In 1978, Drs. Harvey Apotheker and Geza Jako developed the first dental operating microscope. This microscope, known as a Dentiscope, had a single magnification of about 7X. Dental microscopy has seen its greatest expansion into the field of endodontics when the use of microscopes became the standard of care in graduate teaching programs in 1998. The use of the dental operating microscope in anatomic discovery of the pulp chamber, retreatment, instrument removal and perforation repair has been well documented.

With micro-surgical and minimally invasive procedures already common in many medical specialties, the natural progression of microsurgery into the field of periodontics and implant dentistry, which require greater precision, is understandable. Drs. Rino Burkhardt and Niklaus Lang’s split mouth clinical comparison study between micro and macro surgery showed that micro-surgically treated sites had a lower incidence of post-operative edema and a higher percentage of vascularization at the surgical site. A greater amount of root coverage was also seen with the microsurgical site. Later studies by Dr. Luca Franchetti showed similar results. Microscope-enhanced dentistry has been used in cracked tooth diagnosis, finishing of direct restorations, and preparation and evaluation of indirect restorations.

With the popularity of in-office digital laboratories such as CEREC and digital work flow techniques, the dental operating microscope can play a significant role in “precision prosthodontics.” Using the dental operating microscope, repositioning and completing the finish lines have been performed with ultrasonic instruments. Whether the final impression is taken with the PVS and evaluated under magnification, or a digital impression is magnified eight to 12 times in the digital laboratory software, quality marginal preparation is key to the fabrication of the final prosthesis.

In our practice, the dental operating microscope is used for quality control evaluation of all laboratory procedures required for prosthesis fabrication. These include evaluation of the final impression, die trimming, wax-up (Fig. 1), crown margin evaluation of all ceramic crowns before final firing (Fig. 2), final prosthesis evaluation on the model, and in the patient’s mouth.

In implant dentistry, the microscope can be used to aid in the fabrication of properly shaped provisional restorations and final

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Dr. Todd Schoenbaum demonstrated a method for immediate implant provisional restoration fabrication. In our practice, a dental operating microscope is used to modify a provisional restoration in a similar fashion (Fig. 3). The cervical third of the provisional restoration is changed from a convex profile (Fig. 4) to a concave profile to allow for greater tissue growth in this critical area (Fig. 5). When the papilla area is viewed under magnification, it should be pink in color, not red. The red areas of papilla (Fig. 6) are noted and the provisional restoration is re-contoured to allow for papilla growth (Fig. 7).

Case Presentation: Single implant crown case in the posterior region performed with the aid of a dental operating microscope.

The patient is a 55-year-old woman with a history of heavy smoking (one pack per day) for 10 years. All other medical history is non-contributory. She presented with a failing fixed dental prosthesis on the lower right quadrant (Fig. 8). Pocket probing revealed a 9mm pocket in the mid-buccal area of the lower right second molar. The patient was told that the second molar has a hopeless prognosis. The patient opted for sectioning of the existing fixed dental prosthesis, removal of the hopeless tooth and implant placement in the first molar region. Preliminary impressions were taken in alginate using stock rimlock trays and poured in Type 4 stone (Jade Stone, Whip Mix). The models were mounted on a semi-adjustable articulator and the missing first molar tooth was waxed up.

Once satisfied with the occlusion and emergence profile of the wax-up, the model was duplicated and a radiographic guide was fabricated using a cold-cured, clear orthodontic resin (Fig. 9). The radiographic guide was polished and a single 2mm diameter hole was placed using a tabletop drill through the central fossa of the radiographic guide. The hole was filled with gutta-percha. The patient subsequently wore the radiographic guide and a CT scan of the lower jaw was obtained (Fig. 10).
The location of the dental implant was determined using the GP point and the distance to the nerve was measured. Before the implant placement date, the gutta-percha was removed and the radiographic guide was used as a surgical guide. Normal Nobel Biocare protocols were followed to place an 11.5mm regular platform Nobel Replace conical connection implant in the area indicated by the surgical guide. The implant was torqued to 35Ncm on placement. A 3mm x 5mm flared healing abutment was placed and torqued to 15Ncm.

After three months of osseointegration, the healing abutment was removed and the site was irrigated with chlorhexidine gluconate 0.12%. The dental implant and surrounding tissues were examined using the dental microscope at 8X magnification to insure there was no debris inside the implant or around the internal threads (Fig. 11). Due to the flat tissue profile, it was decided that tissue contouring with a provisional restoration was not necessary.

A closed tray impression coping was screwed onto the implant. The microscope was used again and the tissues were gently moved with the probe to confirm seating of the impression coping (Fig. 12). A bitewing radiograph was also taken to ensure seating of the impression coping. An impression was taken with light and heavy body PVS (Reprosil, Dentsply, York, Pennsylvania). The impression quality and the seating of the impression coping within the impression was confirmed with the use of the microscope at 8X magnification (Fig. 13). The models were poured and scanned using a NobelProcera 2G Scanner.

The titanium abutment was designed to provide the proper emergence profile expected of a natural molar tooth and support the final crown (Fig. 14). When the titanium abutment was received from the milling center, it was examined for defects under magnification (Fig. 15). The intaglio surface of the abutment was highly polished using titanium polishing cups. The abutment was steam cleaned and inserted. The abutment was torqued by hand. The tissue was checked for blanching using the microscope. Any areas of blanching were marked and the abutment was removed and the intaglio surface adjusted again to insure a concave surface in the area to allow for tissue health. The abutment was polished again and steam-cleaned. Once the abutment was placed passively on the tissues, the abutment screw was dipped in 2% chlorhexidine gel and was torqued to 35Ncm. The excess gel was removed, Teflon tape was placed in the access hole and the crown was placed on top of the abutment. The crown was checked for marginal fit and interproximal contact.

The metal ceramic crown (Fig. 16) was designed to hold Shim Stock in centric occlusion only along with other teeth in the arch. In eccentric movements, the Shim Stock would disengage. The polish of the crown was examined under magnification and any rough areas were smoothened using dialyte polishing stones. The crown was cemented with RelyX Unicem Self-Adhesive Universal Resin Cement made by 3M ESPE. Excess cement was removed under 12X magnification.

**Discussion**

The patient was initially given the option of having implant crowns placed in the first and second molar area. However, the CT scan revealed a danger to the inferior alveolar nerve if an implant was placed in the second molar region, and given the studies suggesting a shortened dental arch is a viable clinical option, she was advised to receive one implant only.14

The complete seating of impression copings in radiographs are at times difficult to verify and if an implant is not too submerged, the microscope is a valuable secondary tool in confirming seating.

There has been great concern regarding the deleterious effects of remaining cement on the peri-implant tissues. One of the most important uses of the dental operating microscope comes in cement removal and quality control of marginal integrity under 12X magnification. While cement-retained restorations have been questioned lately in literature, a meta-analysis by Dr. Marcus Brandão et al. shows that peri-implant bone loss is equivalent between cement retained and screw retained restorations. The choice of cement- versus screw-retained restorations should therefore be based on prosthetic space available and clinician preference.

**Conclusion**

The dental operating microscope is an extremely important tool in every step of the prosthesis design, fabrication and delivery. The microscope can be used effectively in checking the seating of the impression coping, confirming the quality of the final impression, quality control of the fabrication of the prosthesis, and confirmation of the final delivery of the prosthesis. With significant concern being raised with excess cement below the finish lines and the resultant peri-implantitis, the microscope is a powerful tool in minimizing this troublesome implant sequela.


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**Author’s Bio**

Dr. AminZadeh obtained his Doctor of Dental Surgery degree from the University of Western Ontario, graduating in 2001. Following a successful decade long practice in Vancouver, he returned to study at the prestigious University of Michigan dental school where he received his Masters of Science in Prosthodontics. He practices precision prosthodontics through the use of a dental operating microscope and is a global speaker for Seiler Dental Microscopes. Dr. AminZadeh is an expert in digital laboratory workflow and utilizes an on-site state of the art digital laboratory in his office. He has published several epidemiological articles in peer reviewed journals on medication side effects as they relate to dentistry. He is a fellow of the Royal College of Dentists of Canada. In addition to his private practice, Dr. AminZadeh is a clinical assistant professor in the School of Dentistry at the University of British Columbia.

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