MAGNIFICATION IN DENTISTRY

PRESENTED BY : DR. ABHISHEK PARMAR

MAGNIFICATION

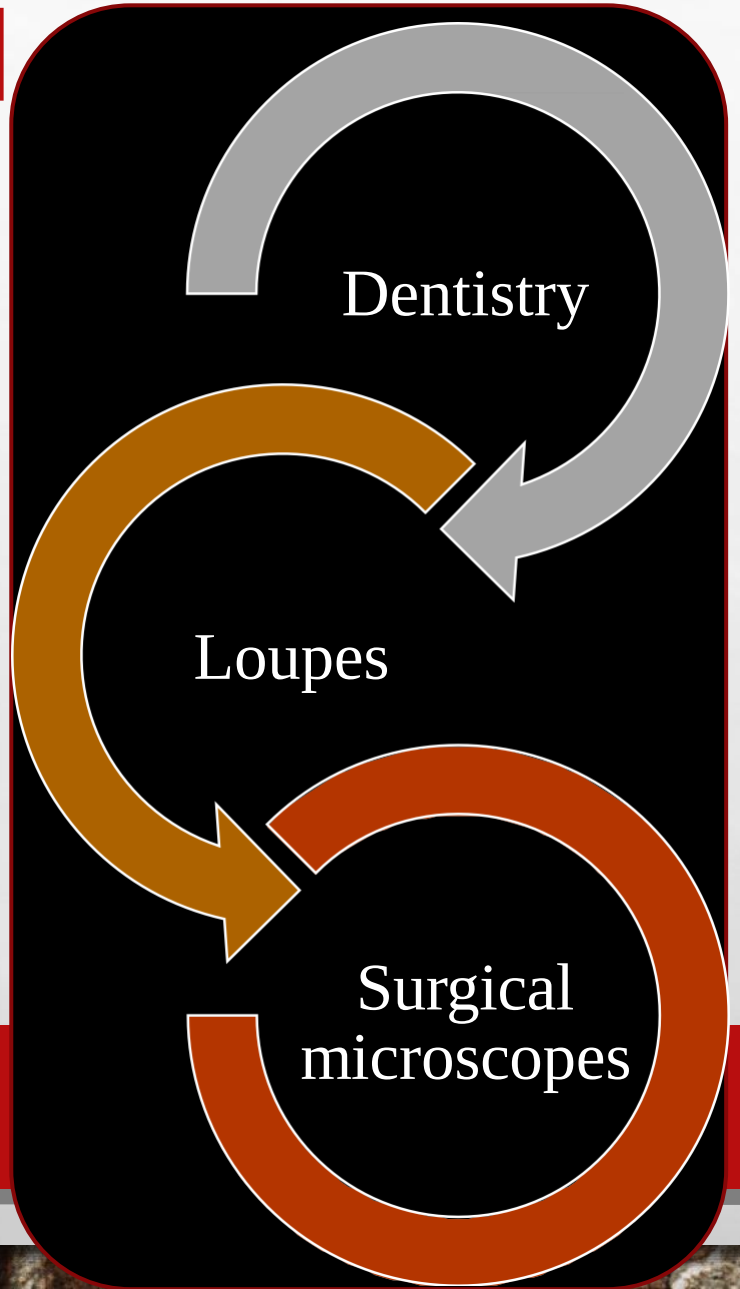


TABLE OF CONTENTS

- Loupes
- Classification
  - Based on evolution
  - Based on design
  - Based on magnification
  - Based on optical systems
  - Based on number and alignment of lens
- Galilean system
- Kaplarian sytem
- Simple loupes
- Compound loupes
- Prism loupes
- How to choose loupes
- Illumination

- ADVANTAGES OF LOUPES
- DISADVANTAGES OF LOUPES
- OPERATING MICROSCOPE
- THE ANATOMY OF THEOPERATING MICROSCOPE
- THE SUPPORTING STRUCTURE
- THE BODY OF THE MICROSCOPE
    - EYEPIECES
    - BINOCULARS
    - MAGNIFICATION CHANGER FACTOR
    - THE OBJECTIVE LENS
- THE LIGHT SOURCE.

- FORMULA FOR TOTAL MAGNIFICATION
- ILLUMINATION
- ACCESSORIES
  - BEAM SPLITTER
  - AUXILIARY ILLUMINATION
  - FILTERS
  - EYEPIECE WITH RETICLE FIELD
  - MONITORS/ LCD SCREENS
  - ASSISTANT SCOPE
  - PISTOL GRIPS
  - CINE OR PHOTOGRAPHIC ADAPTERS
  - DOCUMENTATION

- PRE REQUISITES FOR THE USE OF THE MICROSCOPE IN NON-SURGICAL ENDODONTICS
  - Rubber dam placement
  - Indirect view and patient head position
  - Mouth mirror placement
- MICROSURGICAL INSTRUMENTS
  - Examination instruments
  - Incision and elevation instrument
  - Curettage instruments
  - Retrofilling carrier and plugging instruments
  - Miscellaneous instruments
  - Osteotomy instruments
  - Suturing instruments
  - Tissue retraction instruments
  - Stropko irrigator
  - Ultrasonic unit

- **THE LAWS OF ERGONOMICS**

. Operator positioning

. Rough positioning of the patient

. Positioning of the microscope and focusing

. Adjustment of the interpupillary distance

. Fine positioning of the patient

. Parfocal adjustment

. Fine focus adjustment

. Assistant scope adjustment

MICROSURGERY IN ENDODONTICS

- Diagnosis
- Locating hidden canals

- Management calcified canals
- Perforation repair
- Removal of broken instruments
- Final examination of the canal preparation
- Intracanal medicament
- Obturation
- Surgical endodontic procedure

- Advantage of operating microscope
- Limitations of operating microscope
- Maintenance of the microscope
- Endoscopy

- Orascope
- Endodontic visualization system(EVS)
- Conclusion
- References

INTRODUCTION

- Traditional endodontics has been based on feel not sight.

- Together with radiographs and electronic apex locators this blind approach has produced surprising success.

- There is however a significant failure rate, especially in long-term. magnification helps the user not only to see more, but to see well.

- High levels of magnification increase the aggregate amount of visual information available to endodontists for diagnosing and treating dental pathology.

- Improved ergonomics and zero defect endodontics.

- Surgical loupes date back to the 1870s; however, they had been developed into a binocular loupe that could be attached to spectacles by the early 1900's

The microscope according to American English dictionary defines it as an “optical instrument that uses a lens or a combination of lenses to produce magnified images of small objects, especially of objects too small to be seen by the unaided eyes”.

- OMs have been used for decades in other medical disciplines: ophthalmology, neurosurgery, reconstructive surgery, otorhinolaryngology, and vascular surgery. Its introduction into dentistry in the last 15 years, particularly in endodontics, has revolutionized how endodontics is practiced worldwide.

- Before the OM, the presence of a problem (a ledge, a perforation, a blockage, a broken instrument) was only ‘‘felt,’’ and the clinical management of the problem was never predictable.

The OM has changed both nonsurgical and surgical endodontics. In nonsurgical endodontics, every challenge existing in the straight portion of the root canal system, can be easily seen and competently managed under the OM.

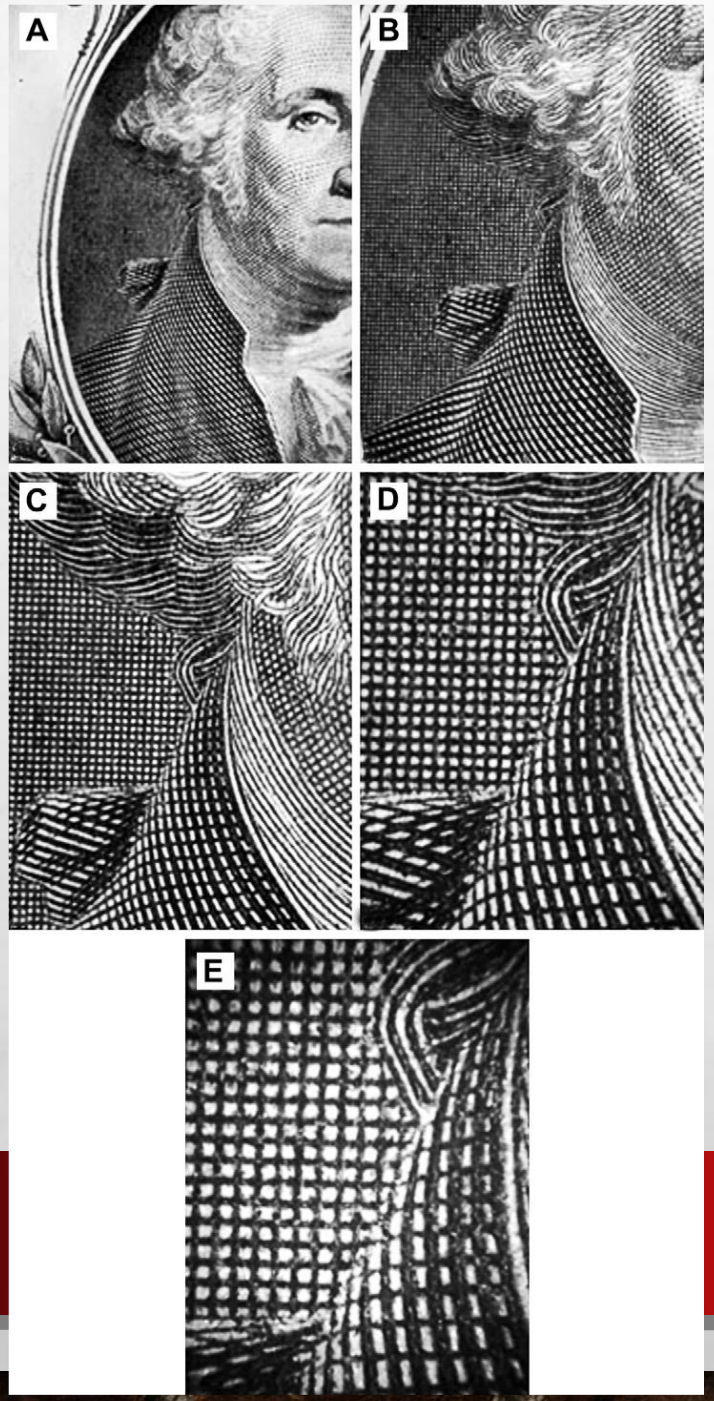
In surgical endodontics, it is possible to carefully examine the apical segment of the root end and perform an apical resection of the root without an exaggerated bevel, thereby making class I cavity preparations along the longitudinal axis of the root easy to perform.

Why microscopes?

THE LIMITS OF HUMAN VISION

The resolving power of the unaided human eye is only 0.2 mm. Most people who view 2 points closer than 0.2 mm will see only 1 point.

A dollar bill without magnification. Note that the lines that make George Washington's face cannot be seen in detail.



A common OM can raise the resolving limit

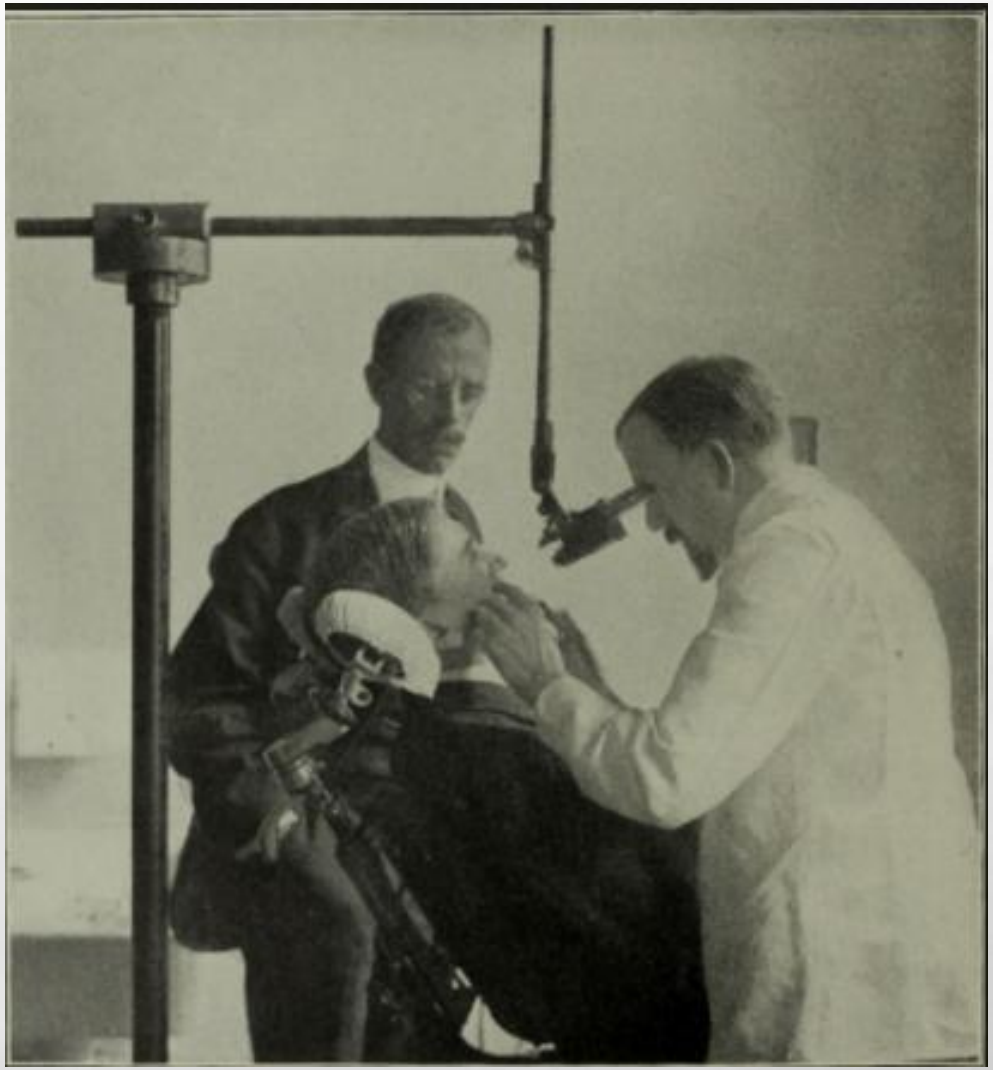
from 0.2 mm to 0.006 mm (6 mm), a dramatic

improvement

Different magnifications of a dollar bill as seen through an OM. (A) Magnification x3. (B) Magnification x5. (C) Magnification x8. (D) Magnification x10. (E) Magnification x18.

Microscopes have been around for a long time. It may be surprising that the microscope is not a high-tech instrument. It has been used in the medical field for over 50 years; the microscope was first introduced to the otolaryngology around 1950’s, then to neurosurgery in 1960’s and to endodontics in the early 1990’s.

History…

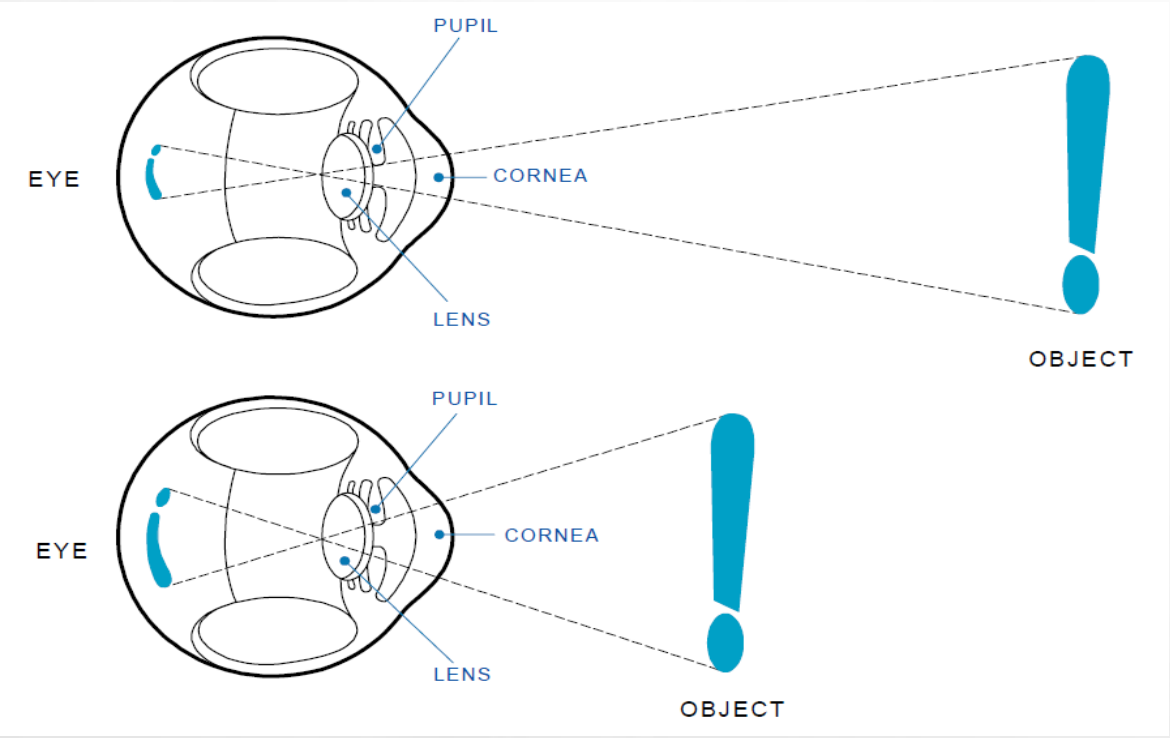


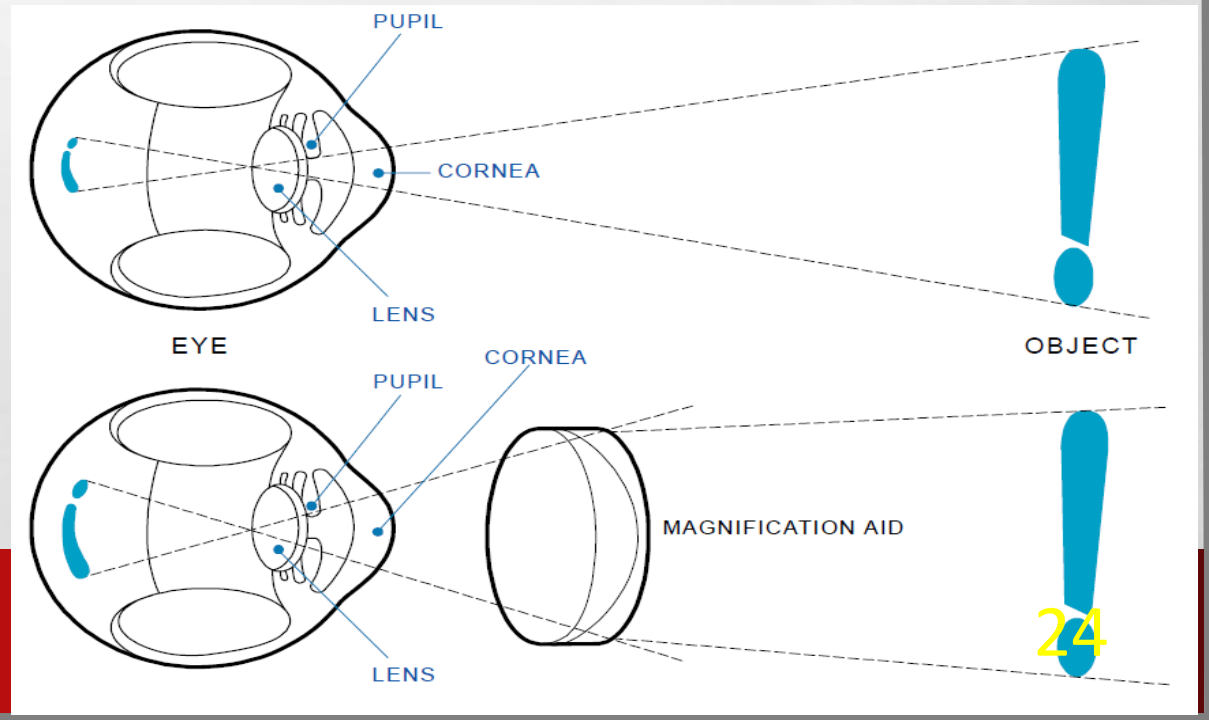
YEAR	DEVELOPMENT
1922, Carl Nylen	Developed monocular microscope for ear surgery
1953, Carl Zeiss	marketed the first binocular operating microscope
1978-81, Apothekar	Developed the first dental operating microscope
1983, Humes and Greaves	Reported various uses of the operating microscope in general dentistry
1984, Reuben and Apotheker	Tested the dental microscope (Dentiscope) in an apical surgery
1986, Pecora and Adreana	Reported reduced incidence of post-operative symptoms in cases of apicoectomies
March 1993	The first symposium on microscopic endodontic surgery was held
1995, AAE	Microscopy training be included in speciality education programs
1999, Garry Carr	Introduced an OM, ergonomically configured for dentistry

FEW BASIC CONCEPTS OF OPTICAL PROPERTIES

MAGNIFICATION

- Magnification of an image is a relative value and has to do with the size of an image as projected onto the retina of the eye.
- The magnification of an image is increased by simply decreasing the distance between the eye and the object in question.


PUPIL
EYE
CORNEA
LENS
OBJECT
PUPIL
EYE
CORNEA
LENS
OBJECT

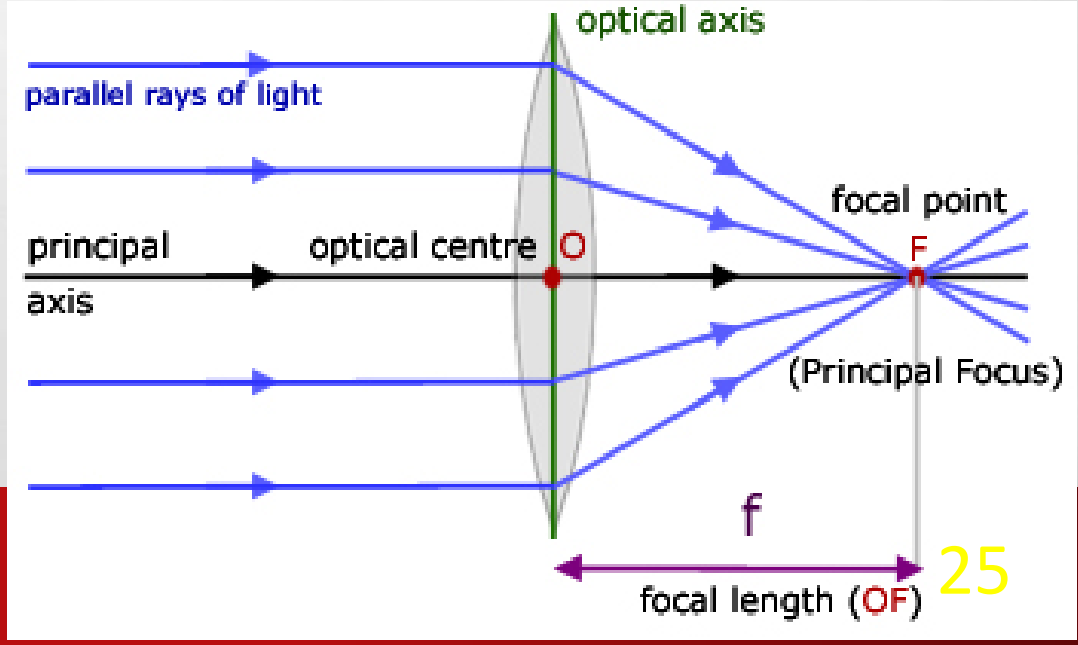

PUPIL
CORNEA
LENS
EYE
OBJECT
CORNEA
PUPIL
MAGNIFICATION AID
LENS

FOCUS AND PARFOCAL

FOCUS –the point at which initially collimated rays of light meet after passing through a convex lens, or reflecting from a concave mirror.

- Also called focal point.
- Optical power is the inverse of a lens' focal length

PARFOCAL – "having the same focus in the entire range of magnifications"



RESOLUTION

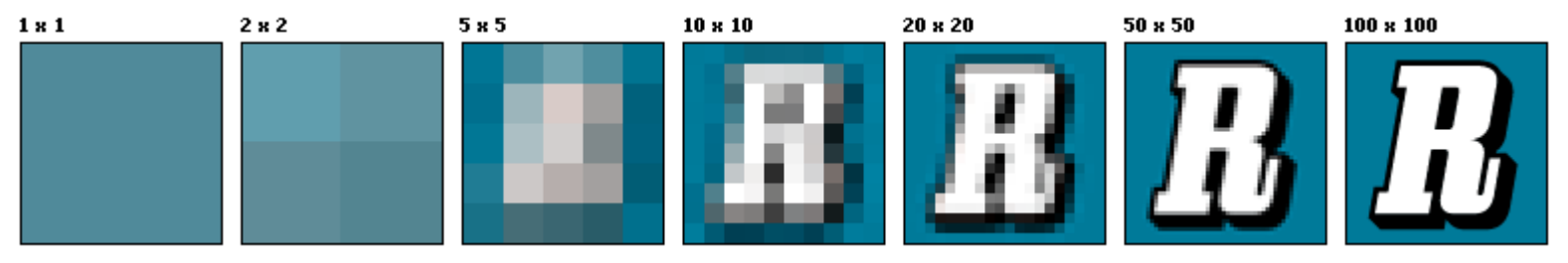
- The ability to differentiate between two closely positioned bright objects.

- This optical term, simply stated, is the quality of a lens (prism or mirror) which enables it to deliver a perfectly crisp image where intended.

- Resolution and depth-of-field are reciprocals of one another

  in that more resolution implies less depth-of-field

RESOLUTION



Resolution is a measure used to describe the sharpness and clarity of an image or picture

OPTICAL DEFINITIONS

Working distance

The distance measured from the dentist's eye to the treatment field being viewed.

Depth of field

The amount of distance between the nearest and the farthest objects that appear in acceptably sharp focus.

Convergence angle

The aligning of two oculars in order that they are pointing at the identical distance and angle to the object or treatment field.

Field of view

The area that is visible through optical magnification.

Viewing angle

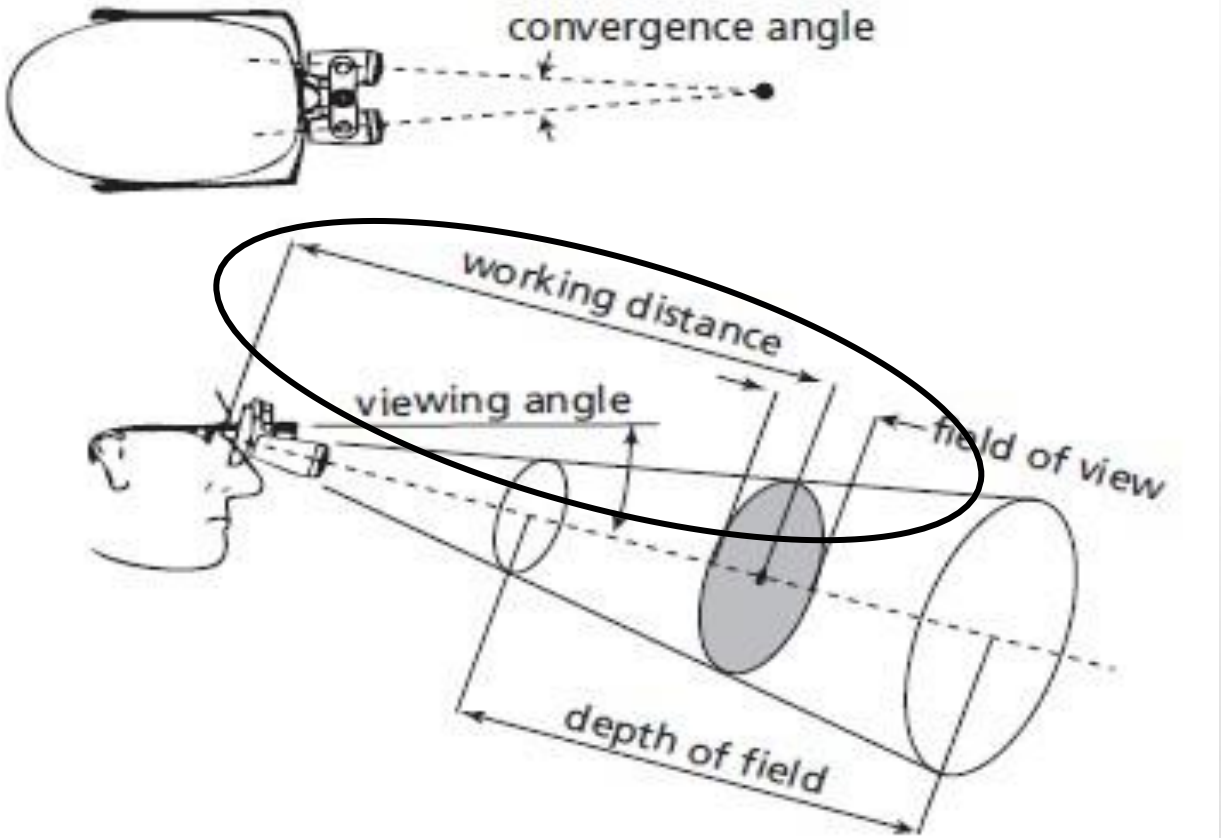
The angular position of the optics that allow for a comfortable viewing position for the operator.

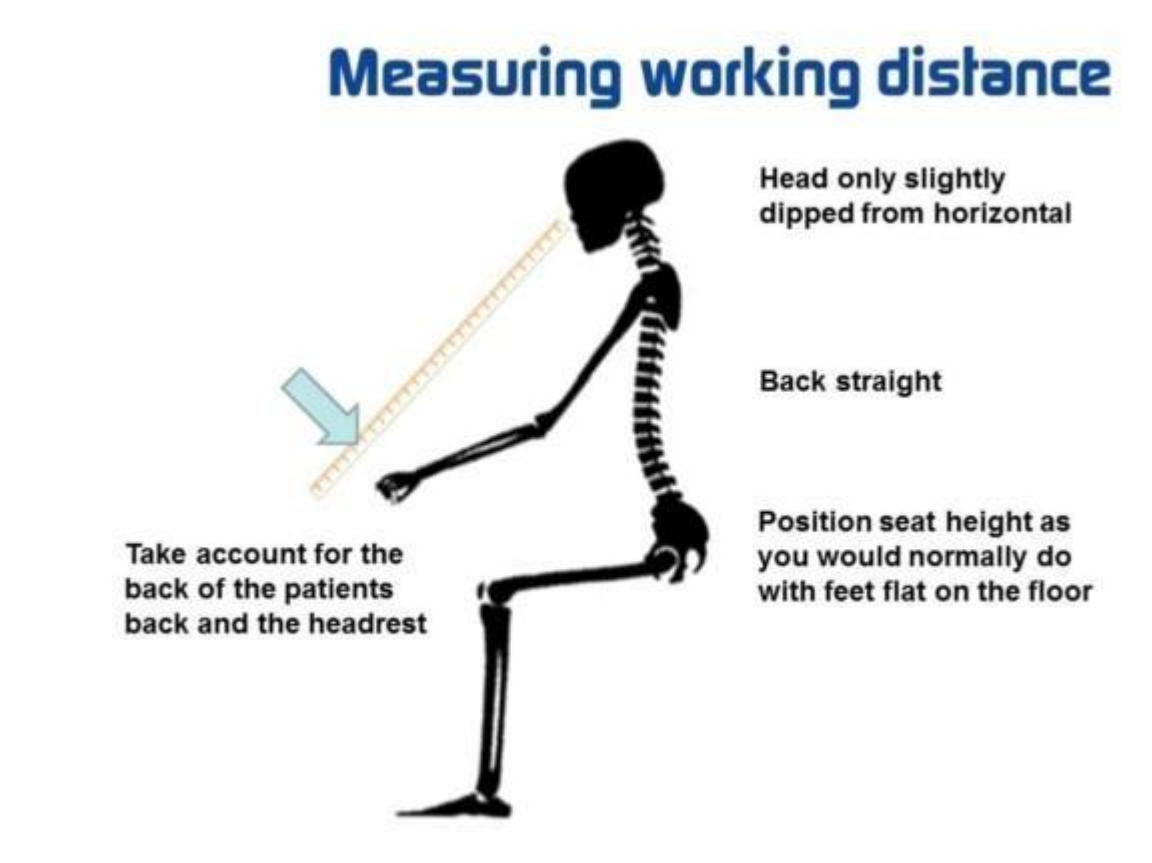
WORKING DISTANCE

- The distance from the microscope objective lens to the point of focus of the optical system and this value is fixed and dependent totally on the chosen focal length of the objective lens.

- Distance should be sufficient to place the hands and the instruments comfortably between the microscope and the operating area.

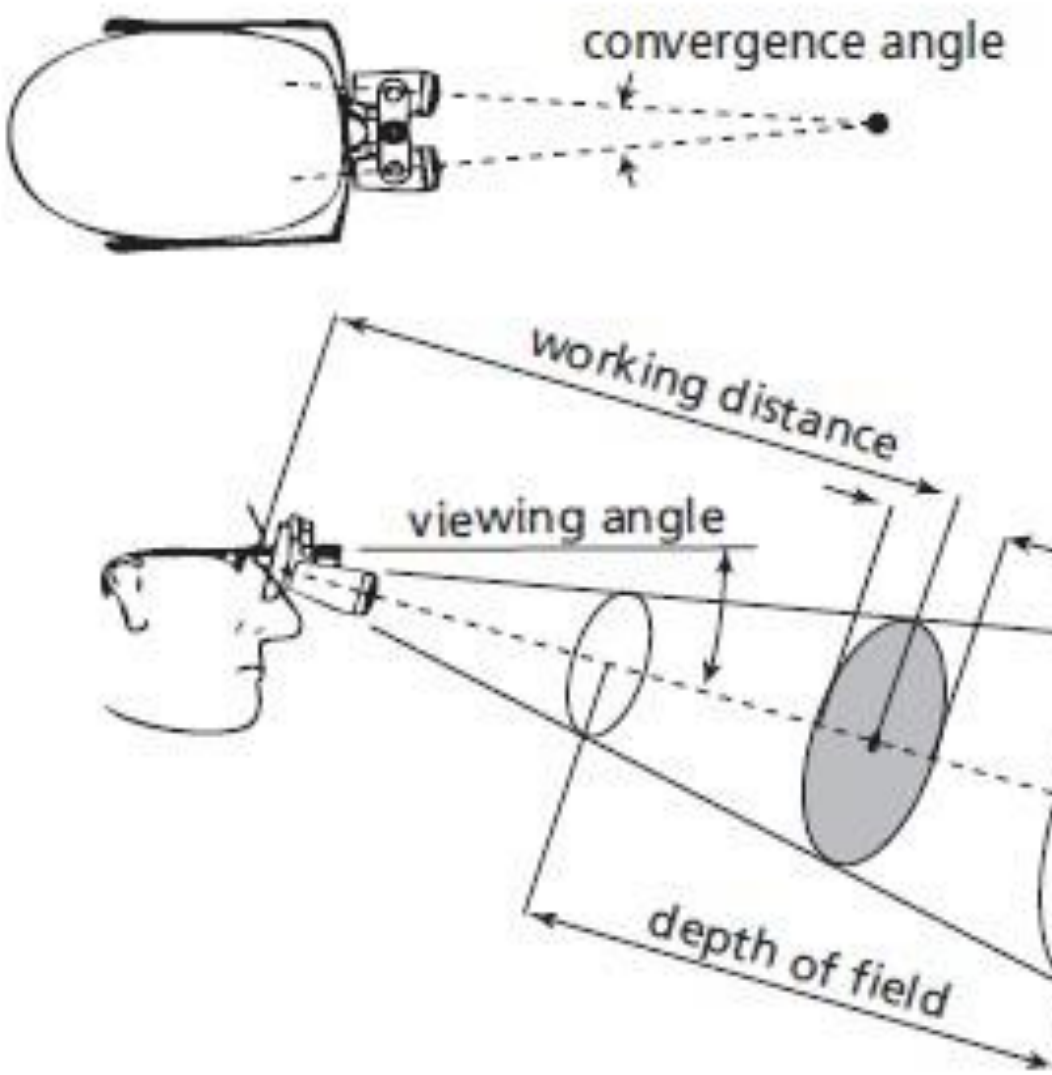
WORKING DISTANCE





Depending on the height and the resulting length of the arms, the working distance with slightly bended arms usually ranges from 30 to 45 cm.

FIELD DEPTH/DEPTH OF FIELD/WORKING RANGE



Range within which the object remains in focus.

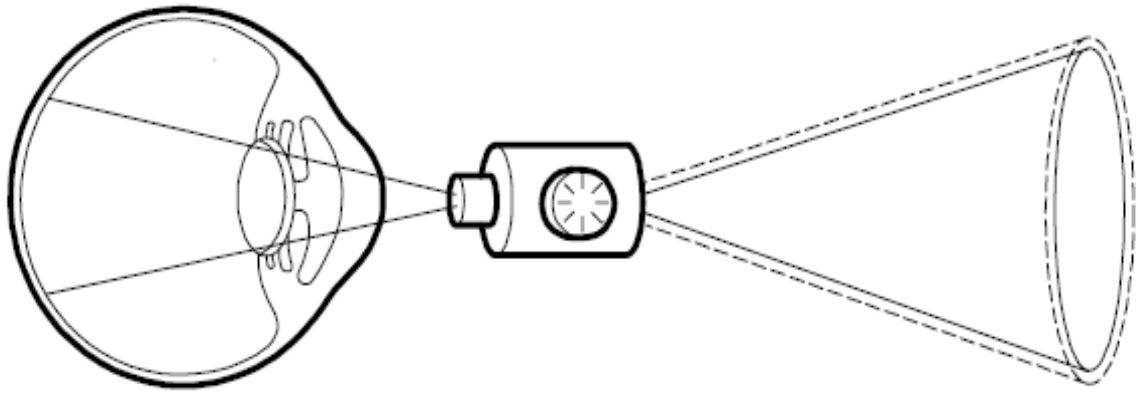
Large field depth = Greater degree of freedom

With any brand of loupe, the depth of field decreases as the magnification increases.

DEPTH-OF-FIELD / DEPTH-OF-FOCUS

- These terms f perfect optical focus, where

FIELD OF VIEW

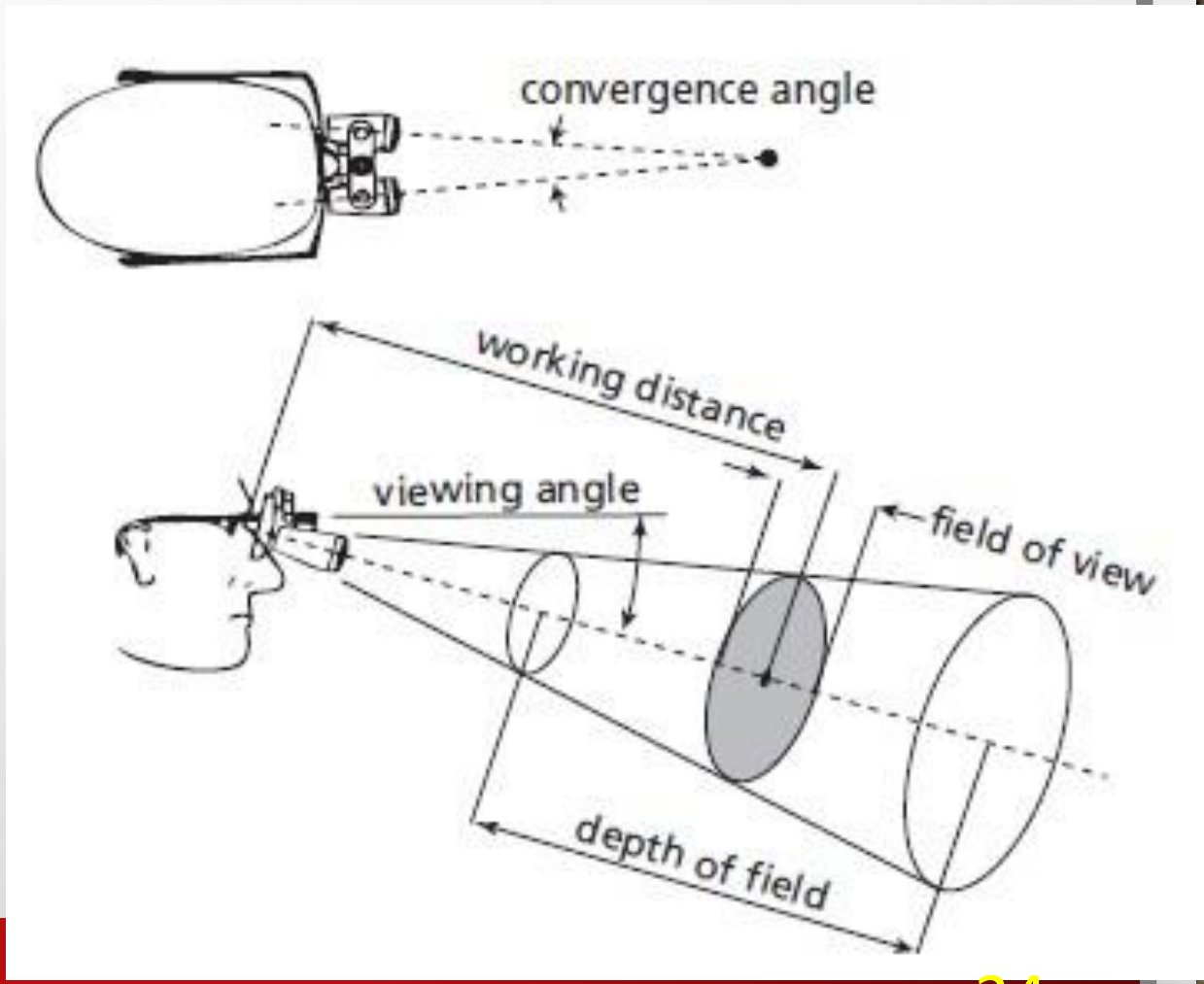


DETAIL A. LOWER MAGNIFICATION

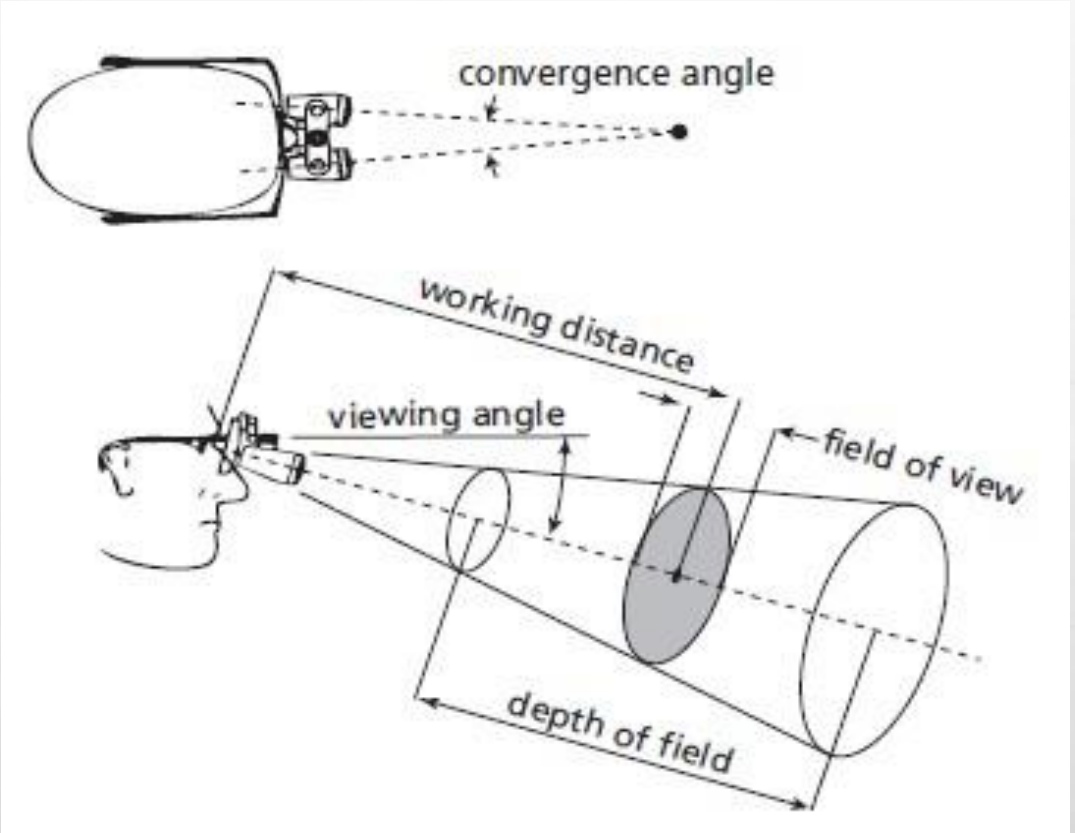
FIELD OF VIEW

linear size or angular extent of an object when viewed through the telescopic system.

As with depth of field, when magnification increases, the field of view decreases.

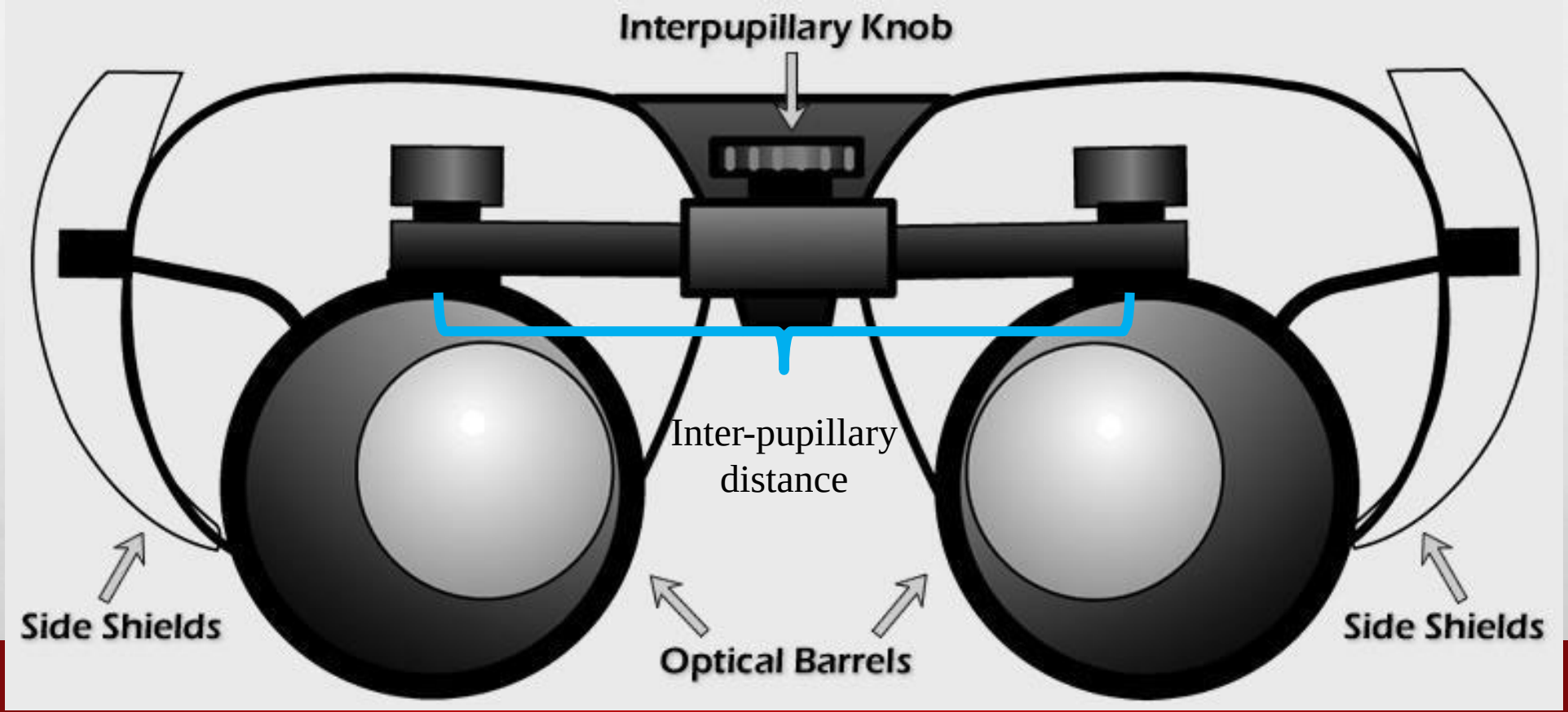


CONVERGENCE ANGLE



Is the pivotal angle aligning the two oculars, such that they are pointing at the identical distance and angle.

INTERPUPILLARY DISTANCE



INSTRUMENTS FOR MEASURING PD

Cal coast PD Meter

Digital Essilor Pupillometer

PD ruler

Several elements are important for consideration in improving clinical visualization. Included are factors such as

- Stereopsis- Perception of depth
- Magnification range
- Depth of field
- Resolving power
- Working distance
- Spherical and chromatic distortion (ie, aberration)
- Ergonomics
- Eyestrain
- Head and neck fatigue
- Cost.

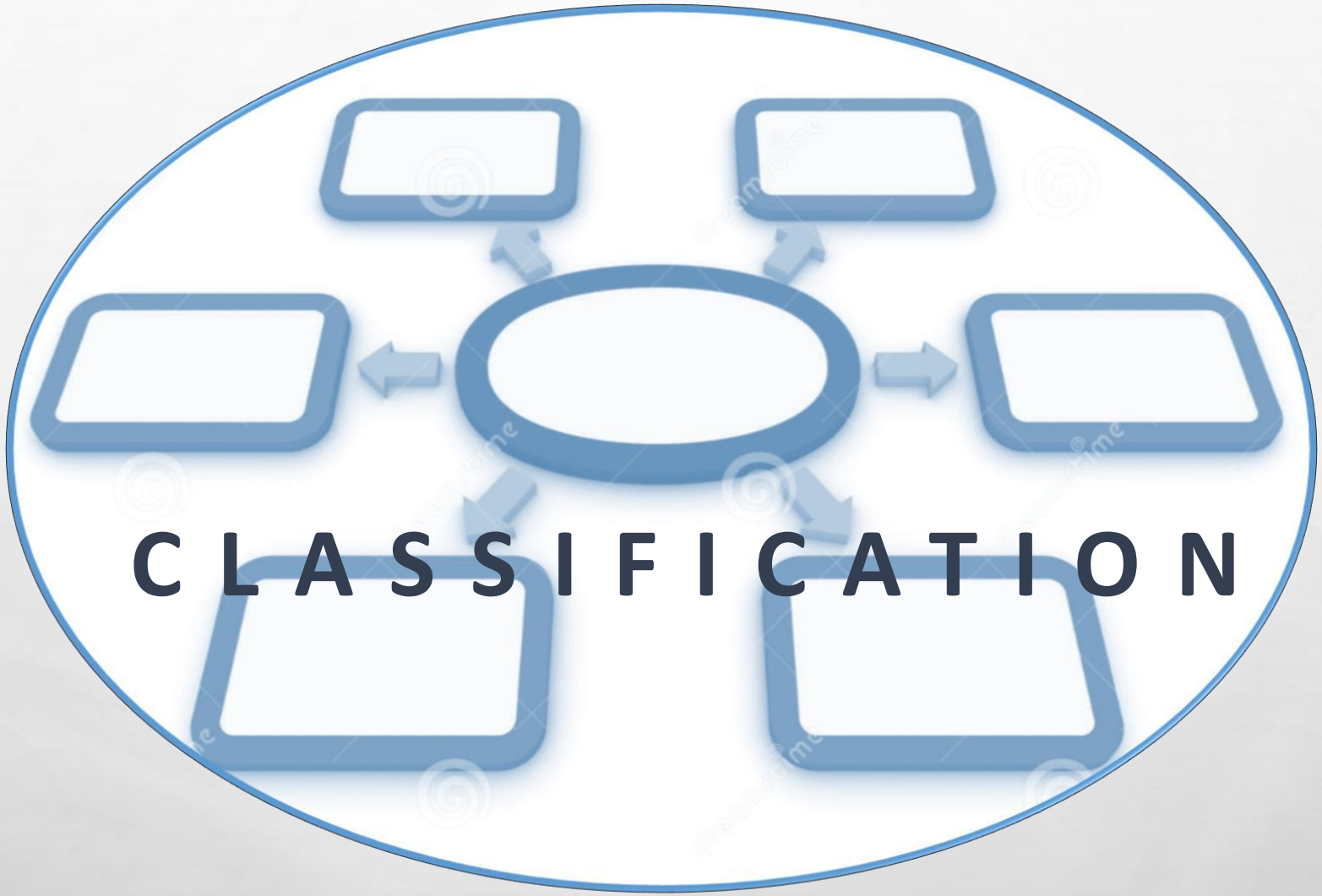
I. LOUPES

The most common magnification system used in dentistry is magnification loupes.

Fundamentally two monocular microscopes, with side-by-side lenses, angled to focus on an object.

- The degree of magnification is usually measured in diopters.
- The diopter system relies on a simple magnifying lens.
- One diopter (D) means that a ray of light that would be focused at infinity now would be focused at 1 meter (100 cm or 40 inches).
- A lens with 2 D designation would focus to 50 cm (19 inches); a 5 D lens would focus to 20 cm (8 inches).
- Diopter(D) is not equal to magnification(x).

- The only advantage of the diopter system is that it is the most inexpensive system.
- But the plastic lenses that it uses are not always optically correct.
- Furthermore, the increased image size depends on being closer to the viewed object, which can compromise posture and create stresses and abnormalities in the musculoskeletal system



CLASSIFICATION

BASED ON EVOLUTION

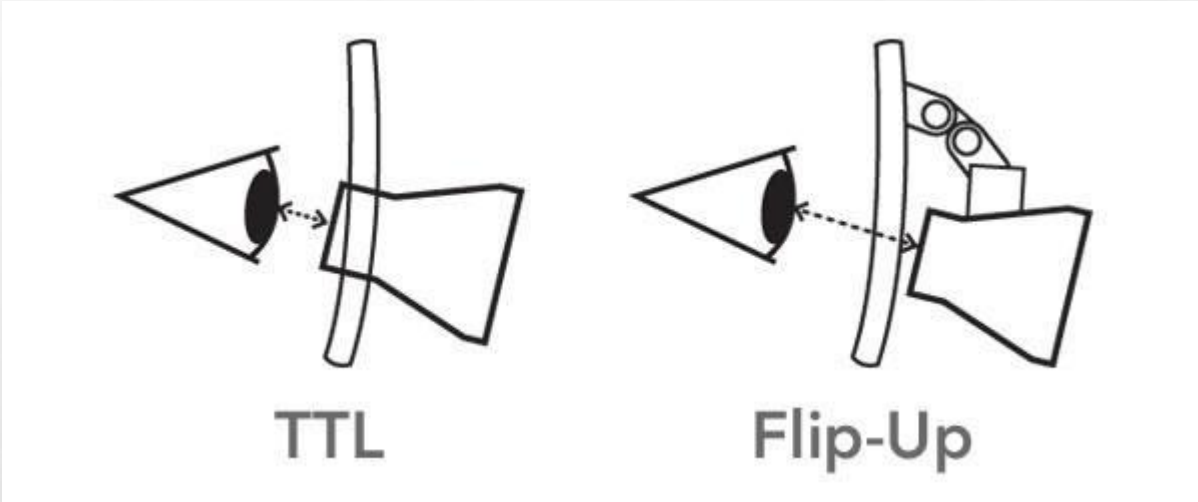
First generation: Single-lens diopter magnifiers (clip-on, flip-up, jeweller's glasses)

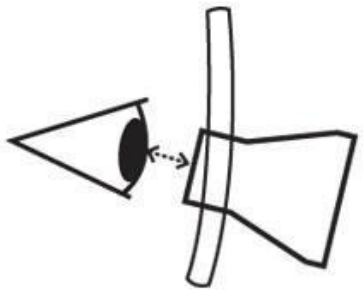
Second generation: Surgical telescopes with preset declination angles;

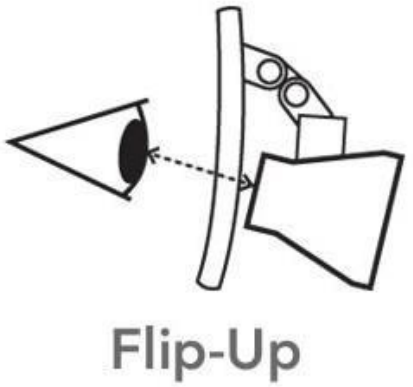
Third generation: surgical Telescopes with the fully adjustable declination angle option.

BASED ON DESIGN

- Through the lens (TTL)
- Flip up

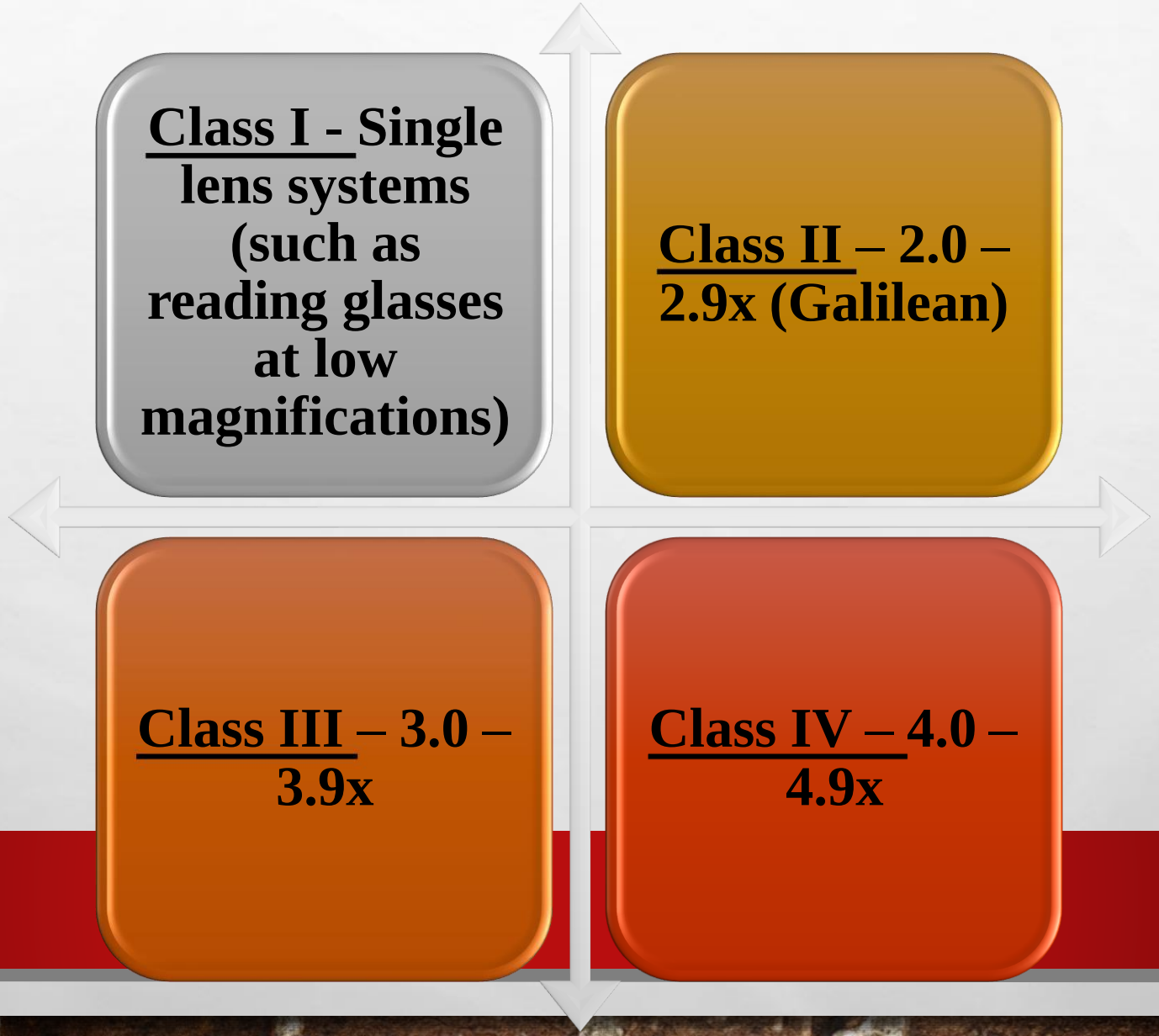




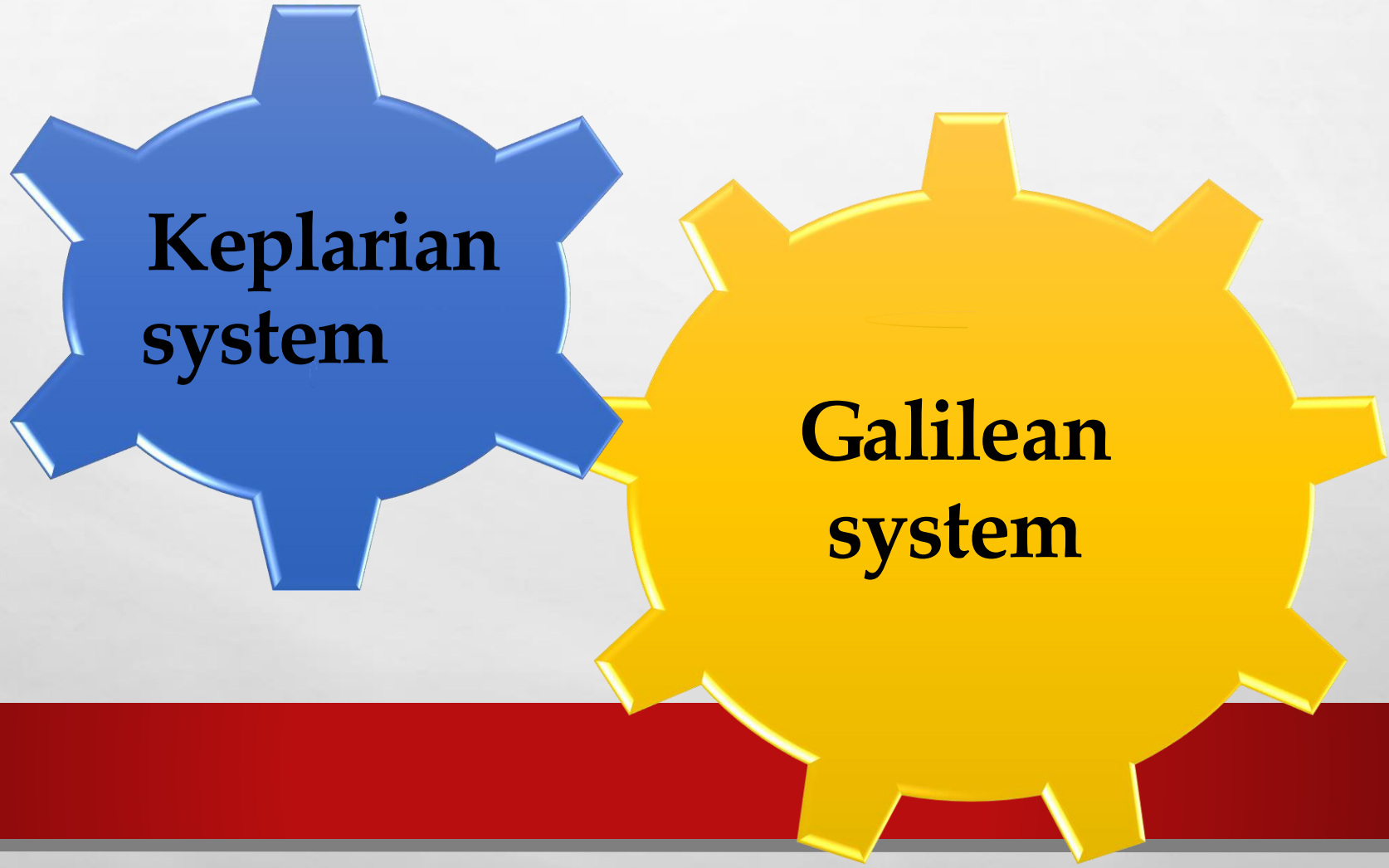


Feature	• TTL	• Flip up
weight	• Less	• More
• Field of view	• Wide	• Narrow
• Fit	• Customized (prescription)	• Fully adjustable
• Declination angle	• Preset	• Adjustable
• No: of operators	• Single	• Multiple
• Cost	• More	• Less

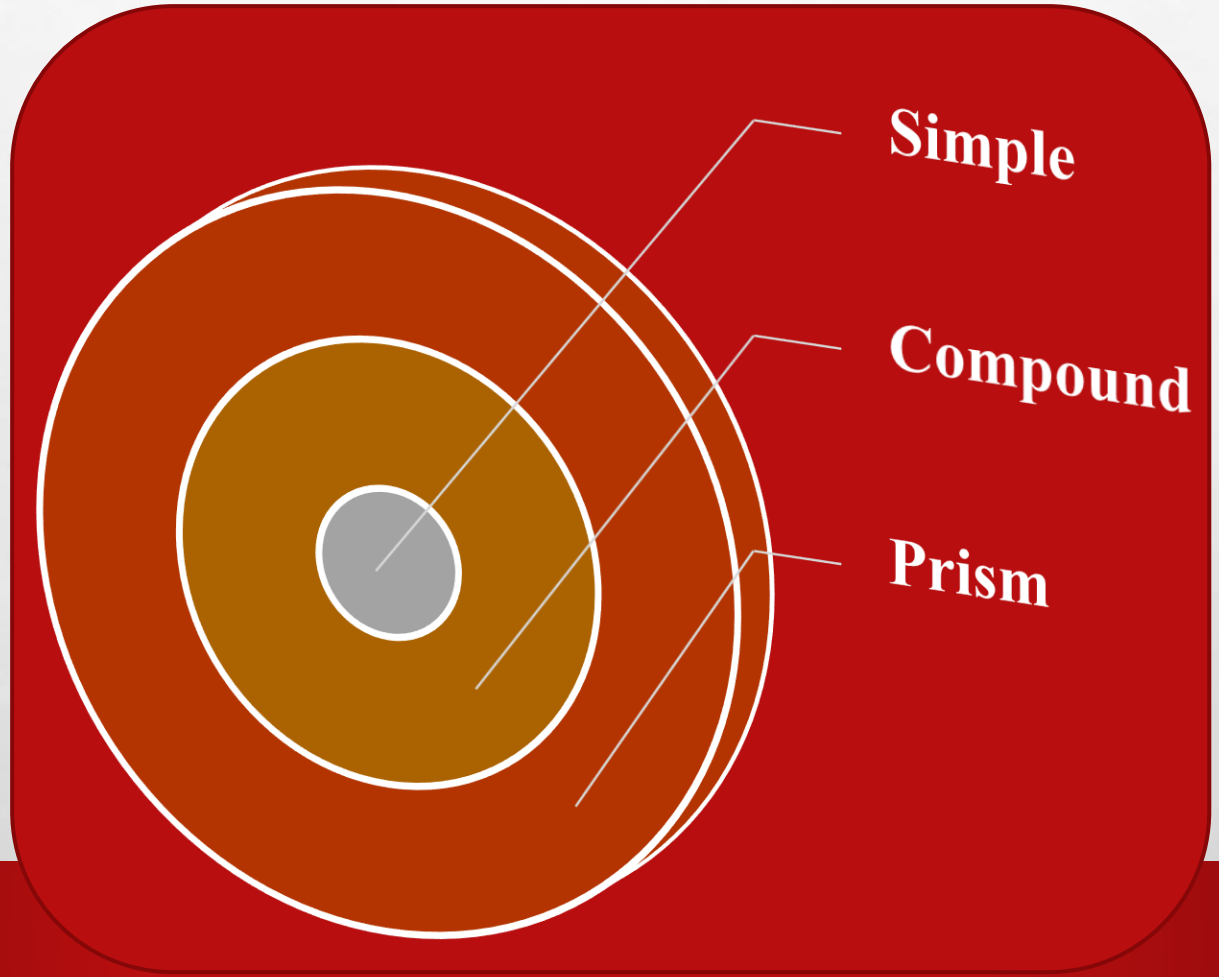
BASED ON MAGNIFICATION



BASED ON OPTICAL SYSTEMS

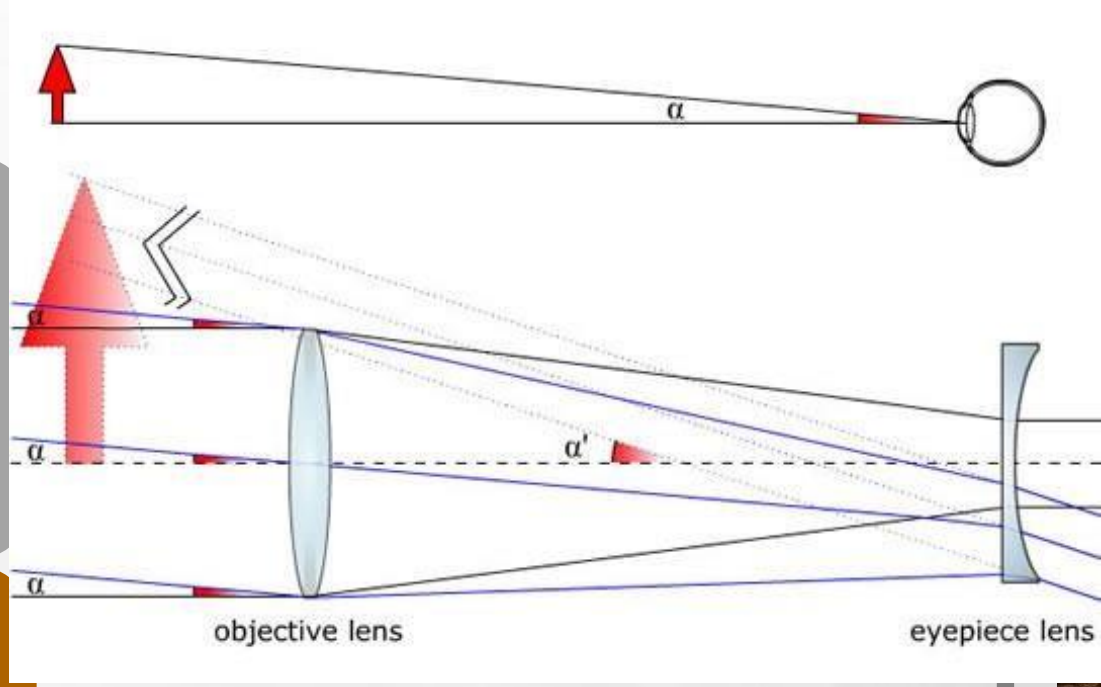


BASED ON NUMBER AND ALIGNMENT OF LENS



GALILEAN SYSTEM

Consists of a converging lens (plano-convex or biconvex) serving as objective, and a diverging lens (plano-concave or biconcave) serving as eyepiece.



The eyepiece is situated in front of the focal point of the objective, at a distance from the focal point equal to the focal length of the eyepiece.

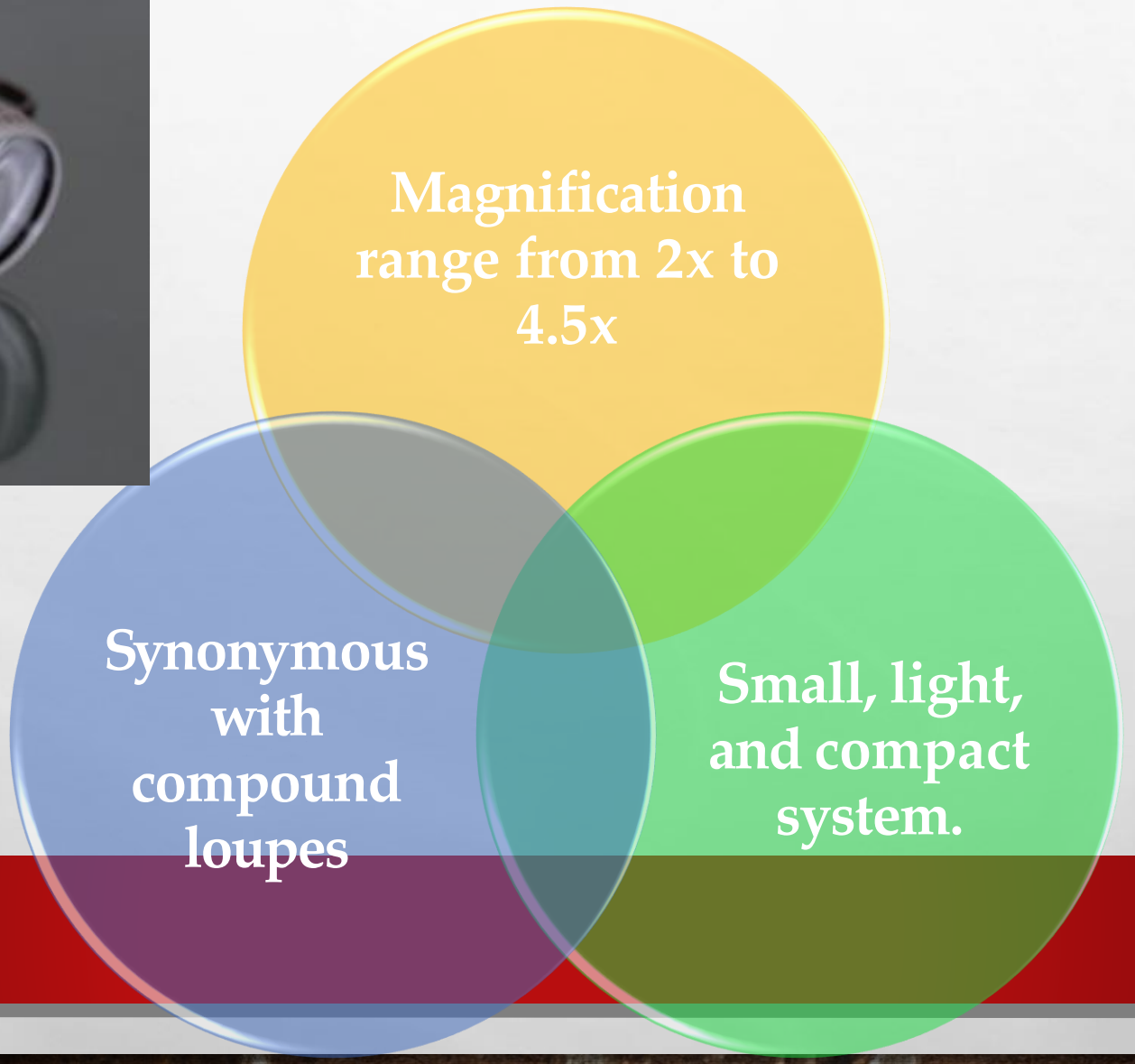
Converging lenses are conventionally positive (or of positive optical power) and diverging ones negative (or of negative optical power)

The negative eyepiece intercepts the converging rays coming from the objective, rendering them parallel and thus forming, to the infinite (afocal position), a virtual image, magnified and erect.

The magnification of the system is determined by the ratio between the focal length of the objective and that of the eyepiece.

The Galilean telescope, although it furnishes erect images with the aid of erector devices, has the severe drawback of an extremely narrow field of view (which makes it, in practice, usable only for magnifications up to around 3X).

GALILEAN SYSTEM

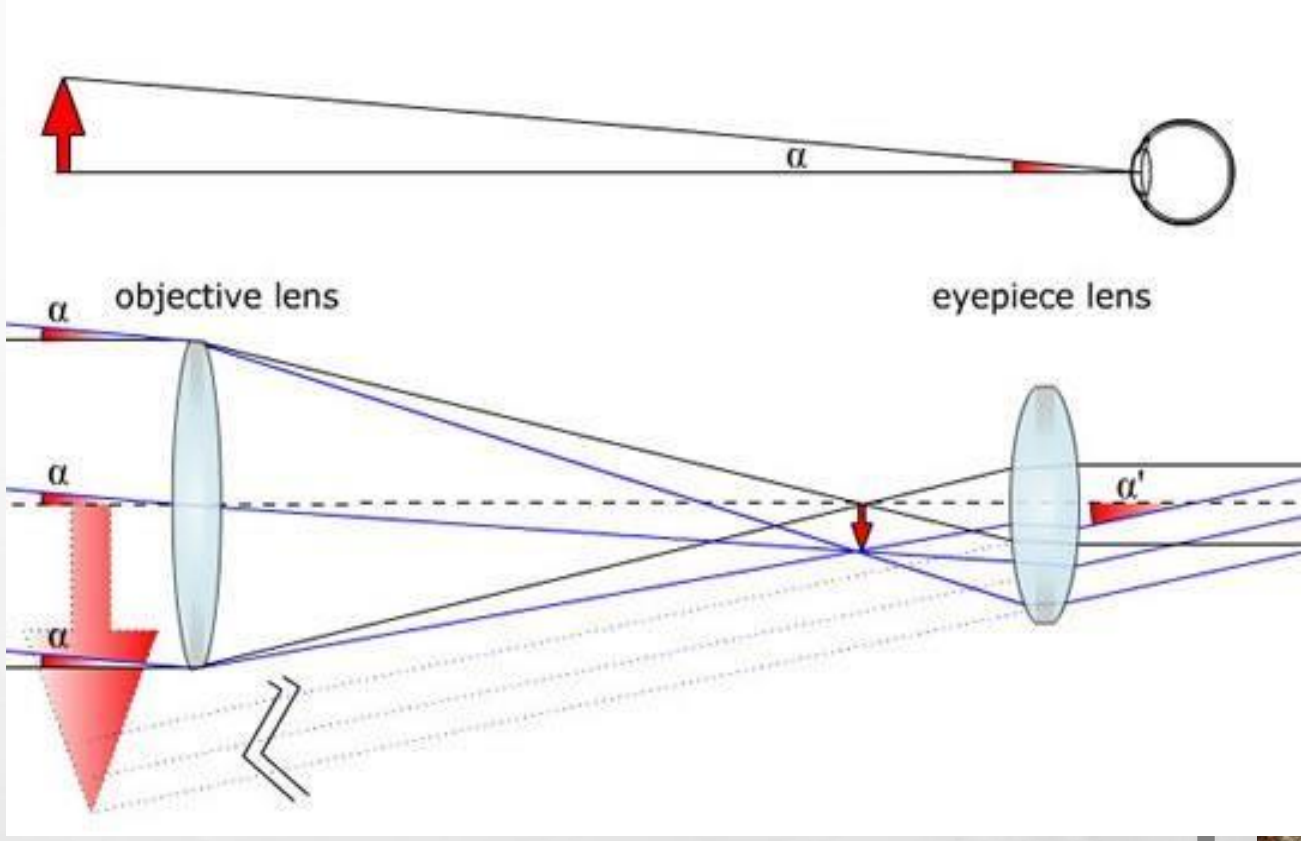


KAPLARIAN SYTEM

The objective forms a real image, diminished in size and upside-down, of the object observed.

The eyepiece — which, consisting of a converging lens with short focal length, is actually a magnifying lens — enlarges the image formed by the objective.

The image observed is however upside-down, so that the Keplerian telescope must be fitted with some kind of erector device which, by inverting the image again, erects it.



SIMPLE LOUPES

Simple loupes consist of a pair of single, positive, side-by-side meniscus lenses.

Each lens has two refracting surfaces, with one occurring as light enters the lens and the other when it leaves.

Its main advantage is that, it is cost effective.

The disadvantages include- It is primitive with limited capabilities.

HIGHLY SUBJECTED TO SPHERICAL AND CHROMATIC ABERRATION,

Size and weight limitations - no practical dental application beyond a magnification range of 1.5 diameters.

COMPOUND LOUPES

Compound loupes consist of converging multiple lenses with intervening air spaces to gain additional refracting power, magnification, working distance, and depth of field.

They can be adjusted to clinical needs without excessive increase in size or weight.

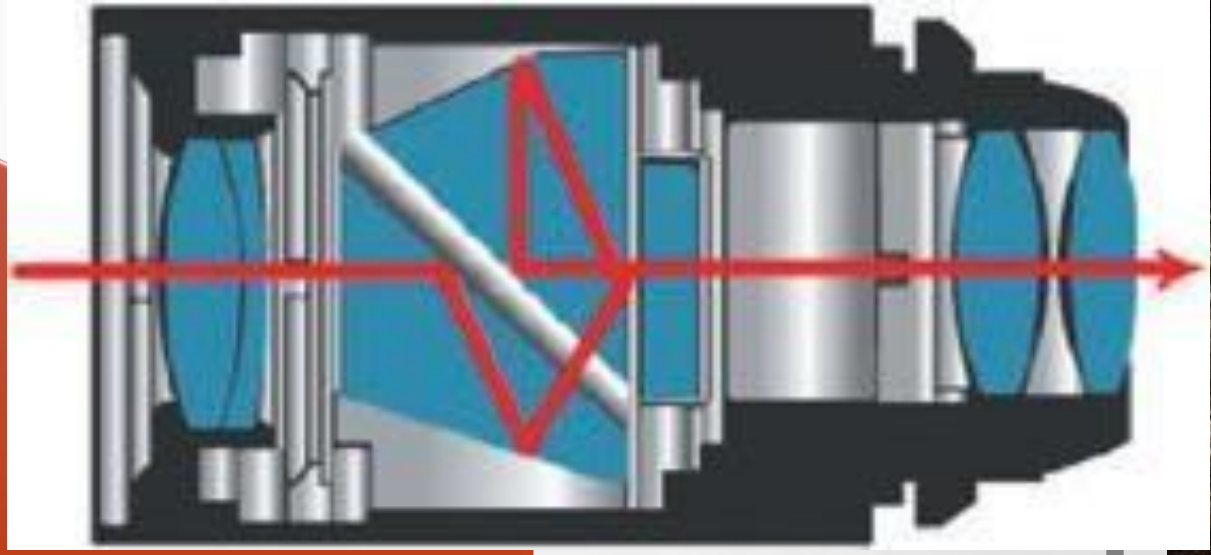
Compound lenses can be achromatic, in addition to improved optical design.

• SIMPLE LOUPE	• COMPOUND LOUPE
• Pair of single meniscus lenses	• Multi-element lenses
• Each lens limited to only 2 refracting surfaces,	• Multielement with intervening air spaces to gain additional refracting surfaces.
• Magnification can only ↑ by increasing lens diameter & thickness.	• ↑sd by lengthening the distance between the lenses , avoiding excessive size & wt.
• Impractical beyond 1.5 X	• Optically insufficient beyond 3X
• Greatly affected by spherical & chromatic aberrations	• Can be achromatic

PRISM LOUPES

Prism loupes are the most optically advanced type of loupe magni-fication presently available.

These loupes actually contain Schmidt or roof-top prisms that lengthen the light path through a series of mirror reflections within the loupes.



They lengthen the light path by virtually folding the light so that the barrel of the loupe can be shortened.

THEY ARE SUPERIOR TO OTHER LOUPES IN TERMS OF

- Better magnification
- Wider depths of field
- Longer working distances
- Larger fields of view

The barrels of prism loupes are short and can be mounted on eyeglasses or a headband.

But the increased weight, at magnifications of 3.0 diameters or greater, causes headband mounted loupes to be more comfortable and stable than mountings on glasses.

Type	*Lens*	*Maximum Usable Magnification*	*Advantages*	*Disadvantages**
Simple	Single	1.5 ×	Simplicity	Spherical (shape) and chromatic (color) distortions with increased size and weight increased magnifications
Compound	Multiple	3.0 ×	Increased magnification	Limited depth of field Limited field access
Prism	Multiple	4.0 ×	Higher magnification Wide depth of field Longer working distances Larger fields of view	Increased weight above 4×

HOW TO CHOOSE LOUPES

Table 45-1 Features to consider in the selection of a magnifying loupe system

Compound loupes (Galilean)	• Magnification range 2–3.5×
	• Lighter in weight
	• Shorter working distance
	• Shorter loupe barrel
Prism loupes (Keplerian)	• Magnification range 3–5×
	• Heavier in weight
	• Longer working distance
	• Longer loupe barrel

Front-frame mounted

- Allow up to 90% of peripheral vision
- No prescription glasses
- Require soft and cushioned nose piece
- Better weight distribution

Head-band mounted

- Restricted peripheral vision
- Allow to use prescription glasses
- Better weight distribution
- Require adjustment more often

Fixed-lens magnifiers	• No adjustment options when changing posture • Minimum weight
Flip-up capability	• Require removable, sterilizable handle • Allow switch from magnified to regular vision

Quality of the lenses	• Corrected for chromatic and spherical aberration • No drop-off in clarity when approaching the edges • Sealed system to avoid leakage of moisture • Option for disinfection
Adjustment options	• Interpupillary distance • Viewing angle • Vertical adjustment • Lock in adjusted position • Convergence angle (preset angle may be more user-friendly)
Lens coating	• Brighter image • More light
Accessories	• Transportation box • Side and front shields for protection • Mounted light source • Removable cushions

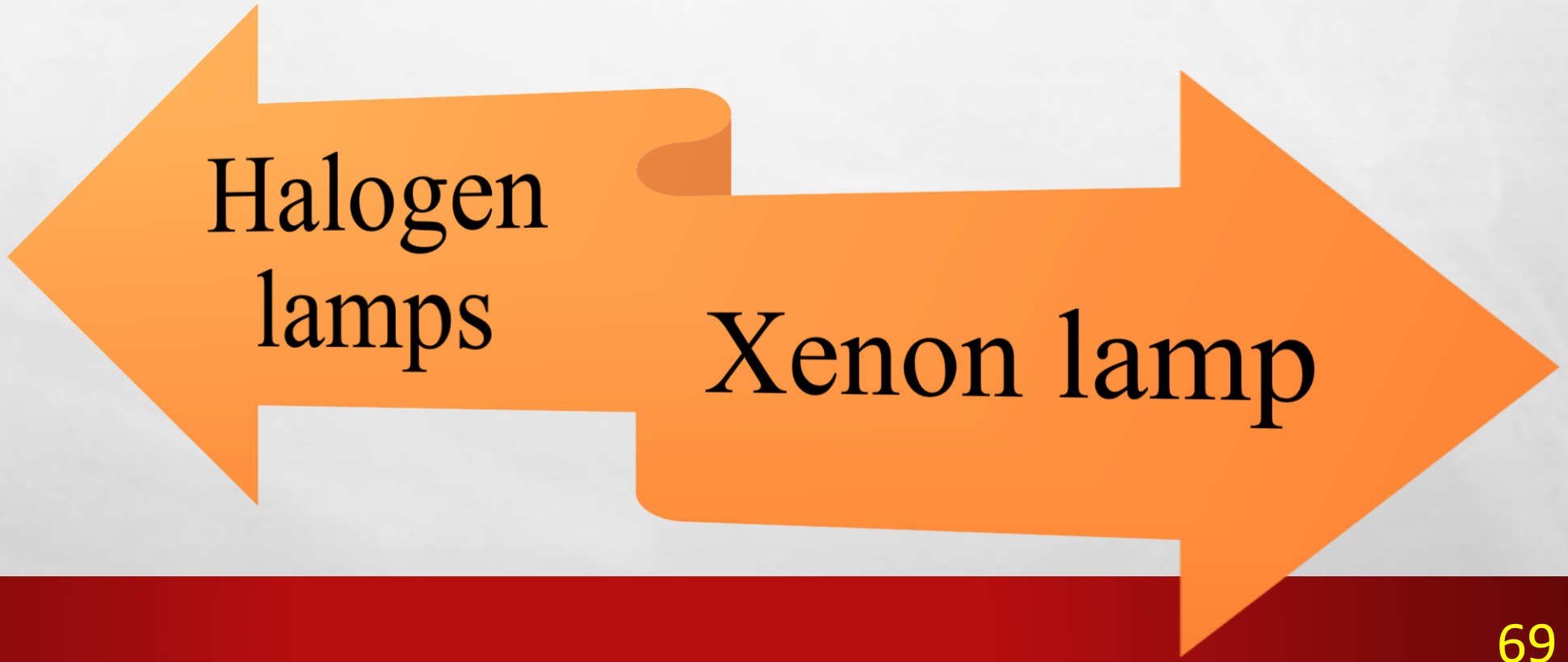
ILLUMINATION

LOUPES WITH LIGHTING

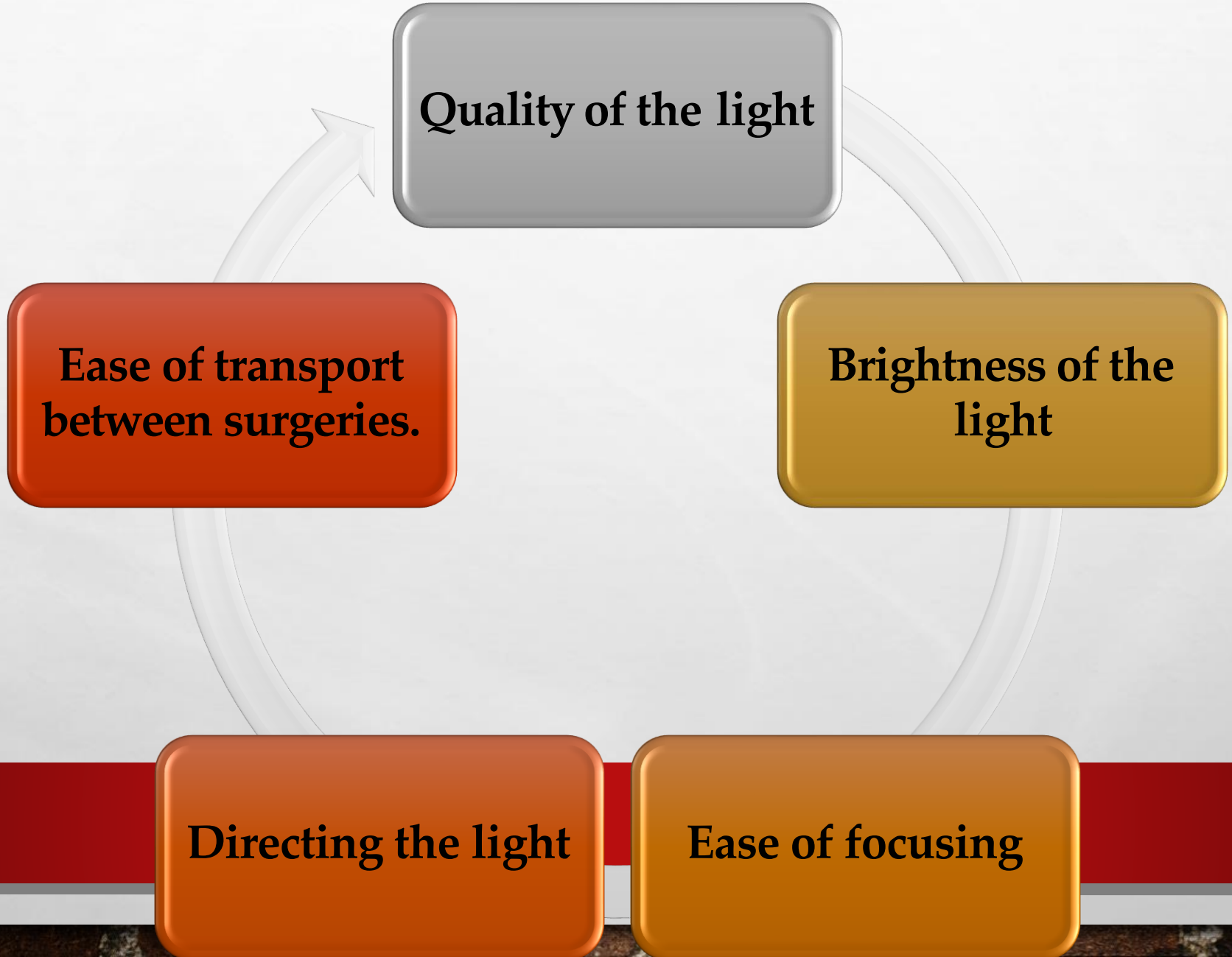
MOST OF THE MANUFACTURERS OFFER COLLATERAL LIGHTING SYSTEMS OR SUITABLE FIXING OPTIONS.

These systems may be helpful, particularly for higher magnification in the range of 4X and more loupes with larger field of view will have better illumination and brighter image than those with narrower fields of view.

SOURCE



IMPORTANT CONSIDERATIONS IN THE SELECTION OF AN ACCESSORY LIGHTING SOURCE



IT SHOULD BE REALIZED THAT EACH SURFACE REFRACTION IN A LENS WILL RESULT IN A 4% LOSS IN TRANSMITTED LIGHT DUE TO REFLECTION.

In telescopic loupes, this could amount to as much as 50% reduction in brightness.

Anti-reflective coatings have been developed to counteract this effect by allowing lenses to transmit light more efficiently.

This quality of lens coating also varies and should be evaluated when selecting loupes.

ADVANTAGES OF LOUPES

- Less expensive .
- Easier to use .
- Tend to be less cumbersome in the operating field.
- Less likely to breach a clean operative field.

DISADVANTAGES OF LOUPES

- The eye must converge to view the object.
- Vision changes with prolonged usage of poorly fitting loupes.
- Increased weight at higher magnification
- Lack of variable magnification.
- Individual light source may be required.
- Protective coating of anti-reflective material to prevent loss of light transmitted is essential.
- Imaging and documentation not possible.

MICROSCOPE

- A **microscope** (greek: *μικρόν* (*micron*) = small + *σκοπεῖν* (*skopein*) = to look at) is an instrument for viewing objects that are too small to be seen by the naked or unaided eye.

- The science of investigating small objects using such an instrument is called microscopy.

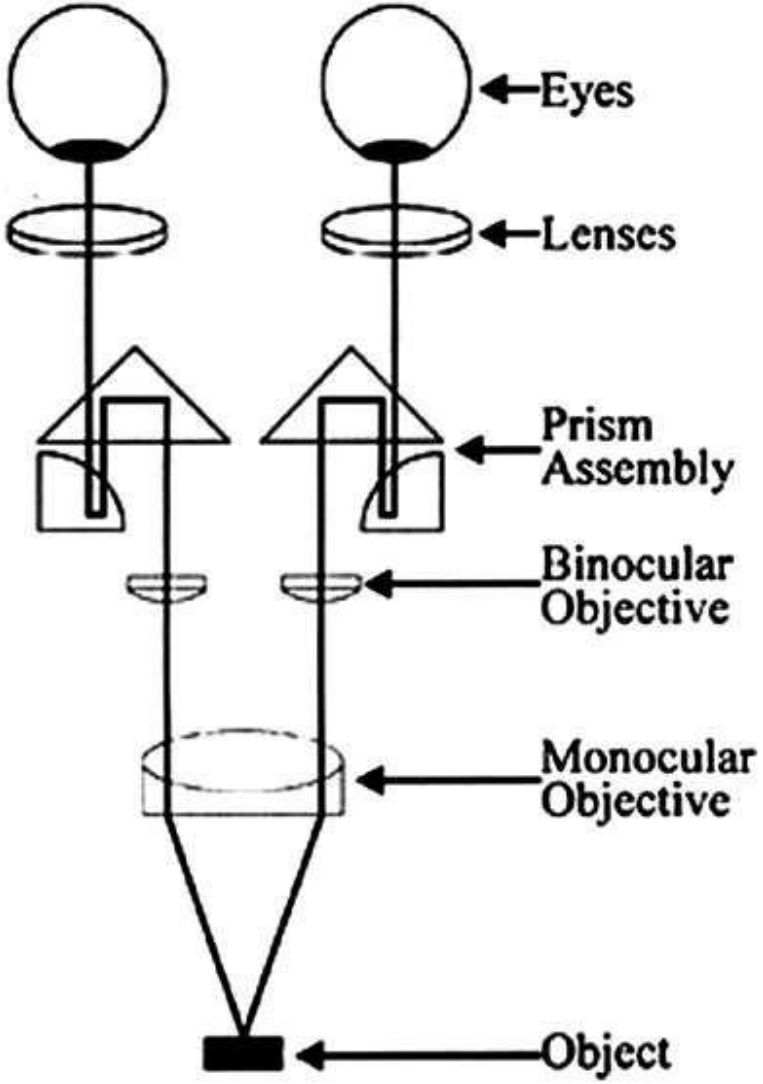
- The term microscopic means minute or very small, not visible with the eye unless aided by a microscope.

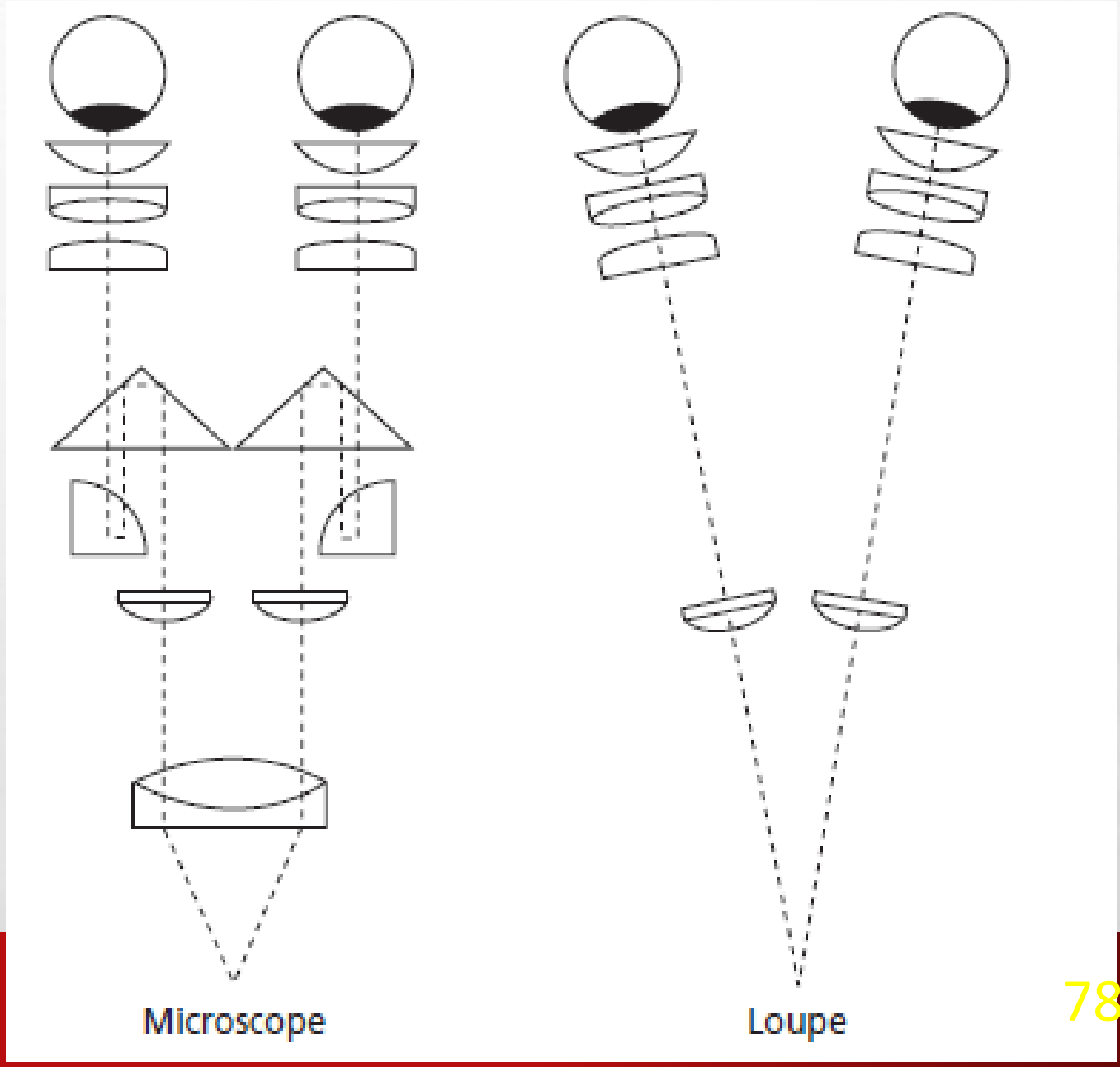
OPERATING MICROSCOPE

- A basic operative microscope is an optical instrument, mechanical, electrical or both, consisting of a combination of lenses which provide the surgeon with a stereoscopic, high quality magnified image of small structures.
- A microscope is a combination of lenses which forms a magnified image of the object in the field of view.

Microscopes use the application of the magnifying loupe in combination with a magnification changer and a binocular viewing system, so that it employs parallel binoculars for protection against eye strain and fatigue.

THE OPERATIVE MICROSCOPES PROVIDES GREATER MAGNIFICATION AND ILLUMINATION & FUNCTIONS AS AN EXTENSION OF LOUPES


Eyes
Lenses
Prism Assembly
Binocular Objective
Monocular Objective
Object


Microscope
Loupe

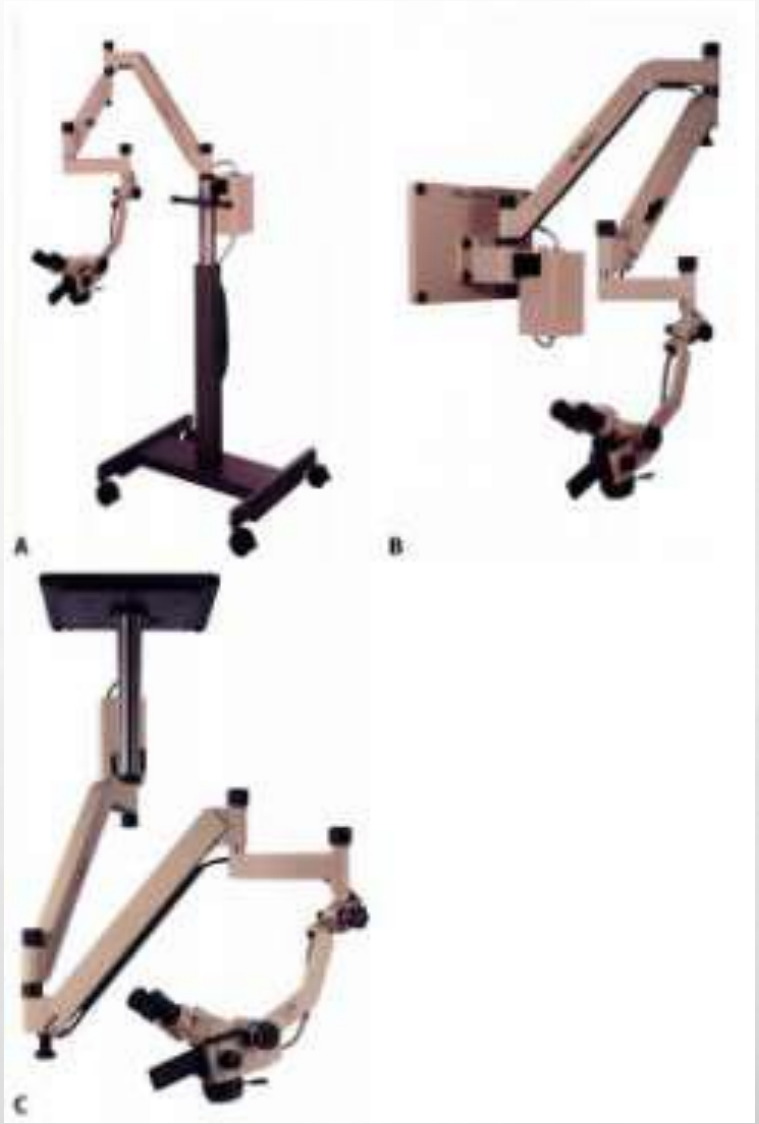
THE ANATOMY OF THE OPERATING MICROSCOPE

The operating microscope consists of three primary components:

- **the supporting structure,**
- **the body of the microscope, and**
- **the light source.**

THE SUPPORTING STRUCTURE

It is essential that the microscope be stable while in operation particularly when used at high power. The supporting structure can be mounted on the floor, ceiling, or wall



Wall Mounted microscope

Floor mounted microscope

Ceiling mounted microscope

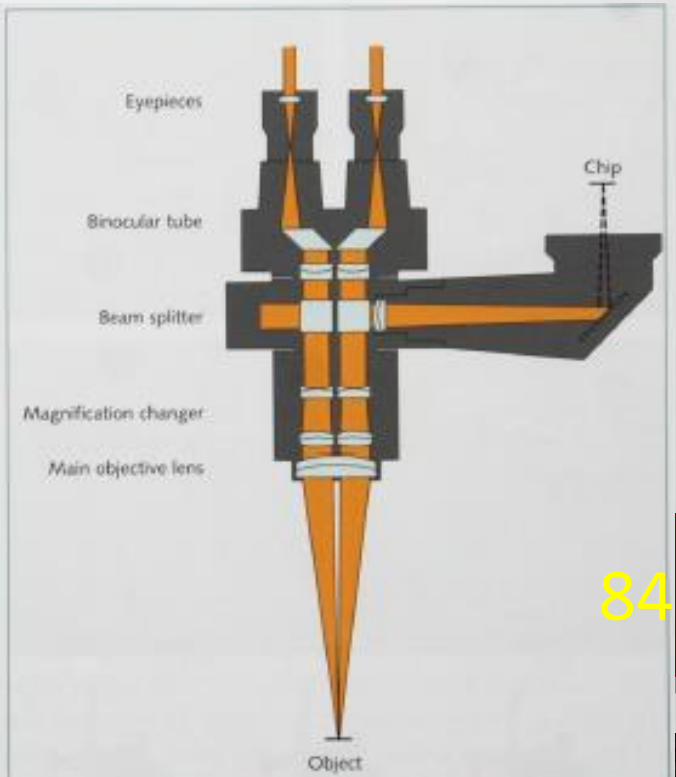
THE BODY OF THE MICROSCOPE

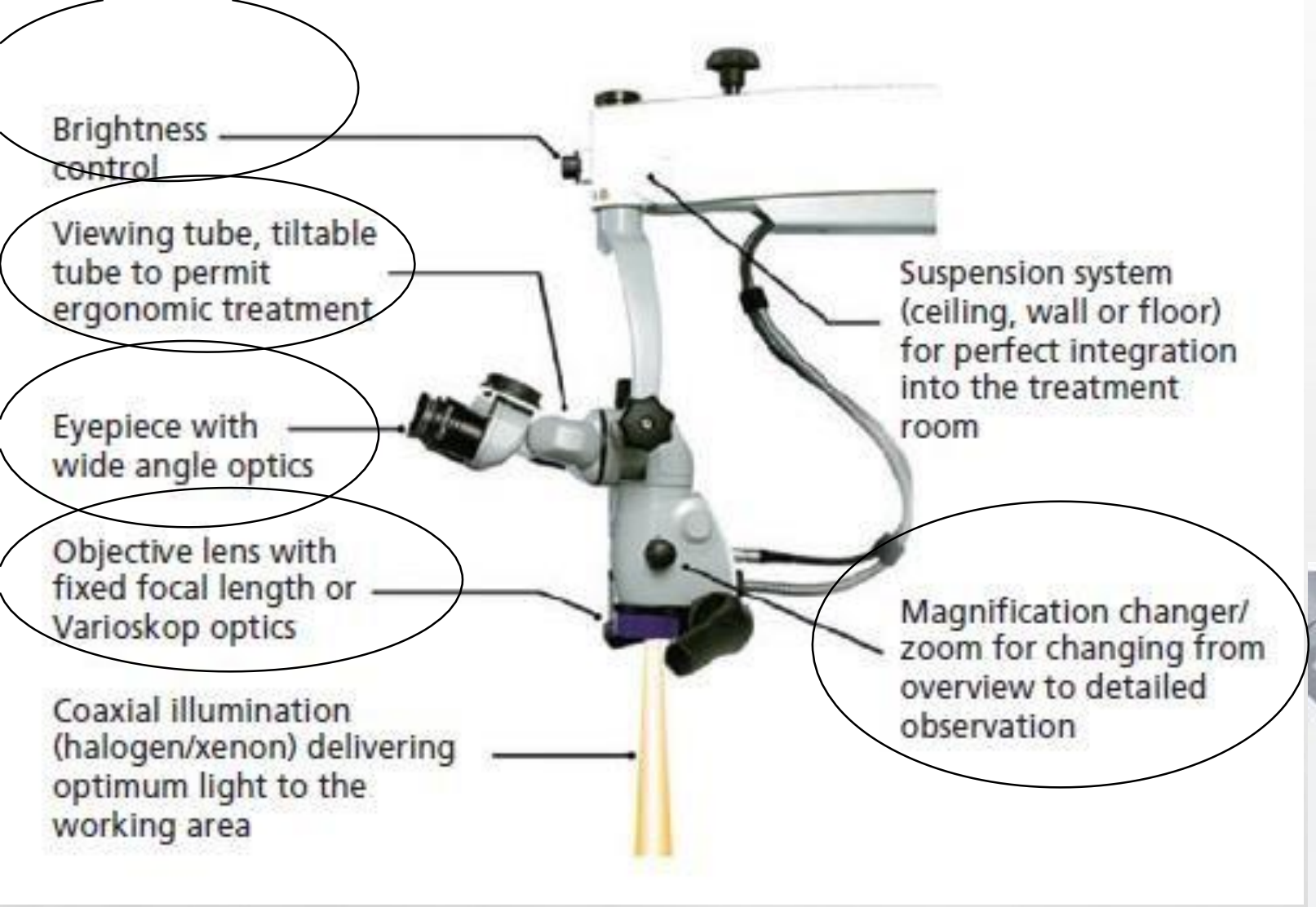
The body of the microscope is the most important component of the instrument , and it contains the lenses and prisms responsible of magnification and stereopsis.

The body of the microscope is made of

- eyepieces,
- binoculars,
- magnification changer factor, and
- The objective lens.

Fig. 32.10 Body of the microscope Global Protege™





(BURKHARDT & HÜRZELER 2000)

Three main components: optical components, the lighting unit,and a mounting system

EYEPIECES

- Generally availabale in magnification 6.3x, 10x, 12.5x, 16x, and 20x.
- The end of each eyepiece has a rubber cup that can be lowered for clinicians who wear glasses.
- Have adjustable diopter settings (adjust for accommodation i.e. The ability to focus the lens of the eyes) .
- Diopter setting also adjusts for refractive errors.
- Ranges from -5 to +5

BINOCULARS

- Function to hold the eyepieces
- Ipd set by adjusting the distance between two binocular tubes.

- Once diopter setting and IPD are set, they are not to be changed until the microscope is used by a surgeon of different optical requirements
- Comes in different focal lengths
- Available with straight, inclined or inclinable tubes


90
1.6


GLOBAL

SELECTION OF BINOCULAR IS CRITICAL

- Inclinable binocular are the best one.
- Inclinable tube provide the operator with additional postural comfort during long procedures but they are comparatively expensive.

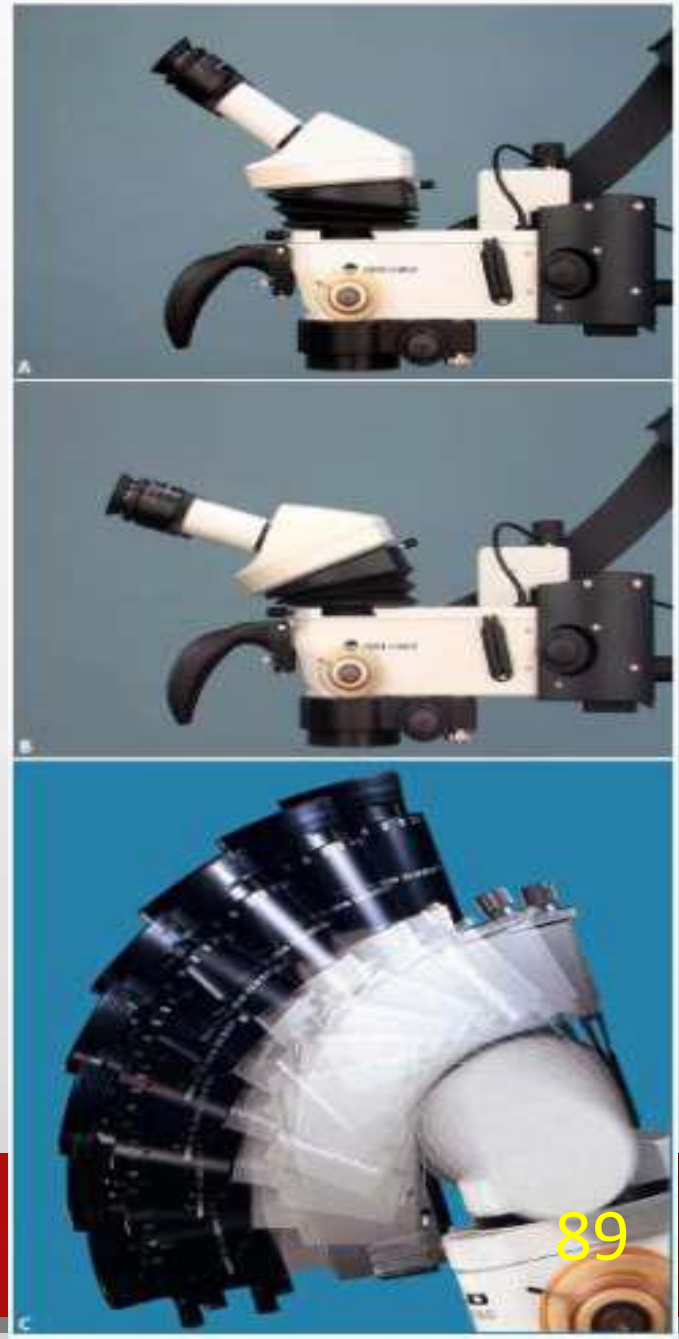


Fig. 32.12. **A-C.** Inclinable binoculars (Courtesy of Leica Microsystems, Heerbrugg, Switzerland).

MAGNIFICATION CHANGERS

- Available as either three/five/six step MANUAL CHANGERS OR POWER ZOOM CHANGER
- Series of lenses that move back and forth on a focusing ring to give a wide range of magnification
- Controlled by either a foot control or a manual override.
- Foot control allows the clinician to adjust magnification and focus without taking the hands or eye away from the surgical field.

MAGNIFICATION

The magnification possibilities of a microscope are determined by;

the power of the eyepiece,

the focal length of the binoculars,

the magnification changer factor, and the focal length of the

objective lens.

Diopter settings on the eyepieces adjust for accommodation and refractive error of the operator.

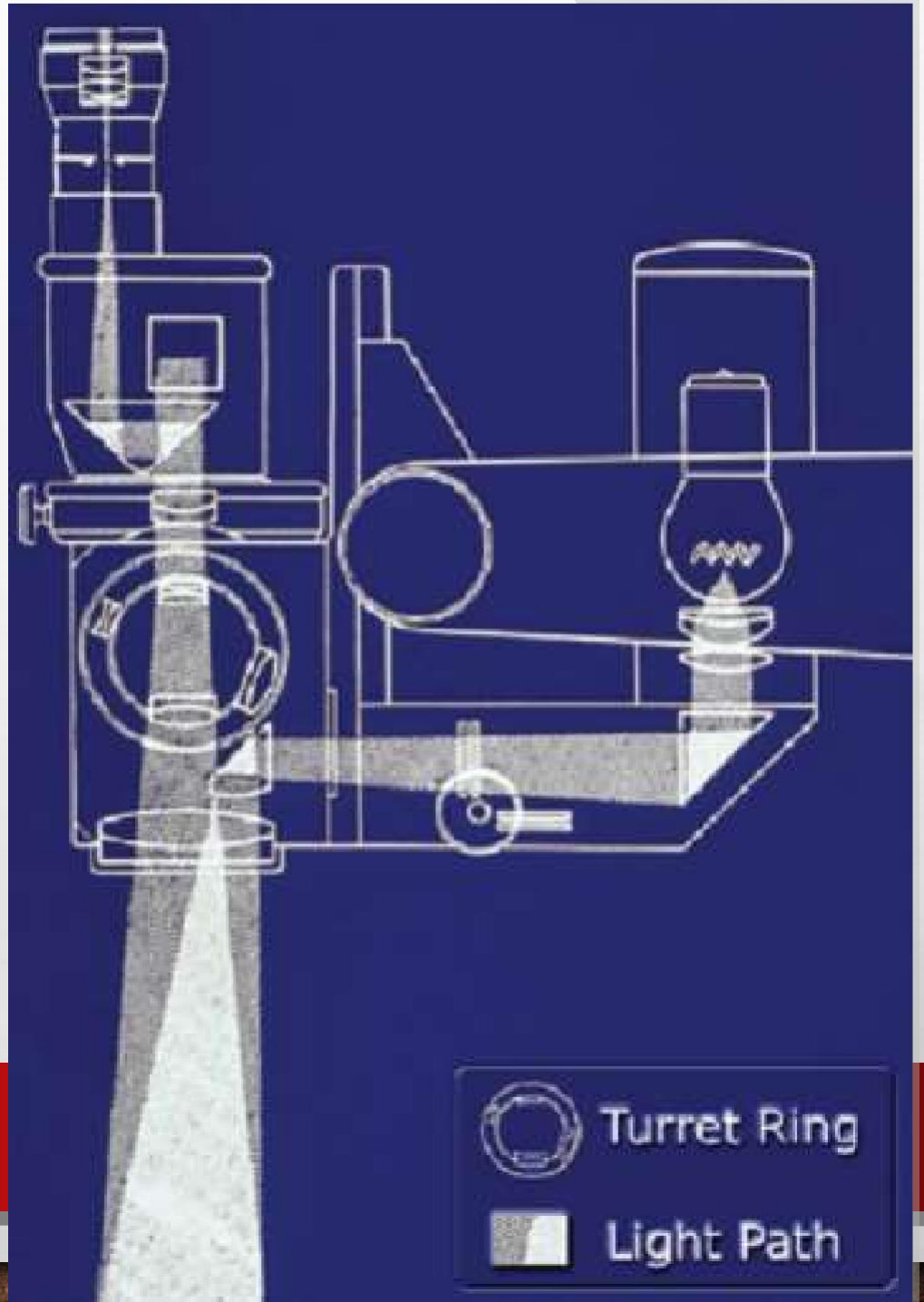
As in a typical pair of field binoculars, adjusting the distance between the two binocular tubes sets the interpupillary distance.

Binoculars are now available with variable inclinable tubes from 0° to 220° to accommodate virtually any head position.

Magnification changers are available in 3-, 5-, or 6-step manual changers, manual zoom, or power zoom changers.

Manual step changers consist of lenses that are mounted on a turret.

Cross-sectional diagram of a typical 5-step SOM head showing the turret ring in the body of the microscope.



The turret is connected to a dial, which is located on the side of the microscope housing.

The dial positions one lens in front of the other within the changer to produce a fixed magnification factor.

Rotating the dial reverses the lens positions and produces a second magnification factor.

Turning the dial rotates the turret ring inside the body of the SOM and creates five magnification factors.

The focal length of the objective lens determines the operating distance between the lens and the surgical field.

With the objective lens removed, the microscope focuses at infinity.

Many endodontic surgeons use a 200 mm lens, which focuses at about 8 in.

With a 200 mm lens there is adequate room to place surgical instruments and still be close to the patient.

Increase in the magnification, decreases the depth of field and field of view.

While this is a limitation for fixed magnification loupes, it is not a limiting factor with the DOM because of the variable ranges of magnification.

If the depth of field or field of view is too narrow, the operator merely needs to back off on the magnification as necessary to view the desired field.

Low range Magnification: (×2.5-×8).

Orientation of surgical field & allows wide inspection of the field of view

Mid range Magnification: (×8 - ×14).

Surgical procedure including curettage of the granulation tissue, resection of root tip, root –end preparation, & root –end filling.

High range Magnification: (×14 - ×30).

Observing the finer details & documentation purposes.

MAGNIFICATION DETERMINED BY :

- POWER OF THE EYEPIECE
- THE FOCAL LENGTH OF THE BINOCULARS
- THE MAGNIFICATION CHANGER FACTOR
- THE FOCAL LENGTH OF THE OBJECTIVE LENS

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

TM	Total magnification
FLB	Focal length of binocular
FLOL	Focal length of objective lengths
EP	Eypiece power
MV	Magnification value

$$\text{End magnification} = \frac{\text{Focal distance tube x Magnification changer factor x Eyepiece factor}}{\text{Focal distance lens}}$$

Mag. factor	0,4	0,6	1	1,6	2,5
Total magnification	3,4	5,1	8,5	13,6	21,25
Field of view (diameter)	64 mm	41 mm	25 mm	16 mm	10 mm
Image impression					

Glossary

OBJECTIVE LENS

- Nearest to the surgical field.
- Focal length of it determines distance between the lens and the surgical field
- Available with focal length ranging from 100 to 400mm
- A 200-250mm objective lens is recommended.

  - **Reason :**
  - There is enough room to place surgical instruments and still be close to the patient.

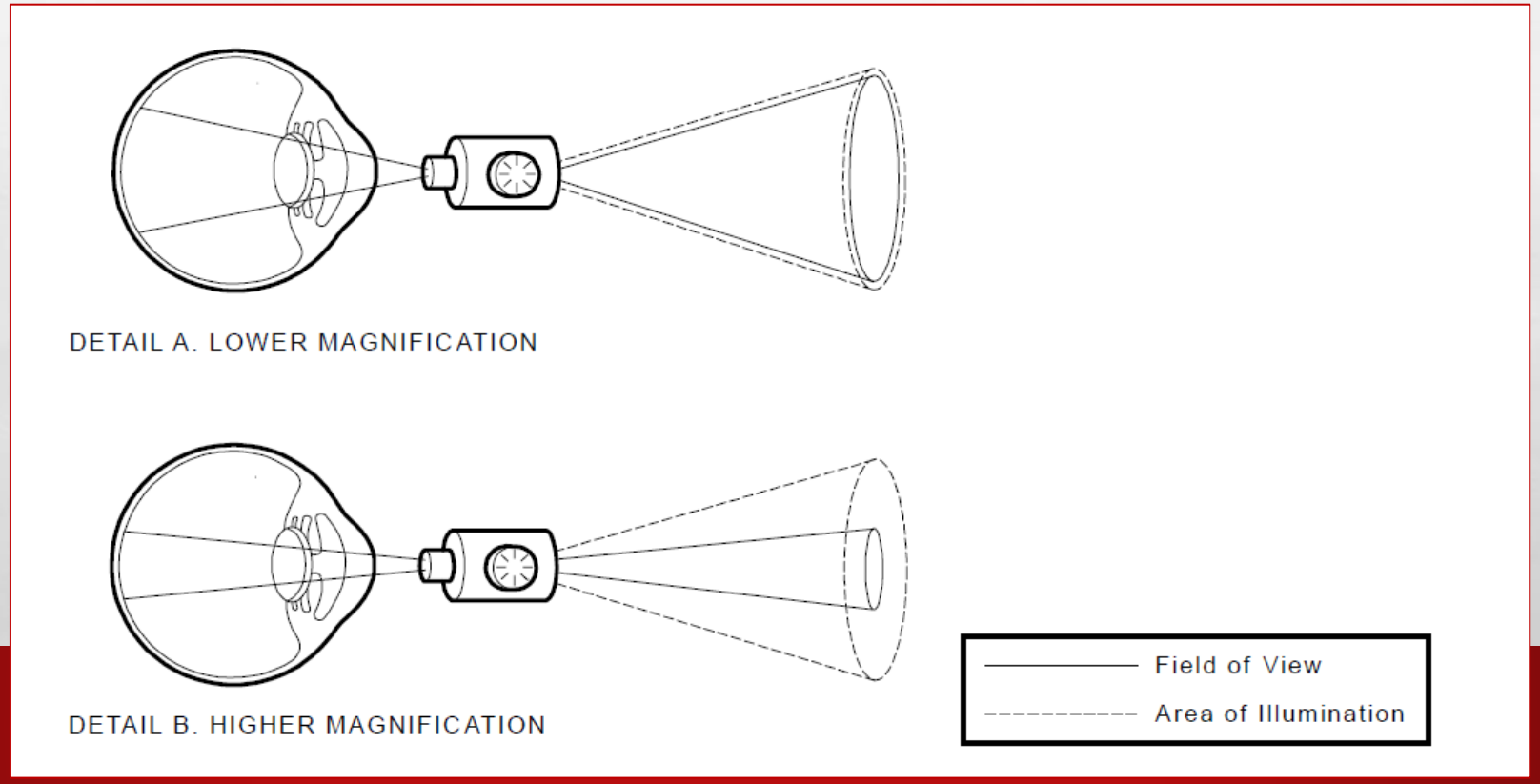
LIGHT HOUSE (ILLUMINATION)

- Microscope illumination can be of two varieties.
- Originally, microscopes had only externally mounted independent illuminators transmitting light but creating some shadows and unable to get down deep into cavities.

CO AXIAL ILLUMINATION

- This r bulb is re-r
  viewi ed down thr
  used
- No sh
- Unde ight will be e in
  micro on the amo m
  the m

- However, changes made in the magnification of the microscope do, increase or decrease the amount of light which will be projected back through the microscope and onto the retina of the eye of the viewer.



- Therefore an increase in magnification is accompanied by a decrease in illumination
- Several manufacturers, however, have gone to great efforts to minimize this by using ultra-wide, multi-coated optics.
- Therefore, this effect will be difficult to notice, if not impossible.

RECOMMENDED LIGHTING

- The light source can be powered by a halogen light bulb or by a xenon light.

- Some halogen lights provide an artificial yellow light, which is not ideal for documentation, so any product must be carefully selected.
- Intensity can be controlled by a rheostat and cooled by fan.
- Additional light can be feasible by boosting the current to the bulb ,

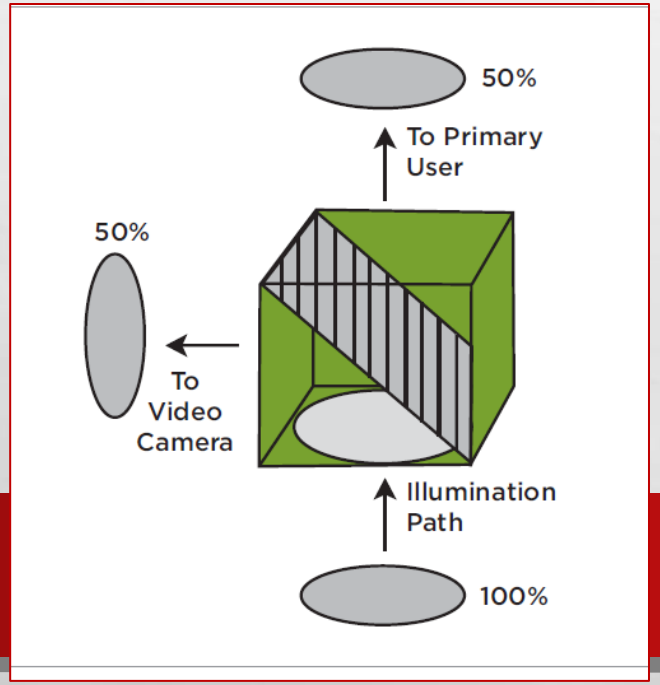
  but shortens its life.

ACCESSORIES

- BEAM SPLITTER
- AUXILIARY ILLUMINATION
- FILTERS
- EYEPIECE WITH RETICLE FIELD
- MONITORS/ LCD SCREENS
- ASSISTANT SCOPE
- PISTOL GRIPS
- CINE OR PHOTOGRAPHIC ADAPTERS

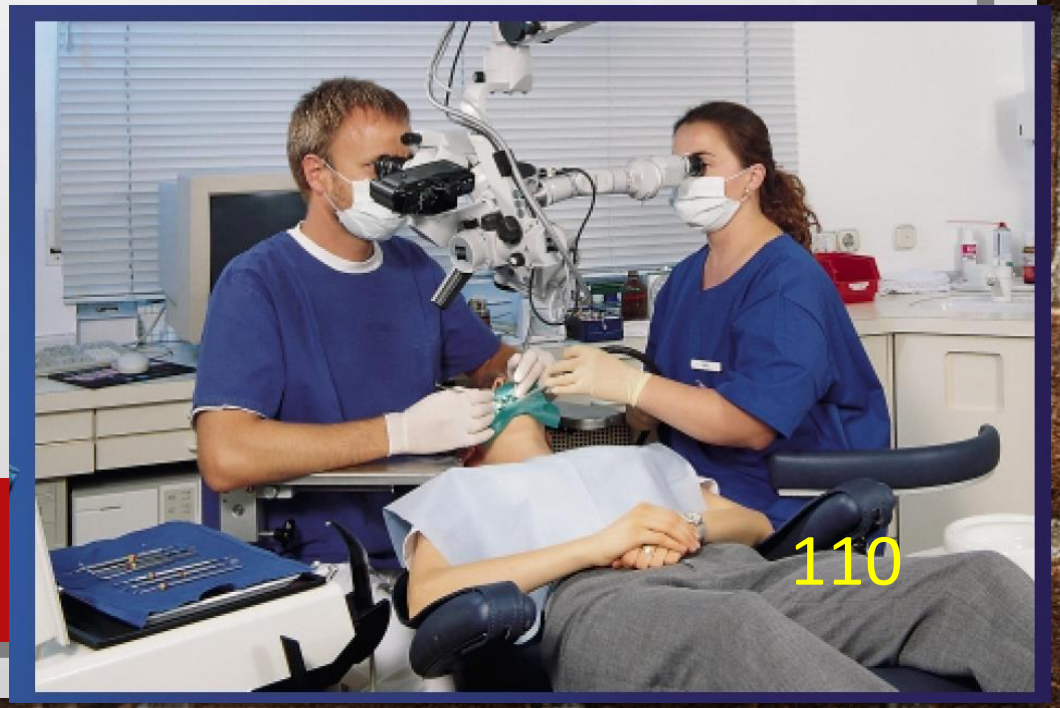
BEAM SPLITTER :

- Function is to supply light to accessories such as a camera or an auxiliary observation tube.
- 50:50 beam splitter along with other configuration available



ASSISTANT SCOPE/ CO-OBSERVATION TUBE

- Useful to assistant.
- Also better to assistant than looking at monitor.
- Can be monocular or binocular.



- Photo adapters attach camera & video camera to beam splitter

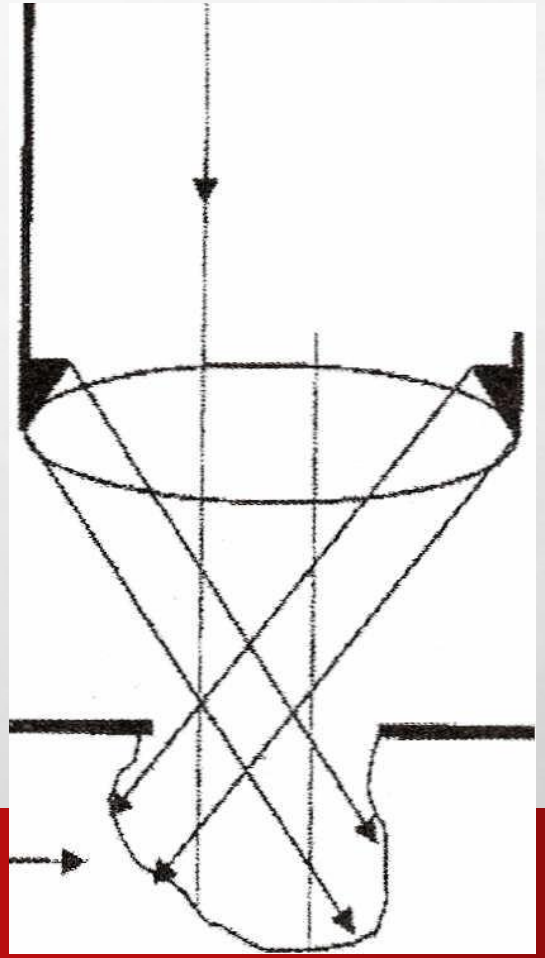
- Photo or cine adapters also provide the necessary focal length so that the camera records an image with the same magnification and field of view as seen by the operator

- Camera requires more light to capture image.

- In contrast the video cameras are extremely sensitive, low light is sufficient for documentation in form of a video or a video print.

AUXILIARY ILLUMINATION

- In some advanced models Auxiliary illumination is being used to decrease shadowing when changing the viewing angle.



FILTERS

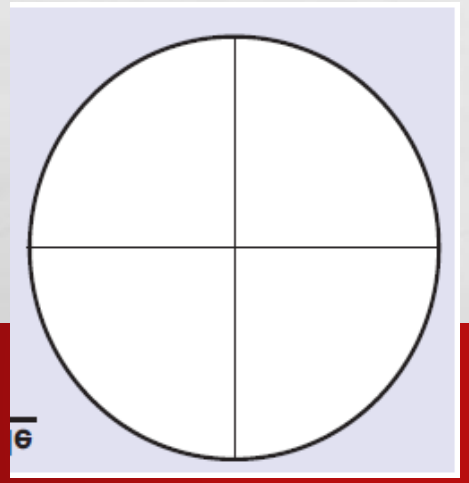
- Green for surgical procedures - it removes the confounding red reflections of the blood

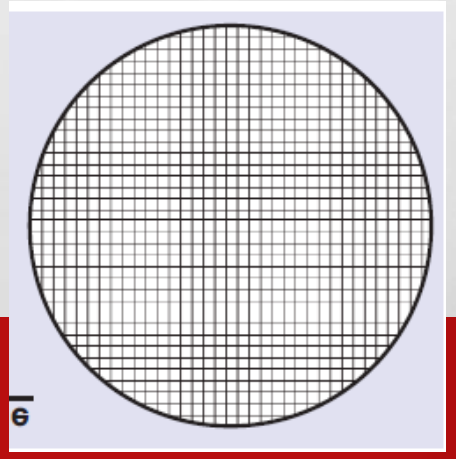
- Orange filter – prevents premature setting of composite resin.

EYEPIECE WITH RETICLE FIELD

- An eyepiece reticle is a glass disc with a pattern on it that fits at the optical plane inside a microscope eyepiece.

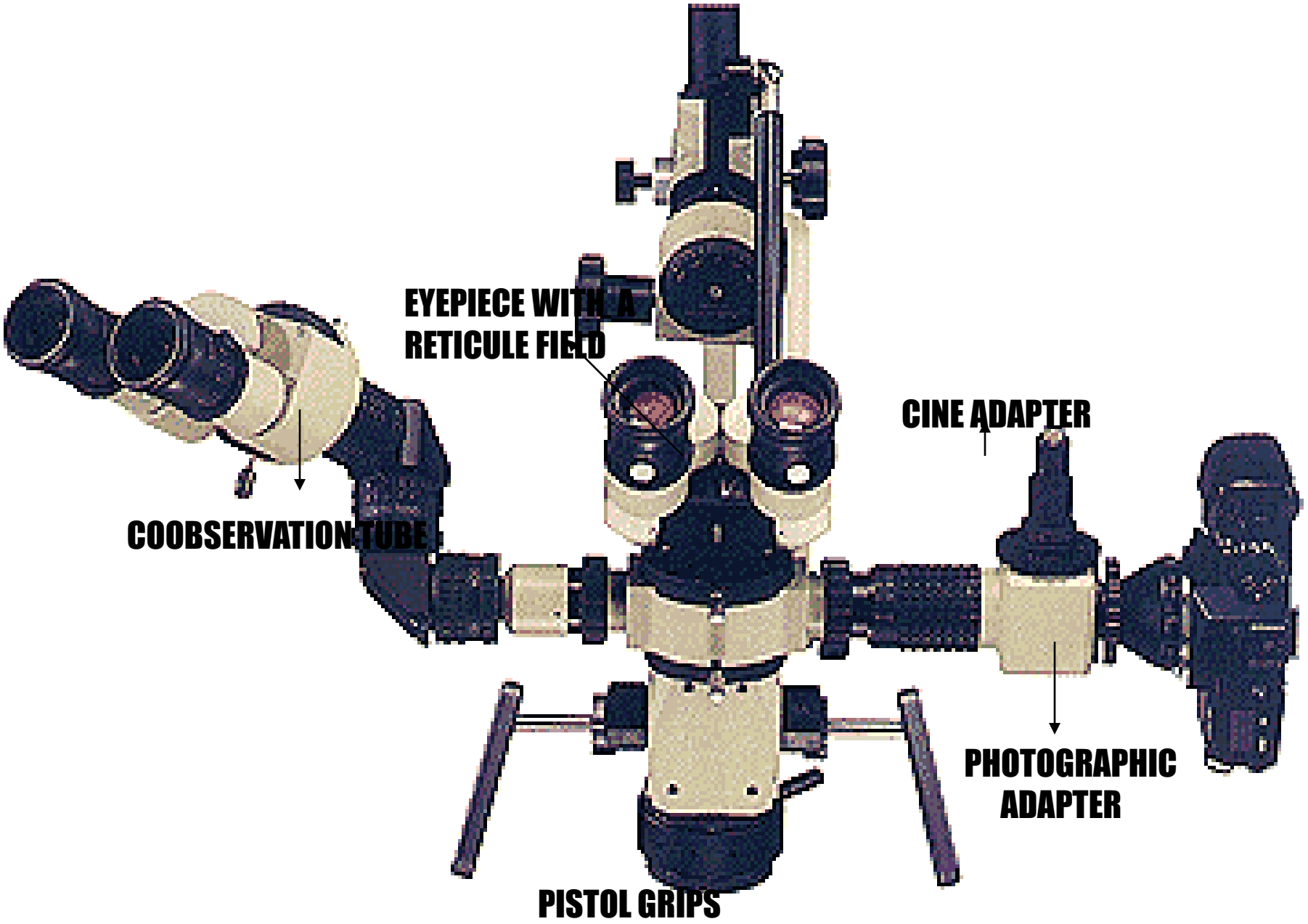
- An eyepiece with a reticle field can be substituted for a conventional eyepiece and can prove an invaluable aid for alignment during videotaping and 35 mm photography.



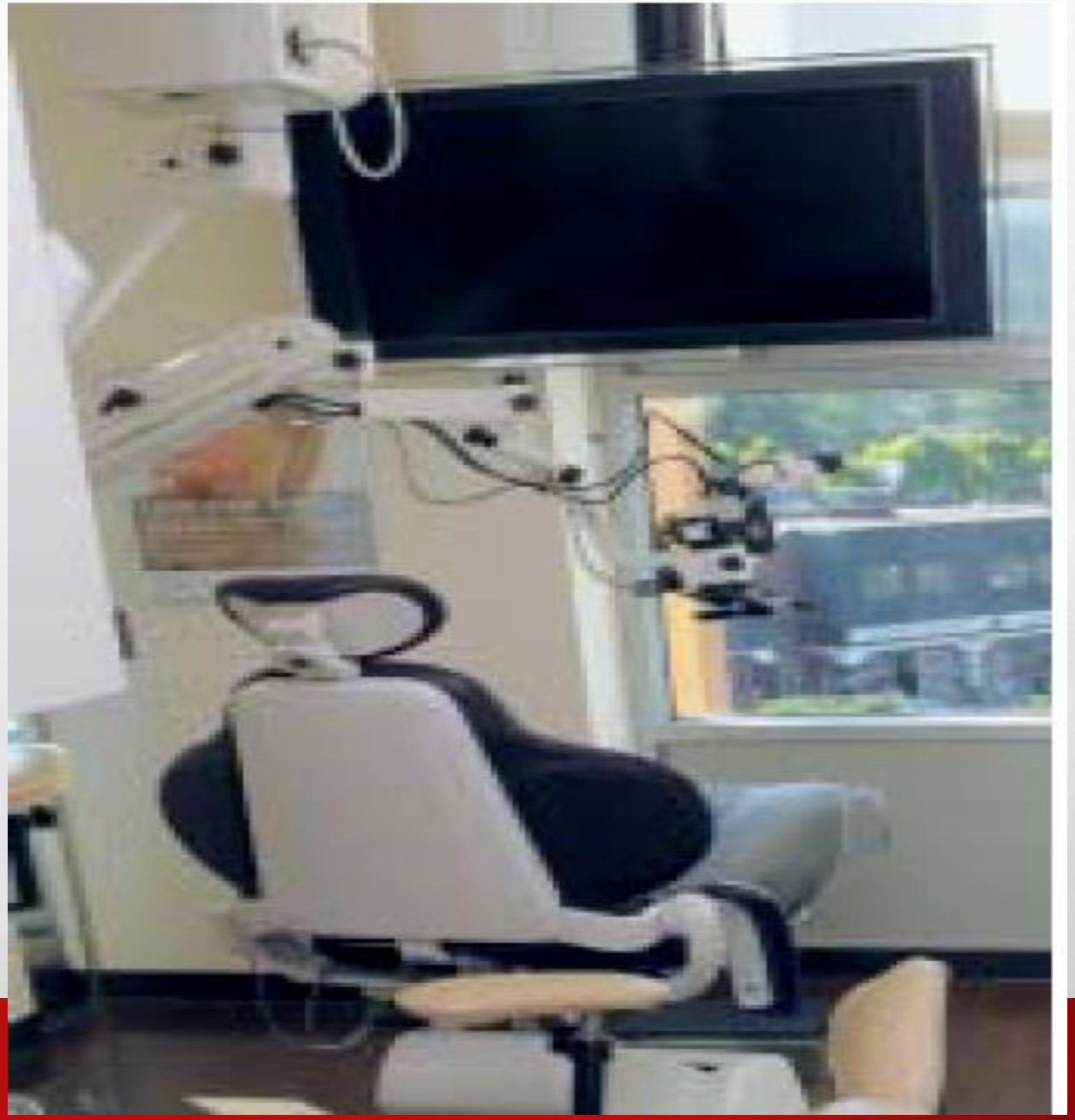


PISTOL GRIP OR BICYCLE STYLE HANDLES CAN BE ATTACHED

Zeiss OPMI PROergo (Carl Zeiss Surgical Inc., Thornwood, NY, USA) with magnetic clutches, power zoom, and power focus on the handgrips.


EYEPIECE WITH A RETICULE FIELD
CINE ADAPTER
COOBSERVATION TUBE
PHOTOGRAPHIC ADAPTER
PISTOL GRIPS

LCD SCREEN



DOCUMENTATION

- Documentation is useful for

Patient education,

Medicolegal documentation,

Reports to referring dentist, & insurance companies

- Ability to produce quality videos & slides is proportional to the quality of magnification & illumination systems.

PRE REQUISITES FOR THE USE OF THE MICROSCOPE IN NON-SURGICAL ENDODONTICS

PRE REQUISITES FOR THE USE OF THE MICROSCOPE IN NON-SURGICAL ENDODONTICS

- Rubber dam placement
- Indirect view and patient head position
- Mouth mirror placement
- Some key instruments

RUBBER DAM PLACEMENT

- While using operating microscope rubber dam becomes a necessitiy.
- Most of the procedure is performed using a mirror and indirect vision
- If rubber dam is not used then the mirror would fog immediately from the exhalation of the patient.
- Thus, the powerful microscope magnification and illumination would be rendered totally useless

- To absorb reflected bright light and to accentuate the tooth structure, it is recommended to use blue or green rubber dams

INDIRECT VIEW AND PATIENT HEAD POSITION

- It is nearly impossible to view the pulp chamber directly under the microscope

- Instead, the view seen through the microscope lens is a view reflected by way of a mirror.

- To maximize the access and quality of the view by this indirect means, the position of the patient (especially the head position) is important

- The optimum angle between the microscope and the mirror is 45, and the clinician should be able to obtain this angle without requiring the patient to assume an uncomfortable position.

MOUTH MIRROR PLACEMENT

- Mirror must be placed away from the tooth within the confines of the rubber dam.
- Use of flexi mirrors is suggested.
- If the mirror is placed close to the tooth, then it will be difficult to use other endodontic instruments
- Readjusting the mirror will necessitate refocusing of the microscope, making the entire operation time-consuming and, at times, frustrating.

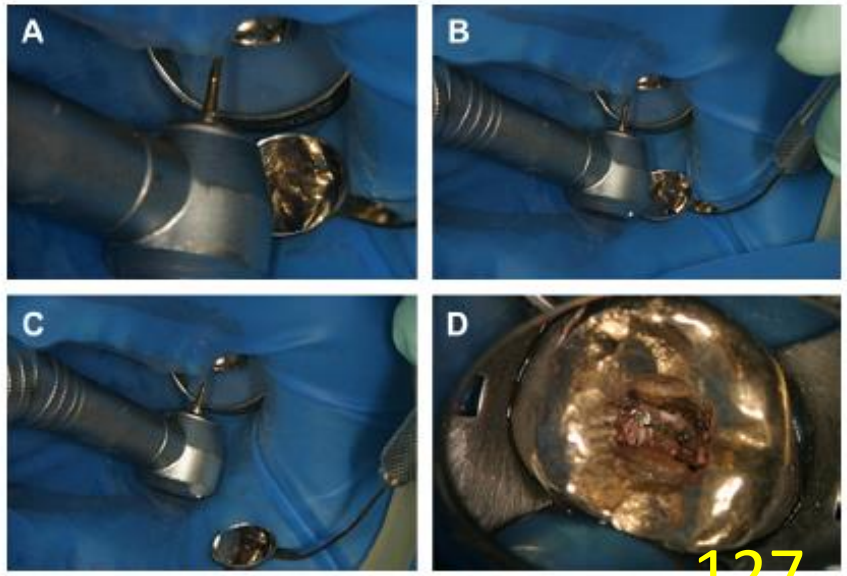
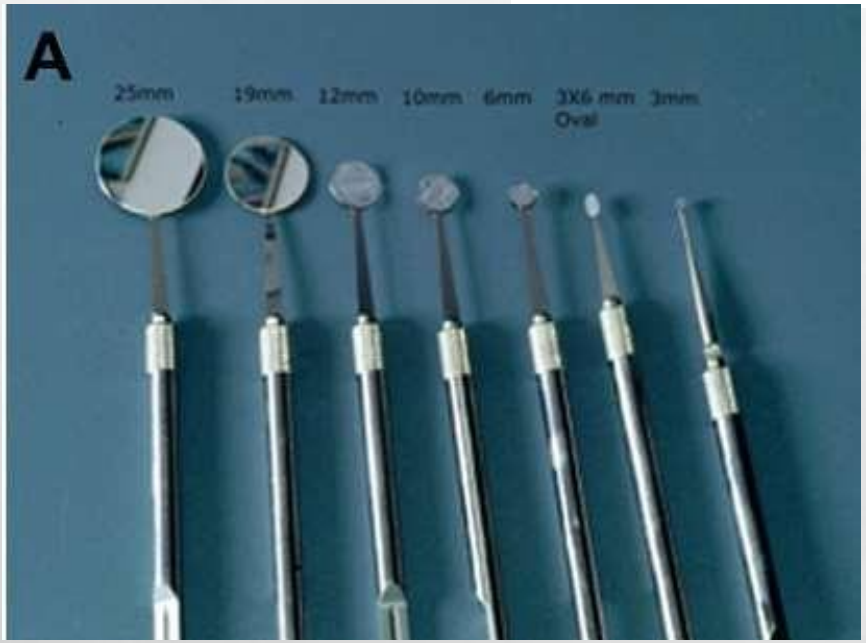
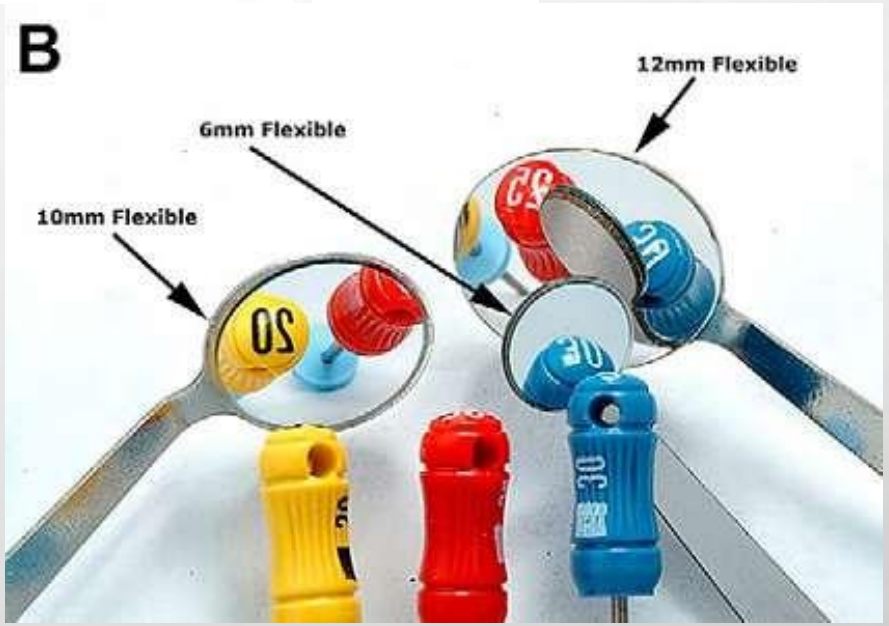


Fig. 23. (*A*) Inadequate level of magnification and mirror position. (*B*) Adequate magnification to position mirror. (*C*) Adequate mirror position. Notice the flex of the mirror staff. (*D*) Adequate magnification level with clear view of the operatory field.





(A) A selection of flexible mirrors in different sizes and shapes.

(B) Detail of highly reflective mirrors with flexible and flat shafts.

MICROSURGICAL INSTRUMENTS

- Dr.Gary carr – designer and manufacturer of first generation of microsurgical endodontic instruments.

- Some microsurgical instruments are miniature versions of traditional surgical instruments.

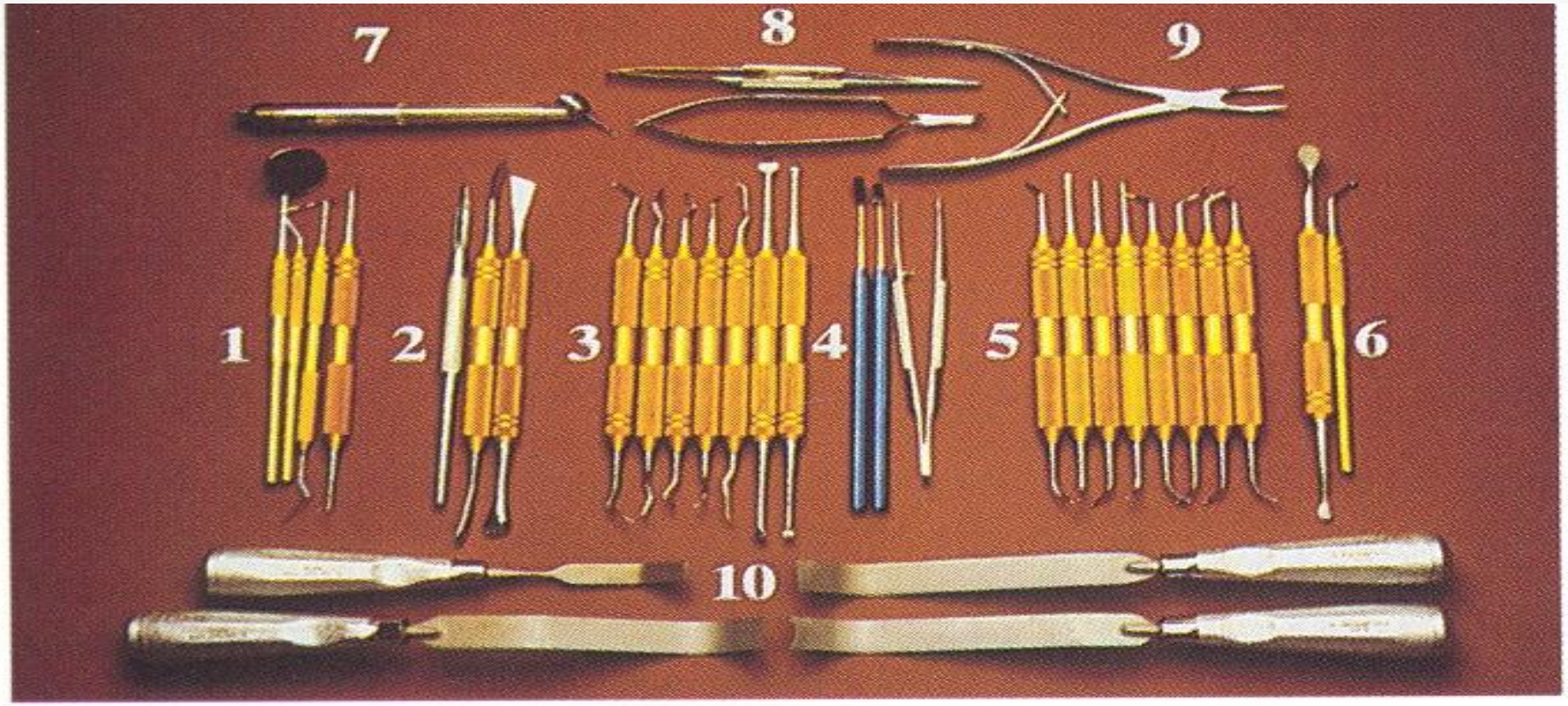


Fig. 4–1 Endodontic microsurgical instrument setup used in the Department of Endodontics at the University of Pennsylvania School of Dental Medicine. The objects are grouped as follows: *1,* Examination instruments; *2,* incision and elevation instruments; *3,* curettage instruments; *4,* inspection instruments; *5,* retrofilling carrier and plugging instruments; *6,* miscellaneous instruments; *7,* osteotomy instruments; *8,* suturing instruments; *9,* tissue removal instruments; *10,* tissue retraction instruments.

Classified as-

Examination instruments:

mirror, periodontal probe, endodontic explorer

INSPECTION INSTRUMENTS

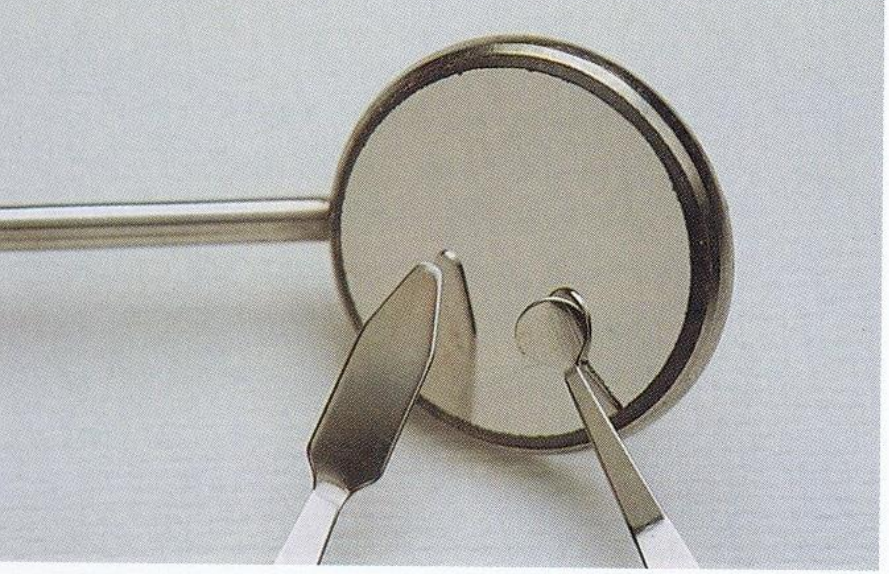


Fig. 4–11 Stainless steel surface micromirrors. Round (3 mm in diameter) and modified rectangular; size comparison with regular dental mirror.

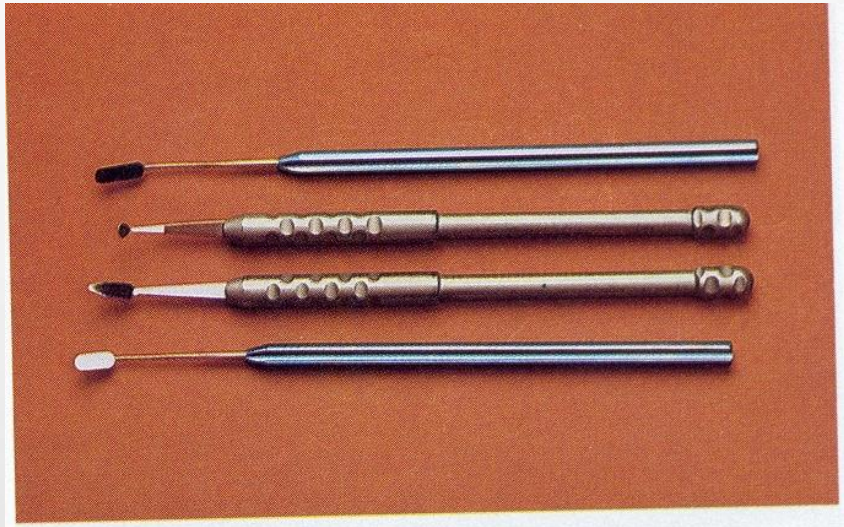
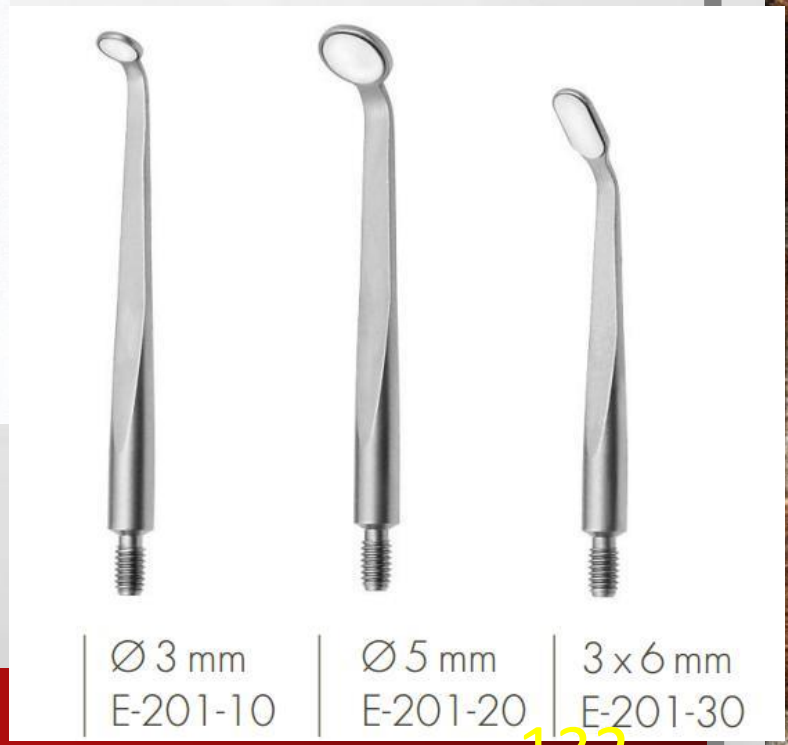


Fig. 4–10 Micromirrors with sapphire surfaces *(center)* and stainless steel surfaces (*top* and *bottom* with blue handles).



Thls new rhodium micromirror is extremely hard, durable, scratch resistant and autoclavable, wlth unsurpassed brightness

MICRO EXPLORER

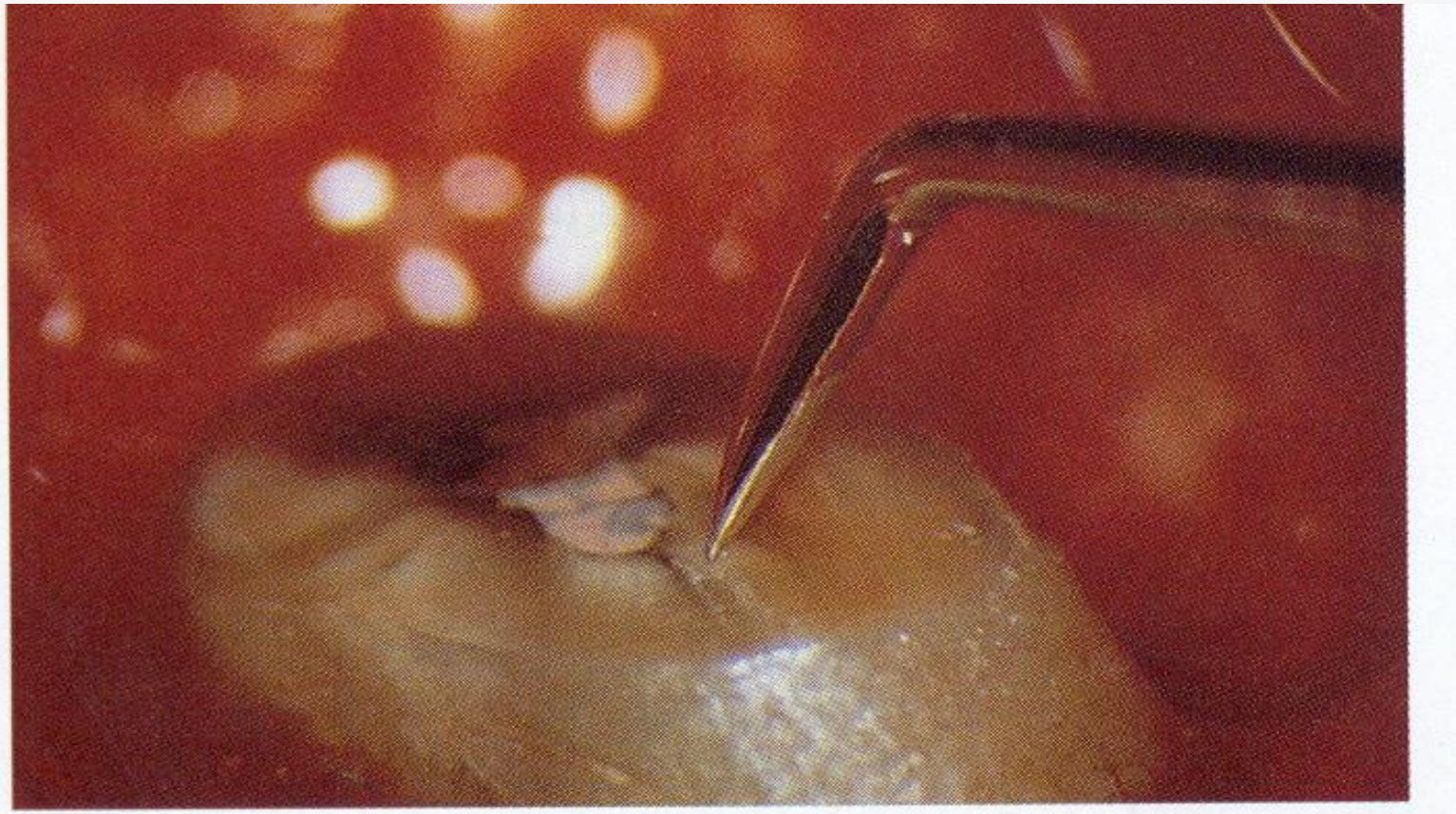
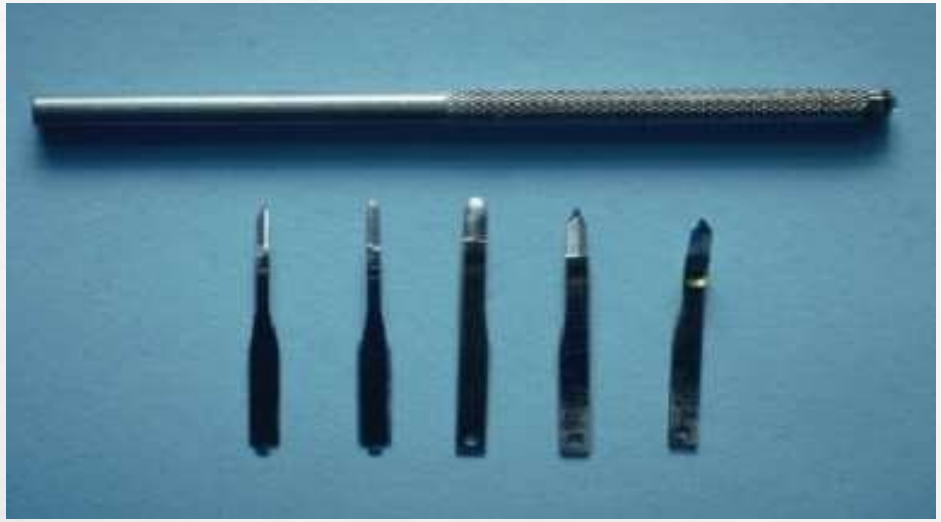


Fig. 4–3 The tip of the microexplorer can be used to search for a leak in a root end filling, to distinguish a canal or craze line from a microfracture line, and to point to the origin of a leak for explanation and documentation purposes (×16).

INCISION AND ELEVATION INSTRUMENT

15C blade, handle, soft tissue or pereosteal elevators



A variety of micro scalpels sized 1-5 used for precise incision.

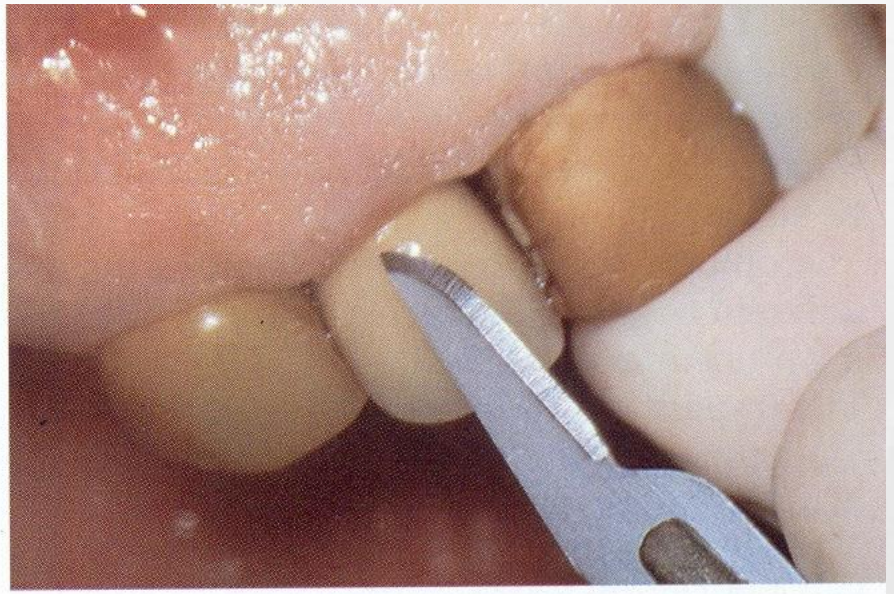


Fig. 4-5 15C blade in use.

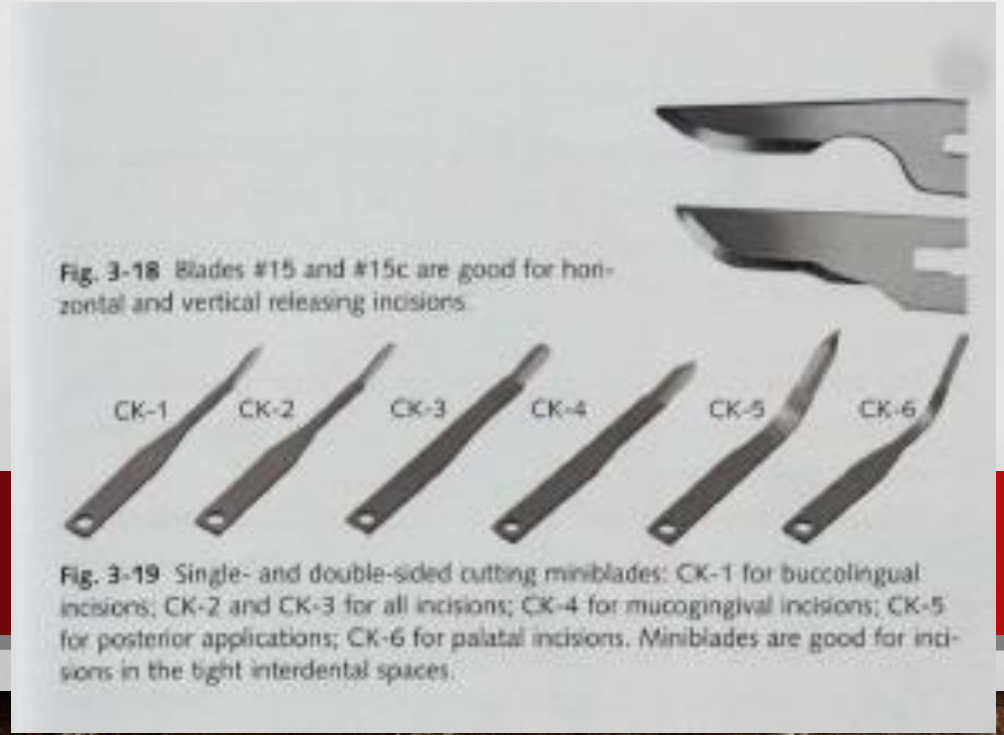


Fig. 3-18 Blades #15 and #15c are good for horizontal and vertical releasing incisions.

Fig. 3-19 Single- and double-sided cutting miniblades: CK-1 for buccolingual incisions; CK-2 and CK-3 for all incisions; CK-4 for mucogingival incisions; CK-5 for posterior applications; CK-6 for palatal incisions. Miniblades are good for incisions in the tight interdental spaces.

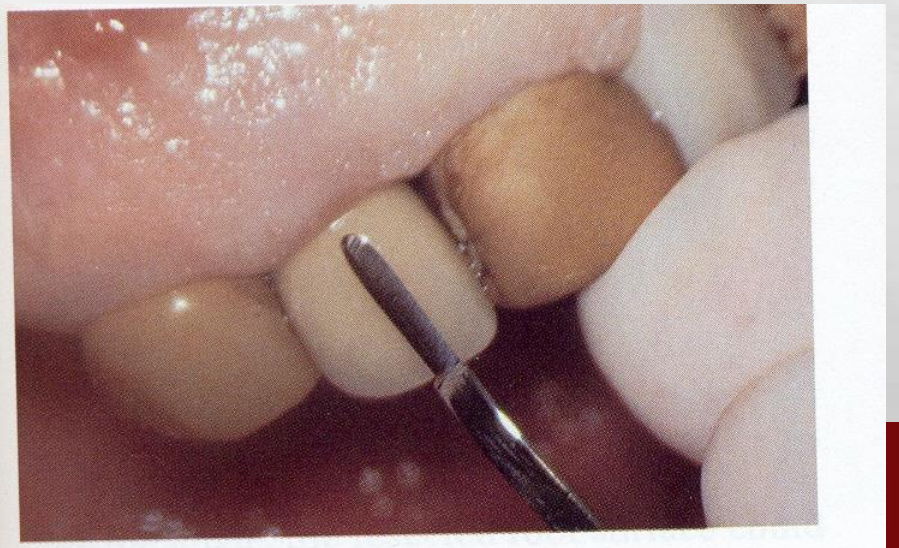


Fig. 4-6 Microblades are used when the interproximal spaces are very tight.

CURETTAGE INSTRUMENTS

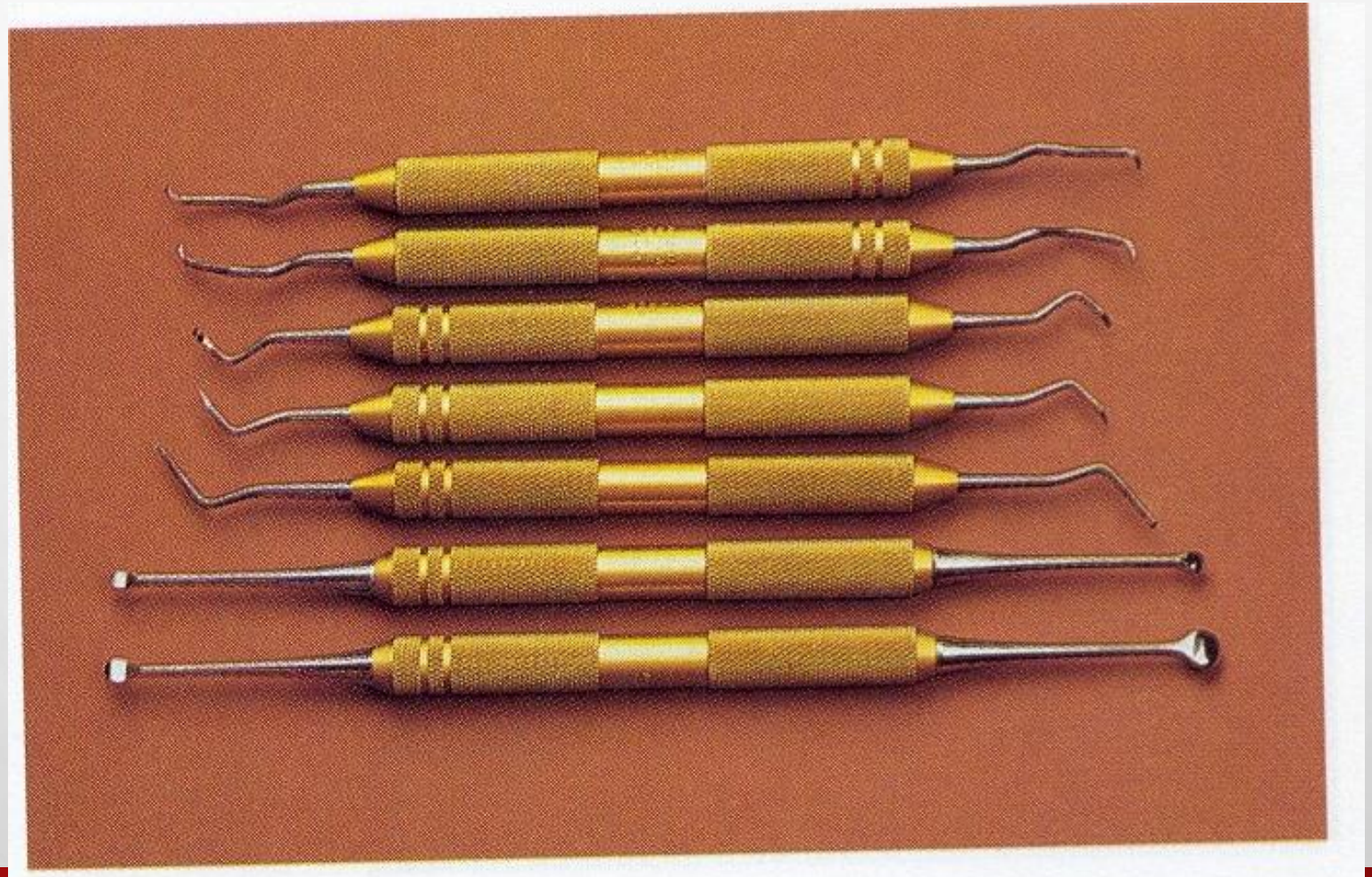


Fig. 4–8 Curettage instruments. Specially designed minicurettes *(top five)*. Minimolten curettes *(bottom two)*.

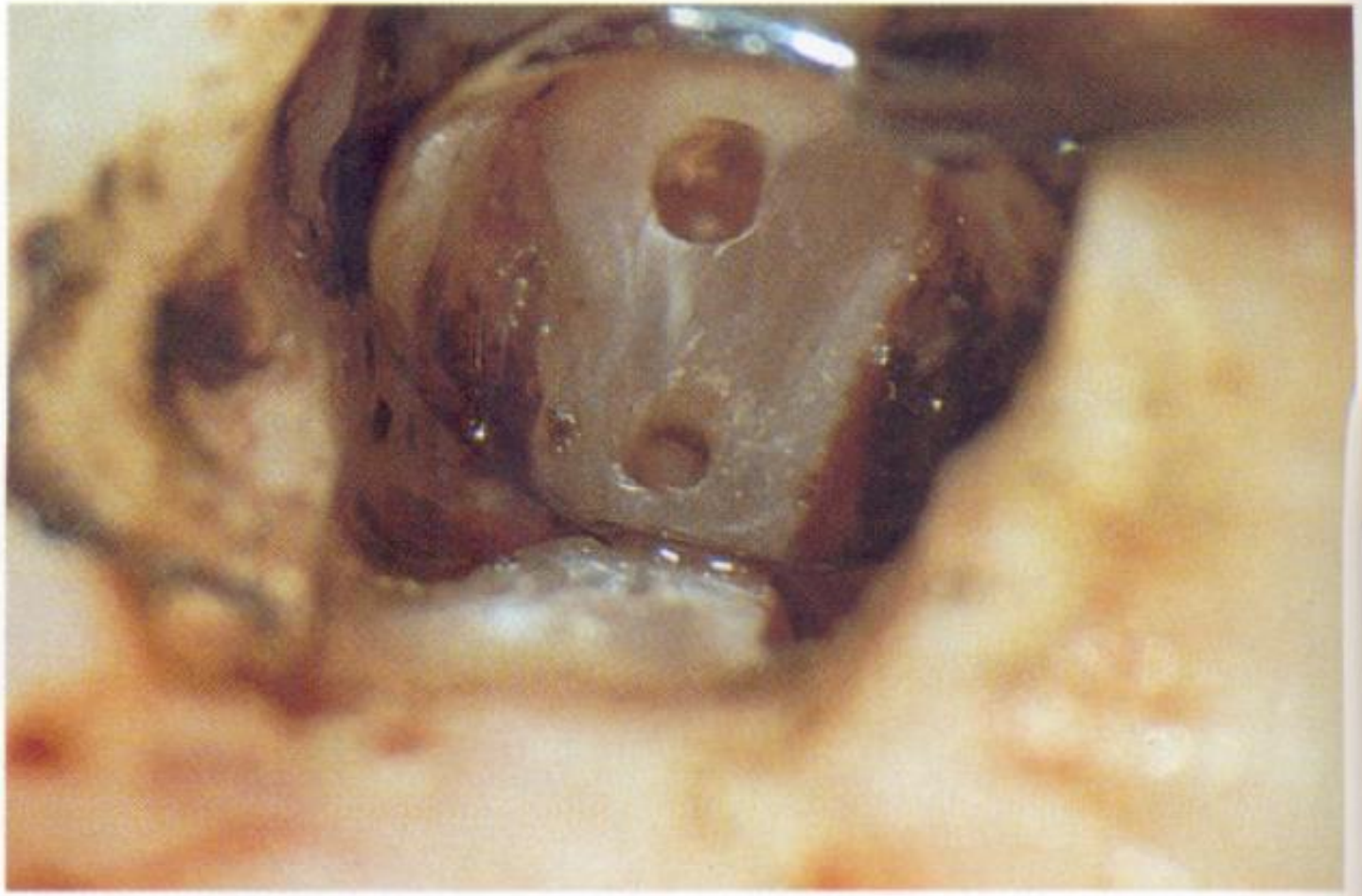


Fig. 4–12 Round micromirror reflecting the entire surface of the resected root of a maxillary anterior root.

RETRO FILLING CARRIER AND PLUGGING INSTRUMENTS

Fig. 4–13 Retrofilling carriers. One has a straight blade; the other has a 45-degree angled blade for hard to reach areas.

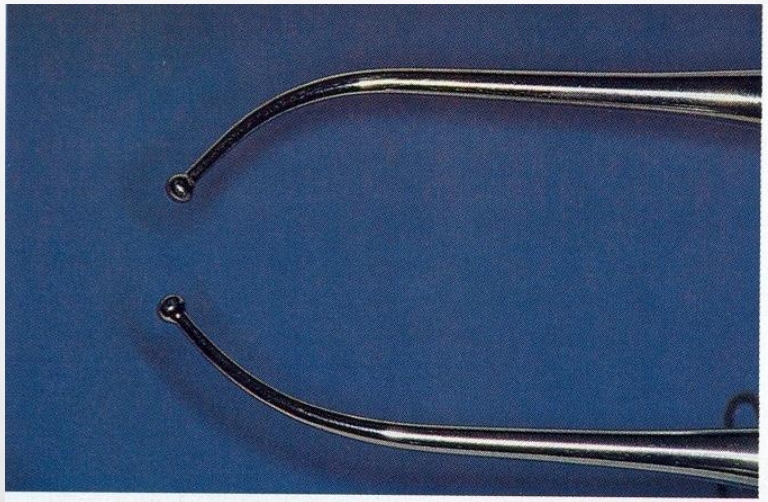


Fig. 4–15 Magnified view of ball burnisher end of retrofilling carriers shown in Fig. 4–13.

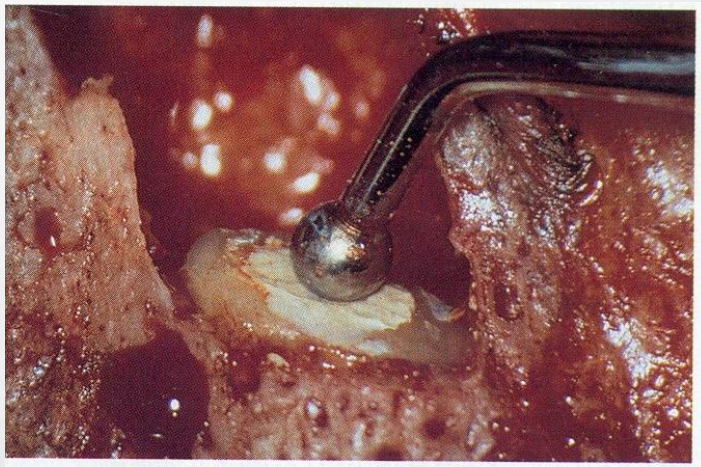


Fig. 4–16 Retrofilling material (SuperEBA) is carried to the retro-preparation with the flat surface of the retrofilling carrier and condensed with the ball burnisher end of the carrier.

MISCELLANEOUS INSTRUMENTS

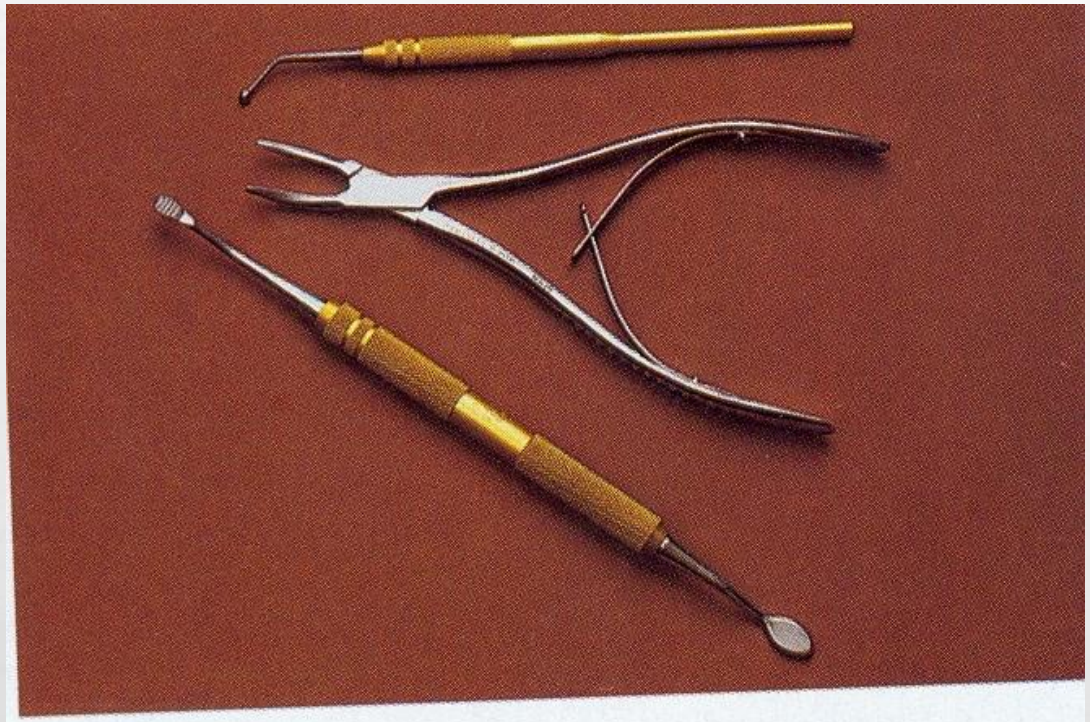


Fig. 4–21 Miscellaneous instruments used in endodontic m
crosurgery. *Top,* Large ball for facilitating condensation of larg
areas of calcium sulfate. *Middle,* Minirongeur for removir
granulation tissue from the bone crypt. *Bottom,* Double-ende
bone file for smoothing rough edges.

Fig. 4–22 Miniaturized rongeur beaks shown in Fig. 4–21. The
thin beaks are ideal for removing tissue from small osteoton
sites.

Osteotomy instruments

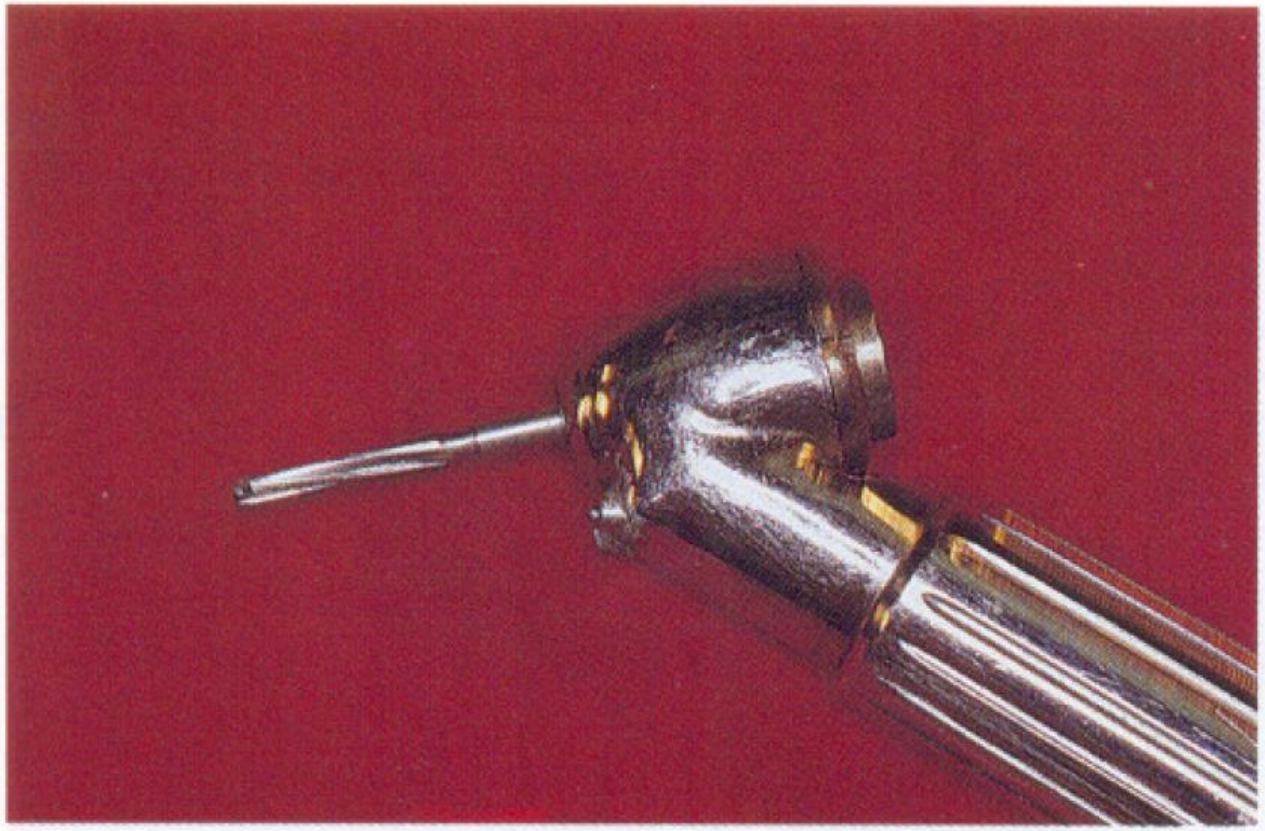


Fig. 4-23 Osteotomy instrument. The impact Air 45 handpiece is designed to irrigate the surgical site while ejecting air from the back of the handpiece, eliminating water splatter.

SUTURING INSTRUMENTS

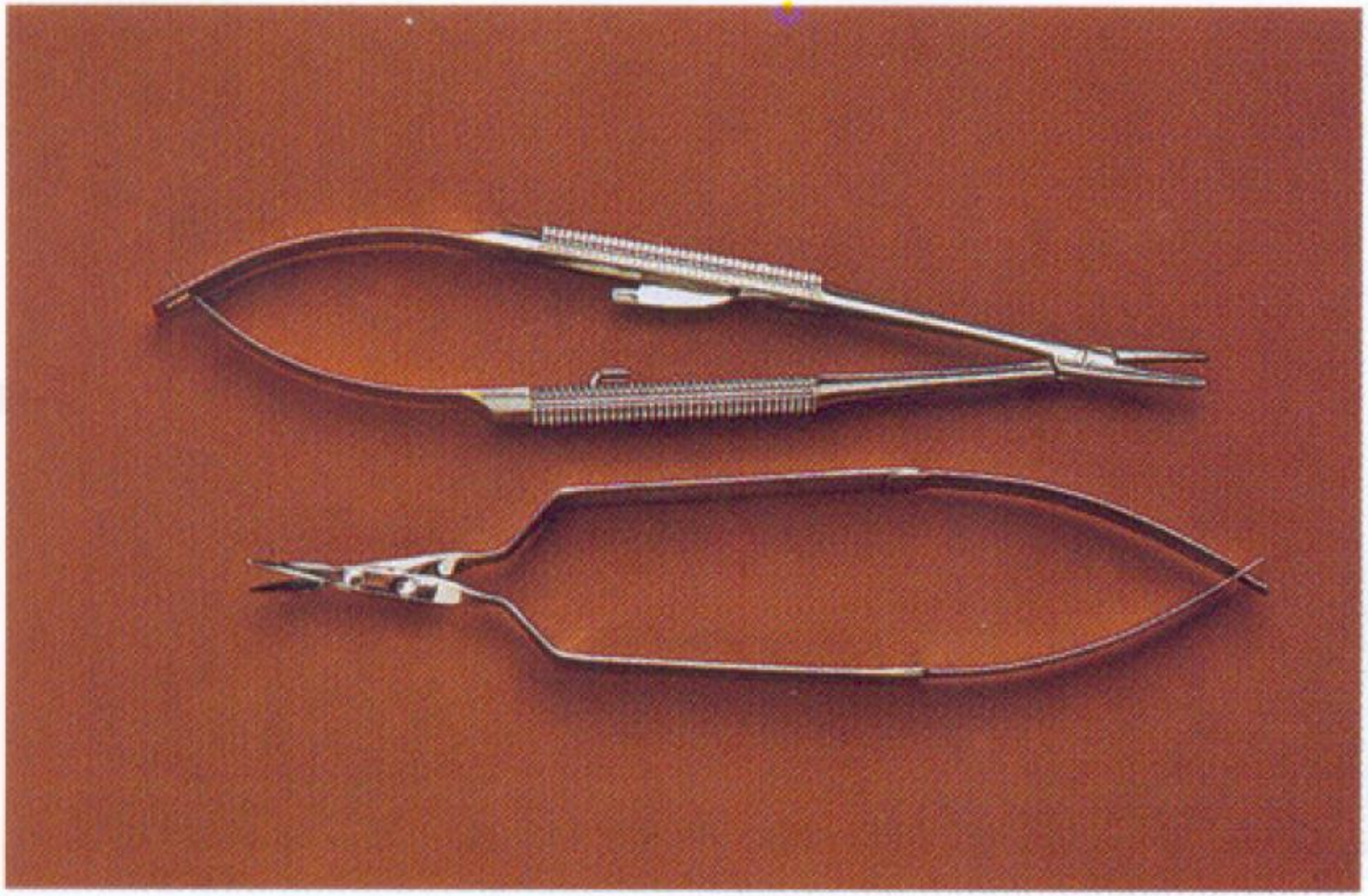
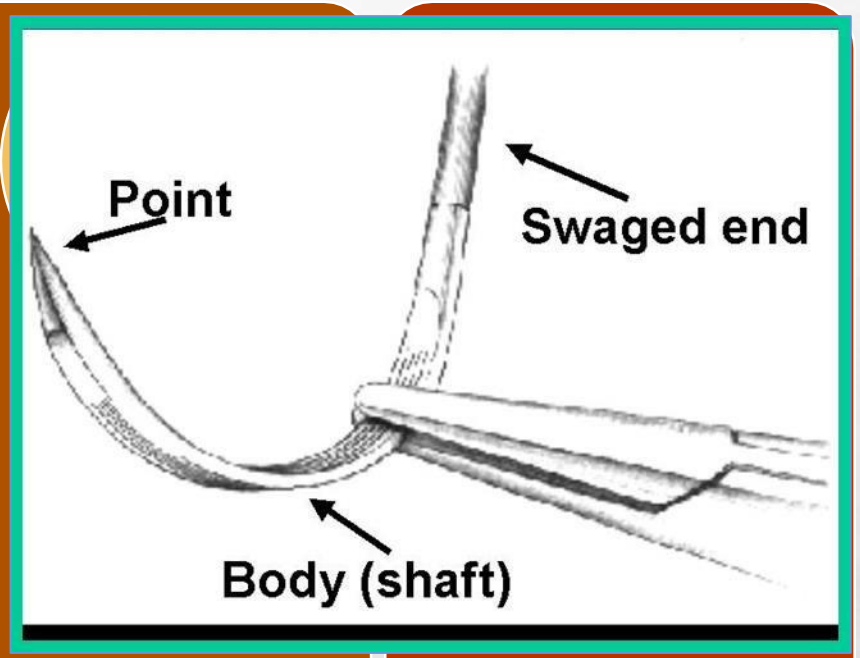


Fig. 4–24 Suturing instruments. *Top,* Castroviejo needle holder. *Bottom,* Laschal microscissors.

MICROSURGICAL NEEDLES

Needle consists of a swage, body, tip & differs concerning material length, size, body diameter and the nature of connection between needle & thread.

The body of the needle should be flattened.



Tips are appropriate for atraumatic penetration.

Shape of needle – straight/bent.

TISSUE RETRACTION INSTRUMENTS

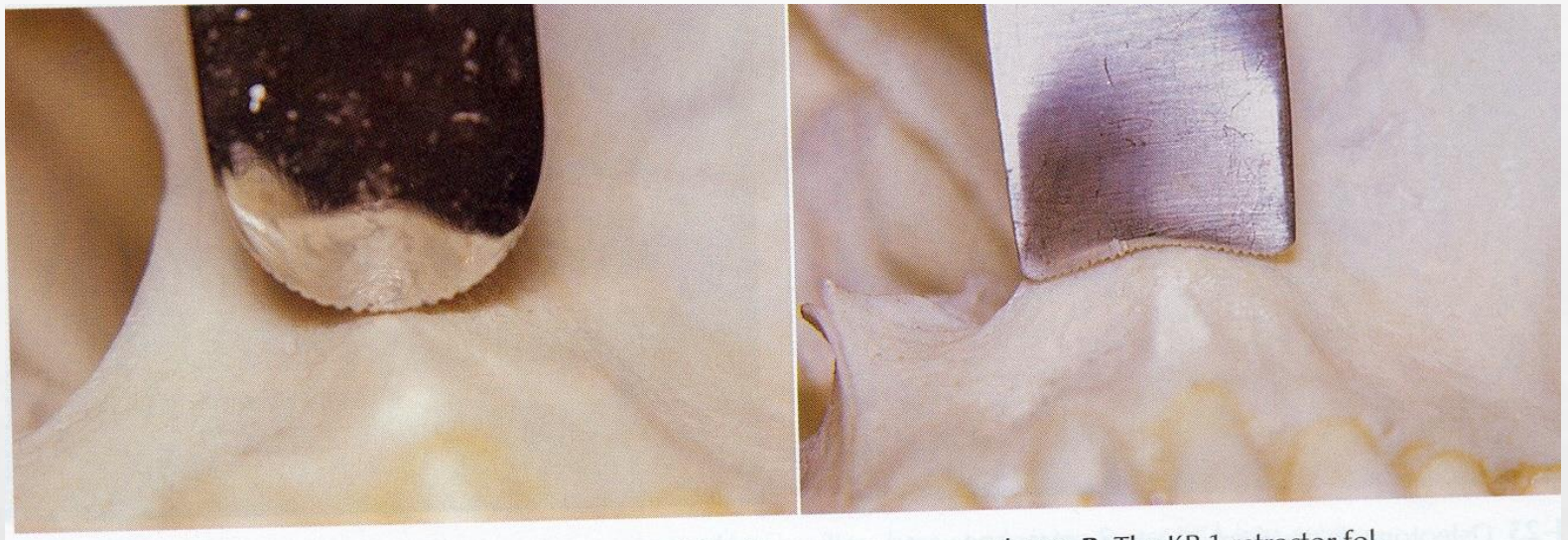


Fig. 4–27 **A**, Endodontic retractor is difficult to use on a convex bone. **B**, The KP 1 retractor follows the contour of the bone.

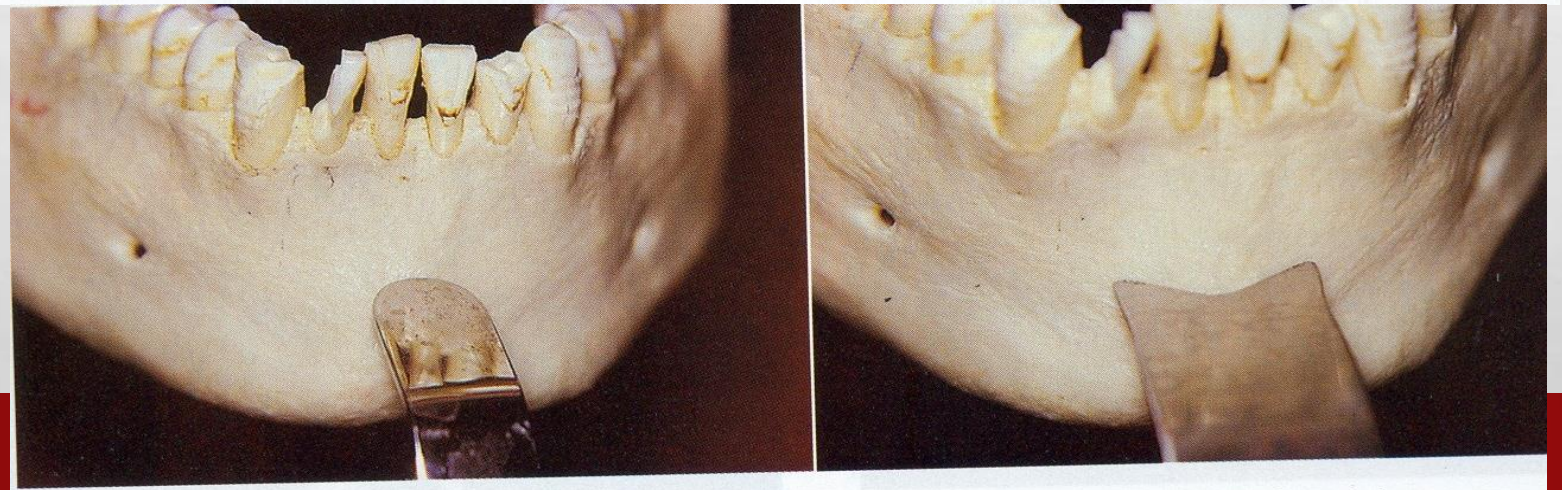


Fig. 4–28 **A**, Endodontic retractor is difficult to use on a convex bone of the mandibular anterior region. **B**, KP 2 retractor follows the convex contour of the mandibular bone for perfect retraction.

STROPKO IRRIGATOR

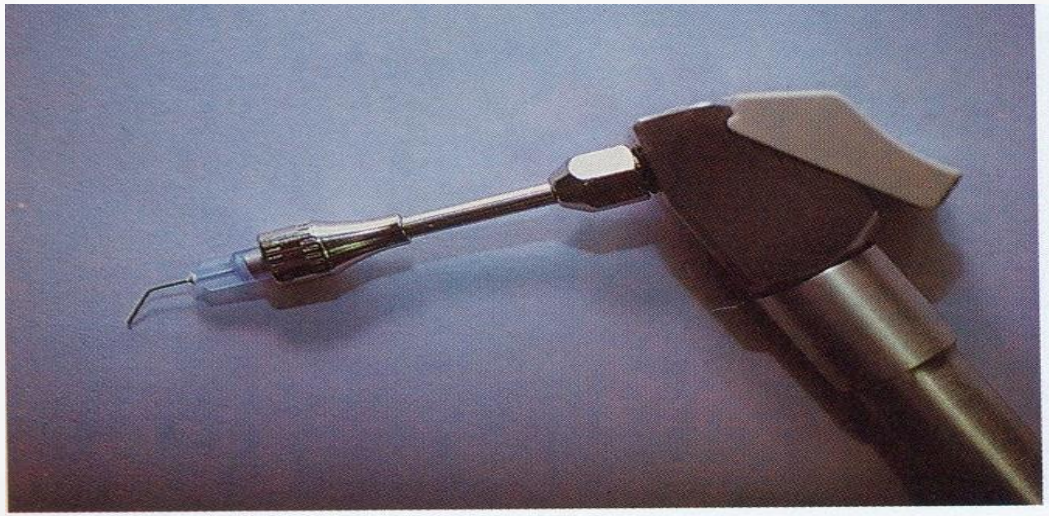


Fig. 4–29 Stropko irrigator/drier with Ultradent microtip.

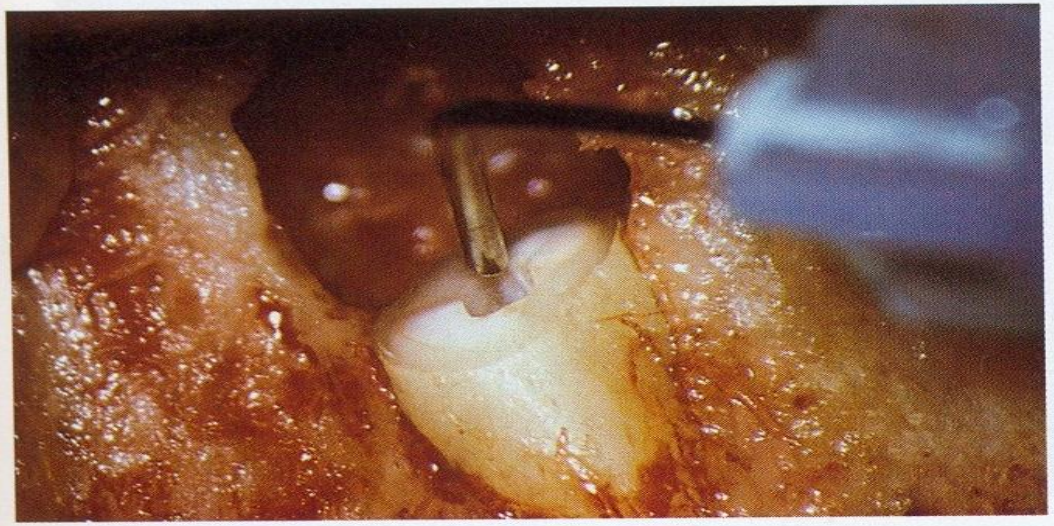


Fig. 4–30 Use of the Stropko irrigator/drier to dry prepared cavities (×10).

ULTRASONIC UNIT

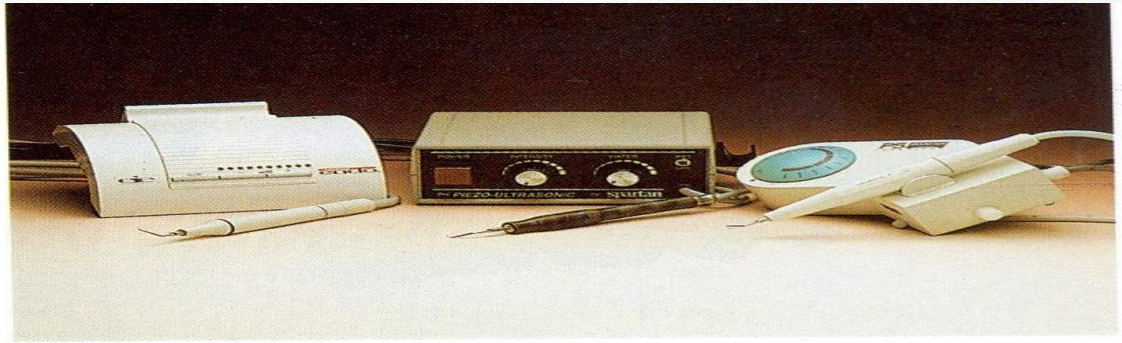


Fig. 4–31 Ultrasonic units. *Left,* EMS Miniendo (Analytic Endo). *Center,* Spartan (Spartan/Obtura). *Right,* P–5 (Satelec).

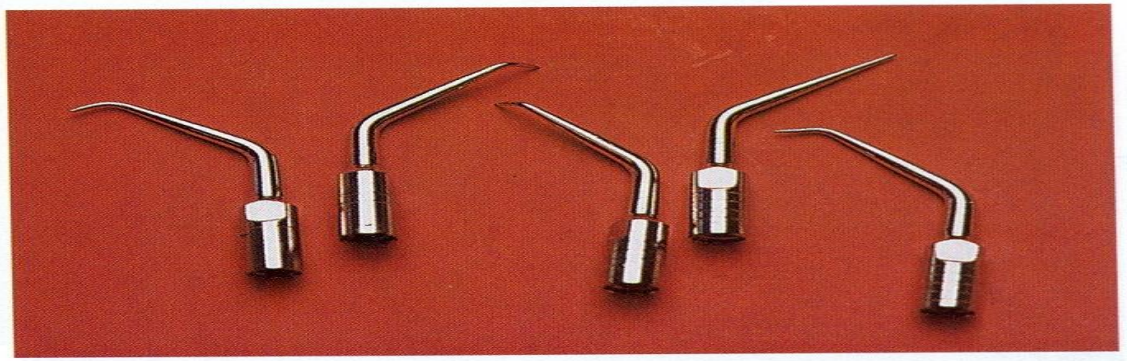


Fig. 4–32 Original ultrasonic Carr tips. *Left to right,* CT 1, CT 2, CT 3, CT 4, and CT 5.

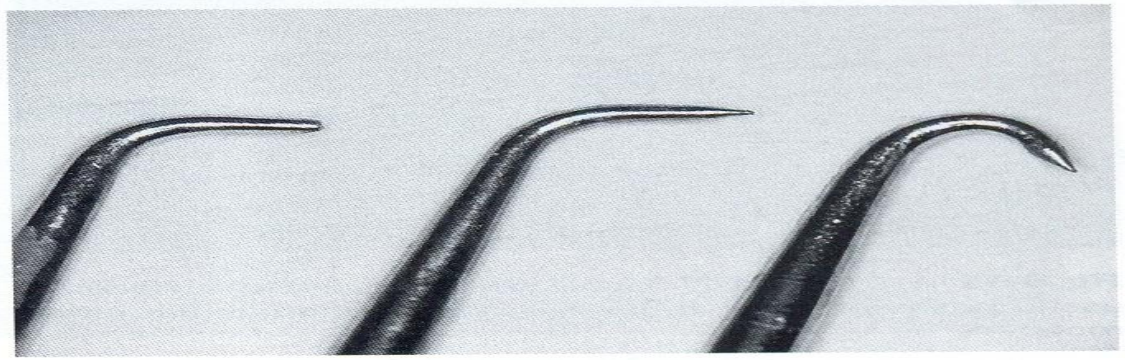


Fig. 4–33 Enlarged view of ultrasonic tips. *Left,* CT 1. *Center,* CT 5. *Right,* Back–action (or CK).

KIS TIPS

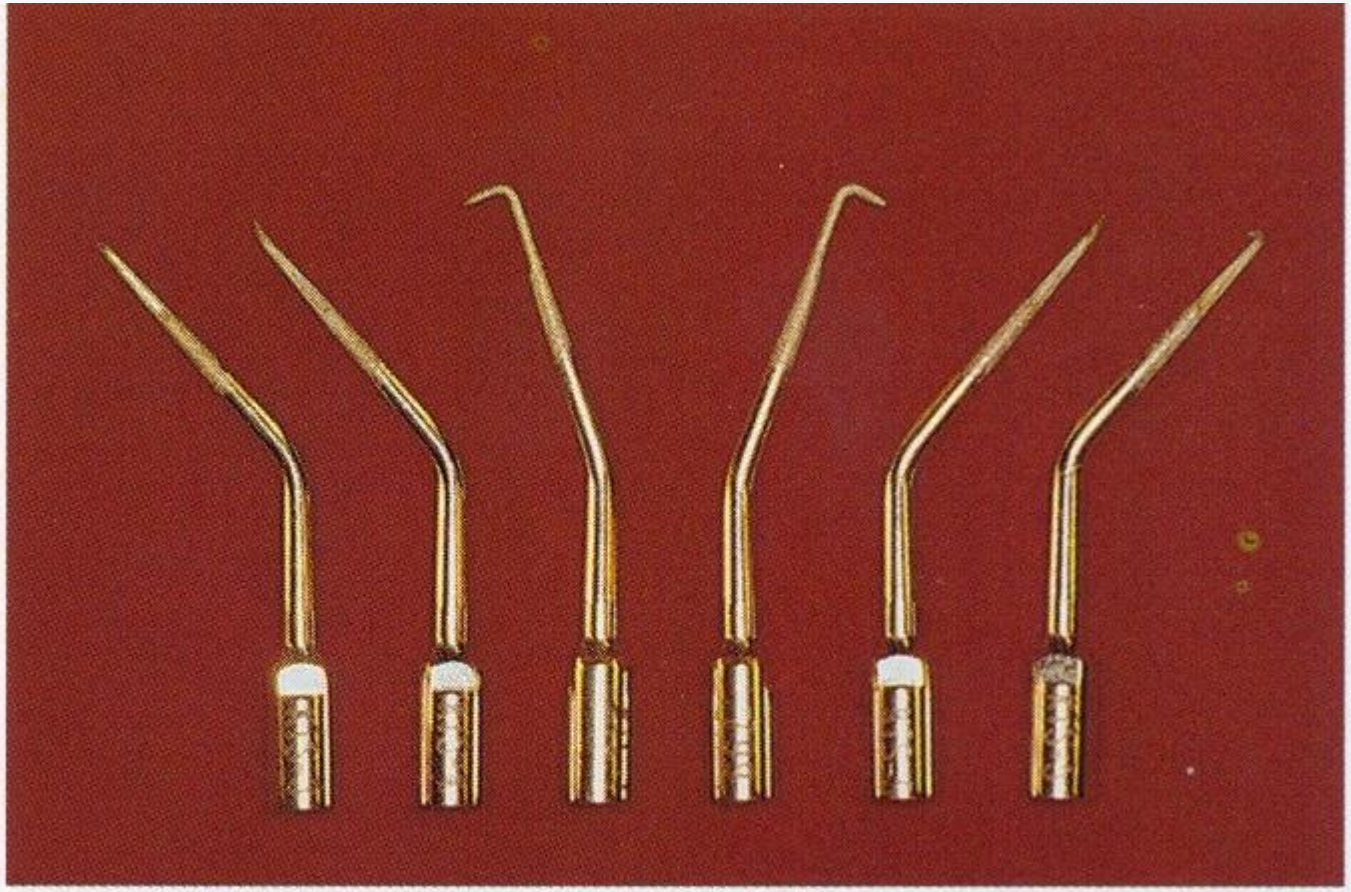


Fig. 4-36 KiS tips. *Left two tips,* KiS 3 and KiS 4; *middle two,* KiS 1 and KiS 2; *right two tips,* KiS 5 and KiS 6.

THE LAWS OF ERGONOMICS

An understanding of efficient workflow using an OM entails knowledge of the basics of ergonomic motion. Ergonomic motion is divided into 5 classes of motion:

Class I motion: moving only the fingers

Class II motion: moving only the fingers and wrists

Class III motion: movement originating from the elbow

Class IV motion: movement originating from the shoulder

Class V motion: movement that involves twisting or bending at the waist.

CLASS I MOTION: MOVING ONLY THE FINGERS

(A) Fingers waiting for the file. (B) File placed in between fingers.
(C) Fingers capturing file.

CLASS II MOTION: MOVING ONLY THE FINGERS AND WRISTS

(A) Hand waiting for the instrument. (B) Fingers and wrist movement receiving the instrument. (C) Fingers movement receiving the instrument.

CLASS III MOTION: MOVEMENT ORIGINATING FROM THE ELBOW

(A) Elbow rested at the stool support. (B) Supported elbow rotation and instrument apprehension. (C) Supported elbow rotation to working position.

CLASS IV MOTION: MOVEMENT ORIGINATING FROM THE SHOULDER

(A) Professional at the neutral position. (B) Shoulders, arms, elbows, and hands moving to reach the OM. (C) OM moved to the ideal position without rotational movement of the waist.

IN CHRONOLOGICAL ORDER, THE PREPARATION OF THE MICROSCOPE INVOLVES THE FOLLOWING MANEUVERS:

1. Operator positioning
2. Rough positioning of the patient
3. Positioning of the microscope and focusing
4. Adjustment of the interpupillary distance
5. Fine positioning of the patient
6. Parfocal adjustment
7. Fine focus adjustment
8. Assistant scope adjustment

MOST APPROPRIATE OPERATING POSITION IS A COMBINATION OF:

I. Patient head position
II. Dental chair position
III. Microscope position
IV. Surgeon position
V. Assistant position
VI. Assistant observation devices

Clinical application of the microscope. The operator and assistant are in comfortable positions

PATIENT HEAD POSITION

- Ensuring patient comfort during surgery utmost important
- No straining/torquing of head & neck muscles
- Occlusal plane be / / to floor for mandibular surgery, perpendicular for maxillary surgery
- Head be comfortably centered or slightly turned

Microscope Position

- Most endodontists prefer ceiling mounted operating microscope
- Suspension arms supports and position the microscope in horizontal & vertical dimensions

SURGEON POSITION

- Should use an adjustable stool
- Thighs parallel to floor
- Arms relaxed, and placed comfortably at side

Fig. 32.20. **A.** Body of the microscope without the Carr Binocular Extender. **B.** Poor position: holding this position, leaning forward, for long periods can cause muscle fatigue.

Fig. 32.19 Correct position at the microscope.

PAR-FOCALITY

- When we change the magnification from low to high or high to low magnification the microscope should remains in focus.
- It is particularly important that the microscope be parfocused when doing photography through the scope.
- Camera and microscope need to be focused at same, achieved only with parfocality.

PAR FOCUS PROCEDURE

SET DIOPTER AT “0”

FOCUS MIDDLE OF FOCAL RANGE

SET HIGHEST MAGNIFICATION AND DO FINE FOCUS

THEN CHANGE TO LOWEST MAGNIFICATION

FOCUS LEFT AND RIGHT ONE AT A TIME

TIGHTEN DIOPTER LOCK & RECORD SETTINGS

NEED TO REPEAT ONCE EVERY SIX MONTHS

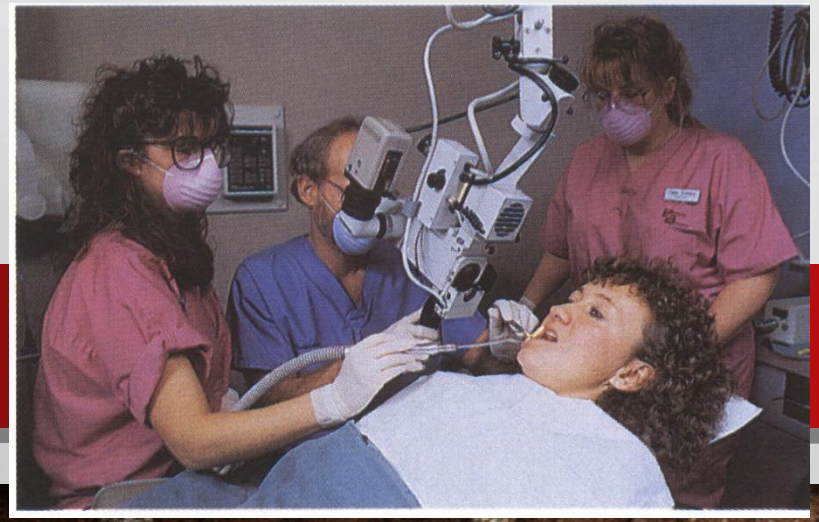
ASSISTANT POSITION

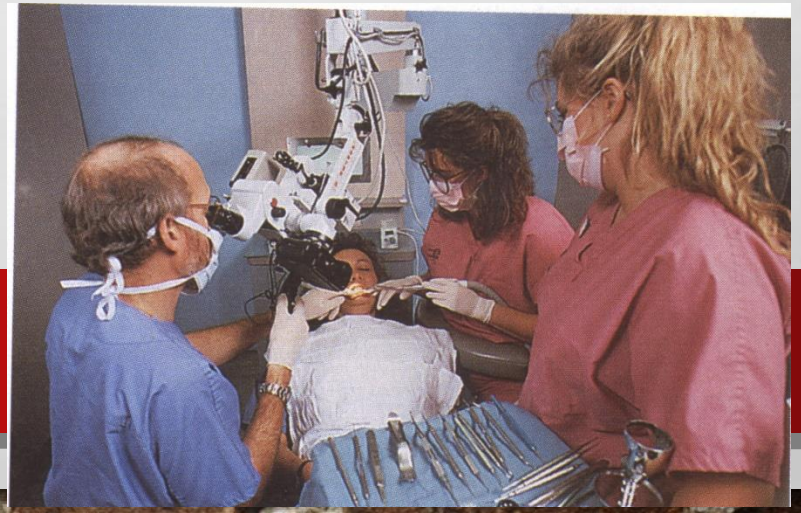
A well designed microsurgery may need three assistants

- **First assistant :**
  responsible for suctioning, usually seated

- **Second assistant :**
  passes instruments, positioned next to the surgeon's dominant site
  If a front delivery system is used, positioned across the surgeon

- **Third assistant :**
  incharge of the video and photographic functions





CIRCLE OF INFLUENCE

- That all instruments and equipment needed for a procedure are within reach of either the clinician or the assistant, requiring no more than a class IV motion,
- And that most endodontic procedures are performed with class I or class II motions only
- Therefore, the circle of influence design principle places the om at the center and all other things required within the circles

CIRCLE OF INFLUENCE

INDICATIONS

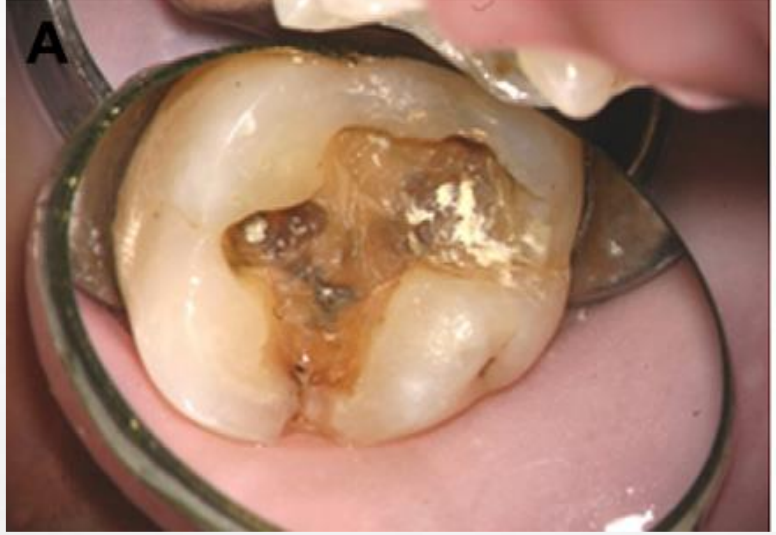
ENDODONTICS

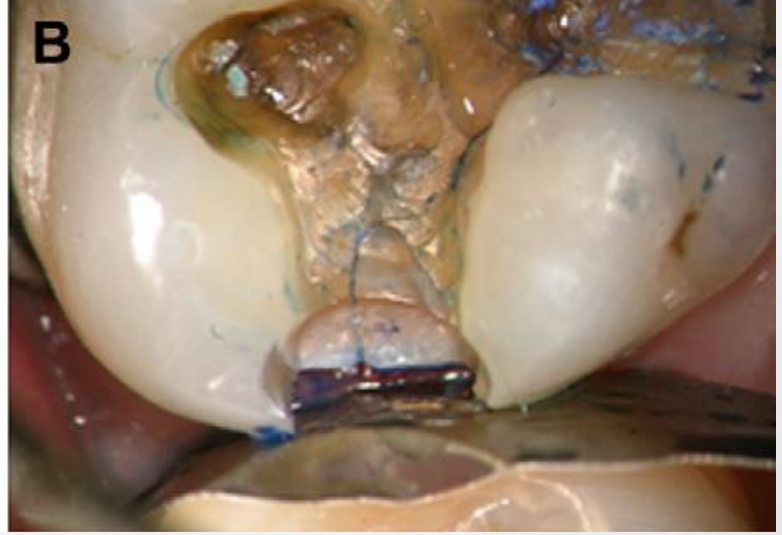
- Diagnosis
- Locating hidden canals
- Management calcified canals
- Perforation repair
- Removal of broken instruments
- Final examination of the canal preparation
- Intracanal medicament
- Obturation
- Surgical endodontic procedure

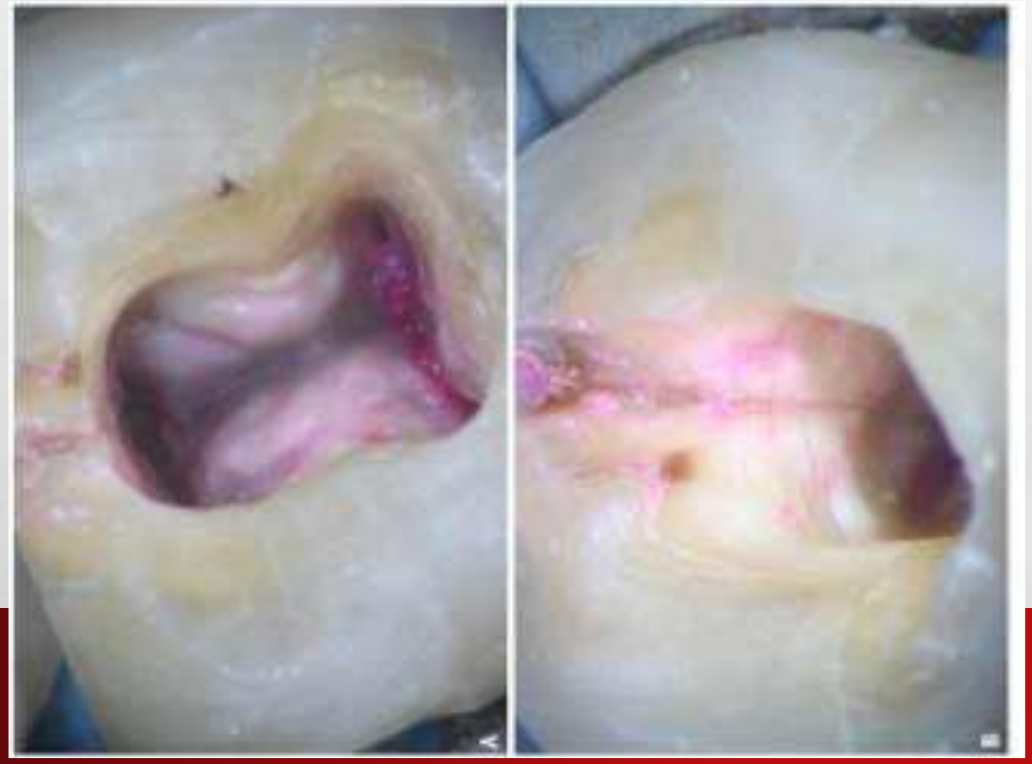
DIAGNOSIS

"CRACKED TOOTH SYNDROME":

- For optimal visibility, it is important to control the hydration of the dentin.
- Reason :
  - If the dentin is too dry, the texture appears white and chalky, and the crack will not be visible; if the dentin is too wet, the reflection of water on the surface will mask the crack.
- The use of a dye like methylene blue or a caries detector can be very helpful to better visualize the crack and to follow its length to its termination.


A

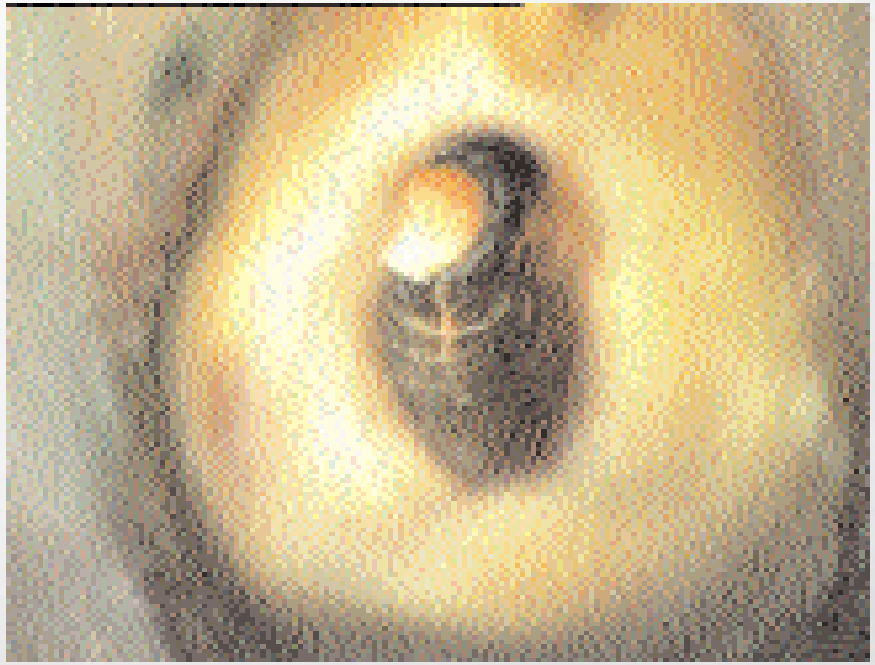

B



ROOT FRACTURES

After removal of the crown and the old obturating material. It is possible to make diagnosis of vertical root fracture from the inside of the root canal.

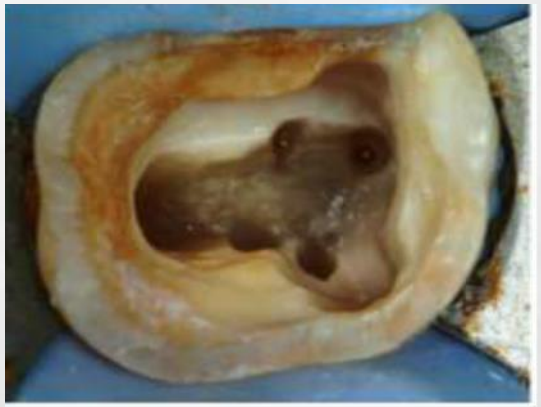
The fracture is evident as a pink line on the canal walls.



ACCESS TO THE ROOT CANAL/LOCATING HIDDEN CANALS

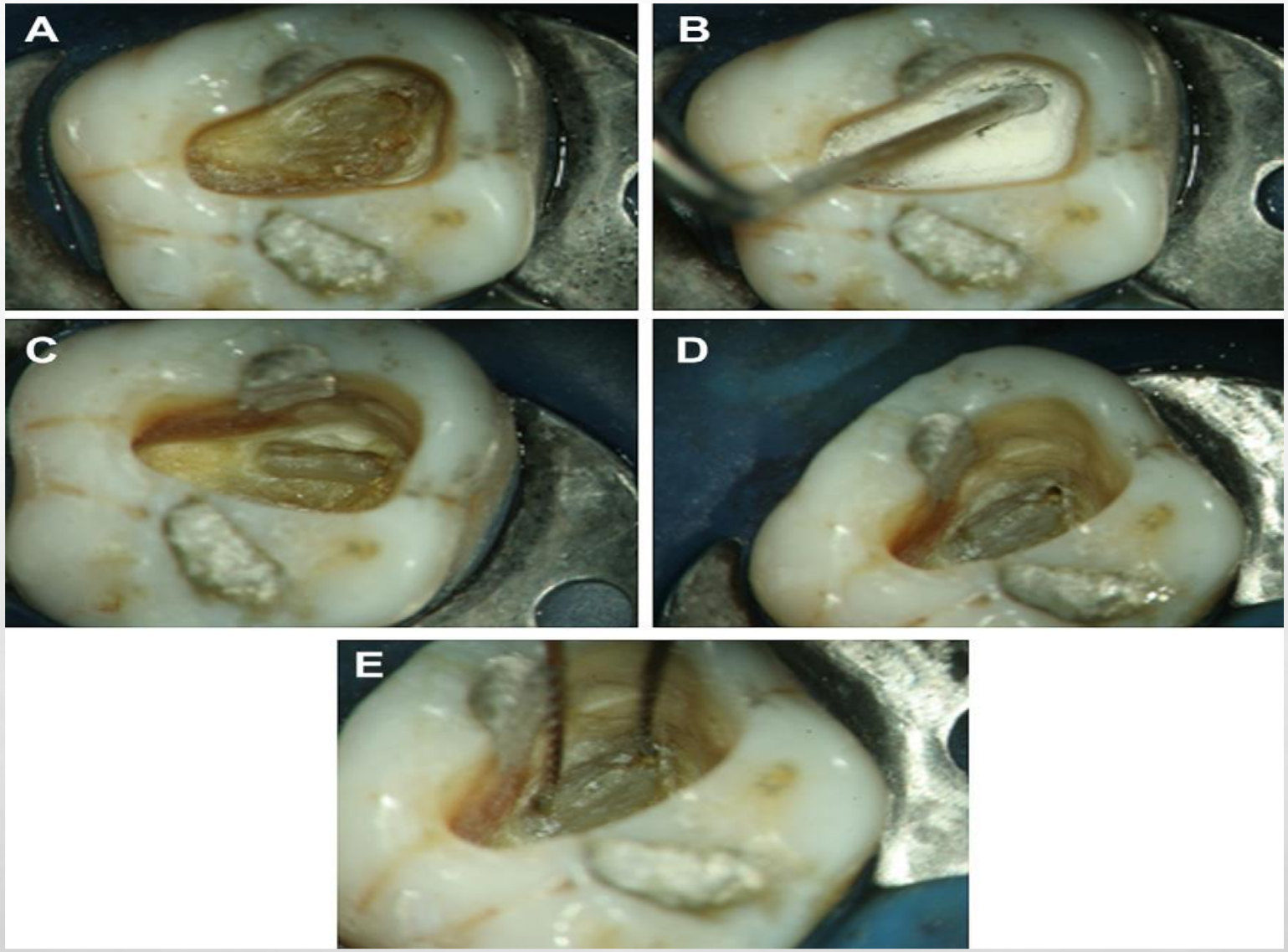
- The most important utility of the microscope in nonsurgical endodontics is locating hidden canals.
- What was considered a rare exception in the past has become a routine finding when using the microscope.
- Access is enhanced by the use of microscope
- Access cavity should be made larger when using endodontic microscope to enhance illumination.
- Greater flare not greater extension

- Subtle changes in color, texture shading and contrast can be precisely detected when visualizing the pulpal floor through a microscope.



- This aids in locating canal entrances.

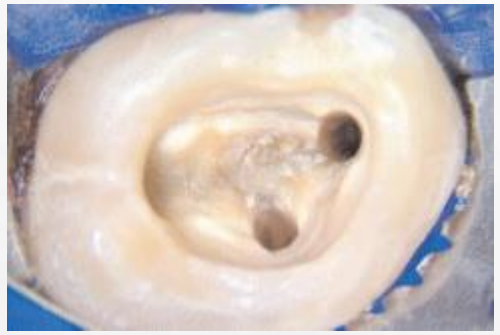
- Pulp stones and secondary or sclerotic dentinal plugs in a canal orifice can be detected and removed with a small round bur/ ultrasonic tips with accuracy


A
B
C
D
E

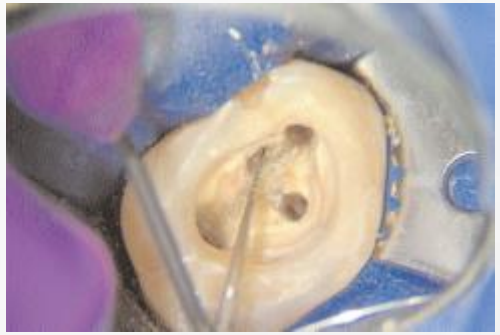
- There are teeth where the canal bifurcates at 3 to 5 mm into the canal the microscope is an invaluable tool in clearly detecting the bifurcation.

- In the maxillary second molar, where the mb and db are in very close proximity of each other microscope helps in identifying the two separate canals.

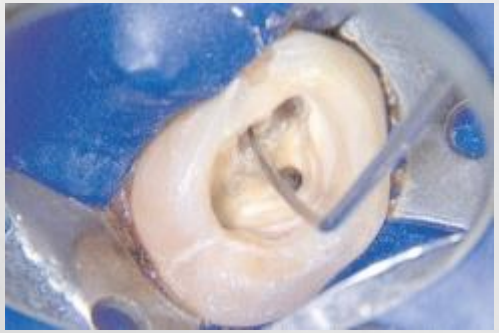
- Identification of mb2 is more with microscope.



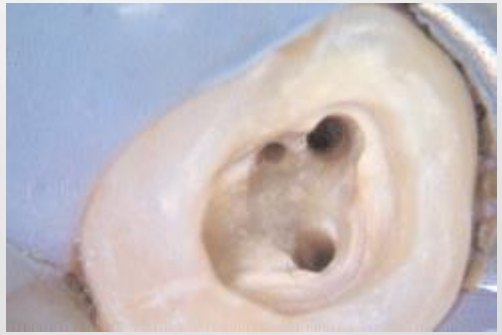
A groove is evident starting from MB1 in palatal direction, in this upper second molar



Micro-opener (Dentsply, Maillefer) is enlarging the orifice



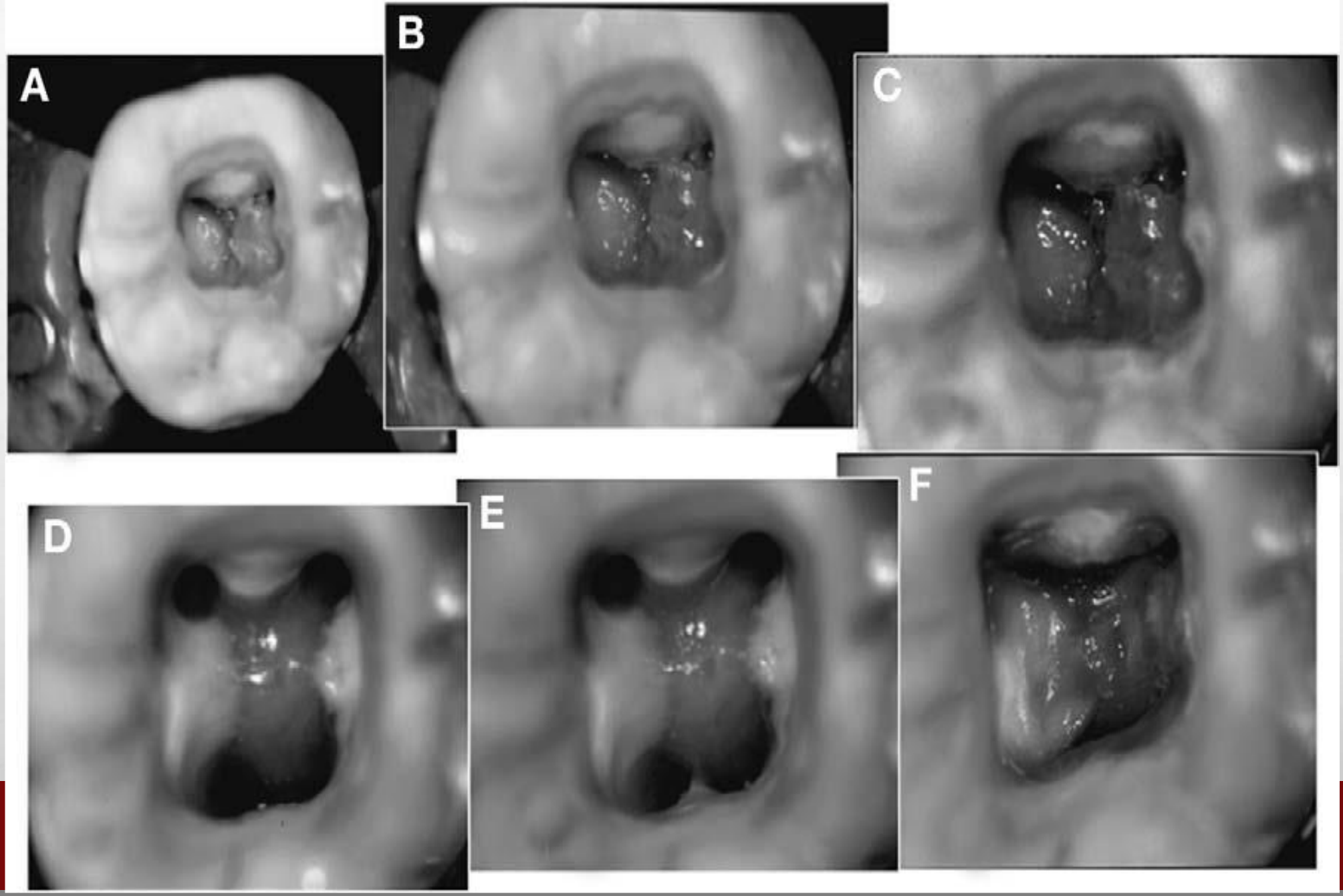
The endodontic probe is demonstrates the orifice of MB2



The photograph shows the orifice of MB2 after the canal has been shaped and cleaned

MANAGEMENT OF CALCIFIED CANALS

- With normal vision or low-power loupes, calcified canal in the pulp chamber is not detectable
- With 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 ultrasonication using CPR or BUC tips will allow clinicians to detect and negotiate the calcified canal easily
- The microscope allows the clinician to detect and prepare conservatively, and not to gouge the healthy dentin structures


A
B
C
D
E
F

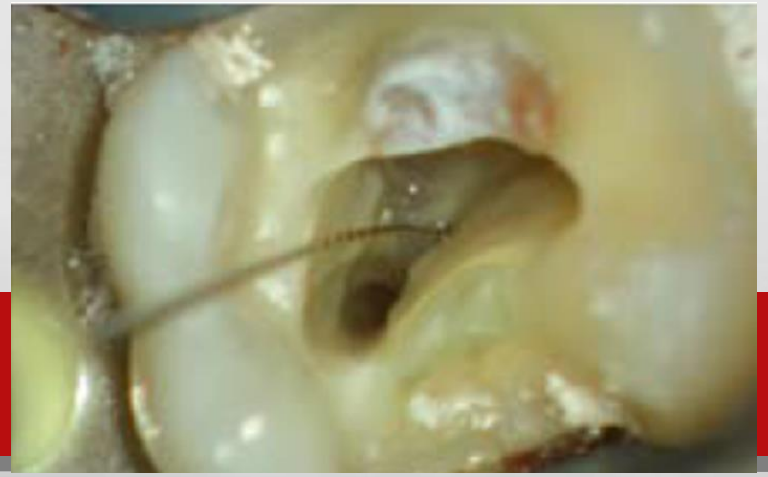
PREPARATION OF THE ROOT CANAL SYSTEM

- This stage of conventional root canal treatment is easy to carry out without using the microscope
- When an instrument is placed in the root canal the operators view is blocked.
- Even if you are able to see the instrument a moving instrument is difficult to focus

- However the microscope may be useful in initial placement of the instrument in the root canal orifice.

- Examining the shape of the preparation in the coronal part of the root canal and do necessary modifications.

- To look for the smoothness of the root canal.



FINAL EXAMINATION OF THE CANAL PREPARATION

- Under the microscope, a small amount of sodium hypochlorite, 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.

INTRACANAL MEDICAMENT

- It is important that the root canal system is dry before placement of an intracanal medicament
- Inspection of the walls under the microscope can ascertain whether the canal is dry sufficiently
- While placement examination of the root canal under the microscope ensures that air voids in the root canal are kept to a minimum.

OBTURATION OF ROOT CANAL

- To check the dryness of the root canal.
- To ensure that the intracanal medicament has been completely removed.
- Even distribution of root canal sealer coronal to the curvature can be easily verified using the microscope.
- Ensure complete gp removal while post space preparation.

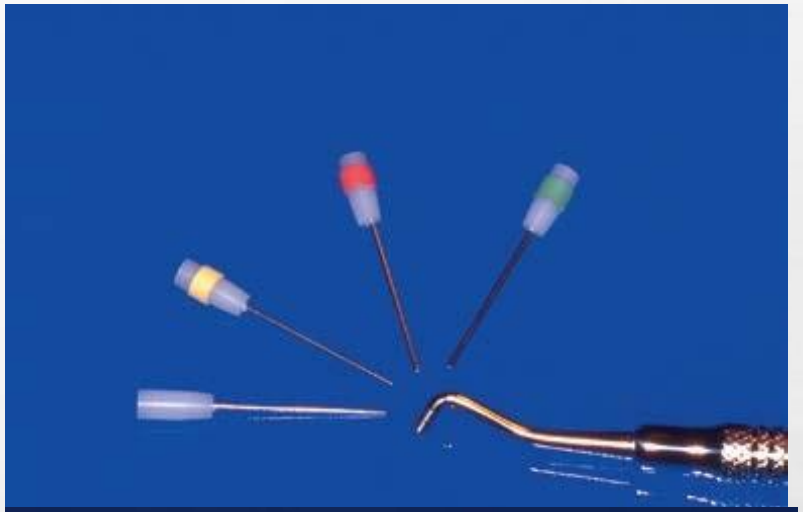
PERFORATION IDENTIFICATION

- Vigorous bleeding in a previous dry canal can be an objective sign of perforation.
- Repeated placement of paper point helps pinpoint its exact location.
- The increased magnification and illumination enhances the visualization and accurately locate the area where this perforation has occurred.

RETRIEVAL OF BROKEN FILES

- With the more frequent use of nickel-titanium rotary files in general dentistry, 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.
- The broken file can be removed while minimizing the damage to the surrounding dentin.

- Specifically for use with Microscopes :
  - Cancellier instrument (Sybron Endo)
  - Mounce extractor (Sybron Endo)



IDENTIFICATION OF THE APEX IN INTACT BUCCAL PLATE

There are a few clues distinguishing the bone from the root apex:

- The bone is soft and the root is hard when probed with an explorer
- The bone is white and the root is yellowish
- These distinctions can be felt and seen with the unaided vision but they are clearly apparent at mag of 10x to 16x under the microscope.
- Staining the osteotomy site near the apex with methylene blue clearly identifies the root apex by preferentially staining the periodontal ligament around the root.

OSTEOTOMY SIZE

- A simple rule applies , the osteotomy should be as small as possible but as large as necessary.

- The only reason for a large osteotomy was that the instruments used (straight handpiece and micro handpiece) were large as compared to microsurgical instruments (ultrasonic tips)

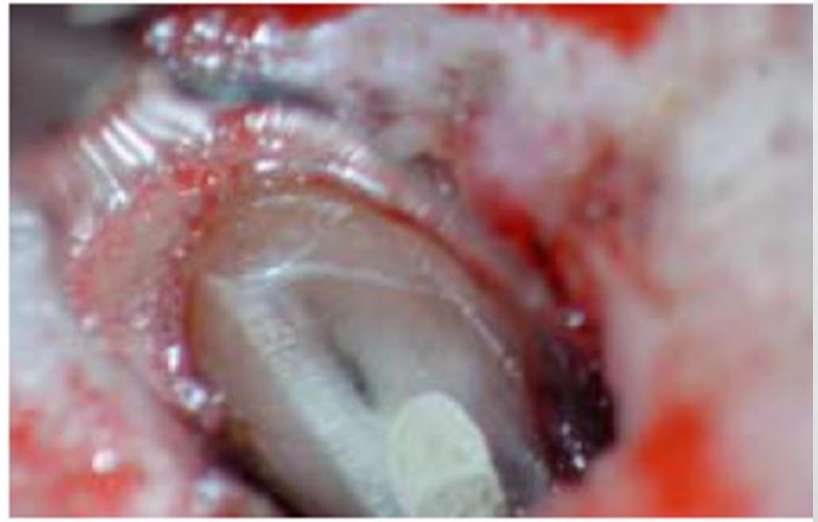
Frequently this large size of the osteotomy resulted in destruction of buccal plate and endo- perio communication .

- It caused slower and incomplete healing with more complications during the healing period

- With the microsurgical method the osteotomy is less than 5 mm a bit larger than ultrasonic tip (3 mm)

INSPECTION OF RESECTED ROOT SURFACE

- Earlier it was not possible
- Now with microscopes it is possible
- Staining with methylene blue may be useful



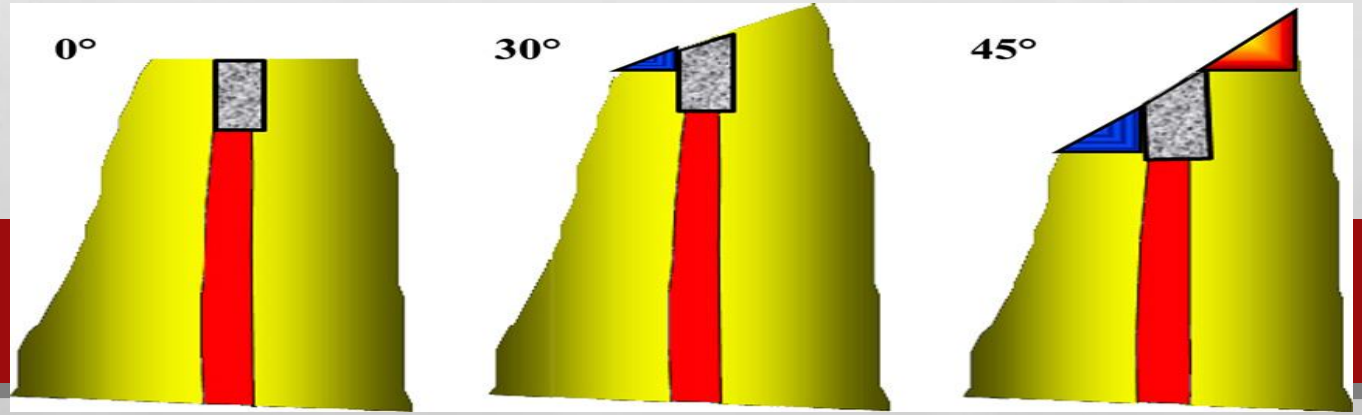
- The frequently seen structure are isthmuses, accessory canals, canal fins, apical micro fractures, leaky canals with incomplete gutta percha seals, c shaped canals and misplaced old amalgam retrofillings.

BEVEL ANGLE

- The sole purpose of the bevel is for the surgeon to view the apex so that it can be identified and retroprepared.

- In the past a 45 degree bevel was suggested.

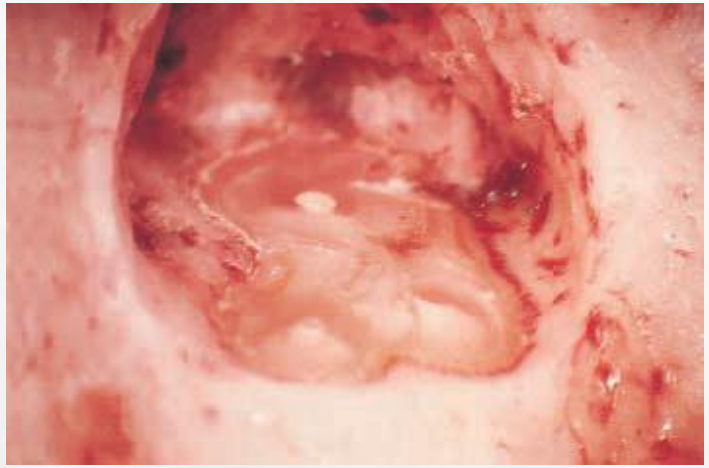
- Now it is possible to give a minimum bevel of 0 to 10 degrees.



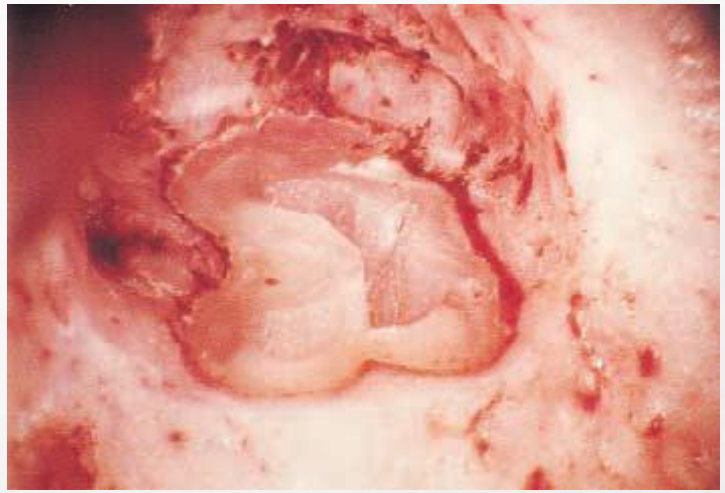
ISTHMUS IDENTIFICATION AND PREPARATION

- In the past there was no mention of the identification or management of isthmus because the isthmus was not visible to the naked eye or the loupes

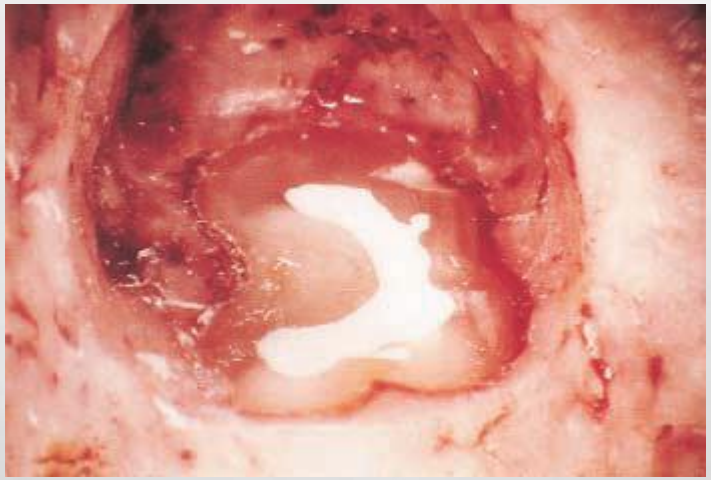
- But it is suggested that 50% of the mesial root of the mandibular first molars had isthmuses between 3 and 4 mm from the apex.



View of a beveled root surface, revealing a more complex anatomy.



Ultrasonic preparation of the 3 canals and the isthmus joining them.



- This is one of the reasons why mesial root apicectomy of mandibular molars fail
- Even if the isthmus was identified by older methods it could not be prepared by the earlier instruments .
- Magnification with a microscope and microsurgical instruments allow predictable management of these isthmuses and a successful outcome.

RETROPREPARATION

Problem with **microhandpiece** are:

- Depth which is not sufficient
- Did not follow the long axis of the tooth
- Perforation on the lingual side

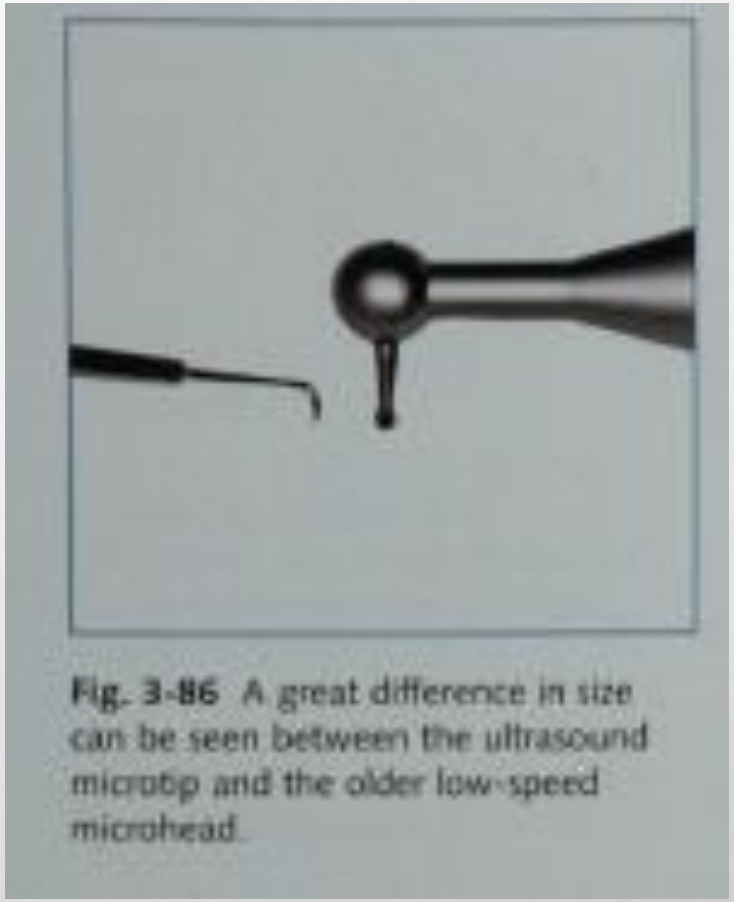


Fig. 3-86 A great difference in size can be seen between the ultrasound microtip and the older low-speed microhead.

WITH ULTRASONIC TIPS

- Much smaller bony access
- Can be easily extended bucco lingually
- Parallel to the long axis of the root
- Sufficient depth
- Allows easy preparation of the isthmus.

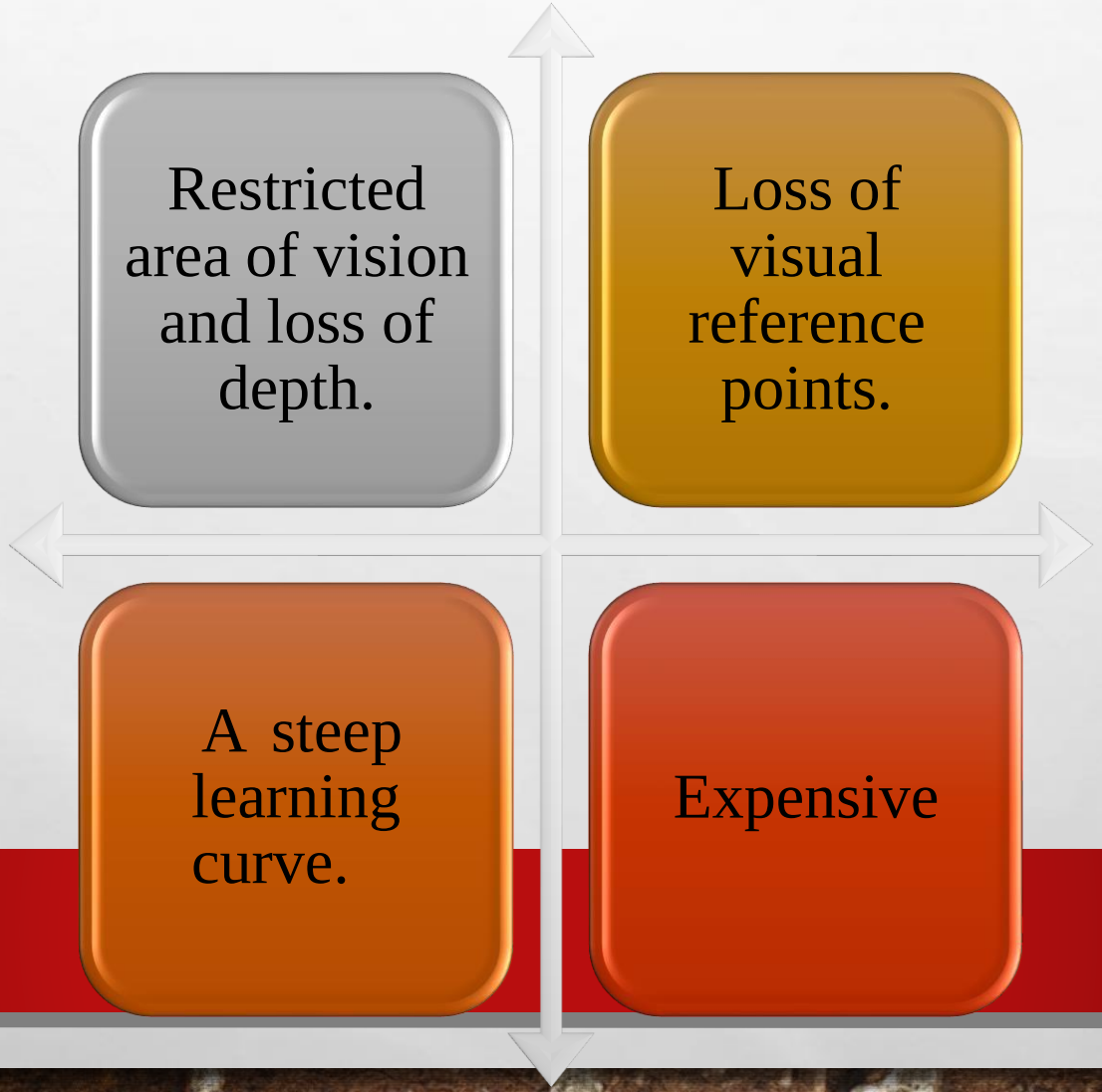
TABLE 1. Differences between traditional and microsurgical approaches

	Traditional	Microsurgery
1. Osteotomy size	Approx. 8–10 mm	3–4 mm
2. Bevel angle degree	45–65 degrees	0–10 degrees
3. Inspection of resected root surface	none	always
4. Isthmus identification & treatment	impossible	always
5. Root-end preparation	seldom inside canal	always within canal
6. Root-end preparation instrument	bur	ultrasonic tips
7. Root-end filling material	amalgam	MTA*
8. Sutures	4 × 0 silk	5 × 0, 6 × 0 monofilament
9. Suture removal	7 days post-op	2–3 days post-op
10. Healing Success (over 1 yr)	40–90%	85–96.8%

ADVANTAGE OF OPERATING MICROSCOPE

- Greater operator eye comfort because of the parallel viewing optics of the Galilean system .
- Greater range of variable magnification,
- Excellent coaxial fiberoptic illumination
- Countless accessories such as still and video cameras for case documentation.

LIMITATIONS OF OPERATING MICROSCOPE



ADVANTAGES OF LOUPES OVER MICROSCOPE

- Small in size, and easy to carry and store.
- No formal training is required and the clinician gets easily adjusted to it.
- Very minimal maintenance required.
- Not as expensive as a microscope.

MAINTENANCE OF THE MICROSCOPE

- Image quality is impaired by slight contamination of the optics or by a finger point.
- The external surfaces of the optical components (eyes pieces, objectives) should be cleaned only when necessary.
- Do not use any chemical cleaning agents.
- Blow off dust on the optical surfaces using a squeeze blower or grease free brush
- Thorough cleaning can be performed with moist cleaning cloths.

ENDOSCOPY

Endoscopy is a medical imaging procedure whereby a long tube is inserted into the body usually through a small incision.

It is used for diagnostic, examination, and surgical procedures in many medical fields.

Goss and Bosanquet reported that Ohnishi first used the endoscope in dentistry to perform an arthroscopic procedure of the temporomandibular joint in 1975.

Detsch et al. (1979) first used the endoscope in endodontics to diagnose dental fractures.

Held et al. and Shulman & Leung (1996) reported the first use of the endoscope in surgical and non-surgical endodontics.

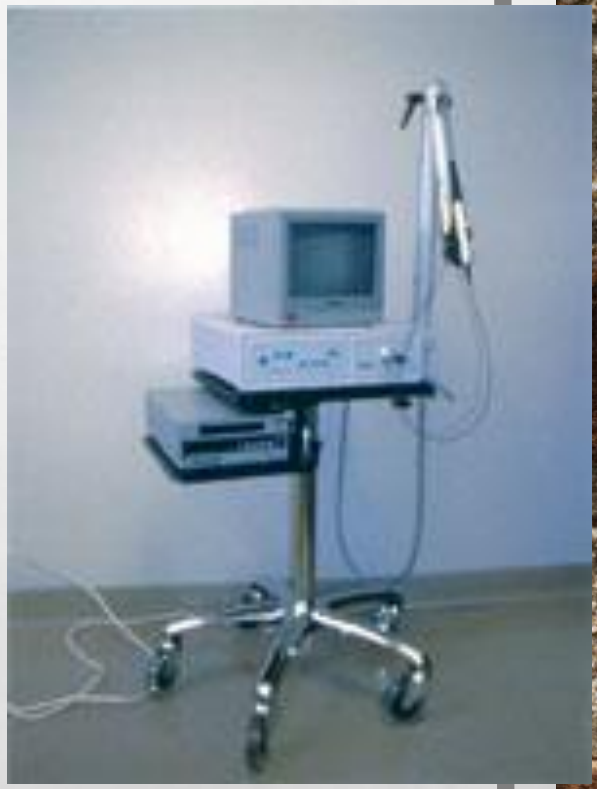
Bahcall et al. (1999) presented an endoscopic technique for endodontic surgery.

The endoscopic system consists of a telescope with a camera head, a light source, and a monitor for viewing.

The traditional endoscope used in medical procedures consists of rigid glass rods and can be used in apical surgery and non-surgical endodontics.

- A 2.7 mm lens diameter, a 70° angulation, and a 3 cm long rod-lens are recommended for surgical endodontic visualization.

A 4 mm lens diameter, a 30° angulation,a 4 cm long rod-lens are recommended for non-surgical visualization through an occlusal access opening.

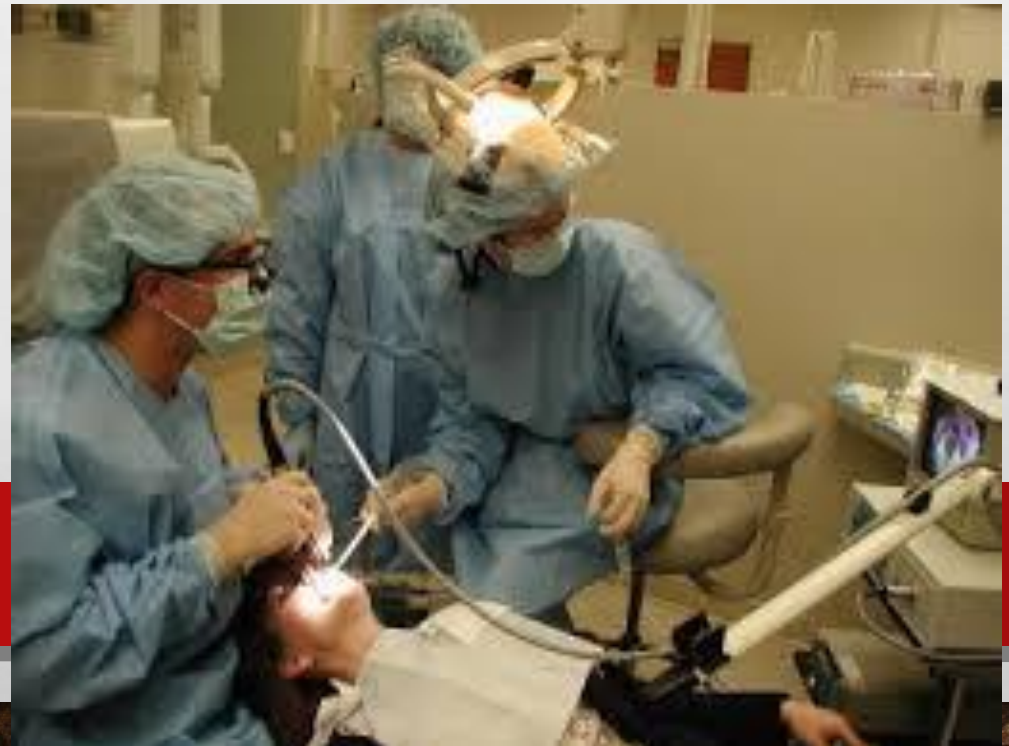


Flexible fiberoptic orascope is recommended for intracanal visualization, has a .8 mm tip diameter, 0° lens, and a working portion that is 15 mm in length.

Bahcall J , Barss J. Orascopic visualization technique for conventional and surgical endodontics. Int Endod J 2003: 36: 441–447.

The term orascopy describes the use of either the rigid rod-lens endoscope or the flexible orascope in the oral cavity.

Endodontic Visualization System (EVS) (JEDMED Instrument Company, St Louis, MO, USA) incorporates both endoscopy and orascopy into one unit.



Clinicians who use orascopic technology appreciate the fact that it 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.

Critics of this form of magnification point out that the images viewed are **two-dimensional** and too restrictive to be useful when compared with the stereoscopic images provided with loupes or microscopes.

CONCLUSION

The introduction of the microscope into precision dental practice is one of the greatest advances seen in modern dentistry.

This will help in improvement of the abilities and skills of dentists to provide better dental care, as well as cutting down on the efforts and stress involved in dental practice.

REFERRENCES

- The Use of the Operating Microscope in Endodontics, Gary B. Carr and Arnaldo Castellucci.
- Essentials of EndodonticMicrosurgery, Stephen P. Niemczyk.
- Castellucci A.Magnification in endodontics: the use of the operating microscope. Pract Proced Aesthet Dent. 2003 Jun;15(5):377-84; quiz 386.
- Syngcuk Kim,Seungho Baek. The microscope and endodontics. Dent Clin N Am 48 (2004) 11–18.
- Syngcuk Kim. Modern endodontic practice: instruments and techniques. Dent Clin N Am 48 (2004) 1–9.
- The Use of the Operating Microscope in Endodontics. Gary B. Carr, Carlos A.F. Murgel

Thank you☺