Endoscopic Approach to Dental Implantology

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Objective: To describe an innovative miniature visualization surgical endoscope and endoscopic techniques applicable to dental implant procedures.

Materials and Methods: A newly developed modular dental implant endoscope is introduced, and the first impressions from its use in different implant procedures are reported.

Results: Details of the device that combines an endoscope, irrigation cannulas, and a surgical micro-instrument channel are presented. The advantages of using it in dental implant procedures are described, and examples of how miniature visualization and surgical endoscopic techniques can be applied to increase the success of implantation are outlined. The new modular implant endoscope accurately identified all microanatomical and pathological structures, and simplified dental implant procedures.

Conclusion: Endoscopy should be considered not only for intraoperative observation and assessment of implant sites, but also should be applied for active assistance during implant placement procedures.

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Endoscopic surgery has changed the philosophy and practice of modern surgery in all aspects of medicine. It gave rise to minimally invasive surgery procedures based on the ability to visualize and to operate via small channels. In maxillofacial surgery, our ability to see clearly the surgical field opened an entirely new world of exploration, as conditions that were once almost impossible to control and whose outcome was uncertain can be now predictably managed.1,2 In the 1990s, only a few clinicians believed in the utility of endodontic microscopy and endoscopy, while nowadays, with magnifications of ×10 and more, clinicians can look for fractures or cracks and even evaluate the quality of restorative procedures. No wonder that graduates of advanced education programs in endodontics are now required to show competence in microscopy.

Naturally, the introduction of microendoscopy into dental implant procedures has followed, adding to recent progress in implantation techniques. Implantation techniques have gradually developed from blind drilling and insertion procedures to computerized guided surgery (stereolithographic stents). Later on, navigation equipment was introduced to assist in accurate and precise implant placement, so overcoming the shortcomings of the blind technique. In the present report we introduce a simple compact direct visualization and working technology for assisting the physician during the implantation procedure.

In the past, pathologies of the implant cavity’s wall could not be diagnosed by direct observation because of the rapid beclouding of the optical system. A technique to intraoperatively examine prepared implant sites was presented in the early 2000s, and it facilitated diagnosis. Examination of implant cavities was performed with immersion endoscopy. In 2006, a microendoscope (Visio Scope, Ulm, Germany) was
introduced for multidisciplinary use in dentistry, including dental implantology. Overall, the usefulness of similar endoscopes in maxillofacial surgery and dentistry has already been established. The adaptation of any general-use endoscope to the specific tasks required for implant surgery is first described here.

The objective of this report is to describe the Modular Implant Endoscope, its working options, and endoscopic observations and possibilities and to highlight its potential for the development of innovative endoscopic techniques for dental implant procedures.

Materials and Methods

We describe the newly introduced Modular Implant Endoscope (Sialotechnology, Ashkelon, Israel). The device was tested in 56 procedures, such as routine dental implants procedures (34), closed sinus lift procedures (18), and implant preparation site surgery (4) by 4 experienced clinicians, and their preliminary observations are outlined.

Results

THE DEVICE

The Modular Implant Endoscope (Sialotechnology) is a semirigid microendoscope with an external diameter of 1.5 to 3.2 mm, designed to fit standard implant drills. It has high-resolution optics, 0.9 mm in diameter, allowing easy and safe introduction into the endoscopic cannula. The optic element is covered with a Nitinol tube that protects it from the instruments inserted next to it through the same cannula. For easy use, the optic element has an optic shifter that is adjustable to cannulae of different lengths, and it always keeps the optic element at the distal end of the endoscopic cannula. By changing only the disposable cannula, it is possible to alternate between diagnostic and treatment procedures using the same modular endoscope.

The Dental Implant Endoscope is available with an optical system of 10,000 pixel resolution and wide field lens (120°), and it can be used with certified xenon light sources, a camera, and a monitor. For dental clinics and medical centers, the integrated all-in-1 laptop-like system, having a light source, camera, and monitor (Model SIA-COM-01; Sialotechnology) is recommended. Special adapters are available for other light sources. Routine instruments and microinstruments (irrigation device, injection cannula, mini-forceps, microdrills, needles) are also compatible with the endoscope (Fig 1A-E).

APPLICATION TECHNIQUES

The Modular Dental Implant Endoscope permits simultaneous visualization, irrigation, and use of surgical microinstruments. Irrigation is crucial in every endoscopic procedure, because the implant’s locus

![FIGURE 1. A, The endoscopic system: 1. Laptop-like (all-in-1) endoscopic mobile system with camera, video, monitor, a light source, and an archive system. 2. Dental Implant Endoscope (yellow arrows). B, A close-up magnification of the 0.9-mm endoscope tip with 10,000 pixels and wide angle lens (120°). C, The 0.9-mm-diameter endoscope, note the flexibility due to the nitinol coating. D, The irrigation and injection cannula (black arrow) enables direct injection of saline and low viscosity material via the instrument channel under direct vision. The cannula can be advanced. Jet elevation of the paranasal sinus floor is possible with the injection cannula. E, Mini-forceps permits the delivery of collagen sponge with or without BMP (bone morphogenic protein) into the sinus via the endoscope. F, Intraoperative view of the usage of the endoscope during routine implant surgery. G, Insertion of the endoscope cannula into the drill socket for immediate inspection. H, The endoscope in conjunction with the low-speed engine during surgery.](image-url)
must be filled with fluid to allow free and full visualization of the 120°-wide field. To maintain good visibility, the area must be lavaged, preferably with isotonic saline. Thus, intravenous tubing containing isotonic saline is connected to the irrigation port, and the endoscope’s move forward is accompanied by a gentle flow of saline.

Irrigation and suction employ small diameter cannulae that irrigate and connect the suction to the side port. After assuming the form of the implant site, the tip of the irrigation cannula should be fixed 1 or 2 mm in front of the tip of the suction cannula, using the endoscope’s control module, to prevent premature removal of the rinsing saline (Fig 1F-H).

INDICATIONS FOR APPLICATION IN IMPLANTOLOGY

The main goal of the endoscopic-assisted dental implantation is to increase the longevity of oral implants by securing proper implant placement into bone of sufficient density. To meet this objective, the Modular Dental Implant Endoscope can perform several tasks. For the planning of surgery, bone conditions can be accurately evaluated without causing any pressure necrosis of the bone. In complementary procedures, the endoscope can assist in sinus lifting intervention, and during the operation, endoscopic observation can further assess bone density and implant stability (Figs 2-4).

IMPLANT SITE PREPARATION

Endoscopy during routine implantology and during implant site preparation depends on the timing of the procedure. In immediate implant placement, endoscopic evaluation of socket condition can be performed in real-time. The irrigation procedure allows observing the cavity walls of the immersed bleeding alveolar socket under variable magnification. Cortical and cancellous bone structures can be differentiated in situ, and pathologies are detectable even with capillary bleeding.

In late implantations, a pilot hole is drilled into the recipient site and expanded using progressively wider drills. Before each drill is used, endoscopic observation assures that anatomical structures, like the inferior alveolar nerve, maxillary sinus, are avoided.

BONE QUALITY

The fundamental cause for differences in the survival of dental implants is bone quality. Currently, the...

assessment of bone quality is based on radiographic evaluation and on the subjective sensation of resistance experienced by the surgeon when preparing the implant site. Thus, additional qualitative objective methods for evaluating bone quality are needed, and indeed, endoscopic observation of the site can determine the quality of bone density. The difference in the endoscopic appearance of low- and high-density bone is evident from Figure 2A, B.

**SURGICAL ASSISTANCE**

Special case application of this endoscope includes endoscopic assistance in closed sinus lift, inspection of perforations and of other drilling and implant preparation errors, and assistance in flapless implant procedures. Specifically, for closed sinus lift, jet elevation of the paranasal sinus floor is possible with the Dental Implant Endoscope injection cannula. If such a procedure is necessary, a viscous material can be easily injected directly. The armamentarium of the Dental Implant Endoscope’s module also permits delivering a collagen sponge, with or without bone morphogenic protein, into the sinus.

**OVERALL EVALUATION**

In general, a significant improvement in all tested aspects, including handling and flexibility, and verification of findings that were not detected radiographically were obtained with the endoscope. The endoscope proved superior to conventional optical aids, foremost the surgical microscope. Its working canal facilitated specific application of medication and irrigation solutions. However, room for further perfection is clearly seen in designing a specific microendoscope for dental implantology.

**Discussion**

Dental implants were recognized as significant in restorative dentistry 3 decades ago, and since then, dental implantology has been established and widespread. Still, the rapid growth of any new discipline inevitably leads to some decline in the quality of procedures performed, and in implantology we hope that the Modular Dental Implant Endoscope will reverse this trend and guarantee a high rate of success in implant procedures.

The advantages of the device, besides visualization of the implant site, include options for microsurgery at the site of implant and the sinus, and the ability to perform minimally invasive implantology in cases of sinus involvement. With a magnification of ×20, high-resolution optics, and a wide field-of-view of 120°, this compact and easy-to-handle ergonomic and modular device is a welcome addition to the equipment of dental implantology.

Until now, the number of reports on the application of endoscopy in dental implantology has been minimal. The authors admitted that currently diverse endoscopic applications remain a specialized technique practiced by a minority of surgeons in few specialized centers. At the same time, these publications have reported that endoscopic assistance resulted in minimal invasive surgery, low intraoperative trauma, good implant stability upon placement, few postoperative symptoms, and high success rates after years of loading. We hypothesize that future studies will find that endoscopic implant techniques can also significantly reduce the associated complication rate. Nevertheless, the need for intensive training might be considered a disadvantage.

We envision that additional applications of Modular Dental Implant Endoscope will be developed in the future. These include assistance in implant planning and design, development of a membrane suitable for endoscopic application for the closure of perforations, and endoscopic nerve repositioning.

In conclusion, the new Modular Dental Implant Endoscope that we have used accurately identified all microstructures and facilitated simplified dental im-
plantation procedure. The endoscope should be considered not only for intraoperative observation and assessment of bone density, but also for active assistance during the procedures of implantation.

References