

3 Spinal Microsurgery

A Short Introduction

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3.1 Terminology

Microsurgery means, by definition, to perform surgery with the help of a surgical microscope or other tools (e.g., loupes) which can magnify and illuminate the surgical field. Microsurgery does not mean doing non-microsurgical procedures with the help of small or microsurgical instruments.

3.2 Surgical Principle

Microsurgery not only means working with the help of a surgical microscope. One of the major advantages lies in the possibility to perform operations through small skin incisions (“keyhole surgery”). This needs meticulous preoperative planning, exact positioning of the patient, and reliable localization of the surgical target area in projection to the entry level on the skin surface. All these factors contribute to the “microsurgical philosophy” which realizes one of the major principles in surgery: to perform the most efficient operation with minimum iatrogenic trauma.

3.3 History

The surgical microscope was introduced in the mid-1950s and was first used in specialties such as hand surgery, ENT, and neurosurgery. The pioneers who proposed its use and proved its usefulness in spine surgery were Caspar (1977), Yasargil (1977), and Williams (1978) who were the first surgeons to perform microsurgical approaches for the treatment of lumbar disc herniations [1, 3, 5]. Since the middle of the 1980s, microsurgery has gained more acceptance among spine surgeons. There is now a broad spectrum of possible indications which have been summarized recently by McCulloch and Young [2, 4].

3.4 The Surgical Microscope

A variety of surgical microscopes are currently on the market. For spine surgery, the equipment should fulfill the following criteria

3.4.1 Optical System

- Objective lens with a focal length of 300, 350, or 400 mm. These lenses are available separately, however, the newer microscope models allow for variable adaptation of the focal length (e.g., Zeiss Vario NC 33; Fig. 3.1).



Fig. 3.1. Surgical microscope OPMI Vario NC 33 by Zeiss

- At least two binocular tubes (surgeon, assistant) with adjustable eyepieces.
- One camera tube for documentation.
- Adjustable interpupillary distance.

3.4.2

Illumination System

- Xenon light source. This is the best possible light source with the highest intensity and the longest life span.

3.4.3

Control systems

- For spine surgery, control of the position, focus, magnification, and working distance can be performed via handpieces (Fig. 3.2) or foot switches. With the use of foot switches, the surgeon can continue the operation while simultaneously adjusting the microscope.
- Modern microscope models allow for independent correction of zoom, focus, and magnification by the surgeon as well as by the assistant (Fig. 3.3).



Fig. 3.2. Adjustment of microscope position, focus, magnification, and working distance with the handpiece

3.4.4

Stands

- Electromagnetic coupling of the microscope to its stand is the most advanced principle. It has the advantage of free movement simultaneously in all axes. However, for spinal microsurgery a standard stand can be sufficient (Fig. 3.4).



Fig. 3.3. Vis-à-vis position of surgeon and assistant. Independent control of focus



Fig. 3.4. Standard stand for microsurgey operations on the spine

3.4.5

Video Technology and Documentation (see also Chapter 5)

Documentation for medicolegal as well as for scientific reasons has become easier with the use of microsurgey. It is strongly recommended to couple a video system (chip-camera, video screen, video recorder) to the microscope. This enables the surgeon to document the significant steps of an operation. To achieve the best quality, we propose the use of 3-chip digital cameras as well as a professional video-recording system (e.g., Betacam). For rapid documentation of intraoperative findings, a video color printer can be helpful (see also Chapter 2).

3.5

Advantages

The technical advantages of the surgical microscope are obvious:

- Simultaneous illumination and magnification of the surgical field
- Variable adjustment according to the surgical topography
- Coaxial projection of light
- Three-dimensional-like image
- Sufficient focus depth even with higher magnification

These technical advantages lead to a number of surgical advantages:

- Discipline in surgical planning and positioning.

- Gentle, careful, and less traumatic surgical preparation.
- Surgical training: since the assistant always has the same view of the surgical field, assistance as well as education is more efficient as compared to microsurgey preparation e.g., with loupes.
- Smaller skin incisions and less traumatic approaches decrease peri- and postoperative morbidity and discomfort for the patient.
- In spine surgery this directly results in shorter hospitalization, shorter rehabilitation periods, and thus decreased overall costs.
- Although this is not the strongest argument for microsurgey techniques, the favorable cosmetic result due to smaller skin incisions should not be overlooked.

3.6

Disadvantages

In my opinion there are no true disadvantages of the use of a surgical microscope in spine surgery. However, there are some objections which might depend on the surgical training, the acquired surgical philosophy, as well as the age and experience of the individual surgeon:

- The visual field is limited. This is one of the difficulties which is faced by the surgeon at the beginning of his individual learning curve. The visible area is limited; depending on the magnification

and focus depth this can be an area of less than 1 cm². In deep approaches (e.g., transthoracic, retro- or transperitoneal anterior approaches), the “approach track” is not visible after having entered the target area. This requires surgical discipline in order to avoid direct or indirect injury to structures along the way to the target area. It also requires meticulous preoperative planning and detailed knowledge of topography anatomy. For example, in cervical or lumbar disc surgery as well as in anterior approaches to the thoracic and lumbar spine, orientation concerning the right level is not always possible intraoperatively. Since wrong level exploration belongs to the most frequent mistakes in microsurgical approach to the spine it is recommended to routinely use the fluoroscope or computerized navigation techniques (see also Chapters 4, 5).

- Magnification of approach and target area. The surgeon has to be familiar with microanatomic landmarks. This affords a detailed preoperative evaluation of MR images which provide the surgeon with sufficient information. Spinal microsurgery is not “go-and-see” surgery.
- Visual axis. One of the difficulties beginners are faced with is the adaptation of the visual axis to the axis of the approach as well as to the area of pathology. If the visual axis is not adjusted in parallel to the “approach tunnel,” the target area might be obstructed by the surgeon's hand or instruments introduced into the surgical field. Especially in approaches which are oblique to the skin surface, the microscope tilt has to be adjusted.

- Hand-eye coordination. This usually is the major problem for surgeons not trained in the use of the microscope. Be patient! It only takes a few hours of practice until correct hand–eye coordination is achieved.
- Adjustment of focus. In non-microsurgical procedures, the eyes of the surgeon adjust to the depth of the surgical field. In surgical approaches deep into the human body, permanent adjustment of focus depth is necessary. This can easily be achieved with the help of the foot switch without interrupting the surgical preparation.

The critical reader might notice that all these “disadvantages” are obviously associated with the “learning curve” of the individual surgeon. However, they can best be avoided by surgical education and discipline which leads to a more sophisticated and safer kind of surgery. In fact there are no “real disadvantages” of the application of microsurgical techniques in spine surgery.

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