

INTRAOPERATIVE MAGNIFICATION: WHO USES IT?

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Surgeons over recent decades have made increasing use of intraoperative magnification to enhance the outcome of surgical procedures, yet no published information exists regarding the extent of magnification use within surgical specialties. A sample of surgeons consisting of 148 specialists and senior surgical trainees in the west of Scotland was surveyed by postal questionnaire regarding their frequency and types of magnification use. Patterns of use were similar within each specialty, but varied markedly between specialties. Otolaryngologists and plastic, maxillofacial, and ophthalmic surgeons use both loupes and microscopes frequently. Cardiothoracic and pediatric surgeons tend only to utilize loupes, whereas neurosurgeons tend only to use microscopes. General surgeons, urologists, orthopedic surgeons, and gynecologists are infrequent users or nonusers of magnification, and when required will utilize loupes rather than microscopes. As a clear pattern of magnification use exists, it should be possible to anticipate the equipment needs of surgeons when providing theater services. © 2004 Wiley-Liss, Inc. *Microsurgery* 24:420–422, 2004.

During the last 50 years, developments in surgical techniques, surgical instrumentation, and optical systems have allowed surgeons to increasingly undertake microsurgical procedures. Magnification allows more accurate perception of operative anatomy and positioning of instrumentation, which can improve outcomes and facilitate procedures that would be impossible to undertake without assisted vision. Intraoperative magnification may also reduce surgeons' fatigue as a result of improved ergonomics.

Two types of optical systems are used by surgeons to produce magnification. Loupes can provide up to 6 times magnification,¹ while operating microscopes are required for higher magnifications routinely up to 40 times or greater. Loupes are easier to use, less expensive, and more portable than operating microscopes, but in procedures undertaking work on structures under one to two mm in diameter, an operating microscope may be required.

Much work has been undertaken looking at the improvement of outcomes attributable to the use of magnification in certain procedures, including studies comparing the outcomes of procedures conducted using either loupes or an operating microscope, with excellent outcomes produced with either technology.^{2–4} However, no published study was uncovered which documented the incidence of the use of intraoperative magnification during surgery and differences in usage between different surgical specialties. It was felt that investigation into this area could produce useful infor-

mation to allow the provision of instrumentation for surgeons and to identify areas where magnification may be useful or felt desirable but was not yet provided.

MATERIALS AND METHODS

A study was constructed to document the use of intraoperative magnification equipment by surgeons in the west of Scotland. A list was obtained of all specialist surgeons in the west of Scotland, which is a region that includes both teaching and district general hospitals and includes departments of all surgical specialties. Postal questionnaires were sent directly to 90 specialist surgeons, and the Faculty of Post-Graduate Medicine at the University of Glasgow delivered questionnaires to 58 surgeons in training. From the specialties of general surgeon, orthopedic surgery, otolaryngology, ophthalmology, obstetrics, and gynecology, every third specialist surgeon on the list was questioned. For specialist surgeons in the fields of maxillofacial surgery, neurosurgery, pediatric surgery, plastic surgery, and urology, all surgeons were sent questionnaires due to the relatively small number of surgeons in each group. The trainees selected for questioning were the most senior in their training programs. The postal questionnaire (Table 1) inquired as to the surgeon's specialty and grade, and questioned their use of magnification. The provision for magnification in the surgeon's institution was detailed, as was the rationale behind not requiring magnification in those surgeons who did not use it. All questionnaires were anonymous, and reply-paid envelopes were provided for their response.

RESULTS

Of the 148 questionnaires which were sent, 93 were returned (63%). With few exceptions, all questions were completed by the replying surgeons. Clear patterns of use were seen by surgeons within each surgical specialty.

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Table 1. Questionnaire

Intraoperative magnification questionnaire
 Specialty _____
 Grade _____

- 1) Have you used loupe magnification while operating?
 - o Never
 - o Infrequently
 - o Monthly-Weekly
 - o Weekly or more frequently
- 2) Have you used microscopes while operating?
 - o Never
 - o Infrequently
 - o Monthly-Weekly
 - o Weekly or more frequently
- 3) If you do not use loupes/microscopy, why not?
 - o Not required in my practice
 - o Had not thought about using them before
 - o Too expensive to obtain
 - o Would be of use too infrequently
- 4) What magnification(s) do you use (if any)? _____
- 5) Do you think magnification enhances/would enhance your surgery?
 Yes/No
- 6) I own a pair of loupes: Yes/No
- 7) My theater provides loupes: Yes/No
- 8) My theater provides a microscope: Yes/No
- 9) How much would you expect to pay for a pair of loupes? £_ _ _

The results can be demonstrated by dividing the specialties into five groups.

Group 1 surgeons (loupes only; cardiothoracic and pediatric) use loupes frequently, but do not use microscopes. They tend to routinely use loupes with 2.5 times magnification, and provide their own loupes.

Group 2 surgeons (loupes more than microscopy; plastic and maxillofacial) use loupes frequently and also use microscopes frequently but less commonly than loupes. They use loupes with 2.5–3.5 times magnification, and provide their own loupes. Plastic surgeons use the microscope more commonly than do maxillofacial surgeons.

Group 3 surgeons (microscopes more than loupes; ophthalmologists and otolaryngologists) use microscopes frequently and also use loupes frequently but less commonly than microscopes.

Group 4 surgeons (microscopes only; neurosurgeons) use microscopes, but tend not to use loupes.

Group 5 surgeons (infrequent users and nonusers; general surgeons, urologists, obstetricians, gynecologists, and orthopedic surgeons) infrequently use magnification. Loupes are used more commonly than microscopes, and equipment is usually provided by the hospital.

Of the surgeons not using magnification, 29 believed that there were no requirements for magnification in their practice, and another 6 surgeons felt that magnification would be useful in some cases but not sufficiently frequently to make this a viable option. One surgeon felt that

magnification would be useful but that the equipment was too expensive. When replying to the question regarding what price the surgeon believed a pair of loupes would cost, the mean value was £657 (US \$1,120), with a range of £50–2,000 (US \$85–3,400).

DISCUSSION

The use of magnification can provide benefits for surgeons and patients during surgical procedures. In planning provisions for surgeons and operating theaters and for optical companies to allow proper distribution of equipment, information about intraoperative magnification use would be beneficial.

Since the 1960s, the field of microsurgery has exploded. Initially the operating microscope was used extensively in fields such as plastic surgery, ophthalmology, otolaryngology and neurosurgery. With the introduction of higher-quality loupe magnification and the publication of studies demonstrating excellent outcomes following surgery with both loupes and the operating microscope,^{2–4} more surgeons are utilizing loupes. In addition, loupes are often easier to use, take less time to set up, and cost significantly less than operating microscopes.

The incidence of use of intraoperative magnification and the types of magnification used were not previously documented: a Medline search revealed no papers investigating or commenting on this question, nor did medical optics manufacturers when questioned have complete information on the end users of their products.

Thirty-seven percent of surgeons did not reply to this questionnaire. This may have been a potential area of bias. However, the return rate of questionnaires was similar between specialties in which magnification is used and specialties in which it is uncommonly used, and it is therefore probable that the results represent an accurate picture of magnification use in the west of Scotland. It is possible that the use of intraoperative magnification may vary between regions, especially between North America, Britain, Continental Europe, and Asia, a subject that this current study does not touch on.

The surgeons in each individual specialty demonstrated similar magnification use and requirements. However, as expected, there was considerable difference between specialties as to surgeons' use and types of magnification. Surgeons who frequently use loupes usually provide their own, but operating microscopes are provided by the hospital, and provision for operating microscopes is required when providing operating equipment for neurosurgeons, plastic surgeons, otolaryngologists, ophthalmologists, and maxillofacial surgeons.

Table 2. Results

| Specialty | Response | | Loupe use and magnification | Loupe frequency | Microscope use | Microscope frequency |
|----------------|------------|---------|-----------------------------|-------------------|----------------|----------------------|
| | Consultant | Trainee | | | | |
| General | 11 | 6 | 7/17 (2–2.5x) | Infrequent | 0 | Never |
| Obstetrics | 8 | 6 | 4/14 | Infrequent | 4 | Infrequent |
| Cardiothoracic | 7 | 5 | 12/12 (2–3.5x) | Weekly | 2 | Infrequent |
| Pediatric | 6 | 2 | 6/8 (2.5–4x) | Mostly weekly | 1 | Infrequent |
| Plastic | 4 | 3 | 7/7 (2.5–3.5x) | Weekly | 7 | Mostly weekly |
| Neurosurgery | 4 | 3 | 1/7 | Infrequent | 7 | Weekly |
| Orthopedics | 5 | 2 | 2/7 (2.5 and 4x) | Infrequent | 4 | Mostly infrequent |
| Ophthalmology | 6 | 0 | 5/6 (3.5x) | Mostly infrequent | 6 | Weekly |
| Maxillofacial | 3 | 2 | 5/5 (2.5x) | Mostly weekly | 4 | Monthly or weekly |
| Otolaryngology | 4 | 1 | 2/5 | Infrequent | 5 | Weekly |
| Urology | 2 | 3 | 1/5 (2.5x) | Infrequent | 5 | Mostly infrequent |
| Cardiothoracic | 7 | 5 | 12/12 | Weekly | 0 | Never |

Prior to this study, the author hypothesized that the use of loupes would be restricted to some degree by the price of purchasing loupes. However, only one surgeon believed that cost was a prohibitive factor in preventing the use of loupes in their practice. It is gratifying to see that surgeons who believe that magnification will benefit their surgery on a frequent basis obtained the required equipment to do so. Surgeons who believed that they would be very infrequent users of magnification did not use a magnification system, which is reasonable, as effective use of these systems requires a certain level of practice.

CONCLUSIONS

As anticipated, the use and types of intraoperative magnification vary between surgeons in different specialties, and surgeons in an individual specialty maintain similar patterns of magnification use. Magnification is

in frequent use by many surgical specialties, and is infrequently used in others. Due to the demonstration of clear patterns of magnification use, it will be possible to anticipate the equipment needs of surgeons when providing theater services.

REFERENCES

1. Baker JM, Meals R. A practical guide to surgical loupes. *J Hand Surg [Am]* 1997;22:967–974.
2. Shenaq SM, Klebuc MJA, Vargo D. Free-tissue transfer with the aid of loupe magnification: experience with 251 procedures. *Plast Reconstr Surg* 1995;95:261–269.
3. McManamny DS. Comparison of microscope and loupe magnification: assistance for the repair of median and ulnar nerves. *B J Plast Surg* 1983;36:367–372.
4. Serletti JM, Deuber MA, Guidera PM, Reading G, Herrera HR, Reale VF, Wray RC. Comparison of the operating microscope and loupe for free microvascular tissue transfer. *Plast Reconstr Surg* 1995;95:270–276.