

ORIGINAL ARTICLE

A comparison between different suture techniques in lumbar spine surgery

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Abstract

As a result of solicited muscles, strong friction, and tensile force on cutaneous tissue, the difference in closure procedure and management strategies and complications of surgical incision healing is a real challenge in lumbar spine surgery. We performed a retrospective study to compare different types of wound closure in lumbar spine surgery. 4383 patients were included in this study. Wound dehiscence was more common in the intracutaneous suture group than in the far- near-near-far suture group. Delayed wound healing occurred more in the far-near near-far suture group than intracutaneous suture group. Also, the far-near near-far interrupted point suture group showed a higher ratio of delayed wound healing compared with crossover suture. The superficial wound infection rate was roughly the same in all types of sutures with an average value of 0.79% with 0.81% SD. This is a preliminary study to compare different types of operative wounds showing the pros and cons related to each option.

KEYWORDS

infection, lumbar spine surgery, postoperative wound healing complications, suture techniques

Key Messages

- as a result of solicited muscles, friction in cutaneous tissue, and great pressure, the procedure of closure and management of closure complications are a real challenge in lumbar spine surgery
- we performed a retrospective study to compare different types of cutaneous closure in lumbar spine surgery. 4383 patients were included in this study
- we had 5.41% delayed wound healing with far-near near-far sutures vs 1.66% with intradermic sutures. On the other hand, wound dehiscence is more common with intradermic sutures (2.57%) vs 0.74% with a far-near-near-far suture. The infection rate was roughly the same in all types of closure with an average of 0.78%

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1 | INTRODUCTION

One of the most persistent problems in lumbar spine surgery is wound healing complications. According to a recent study, surgical site infection was the most common primary reason for unplanned readmission.¹ Other reasons for readmissions or early unplanned consultation are wound dehiscence (WD) and delay of wound healing (necrotic, slough, or fibrinous wound).¹⁻⁸

We have found no in the literature addressing in great detail the reasons for the relatively high incidence of dehiscence and delay of wound healing in lumbar spine surgery. As far as this issue puts many cost and work burden on the treatment system, identifying the cause of this phenomenon can be very valuable, to eliminate it to avoid the repeated annoyance of patients. Our experience shows that muscles of the lumbar spine are among those most solicited and exert strong friction and tensile forces on the skin. In this paper, we aim to present our experience in retrospect with wound closure and we will undertake to do a comparison between different procedures to balance the advantages and disadvantages of each procedure.

2 | MATERIAL AND METHODS

We conducted a retrospective review of hospital records of 12 768 patients operated on for lumbar spine between January 2007 and December 2018. To avoid other factors that influence wound healing, diabetic patients and patients with body mass index (BMI) lower than 18.5 kg/m² and higher than 24.9 kg/m² were excluded from our study. Furthermore, cases with incision lengths of shorter than 4 cm or longer than 8 cm, cases suffering intraoperative dural tears and CSF leakage, and cases with surgery duration of longer than three hours were excluded. Patients who were operated on for metastasis were also excluded because poor general health is an important factor affecting wound healing. It needs to be noted that wounds move from one stage of complication to the next. We took into account the stage at the time of diagnosis of wound complication. Only patients who had superficial infectious wounds (IW) have been included in the study. The choice of closure method was random, the authors had no inclination for such or such closure. Choice of closure method was made at the time of closure at the end of surgery based on having more variety in mind to compare different closures.

All in all, 4383 patients were included in our study. There were 2284 males (52.11%) and 2099 females (47.89%)

TABLE 1 : Different wound suture techniques and the number of patients in each group

Groups	Number of cases	Skin incision suture technique
Group 1	943	Far-near near-far suture or Blair Donati
Group 2	834	Far-near near-far interrupted point suture
Group 3	901	Simple suture
Group 4	889	Crossover suture
Group 5	902	Simple interrupted suture
Group 6	815	Intracutaneous suture

Abbreviations: CS, crossover suture; FNP, far-near near-far interrupted point suture; FNS, far-near near-far suture; ICS, intracutaneous suture; SIS, simple interrupted suture; SS, simple suture.

aged from 22 to 93 years (mean age of 57.86 years). Patients were operated on for disc herniation, lumbar canal or foraminal stenosis, Baastrup Syndrome, intraspinal tumors like meningioma, schwannoma, etc. The length of surgery was between half an hour and two and a half hours. Depending on the case, surgical stitches have been removed 12 to 15 days after surgery.

There were six patient groups based on different suture techniques consisting of far-near near-far suture (FNS), far-near near-far interrupted point simple suture, crossover suture (CS), simple interrupted suture, and intracutaneous suture all of which have been mentioned in detail in Table 1. The postoperative documents of all patients were evaluated for any wound complications such as wound dehiscence, delayed healing (DH), and IW. To consider in more detail, DH complications are divided into three categories including necrotic wounds, fibrinous wounds, and exudative wounds.

According to the definition of the Centers for Disease Control and Prevention, we defined IW when the patient had only a superficial wound infection. The infection complication was defined according to the following criteria: infection occurs up to 30 days after surgery, the infection involves only the skin or subcutaneous tissue and there are at least one of these criteria:

- Purulent secretion with or without microbiological confirmation
- Organism isolation in liquid culture or in the tissue from the superficial incision obtained under highly controlled aseptic conditions
- At least one of the following signs: fever, pain or tenderness, localised tissue swelling, redness, and skin warmth (Figure 1, 2).⁹⁻¹⁶

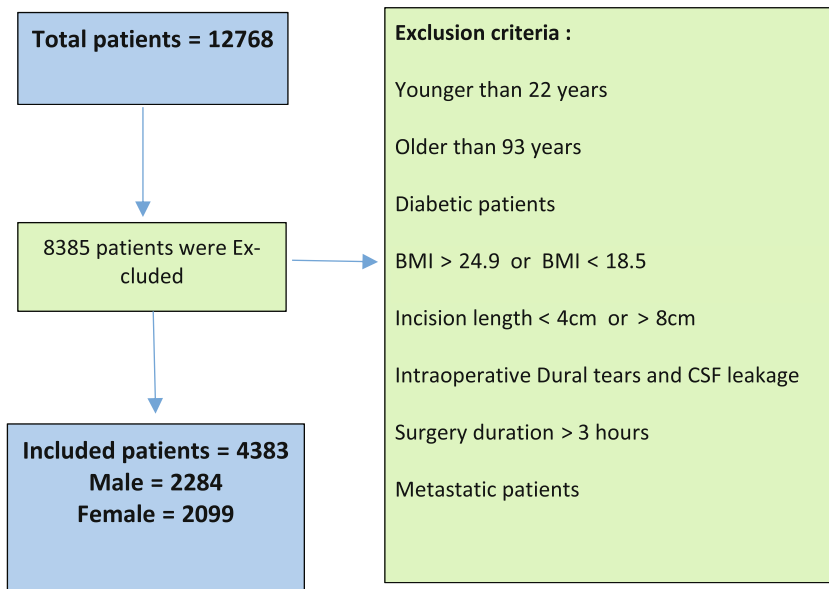


FIGURE 1 An overview of the sample size in the study

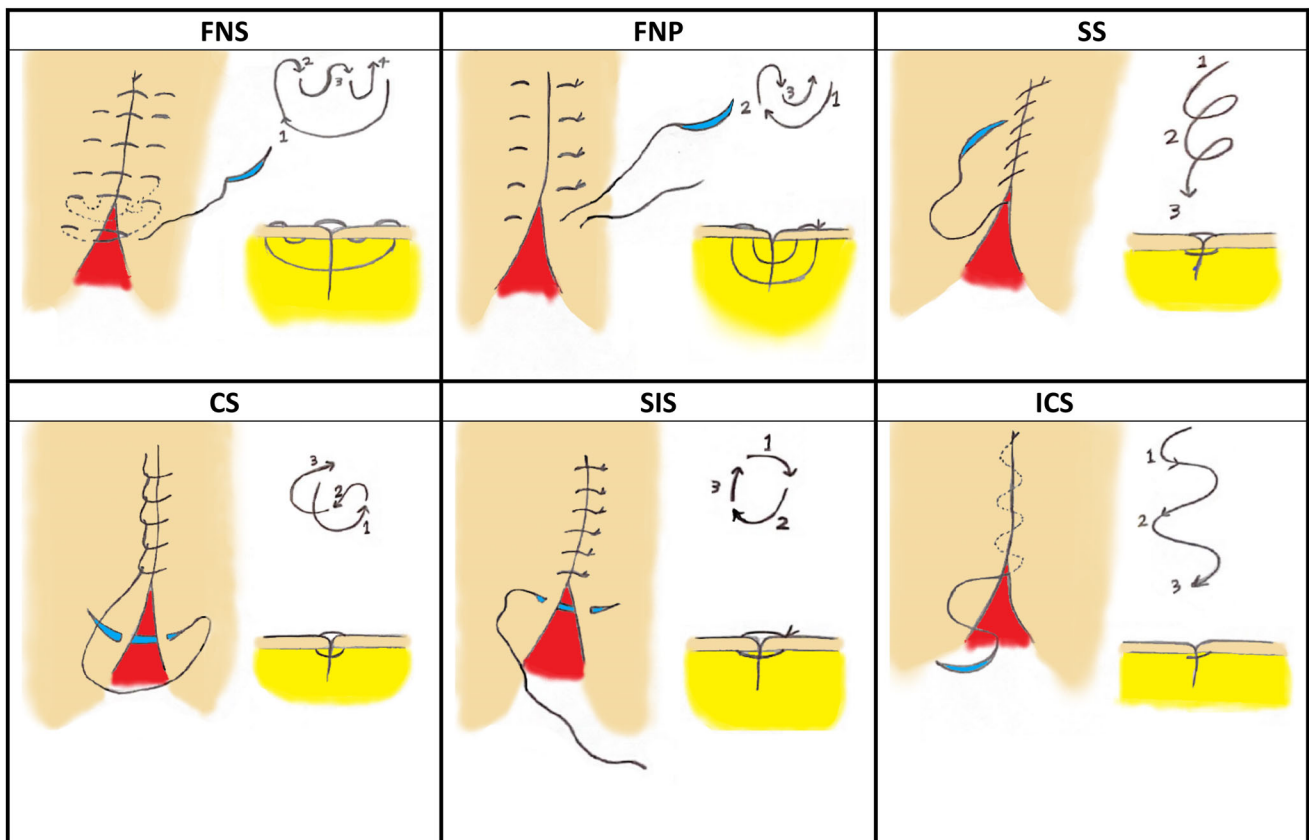


FIGURE 2 Pictures of different Suture techniques

3 | RESULTS

Table 2 summarises the results of our study about the occurrence of wound healing complications in each suture technique group. There were some meaningful

differences between the groups all of which have been mentioned in the table in detail.

Overall, WD was more prevalent in FNS and FNP groups rather than intracutaneous suture (ICS) and simple interrupted suture (SIS) groups after surgery. The ICS

TABLE 2 Baseline of patients and comparison of complications in different techniques of suture

Technique of suture	Number	WD		DH				IW	
		Nr.	Rate	N.	F	E	Rate	Nr.	Rate
FNS	943	7	0.74%	5	23	18	5.41%	8	0.85%
FNP	834	6	0.72%	3	19	16	4.56%	7	0.84%
SS	901	9	1%	2	10	11	2.55%	8	0.89%
CS	889	8	0.90%	1	8	8	1.91%	6	0.67%
SIS	902	14	1.56%	2	11	11	2.66%	7	0.78%
ICS	815	21	2.57%	0	6	7	1.66%	6	0.74%

Abbreviations: CS, crossover suture; DH, delayed healing; E, exudative wound; F, fibrinous wound; FNP, far-near near-far interrupted point suture; FNS, far-near near-far suture; ICS, Intracutaneous suture; IW, infectious wound; N, necrotic wound; Nr., number of cases; SIS, simple interrupted suture; SS, simple suture; WD, wound dehiscence.

group showed a 2.57% rate of WD which was significantly higher than the FNS group with 0.74% (P value = .002). Also, this difference was prominent between ICS and FNP (2.57% vs 0.72% with P value = .003), ICS and simple suture (SS; 2.57% vs 1% with P value = .013), ICS and crossover suture (CS; 2.57% vs 0.90% with P value = .008); however, WD was not diverse between the two last groups. (ICS with 2.57% vs SIS with 1.56%, P value = .134).

To consider the DH complication, the necrosis phenomenon was notably lower than fibrinous and exudative wound complications in all groups separately; Nonetheless, the overall rate of DH was significantly higher in FNS and FNP groups in comparison with other groups. For example, FNS considerably exhibited 5.41% of DH vs SS with 2.55%, CS with 1.91%, SIS with 2.66%, and ICS with 1.66% all of which showed meaningful disparity (P values are .009, .000, .013 and .000 respectively). Similarly, the DH rate in FNP was higher rather than other groups (4.56%) with significant P values, (FNP vs SS with P value = .024, FNP vs CS with P value = .002, FNP vs SIS with P value = .033, FNP vs ICS with P value = .001) but this complication among the two types of FNS techniques were not significantly different. (FNS with 5.41% vs FNP with 4.56%, P value = .750).

IW complication was approximately the same among all techniques and the average ratio was 0.79% with a SD of 0.81%. The comparison of IW between the six groups showed a P value of .996.

4 | DISCUSSION

Although there are different methods for suturing in spinal surgeries, most articles have compared the effect of the materials used on the incidence of complications rather than types of sutures, most of which reported contradictory results.

To evaluate the effectiveness of various techniques in minimising complications, some researchers have studied the complications of deeper layers. Even in a deeper context, there is a lack of exact study about the role of different suture techniques extendedly. For example, in a short review, SK. Menona and ChU. Onyiah studied the incidence of CSF leak in spinal surgeries and its etiologies.¹⁷ They mentioned decompression procedures, a posterior approach in surgery, open surgery vs minimally invasive technique, the occurrence of a synovial cyst, ossification, or previous scars as the contributing factors, but they did not discuss any study associated with the effect of different suture techniques in this issue. The result of our study showed that the important role of various sutures in WD and DH could be associated with an unrecognised effect of suture technique on CSF leak and other deeper complications, which should be investigated in further studies.

Maria Kamenova et al in a retrospective study on 1173 patients undergone degenerative lumbar spine surgery, examined the incidence of incidental dural tear in three groups of suture techniques.¹⁸ They studied techniques including sole dural suture, the patch only, and dural suture in combination with a patch. The researchers studied the need for revision surgery aroused from cerebrospinal fluid leakage, an increase in operation time, hospitalisation time, and surgical morbidity. In the end, they did not catch any difference in the aforementioned factors and clinical outcomes between the three groups and stated that postoperative immobilisation and insertion of a drainage tube were not contributing to a higher rate of revision surgery. High BMI among patients could cause more complications and revision surgery necessity; although, more studies are needed. This study investigated more surgical techniques than suturing techniques. Meanwhile, in this study, two important factors, BMI and the American Society of Anesthesiology score were not matched between the three groups. This issue

can be a reason for the failure of significant differences in the rate of complications between the three groups. However, our study was based on suture techniques and the patients of all 6 groups were matched in terms of BMI and other contributing factors.

Different suture types could be assessed in economic aspects for patients. In a retrospective study in 2018, Stephen S Johnston et al compared the effects of two suture techniques on spine surgery in 3705 patients.¹⁹ They examined admission's length of stay, hospital costs, non-home discharge, operating room time, wound complications, and readmissions in terms of Barbed and conventional sutures. Finally, they stated that the Barbed method is more efficient in terms of lower operating room time and costs than the conventional sutures. Also, there were no considerable differences in wound complications or readmissions between the two groups. Although their results about complications were not compatible with ours, probably because of their narrow study only on two categories vs six groups in our article. The economic considerations are another point that could be evaluated in studies resembling us in the future.

To look at the complications in more detail, Emre Yilmaz et al in a systematic review, worked on searching for an optimal wound closure technique for major posterior spine surgery.²⁰ They investigated the various wound complications, decreasing factors of complications, the effectiveness of subcutaneous closure technique in obese patients, and different types of dressing for wounds. In this study, the complication of infection was variable in patients with more than three levels of posterior spine fusion. Suturing was more efficient than staples in skin closure in terms of wound infection, as we found FNS and FNP more trustable for WD reduction compared with ICS. Nonetheless, no correlation was found between the number of levels of fusion and infection risk in their results, the same as ours. Silverlon dressing showed less infection rate than conventional dressing. Finally, they mentioned that more studies are needed to obtain complete evidence for optimal wound closure technique in posterior spine surgery.

5 | CONCLUSION

This study presented significant differences in WD and delayed wound healing among the various suture techniques in lumbar spine surgery. We believe that the intracutaneous sutures cannot always resist the high tensile forces in the lumbar area and therefore tear. We also hypothesize that the delayed wound healing in FNS and FNP groups may be attributed to some local ischemia because of the high tensile forces in cutaneous and subcutaneous tissues exerted by this suture type. Therefore,

it is wiser to choose the type of suture technique according to the patient's BMI and other contributing factors in order not to force unnecessary tension on the wound with FNS or FNP technique which induces DH, or perform weak stitches with the ICS technique for an extended wound which ends up with wound dehiscence. More studies are needed to recognise the application of each suture technique in spine surgery more exactly.

AUTHOR CONTRIBUTIONS

Keyvan Mostofi: wrote the paper. **Morad Peyravi:** collected information and analysed data. **Ali Shirbacheh:** collected information and analysed data. **Kamran Shirbacheh:** revised the paper and drew the images.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing not applicable - no new data generated, or the article describes entirely theoretical research

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