



# Effects of Surgical Position on Blood Loss in Single Level Lumbal Disc Hernia Microsurgery

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- Received Date: 20 Aug 2023
- Accepted Date: 20 Sep 2023
- Publication Date: 24 Sep 2023

## Keywords

Lumbar Disc Herniation, Microsurgery, Blood Loss, Spine Surgery Frame, Thoracic Gel Rolls.

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## Abstract

**Background:** Lumbar disc herniation refers to the protrusion or rupture of intervertebral discs. Blood loss during spinal surgery can have substantial implications for patient outcomes, including the risk of complications, transfusion requirements, and length of hospital stay. Our study aims to compare the effects of two auxiliary materials used in spinal surgical procedures on surgical blood loss.

**Methods:** This study was conducted in two centers. This is a prospective, randomized, controlled trial. It included 100 participants. The study was conducted at two centers. The radiolucent spine surgery frame was utilized at one of them, while at the other center, thoracic gel rolls were employed. Body mass index, surgery duration, and bleeding are some variables examined in the study.

**Results:** No statistically significant difference among the groups regarding age, side, and gender variables ( $p>0.05$ ). However, statistical analysis has revealed significant differences in the distribution of other analyzed variables, namely Body Mass Index, Duration of Surgery, and Amount of Bleeding, among the groups ( $p=0.03$ ,  $p<0.01$ , and  $p=0.01$ , respectively). There is a significant positive correlation between body mass index and the amount of bleeding in both groups.

**Conclusion:** The effects of surgical position on blood loss in lumbar disc hernia microsurgery remain a topic of ongoing research. Assessing other important perioperative outcomes would provide a more comprehensive understanding of the impact of devices like spine surgery frames and gel rolls on the surgical process.

## Introduction

Lumbar disc herniation (LDH) is the protrusion or rupture of intervertebral discs in the lumbar region, leading to compression or irritation of adjacent nerve roots [1]. Epidemiological studies have elucidated that LDH affects a substantial proportion of the global population, with varying prevalence rates across different regions and demographic groups [2]. Numerous risk factors have been identified, including heavy physical labor, repetitive lifting, obesity, smoking, and genetic predisposition. Furthermore, degenerative changes in the intervertebral discs over time contribute to the pathogenesis of LDH [3].

Lumbar disc herniation microsurgery is a surgical technique employed to manage lumbar disc herniation, a common cause of lower back pain and radicular symptoms [4]. The key objective of lumbar disc herniation microsurgery is to achieve decompression of the affected nerve roots while preserving spinal stability [5]. This microsurgical approach offers several advantages, including reduced tissue trauma, minimized blood loss,

shorter hospital stays, and faster recovery than traditional open surgeries [6]. Meticulous patient selection, preoperative evaluation, and surgical expertise are paramount to ensure optimal outcomes and minimize potential complications associated with lumbar disc herniation microsurgery [7].

Blood loss during surgery can have substantial implications for patient outcomes, including the risk of complications, transfusion requirements, and length of hospital stay [8]. While numerous factors contribute to intraoperative bleeding, the influence of surgical position on blood loss has garnered considerable attention [9]. The patient's position during surgery can impact blood flow dynamics, venous return, and hemostasis, affecting the amount of blood lost [10]. Understanding the effects of different surgical positions on blood loss is vital for optimizing surgical strategies and patient outcomes [11].

The spine surgery frame has emerged as a crucial tool for achieving stability, alignment, and fusion in complex spinal surgeries. The development and refinement of the spine surgery frame have significantly improved

**Citation:** Karaoğlu A, Bayat M, Bayram S, Kuytu T. Effects of Surgical Position on Blood Loss in Single Level Lumbal Disc Hernia Microsurgery. Japan J Res. 2023;4(8):1-6

surgical outcomes, reducing morbidity and enhancing patients' quality of life [12].

The use of thoracic gel rolls has garnered attention in the field of spinal surgery as a means to enhance patient outcomes and optimize postoperative care. These rolls are designed to alleviate pressure points, distribute weight evenly, and maintain proper alignment of the spinal region. The ergonomic advantages and potential clinical benefits of gel rolls make them an effective adjunct in spinal surgery [12].

It is imperative to acknowledge the minimal existing literature in this field. Therefore, planning studies that contribute to the literature in this area is crucial. In this context, our planned study compares the impact of two adjunct materials used in spinal surgery procedures on surgical outcomes.

## Materials and methods

### Study population

This study encompasses individuals who have undergone microsurgery due to lumbar disc herniation and were examined at the two centers where the study was conducted. These individuals constitute a population that did not respond to conservative treatment methods..

### Power analysis

A power analysis was conducted to determine the sample size for the research. With an effect size of  $d = 0.75$ , a power ( $1-\beta$ ) of 0.90, and an allocation ratio of 1, the calculation resulted in a minimum required sample size of 39.

### Study design and participants

Our study was designed as a prospective, randomized, controlled trial. It included 109 participants who underwent microsurgery for lumbar disc herniation between December 2020 and April 2022 at two tertiary healthcare institutions. Before surgery, patients underwent a comprehensive preoperative evaluation, including a detailed medical history, physical examination, and radiological imaging. All surgeries were conducted by a skilled neurosurgeon specializing in spine procedures, utilizing a posterior approach under general anesthesia. During this phase, eligibility for research participation was assessed. Those meeting the inclusion criteria were enrolled in the study, while those not meeting the criteria were excluded from the research. Nine participants who did not meet the criteria were excluded from the study.

Consequently, the study continued with 100 participants. The participants were randomly assigned to two groups using the sealed envelope method. The study was conducted at two centers. The radiolucent spine surgery frame (Acomed Industrial Co., Taiwan) was utilized at one of the centers, while at the other center, thoracic gel rolls (Universal Medical USA) were employed. Our study aimed to compare two commonly used platforms in microdiscectomy procedures. All participants underwent surgery in the prone position.

### Measurements

Researchers measured the participant's height and weight values, and their BMI values were also calculated by the researchers. The researchers also measured the duration of the operation. The amount of bleeding has been measured in two ways. The first method involves counting the surgical gauze pads used during the operation. Two types of gauze pads were utilized, namely 4 x 4 gauze pads and 30 x 30 cm gauze pads. It

was determined that 15 cc of blood corresponds to the former, while the latter represents 50 cc of bleeding. The second method entails recording the quantity of blood in the suction bottle during aspiration.

### Exclusion criteria

- Those who refuse to participate.
- Allergic to analgesics.
- Unsuitable candidates for regional or spinal anesthesia.
- Individuals who have used narcotic analgesics prior to surgery.
- Neuropathy.
- Cirrhosis.
- Renal insufficiency (Creatinine >1.2).

### Groups

- Group 1: The participants underwent surgical intervention utilizing a radiolucent spine surgery frame.
- Group 2: The participants underwent surgical intervention utilizing a thoracic gel rolls.

### Examined variables

- Age
- Gender
- Operated side
- Weight (kg)
- Height (cm)
- Body Mass Index (BMI)
- Duration of surgery (minutes)
- Amount of bleeding (cc)

### Surgical technique

All patients were operated with the Microdiscectomy technique. A midline incision was made, followed by a meticulous dissection of the paraspinal muscles to expose the affected intervertebral disc. Fluoroscopic guidance was used to ensure accurate localization. The herniated disc material was then meticulously removed using specialized microsurgical instruments while preserving as much healthy disc tissue as possible. Throughout the procedure, meticulous hemostasis was maintained to minimize bleeding. After completing the discectomy, the wound was thoroughly irrigated, and a layered closure was performed. Patients were closely monitored postoperatively, and appropriate pain management and rehabilitation protocols were implemented. The outcomes of the Microdiscectomy procedure were evaluated through clinical follow-up visits, including assessment of pain levels, functional status, and radiological imaging to confirm the success of the surgical intervention. The study was conducted at two centers. At one of the centers, the radiolucent spine surgery frame (Acomed Industrial Co., Taiwan) (Figure 1-A) was utilized, while at the other center, thoracic gel rolls (Universal Medical USA) (Figure 1\_B) were employed. Our study aimed to compare two commonly used platforms in microdiscectomy procedures. All participants underwent surgery in the prone position.

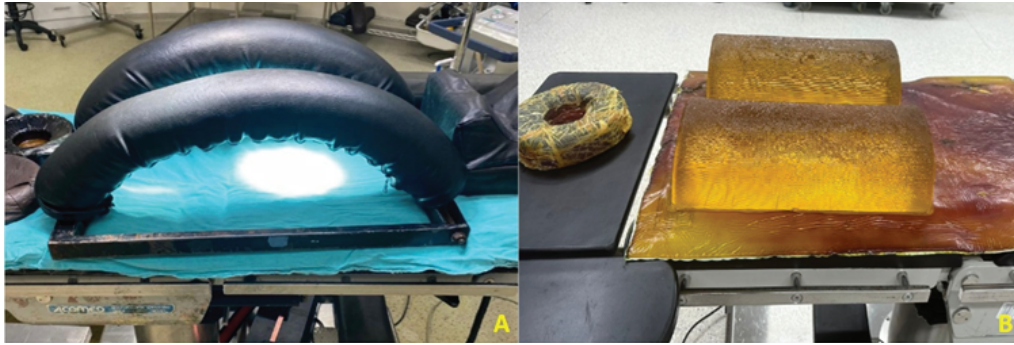


Figure 1. A. Radiolucent spine surgery frame B. Thoracic gel rolls

**Ethics**

The principles of the Helsinki Declaration conducted our research. Ethical approval was obtained from the institutional review board of the conducting institution. Participation in the study was carried out voluntarily. Informed consent was obtained, which emphasized the confidentiality of the participants' identities and the study's content.

**Primer & seconder outcomes**

Our study's primary and secondary outcomes pertain to the quantity of bleeding occurring during the operation and its associations with the characteristics of the participants.

**Statistical analysis**

SPSS 26 software was utilized for statistical analyses. The suitability of data for normal distribution was examined using the Kolmogorov-Smirnov test. The relationships concerning categorical variables were explored by implementing the Chi-Square test. In the analysis of repeated measurements, the One-way ANOVA test was employed for two measurements. In order to investigate the correlation between BMI and the amount of bleeding, a linear regression analysis was conducted. In the analyses, a p-value less than 0.05 was considered statistically significant.

**Results**

In our study, the participants' demographic data, namely age, gender, weight, and height, have been presented as baseline characteristics. Each participant's body mass index (BMI) has been calculated and included in the analyses. Furthermore, variables such as the operated side, surgery duration, and bleeding amount have also been incorporated into the analyses. According to the study, the distribution of the variables examined in the research across groups can be observed in Tables 1 and 2.

The data obtained from our research has been compared among groups. Accordingly, it has been determined that there is no statistically significant difference among the groups in terms of age, size, and gender variables ( $p > 0.05$ ). However, statistical analysis has revealed significant differences in the distribution of other analyzed variables, namely BMI (Body Mass Index), Duration of Surgery, and Amount of Bleeding, among the groups ( $p = 0.03$ ,  $p < 0.01$ , and  $p = 0.01$ , respectively) (Table 3).

A correlation analysis was conducted between BMI and the amount of bleeding. The obtained results demonstrate a significant positive correlation between BMI and the amount of bleeding in both groups. However, this correlation is more pronounced in the spine surgery frame group, reaching a higher level of statistical significance ( $p = 0,01$  and  $p = 0,045$ , respectively) (Figure 2).

Table 1. Demographic data of study groups.

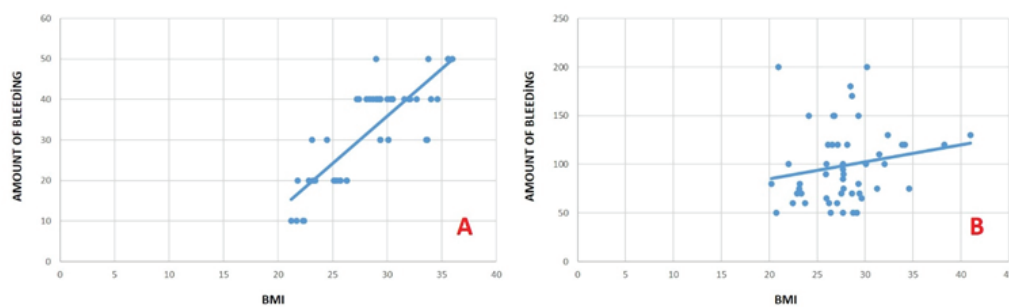
	Age		BMI		Duration of Surgery		Amount of Bleeding	
	Min.-Max.	Mean SD	Min.-Max.	Mean SD	Min.-Max.	Mean SD	Min.-Max.	Mean SD
<b>S.S.Frame</b>	24-70	48,3±11,3	21-36	27,7±4,2	20-40	31,0±5,6	10-50	32,2 ±11,6
<b>Gel Rolls</b>	26 - 81	49,5±12,7	20-41	31,4±4,1	40-115	62,9±13,8	50-200	98,6±29,3

Table 2. Demographic data of study groups.

	Gender		Side	
	Male (n %)	Female (n %)	Left (n %)	Right (n %)
<b>S.S.Frame</b>	28 %56	22 %44	34 %68	16 %32
<b>Gel Rolls</b>	27 %54	23 %46	28 %56	22 %44

**Table 3.** Analysis of variables according to groups\*.

		n	Mean ± SD	Z	p
Age	Spine Surgery Frame	50	48,3±11,3	0,097	0,4
	Gel rolls	50	49,5±12,7		
BMI	Spine Surgery Frame	50	27,7±4,2	-2,699	0,03
	Gel rolls	50	31,4±4,1		
Duration of Surgery	Spine Surgery Frame	50	31,0±5,6	-4,599	<0,01
	Gel rolls	50	62,9±13,8		
Amount of Bleeding	Spine Surgery Frame	50	32,2 ±11,6	-5,669	<0,01
	Gel rolls	50	98,6±29,3		



**Figure 2.** Correlation annalysis between BMI and the amount of bleeding A. Radiolucent spine surgery frame B. Thoracic gel rolls

**Discussion**

Studies comparing the positions of patients undergoing spinal surgery can be found in the medical literature. However, research examining the specific support devices utilized during these procedures and comparing their outcomes is minimal. Our study represents the first investigation that examines the effects of the spine surgery frame and gel rolls on spinal surgery and compares the results.

The precise positioning of the patient is of paramount importance in spinal surgery. Various systems have been developed for this purpose [12]. The primary function of these developed systems is to decrease lumbar lordosis and facilitate optimal surgical conditions [13]. Accurate positioning diminishes intra-abdominal pressure by reducing lumbar lordosis, reducing the likelihood of bleeding [14].

During microdiscectomy, the primary concern is intraoperative bleeding [15]. This apprehension arises due to the potential limitation of the surgeon's visual field caused by intraoperative hemorrhage [15]. The elevation of intra-abdominal pressure during microdiscectomy leads to an increase in epidural venous pressure [13]. Establishing the ideal patient position during the procedure decreases epidural venous pressure, thereby reducing bleeding [12].

The effects of surgical position on blood loss in lumbar disc hernia microsurgery have been a subject of interest and investigation in recent years. Patients' positioning during surgery can significantly impact intraoperative bleeding and subsequent blood loss [16]. Various surgical positions, including prone, lateral, and supine, have been employed during lumbar disc hernia microsurgery, each with advantages and potential drawbacks [17].

A prospective, randomized study compared the effects of two patient positions on intraoperative surgical bleeding. The study examined patients undergoing lumbar microdiscectomy in the prone and knee-chest positions. Initially, intraabdominal pressures were observed to be at similar levels between the groups during the baseline and the operation. Despite no significant difference in intraabdominal pressures, it was determined that the amount of bleeding was significantly higher in patients operated on in the knee-chest position [18]. Another study compared the effects of prone and jackknife positions on intraoperative bleeding during microdiscectomy. It was observed that mean arterial blood pressure values were at similar levels between the groups during the operation. However, intraabdominal pressure and bleeding were higher in the prone group than in the jackknife group. This finding is statistically significant [19]. A study examining the relationship between measured airway pressure values and bleeding during surgery determined that airway pressures increased during the transition from the supine to the prone position [20].

The spine surgery frame employed in our study is crucial for achieving precise surgical interventions and improved patient outcomes [21]. This specialized frame provides a stable and adjustable platform that enables surgeons to access and manipulate the spine with heightened accuracy and control. By securely immobilizing the patient's body during the procedure, the frame minimizes the potential for intraoperative complications and facilitates the execution of intricate surgical maneuvers. Additionally, the frame's adaptability allows for customization according to the unique anatomical characteristics of each patient, ensuring optimal alignment and positioning during the surgical intervention. The spine surgery frame offers advantages such as enhanced operative field visualization, facilitating meticulous



dissection, and instrumentation placement. Furthermore, the frame aids in maintaining spinal stability, particularly in cases involving complex spinal pathologies or deformities [22–24].

Using gel rolls in spinal surgery has garnered considerable attention and interest within the medical community [24]. Gel rolls, composed of biocompatible materials, have emerged as a potential adjunct in achieving optimal surgical outcomes and promoting postoperative patient comfort. Their versatile nature allows various applications, such as facilitating spinal alignment, maintaining appropriate anatomical positioning, and reducing tissue trauma during surgery [25]. Furthermore, gel rolls have demonstrated the capacity to cushion and support vulnerable structures, such as the spinal cord and nerve roots, thereby potentially minimizing the risk of iatrogenic injury. Additionally, their conformable and malleable properties enable customization and adaptation to the specific needs of individual patients, offering improved surgical precision and efficacy [12].

Based on the findings obtained from our study, it is observed that an increase in BMI contributes to an elevated amount of bleeding in both groups. Additionally, it has been determined that the bleeding volume during the operation is significantly higher in the "Gel Rolls" group compared to the "Spine Surgery Frame" group. The underlying leading cause for the disparity in bleeding levels is the difference in intra-abdominal pressure.

Intra-abdominal pressure, commonly influenced by patient positioning, surgical technique, spine frames, and mechanical retractors, can exert substantial hemodynamic effects during spinal procedures [26]. Studies have suggested that elevated intra-abdominal pressure may result in increased bleeding due to the compression of abdominal vessels and subsequent impairment of venous return. This, in turn, can lead to venous congestion, compromised tissue perfusion, and a greater propensity for surgical site bleeding. Furthermore, the rise in intra-abdominal pressure can engender fluctuations in systemic blood pressure, potentially exacerbating bleeding complications. Conversely, lowering intra-abdominal pressure through measures such as using specialized devices, such as spine surgery frames, has shown promise in reducing bleeding during spinal surgery [27].

Several studies have explored the relationship between elevated intra-abdominal pressure, and bleeding in the context of spinal surgery. For instance, a study demonstrated that increased intra-abdominal pressure was correlated with higher intraoperative blood loss during posterior lumbar fusion procedures [28]. Similarly, a retrospective analysis found that patients with elevated intra-abdominal pressure during spinal surgeries had a higher incidence of postoperative bleeding complications [10]. A prospective study elucidates the effects of body mass index on intra-abdominal pressure and bleeding in lumbar spinal surgery. In the study groups, intra-abdominal pressure values are similar in the supine position. However, they differ in the prone position, and the average amount of bleeding is notably higher, particularly in the obese group. The findings indicate that obese patients undergoing lumbar spinal surgery exhibit significantly elevated intra-abdominal pressure values and increased bleeding [29].

Management strategies to mitigate the effect of elevated intra-abdominal pressure on bleeding in spinal surgery have also been explored. One approach involves using measures to reduce intra-abdominal pressure, such as the intermittent release of abdominal retraction, applying low-pressure pneumoperitoneum, or adopting a modified patient positioning. These strategies aim to optimize hemodynamic stability and minimize bleeding risks

associated with elevated intra-abdominal pressure [18,24].

## Conclusion

In conclusion, the effects of surgical position on blood loss in lumbar disc hernia microsurgery remain a topic of ongoing research. Assessing other important perioperative outcomes, such as complications, and patient satisfaction, would provide a more comprehensive understanding of the impact of devices like spine surgery frames and gel rolls on the surgical process.

Despite these pleasing attributes, the precise role and benefits of spine surgery frames and gel rolls in spinal surgery necessitate further investigation and clinical evaluation. Future studies should aim to elucidate their impact on surgical outcomes, postoperative pain, patient satisfaction, and long-term functional recovery. Moreover, comparative studies comparing spine surgery frames and gel rolls to conventional surgical techniques and other adjunctive devices are warranted to establish their relative efficacy and safety profile. A thorough understanding of the utilization of gel rolls in spinal surgery will facilitate evidence-based decision-making and potentially enhance patient outcomes in this complex surgical field. However, further investigation is warranted to elucidate the precise relationship between intra-abdominal pressure and bleeding and ascertain optimal strategies for mitigating this effect. Prospective studies with rigorous methodology and larger sample sizes are required to comprehensively evaluate the impact of intra-abdominal pressure on bleeding in spinal surgery and determine the most effective interventions to minimize associated risks.

Our study has certain limitations, with the main limitation being the absence of intra-abdominal pressure measurements among the participants. Prospective studies with larger sample sizes are required to comprehensively evaluate the impact of intra-abdominal pressure on bleeding in spinal surgery and determine the most effective interventions to minimize associated risks. The study sample size was relatively small, limiting the generalizability of the findings. Additionally, the study duration was relatively short, and the long-term effects and durability of the spine surgery frames and gel rolls remain uncertain.

## Authors' declaration

**Author Contributions:** Ahmet KARAOĞLU, Muhammet BAYAT and Serdar BAYRAM conception and design of the study. Ahmet KARAOĞLU and Turgut KUYTU performed the experiments, data acquisition and analysis. Muhammet BAYAT and Serdar BAYRAM wrote the manuscript. All authors contributed to revise the manuscript

**Conflicts of Interest:** There is no conflict of interest to disclose.

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