Editorial

World Environment Day was first held in 1974 and is celebrated every year on June 5th to encourage awareness and action for the protection of the environment. It stood for raising awareness about issues related to the environment like air pollution, marine pollution, global warming, human overpopulation, etc. As World Environment Day 2020 nears, we should take a look at the positive impact the COVID-19 lockdown has had on our environment. Worldwide spread of COVID-19 has brought a dramatic decrease in industrial activities, road traffic and tourism. Restricted human interaction with nature during this crisis time has appeared as a blessing for nature and environment. Reports from all over the world are indicating that after the outbreak of COVID-19, environmental conditions including air quality and water quality in rivers are improving and wildlife is blooming.

Before the start of the COVID-19 pandemic, the air around us had been toxic to breathe in due to the amount of greenhouse gases that had been emitted over the centuries. The Earth has faced rising temperatures, which in turn led to the melting of glaciers and rising of sea levels. Environmental degradation was happening fast due to the depletion of resources such as air, water and soil. After the lockdown was put in place, there was lesser travelling done by people; even industries were closed down and not allowed to function. This in turn led to the pollution in the air dropping significantly. Since there were no boats, whether they be fishing or pleasure ones, plying on the rivers and waterways, the water has cleared up. Impact on wildlife also, animals have been spotted moving about freely where once they would not dare to go.

In conclusion, though there has been a positive impact on the environment due to the lockdown, there is fear that once people start travelling again or go back to doing what they have been doing, all the positive impact will also disappear.

Dr Manoj Kumar KP
Chief Editor

TABLE OF CONTENTS

“A SMALL LEAK WILL SINK A GREAT SHIP’’ STEREOMICROSCOPIC EVALUATION OF MICROLEAKAGE IN RESTORATIONS USING DIFFERENT COMPOSITE INSERTION TECHNIQUE AND LINER PLACEMENT: AN INVITRO STUDY

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Abstract

Aim : To evaluate microleakage in restorations when resin composite is placed by three different insertion techniques and also to judge the effects of liners on microleakage. **Materials and methods**: Standard class 1 cavities were prepared in 18 caries free premolars. The teeth were randomly assigned to three groups corresponding to three different insertion techniques (1)oblique incremental insertion, (2) horizontal incremental insertion, (3) bulk fill insertion and subdivided into 3 groups depending on the type of liner used (1) no liner used (2) GIC liner(3) Flowable composite liner. The preparations were etched and restored with an adhesive, liner(except for the no liner group) and composite. Specimens were isolated with nail varnish except for 2mm wide rim around the restoration. All the teeth were then immersed in 2%methylene blue dye for 48 hours. Teeth were then sectioned bucco-lingually with a diamond disc and the sections were evaluated under a stereomicroscope to evaluate the amount of dye penetration. **Result and conclusion:** Within the limitation of this in-vitro study,the use of the oblique insertion technique and use of an intermediate liner of flowable composite resin showed least microleakage among the other materials used.

Key words: microleakage, resin composite, insertion techniques, liners

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Introduction

The main goal of operative dentistry is to restore normal form and function of the tooth. To achieve this goal the restorative material should have good esthetics, biocompatibility, marginal seal, adhesion and less polimerisation shrinkage. Amalgam was the material of choice worldwide for class 1 and class 2 restorations for more than a century.[1] Resin composite restorations have gained popularity because they match the shade of the natural teeth, are mercury-free and thermally non-conductive,[2] and they bond to the tooth structure with the use of adhesive agents.[3] Although composites are now the material of choice for most restoration, their polymerization shrinkage remains a problem.

Several techniques have been suggested to improve marginal adaptation of high C-factor preparation, including adhesive systems that potentially resist composite shrinkage,[4,5] placement techniques for resin composites,[6,7] protocols for polymerisation[8] and different cavity preparations.[9,10]

The purpose of the present in vitro study was to evaluate microleakage around Class-I resin composite restoration and also with different liner placement.

Materials and methods

Eighteen extracted non carious human premolars without enamel fracture were cleaned and stored in saline solution (0.9%) at room temperature. Occlusal surfaces were ground with a coarse diamond bur, under profuse water cooling, to produce a flat surface perpendicular to the long axis of the tooth, without removing whole of the occlusal enamel. Class-I cavity preparation of approximately 3 mm in length, 2 mm in width and 3 mm in depth was prepared using straight fissure bur, with a high speed handpiece and copious amount of water. No bevels were placed.

All teeth were restored with the same adhesive system, according to the manufacturer's instructions and with the same restorative material (Filtek Z-350 A2 Shade). To light cure the composite resin, a curing unit was used, set to a light intensity of approximately 800 mW/cm2. The specimens were divided into three main groups, with 6 teeth each, and again subdivided into 3 subgroups.

Group 1-bulk fill group
Group 2-Horizontal incremental group
Group 3-vertical incremental group

Again each group is subdivided into,
Subgroup 1-with no liner
Subgroup 2-with GIC liner
Subgroup 3-with flowable composite liner

Immediately after curing, each restoration was contoured with finishing burs operated at high speed, using air-water coolant. All preparation, restoration and finishing were carried out by one author simulating clinical instrumentation, as much as possible.The apices of the teeth were sealed with acrylic and all tooth surfaces, except for a 1 mm wide zone around the margins of each restoration, were sealed with two coats of nail polish. The teeth were then immersed for 24 hours in a 0.5% solution of methylene blue dye. The teeth were rinsed and then sectioned longitudinally in a mesio-distal direction, coincident with the centre of the restoration, using slow speed diamond disc cooled with water. The two hemisections of each tooth showing the cleanest dye penetration was selected and examined at 20X magnification, under a stereomicroscope. The degree of leakage was observed and scores were given according to an ordinal ranking system.

Score 0: No microleakage
Score 1: Dye penetration up to one-third of axial wall
Score 2: Dye penetration up to two-third of axial wall
Score 3: Dye penetration onto the entire axial wall
Score 4: Dye penetration onto the pulpal wall.

Figure 1: Cavity prepared

Figure 2: Restoration

Figure 3: Materials used

Figure 4: Specimen preparation

Results

Scores	No liner	GIC liner	Flowable composite liner
Bulk fill composite	4	4	2
Horizontal incremental	4	4	4
Vertical incremental	1	0	0

The oblique insertion technique and use of an intermediate liner of flowable composite resin showed least microleakage among the other materials used.

Discussion

The rationale of using flowable composite is to improve marginal adaptation while decreasing internal voids, ultimately resulting in a reduction in marginal leakage GIC has chemical bonding with the tooth material.

Georges et al[8] suggested that if all composite increments were perfectly standardized, the horizontal technique would possibly show less microleakage. According to Hansen E K[10] the incremental technique especially the oblique technique tends to improve marginal adaptation by resisting resin composite shrinkage stress.

Winkler M M et al advocate the bulk increment as a safe restorative technique because it fills the total volume of the preparation and creates less residual shrinkage stress than the incremental technique.[11]

Conclusion

Within the limitation of this in-vitro study, the use of the oblique insertion technique and use of an intermediate liner of flowable composite resin showed least microleakage among the other materials used.

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APPLICATION OF RAPID PROTOTYPING IN MAXILLOFACIAL SURGERY: A REVIEW

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Abstract
Rapid prototyping (RP) technologies have found many applications in oral and maxillofacial surgery. This paper provides an overview of RP technologies for maxillofacial reconstruction, traumatology, maxillofacial prosthesis and orthognathic surgery. Key fundamentals, materials and methods of stereolithography have been discussed. . A number of RP applications to the main fields of oral and maxillofacial surgery, including restoration of maxillofacial deformities and defects, reduction of functional bone tissues, correction of dento-maxillofacial deformities, and fabrication of maxillofacial prostheses, are elaborated. The most remarkable challenges for development of RP-assisted maxillofacial surgery and areas for further development are also discussed.
Key words: rapid prototyping, stereolithography, orthognathic surgery, maxillofacial surgery

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Introduction
The advents of technology leads to the rapid progression of 21st century medicine. The use of physical models creates improved reflection in the preparation of plastic prototypes of damaged bones in the maxillofacial region. It is also necessary in healthy bones for the replacement of the foregoing. It was latter shown that the existence of these prototypes significantly contributed to the advancement of the process of implantation and reconstruction of facial bones. prerequisites for planning and simulation of complex surgery.[1]

Clinically, these models are used mainly for craniofacial deformities, reconstructive surgeries, pathologies, and trauma.[1] Bio models generated by stereolithography (SL) have been confirmed to have a higher accuracy compared with milled models and 3-dimensional (3D) computed tomography (CT) visual models.[2-5] The SL technique can also overcome any undercutting problem in the anatomy, which is a major drawback of milled models during model processing. Since the first article on stereomodeling published in 1990 by Mankovich to display the 3D skull anatomy, studies have focused mainly on developing the technique and improving the accuracy of model manufacturing as well as on reporting applications of stereomodels in different clinical situations.

Classification
Broadly rapid prototyping may be categorized into:

A. Additive method – which is widely used

B. Subtractive – less effective.

The most commonly used RP technologies in medicine are:[6-10]

- Stereolithography (SLA)
- Selective laser sintering (SLS)
- Fused deposition modeling (FDM)
- Laminated object modeling (LOM)
- 3D printing (3DP)

Other less used technologies:

- Selective mask sintering (SMS)
- Solid foil polymerization (SFP)
- Laser jet chemical vapor deposition (LCVD)

Materials Used with Rapid Prototyping[11-20]

The materials can be classified into three categories:

- autologous bone grafts,
- non-autologous bone grafts
- alloplastic bone replacement materials such as titanium, ceramics and polymers [e.g. acrylic bone cement, polyetheretherketones and silicone. Acrylonitrile butadiene syrene, Acrylic, Polyphenylsulfonem, Polycarbonate ,nylon]

Characteristics of RP technologies

The wide applications of RP technologies are attributed to their technical characteristics, especially the advantages over traditional manufacturing approaches.

They include

- High-precision manufacturing
- Short manufacturing cycle
- Simple production process and low production cost
- Personalized manufacturing, complex manufacturing
- Early visualization of product design

The success of these virtually planned cases depends on each step of the workflow process:

- choice of image modality
- data acquisition,
- patient workup
- virtual planning session
- surgical execution.

Pathology and Reconstruction

VSP is used extensively in the management of maxillofacial pathology for its ability to virtually visualize pathology and to provide guidance on the location of resection margins.

The application of guided osteotomies is most beneficial in surgical resections of the midface and for large tumors that have deformed anatomic. The coupling of real-time 3D navigation and VSP further enhances these advantages to provide immediate feedback to confirm position of guides and planned osteotomies .RP models can also be used for presurgical planning for reconstruction with vascularized or nonvascularized autogenous bone.[21-25]

Bernstein and colleagues found that osteotomies made with 3D navigation to be more accurate in distance, pitch, and roll. [26]

Leonardo Ciocca[27] and colleagues presented a new method for secondary reconstruction using DMLS technology allows the restoration of the patient’s mandibular function and native mandibular contour. They also mentioned the potential drawbacks of this technique which include the adjunctive cost of design and prototyping, and the difficulty of adapting to situations in which the surgical plane changes intraoperatively (i.e. presence of tumour recurrence).Xiao-Jing Liu et al. shaped the fibula flap by applying a RP-made resin template as a guide to reconstruct maxillofacial defects caused by mandible tumor ablation.Leonardo Ciocca et al. developed an innovative protocol using the FDM technology to produce individual HA scaffolds for bone marrow stem cells to reconstruct bony defects of a functional stress-loaded area.[28]

Maxillofacial prosthesis [29-32]

The fabrication of a maxillofacial prosthesis similar to the area adjacent to the defect and with adequate fit was a challenge to the maxillofacial professional. However, the introduction of the RP reduced the time and improved the accuracy and quality for fabrication of maxillofacial prostheses. Prototyping has been largely used for fabrication of maxillofacial prostheses to obtain three dimensional anatomic models.

For Jiao et al, fabrication of auricular prostheses by CAD/ CAM are advantageous because a highly qualified technician is not necessary to sculpt an ear in wax and the patient can visualize the result at the screen before fabrication. Wu et al described the fabrication of a nasal prosthesis by prototyping (SLS). The accuracy of the computed model allows satisfactory reproduction of the facial contours but this process expensive owing to the cost of the equipments. Karayazgan-Saracoglu et al, reported that auricular prosthesis sculpted hand is considered satisfactory, it is inferior in comparison to the prosthesis obtained by prototyping. Jennifer V. Sabol reported some limitations to this type of technology which includes the color mismatching and this method may not be indicated when tissue is lacking in tone, so it must be supported.

Traumatology

RP is used for diagnostic and reconstrutive purposes in maxillofacial and craniofacial fractures. The RP-reproduced 3D model of skeleton structure has proved helpful in diagnosing fracture form, evaluating fracture characteristics, and formulating surgery design. Peng Li et al. introduced a method to treat ZOMC fracture and deformity occlusion using the FDM technology with the help of software Mimics 10.01 RP can be used to reconstruct inaccessible areas like orbital floor and temporomandibular joint cavity for effective surgical treatment. Marcin Kozakiewicz et al. [33] reported fixing orbital floor fractures of six patients using the 3D pre-bent titanium implants, Piotr Loba et a1 reported the use of modern imaging techniques in the diagnosis and treatment planning of patients with orbital floor fractures. Modern imaging techniques such as dMRI and 3-dimensional CT reconstruction allow us to better understand the pathophysiology of orbital floor fractures and to precisely plan surgical treatment. MarcinKozakiewicz et a1 supported treatment with individual orbital wall implants in humans – 1-Year ophthalmologic evaluation; he also reported Computer-aided orbital wall defects treatment by individual design ultrahigh molecular weight polyethylene implants.

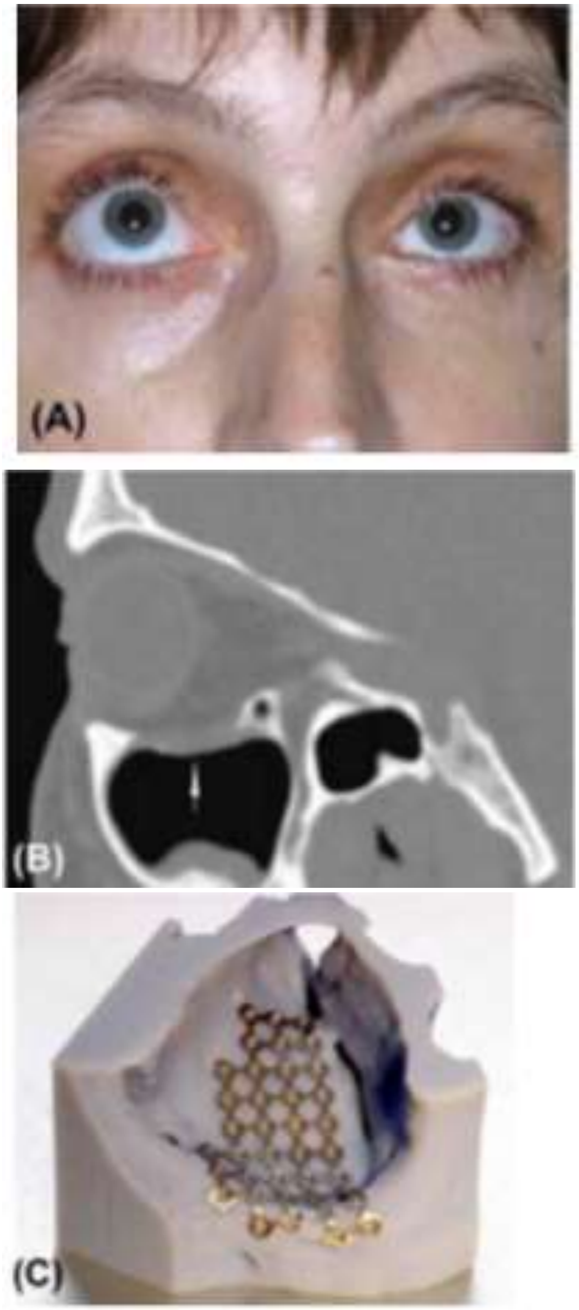

Figure 1 a,b,c: (a) Appearance of face before treatment of left side blowout orbital fracture where lowered left eyeball, restricted upward movement, and narrowed palpebral fissure are observed. (b) Computer tomography image of the left orbit with sagittal plane reconstruction with arrow indicating the damaged orbital floor. (c) Physical (solid) model of left orbital floor with formed titanium mesh. (Image courtesy- Peng Q, Tang Z, Liu O, Peng Z. Rapid prototyping-assisted maxillofacial reconstruction. Annals of medicine. 2015 Apr 3;47(3):186-208)

MaartenVehmeijer introduced a method of Orbital Floor Reconstruction Using Virtual Planning, 3-Dimensional Printing, and Autologous Bone. Adel Abou-ElF etouh et al. proposed to use a RP machine for fabricating patient-specific templates to pre-bend reconstruction plates symmetrically, guide osteotomies, and reposition the condylar process in the proximal edentulous segment in its preoperative position. Nicholas Martelli et al in his systemic review mentioned that the surgical implants were not satisfactorily accurate in due with their increased time and cost.

Orthognathic surgery

B. Ying et al studied efficacy of combined orthognathic surgeries, together with guiding templates and splints fabricated by rapid prototyping technique, for the correction of facial asymmetry and concluded that it can offer improvements in accuracy, complexity, and duration over traditional procedures. L. Seres et al proposed that by three-dimensional planning software, designing of a virtual intermediate surgical wafer , predlicted accurate outcomes and better protocol for management of facial asymmetries Libin Zhou et al. used a customized implant to treat a 23-year-old man with an 8-year history of unilateral hemifacial microssomia.

A study on manufacturing orthognathic splints was reported by Marc Christian Metzger et al. They developed a new approach that combined the conventional splint technique, modern virtual 3D planning, and the 3DP technology to manufacture orthognathic splints for ideal occlusion for correction of dento-maxillofacial deformities. According to Q. Peng et al systematic analysis-planning protocol using a 3D surgery simulation software and a RP model is effective in planning distraction osteogenesis in hemifacial microsomia.

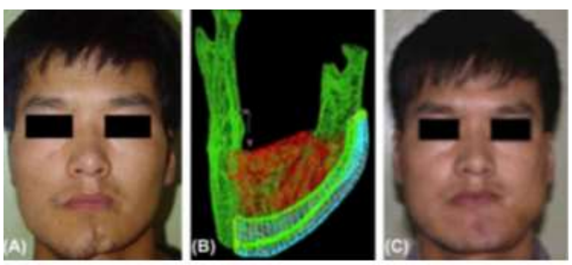

Figure 2a,b,c: (A) Preoperative view. (B) Computer-aided design. The unaffected right mandible was mirrored to the left (red). The discrepancy between the mirrored right mandible and the native left mandible (green) was extracted (blue). For additional compensation of the atrophied soft tissue, the outer surface was expanded by 1.5 mm. (C) Postoperative view with the facial symmetry reconstructed. . (Image courtesy- Peng Q, Tang Z, Liu O, Peng Z. Rapid prototyping-assisted maxillofacial reconstruction. Annals of medicine. 2015 Apr 3;47(3):186-208)

Discussion

RP is a fast-growing manufacturing technology that has been extensively used in medicine, especially dentistry including orthopedics, prosthetics, implantology[6,7] and oral and maxillofacial surgery.[8-13] Its applications to maxillofacial reconstruction include restoration of acquired maxillofacial deformities and defects, reduction of functional bone tissues, correction of dento-maxillofacial deformities, and fabrication of maxillofacial prostheses. pathology include the difficulties in removing tumours within the maxillary sinus or nasal With RP technologies, complex 3D models, personalized implants, intermediate splints, and prostheses are fabricated. The application of guided osteotomies is most beneficial in surgical resections of the midface and for large tumours that have deformed anatomic Characteristics of midface cavity, where osteotomies are often performed without direct visualization of the tumour. Surgical planning allows for such resections to be performed with greater confidence when visual cues are absent. Furthermore, the proximity to vital structures of the skull base can be accounted for and designed into the cutting guides to prevent inadvertent injury. The coupling of real-time 3D navigation and VSP further enhances these advantages to provide immediate feedback to confirm position of guides and planned osteotomies.

The virtual planning of a guide for mandibular segment repositioning and a reconstruction plate manufactured using DMLS technology allows the restoration of the patient's mandibular function and native mandibular contour, provides the surgeon with better procedural control and achieves important time and cost reductions. The potential drawbacks of this technique which include the adjunctive cost of design and prototyping, and the difficulty of adapting to situations in which the surgical plane changes intraoperatively. To reconstruct maxillofacial defects caused by mandible tumor ablation.[14]

Using the FDM technology to produce individual HA scaffolds for bone marrow stem cells to reconstruct bony defects With this protocol, a resected condyle model fabricated by the FDM technology was applied to evaluate the fit of the bone substitute scaffold. The fabrication of a nasal prosthesis by prototyping (SLS). According to the authors, this method is advantageous for both patient and the maxillofacial prosthetist. In addition, the laboratorial period for sculpting was significantly reduced because the nasal waxing was automatically fabricated by the machine. Besides, the accuracy of the computed model allows satisfactory reproduction of the facial contours. However, this process is still expensive owing to the cost of the equipments.[15]

The advent of prototypes, which enlarge the capacity of the surgeon to understand the real extension of injuries, as if handling the fragments in an open surgical field. The RP-reproduced 3D model of skeleton structure has proved helpful in diagnosing fracture form, evaluating fracture characteristics, and formulating surgery design. Surgical planning became simple because these new technologies determine the most appropriate point for access, plate casting and screw size. Prototypes are equally important in planning bone graft reposition, either to repair loss or correct a defect[16,17] Though it is an important method clinicians should be aware of potential areas for inaccuracies within models and review the source images in cases where model integrity is in doubt.

Occular motility impairment associated with orbital trauma may have several causes and manifest with various clinical symptoms. In some cases orbital reconstructive surgery can be very challenging and the results are often unsatisfactory. The superiority of the RP treatment method over CM was shown on the basis of early results when BSV loss area and reduction of vertical visual disparity (VVD) in upgaze were considered. Better outcomes for the RP group were confirmed in the late follow-up results which showed a reduction of BSV loss area, correction of primary globe position and a very significant improvement in upgaze.. patient-specific templates to pre-bend reconstruction plates symmetrically, guide osteotomies, and reposition the condylar process in the proximal edentulous segment in its preoperative position.

Supplementary computer-assisted surgical (CAS) techniques including the mirror-imaging technique have been found useful for restoring maxillofacial fractures, improving facial symmetry, and increasing the accuracy of the surgical procedure. Integrating RP technologies with supplementary CAS techniques will have great practical value of repairing maxillofacial fractures, although long-term functional follow-up for verification of its effectiveness.

The use of 3D printing methods in orthognathic surgery provide the benefit of optimal functional and aesthetic results, patient satisfaction, and precise translation of the treatment plan.. RP can be integrated with other techniques to produce intermediate splints. By combining RP technologies, optical dental scanning, cone beam computed tomography (CBCT), and manufacturing technique of traditional plaster dental casts, the fabrication of intermediate splints can achieve adequate accuracy for clinical uses.

By obtaining life-sized, 3D models of our patients preoperatively, we got the chance to perform the planned osteotomies before the operation. Temporomandibular joints of the models were fixed with Kirschner wire application instead of temperomandibular joints of the patients. Therefore, time spent for rigid condylar fixation techniques was spared. Additionally, we were quite sure that we precisely maintained condylar position within glenoid fossa if we could fix the mandibular fragments in the same interfragmental relation with the one we observed on models preoperatively.

In traditional methods, intermediate wafer was one of the most frequently used surgical-assisted devices for orthognathic surgery. However, manufacturing the wafer is time-consuming, and positioning the maxilla with the wafer during the operation is difficult. To overcome these challenges, a pair of surface templates fabricated by the SLA technology was developed as an alternative to the use of intermediate surgical wafer for treating a patient with transverse maxillary cant and maxillary midline deviation.

Management of significant facial asymmetry presents a challenge due to the geometric complexity of the bony and other facial structures.. Virtual Le Fort-I osteotomy with correction the symmetry of the maxilla by three-dimensional planning software, designing of a virtual intermediate surgical wafer and rotation of the mandible into the correct position following virtual bilateral sagittal split osteotomy to visualize the movements of the osteotomised mandibular segments. This method has predlicted accurate outcomes and better protocol for management of facial asymmetries.

As it is a technically demanding process, which requires advanced computer skills and additional training. It is also a time extended process, as the completion of each model usually takes about 12 hours. Technical failure of the model during printing, which may extend timeframe further. The 3D template is accompanied by a CT- scan of every patient, which makes it more expensive and therefore requires additional radiation exposure as compared to conventional surgery. In certain cases the accuracy was found not to be satisfactory.

Conclusion

Rapid prototyping is a fast-growing manufacturing technol¬ogy that has been widely used in medicine, including oral and maxillofacial surgery. Due to its ability to promote product development, at the same time reducing the cost and degree of complexity. The paper reviews the fundamentals and applications of RP technologies to maxillofacial surgery. The application of RP in various fields of maxillofacial surgery namely reconstruction, pathology, traumatology and orthognathic surgery have been discussed. Rapid prototyping with its wide applications in the surgical field pose as a boon with its high accuracy and ability to duplicate the anatomical structures. Further studies are necessary to broaden the spectrum of 3 dimensional printing and its clinical implications.

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MAGNIFICATION IN ENDODONTICS: A REVIEW

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Abstract

Conventional endodontics has been based on feel not sight. Endodontic therapy has always been very dependent from the tactile sensation of the operator and its anatomic knowledge. With the recent advances of magnification devices with increased magnification and illumination there is improved technical accuracy and performance. This review paper, highlights about the various magnification systems with its added advantages in endodontics.

Key words: loupe, dental operating microscope, endoscope, oroscope.

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Introduction

Magnification is an apparent increase in size especially by the use of lenses. History of the Magnification dates back to 1694 when Anton van Leewenhook constructed first compound lens microscope. Optical magnification has broadened the horizons of dentistry in general, and Restorative dentistry Endodontics, and Periodontology in particular.

Introduction of Dental Loupes & Surgical Operating Microscope endoscopes and orascope enable the clinician to magnify and view an object beyond that perceived by human eye. Magnification used in dentistry for diagnosis, esthetic restorations, routine endodontic procedures, non- surgical periodontal procedures, periodontal plastic microsurgeries, implant dentistry etc. for better visualization, improved treatment quality and ideal treatment ergonomics enhancing motor skills to improve surgical ability by maintaining the right posture. Minimally invasive dental procedures with ease and precision are possible today with the use of magnification in dental practice.

History[1,2]

2,800 years ago: simple glass meniscus lenses in Egypt.

In the first century: Romans noted that objects viewed through glass appeared larger.

1590: Hans and Zacharias Janssen (1580-1638) father and son, Dutch spectacle makers, produced the first compound microscope. The magnification ranged from 3 to 9x.

1609: Galileo Galilei mounted a convex and concave lens and created the compound microscope

1625: Johannes Faber coined the term microscope (micron = 'small', scopos = 'aim' or skopein = 'to look at').
1665: Robert Hooke – identified cell under microscope
1674: Anton van Leeuwenhook - single-celled life forms under microscope -father of microscope
1876: Dr. Edwin Saemisch, a German ophthalmologist introduced simple binocular loupes to surgery. Dentist also began experimenting with loupes.
1888: Carl Zeiss (1816-1888) marketed the apochromatic microscope objective.
1921: Carl Nylen, first performed ear surgery under a microscope – Father of microsurgery
1922: Nylén's microscope was replaced by a binocular microscope developed by GunnarHolmgren.
1950s: Barraquer, began using microscope for corneal surgery.
1953: The Carl Zeiss Company marketed the first modern operative microscope.
1960: Jacobsen & Suarez, obtained 100% patency in suturing 1 mm diameter blood vessels for anastomosis
1960s: microsurgery was standard in many specialities such as neurology & opthamology.
1962: Dr Geca Jako, an otolarygologist, used the SOM in oral surgical procedure.
1970s &1980s: First articles about using a microscope in Odontology Dentistry were published
*1977:*Dr. Robert Baumann, an otolaryngologist and practicing dentist, described the use of otologic microscope in dentistry.
1978: Dr. Harvey Apothekar & Dr. Jako brought the concept of extreme magnification in the form of an operating microscope, into dentistry called the Dentiscope. The dentiscope was manufactured by Chayes- virginia Inc., USA & marketed by the Johnson & Johnson Company.
1979: use of endoscope in endodontics, which was made up of glass rod, was first reported in literature.
1980: Dr. Apothekar coined the term "Micro dentistry".
1981: Apotheker introduced the dental operating microscope
1982 July: First International Congress in Microsurgical dentistry was held in Bordeaux, France. Dr. Apothekar continued to work and research on the operating microscope.
1986: microsurgery has been practiced in endodontics.
1990: Dr. Richard Rubinstein and Dr. Garry Carr began using medical-grade microscope for apical surgery
1990s: systematic use of surgical microscopes started and was applied by the different odontological dentistry specialities
1992: Dr Gary Carr introduced an ergonomically configured operating microscope with Galilean optics for endodontics
1992: Gary Carr and Arnaldo Castellucci, published an article outlining the use of a surgical microscope during endodontic procedures
1993: Shanelec & Tibbetts, Presented a continuing education course on periodontal microsurgery at the annual meeting of the American Academy of Periodontology.

1994: The first microscopes were routinely used for restorative dentistry.
1997: Syngcuk Kim pointed out apical resection technique that is totally different than before and orthograde procedure that was once very difficult can be done with much certainty with surgical microscope.
1999: The American Association of Endodontists required all endodontic graduate students to be microscope proficient.
1999: Use of Endoscopy in periapical surgery was described by Bahcall et al.
1999: Bahcall and Barss first reported the use of orascopic visualization made up of fiber optic
2001: The term "Magnification Continuum" was coined to try and quantify the growth of magnification users.
2002: The Academy of Microscope Enhanced Dentistry is formed.
2005: Several dental schools integrate microscopes into undergraduate programs.

Types of magnification

Presently, Loupes, Dental Operating Microscope, Orascope, Modular Endoscope system (microendoscope) and Miniature endoscope systems are the magnification devices used in dentistry.

Loupes

Magnifying loupes were developed to address the problem of proximity, decreased depth of field, and eyestrain occasioned by moving closer to the subject. Normal range of loupe magnification in dentistry is 2X to 6X. If Magnification is beyond 5X, loupes tend to become heavy and a microscope would be a better option. Loupes are classified by the optical method in which they produce magnification and also based on the design.[3]

- According to the optical method of magnification
  - Dioptre or flat plane or single lens loupe
  - surgical telescope with a Galilean system configuration
  - surgical telescope with a Keplarian system configuration.
- On the basis of design
  - Flip-up loupes
  - Through the lens loupes (TTL)

Single Lens Loupe

It relies on a simple magnifying lens. A single lens system is made up of one object and one convex, positive, light-converging lens. An image of object is formed when light travels from the object and reaches the lens, which then focuses the light from the object. The distance of the image of the object from the lens is decided not only by the quantity of divergence of light that is traveling from an object but also by the strength of the lens. The degree of magnification is usually measured in dioptres.

Advantage: The only advantage is low cost.
Disadvantages:

- the plastic lenses used are not always optically correct.
- the increased image size depends on the proximity with the object being viewed, which can lead to postural problems and create stresses and abnormalities in the musculoskeletal system.
- size and weight limitation.

Galileian Lens Loupes

It is also known as multi-lens optic system. An enlarged viewing image is produced with a multiple lens system which should be at a working distance between 11 and 20 inches. The Galilean telescope is made up of two lenses; a concave eyepiece lens and a convex objective lens, in which the eyepiece lens has greater strength than the objective lens.

Advantages:

- compared to other compound loupes, these loupes are economical
- simple to operate having only 2 or 3 lenses
- these loupes are lighter in weight.
- Reduced eyestrain and head and neck fatigue.

Disadvantages:

- Blurring of peripheral border of the visual field
- limited magnification (2.5- or 3.5fold).

Keplerian loupes

Keplerian also known as Prism loupes. They are the most optically advanced type of loupe magnification of present era. They are called rooftop or Schmidt prisms as a prism is fixed at the top of it. They provide magnifications up to 6x by using refractive prisms. They are actually telescopes with complicated light paths. The surgical telescope produces an enlarged viewing image with a multiple lens system positioned at a working distance between 11 and 20 inches.

Advantages:

Compared to any other loupes, prism loupes provide broader fields of view, wider depths of field and longer working distance.

Disadvantages:

- heavier
- ore costly due to increased number of lenses.

Prism loupes

Flip-up loupes: The telescope is mounted further away from the eyes whereas its scope is mounted in front of the lens in a hinge mechanism, which provides a narrower field of vision. It has better declination angle (at which the eyes look down toward the area being worked on) which can be changed according to the user. Forward head movement should not exceed 25° more strain on neck and back muscles occurs if the head is forwarded further. The head position becomes neutral if the declination angle is steeper.

Advantage: Changing the eye prescription glasses does not require demounting the scope.

Disadvantage: It is heavier than TTL loupes.

Through the lens loupes: TTL loupes provide comfort and a wider field of vision as they are positioned closer to the eyes. The scope is mounted on the lens. It is designed specifically for an individual and the angle of declination is set in the factory where they are made.

Advantage: It is lighter and expensive than flip-up loupes.

Disadvantage: Change in eye prescription requires scope to be demounted to replace the glass.

Optical features in loupes[4]

1. Working distance - is measured from the eye lens location to the object in vision, or is the distance between the plane of the eye and the surface being treated. Working distance with slightly bended arms usually ranges from 30 to 45 cm. At this distance, postural ergonomics are greatly improved and eye strain reduced due to lessened eye convergence.

One way to measure it is to ask the clinician to adjust the second hand on their watch while holding their arm at midline or heart level. The correct working should never allow for overextension of the neck, chin, or shoulders.

2. Working range (depth of field): is the range within which the object remains in focus or, within which one is able to maintain visual accuracy at the appropriate working distance. Normally, eye position and body posture vary constantly. Wearing loupes changes this geometry, as the body posture and position of the extraocular muscles are confined to a range determined by the loupe's characteristics. The proper depth of field allows the practitioner to avoid too much leaning and any overextension while practicing. The depth of field decreases as the magnification increases.

3. Convergence angle - is the pivotal angle aligning the two oculars, such that they are pointing at the identical distance and angle. At a defined working distance, the convergence angle varies with interpupillary distance. A preset convergence angle as well as preset interpupillary distance is more user friendly, since they should not be changed once correctly positioned. Whereas an adjustable interpupillary distance allows the loupe to be used by more than one person.

4. Field of view (Width of field): is the linear size or angular extent of an object when viewed through the telescopic system or, represents the width and height of the area the practitioner sees while using the magnification device. The higher the magnification, the smaller the width of field.

5. Interpupillary distance: depends on the position of the eyes of each individual and is a key adjustment that allows long-term, routine use of loupes. The ideal setting, as with binoculars, is to create a single image with a slightly oval-shaped viewing area.

6. Viewing angle: The viewing angle is the angular position of the optics allowing for comfortable working. The shallower the angle, the greater the need to tilt the neck to view the object being worked at. Therefore, loupes for dental clinicians should have a greater angulation than loupes designed for industrial workers. The ocular structure for vision loupe is small and lightweight and is physically secured to the lens of the glasses. The viewing angle is customized for each

operator and then locked into position by building the magnifier into the lens. The ocular structures of Dimension Three loupes are front frame- mounted. These systems offer pivotal angle adjustments that can easily be altered and locked into position based on the wearer's comfortable working posture.

Advantages of Loupes

- It does not acquire much space, as it is small in size.
- No formal training is required as it can be easily operated.
- Surgeon's position is not restricted.
- Not expensive as a microscope
- No need of higher maintenance.

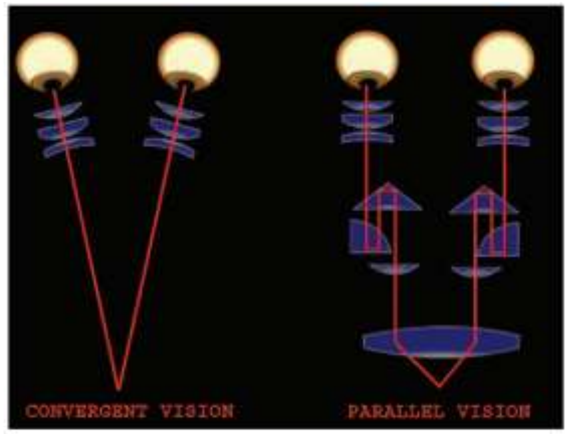
Disadvantages of Loupes

- It does not provide depth perceptions due to lack of Stereoscopic view.
- Magnification beyond 5x is uncomfortable due to their large size and increased weight.
- Head movement makes image unstable.
- Illumination is less in comparison to microscope.
- Eyestrain, fatigue and changes in vision can be experienced.
- No inbuilt documentation possible.

Dental operating microscope

The emergence of Endodontic operating microscope is the most important development that took place in the field of endodontic. The microscope not only provides better magnification from 3x upto 30x but also better illumination. The microscope through its enhanced vision has greatly contributed to improved surgical as well as conventional endodontic treatment.

The introduction of the microscope includes numerous ergonomic changes. The range of working positions is usually from the 9 o'clock to the 12 o'clock position.



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

Total magnification of microscope[1]

Similar to loupes, the microscope uses the Galilean lens system. The magnification of the SOM is determined by the magnification power of the eyepiece, the focal length of the binoculars, the magnification changer factor and the focal length of the objective lens.[5]

$$TM = (FLT/FLOL) \times EP \times MV$$

TM: Total magnification.

FLT: Focal length of tube.

FLOL: Focal length of objective lengths.

EP: Eyepiece power.

MV: Magnification value.

Pre requisites of microscope[2]

Vision

Direct vision is impossible with microscope for endodontic treatment. A good quality front surface mirror should be used for having best quality undistorted reflected image.

Illumination

Adequate lighting is mandatory for using microscope. Auxiliary lighting can be used in addition to the inbuilt light system present in microscope.

Patient compliance

Slight movements of the head of patient can affect the field of vision.

Cooperation from dental assistant

Dental assistant should be given adequate training for the use of microscope which can also improve the efficiency of clinician.

Rubber dam placement

The placement of a rubber dam prior to any endodontic procedure is a standard of care and an absolute requirement for sterility and protective purposes. Direct vision is usually impossible with microscope. If the mirror were used for indirect vision without a rubber dam, then the mirror would fog immediately from the exhalation of the patient. Also, to absorb reflected bright light and to accentuate the tooth structure, it is recommended to use blue or green rubber dams.

Mouth mirror

It should be placed slightly away from tooth. If it is placed close to the tooth, it will interfere with endodontic instrumentation. Mirror should be placed at 45degree to the microscope.

Instruments

Use of micro instrument such as micro-opener, micro mirrors, micro explorers, micro restorative and endodontic instruments and hand spreaders instead of finger spreaders, rotary files instead of hand files. In order to avoid an unfavorable metallic glare under the light of the microscope, the instruments often have a colored coating surface. The instruments should be approximately 18 cm long. The weight of each instrument should not exceed 15-20 g (0.15-0.20 N) in order to avoid hand and arm muscle fatigue.

Parts of operating microscopes[2]

The head of the microscope has three main parts:

1) Body tube optics
2) An eye piece lens
3) An objective lens

Eye piece is the one through which the operator views & the objective lens is towards the patient. The eye piece lens & the objective lens are two convex lenses (lenses are thicker at the center & narrower at the edges.

Eyepiece:

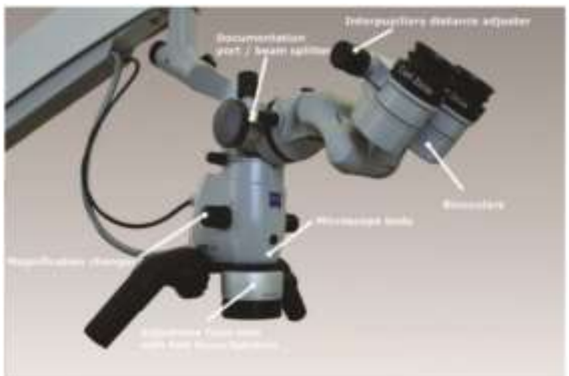
Eye piece plays an important role in magnification. Together with the focal length & the magnification change factors, they provide the desired magnification.

Binoculars:

The function of binoculars is to hold the eyepieces. The binocular projects an intermediate image into focal plane of the eyepieces. It comes in different focal lengths. Longer the focal length, greater the magnifications, narrower the field of view.

Objective lens:

The focal length of objective lens determines the operating distance between the lens and the surgical field. Objective lenses are available with focal length ranging from 100 to 400 nm.



Light Source[7]

Halogen lighting was the first dental microscope light source introduced. It is still available for standard applications and basic microscopes and displays a yellowish hue. Xenon and the more recent LED light sources were developed to deploy better illumination to the operating field. All three light sources differ from each other in light intensity, peak wavelengths, color, temperature, heat emission and lifetime. Xenon light sources appear almost as natural as daylight while providing the highest light intensity. This ensures the best illumination for fine anatomical details and allows shorter documentation exposure times, which will provide sharper images.

LED light sources are similar to xenon in color temperature and appear close to natural daylight. In comparison to xenon and halogen the heat emission from LED radiates from the back of the light source, resulting in a greatly reduced temperature surrounding the microscope. Most microscopes provide additional orange and green filters for restorative work or surgical procedures with increased blood flow. Recent developments include depolarization and day light UV filters as well as fluorescence for caries detection.

Uses of various levels of magnification in endodontics[7]

Adjustments of magnification can be categorized into three levels:

- Low magnification (3x – 8x)

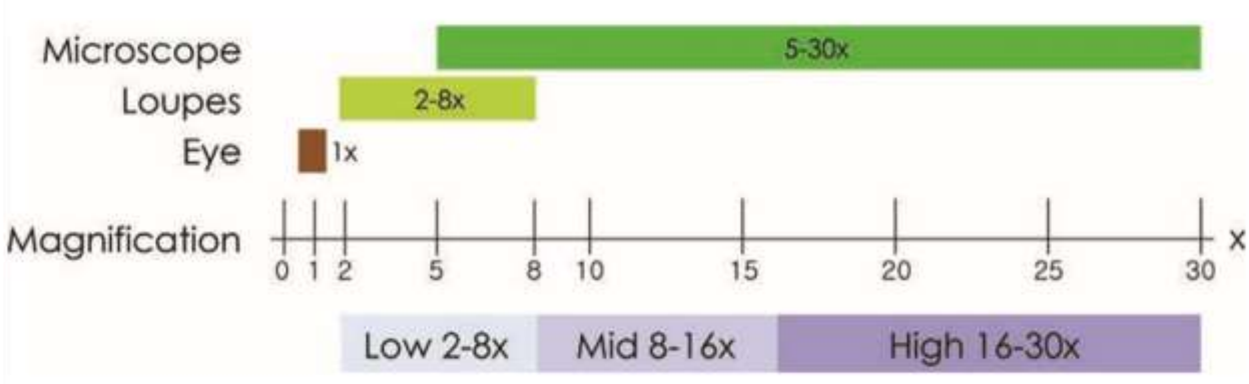
Appropriate for examination of tooth orientation and positioning of bur or ultrasonic tip. The wide field of view allows comparisons of the adjacent anatomic landmark. This magnification level is used in loupes in which straightforward cases can still be competently performed.

- Medium magnification (8x – 16x)

Commonly used in non-surgical and surgical endodontic procedures as it provides an acceptable field of view and depth of field. It is used for performing intricate procedures such as perforation repair, separated instrument retrieval and surgical procedure which requires higher precision and accuracy.

- High magnification (16x – 30x)

Employed mostly for close-up examinations and inspections of minute anatomies, e.g., calcified canal orifice and minute cracks. Apart from having a diminutive field of view, immediate loss of focus may ensue following minor movements. The subtle color variance between secondary and tertiary dentin in teeth with calcific metamorphosis can be distinguished at this level.



Comparison of magnification ranges: loupes versus microscopes.

Uses of microscope [1,2,3,8,9,10]

A clinician must consider the benefit/risk ratio when using the microscope. The following procedures are those that are done and benefited from the use of the microscope.

1. Diagnosis

The use of magnification in cases such as cracked or vertically fractured teeth has a tremendous help in visualizing how far these fracture lines extend and where they end. The microscope is an excellent instrument to detect microfractures that cannot be seen by the naked eye or by loupes. Under 16x to 24x magnification and focused light, any microfracture can be easily detected. Methylene blue staining of the microfracture area assists this effort greatly. A persistently painful tooth after endodontic therapy may be due to an untreated missing canal (e.g. MB2 in a maxillary molar). Re-examination of the chamber at high magnification under the microscope may locate the missing canal.

2. Nonsurgical Endodontics

Magnification helps in conventional root canal treatment like preparing and finishing the access cavity; shaping the root canal precisely; filling the system completely in three dimensions. Another uses such as detection of root canal orifice, location of missed canal, removal of fractured post and instrument, perforation repair.

3. Identification and removing of Denticles

Calcification is encountered very frequently, can block the canal entrance or even obstruct further instrumentation. Denticles can be found and canals can be negotiated with the help of a dental operating microscope.

4. Locating hidden canals

The most important utility of the microscope in nonsurgical endodontics is locating hidden canals. The canal anatomy is extremely complex. What was considered a rare exception in the past has become a routine finding when using the microscope. Considering this as the benefit of using the microscope for endodontic procedures is obvious. Magnification devices have more chances to detect MB2 canals in comparison to naked eye. However, Operating Microscope has better outcome than loupes in detecting MB2 canals. There are teeth where the canal bifurcates at 3 to 5 mm into the canal. In the maxillary second molar, where the MB and DB are in very close proximity of each other; the microscope is an invaluable tool in clearly detecting the bifurcation and the two separate canals.

5. Management of calcified canals

With normal vision or low-power loupes, calcified canal in the pulp chamber is not detectable. When the calcified canal is looked at through the microscope at high magnification, the difference in the color and texture between the calcified canal and the remaining dentin can be easily seen. Careful probing and ultrasonic will aid in detecting and negotiating the calcified canal easily. Sometimes in these cases, the ultrasonic preparation of the canal or canals has to go as far as a couple of millimeters short of the apex. Again, the microscope allows the clinician to detect and prepare conservatively, and not to gouge the healthy dentin structures.

6. Perforation repair

Perforation does occasionally occur no matter how carefully the tooth is accessed for endodontic therapy. When a perforation occurs, the microscope is the key instrument to identify and evaluate the damaged site. The results of a careful inspection will be the basis for which the preparation of the perforation repair will be made. Briefly, the microscopic procedure is to place a matrix precisely, just outside of the perforation site. The matrix can be calcium sulphate or resorbable collagen. After the matrix is placed, mineral trioxide aggregate is packed against the matrix. This procedure requires delicate and careful handling of the materials so as not to extrude, overfill, or under fill.

7. Removal of fractured post

The enhanced vision with magnification and illumination from a microscope allows endodontics to observe the most coronal aspect of fractured post and to remove them without any major loss of tooth structure and perforation, the prognosis for preservation of tooth is good.

8. Retrieval of broken files

With the more frequent use of nickel-titanium rotary files in endodontics, the incidence of file separation within the canals has increased. When the file is broken at the apex, the microscope cannot be of help. If the file breaks within the coronal half of the canal, however, then the microscope is essential to guide the clinician to retrieve the broken files. A combination of Operating Microscope & ultrasonics is an effective method for removing fracture instrument than conventional method. In this manner, the broken file can be removed while minimizing the damage to the surrounding dentin.

9. Final examination of the canal preparation

It takes a simple step to see whether a canal is completely cleaned. Under the microscope, a small amount of sodium hypochlorite, a popular irrigation solution, is deposited into the canal and observed carefully at high magnification. If there are bubbles coming from the prepared canal, then there is still remnant pulp tissue in the canal. In short, the canal needs more cleaning.

10. In conservative dentistry[3]

- Caries detection
- Coronal preparation
- Impression quality
- Evaluating the restoration under surface
- Restoration delivery and polish
- Bonded restorations

Difficulty with operating microscope[2]

Common difficulty in the use of operating microscope:

1. High magnification & narrow field of vision
2. Changing technique
3. Lack of practice

Advantages of Dental Operating Microscope[3,6,11]

- Increased visualization, and hence improved the quality and precision of treatment.
- Enhanced ergonomics.
- Ease of proper digital documentation
- It contains integrated video, which makes the communication skill better.
- Low strain to the eye.

Disadvantages of dental operating microscope6

- It's expensive.
- It is difficult to fit in a small operation because of its size.
- It takes the operator some time to get used to the equipment.
- Need for expertise by auxiliary staff and adaptation is quite difficult.
- It provides narrower field of vision.
- As a DOM has a restricted working field, 11mm -55mm. An operator using a DOM can see only the tip of the instruments, and they are used in delicate movements of small amplitude.
- Limited surgical access
- Prolonged pre surgical preparations
- Expensive to patients

Microscope Features and Upgrades[12]

Modern dental microscopes have evolved considerably with regard to features and options available to the dental clinician. Depending on personal preferences and possible locations in the operatory, floor-standing, wall- or ceiling-mounted units are available. While standard microscopes come with basic optics and light options, certain accessory features are recommended for endodontic purposes. Surgical procedures will require greater angulations to view resected root surfaces and other surgical details. At a minimum, a microscope should be equipped with 180°-tiltable binoculars to address the angulation requirements and an eyepiece with a reticle. A reticle is a set of fine lines, most commonly in the shape of crosshairs or concentric rings, that provides proper centering on the object in focus and allows for easier individual calibration (parfocaling) of the microscope. It also is an indispensable tool for documentation. Since light and the object image reach the binoculars virtually free of shadows, microscope photography and recording allow for excellent image quality for documentation and clinical operations. However, this requires perfect calibration with an external monitor and a reticle to center the image. Full high-definition and three-chip cameras are the gold standard for video recording and available as external or internal solutions. Screenshots from video recordings can be obtained at higher quality by using post-processing software applications that allow for image stacking. For still photography new generation digital mirrorless cameras have demonstrated advantages compared to DSLRs.

There is a variety of additional upgrades for core microscope functions. Instead of fixed focal distances that limit the microscope to an object distance of 200 mm, 250 mm or 300 mm, variable focal distance adapters have become available, allowing for easier switching between practitioners and easier adjustment to patients of different statures. These are offered in top-of-the-line microscopes, often in conjunction with electrical zoom and fine focus options that allow smooth and stepless adjustments of both magnification and focus. Extendable (foldable) binoculars were introduced for better ergonomics. Magnetic arrest functions (clutch) are available for increased stability, particularly for microscopes with several documentation ports and attachments. The practitioner can choose from a variety of light sources. The traditional standard is still halogen (yellowish hue, peak at 600-700 nm, ~3300K) and the brightest option is xenon (like daylight, homogeneous spectrum 400-700 nm, ~5500K), making it most useful for the identification of fine details in deeper areas of the root canal system and documentation. Recently LED lights (green part of emission spectrum, low at 450 nm and 550 nm, ~5700K) became available and offer a significantly longer lifetime, however, at a reduced brightness compared to xenon.

Infection contro[l4]

Magnifying loupes collect debris from many procedures. Infection control is difficult at best. Ideally, all areas of the loupe should be disinfected with a high-level disinfectant after each patient. Disinfecting with ethyl alcohol solution is recommended. The telescopes are disinfected with alcohol (Isopropyl Alcohol 70% by volume). If the lenses are water resistant, products such as Lysol Disinfectant Spray may be sprayed into a gauze sponge and used to wipe the frames and lenses before the procedure. Parts of microscope such as the rubber caps, sleeves & handgrip can be sterilized in autoclave at 134º C for 10 minutes. Other non-sterilizable parts can be cleaned using a moist cloth. Any residue can be wiped off using a mixture of 50% ethyl alcohol + 50% distilled water + a dash of household dish-washing liquid.

Endoscope[3,13]

The term endoscopy is of Greek origin and is literally translated as endon (within) and skopion (to see), thus meaning, "to see within". With the advent of dental endoscope, the field of endoscopy has expanded further. The traditional endoscope used in medical procedures consists of rigid glass rods. It can be used in apical surgery as well as nonsurgical endodontics. The recommendation for surgical endodontic visualization is a 2.7mm lens diameter, a 70º angulation, and a 3 cm long rod-lens and for a non-surgical visualization through an occlusal access opening, a 4mm lens diameter, a 30º angulation, a 4 cm long rod-lens are recommended. Prior to the use of an endoscope, a pair of 2-2.5 X loupes should be used for visualization. The scope cannot provide a discernible image when placed in blood, thus hemostasis of the surgical field must be obtained before the endoscope is used.

To stabilize the endoscope, it should be placed on bone around the crypt.20 Endoscope can be rigid, flexible and semiflexible. The rigid endoscope is of less value, while the flexible and semi-flexible endoscopes can be very valuable addition to armamentarium. The semi-rigid endoscope incorparates the advantages of flexible and rigid mini-endoscopes: it has a clear view, a small diameter, stiffness and good "pushability". Hence it is considered the best instrument available.

Miniature endoscope[14]

Miniature endoscope for root canal treatment includes a handpiece basically consists of three segments: A semi-flexible examination probe, which is inserted into the root canal, including an ergonomic handle, flexible optical fiber connections for light transmission (toward distal) and image transmission (toward proximal) and rigid eyepiece with a cold light source connection and coupler for a high-quality CCD camera. In endodontic endoscopy, the best method is suction formation with low-pressure vacuum via the channel and intermittent irrigation using isotonic saline. Parallel working is another option of working with the endoscope is. In this option the endoscope in the channel together with the instrument.

The 2.2 mm modular endoscope with the endoscope projectionoutside the handpiece

Modular Endoscope System[15]

It is based on modern technology of micro endoscope. It is used in small channel organs like salivary gland ductal system and tear channel. It is designed to enable the practitioner to work inside the root canal with magnification and instrument access. The endoscope has a nitinol coating which makes it flexible. This system includes three parts: endoscopic compact system, optical part that includes ocular part and the endoscope, and handpiece with a disposable part.

Orascope[3]

An orascope is a fiberoptic endoscope, which is made up of plastics, and therefore, they are small, lightweight, and flexible. It has a 0.8mm tip diameter, 0º lens, and a working portion that is 15mm in length and it is used for intracanal visualization. The image quality depends on the number of fibres and the size of the lens used in an orascope. The orascope has 10,000 parallel visual fibres with diameter 3.7 to 5µ. The visual fibres are surrounded by a ring of much larger light transmitting fibres that aid in illumination of the treatment field. Clinicians appreciate that orascopic technology has a non-fixed field of focus, which allows visualization of the treatment field at various angles and distances without losing focus and depth of field. The canal must be prepared to a size No. 90 file in the coronal 15 mm prior to the placement of the 0.8mm fiber-optic scope. This allows the full 15 mm of the orascope to penetrate within the canal otherwise a wedging of the probe may occur, damaging some of the fibers within the scope. Although the orascope can be used when sodium hypochlorite is present in the canal but this solution has a high light refractory index which causes greater amounts of light to be reflected, thus making it difficult to see the details of the canal. Therefore, the canal must be dried prior to usage of the 0.8-mm scope.

Conclusion

The operating microscope has revolutionized the specialty of endodontics. It represents a quantum leap in the development of competence for endodontics and dentistry in general. The increased magnification and the co- axial illumination have enhanced the treatment possibilities in non-surgical endodontics. Treatment modalities that were not possible in the past have become reliable and predictable. We can state microscopes in endodontics represent what the discovery of X-ray radiations represented for dentistry more than 100 years ago. As today we cannot imagine a dental office without the x-ray machine, in the same way we can state that the day is not far away when dentistry will be entirely and diffusely performed under the operating microscope. All endodontic graduate programs are now teaching its use as part of their curriculum. The only limitation that exists for the operating microscope is the imagination and it certainly a most useful adjunct in the continual search for endodontic excellence.

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IMPACTED MESIODENTES; A CASE REPORT

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Abstract

Supernumerary teeth are considered to be one of the most significant dental anomalies affecting the primary and early mixed dentition and may cause a variety of pathological disturbances to the developing permanent dentition and also resulting in poor dental and facial aesthetics. Mesiodens are the erupted or unerupted extra tooth in the midline of maxilla, along with normal teeth (between the central incisors). Early diagnosis and prompt treatment is necessary for prevention of deleterious effects of mesiodens on dentoalveolar structures. The aim of this case report is to share knowledge about management of mesiodens which might assist the clinician in decision-making.

Key words: superneumerary teeth, mesiodens, mixed dentition

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Introduction

By definition, supernumerary teeth are extra teeth in comparison to normal dentition. It is more common in the central region of the upper or lower jaw; however, its occurrence in the mandible is rare. The most common type of supernumerary tooth as indicated by Alberti et al is mesiodens.[1]

Mesiodens may occur as single, multiple, unilateral or bilateral. The presence of multiple supernumerary teeth is called 'mesiodentes'.[2] It seems that positive family history is one of the predisposing factors.[3] In permanent dentition, a 0.15 to 3.8% incidence of mesiodens has been reported, with a two-fold risk of occurrence in the male population compared to the female population.[4] Morphologically, mesiodens may have heterogeneous forms. Three common types; namely, conical or peg shaped, tuberculate and supplemental (tooth like) have been reported, of which the conical form is the most common type.[2,3,5]

Mesiodens may be seen as an isolated finding or as part of a syndrome, especially cleft lip and palate, cleidocranial dysostosis and Gardner's syndrome.[6] The possibility of genetic transmission via an autosomal dominant trait is documented which can explain sex dominance in this anomaly. Environmental factors might have influence on genetic susceptibility.[7] The hyperactivity theory, which is the restricted increase in the activity of dental lamina is considered as the most acceptable etiologic factor in the development of mesiodens.[8]

Complications

1. Delay in the eruption or failure of eruption of maxillary incisors and displacement of permanent maxillary incisors.[9,10]
2. Cyst formation may happen, or the tooth might erupt into the nasal [cavity11]
3. Displacement or Rotation of the incisors which might delay its eruption.
4. Crowding or abnormal Diastema
5. Root resorption of the adjacent teeth occur quite rarely.
6. Dilaceration of the permanent incisors may happen.
7. Loss of tooth vitality has been reported in rare conditions[12,13.]

Case report

An 8 -year-old girl reported to the Department of Pedodontics and Preventive Dentistry with a chief complaint of non-eruption of maxillary front tooth. A thorough general examination was done to rule out any syndromes. Medical and family histories were noncontributory. Intraoral examination revealed presence of deciduous central and lateral incisors with no signs of mobility. An OPG was taken and revealed the presence of two supernumerary teeth palatal to the permanent maxillary central incisors. (Figure 1,2)

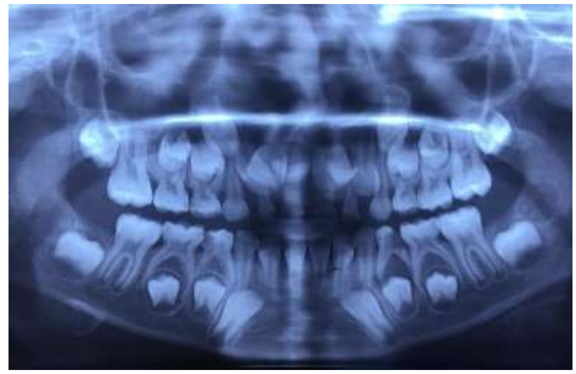

Figure 1 : OPG

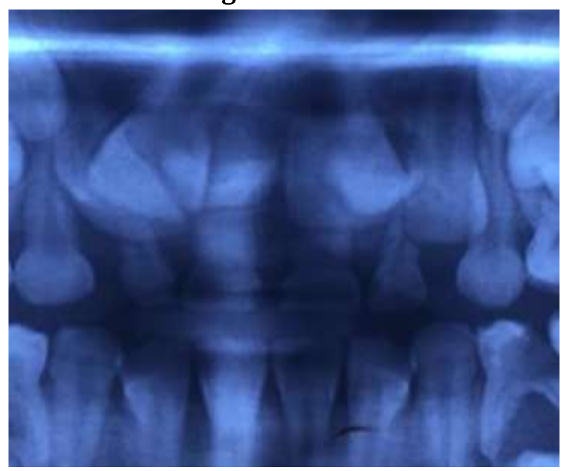

Figure 2: Mesiodentes

It was decided not to have a surgical intervention immediately. The two deciduous central incisors were extracted to aid in eruption of the permanent central incisors and to aid in occlusal movement of the supernumerary tooth to a lower position so that the surgical removal when attempted will be less traumatic. The patient was asked to wait for 6 months and report.

Patient reported after 8 months with eruption of permanent right and left lateral incisors but still non-eruption of permanent central incisors despite clinical signs of eruption which includes a visible bulge in the region of central incisors (Figure 3, 4).

Figure 3: Clinical picture after 8 months

Figure 4: The clinical bulge of permanent incisor

Figure 5: IOPA view

Intra oral periapical radiograph was taken and showed occlusal movement of the permanent central incisors along with the supernumerary teeth (Figure 5) when compared to the radiographs taken at the first visit (Figure 1,2).

Surgical removal of the supernumerary teeth was planned and carried out. Two supernumerary teeth were surgically extracted under LA. (Figure 6,7,8). Sutures were placed.

Figure 6 : Intra operative view

Figure 7: The extracted mesiodentes

Figure 8: Sutures placed

Patient had an uneventful post extraction period. Sutures were removed after one week. Healing of the site was satisfactory(Figure 9). Patient reported after 3 months after the procedure with erupted upper left central incisor and erupting upper right central incisor(Figure 10,11).

Figure 9: Healing phase

Figure 10: After 3 months

Figure 11: Erupting 11

Patient is being continuously followed up to monitor the eruption of 11.

Discussion

The timing of mesiodens removal has remained controversial. Extraction of mesiodens is usually not advocated in primary dentition since they often erupt into the oral cavity and thus risk of damaging the permanent incisor during surgical removal of mesiodens can be avoided. At early mixed dentition stage, the permanent central incisors erupt spontaneously after the extraction of mesiodens. This also promotes better alignment of the teeth and minimizes the need for orthodontic treatment.

Close monitoring of the dentition is required after the extraction of a mesiodentes. Delay in extraction of mesiodens might result in failure of spontaneous eruption of permanent incisor due diminished eruptive forces, arch perimeter loss, midline shifting and mesial drifting of lateral incisors into central incisor space, which might require comprehensive orthodontic treatment.

Some researches support delayed intervention until the root development of the adjacent teeth is almost completed, which usually means that the patient is 8–10 years of age. Potential disadvantages to this approach, include a loss of eruption potential regarding the central incisors, the loss of anterior arch space, a midline shift, the need for more extensive orthodontic treatment, and a requirement for surgical exposure of the impacted incisors.

The influence of the patient's chronological age, the dental maturity stage of permanent central incisors adjacent to the mesiodens, and the vertical location of the mesiodens were explored with respect to their effect on the frequency of clinical complications at the time of surgery, the effect of the surgical intervention on the adjacent permanent teeth, and the need for subsequent orthodontic treatment or further surgery for exposing the impacted incisor.

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CU-SIL LIKE DENTURE: A CASE REPORT

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Abstract

Some patients hesitate to extract one or few remaining healthy tooth/teeth when they report for denture treatment. Though these types of patients can better be treated with complete dentures, the hesitation for extraction usually results in compromised removable partial denture treatments. But introduction of Cu-sil dentures to prosthodontics helped in tackling these situations. Cu-sil dentures have elastomeric gasket around the neck of remaining teeth that acts as a clasp in holding the denture. Since this is costlier, time consuming and technique sensitive, simpler techniques to fabricate Cu-sil like dentures are introduced. This case report describes a method to fabricate Cu-sil like dentures using soft liners.

Key words: Cu-sil dentures, Cu-sil like dentures, soft liners

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Introduction

The preservation of remaining healthy natural teeth is the prime aim of dentist. But when patients report for rehabilitation of missing teeth with few remaining natural teeth using removable partial dentures, the treatment would appear complicated. Retention, stability and support would be compromised in such situations. Cu-sil denture is a good alternative to this. This is similar to complete denture, but with holes that allowes the remaining natural tooth to protrude through. These holes are surrounded by elastomeric gasket that clasps the neck of the remaining natural teeth thereby providing a seal and natural retention.[1] Additionally it prevents residual alveolar bone resorption and provides proprioception by the periodontal ligament.[2,3] But Cu-sil dentures are technique sensitive and since it requires materials other than acrylic, cost would be high. Thus to reduce the cost, some authors modified the method using soft liners and are hence reported as Cu-sil like dentures.[4]

Case Report

A 55 year old female patient reported to the department of prosthodontics with the chief complaint of inability to chew due to missing teeth in the upper arch since one year. She was partially edentulous in both maxillary and mandibular arches. Only 17 was present in upper arch, but was firm and healthy. Patient was not willing for extraction of firm tooth (Figure 1). Her mandibular arch was also partially edentulous with missing teeth- 36, 37 and 46 (Figure 2). So Cu-sil like denture for upper arch and conventional removable partial denture (RPD) for lower arch were planned.

Figure 1: Maxillary arch

Figure 2: Mandibular arch

The maxillary and mandibular impressions were made using alginate and casts were poured with type III gypsum. A special tray for maxillary arch was made using self cure acrylic (DPI) with full wax spacer and an additional layer of wax over 17. Border molding of maxillary arch was made using addition silicone impression material (heavy body consistency). The final impression was made using addition silicone impression material (light body consistency). The master cast was poured with type III gypsum product. The jaw relation and articulation was done using conventional methods. Try-in was performed. The denture borders were sealed in all areas except for the opening corresponding to the natural tooth – 17.

Figure 3: Acrylised, and polished denture with widened hole for soft liner material

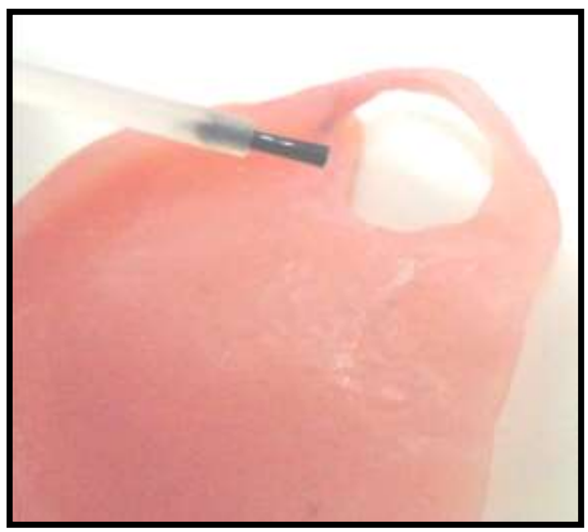

Figure 4: Adhesive applied

The denture was acrylised using heat cure acrylic (DPI). The acrylised denture was trimmed, finished and polished. Then the opening corresponding to 17 was widened to give clearence around the tooth by about 4-5mm (Figure 3). Silicone adhesive was applied to denture (Figure 4).

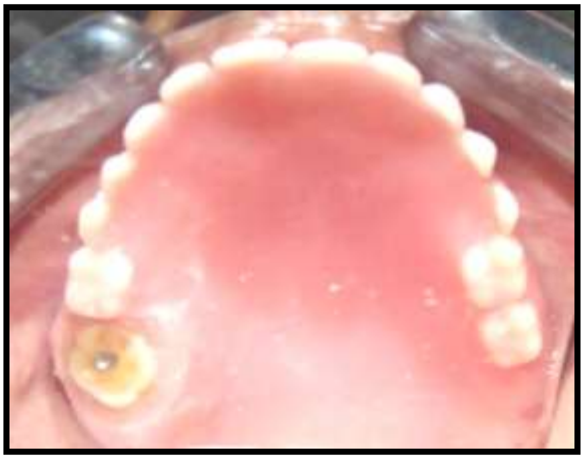

Figure 5: Relining material added intraorally

Figure 6: Extraoral view Post insertion

Mixing of silicone soft liner base with catalyst was done and placed into oral cavity to occupy space between denture and natural teeth. Denture was inserted in patient's mouth and held in position (Figure 5). Once material was set, denture was removed. The excess liner material was trimmed and denture was finally inserted in the patient's mouth. Mandibular RPD was also acrylised and inserted. Occlusal errors were corrected and post-insertion instructions were given which was same as for any removable prosthesis (Figure 6).

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