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Technical White Paper

Widen Your Vision for Minimally Invasive Surgery

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As minimally invasive surgical techniques become increasingly more commonplace in replacing traditional open-surgery procedures to some degree, the continuous evolvement of surgical technique and philosophy have given rise to several benefits for surgeons, theatre staff, patients, and healthcare facilities. Less post-operative pain, scarring, and inadvertent damage to otherwise healthy tissue means patients have a faster recovery, hospital stay is shortened, and facilities can treat more patients as a result.

During minimally invasive surgical procedures, surgeons rely upon their visual acuity to a greater degree by reliance upon high-specification laparoscopic imaging systems and their own dexterity.

How to meet this new requirement for surgery lighting?

As a pioneer of clinical solutions, Mindray continues to bring innovative products to the international market and designs such as the new HyLED C Series surgical light to meet and exceed the current lighting requirements for minimally invasive surgery.

Stage I

As MIS became increasingly popular in the early 1990' s, the resolution of the laparoscopic display was very low and many fine structures within the surgical field-of-view such as nerves and lymph nodes were difficult to identify. The brightness and contrast ability of these displays was also quite low in quality with the surface of the screen often prone to reflections and artifacts due to the ambient lighting within the operating room, thus affecting the view as seen by the surgeon.

During these procedures, surgeons would often choose to turn off or dim the lights in the operating room to try and increase

the contrast of the image displayed, as well as reducing glare and artifacts on the imaging screen. This practice then increases the risks associated with movement around the room, correct identification of instruments, and other possible complications.

Some surgical light manufacturers at this time began to introduce the concept of a "ambient light" mode for their surgical lights which usually involved a reduction in main surgical light output to its minimum designed specification of around 5% or 8,000 lux. Ambient lighting in this instance was usually orange or white, depending on the specification of the bulb in the main surgical lighting platform (such as Xenon vs Halogen).

Stage II



Based on the principle of complementary color, people began to use green or blue ambient (usually less than 500lux) to limit glare on the monitors and improve contrast. This helps to reduce the risk of surgery caused by the surgeon's visual residue.

Various colours of ambient lighting may also represent a calming and relaxing environment for patients upon entering the operating room and may also have this additional benefit.

Stage III

As laparoscopic and endoscopic imaging clarity continues to improve, high-definition and ultra-high-definition have vastly improved the details seen within the scope view and the increase in colour correction has also provided a far greater ability to identify and distinguish various anatomical structures during procedures. As such, the surgical viewing screens have also evolved to provide ultra-low reflection and external artifact that once inhibited a clear view of the operative field; this coupled with the increasing size of the viewing monitors also alleviates the need for turning off the room lights when MIS is performed.

The ambient light mode of traditional-style operating lights can no longer meet the needs of modern MIS.

More attention is now focused on surgeon comfort, image quality, and efficiency during laparoscopic and endoscopic procedures. Eye discomfort and excessive illumination have come to be important factors when considering safe, efficient, and effective minimally invasive surgery.

1. Surgical lights & surgical efficiency

Due to the relatively larger working surface area when compared to open surgery, MIS requirements for field lighting can differ from those when compared to open surgical procedures. On bariatric patients, field illumination is even more paramount to ensure all working areas are uniformly illuminated when inserting ports and trocars. The need for a surgeon to continuously adjust the surgical light when working on different port insertion sites can affect the efficiency of the of the procedure. As an average cost-per-minute exceeding over \$100 for operating room time, time-saving techniques and reduction in downtime can be beneficial to facility profitability.

Research shows that after one interruption, it can take an individual an average of 23 minutes to fully regain their concentration to the original task at hand.^[1]

2. Surgical light & visual fatigue

Today's surgeons often use the same operating light brightness as open surgery when performing laparoscopic surgery to place a trocar or suture. As the surgeon will be converting the procedure to looking at a surgical monitor when the laparoscopic camera is inserted, the initial stages of the MIS procedure do not require surgical field illumination as bright as a comparative open procedure. The high brightness and glare associated with the initial stages of field illumination during preparation of the site for MIS can therefore created undesirable eye fatigue resulting in poor posture and physical fatigue, which can then affect the surgeon's performance.

In one meta-analysis of over 5,000 surgeons, stucky survey? found that over 25% of surgeons reported eye strain as an occupational health hazard.^[2]

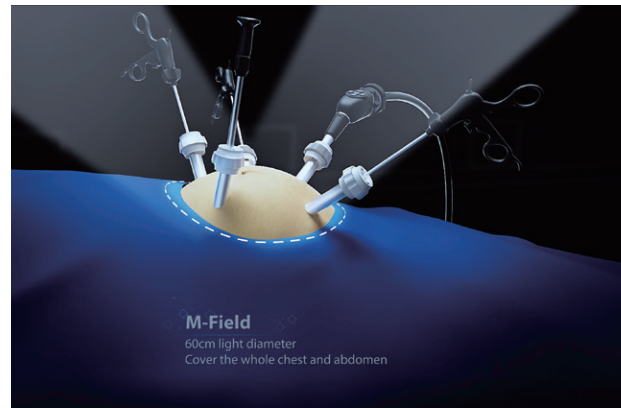
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Our innovative optical design for minimally invasive surgery M-Field: Widen your Vision, beyond ambient light



Eodo Mode Comparison

	Tradition ambient light mode	M-Field™
Light field diameter (1m)	About 30cm	60cm cover the whole chest and abdomen
Max. illuminance (Ec) (1m)	>8,000 lux or <500 lux	3,000 lux
Light field uniformity (D50/D10)	<50%	>60%

To solve the current problem of ambient lighting in minimally invasive surgery, Mindray refers to IESNA lighting recommendation: the surrounding operating field lighting should be 3,000 lux for medical staff between 25 to 65 years of age. In addition to this recommendation, Mindray is further enhancing the illumination that meets the needs of both the procedure and surgeon comfort through extensive clinical research. M-Field ambient lighting produces a field illumination focal point of 60cm diameter that can simultaneously cover both chest and abdomen, negating the need for constant repositioning of traditional surgical lights when preparing the field for MIS. This M-Field technology provides the optimal 3,000 lux of lighting in a 60cm diameter patch and utilizes Mindray's advanced "Compound Eye Structure" lens technology which produces a clear and homogenous light field (D50/D10 > 60%) all while reducing glare and discomfort to the staff in the operating field.

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