Emerging Endoscopic Minimal Invasive Laser Spinal Surgery (lumbar, cervical and thoracic)

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Citation

Abstract

Introduction: Laser Minimally Invasive Spine Surgery (MISS) was thought to be impossible and impractical not long ago, but has rapidly come of age1,2,3,4,5, due to much improved endoscopic and micro spinal surgical instruments the explosive development of bio-computer technology, digital video imaging, ultra fast virtual spino scan, and tissue modulation technology6,7. A significant percentage of spinal surgeries will be modified or replaced with laser MISS8. Therefore a new algorithm in the treatment of degenerative spinal disease is urgently needed (Table 1).

Purpose: To identify and demonstrate the laser MISS surgical techniques and treatment for herniated cervical, thoracic and lumbar discs, and degenerative spine disease; to demonstrate the current and future laser MISS related technology, and to describe potential surgical complications and their avoidance.

Material and Methods: Recent innovative endoscopic laser MISS instruments, various spinal endoscopes, 3 intra-operative digital x-ray fluoroscopy, digital video photography, various laser application, newer endoscopy for better visualization, and thermodiskoplasty (i.e. the use of the laser at low energy levels, to shrink and tighten disc material) 6,7 are described. Endoscopic laser MISS surgical techniques are demonstrated for lumbar, cervical, and thoracic spinal operations. 6,7,9,10,11 On the horizon, many digital computer aided innovations1 including surgical robotics, image guided technology and other surgical systems are also described.

A well designed digital Institutional Information System (IIS) including a Picture Archiving and Communication System (PACS),1,12and a digital 3-D imaging virtual reality system in a surgical planning laboratory1 provides precise diagnosis and pre-operative surgical planning in order to facilitate MISS process, and to provide intramural and extramural connectivity. Digital video game technology, haptic technology and surgical simulator are on the horizon13 to facilitate and to improve education, research, development, and endoscopic laser surgical training 12,13,14,15,16,17 in addition to better patient care.

Results and discussion: Laser minimally invasive spine surgery outcome has improved the overall success rate to above 91% or
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more (94% for one level) with less than 1% of morbidity and zero mortality as demonstrated in a recent multicenter study.16. Also potential laser MISS complications and avoidance are fully discussed.

The rapid progress in endoscopic laser MISS has been facilitated by modern bio technology. There is a definite correlation between clinical findings, digital radiology, neuropsychological studies, MRI, CT, 3D virtual imaging, virtual spinal endoscopy, surgical findings and positive surgical results. Digital video technology, heptic technology and surgical simulation will assist in the training of the minimally invasive spine surgeons, and to shorten the learning curve. Surgical robotics and image guided technology for MISS are on the horizon.

Conclusion: Endoscopic laser MISS has rapidly become of age and has many obvious advantages.7,10,11,16 Digital technology assists in the advancement, development, the training, and the practice of endoscopic laser MISS for treatment of degenerative disc disease, with preservation of segmental spinal motion. This minimally invasive, less traumatic, outpatient endoscopic laser MISS treatment for cervical, lumbar and thoracic disc disease leads to excellent results, faster recovery, and significant economic savings. In the near future with the assistance of digital technology, endoscopic laser MISS applications will further provide an excellent and effective access or platform for spine arthroplasty, spinal disk replacement, artificial disk, vertebroplasty, spinal fixation/fusion, disc re-growth technology and perhaps genome therapy.

References

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