

“Incorporation of MISS in Routine Spine Practice”

Amit C. Jhala¹

Abstract

Traditional open spine surgery is the gold standard procedure in spine practice. Minimally invasive spine surgery (MISS) since last two decades have tremendously improved in technique and technology, improving the clinical and functional outcomes of the surgery and patients. But still MISS has steep learning curve, many challenges and hurdles to inculcate it in the routine spine practice of the surgeon who may be either a novice or even an established in spine practice. The author has tried to identify the hurdles in incorporating MISS in routine spine practice and suggested methods to overcome these hurdles to incorporate MISS in routine clinical practice.

Keywords: Minimally Invasive Spine Surgery (MISS); Spine practice; Spine Surgeon.

Introduction

Conventional open spine surgery is the gold standard procedure in routine spine practice. This is obvious considering the long history of spinal surgery. History of spinal surgery is very old and Paul of Aegina performed the first laminectomy around 650 A.D [1]. But the real impetus to spinal surgery came in early 1900's when initially Russell A. Hibbs [2] started posterior spinal fusion in spinal tuberculosis and then Mixer and Barr [3] reported in 1932 the surgery for lumbar discectomy. Keeping in mind such a long history of open spinal surgery, it is quite evident that traditional open spine surgery is in the comfort zone of the spine surgeons and is the gold standard. However, the science progresses on the building blocks of the history. Contrary to conventional open spine surgery, the history of minimally invasive spine surgery is quiet short. Kambin et. al. reported first endoscopic spine surgery in 1973 [4]. Caspar (1977)[5], Yasargil (1977)[6] and Williams (1978)[7] were the first to report the microsurgical techniques to decrease the collateral damage with the use of microscope. Building on the same philosophy Prof. Kevin Foley (1997) developed microendoscopic discectomy (MED) by inventing tubular retractor [8]. The philosophy of the modern minimally invasive spine surgery (MISS) is built on what was intended by these surgeons, to

decrease the approach related collateral damage without compromising the intended goals of the surgery. With these intentions in mind, newer technological advances in form tubular retractors, microscope and endoscopes, development of dedicated sophisticated surgical instrumentations and implants for MISS helped in further decreasing the surgical trauma and gave a targeted approach. These technological and surgical advances are backed by good evidence based functional outcomes [9-11]. These better surgical and functional outcomes trickle in the patient community demanding the MISS surgery. The patient demand, forces the spine surgeons to incorporate MISS into his armamentarium. However, inspite of this knowledge, it becomes challenging for conventional and traditional spine surgeon to incorporate MISS in the clinical practice. Aim of this article is to define the causes why it is difficult to incorporate MISS in clinical practice and measures suggested to overcome these hurdles.

Scope of Minimally Invasive Spine Surgery in Routine Spine Practice.

Minimally Invasive spine surgery is aptly defined by AOSpine MISS Curriculum Task Force [12]. They defined as “Minimally invasive spine surgery (MISS) is a suite of technology-dependent techniques and procedures that reduces local operative tissue damage and systemic surgical stress enabling earlier return to function striving for better outcomes than traditional techniques”. So MISS has gradually evolved over years with development of the technology and surgical skills. Initially MISS started with only lumbar discectomy and decompression procedures; however, with advancing techniques and technology, the scope of MISS has become wider and most of the commonly performed routine

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¹Department of Spine Surgery, Chirayu Hospital,
Vishwakunj Cross Roads, Paldi, Ahmedabad, Gujarat, India.

Address of correspondence :

Dr. Amit C. Jhala,
Consultant Spine Surgeon, Chirayu Hospital, Vishwakunj
Cross Roads, Paldi, Ahmedabad, Gujarat, India.

E-mail: acjhala@gmail.com

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Table 1: Current Scope of Minimally Invasive Spine Surgery

	Cervical	Thoracic	Lumbar
Anterior	Percutaneous endoscopic cervical discectomy	Thoracoscopic surgeries Minimally invasive thoracic procedures by specialized retractors Discectomies/Corpectomies and Fusion	LLIF OLIF Corpectomies
Posterior	Full endoscopic procedure or by tubular retractors - Posterior cervical discectomies or foraminotomies - Cervical decompressions	Full endoscopic procedure or by tubular retractors - Thoracic discectomies and decompressions - Fusion Vertebroplasty/Kyphoplasty	Transforaminal Endoscopy - Discectomy, foraminotomy and fusion Interlaminar endoscopy - Discectomy and decompression Micro endoscopic Discectomies and decompressions (MED) MIS TLIF

spinal procedures can be managed by MISS now as shown in Table 1. The reasons why MISS has exploded in the last decade is not only that there is less collateral spinal muscle damage which has reflected clinically in practice but patients are experiencing less post-operative pain, early rehabilitation and return to work, less blood loss, less hospitalization and small cosmetic scars. It can now be performed in any region of the spine such as, cervical, thoracic or lumbar and any type of procedure in form of decompression, single or multilevel fixations and fusions. It has been also used for anterior or posterior approaches and even in complex procedures such as, deformity corrections, intradural lesions and tumour surgeries. Actual benefit of MISS is in the “mid zone” [13]. Discectomy by open or MISS will give equal results; however, MISS has maximum benefit as the complexity increases such as, stenosis decompression, Transforaminal Lumbar Interbody Fusion (TLIF), and single or double level or Multilevel Oblique Lumbar Interbody Fusion (OLIF). However, we must remember that in more complex surgeries again the benefit of MISS decreases and open procedure comes into play in complex spinal deformities. These mid zone surgeries actually forms the major part of routine spine practice where scope of MISS is the most. All these have compelled the spine surgeon to expand their horizons and incorporate MISS into routine spine practice. There is a long phase of evolution for every spine surgeon and he, a novice or established, has to climb this ladder of evolution. Incorporating MISS is inevitable because of several reasons such as, competition and peer pressure, strong marketing force, to have thrust in the established practice, foreseeing the future of spine surgery or pressure from the patients to do MISS etc. However, inspite of this, there are definite hurdles faced by the spine surgeons to incorporate MIS in their practice.

Reasons for difficulty in incorporating MISS in Clinical Practice

Lack of Conceptualization

One of the main reasons for difficulty in adopting the MISS in clinical practice is lack of belief in the concept with an extreme bias towards the conventional surgeries and secondly, lack of openness towards accepting the benefits of MISS surgery. Conventional surgeons point to only short-term benefits of the

procedure because of less collateral muscle damage in MISS. Often it is quoted that there is no clinical benefit of doing most common procedure in spine surgery of discectomy by traditional methods or endoscopic/tubular methods however, they miss on two points. First, discectomy is the first step in further evolution in other complex MIS procedures where benefit is the most. Unless one starts with simpler discectomy procedure climbing the ladder of evolution to do further complex MIS procedure is not possible. Second, in long term if revision is required it is much easier to revise MIS procedure than traditional open procedures. There is an apprehension, anxiety and scepticism about the reproducible clinical outcomes after MISS compared to conventional open surgery. Questions which arises are whether adequate decompression is possible in lumbar spinal stenosis? Is there a chance of recurrent disc herniation after lumbar discectomy or whether fusion will occur after MIS Fusion techniques? In the beginning of the career, the fresh spine surgeons have anxiety of not producing adequate functional outcome after MISS and so they shy away from MISS procedures; and contrary to that well-established spine surgeons have fixed concepts built with their stable practice and therefore, they find no reason to accept or change.

Learning Curve

Even if one accepts the concept of MISS and its better functional outcomes, the next hurdle is to reproduce the same result by individual spine surgeon. This is because of the learning curve attached to it [14]. As with any newer technique, MISS has its own share of learning curve and the learning curve of MISS is steep. To overcome this, it requires a lot of mental conviction and motivation. The anxiety to overcome the hurdle of the learning curve demotivates the surgeon to adopt MISS and continue the conventional spinal surgery. There is a tremendous amount of stress in initial phase of learning curve. There is a stress of surgery, stress of producing equal results, stress of peer group comments in case of failure, stress of facing the patient and their relatives, stress of facing the complications and in case it happens there is financial stress to redo the surgery and in today’s era, there is added stress of medicolegal aspect. The beginners and fresh spine surgeons have been exposed to observing the MISS, have seen the results, have good motivation initially; however, when they go into clinical practice, they lack adequate patient pool and as well lack adequate skills to apply on their patients. They have less opportunity to select the right patients and frequently repeat the procedure for adequate development of the skill. Sometimes inadequate training with only a workshop or short observership make them motivated to do MISS. This is often inadequate to incorporate MISS. On the other hand, the established surgeons are at advantage of having a good patient

pool and opportunity to select right patients, however, they have fixed ideas, stable practice with no motivation and intention to change along with lack of time to develop new surgical skills. They try to always compare MISS in terms of time taken for surgery as they have pressure of finishing their workload.

Cost Factor

This is one of the major determinant and detrimental factor for adopting MISS even if there is acceptance and motivation to do MISS. There is a definite cost of initial establishment for the equipment like endoscope or microscope or tubular set, dedicated surgical instruments for endoscopic or microscopic procedure and good implants if MISS fixation is required. The young surgeon who has just started the practice finds it difficult to invest in MISS equipment's because of other overheads of establishing spine practice and established surgeons lack motivation to invest in MISS equipment's unless confident of practicing it. There is a negative vicious feedback which develops if somebody tries to cut the cost. A young or established surgeon with good motivation to start MISS but if lacks dedicated MISS equipment or implants, and tries to do the procedure because of overzealousness, will face problems. This may lead to failure of the procedure and demotivation. Failure will make him refrain from doing MISS again. There is also recurrent cost attached in endoscopic procedures because of slender instruments which has recurrent breakage.

Radiation Exposure

This is a downplay in MISS. There are ample evidence in literature of increased radiation exposure in MISS especially in MIS TLIF or MIS deformity correction or even in transforaminal endoscopy while inserting the needle [15]. A young surgeon starting his career in MISS has to be very much conscious about the radiation exposure and need to take adequate precautions during the surgery to protect the eyes, hands and body. This is sometimes the factor considered for not adopting MISS. Navigation and Robotics may decrease the radiation but prohibitive cost of these sophisticated gadgets may preclude their use in routine clinical spine practice. It may be affordable at tertiary spine care centres only.

Overcoming Difficulties and Hurdles and Incorporate MISS in Spine Practice

Proficiency in Open Spine Surgery

As for any minimally invasive procedure it is of the utmost importance to be proficient in open or conventional surgery first. This is important step even in spine surgery. Proficiency in conventional surgery helps to gain thorough knowledge of the spinal anatomy in three dimension. MISS requires lot of three

dimensional orientation. If surgeon is not good in open spine surgery, the novice MIS surgeon will not have orientation of the targeted MIS surgery. Also, open surgery is a perfect bail out strategy for MISS if surgeon is not able to complete the procedure. For example if there is no exposure of a surgeon for anterior retroperitoneal approach and attempts MIS OLIF approach then if surgeon is not able to complete the surgery or if there is any complication he will be in trouble. Therefore, open surgery will help in stepwise progression in evolution towards MISS.

Extensive Literature Reading

MISS has a tremendous scope and if one wants to start it is important to have extensive literature search and reading. In this era of knowledge explosion there is tremendous opportunity to go through the literature via internet. There are articles, technical videos, presentations, one to one communication with expert surgeons and many other avenues to gain knowledge. This will give in depth knowledge of the advantages of a particular procedure over the conventional and makes oneself theoretically sound. This will help to 'Target' right procedure for the right patient. Literature reading will also motivate the surgeon to perform MISS if he is convinced. This is very helpful especially to the young surgeons and fellows as they are motivated to read but the established surgeon will require a conscious internal drive and internal push from within to read and change.

Adequate Training

Incorporating MISS is not an overnight learning. It is a gradual process of adaptation of different surgical skill sets. Each skill set will require adequate training with gradually building the blocks over the previous surgical skill set. Unless there is adequate training which may be different for each surgeon in their evolution ladder. A novice surgeon will require a long time of training over a surgeon who is already doing basic MISS and wants to further improve on the skill. Short condensed course/observership or a small workshop is not enough for the novice but it may be adequate for a surgeon who is already performing MISS. For a novice it is important to do a long-term fellowship and to have a mentor to be proficient with the intricacies of the surgical technique. There are no short cuts for novice surgeons. Cadaver workshops and observership will only help to get oriented with the procedure and instrumentation. It will help in use of microscope, endoscope, working through tubes and orientation of anatomy through small ports, use of burrs, managing dural tears and managing bleeding. These courses may be helpful for surgeons who are already into the spine practice for long time performing traditional spine surgery and need add on training in MISS.

Adequate Set up

Conviction, reading and training will motivate the surgeon to perform the procedure. But if the surgeon does not have adequate set up of instruments, microscope, endoscope or MISS specific instruments either the training acquired will gradually fade or the surgeon will start with inadequate and improper instruments. Doing the procedure with inadequate and improper instruments will lead to failure of the procedure or complication and lead to frustration, negative feedback towards the procedure and will have a lifetime bad impact with demotivation to perform the procedure next time. Therefore, it is very important to acquire right set of instruments and equipments required to perform the procedure before attempting it.

Investment in Time

For acquiring any surgical skill it requires development of psychomotor skill. This is especially important in MISS to develop the psychomotor skill to either work through the microscope, endoscope or working through the tube. It is even important to be ambidextrous and develop to work with both the hands and without the help of the assistant. Developing psychomotor skill will reduce the speed of surgery and in initial phase will require lot of time to perform the same procedure compared to open. Hence, investment in time is an integral part of incorporating MISS in spine practice. Young surgeons have time but lack in skill. But because they can invest in time, have lot of patience and bold attitude to do something new in initial career, they can easily acquire the skill for MISS with persistent efforts. Young surgeons are actually the torch bearers for MISS. Established surgeons have patient pool, money to invest in equipment but lack adequate time and attitude to develop the skill because of the work pressure and fixed thought process and unless duly motivated it becomes difficult to acquire the adequate skill.

Surgical Learning without Harming

"Primum non nocere" meaning 'do no harm' – This phrase is very much apt for MISS. "The surgeon must have two special objects in view with regards to MISS, namely, to do good or to do no harm". While performing MISS during the learning process the surgeon should primarily look to the patient interest and not to do any harm while performing the procedure. So the question is how to do the first procedure after adequate exposure, reading and training? The most important is to perform the surgery under the supervision of an expert surgeon so in case of any problems during the surgery expert can help. The other way is to do the MISS procedure and after that traditionally do open surgery initially to check for adequacy of the procedure. Other way for example suggested by Kulkarni et. al. is if one wants to do tubular discectomy then

first do traditional open exposure upto lamina, then dock the tubular retractor at interlaminar area under vision and start doing the procedure through the tube. This will help not only developing the skill to work through the tube but also give wider view to exactly know in three dimension about the procedure. And in case of difficulty this will help to change from tubular to open very easily by just removing the tubular retractor [16].

Self-Evaluation

In initial phase of starting the MISS, strict documentation, self-evaluation of the surgical technique and problems faced during the procedure and monitoring the patient postoperatively is of the utmost importance. One needs to evaluate the problems faced during the surgery to improve next time. It is also necessary to note clinical improvement post operatively and radiological evaluation by X-ray and MRI to find out completeness of the procedure or residual problems. For example if over the top decompression is attempted, postoperative MRI will help to evaluate the completeness of decompression. Self-evaluation after ever procedure will help perfecting the technique.

Conclusion

Since long the traditional open surgery has been considered as the gold standard procedure; however, with the advent of endoscopes, microscopes, tubular retractors, dedicated instruments for MISS, burrs and specialized spinal fixation implants, MISS has matured enough to replace the traditional open spine surgery as gold standard in certain areas of spine surgery. The scope of MISS in spine surgery has widened to include all diagnosis and all regions of the spine. Still there is a long way for MISS to incorporate fully in spine practice, though it has become an integral part in spine surgeon's armamentarium. Although most of the routine spinal procedures can be performed by MISS, there are still a lot of hurdles to incorporate MISS in routine spine practice by traditional spine surgeons. It is only conviction to improve, passion to perform MISS, lot of patience, adequate training, overcoming learning curve and humility of converting to open in case of failure along with investment in adequate time, money and energy will help to incorporate MISS in spine surgeons practice.

References

1. Markatos K, Korres D, Kaseta MK, Karamanou M, Androutsos G, Paul of Aegina (625-690), his work and his contribution to neurological surgery: trephinations and laminectomies in the Dark Ages, *World Neurosurgery* (2017), doi: 10.1016/j.wneu.2017.10.047.
2. Tarpada SP, Morris MT, Burton DA. Spinal fusion surgery: A historical perspective. *J Orthop*. 2016;14(1):134-136. Published 2016 Nov 9. doi:10.1016/j.jor.2016.10.029
3. Truumees E. A history of lumbar disc herniation from Hippocrates to the 1990s. *Clin Orthop Relat Res*. 2015;473(6):1885-1895. doi:10.1007/s11999-014-3633-7
4. Telfeian, A. E., Veeravagu, A., Oyelese, A. A., & Gokaslan, Z. L. (2016). A brief history of endoscopic spine surgery, *Neurosurgical Focus FOC*, 40(2), E2.
5. Caspar W. A new surgical procedure for lumbar disc herniation causing less tissue damage through a microsurgical approach. In: Wullenweber R, Brock M, Hamer J, editors. *Advances in Neurosurgery*. Berlin: Springer-Verlag; 1977. pp. 74–7.
6. Yasargil MG. Microsurgical operation for herniated disc. In: Wullenweber R, Brock M, Hamer J, Klinger M, Spoerri O, editors. *Advances in Neurosurgery*. Berlin: Springer-Verlag; 1977. p. 81
7. Microlumbar discectomy: a conservative surgical approach to the virgin herniated lumbar disc. *Williams RW. Spine (Phila Pa 1976)*. 1978 Jun; 3(2):175-82
8. Foley KT, Smith MM. Microendoscopic discectomy. *Techniques in Neurosurgery*. 1997;3:301–7
9. Vaishnav AS, Othman YA, Virk SS, Gang CH, Qureshi SA. Current state of minimally invasive spine surgery. *J Spine Surg*. 2019 Jun;5(Suppl 1):S2-S10. doi: 10.21037/jss.2019.05.02. PMID: 31380487; PMCID: PMC6626758.
10. Hammad A, Wirries A, Ardeshiri A, Nikiforov O, Geiger F. Open versus minimally invasive TLIF: literature review and meta-analysis. *J Orthop Surg Res*. 2019 Jul 22;14(1):229. doi: 10.1186/s13018-019-1266-y. PMID: 31331364; PMCID: PMC6647286.
11. Miller LE, Bhattacharyya S, Pracyk J. Minimally Invasive Versus Open Transforaminal Lumbar Interbody Fusion for Single-Level Degenerative Disease: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *World Neurosurg*. 2020 Jan;133:358-365.e4. doi: 10.1016/j.wneu.2019.08.162. Epub 2019 Aug 30. PMID: 31476471.
12. Schmidt FA, Wong T, Kirnaz S, et al. Development of a Curriculum for Minimally Invasive Spine Surgery (MISS). *Global Spine Journal*. 2020;10(2_suppl):122S-125S. doi:10.1177/2192568220910711
13. Härtl R. The 6 T's of Minimally Invasive Spine Surgery. *Global Spine Journal*. 2020;10(2_suppl):S5-S7. doi:10.1177/2192568220911617
14. Modi HN. Learning Curve for Minimally Invasive Spine Surgeries: A Review of Initial 162 Patients in Five Years of Implementing MISS Technique. *Journal of Minimally Invasive Spine Surgery and Technique* 2020; 5(2): 43-50.
15. Dushyanth Srinivasan, Khoi D. Than, Anthony C. Wang, Frank La Marca, Page I. Wang, Thomas C. Schermerhorn, Paul Park. Radiation Safety and Spine Surgery: Systematic Review of Exposure Limits and Methods to Minimize Radiation Exposure. *World Neurosurgery*; Volume 82, Issue 6, 2014, Pages 1337-1343.
16. Kulkarni A., Ruparel S. How to Incorporate Minimally Invasive Spine Surgery in Practice? *J Minim Invasive Spine Surg Tech*. 2018;3 (1): 9-12.

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