



The 'Nightmare' of Wrong Level in Spine Surgery: Is Minimally Invasive Spine Technique More Forgiving?

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Objective: Operating on a wrong level is a nightmare for every surgeon, which has devastating consequences for the patient as well as the surgeon and has potential for serious medical, personal and legal repercussions. There is limited literature of Wrong Level Spine Surgery (WLSS) in Minimally Invasive Spine Surgery (MISS). The aim of the study is to evaluate the incidence of WLSS in MISS using tubular retractors. **Methods:** The study included a retrospective review of prospectively collected data of all MIS surgeries utilizing tubular retractors during the period extending from January 2007 to December 2014. The surgeries included Micro-Endoscopic Discectomies, Micro-Endoscopic Decompression surgeries for lumbar canal stenosis and Minimal Invasive Trans-Foraminal Lumbar Interbody Fusion (MI-TLIF) surgeries. The surgeries involved docking of the tubular retractor at the level of interest under fluoroscopic guidance. Surgical charts as well as clinical and imaging follow-up data were analyzed. The incidence of WLSS was analyzed. **Results:** There were 1,043 surgeries in all in the study period. There were 393 discectomies, 370 decompressions and 280 MI-TLIF surgeries. There were no wrong level surgeries in the entire series. There were two (0.19%) wrong side tube dockings which were subsequently rectified during surgery. No clinical complications were seen. The results were reviewed in light of a meta-analysis of current literature available on WLSS in open and MISS. The results were consistent with the present literature in demonstrating a decreased incidence of WLSS with MISS. **Conclusion:** The docking of the tubular retractor under fluoroscopic guidance offers an advantage of preventing WLSS. This is an additional benefit of MISS using tubular retractors.

Key Words: Minimally invasive spine surgery, Wrong level surgery, Incidence

INTRODUCTION

Among the peri-operative incidents, operating on a wrong level/site is a nightmare for every surgeon. The term 'wrong-site surgery' was devised as a concept to include events such as operating on the wrong person, the wrong organ or limb, or the wrong vertebral level¹⁾. Wrong-level indicates that a level other than the level of the disorder is operated²⁾. Wrong Level Spine Surgery (WLSS) is a unique pitfall and it fails to resolve the pathologic abnormality, clinical symptoms and has profound medical, legal, social and emotional implications^{3,4)}. WLSS is significantly underreported⁵⁾, as per Joint Commission's (JCAHO) report, wrong-patient, wrong-site, or wrong-procedure events were the most common sentinel events amounting to 13% of all the events (928 of 6,994 events) between 2004 to 2012⁴⁾.

Groff et al.⁶⁾ in their survey on members of American Association of Neurological Surgeons had concluded that there is a

substantial heterogeneity in approaches among different surgeons to localize the desired surgical level. They also concluded that presently there is no universally implemented standard in place to reduce the incidence of wrong-level surgery, and the existing safety protocols are not decreasing the occurrence of wrong-level surgery to the extent as thought.

There has been an increasing interest in Minimally Invasive Spine Surgery (MISS) in recent times. There are obvious advantages of MISS over open surgery which include less tissue trauma, less blood loss, low rate of peri-operative complications, minimal post operative morbidity, decreased hospital stay and eventually cost⁷⁾. In view of current literature the study was done to assess the association of MISS and WLSS.

MATERIALS AND METHODS

The study included a retrospective review of prospectively

collected data of all MIS surgeries commonly performed in our department of varied etiologies, utilizing tubular retractors during the period extending from January 2007 to December 2014. The surgeries included Micro-Endoscopic Discectomies, Micro-Endoscopic Decompression for lumbar canal stenosis and Minimal Invasive Trans-Foraminal Lumbar Inter-body Fusion (MI-TLIF) surgeries. Microendoscopic Discectomy was done using 16/18 mm diameter tubes whereas Microendoscopic Decompression was performed with 18 mm tubes; MI-TLIF was done using 22 mm

tubes. All the procedures involved similar techniques of docking of the tubular retractor at the level of interest under fluoroscopic guidance and performing the respective surgeries⁷. Surgical charts as well as clinical and imaging follow-up data were analysed. Imaging involved radiographs, computed tomography scans and magnetic resonance imaging scans done as per the need. All the patients in whom instrumentation was done were followed up with a postoperative radiograph. The incidence of WLSS was analysed. The results were reviewed in the light of an analysis of current literature available on WLSS in Open and MISS.

Table 1. Total number and type of surgeries in the study

Surgery performed	Number (n)
Microendoscopic discectomy	393
Microendoscopic decompression	370
Minimally invasive - TLIF	280
Total	1,043

RESULTS

A total of 1,043 MIS Surgeries of varied etiologies were included in the study period (Table 1). There were no wrong level surgeries in the entire series. There were two (0.19%) wrong side tube dockings which were subsequently rectified during

Table 2. Meta-analysis of Literature on WLSS in Open and MISS

Author/s	Number (n)	Diagnosis	Procedure	Wrong level frequency
Williams RW ⁸	530	Lumbar disc herniations	Microdiscectomy	3 (0.6%)
Eie et al. ⁹	943	Lumbar disc herniations	Lumbar disc surgery with or without fusion	20 (2.1%)
Ruggieri et al. ¹⁰	872	Lumbar disc herniations	Discectomy	7 (0.8%)
Barrlos et al. ¹¹	150	Lumbar disc herniations	Microdiscectomy (75), Discectomy (75)	5 (3.3%)
Goodkin and Laska ¹²	21	Lumbar disc herniations	Discectomy (7), Microdiscectomy (1), Laminectomy (15)	1 (14.3%) (wrong level exposure)
Ebraheim et al. ¹³	80	Varied Etiologies	Posterolateral fusion without instrumentation	4 (5%)
Ammerman et al. ¹⁴	100	Lumbar disc herniation	Standard Discectomy	15 (15%)
Jhavar et al. ¹⁵	7,344 cases	Disc degeneration and disc herniation	Lumbar discectomy (4,695), Cervical discectomy (2,649)	8 (0.01%) Lumbar- 6 (0.1%), Cervical- 2 (0.1%)
K N Acharya et al. ¹⁶	273	Disc herniation	259 Primary discectomy and 14 revision surgeries	1 (0.3%)
Mody et al. ¹⁷	1,300,000 spine procedures	Disc degeneration and disc herniation		418 (0.03%)
Irace and Corona ¹⁸	818	Primary lumbar disc herniations (765), recurring lumbar disc herniations (53)	Single-level lumbar microdiscectomy	1- (0.1%) (Wrong-level exposure)
Matsumoto M et al. ¹⁹	6,239 spinal endoscopic surgeries		4,336 cases of microendoscopic discectomy (MED), 1,273 cases of microendoscopic laminectomy and 379 fusions	7 (0.01%)
Ebata et al. ²⁰	611	Lumbar disc herniation, lumbar spinal stenosis, degen spondylololishesis, facet joint cysts	Microendoscopic decompression	3 (0.49%)

surgery. The absence of frank disc herniation led to fluoroscopic control in this case, and the corrective surgery was done from the contra-lateral side. This kind of contra-lateral decompression/discectomy can be performed with the tubular retractors. No clinical complications were seen. The results were reviewed in light of a meta-analysis of current literature available on WLSS in open and MISS (Table 2). The results were consistent with the present literature in demonstrating a decreased incidence of WLSS with MISS.

DISCUSSION

The term Never Event is currently used to refer those operations performed on the incorrect side or at the wrong level, with the later particularly referring to spinal surgery²¹. Wrong level spine surgery occurs when a surgeon performs decompression, resection or reconstructive procedure on an unintended anatomic location along the spinal axis²². It is a unique problem in spinal surgery and has profound medical, legal and social repercussions. From a Clinical stand point, the pathologic process and patient's symptomatology are not addressed in the setting of WLSS.

The incidence of WLSS in open spine surgeries worldwide varies from 0.1 to 15%⁸⁻¹⁷. There is heterogeneity of the data available and the incidence is expected to be higher than has been reported. Mody et al.¹⁷ in his questionnaire study found high prevalence of wrong level surgeries among spine surgeons with nearly 50% of surgeons performing at least one WLSS during their career. The overall strength of the data available to establish the risk factors for WLSS has been rated as 'Low'.

A number of universally accepted protocols have been established and practised for reducing the incidence of WLSS. These protocols varies among different hospital and among surgeons. The 'Sign Through Your Initials' by the Canadian Orthopaedic Association²⁴, the 'Sign Your Site' programme by American Orthopaedic Surgeons, the Sign, Mark and X-ray (SMax) programme by North American Spine Society²⁵, and the Universal Protocol for Preventing Wrong Site, Wrong Procedure, Wrong Person Surgery by the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO)²⁶ are among the commonly

recognized protocols.

The most trusted methodology is to obtain an intra-operative radiograph check to exact the vertebral level by marking a fixed anatomical structure with metallic marker⁴. However, obtaining intra-operative radiograph does not guarantee the correct level. Congenital variations, inadequate radiological exposure or incorrect identification of the level, inadequate radiological visualisation because of large body size or inadequate size of operating table, and failure to recognise the absence of an expected lesion at the operative.

Level, can all lead to misinterpretation of the radiological image. Optimum pre-operative planning is an integral part of reducing the incidence of WLSS in MISS. Several other methods have been proposed to identify the site of operation, including intra-operative CT, spinal neuronavigation, transligamentous ultrasound, and longitudinal surface markers filled with halibut liver oil¹⁷.

The ongoing efforts to reduce the incidence of WLSS are credited with widespread use of Minimally Invasive Spine Surgery. The incidence of WLSS is 0.09-3.3%¹⁸⁻²⁰. The MIS surgeries using tubular retractors involves operating through tubular ports. The tubular ports land over the lamina of interest following progressive dilatation of the intermuscular plane. The inter-muscular dilatation is performed using a series of dilators of increasing diameter that are passed over a guide wire. The passage of the guide wire is central to localization of the operating level following which the dilators are passed. All these steps are performed sequentially under C-arm guidance (Fig. 1). Hence there are ample opportunities for the operating surgeon to not only confirm the localization of the correct level but also cross-check the same. The sequential series of steps initially starting with the guide-wire and then the dilators and finally the tubular port, being C-arm guided provide serial check-points to assure that the correct level is localized and operated upon. These radiographs are compared with the pre-operative films. In the present study the incidence is Zero and this can be attributed to serial radiographic guidance which is unique in MISS (serial check points from guide wire to final tube) to dock the tube.

To authors knowledge this is the maximum number of MISS cases studied at a single centre by a single surgeon. There

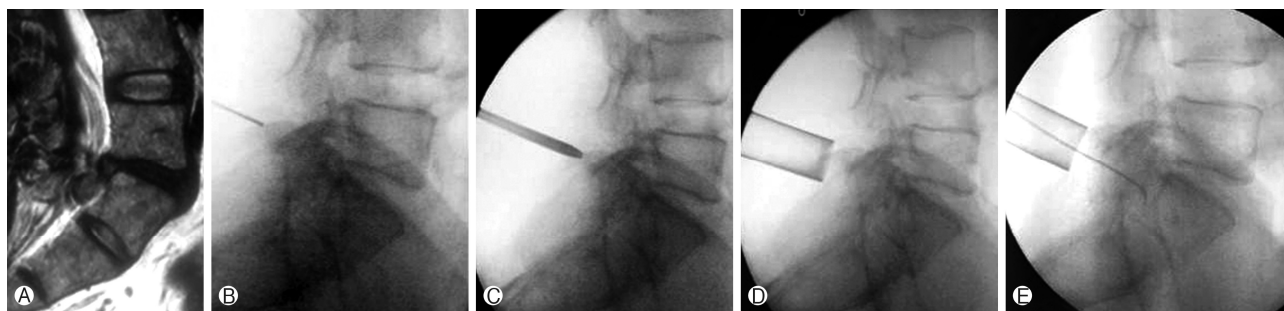


Fig. 1. (A) Pre-operative MRI showing Sacralisation of last lumbar vertebra, (B) A spinal needle is first inserted at desired level (C) Progressive dilators are passed, (D) Radiograph after docking the tube, (E) Penfield at the pedicle showing satisfactory decompression.

were two cases of wrong side tubular docking but it did not result in additional incision/exposure as the contralateral decompression is easily done using tubular retractors by 'over the top' technique^{7,23}. Using a unilateral tubular portal a bilateral bony and ligamentous decompression can be achieved under the midline, thereby preserving the supraspinous-interspinous ligaments and contralateral musculature. Even if the tube is docked on the wrong side it is possible to decompress or perform a discectomy on the opposite side without any additional incision/exposure. It is our protocol to obtain radiographs post-operatively in all instrumentation cases.

The present study is not without limitations. There is relatively increased exposure to radiation in confirming levels at each step in MIS surgeries. Use of better planned pre-operative template and obtaining selected intra-operative radiographs will reduce the exposure to radiation.

CONCLUSION

It can be stated that the spine surgeon is the only healthcare provider with access to all the information necessary to identify the correct spinal segment at the time of surgery. Inherent technique of MISS using tubular retractors involves serial checkpoints and final confirmation of parking the tubular retractor on a lateral image intensifier image. Hence the risk of exploring and operating on wrong level is unlikely. This is an added advantage of tubular retractors along with other benefits such as minimal soft tissue trauma, early mobility, less blood loss, better cosmesis etc.

KEY POINTS

Wrong site surgery fails to improve the patient's symptoms and has medical, emotional, social, and legal implications.

The spine surgeon is the only healthcare provider with access to all the information necessary to identify the correct spinal segment at the time of surgery.

Inherent technique of MISS using tubular retractors involves final confirmation of parking the tubular retractor on a lateral image intensifier image.

Added advantage of tubular retractors along with other benefits such as minimal soft tissue trauma, early mobility, less blood loss, better cosmesis etc.

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