Applications of microscope in periodontal therapy- Role in magnification really matters!

Mohan Kumar. P[1,*], Jaswitha. V[2], Gautami S P[3], Ramesh KSV[4]

[1]Reader, [2]Post Graduate, [3]Professor, [4]Associate Professor, [1-4]Dept. of Periodontics, [1-4]Vishnu Dental College, Bhimavaram, Andhra Pradesh, India

***Corresponding Author: Mohan Kumar. P**
Email: mosups@gmail.com

Abstract

Introduction: Currently, the leading theme in periodontal surgery is the use of magnification system in treating any kind of periodontal diseases. Periodontal microscope has been successfully in use in both the categories of non-surgical and surgical therapies.

Objectives: The aim of this systematic review was to evaluate the literature with respect to efficacy of periodontal microscope in treating periodontal diseases.

Data Sources: Search strategies were performed via electronic database which included Pubmed-Medline, Journal on Web, Google scholar and manual search using University library resources. Two reviewers assessed the eligibility of the studies.

Study Eligibility Criteria: Controlled clinical trials, randomized clinical trials and longitudinal studies evaluating the efficacy of surgical microscope with minimum of 6 months follow up were included. In-vitro and animal studies, studies mainly done under surgical loupes and case series and case reports were excluded from the search.

Results: The electronic and manual search identified a total of 217 articles. A final screen consisted of 107 articles out of which articles were selected for full-text assessment. Finally, articles were selected for detailed evaluation for this systematic review. Surgical microscope has shown significant results in all the studies except for one study.

Conclusion: Surgical microscope usage gives an impression of being the best option now days which helps in better diagnostic ability and enhances the treatment quality of both non-surgical and surgical therapies. Thus, resulting in best outcome for the patients and also provide ergonomic benefit to the operator playing as an important factor for future to adopt microsurgery by all the professions including dentistry.

Keywords: Magnifification, Microscope, Microsurgery, Periodontal surgery.

Introduction

Even though various procedures have demonstrated potential for treating periodontal diseases, use of operating microscope and microsurgical instruments increases the ability of clinician in controlling the manipulation of tissues during surgery.[1]

A therapeutic revolution, using magnification and microsurgery in periodontal therapy has changed the clinical outcome of both non-surgical and surgical success in practice. Now days microsurgery is applied to many of the operations in medical practice to wide variety of treatment procedures in dental practice.[1,2]

Microsurgery uses the operating microscope or high-powered loupe magnification to aid in the technique outcome of periodontal surgeries. Currently, the "criterion standard" of performing microsurgery is under the operating microscope in many of periodontal therapies.[3]

There have been many research studies comparing various magnification systems versus conventional surgeries used in the management of periodontal diseases However, there is no systematic review available concerning the efficacy of surgical microscope over other magnification system used in the management of periodontal diseases.

Optical Features

Microsurgery

This refers to a surgical medical procedure performed under magnification by a microscope.

Magnification

This is a phenomenon of visually amplifying and availing an enlarged, exaggerated, intensified view of an object or an image or a model.

Magnification is determined by the power of the eyepiece, the focal length of binoculars, the magnification changer factor, and the focal length of the objective lens.

The surgical operating microscopes unlike loupes offer several different options of magnification within the same instrument. Such instruments used by the dentists for microsurgery has six steps of magnification (2.5x, 4.0x, 6.7x, 10x, 16x, and 24x).[4]

Working Distance

This is the distance between the plane of the eye of the operator and the surface subjected for the surgical treatment. The determination of this working distance is done by the linear measurement of the distance between the objective front lens of the microscope and surgical site. A fairly longer working distance facilitates the operator to perform comfortably with the help of the magnified vision.[5]

Working Range/Depth of field

This is the range within the appropriate working distance, where the operator has the ability to maintain visual accuracy.[4,5]

Width of field/Field of View

This is also often referred as "field of view." This represents the width and height of the area the operator sees while using the magnification device.[4,5]

Convergence Angle

It is the angle aligning the two oculars, such that they are pointing at the identical distance and angle. At a defined working distance, the convergence angle differs with interpupillary distance.[6]

Declination Angle

This is the degree where the eyes of the operator are declined to view the area being treated. Declination angles range from 15 degrees to 44 degrees.[7]

Interpapillary Distance

Depends on the position of eyes of each individual and is a key adjustment that allows long-term routine use of loupes.[7]

Illumination

Collateral lighting systems may be helpful for higher magnification in the range of 4X and more. Loupes with a large field of view will have better illumination and brighter images than those with narrower fields of view.[6,7]

Use of microsurgery has evolved to a multitude of applications with increasing technical challenge in both medical and dental profession. However, many studies under surgical microscope in periodontal surgeries produced substantial results till now. But, highly depends on the operator's skill and experience.[8]

Use of high level magnification improves the ability of dentist to observe the minute details at and below the gingival margin that aid in performance of periodontal therapies which lead to better treatment outcomes. Microscope-aided observation helps in detecting the microscopic amount of calculus at the gingival margin and the tactile perception is also improved at even small point on the tooth surface subgingivally. Following are the various types of magnifications systems used in dentistry. (Table 1)[9]

There have been many systematic reviews comparing various treatment modalities by using surgical loupes with the conventional methods in Periodontics. However, there is no systematic review available in the literature concerning the efficacy of operating microscope and its applications in various treatment options in periodontal therapies.

Flow chart 1: Comprehensive search criterion was followed as indicated by the PRISMA (Preferred Reporting Items for Systematic review and Meta-analysis).

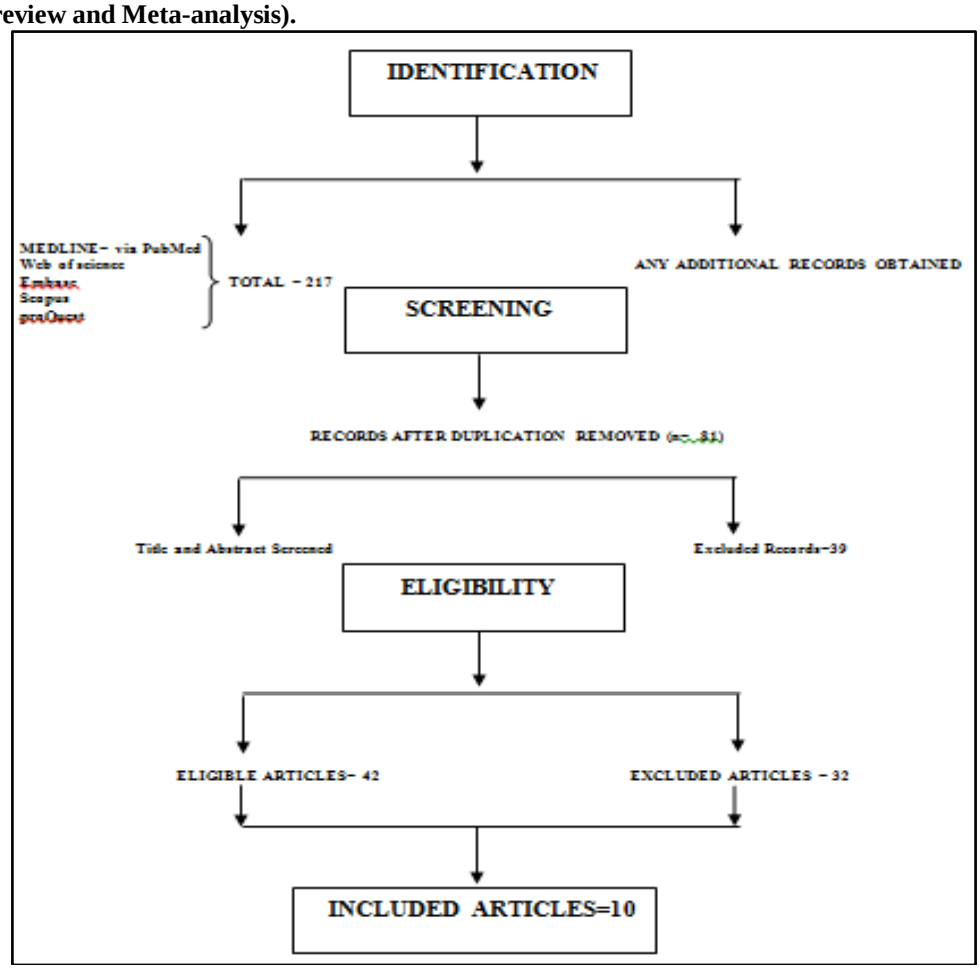

Table 1: Types of magnification Systems and its structural components

A. Loupes	B. Surgical Operating Microscope
Simple loupes: A pair of single meniscus lenses	Eyepieces with 12.5X reticule.
Compound loupes: Multielement lenses	Objective lens 200 - 250 mm
Prism loupes: Schmidt or rooftop prisms, Eyeglass frames or headbands	Binocular inclinable at 180 degree
Galilean loupes: Consists 2 or 3 lenses	Magnification with five step manual changer
	Magnification changer
	Fibreoptic illumination system
	Audiovisual accessories (e.g: video camera)
	Documentation

Materials and Methods

Eligibility criteria

Articles were screened considering the inclusion and rejection criteria.

Inclusion criteria

Studies qualified for consideration, in this review were controlled clinical trials, randomized clinical trials (RCTs), longitudinal studies and case reports/series (included as the literature shown very few original studies related to operating microscope) that help in assessing the efficacy of operating microscope in periodontal therapies.

Rejection criteria

Studies done *in vitro* or on animal were excluded; studies or case series reporting use of only surgical loupes were eliminated; and studies that used only microsurgical instruments without any magnifying systems were also excluded.

Information sources and search protocol

An online comprehensive search criterion was followed as indicated by the PRISMA (Preferred Reporting Items for Systematic review and Meta-analysis). Search strategies were performed using electronic database and included PubMed – Medline, Google Scholar, Journal on Web and manual search using university library resources. The term "periodontal microsurgery", was used for literature search in the above databases. All the articles published should preferably in English and the articles screened for literature up to December 2018.

Study selection

Initially, 217 references are obtained from all the databases on "periodontal microsurgery". PubMed/MedLine databases showed only 107 articles on the term "periodontal microsurgery" up to December 2018.

Results

The number of different types of articles published in PubMed/MedLine category is: Clinical trials-12; Comparative studies-22, Clinical studies-13; Controlled clinical trial-10; Case reports-9; Reviews-15.

The number of articles published on "periodontal microsurgery" in the specialty journals of Periodontics: IJPRD-2; JOP-27; JCP-25; JPR-2, JISP-20.

On screening 107 articles, 26 were removed due to duplication. Out of 81 articles 39 were excluded. The excluded ones are reviews, case reports on surgical loupes and studies on only microsurgical instruments. Among the 42 articles remaining 32 were excluded to meet the eligible criteria of studies only under operating microscope. Case series and Clinical case report in order to diagnose the subgingival deposits and to detect the broken screws of implants were included in order to meet all the applications of microscope in periodontal therapies.

Discussion

Changing the perception from use of traditional approach to minimally invasive microsurgery is the current surgical trend in periodontal therapy. Use of different magnifying systems and their application in dentistry is widespread and lots of the work is done till now. Research under microscope is to take lead in all the aspects of treatment. Hence, it is important to do lots of clinical trials in order to know the effectiveness of usage of surgical microscope in periodontal therapies.[10]

Role of microsurgical instruments in surgery

The specially designed instruments which causes less trauma and establishes precise incision without ragged edges that allow close adaptation of the flap and thus promoting healing by primary intention. [11]

Microsurgical instruments are made of titanium and are of light weight and strong enough to perform all the surgical procedures. Following are the commonly available microinstruments such as: Ophthalmic microsurgical scalpels, Needle holder, Micro scissors, Micro scalpel holder, Anatomic surgical forceps, Tying forceps, Set of various elevators, Retractors, Knives, Suture materials and needles, Breakable carbon steel blade, Micromirrors and Root resection instruments.[12]

Clinical applications of Microsurgery

Microsurgery can be of value in many of the following procedures in Periodontics. Transition from conventional to microsurgical approach has got obvious benefit in current day practice. Following table demonstrate the advantage of each procedure done under microscopy with a mention on its effectiveness proved by published clinical reports and studies. (Table 2)

According to John Mamoun et al., A magnified view improved calculus removal ability and lead to better periodontal disease treatment outcomes in dentistry. Hegde R et al., concluded that using a surgical microscope and microsurgical instruments offers definite advantages in terms of improved visual acuity, superior approximation of wounds, rapid wound healing, decreased post-operative morbidity, and increased acceptance by the patients. Microsurgical technique demonstrated a statistically significant increase in width and thickness of keratinized tissue in accordance with Patrica F Andrade et al., It is confirmed that revolution in the technology have played a pleasing role in convincing the patients to opt for microsurgery.[20]

Table 2: Demonstrate the clinical applications of operating microscope.[10-19]

Clinical application	Original Research/Case report/Series/Review	Conclusion
Diagnostic procedures	Mamoun JS. A rationale for the use of high-powered magnification or microscopes in general dentistry	Explains specific general dental applications for high-powered magnification in restorative dentistry, fixed and removable prosthodontics, endodontics, pediatric dentistry, periodontics, and oral surgery.
Non surgical periodontal therapy	John Mamoun. Use of high-magnification loupes or surgical operating microscope when performing prophylaxes, scaling or root planing procedures.	A magnified view improved calculus removal ability and lead to better periodontal disease treatment outcomes in dentistry.
Management of periodontal flaps	Hegde R et al., Microscope-Enhanced Periodontal Therapy:A Review and Report of Four Cases	Using a surgical microscope and microsurgical instruments offers definite advantages in terms of improved visual acuity, superior approximation of wounds, rapid wound healing, decreased post-operative morbidity, and increased acceptance by the patients.
Mucogingival surgery	Burkhardt R et al., Coverage of localized gingival recessions: comparison of microand macrosurgical techniques.	Microsurgical approach substantially improved the vascularization of the grafts and the percentages of root coverage compared with applying a conventional macroscopic approach.
	Bittencourt S et al., Surgical microscope may enhance root coverage with subepithelial connective tissue graft: a randomized-controlled clinical trial.	Use of the surgical microscope was associated with additional clinical benefits in the treatment of teeth with gingival recessions.
	Francetti L et al., Microsurgical treatment of gingival recession: a controlled clinical study.	The application of magnification in mucogingival surgery accomplished better results in terms of success and predictability compared to conventional techniques and might help achieve excellent esthetic outcomes.
	Patrica F Andrade et al., Comparison between micro and macrosurgical techniques for the treatment of localized gingival recessions using coronally advanced flap and enamel matrix derivative.	Microsurgical technique demonstrated a statistically significant increase in width and thickness of keratinized tissue.
Regenerative therapy	Ribeiro FV et al., Clinical and patient-centered outcomes after minimally	Both therapeutic modalities used for the treatment of intrabony defects achieve

	invasive non-surgical or surgical approaches for the treatment of intrabony defects: a randomized clinical trial. Cortellini P et al., Microsurgical approach to periodontal regeneration. Initial evaluation in a case cohort.	successful outcomes in terms of periodontal health. The use a microsurgical approach resulted in clinically important amounts of CAL gains and minimal recessions.
Implant therapy	Hend Mahmoud Abou El Nasr. The use of Dental Operating Microscope for Retrieval of different types of Fractured Implant Abutment Screws: Case Reports	Demonstrated the use of the surgical operating microscope and endodontic instruments for the retrieval of 2 different types of broken abutment screws.

Definitive advantages of microscope

Though microscope is expensive and needs lots of experience and operator skill, it has got obvious advantages to be used in all the periodontal therapies.

1. Improves the quality in patient care
2. High magnification range and brilliant illumination.
3. Increasing precision
4. Improved ergonomic benefit
5. Improving overall dental care
6. Provides an open field for surgery so that microsurgical instrumentation is possible.

Conclusion

The new era of using surgical microscope in all the procedures in dentistry and in Periodontics especially is gaining popularity. The main reason for this is operating microscope helps in better diagnostic ability and enhances the treatment quality. Thus, resulting in enhanced patient care and ergonomic benefit to the operator which are the prime factors for treatment success.

Conflict of Interest: None.

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