Operating microscopes in restorative dentistry: The pursuit of excellence

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Dentistry has never been as exciting as it is today. The development of new materials such as ceramics and composites that can be bonded to tooth structure with dental adhesives, has allowed dentists to perform a variety of aesthetic procedures, giving back to patients not just the function of a total or partially missing tooth but also its natural appearance, thus increasing a patient's self esteem. However, these new materials are much more critical than the metallic ones used in the past. This is because if they are not carefully manipulated, precisely placed in a very well prepared substrate; they will fail rapidly.

So, as dental procedures have become more complex, a number of practitioners started using magnification in their practice. The most common are loupes, and even though they enhance visibility of the working field, they have limitations such as convergent vision, deficient magnification, image distortion, colour alteration, small depth of focus, reduced working field, and fatigue caused by extended use.

An operative microscope (OM) on the other hand, allows amplification of detail, greater versatility in image magnification, excellent visualisation of the working field, the best lighting possible, and a better working posture. Basically, an OM consists of an optical head, a light source and a suspension system.An OM incorporating a mechanical optical head has fixed stages of magnification that can be changed according to the necessity of the operator, and usually goes from three to 30 times magnification. The infinity corrected optics of an OM allow parallel vision which gives the same relaxed visual sensation as that of looking into the horizon, instead of eye convergence as is the case in observations using loupes or even the naked eye. The quality of illumination provided by an OM is as important as is its magnification, with respect to the improvement of image resolution. The lighting given by an OM is close to 100,000 luxes, and, as it is coaxial to the observer, allows a shadow-free visual field. Frequency of use of an OM in dentistry is greater in endodontics, followed by periodontics, and then gingival plastic microsurgery. In restorative dentistry and prosthodontics, its use is still very much in its early stages. Many restorative dentists who have an OM in their practice usually use it only for anterior teeth and occasionally for checking preparations and restorations. This is a great under-use of an important tool.

Working with an OM allows more conservative cavity preparations, more precise insertion of restorative materials, better finishing of restorations, and a more precise diagnosis of carious lesions and of old restorations that need to be replaced. In this case, the removal of old aesthetic materials can be carried out with less loss of sound tooth structure. In short, patients will benefit from the security and quality of the procedures they receive, and dentists, as they are working with the best conditions of visualisation and illumination, have a high probability of achieving excellence. An OM allows the visualisation of textures and details of anatomical structures, restorative materials and prosthetic components that would not

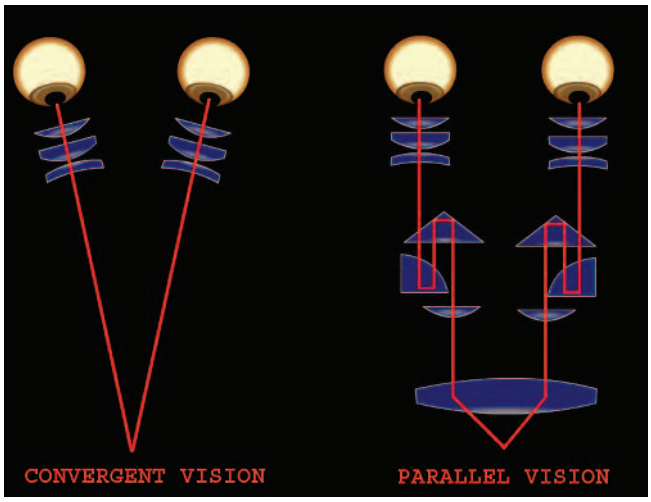

Figure 1: Schematic drawing comparing convergent vision provided by loupes and parallel, obtained by an OM

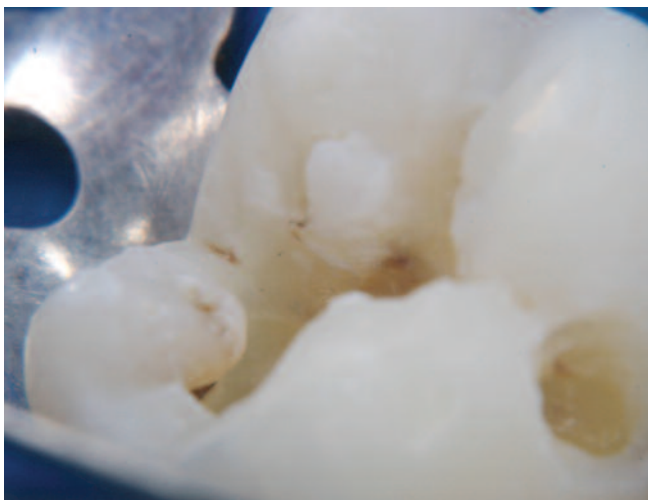

Figure 2: Caries detected under cusps, through magnification

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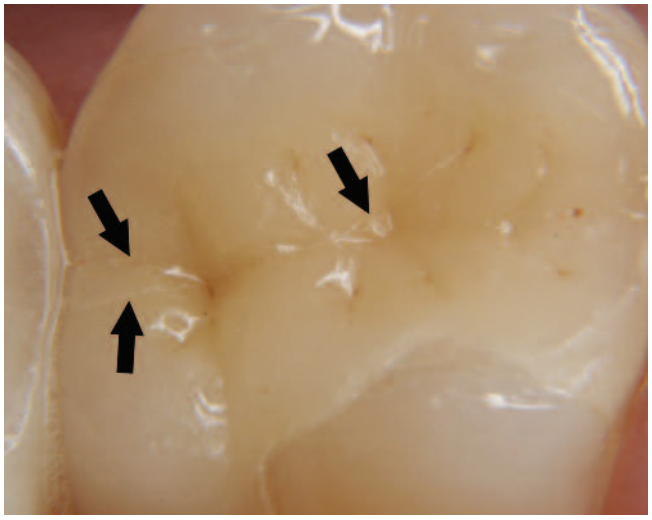
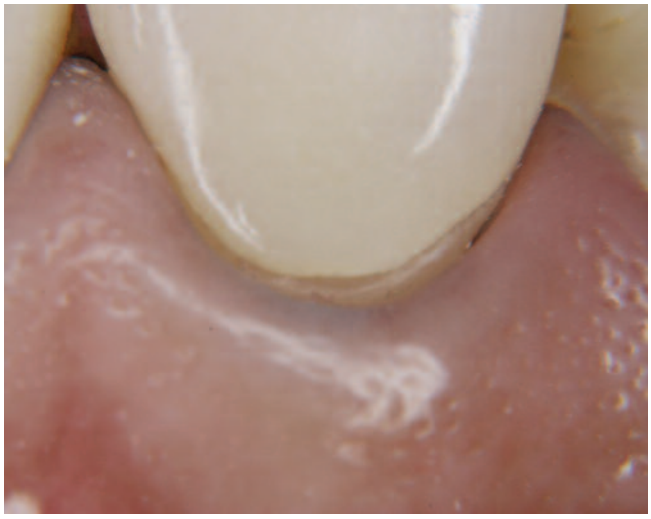


Figure 3: Arrows show crack in ceramic restoration

Figure 4: Small cavity can be seen in proximal surface of inferior incisor



Figures 5 and 6: Gap can be seen between all ceramic crowns and preparation at 25 X magnification

Figure 7: Bubble within adhesive being applied to tooth, if not detected, may prevent proper hybridisation in that spot

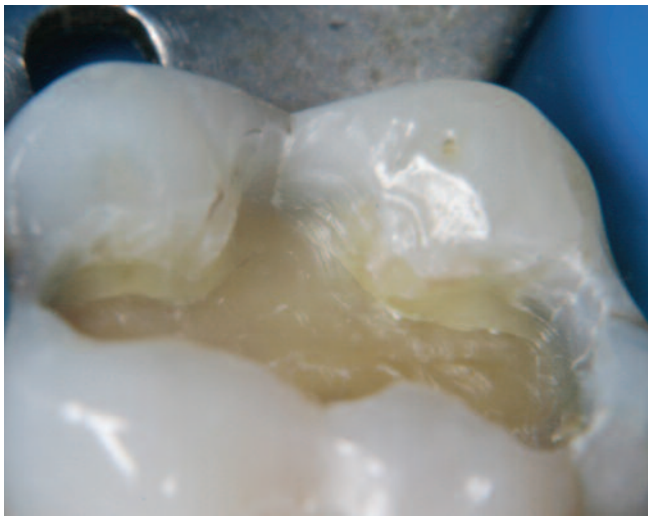


Figure 8: Dental cracks and incomplete fractures that used to be diagnosed by symptom basis, perfectly identified under OM

Figure 9: Excess luting cement identified that can be carefully removed under proper magnification

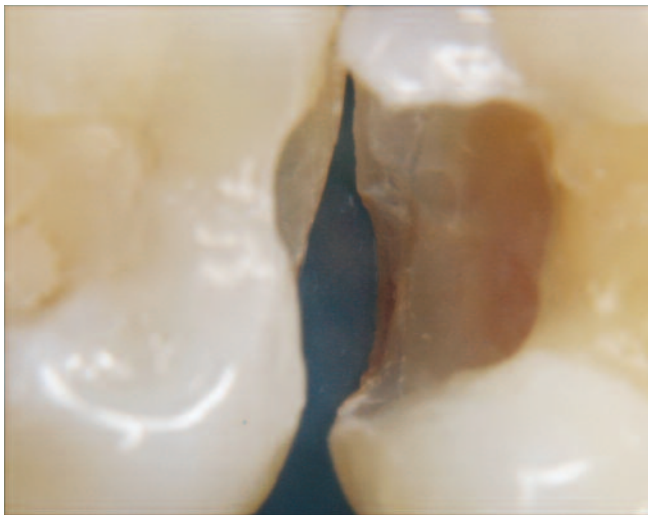


Figure 10: Remaining caries visually detected in gingival margin of proximal cavity

Figures 11 and 12: Images show better posture when operator uses OM promoting reduction in tiredness

be visible, even with loupes. This amount of detail allows the improvement of techniques that have already been used and also the development of others that would be unimaginable with the naked eye.

Another important advantage is the documentation of dental procedures that can be done directly in the optical head of the OM, without the need for interruption or the necessity to move out of the operating field. The use of a beam splitter in the optical head of an OM permits the attachment of digital cameras and camcorders that can capture images as the procedures are done.

Although operating microscopes can greatly enhance a dental practice, there are some disadvantages, especially at the initial stages. Probably the most important one is the need for specific training: as an OM has a restricted working field, 55mm for lower magnifications, and 11mm for higher ones. An operator using an OM cannot see his hands or fingers. Only the tip of the instruments can be seen, and they are used in delicate

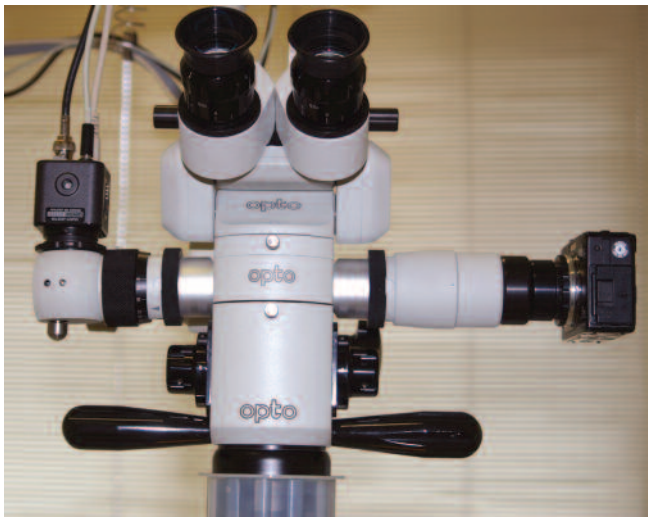


Figure 13: Video camera attached to beam splitter of optical head on left and digital camera attached on right. Allows documentation of procedures in real time

Figures 14a and b: Pre-operative pictures

Figures 14c and d: Direct restorations completed

movements of small amplitude. The development of such abilities cannot be carried out in the patients' mouth. It has to be practiced elsewhere, e.g. in a laboratory. Other disadvantages include the relatively high initial cost of the equipment and instruments, the need for retraining of the auxiliary staff, and an adjustment period for the new treatment paradigms and operator postures.

In the beginning the time spent in the restorative procedures will be longer and it may increase treatment costs and reduce initial productivity, besides the need for rescheduling. However, after a while, slowly the operator will return back to his original speed, and may become even faster as better visualisation and precise movements produce fewer mistakes.

After a period of adaptation, there will be no restorative procedure that cannot be carried out with an OM, and with far superior results regarding the better use of dental materials and restorative techniques. With each procedure, the microscope becomes easier to use, until eventually everything can be done

Figure 14e: Closer view of tooth #8, compared to un-restored tooth #9

Figure 15: Different sized mirrors, all with front reflecting surface

Figure 16: Ideal position for operator to work with OM is that close to 12 o'clock. Auxiliary should be set facing operator

Figures 17 and 18: With a monitor at back of operator, auxiliary in proper position, is able to check what is done in the macro and in the microfield

with the use of an OM.

Figures 14a through to 14e show the case of restoring post orthodontic patient with direct composites, and how biomimetics are achieved using magnification during whole procedure. In order to really incorporate an OM into one's practice, it is important to consider three factors:

1. Equipment and instruments: - Besides purchasing a microscope with proper optics, an inclinable binocular is necessary in order to maintain a proper posture. The microscope must be placed in a position that allows maneuverability around the head of the patient, without restricting the clinician's access to the oral cavity. Some special instruments might be needed, depending on the type of procedures that are carried out by the dentist, but one of the most important issues regarding everyday practice is to have different sized mouth mirrors with a front reflective surface, as many times indirect vision will be needed. Different shapes of lip and cheek retractors are also needed to make the access easier to the oral cavity, besides the regular use of a rubber dam. These are small details that make the use of an OM friendlier.

2. Proper training of the operator: As we mentioned before laboratory training using models, is of great importance in order for the dentist to get acquainted with the fine movements in a smaller field of vision, as is required by the use of an OM. Indirect vision training is also necessary, for example, to prepare upper posterior teeth. It is also important not to use unrealistic levels of magnification for less well-defined tasks. The higher ones should only be used occasionally, as they strongly reduce the size of the working field and the depth of vision.

3. Proper training of the auxiliary staff: as peripheral vision is very limited, the auxiliary must place most of the instruments in

the operator's hand and guide them to the correct site. Thus, it is necessary to have either an extra binocular attached to the beam splitter of the head of the OM, or a video screen. The latter is preferable in our opinion, because it is very important that the auxiliary has a macro vision of the procedures, at the same time being able to check on the well being of the patient.

The use of an OM in dentistry and the development of proper techniques are growing very slowly. However, there has been an increasing acceptance of the OM by renowned dentists and universities. The use of magnification has quietly become the standard of care, as it keeps showing a frank superior result in all restorative techniques, with consequent increase in the longevity of restorations.

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