Introduction to Microsurgery

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Abstract

The operating microscope (OM) was first adopted by otorhinolaryngology professionals for performing surgeries in the early twentieth century. Soon after, it was used by other medical specialties, for example, ophthalmologists, vascular surgeons, reconstructive and plastic surgeons, etc. It was not until the late 1990s when incorporation of OM training in the accreditation standards for advanced specialty education programs in endodontics took place in the USA. The main advantages of using the OM over surgical loupes are unprecedented and adjustable magnification, and confocal illumination, among others. The use of OM for

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performing periodontal and implant surgeries is on a rise. Its uses are justified by improved wound healing at tissue and clinical levels, as documented in the literature. Moving forward, more high-quality studies are encouraged to support the use of OM. A systematic and strategic approach should be developed among interested stakeholders to explore the full capacity of OM for elevating patient care quality and to create innovative learning modules and simulators for improving microsurgical education.

Keywords
Microsurgery · Minimally invasive surgical procedures · Periodontics · Dental implant

1 Introduction

Curiosity has kindled humanity's passion for knowledge and understanding by harnessing realities and deciphering codes that explain the mysteries of its tangible existence. The world continually poses challenges that entice the intellect to interpret its secret language and unmask hidden truths that help us formulate axioms that define our own understanding of being. Unraveling our physical reality has been a fundamental task in the lives of researchers, entrepreneurs, and science leaders following the same common objective: to understand the how and the why of the mechanisms that make up the universe we live in. Whether elevating our gaze at the stars or looking down at the soil, we have been using visual aids to empower the naked eye in its quest for seeing beyond its inherent physiological limitations.

Understanding the world that surrounds us became a necessity to many. Simple lenses crafted with primitive tools opened a door hundreds of years ago that was not to be closed. According to Bradbury, the first individual credited with utilizing a convex lens to magnify an object's image was Ibn al Haitham (962–1038) [1]. It would take hundreds of years for the lens making industry to figure out how to eliminate chromatic aberrations, become proficient in lens polishing, and assembling mechanical contraptions that would facilitate the operation of magnifying tools for industrial and medical applications.

It is hard not to take for granted today's advances in technology that allows clinical operators to incorporate magnifying tools in their daily activities for use as extensions of their own body when providing patient care. In the field of microsurgery, dentistry has greatly benefited from trials and errors, discoveries, and challenges faced by medical colleagues. While otolaryngologists were at the tip of the spear and are credited with the first incursions utilizing an OM, techniques and armamentarium have been refined by an orchestrated collection of efforts by physicians applying microsurgical principles into their respective fields.

The specialty of endodontics embraced the OM as an essential part of their curriculum and mode of practice. The adoption by other dental specialties has advanced at a slow and steady pace. In the fields of periodontics and implant dentistry magnification has been acknowledged as advantageous for the delivery of care. The incorporation of the OM provides significant advantages that benefit patient care and operator well-being simultaneously. This textbook is a unique collaborative effort that brings together experts in the field of microsurgery from different geographical locations. The main goal of all the authors is to compile practical information that will help both novice and advanced clinician alike, to begin, improve, and master the utilization of the OM and microsurgical principles and philosophies with the ultimate goal of enhancing patient care and mental and physical well-being to those willing to challenge themselves to grow by adopting this discipline.

Within the pages of this textbook, the reader will be exposed to key information related to this topic; from wound healing principles, to understanding the mechanisms that regulate the OM and the armamentarium needed by the operator to execute its craft; from recommendations on incorporation of microsurgery to the daily clinical flow to rationale behind microscope-assisted care delivery in periodontal and peri-implant plastic surgery, periodontal regenerative therapy, pre-prosthetic applications, ridge augmentation related procedures, including maxillary antral augmentations and ending with immediate implant therapy and handling surgical and prosthetic complications in implant dentistry.

After studying this book and its supporting visual material, the reader will be able to embrace the rationale behind the incorporation of the OM in periodontics and implant dentistry and will be able to answer the question at the core of this endeavor: why bother working with an OM in periodontics and dental implant dentistry? The primary answer is simple: to see what needs to be done, so the hand can be told what to do. Once this is accomplished, the rest will follow: more delicate tissue manipulation and more accurate surface modifications via precise instrumentation will translate into less trauma, passive tissue approximation, clot stability, enhanced vascularization, thus increasing the predictability in successful clinical outcomes that depend on attention to regal minutia.

Welcome this book and its contents as a tool to help conquer a self-imposed challenge; an intellectual and psychomotor challenge that will help grow and explore the potential of your mind and your skills in a field that is waiting to be discovered and mastered.

2 History of Operating Microscope in Medicine

Names of opticians, scientists, textile and wine merchants like those of Zacharias and Hans Janssen, Galileo Galilei, Giovanni Faber, Anton von Leeuwenhoek, Robert Hook, and Jackson Lister are intimately associated with the assembling of the first microscopes, crafting chromatic-aberration free lenses and scoring numerous discoveries of micro-organisms and cells for the first time in the history of humankind. This craft would be elevated to a science by the work of Carl Zeiss and Ernst Abbé in Jena, Germany, who applied mathematical formulas to allow for a predictable and standardized lens making enterprise [2].

Sweden became the epicenter of microsurgical therapy in 1922 when an otolaryngologist, Carl-Olof Nylén reported his experience with a monocular OM he had designed to perform ear operations [3]. Like most innovations, the OM was not embraced immediately as the go to magnification tool to perform otic surgical procedures; contemporary key opinion leaders were still using surgical loupes with limited magnification. There was a lengthy hiatus until the OM became an indispensable tool in the operating room. In ophthalmology, Perritt reported in 1946, the use of a stationary microscope with an accessory illumination source to perform a superficial keratectomy [4, 5]. In 1954, H. Littmann published an article describing a binocular OM that allowed working at different magnification levels without having to exchange objective lenses or ocular pieces [6]. In vascular surgery, the next logical step to elevate the refinement of treatment execution was the incorporation of the OM as demonstrated by Jacobson and Suarez in 1960 [7, 8]. The advancements achieved on microvascular anastomosis opened the door to neurosurgeons, reconstructive surgeons (plastic, hand, and orthopedic surgeons), gastroenterologists, trauma specialists, urologists, and gynecologists to perform procedures that were not feasible before, thus enhancing the predictability of outcomes to levels not seen previously [9–13]. The following years witnessed a constant improvement on microscope design and versatility geared toward facilitating maneuverability, documentation, and performance. The addition of foot controls to operate zooming and mobility mechanisms, access ports to incorporate photographic and video cameras, dual binoculars for additional operators or assistant personnel, suspension arm features with locking breaks to provide positional stability to the supporting structures, optical filters, different source types of coaxial illumination, the addition of stereoscopic 3D vision and integrated laser applications are some of the most common additions that have made this technology a must have in the operating theater.

The adoption of the OM propelled the design of surgical armamentarium that could support the visual and psychomotor demands inherent to work being performed at high magnification levels. Reduced operating visual fields combined with a vertical plane of vision demand the utilization of instruments that do not interfere with the eye-to-target visual path. Therefore, most instruments that were used for conventional, macro-surgical procedures were adapted by reducing their size, incorporating specially designed finish features in active instrument sections, increasing the handle length, decreasing weight to maximize operational efficiency by reducing hand fatigue, and refining the cross-sectional profile and surface topography of the handle to facilitate execution of delicate digital movements in the presence of equally delicate tissue structures. In order to avoid coaxial light reflection by shiny and highly polished instrument surfaces, extrinsic finish coatings and treatments that mitigate luminous eye-fatigue sources for the operator have been incorporated. Suture thread diameters and needle swage and point design have also been modified to meet working needs associated with delicate tissue manipulation and tensionless wound edge approximation.

Training facilities and educational curriculum development followed to instruct and capacitate microsurgeons across all medical disciplines [14]. Exercises have been developed in different models, both in vitro and in vivo that prepare the microsurgeon in training to think, visualize, and execute the different steps associated with microsurgical performance prior to being exposed to the patient population in need of this expert delivered therapy [15, 16] (Fig. 1).

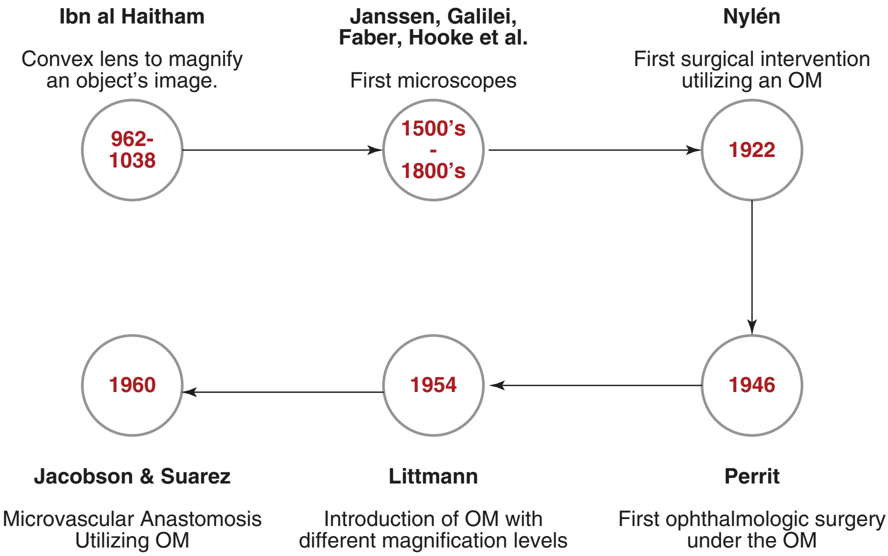

Fig. 1 Timeline landmark events: OM in medicine

3 History of Operating Microscope in Dentistry

Although at first glance the utilization of the OM in the dental field seems to be a relatively new discipline, when compared to historic events in the scientific and medical fields, the first steps toward incorporating this technology in dentistry date back to 1907 when Bowles presented a binocular, bi-objective (Greenough type stereoscopic visual device) microscope to be used in the dental operatory. This device came equipped with an electrical light/reflector combination that illuminated the working field [17]. The mechanical and functional shortcomings of this early model stagnated the interest and adoption of this technology into clinical applications.

In 1975, an otorhinolaryngologist suggested the use of the microscope as a practical tool in dentistry [18]. A few years later, efforts of a dentist and an otorhinolaryngologist, Drs. Apotheker and Jako, lead to the development of the first modern microscope equipped with accessories to allow for documentation (via still pictures and videotapes) and a CO_2 laser [19]. This instrument offered stereoscopic and binocular vision, magnification of 5–10× with high resolution, working distance between the object and the microscope of 200–300 mm, several options to mount it either to the dental chair, floor or ceiling, and independent source of illumination. In spite of having a well thought out product, the commercial enterprise supporting this innovation in the dental field did not prosper.

The dental world had to wait for efforts led by individual clinicians practicing endodontics in the early 1990s who demonstrated the undeniable advantages of incorporating microscopy in their field, for this technology to gain significant traction in the dental profession [20, 21]. Endodontic therapy is mostly performed on individual teeth, usually with operator–patient movements constricted to single planes and minimal engagement of axes of rotation (predominantly occlusal access for non-surgery and buccal access for surgical interventions) which facilitates task execution under the microscope. This simplistic kinematic interaction has been fundamental in the adoption of the OM by this dental discipline. The support of this novel approach to endodontics led to the celebration of the first symposium on microscope endodontic surgery which was held at the University of Pennsylvania School of Dental Medicine in 1993. In view of the interest aroused among the endodontic community, The American Association of Endodontists (AAE) sponsored a workshop on microscopy for endodontic program directors. This event was the catalyst that led to include microscopy training in the accreditation standards for advanced specialty education programs in endodontics in 1998 [22]. Within eight years, from 1999 to 2007, the use of microscopes by endodontists went from 52% to 90% [23].

The remaining dental specialties have not followed in unison the path blazed by the endodontic community. Isolated efforts have been showcased in pediatric dentistry, oral and maxillofacial surgery, prosthetic and restorative procedures and periodontal and implant therapy.

Chou and Pameijer demonstrated the significant benefits of utilizing stereomicroscope in the dental prosthetic laboratory in processes that require precision such as die trimming, wax pattern seals, and finishing and polishing both metal and porcelain materials [24]. Martignoni and Schonenberger showcased the microscope in fixed prosthodontics as an essential tool to execute work demanding high precision in tooth preparation, margin definition, and preservation of soft tissue integrity when working with the natural dentition [25].

Microscope-assisted exodontia has been documented and its merits illustrated by Schmidt and Boudro, emphasizing the reduction in morbidity and avoidance of undesirable sequelae when magnification and optimal field illumination are combined and made available with the use of the OM. Procedures such as teeth subluxation, elevation, and alveolar socket debridement and preservation can be performed with minimal trauma when the OM is incorporated as part of the surgeon's armamentarium [26] (Fig. 2).

4 History of OM in Periodontology and Implant Dentistry

Microscope-assisted periodontal therapy was introduced to the specialty of periodontology in 1992 by Shanelec and Tibbetts during the 78th American Academy of Periodontology annual meeting in Orlando, Florida. Since then, several publications have been made available defining the clinical philosophy behind this approach, describing the armamentarium required to perform microscope-assisted periodontal surgical procedures and spelling the benefits associated with the adoption of this way of clinical practice [27–35]. The current existing evidence supports the benefits

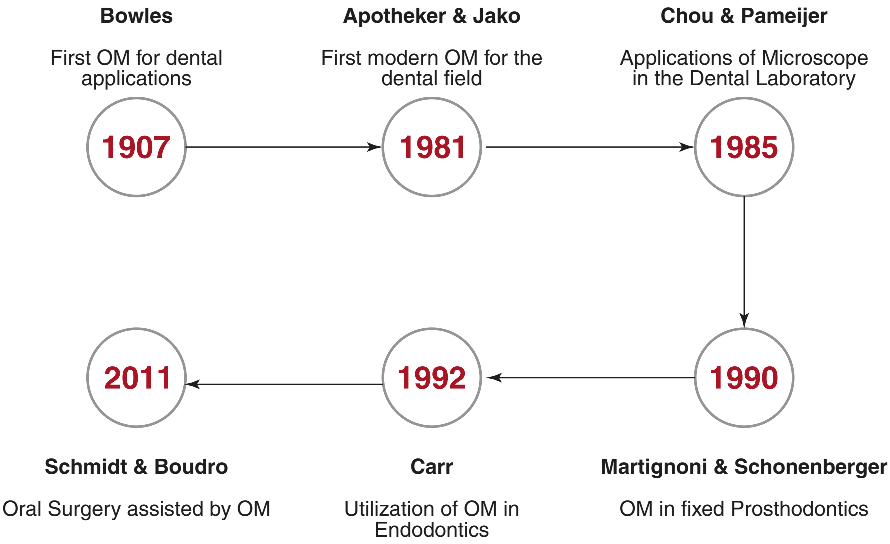

Fig. 2 Timeline landmark events: OM in Dentistry

and superiority of outcomes when utilizing the OM for surgical periodontal therapy geared toward regenerative and root coverage procedures.

The benefitting effects of high degrees of magnification provided by the OM in non-surgical periodontal therapy have also been documented. Facilitating the detection of calculus and its differentiation with tooth structures, while at the same time allowing for the identification of anatomical contours that ultimately lead to accurate access and efficient cleaning of radicular and dental surfaces while scaling and root planing remains as a landmark benefit of incorporating this technology into the non-surgical periodontal practice [28].

When it comes to surgical periodontal therapy, the utilization of the OM has been documented mainly in two clinical arenas: regenerative therapy and mucogingival therapy. These treatment scenarios and their respective historical backgrounds will be covered in finer detail in individual chapters of this textbook.

Published material and professional anecdotes share a common recurring theme: when performing periodontal surgical procedures aided by an OM, visual acuity is enhanced by both magnification and illumination. This translates into enhanced and controlled manipulation of soft and hard tissue structures that make up the periodontium. From incision to final closure of the surgical wound, microsurgical procedures are framed by gentle and accurate soft tissue manipulation, less extensive flap designs, enhanced vision field that facilitates identification of defects, anatomical landmarks like furcations, cemento-enamel projections, anatomical grooves, and others such as accretions, defective restorative margins, caries lesions, etc. Tissue trauma is reduced when smaller suture thread diameter in combination with complementary smaller needles is used. In an in vitro experiment, it was shown that finer suture diameter (7-0) leads to thread breakage rather than tissue rupture when compared to wider diameter suture threads (3-0, 5-0) [37].

When treating periodontal disease and specifically handling pathology affecting interproximal spaces, the OM greatly facilitates access and visibility to execute incisions, delicate flap elevation, removal of granulation tissue, root surface planing, placement of biomaterial and tissue approximation to obtain primary closure thus achieving blood clot stability which is the foundation for a successful regenerative outcome.

Surgical therapy utilizing advanced flap designs without the utilization of an OM allows stable primary closure of the flap in the interdental space in 67 to 70% of the treated sites [30–32]. The incidence of primary closure when performing surgical regenerative therapy aided by an OM reached 92.3% in one study [28], This is a significant difference that translates into an equally significant improvement of the clinical parameters evaluated and relevant to reversing the deleterious effects of periodontal disease.

When it comes to mucogingival surgical applications and the execution of these procedures utilizing an OM, the test groups (OM aided) consistently showed higher root coverage and superior complete root coverage when compared to procedures performed without assistance of the OM [33–35].

It is evident that the scientific literature behind the utilization of the OM in periodontal surgical procedures is constituted mainly by opinion papers, anecdotal case reports, and technical essays illustrating operational procedures. These types of publications are meritorious and form an important segment of the evidence-based-tiers of publications and clinical expertise that guide clinical care [33]. The cohort studies and randomized controlled trials, albeit scarce, seem to consistently suggest the superiority of the outcomes when the OM is utilized to assist surgical periodontal therapy procedures.

The application of the OM in implant therapy has been documented by Shanelec in 2005 showcasing a case series of 100 dental implants in the anterior maxilla placed under the microscope in extraction sockets with immediate fabrication of implant supported fixed interim restorations [42]. In the words of Dr. Shanelec, acknowledged as the father of microscopy in periodontics and implant dentistry, "Microscopy has the potential to advance dentistry from an era of traumatic tooth loss to one of exact and seamless replacement of a failing anterior tooth with an esthetic implant supported crown." Another visionary example of Dr. Shanelec's vibrant legacy in anticipation of what has become routine treatment executions with the assistance of the OM Fig. 3.

5 Advantages of Using OM in Surgical Dentistry

Table 1 summarizes the advantages of using OM in surgical dentistry. The most obvious advantage that OM has over surgical loupes is higher and adjustable magnification [2, 14, 15]. The magnification of a typical OM is adjustable, ranging from

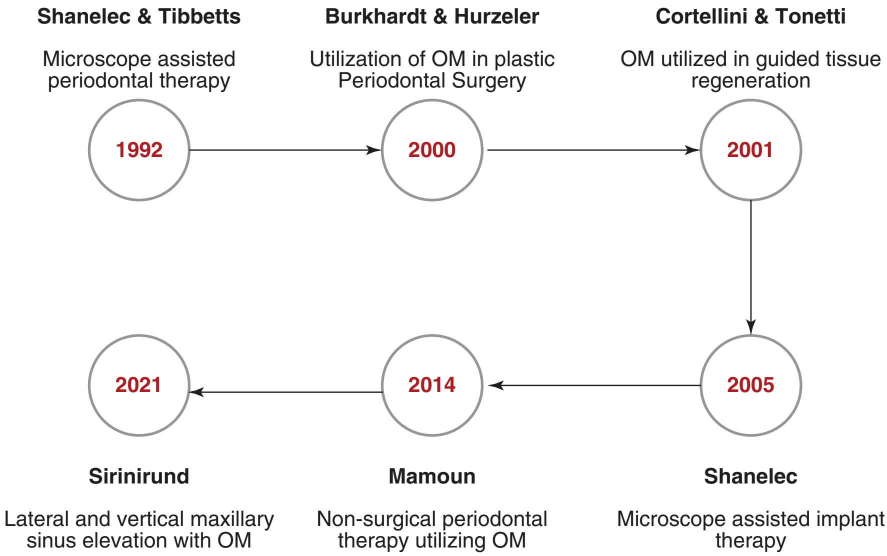

Fig. 3 Timeline landmark events: OM in Periodontics and Implant Dentistry

Table 1 Summary of advantages of using OM in surgical dentistry

At device/instrument level • Provide higher magnification • Provide coaxial illumination • Facilitate use of microinstruments/microsutures • Improve ergonomics
At provider level • Enhance precision • Achieve higher visual acuity and fine motor skills • Improve tactile sensation
At pre-clinical level • Induce less surgical trauma • Achieve faster vascularization • Provide wound stability
At clinical level • Improve surrogate/true endpoints • Improve patient centered outcomes

3.5× to approximately 30× [27–31]. Because of optical principles, higher magnification is at the expense of a narrower field of view. With OM, the surgeon can easily balance between magnification and field of view with magnification changers that are in steps or in continuous fashion. Comparing to most surgical loupes, which have fixed magnification of 2.5×, 3.0× or 3.5×, OM provides versatility and high image resolution of the region of interest (~30–50 line pairs/mm for 8× to 20×) [27–31]. Versatility in selecting the degree of magnification is advantageous because certain procedures require a high magnification (10× and higher), e.g., examination of a root fracture, debridement of calculus in the furcation, sinus membrane integrity evaluation, manage of thin phenotype tissues, etc. Lower magnification (~6×) could be used during suturing when a larger field of view may be needed. Coaxial illumination is another feature of OM that gives brightness to the surgical field, especially confined structures without obstructive shadowing. This built-in function is nowadays provided through LED optical fibers with long life span (~5000 h) and low maintenance [27–31]. It is very useful when examining intraosseous defects during minimally invasive regenerative procedures around teeth and implants, sinus membrane integrity during vertical sinus augmentation, and during socket debridement that is close to the maxillary sinus or at the furcation septum. Additionally, under magnification, now fine surgical instruments, sutures, and needles can be used for delicate soft tissue handling and to introduce less trauma [30–33]. Sutures smaller than size of 6-0 can only be operated efficiently under higher magnification provided by OM.

Improved ergonomics is another distinct advantage of working with an OM. Numerous pairs of lenses in OM direct light in the way the surgeon's eyes can see directly forward with the neck and head staying in a neutral position (straight) during patient treatment. This unique design reduces musculoskeletal stresses significantly compared to what is experienced when working without magnification and with surgical loupes. The delicate yet heavy optical structures that OM is composed of are connected to a supporting arm, which is then attached to a ceiling, a wall, or a pole with a base on wheels (a floor mounted design). Unlike surgical loupes that is mounted on the surgeons' body, the weight of OM does not rest on the surgeon. This ergonomic advantage provides comfort and stability to the surgeon who can perform surgeries for prolonged periods of time experiencing minimal, if any, fatigue, and muscle soreness.

The abovementioned technical advantages inherited to OM have opened opportunities for surgeons to improve visual acuity, surgical precision, and tactile sensation, which eventually convert to optimized pre-clinical and clinical outcomes [38–40]. A series of studies have shown a significant increase in visual acuity with OM in a pre-clinical experimental design [27–30]. Surgical precision and tactile sensation vary drastically among practitioners but can be improved with use of OM [27–30]. In the literature, few studies have shown use of OM is related to reduced surgical trauma by a minimally invasive flap design, faster vascularization, and improved wound stability [38–40]. Improved incision designs accompanied by use of OM have resulted in a higher incidence of primary wound closure, a prerequisite for predictable periodontal regeneration [38–40]. A recent systematic review showed microsurgery significantly achieved a higher percentage of root coverage and prevalence of complete root coverage in periodontal plastic surgeries [43]. Given the obvious technical advantages and promising pre-clinical as well as clinical evidence, it is the prime time for the surgical dental community to revisit the benefits of using OM in periodontal and implant surgeries and design well-structured clinical studies to validate use of OM.

6 Current Trends that Favor Using OM

Table 2 summarizes the current trends that are in favor of using OM. We have witnessed a paradigm shift to practicing regenerative medicine from tissue resection in terms of the therapy approach [38–40]. More procedures are performed with the regenerative concept, in lieu of a resective approach, if the indication allows. Common tissue regeneration therapy includes guided tissue regeneration, guided bone regeneration, sinus augmentation, and periodontal/peri-implant soft tissue augmentation. These procedures require accurate and gentle hard and soft tissue handling and will benefit tremendously from use of OM. Following the same line, over the past few decades, minimally invasive approach emerges as a preferred treatment modality [38–40]. This development in dentistry aligns well with what has occurred in medicine, where laparoscopy, Da Vinci surgery, and minimally invasive endovascular surgeries have been widely used nowadays. The surgical site is exposed by flap reflection “as little as possible, and as large as necessary” for improved wound stability and reduced postoperative morbidity. We anticipate seeing a continuous progression in this direction and a vital role of OM in this development. As for the surgical indications in periodontal and implant field, we are experiencing a decline in the number of patients in need of full mouth surgeries to control periodontal disease and an increase in esthetic demands and use of dental implants [31, 33–35]. These indications are all in favor of use of OM. Use of OM in the esthetic zone, edentulous sites for implant placement, and periodontal surgery involving 1–3 teeth are less challenging, which can reduce the learning curve of using OM. The acceptance rate of adapting this technology could be increased. More and more Millennials and Generation Z are graduating from dental schools and joining our community as dentists. They are technology savvy and willing to embrace technology for patient care. They are enthusiastic to learn about and incorporate new gadgets in the care of their patients and share their user experience through social media. OM is an excellent device to document cases in video formats for knowledge dissemination [34–36]. Last, the cost to invest in OM has decreased in the recent years because many new companies are competing in this market now. OM has low maintenance need; therefore, the recurring expenses are negligible. The cost–benefit ratio of using OM is becoming more favorable, allowing more

Table 2 Current trends in surgical dentistry that favor use of OM

	Current trends	Tradition
Paradigm shift	Tissue regeneration	Tissue resection
Approach	Minimally invasive	Macrosurgery
Focus	Esthetics	Disease control/function restoration
Surgical extent	1–3 teeth	Quadrant
Surgical site	Edentulous sites as well as dentate sites	Predominantly dentate sites
Clinician generation	Millennials and generation Z	Boomers and generation X
Investment costs	Lower cost, more options	High costs, fewer options

practitioners to consider purchase of this useful device. Using OM may improve practitioners' quality of life, prolong the dental career by establishing ergonomically healthy postures while seeing patients, and decrease missing workdays due to musculoskeletal problems.

7 Future Directions

Ultimately, it will be the goal for the periodontal and implant community to consider embracing this useful technology for patient care. Table 3 summarizes the efforts that are required to reach this end. The top priority is to encourage high-quality research to study the differences in wound healing and tissue behaviors with and without using OM. Admittedly, more evidence is much needed of using OM for improved wound healing and surgical outcome [41]. Studies evaluating the influence of minimally invasive approach and use of fine instruments on clinical outcomes will enhance our understanding and provide future directions. The adoption of the OM in endodontic specialty is a successful story that could be duplicated in periodontal and implant dentistry [23]. Nowadays OM use is an essential part of daily endodontic practice, mainly attributing to the inclusion of microscopic training in graduate endodontic curriculum in the USA [23]. Oral and maxillofacial surgery (OMFS) residency programs incorporate microsurgery training in their curriculum as well. OM is mainly used for vascular anastomosis in free grafts in reconstructive procedures [44]. It will be valuable to study how OM training has been developed in the endodontic and OFMS fields. Therefore, these lessons can be learned and implemented in periodontal and implant field. It would be the first logical step to include microsurgery lectures and hands-on exercises as elective periodontal courses. Ultimately, it is the authors' opinion that OM training should become a required course in graduate periodontal curriculum. At the same time, training programs in which the trainees spend 1 to 2 years of undivided efforts to master microsurgery should be developed and eventually accredited. These subspecialty programs can effectively train surgeons who can then become seed coaches to promote microsurgery and to fulfill the increased training demands. At the predoctoral level, an elective program should be rolled out so dental students can be exposed to this technology in their early learning stage. Interested students can be identified and advanced trainings provided. Finally, it is essential to engage related industry and corporations for providing funding and equipment to support training courses, research, and for product development.

Table 3 Efforts and plans to implement OM in surgical dentistry

Encourage research to study the benefits of using OM
Collaboration with other dental specialties, e.g., oral surgery, endodontics, etc.
Consider inclusion of microsurgical training in postgraduate periodontal curriculum
Consider formation of periodontal and implant microsurgical subspecialty
Promote microsurgical training at the predoctoral level
Collaborate with industry/corporation

Taking the University of Michigan as an example, we have been offering microsurgery training in the forms of lectures, hands-on exercises, and in the clinics for patient care to our periodontal residents since 2018 with enormous support from Dr. Laurie McCauley, Dean of the University of Michigan School of Dentistry, Dr. William Giannobile, Department Chair, now Dean of the Harvard University School of Dental Medicine, Dr. Rogerio Castilho, Interim Department Chair, Dr. Hom-Lay Wang, Graduate Periodontal Program Director, and many others. Lectures related to microsurgery are given annually in Classic Literature Review, Periodontal Therapy, Current Literature Review, Implant Literature Review, and Implant Therapy. Currently our clinic is equipped with OM for students to use. The Periodontics, Implant, and Microsurgery Academy (PiMA) at the University of Michigan was established in 2018 with a mission to "achieve minimally invasive, precise, and predictable intraoral soft and hard tissue surgical outcomes by promoting periodontal and implant microsurgery through education, hands-on trainings, and research to predoctoral students, postgraduate students, general dentists, and specialists" (https://www.dent.umich.edu/education/periodontal-and-implant-microsurgery-academy-pima). The first achieved outcome of this Academy is the formation of a 6-month and a12-month dental postgraduate programs in periodontal and implant microsurgery (DPP-PIM) in 2020 (https://dent.umich.edu/education/periodontal-and-implant-microsurgery). Recently, microsurgery webinars with 7 series covering a broad spectrum of periodontal and implant indications were successfully launched during Feb–May 2021 (PiMA webinar 2021).

The PiMA is continuously adding didactic and hands-on courses and research projects to its curriculum and activities. During 2021, two scientific articles from our outstanding periodontal residents were published, Dr. Sirinirund [45] about a case series on microsurgical maxillary sinus augmentation and Dr. Di Gianfilippo [43] about a systematic review on periodontal plastic surgery outcomes with microsurgery. Both articles aimed to bring awareness of the potential benefits of using OM for periodontal and implant-related surgeries. These exciting programs and initiatives are just the beginning of the journey. We are extremely passionate about the minimally invasive concept and microsurgical approach and welcome individuals who share similar dreams to work together toward these goals!!

8 Conclusion

OM has been widely used in medicine for improving surgical outcomes and reducing patient morbidity. The use of this device has contributed to thorough examinations, precise tissue management, and removal of etiologic factors. In dentistry, endodontists have found indications for using OM and adopted this technology in the 1990s. The search for periodontal and implant-related applications started about the same time by an enthusiastic group led by Dr. Shanelec, based in Santa Barbara, California, USA. The paradigm shift to surgical regeneration, higher esthetic standard, increased indications in focal zone (1–3 teeth), and increased number of younger and technology-savvy dentists joining our specialty will propel adoption of this useful technology. It is our primary responsibility and mission to conduct high-quality research to understand therapeutic benefits of the OM, disseminate micro-surgical knowledge through educational platforms involving masterly lectures and hands-on workshops, and collaborate with the industry to develop user-friendly and efficient devices and instruments.

9 Key Points

1. In medicine, the OM was first adopted for surgeries in early 1922 by an otolaryngologist, followed by an ophthalmologist in 1946, a plastic surgeon for vascular anastomosis in 1960 and by many other specialties now.
2. In periodontics and implant therapy, Drs. Shanelec and Tibbetts piloted microscope assisted periodontal therapy in 1992, followed by Drs. Burkhardt and Hurzeler for plastic periodontal surgery, Drs. Cortellini and Tonetti for periodontal regeneration, and Dr. Sirinirund for sinus augmentation.
3. OM can provide higher and adjustable magnification, coaxial illumination, ergonomics, and video documentation, etc.
4. Paradigm shifts to regenerative procedures, esthetic-driven surgeries, localized (1-3 teeth) periodontal procedures, in addition to younger technology-savvy dentists joining our community and cost reduction of the OM, favor adoption of the OM in periodontal and implant field.
5. Increased use of the OM among periodontists and implant surgeons relies on fundamental research on the benefits of using the OM for optimal wound healing, inclusion of OM education in the periodontal postgraduate curriculum, focused continuing education programs, and collaboration with the industry.

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