerve, which are at risk of damage during Oral Surgery if great care is not taken with the lingual flap (lower molar and premolar level) or during surgery on the third included molars (because of their extremely close relationship with the vasculonervous bundle of the mandibular dental canal).

5.- RESTORATIVE ODONTOLOGYDENTISTRY

In contrast to dentists specialising in Endodontics who work in a very reduced area, restorative dentists prepare complete quadrants or arches during the same appointment.

This requires frequent repositioning of both patient and microscope and the use of indirect mirror work.

These professionals, whether performing conservational or prosthetic work, are those facing the most difficulties when using the microscope, as during their work they must not lose sight of the occlusal surface, the parallelism of the teeth being prepared or the antagonistic arcade. This is why one of the main challenges is to find the most appropriate working positions for each sector, how to ergonomically switch positions and how to choose the most appropriate manifestations for the area being restored (30). These conditioning factors also arise in implant insertion surgery, where the parallelism between the different interosseous joinsbone splintering to be inserted is critical for achieving correcting positioning and avoiding difficulties with the ulterior prosthetic procedure.

The main error restorative dentists make in the beginning is attempting to drill or prepare a tooth using excessive magnification, losing perspective and cutting their depth of vision too much (31).

However, for finishing and polishing the final edges of the prosthesis, checking the tooth/material obturation interface and, checking the adjustments of metallic structures and porcelain edges, high resolution magnification using a microscope is extremely useful, so long as the dental laboratory doing the work also has the same ability to magnify.

For these reasons, this type of professional should look for microscopes that provide not only the required optical and lighting results, but that are also flexible and easy to manoeuvre, with tiltable binoculars for better posture and stability to reduce micro-trembling and movements. Finally, it is highly recommended that a filter be installed on the end to avoid premature polymerisation of photosensitive obturation materials during fitting and modelling (32).

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