

Microscopes

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A microscope can generally be described as an instrument that magnifies images. In ophthalmology, a surgical microscope provides magnification of the operating field, with a sufficiently long focus for direct observation of surgery. It may have an autofocus device, be designed to have an assistant's scope, and have a beam splitter for a video camera.

Magnification is the apparent size of an object. The smaller the distance between the object and the eye of the observer, the larger the object's image. The shortest distance for a young, emmetropic human eye to have clear vision is 250 mm, so a refractive medium (converging magnifying lens) is required between the object and the eye to obtain enlarged images. The lens deviates the divergent light rays coming from the object and converges them onto the retina at a distance below the minimal focal distance, which is conventionally established to be 250 mm (Figure 1-1).

In a simple microscope, there is only one lens, so a compound microscope is needed to obtain greater magnification. This kind of microscope has two lens systems: the objective and the ocular. The objective creates a real image of the object. The image size depends on the distance between the object and the objective. The image is further magnified by the ocular lens (Figure 1-2).

To change the total magnification capacity of a compound microscope, the objective and/or the ocular must be replaced, so a compound microscope with variable magnification must have a third system of lenses, the variable group, between the ocular and the objective lens systems.

This makes a surgical microscope more flexible to use because the objective establishes the working distance, the ocular (or better still, the binocular) determines the base magnifying power, and, finally, the variable group is used

to choose the most appropriate magnification. However, it is important to remember that by increasing image magnification, the depth and size of the field of view are reduced.

The components of a surgical microscope are as follows:

- *The objective*, whose total length determines the distance between the microscope (and therefore the surgeon) and the operating field.
- *The binocular complex*, which is made up of a system of lenses that determines magnification and by the prisms that deviate light rays to make them parallel.
- *The oculars*, which is a lens system that determines the microscope's highest magnifying power and can be replaced. Every ocular has a scale to correct the surgeon's refractive error.
- *The eyepieces*, which can be vertical or inclined and their length contributes to determining the total magnification of images.
- *The magnification variable*, which can be manual or an electric zoom.
- *The light sources*, which can be incandescence lamps or fiber optics. Illumination in a microscope is necessary because the brightness of the operating field decreases as magnification increases. The illumination systems can be coaxial with the microscope's optical axis (which has the great advantage of not casting shadows on the field and not changing intensity as magnification changes) or oblique (they avoid direct reflections on the objective).¹

A surgical microscope is an essential instrument in modern eye surgery. For phacoemulsification procedures, microscopes must have the features listed next.