



The Effects of a Positioning Program for Pressure Ulcer and Peripheral Nerve Injury Prevention during Surgery among the Older Patients Undergoing Urological Surgery*

Nalinthip Niruntaweechai, RN, MNS¹, Usavadee Asdornwised, RN, PhD¹, Rattima Sirihorachai, RN, PhD¹, Patkawat Ramart, MD²

Abstract

Purpose: The aim of this study was to compare the pressure ulcer scores and the incidence of peripheral nerve injury among those who received the positioning program for pressure ulcer and peripheral nerve injury prevention with routine care and those who received only routine positioning and care among the older patients during urological surgery in a lithotomy position.

Design: Two groups experimental research with pre- and post-test design.

Methods: Participants were randomized into intervention and control groups. Forty-two elders in the intervention group were assigned to participate in the positioning program with routine care and forty-two elders in the control group received only routine positioning and care. Data were collected using a demographic data questionnaire, the Bates-Jensen Wound Assessment tool (Thai version), peripheral nerve injury assessment form. The positioning program consisted of the guideline for lithotomy positioning together with the use of warm gel cushions on the arm boards and sacrum area and intermittent pneumatic compression. Data were analyzed using independent t-test, the Mann-Whitney U test, the chi-square test and Fisher's exact test.

Main findings: The intervention group had statistically lower pressure ulcer scores, compared to the control group ($p < .05$). In addition, the incidence of peripheral nerve injury of the intervention group was significantly lower than that of the control group ($p < .05$).

Conclusion and recommendations: The outcomes of intervention program based on the guideline for positioning and equipment used including warm gel and intermittent pneumatic compression showed lower scores for pressure ulcers and incidences of peripheral nerve injury than those in the control group. Thus, using the positioning program is recommended as a routine practice for pressure ulcer and peripheral nerve injury prevention in urological surgery patients.

Keywords: elderly, peripheral nerve injury, positioning, pressure ulcer

Nursing Science Journal of Thailand. 2023;41(4):101-114

Corresponding Author: Associate Professor Usavadee Asdornwised, Faculty of Nursing, Mahidol University, Bangkok 10700, Thailand; e-mail: usavadee.asd@mahidol.edu

** Master thesis, Master of Nursing Science Program in Adult and Gerontological Nursing, Faculty of Nursing, Mahidol University*

¹ Faculty of Nursing, Mahidol University, Bangkok, Thailand

² Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Received: 19 April 2023 / Revised: 25 May 2023 / Accepted: 31 May 2023



ผลของการใช้โปรแกรมการจัดทำต่อการป้องกันการเกิดแผลกดทับและการบาดเจ็บของเส้นประสาทส่วนปลายในระหว่างผ่าตัดของผู้สูงอายุที่เข้ารับการผ่าตัดในระบบทางเดินปัสสาวะ*

นลินทิพย์ นิรันดร์ทวีชัย, พย.ม.¹ อุษาวดี อัครวิเศษ, PhD¹ รัตติมา ศิริโหราชัย, PhD¹ ภควัฒน์ ระมาตร, พบ.²

บทคัดย่อ

วัตถุประสงค์: เพื่อเปรียบเทียบคะแนนการเกิดแผลกดทับและการเกิดการบาดเจ็บของเส้นประสาทส่วนปลายในกลุ่มที่ได้รับการโปรแกรมการจัดทำสำหรับการป้องกันการเกิดแผลกดทับและการบาดเจ็บของเส้นประสาทส่วนปลายระหว่างผ่าตัดร่วมกับการพยาบาลตามปกติและกลุ่มที่ได้รับการจัดทำตามปกติในผู้สูงอายุที่เข้ารับการผ่าตัดระบบทางเดินปัสสาวะในท่าชันขาหยั่ง

รูปแบบการวิจัย: การวิจัยแบบทดลองชนิด 2 กลุ่มวัดก่อนและหลังการทดลอง

วิธีดำเนินการวิจัย: กลุ่มตัวอย่างได้รับการสุ่ม แบ่งกลุ่มออกเป็นกลุ่มทดลองและกลุ่มควบคุม กลุ่มทดลอง ผู้สูงอายุจำนวน 42 คน ได้รับโปรแกรมการจัดทำสำหรับการป้องกันการเกิดแผลกดทับและการบาดเจ็บของเส้นประสาทระหว่างผ่าตัด (PP) ร่วมกับการพยาบาลตามปกติ และกลุ่มควบคุมจำนวน 42 คน จะได้รับการจัดทำและการพยาบาลตามปกติเท่านั้น เครื่องมือที่ใช้ในการเก็บรวบรวมข้อมูลประกอบด้วย แบบสอบถามข้อมูลส่วนบุคคล แบบประเมินแผล Bates-Jensen Wound Assessment (ฉบับภาษาไทย) แบบประเมินการบาดเจ็บของเส้นประสาทส่วนปลาย และโปรแกรมการจัดทำ ซึ่งประกอบด้วย แนวปฏิบัติการจัดทำผ่าตัดในท่าชันขาหยั่ง ร่วมกับการใช้เจลอุ่น บริเวณเบาะรองแขนและก้นกบ และเครื่องมือที่ใช้ลมบีบ เพื่อให้เกิดแรงกดเป็นระยะๆ วิเคราะห์ข้อมูลโดยใช้สถิติการทดสอบที แมน-วิทนีย ยู การทดสอบไคสแควร์ และการทดสอบของฟิชเชอร์

ผลการวิจัย: กลุ่มทดลองมีระดับคะแนนการเกิดแผลกดทับต่ำกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ($p < .05$) และอุบัติการณ์การเกิดการบาดเจ็บของเส้นประสาทส่วนปลายของกลุ่มทดลองต่ำกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ($p < .05$)

สรุปและข้อเสนอแนะ: ผลลัพธ์ของการใช้โปรแกรมการจัดทำบนพื้นฐานของแนวทางปฏิบัติในการจัดทำและการใช้เครื่องมือประกอบ ได้แก่ การใช้เจลอุ่นและการใช้เครื่องมือที่ใช้ลมบีบเพื่อให้เกิดแรงกดเป็นระยะๆ ส่งผลให้ระดับคะแนนของการเกิดแผลกดทับและการบาดเจ็บของเส้นประสาทส่วนปลายระหว่างผ่าตัดน้อยกว่ากลุ่มที่ไม่ได้ใช้ ดังนั้น โปรแกรมการจัดทำสำหรับการป้องกันการเกิดแผลกดทับและการบาดเจ็บของเส้นประสาทระหว่างผ่าตัด จึงควรส่งเสริมให้มีการใช้โปรแกรมดังกล่าวในการปฏิบัติประจำ เพื่อป้องกันการเกิดแผลกดทับและการเกิดการบาดเจ็บของเส้นประสาทส่วนปลายในผู้ป่วยที่เข้ารับการผ่าตัดระบบทางเดินปัสสาวะต่อไป

คำสำคัญ: ผู้สูงอายุ การบาดเจ็บของเส้นประสาทส่วนปลาย การจัดทำ แผลกดทับ

Nursing Science Journal of Thailand. 2023;41(4):101-114

ผู้ประสานงานการเผยแพร่: รองศาสตราจารย์อุษาวดี อัครวิเศษ, คณะพยาบาลศาสตร์ มหาวิทยาลัยมหิดล บางกอกน้อย กรุงเทพฯ 10700, e-mail: usavadee.asd@mahidol.edu

* วิทยานิพนธ์หลักสูตรพยาบาลศาสตรมหาบัณฑิต สาขาการพยาบาลผู้ใหญ่และผู้สูงอายุ คณะพยาบาลศาสตร์ มหาวิทยาลัยมหิดล

¹ คณะพยาบาลศาสตร์ มหาวิทยาลัยมหิดล

² คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล

วันที่รับบทความ: 19 เมษายน 2566 / วันที่แก้ไขบทความเสร็จ: 25 พฤษภาคม 2566 / วันที่ตอบรับบทความ: 31 พฤษภาคม 2566

Background and Significance

Perioperative patient positioning is a key to maintain safety and prevent injuries during surgery. Aims to provide adequate exposure of the surgical site, to maintain the comfort of patients and respect their privacy, to allow for optimal airway ventilation and access to monitoring devices, to promote blood circulation, to maintain nerve integrity and to protect their skin, bones, joints, and vital organs. Complications from improper positioning that are often found include pressure ulcers and peripheral nerve injury (PNI)¹. The mean peak contact pressure studied on sacral region in the lithotomy position was 93.3 mmHg. This cuts off tissues of oxygen and nutrients, causing ulcer formation.² When pressure compresses the skin and vessel, blood flow in peripheral circulatory system stops, and peripheral nerve is exposed to an ischemic state.³

The incidence rates 1.3% of surgical patients had a pressure ulcer risk and more than 1.3% of surgical patients could develop surgery-related pressure ulcers.⁴ A study in Ethiopia found that the incidence of positioning that related with soft tissue injuries among adult surgical patients was 9.6%⁵, and 6.7% of the surgery related pressure injury found immediately after surgery.⁶ PNI incidence that related with positioning in patient undergoing urological surgery was 2.1%.⁷ Lithotomy position is often used in urological surgery.⁸ Studies²⁻³ have shown that the lithotomy position has a high risk of PNI and pressure ulcers.

Muscle and fat tissue at the sacral region under bony prominences in the lithotomy position was substantially greater than that when the patient is lying down. The risk factors associated with pressure ulcers and PNI include the duration of the surgery more than three hours⁹, the decreasing of oxygenation at the compressed tissues¹⁰, the type of surgery, positioning during surgery¹¹, BMI below or above the standard¹², and older adults aged 60 years or more. A study in Singapore¹³ found that age (75 years and older) was a significant risk factor that are associated with hospital acquired pressure ulcers among surgical patients caused by loss of dermal collagen. Thus, elders experience an increase in vulnerability for pressure ulcer development¹⁴ and often have comorbidities.¹⁵ Research studies¹⁶ have also found that diabetes mellitus is one of the comorbidities that related to PNI, reported at 50%. When complications arise, it can cause pain, a feeling of being lost and incompetent, lack of socialization, low quality of life, and high cost of care.¹⁷

Oster KA and Oster CA¹⁴ discussed the special needs and care of the elderly population in the perioperative setting. They stated that positioning the older patient in the perioperative setting requires additional attention to the bony prominences and other special high-risk areas. The perioperative team, especially nurses, needs to promote skin integrity in order to prevent pressure ulcer development, such as using extra protection and padding.¹⁸ Foam pads may not as effective as gel pads at reducing pressure ulcers.¹⁹

Shakibamehr, et al.²⁰ showed the significant difference in the term of the incidence of skin redness between the group using a tragacanth gel cushion and a foam cushion. The group using the tragacanth gel cushion showed higher percentages of no redness (29.8%) than the group using foam cushions (8.5%). It was found that a gel pad with an operating room temperature which contacted the patient's skin would cause the body temperature of the patient to be low and would affect blood flow to the tissues. Therefore, it is recommended that gel pads should be warmed at a temperature of 40 °C (104 °F) prior to use with patients.²¹ Further, the operating room (OR) nurses should receive education about skin integrity and alteration, skin assessment, and a proper documentation plan during pre-and post-operative phases. Accessory devices such as gel pads, pillows, or foam should be selected and used appropriately.²⁰ In addition, intermittent pneumatic compression (IPC) is used as a part of AORN guidelines²²⁻²³ for patient positioning during surgery. IPC is a mechanical device for improving peripheral circulation of the lower extremity, prevention of venous thromboembolism and promoting tissue healing.²⁴

From previous studies and literature reviews, it showed the lack of knowledge for guiding positioning in geriatric patients during surgery and equipment uses such as warm gel cushion or intermittent pneumatic compression.

From the aforementioned incidences, the researcher and team developed a positioning program (PP) based

on AORN guideline for lithotomy positioning for geriatric patients.¹⁴ This program consisted of the AORN guideline for lithotomy positioning¹¹ including the use of intermittent pneumatic compression²²⁻²³ and warm gel cushion²¹ on the arm boards and sacrum area.

The aim of this study was to study the effects of a positioning program for pressure ulcer and peripheral nerve injury prevention during surgery among the elderly undergoing surgery. The result of the study can be used as the guideline for positioning during surgery among elders.

Methodology

Study Design and Setting

This research was experimental research with pre- and post-test design conducted in a university-affiliated hospital, Bangkok, Thailand. This hospital is the country's largest quaternary-care medical center with a capacity of 2,154 beds and 3.8 million out-patients per year. This hospital has 65 operation rooms. In this study, the researchers conducted in urological services which have 4 operation rooms and have taken care of a large number of patients; that is, more than 10,000 visits each year.

Population and Sampling

A random sampling method was used to recruit patients who undergoing urological surgery unit. Eligible patients were those who were both males and females; 1) aged 60 years and older; 2) undergoing elective surgery; 3) types of surgery that use only the lithotomy position; and 4) being

under general anesthesia or in combination with local anesthesia. Exclusion criteria were those who: 1) had skin lesions at the sacrum and/or PNI prior to the surgery; 2) had conditions that prevented them from using intermittent pneumatic compression: patients with recent skin grafting, arterial bypass or skin condition that may lead to further damage; and 3) had intubated the endotracheal tube before surgery. The sample of this study was calculated by using the formula from n4Studies program.

$$n_1 = \left\lceil \frac{Z^2 \left(1 - \frac{\alpha}{2} \sqrt{p^- q^- \left(1 + \frac{1}{r} \right) + z_1 - \beta} \sqrt{p_1 q_1 + \frac{p_2 q_2}{r}} \right)}{\Delta} \right\rceil$$

The researchers used the results of a previous study conducted about positioning during surgery in Chinese to calculate the sample size.^{2,5} The prevalence of pressure ulcers in the intervention group and the control group was 0% and 17.7%. The power of test was .80, and Type I error (α) was .05, the required sample size would be 42 participants per group.

Research Instruments

1. A demographic data form developed by the researchers consisted of gender, age, diagnosis, type of surgery, the duration of the surgery (hours), BMI, comorbidities, type of anesthesia, and estimated blood loss.

2. Bates-Jensen's wound assessment Tool (BWAT)²⁶ – Thai version²⁷ is a tool used to evaluate wounds with respect to 13 aspects: size, depth, edge

of the wound, erosion under the wound, type of necrosis, amount of necrosis, tissue granulation and epithelialization, type of secretions and quantity, skin color surrounding the wound, peripheral tissue edema, and induration. Likert scale ranging from 1 (healthiest) to 5 (unhealthiest) is used for the response scale. Total scores range from 13 to 65 points. The higher the total score, the more severe the wound status. The I-CVI ranged between .98 to 1.00 and Cronbach's alpha coefficients was .97.

3. Peripheral Nerve Injury Assessment Form developed by the researchers. The form was composed of three parts sequentially arranged as follow:

Part I – Motor function Assessment. This part was designed to assess the patient's motor function that related with PNI. The form consists of 15 items with dichotomous response of 'normal' and 'abnormal'.

Part II – Sensory function Assessment. This part was designed to assess the patient's sensory function that related with PNI. The form consists of 6 items with dichotomous response of 'normal' and 'abnormal'.

Part III – Reflexes function Assessment. This part was designed to assess the patient's motor function that related with PNI. The form consists of 4 items with dichotomous response of 'normal' and 'abnormal'. The I-CVI of Peripheral Nerve Injury Assessment Form ranged between .98 to 1.00 and Cronbach's alpha coefficients was .81.

4. Positioning program developed by the researchers consisted of the guideline for positioning the patient and the lithotomy positioning for geriatric patients,^{11,14}

placing a warm gel cushion (37 °C)²¹ to support the arm boards and sacrum area and using the intermittent pneumatic compression (IPC)²²⁻²³ with appropriate size selected at both calves. The I-CVI of positioning program ranged between .98 to 1.00 and Cronbach's alpha coefficients was .94.

Three qualified experts validated the positioning program and research instruments for content validity. All the data and assessments were collected by the principal researcher.

Ethical Considerations

This study was approved by the Institutional Review Board, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand. (COA no. Si 458/2021). Participants were assured that their participation in this study was completely voluntary and that they could withdraw from the study at any time with no effect on care provided. The results of the research were presented as an overview. Names of the patients were anonymous and only ID number was

used instead. All data of participants was kept confidential and stored electronic data in an offline device.

Data Collection

Data were collected by the principal investigator. The participants in the urological surgery unit were randomized into a control group (n = 42) and intervention group (n = 42). The control group received only routine positioning and care, while the intervention group received positioning program and routine care. The positioning program (PP) was consisted of Association of periOperating Register Nurses (AORN) guideline for positioning, the lithotomy positioning guideline for geriatric patients, the use of a warm gel cushion on the arm boards and sacrum area for supporting, and the use of the intermittent pneumatic compression.

The researchers compared the pressure ulcers score and the incidence of PNI between the intervention and the control groups. Figure 2 presents a flowchart of the positioning program among older patients undergoing urological surgery.

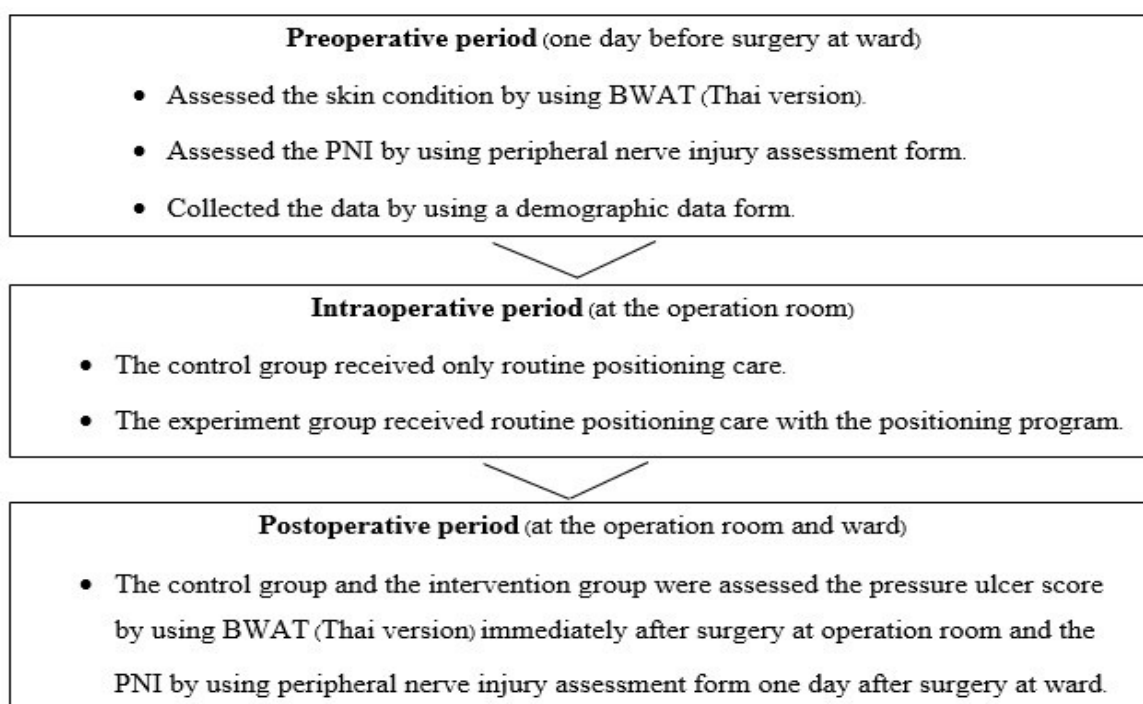


Figure 1: Flowchart of the positioning program among participants undergoing surgery

The control group received only routine positioning and care during the perioperative period. It took about 10 minutes for positioning as follows:

1. The patient's arms were placed on arm boards at less than 90°.
2. After finishing the anesthesia induction phase, the patient was positioned in the standard lithotomy position, high lithotomy or exaggerate lithotomy (level of lithotomy was chosen by the surgeon).
3. After finishing the operation, the patient was transferred to the recovery room; using a slide board while moving the patient from the surgical bed to the transferring bed.

The intervention group received the positioning program with routine care during the surgery. It took about 15 minutes for the positioning as follows:

1. Using the arm boards at the same level as a surgical bed and the patient's arms should be extended less than 90°. The patient's arms and palms should be turned upside down.
2. After finishing the anesthesia induction phase, the patient was positioned in the lithotomy. Both patients' legs were placed on the lithotomy legs at the same time by using two staffs, one on each side.
3. Level of lithotomy was chosen by surgeon. The patient's hips were flexed until the angle between the patient's thighs and the bed was 40°-60° for low lithotomy, 80°-100° for standard lithotomy, 110°-120° for high lithotomy, and 130-150° for exaggerate lithotomy.
4. Placing the gel cushion on the arm board (size: width 11.5 cm, length 61 cm, height 0.95 cm)

and the sacrum area (size: width 43 cm, length 27.9 cm, height 0.6 cm). The gel cushions were heated in a heat incubator at 70°C for about 28 minutes (according to the instructions of the product), until the gel cushions reached the temperature of 40°C and applied to the patients at 37°C (waited around 2-3 minutes and measured again before use). Warm gel cushions were used from the start to the end of positioning without changing and wrapping the gel cushions.

5. Using intermittent pneumatic compression of appropriate size at both calves through evaluating indication with a surgeon that the compression could be used with the participants.

6. After the surgery was complete, both patients' legs were removed from the lithotomy legs at the same time by two staffs, one on each side and slowly brought the legs together on the surgical bed. Then, the patient was transferred to the recovery room with the help of at least four staff members by using the slide board while moving the patient from the surgical bed to the transferring bed.

Data Analysis

SPSS version 18 was used for the data analysis. Differences in the demographic data and in the treatment background data were compared using a chi-square test, a fisher's exact test, a Mann-Whitney U and an independent t-test. The mean scores for pressure ulcers were compared between the control and the intervention groups using independent t-test. The incidences of PNI were compared between the control and the intervention groups using a chi-square test, and a fisher's exact test.

Findings

1. Demographic Characteristics

The intervention and the control groups were compared in terms of age, gender, comorbidities,

diagnosis, type of surgery, type of anesthesia, body mass index, duration of surgery, and estimated blood loss; and no significant differences were found (see Table 1).

Table 1 Comparison of demographic and medical history data between the control (n = 42) and the intervention (n = 42) groups

Demographics & medical history		Control group		Intervention group		p-value
		n (%)	Statistic	n (%)	$\bar{X} \pm SD$	Statistic
Gender	Male	37 (88.1)		40 (95.2)		.43 ¹
	Female	5 (11.9)		2 (4.8)		
Comorbidities	Yes	34 (81)		33 (78.6)		.79 ²
	No	8 (19)		9 (21.4)		
Hypertension	Yes	29 (69)		30 (71.4)		.81 ²
	No	13 (31)		12 (28.6)		
Dyslipidemia	Yes	22 (52.4)		18 (42.8)		.38 ²
	No	20 (47.6)		24 (57.2)		
Diabetes Mellitus	Yes	6 (14.3)		9 (21.4)		.39 ²
	No	36 (85.7)		33 (78.6)		
Surgery	Open	2 (4.8)		2 (4.8)		1.00 ¹
	Endoscopic/ robotic	40 (95.2)		40 (95.2)		
Diagnosis	Prostate cancer	33 (78.6)		38 (90.5)		.14 ¹
	Bladder tumor	5 (11.9)		4 (9.5)		
	Ureteral stone	4 (9.5)		-		
Anesthesia	General	29 (69)		35 (83.3)		.07 ¹
	Regional	5 (11.9)		-		
	Both	8 (19.1)		7 (16.7)		
Age(years)			73 (7.3) ⁵		70 (6.3) ⁵	.22 ³
BMI (kg/m ²)			23.4 (3.4) ⁵		23.8 (2.7) ⁵	.53 ³
Duration of surgery (mins)			172 (53.7) ⁵		192 (46.4) ⁵	.07 ³
Estimated blood loss (ml.)			335 (325) ⁶		200 (300) ⁶	.13 ⁴

BMI = Body Mass Index, ¹ Fisher's exact test, ² chi-square test, ³ independent t-test, ⁴ Mann-Whitney U, ⁵ \bar{X} (SD),

⁶ Median (IQR)

2. Pressure Ulcer

Out of 42 in the control group who received only routine positioning and care, 35 participants (83.3%) developed pressure ulcer while 11 participants (26.2%) in the intervention group who received the positioning program with routine positioning care developed pressure ulcer.

Table 2 showed the mean pressure ulcer scores of participants who developed the pressure ulcer in each group. The pressure ulcer scores in the control group were significantly higher than those in the

intervention group ($p = .008$).

3. Peripheral Nerve Injury (PNI)

As displayed in Table 3, a number of PNI found in both study groups were significantly different ($\chi^2 = 10.2$, $p < .001$); that is, the incidence of PNI in the intervention group was significantly lower than that in the control group. The similar results were also found for motor and sensory function of PNI. Note that none of the participants in both study groups reported the affected reflexes function.

Table 2: Comparison of the mean pressure ulcer scores between the control and intervention groups

Group	Pressure ulcer score		t	p-value
	\bar{X}	SD		
Control group	15.2	1.3	2.8	.008
Intervention group	14.0	1.1		

Table 3: Comparison of the incidence of PNI between the intervention group and the control group

Incidence of PNI	Control group (n = 42)	Intervention group (n = 42)	χ^2	p-value
No PNI (%)	27 (64.3)	39 (92.9)	10.2	.001 ¹
PNI (%)	15 (35.7)	3 (7.1)		
Motor function				
No PNI (%)	32 (76.2)	42 (100)	-	.001 ²
PNI (%)	10 (23.8)	0		
Sensory function				
No PNI (%)	32 (76.2)	39 (92.9)	4.5	.035 ¹
PNI (%)	10 (23.8)	3 (7.1)		
Reflexes function				
No PNI (%)	42 (100)	42 (100)	-	-
PNI (%)	0	0		

¹ chi-square test, ² Fisher's exact test

Discussion

The participants in the intervention group showed lower scores for pressure ulcers and incidences of peripheral nerve injury than those in the control group ($p < .01$). This positioning program was based on the AORN guideline for positioning and evidence-based practice from research studies.^{11,14,21-23} In addition, the program supported and protected the bony prominence by using warm gel cushion for increasing blood circulation and reducing shear and friction.

In this study, the positioning during surgery related pressure ulcer was 26.2% in intervention group and 83.3% in control group immediately after surgery. The incidence in both groups of this study was found to be higher than the previous study⁶ that reported the surgery-related pressure ulcer incidence was 6.7% immediately after surgery.⁶ The high incidence may be explained by the higher of average age compared with previous study.⁶ Age is a factor affecting the development of a pressure injury. In the current study, the average age in intervention group was 70 years and in the control group it was 73 years. A previous study found that the significant risk factor that is associated with hospital acquired pressure ulcers among surgical patients was age at 75 years.¹³

Operation time is another factor affecting pressure ulcer development in patients undergoing surgery. Other studies have found the average operation time that related to pressure ulcer development was 170 minutes⁶ and 181 minutes.²⁸

However, the result found lower pressure ulcer scores in the intervention group. Even though, the average operation time in intervention group (192 minutes) was longer than that in the control group (172 minutes). This may be because the use of the positioning program that help to protect the participants from the development of pressure ulcer.

In this experimental research, the intervention group developed pressure ulcer stage 1 (redness of the sacrum skin) which was lower than that of the control group. Similarly, other studies reported that the intervention group that participated in the positioning program in a curvilinear supine position showed no incidence of pressure ulcers while 17.7% of the pressure ulcer incidence showed in the control group continued to lie on the surgical table in a supine position ($p = .002$).²⁵ Another study investigated the effect of a tragacanth gel cushion (*Astragalus gossypinus* fish: herbal medicine) and foam cushions on the prevention of pressure ulcers at the sacrum area in ICU patients; the finding revealed that the group using the tragacanth gel cushion had a higher incidence of no redness (29.8%) than the group using the foam cushion (8.5%), and there was a significant difference between the two groups in terms of erythema ($p = .008$).²⁰

In this study, a warm gel cushion at 40°C (104°F) was applied to the patients at 37°C (waited around 2-3 minutes and measured again before use), according to the suggestion from the AORN journal for preventing pressure injuries in patients placed on a

spinal table.²¹ The patient's temperature would drop when using the gel pad on the ambient temperature of the operative room and affect blood flow. Further, decreasing blood circulation can cause the incidence of pressure ulcers and PNI. Others studies have found that when 0.55°C drop in body temperature would cause a 20.2% increase in the risk of developing operation room-acquired pressure injuries.²⁹ Without using a warming device, the patients had high scores on the Intraoperative Risk Assessment Scale and a pressure injury incidence 6.7% immediately after surgery was reported.⁶

Another important outcome in this study is a comparison of the incidence of PNI, and it was found that this incidence among those who participated in the positioning program with routine care was lower than those who received only routine positioning and care at a statistical significance ($p = .001$). In this study, all of the participants received a lithotomy position. The researchers found that one subject out of three in the intervention group that had affected sensory function had an operation time of 250 minutes. As noted by Hewson, Bedfordth and Hardman,³⁰ type of positioning is a key risk factor affecting the development of PNI. The factor of lower limb nerve injury was greatest in patients with lithotomy position maintained for more than 4 hours.

The current study showed a result for PNI incidence with sensory function regarding ulnar nerve injury and common peroneal nerve injury in both groups. In the present study, 91.7% of the

participants were male. Gender is another factor that related to PNI in patients undergoing surgery. According to other studies, the ulnar nerve is particularly vulnerable to damage in male patients because men have less adipose tissue around the cubital tunnel and a more prominent coronoid tubercle compared with women.³⁰⁻³¹

The current study showed only sensory function of the intervention group was affected while both motor function and sensory function of the control group were affected. The researchers found that two subjects out of five in the control group that had affected both sensory and motor function had an underlying diabetes mellitus. Similarly, a previous study found that diabetes mellitus was the risk factor for intraoperative PNI among the study patients.³² In contrast, the present study showed lower PNI incidences in the intervention group even though the participants who had diabetes mellitus in the intervention group were higher than the control group. This finding did support that the positioning program helped protecting the participants from the development of the incidence of PNI.

All these findings show the importance of using a positioning program for pressure ulcer and peripheral nerve injury prevention during surgery.

Conclusion and Recommendations

In this study, it was discovered that the positioning program can be recommended for pressure ulcers and PNI prevention during surgery among older

patients undergoing surgery. The perioperative nurse should use the positioning program to prevent the development of pressure ulcers and PNI with patients that have received lithotomy positioning during surgery. This positioning program can be implemented in operation rooms by multidisciplinary teams, including OR nurses and surgeons. The nurse can work as an efficiency coordinator who is aware of the problems and needs of the patient.

According to the findings, the older patients who participated in the positioning program with routine care had lower pressure ulcer scores and incidences of PNI. Therefore, the findings can be used to support the following recommendations for developing and implementing the care of patients:

1. The positioning program should be used for other units of older patients undergoing surgery where the patient is in the lithotomy position.

2. More qualitative studies should be conducted into the etiology of other complications (deep vein thrombosis, compartment syndrome) that associated with patient positioning of older patients undergoing surgery to determine corrective guidelines and to create care models in the future.

Regarding the limitations of this study, most of the participants in the intervention group underwent endoscopic/robotic surgery (95.2%), where the operating time was shorter than that of open surgery. Therefore, this might have affected the incidence of pressure ulcers and PNI slightly. As most of the participants were male (91.7%), this might be another factor to be

concerned about regarding the development of pressure ulcers or PNI. In future research, the researcher might employ an equal number of males and females for the participants.

References

1. Spruce L. Positioning the patient. *AORN J*. 2021;114(1):75-84. doi: 10.1002/aorn.13442.
2. Mizuno J, Takahashi T. Evaluation of external pressure to the sacral region in the lithotomy position using the noninvasive pressure distribution measurement system. *Ther Clin Risk Manag*. 2017;13:207-13. doi: 10.2147/tcrm.S122489.
3. Mizuno J, Takahashi T. Factors that increase external pressure to the fibular head region, but not medial region, during use of a knee-crutch/leg-holder system in the lithotomy position. *Ther Clin Risk Manag*. 2015;11:255-61. doi: 10.2147/tcrm.S72511.
4. Webster J, Lister C, Corry J, Holland M, Coleman K, Marquart L. Incidence and risk factors for surgically acquired pressure ulcers: a prospective cohort study investigators. *J Wound Ostomy Continence Nurs*. 2015;42(2):138-44. doi: 10.1097/won.0000000000000092.
5. Buli B, Diriba T, W/Yohannes M, Tesfaye B. Magnitude of position-related soft tissue injuries and associated factors among elective adult surgical patients at Tikur anbessa specialized hospital, Addis ababa, Ethiopia. *Ann Med Surg (Lond)*. 2022;82:104592. doi: 10.1016/j.amsu.2022.104592.

6. Yılmaz E, Başlı AA. Assessment of pressure injuries following surgery: a descriptive study. *Wound Manag Prev.* 2021;67(6):27-40.
7. Hippalgaonkar AV, Bokil CV. A prospective observational study to find the incidence of position related injuries in patients undergoing urological procedures under anaesthesia. *J Evol Med Dent Sci.* 2020;9(13):1026-31. doi: 10.14260/jemds/2020/221.
8. Pham B, Teague L, Mahoney J, Goodman L, Paulden M, Poss J, et al. Support surfaces for intraoperative prevention of pressure ulcers in patients undergoing surgery: a cost-effectiveness analysis. *Surgery.* 2011;150(1):122-32. doi: 10.1016/j.surg.2011.03.002.
9. Choi MA, Kim MS, Kim C. Incidence and risk factors of medical device-related pressure injuries among patients undergoing prone position spine surgery in the operating room. *J Tissue Viability.* 2021;30(3):331-8. doi: 10.1016/j.jtv.2021.06.006.
10. Peixoto CA, Ferreira MBG, Felix M, Pires PDS, Barichello E, Barbosa MH. Risk assessment for perioperative pressure injuries. *Rev Lat Am Enfermagem.* 2019;27:e3117. doi: 10.1590/1518-8345.2677-3117.
11. Guideline at a glance: positioning. *AORN J.* 2017; 106(5):460-5. doi: 10.1016/s0001-2092(17)30919-5.
12. Xiong C, Gao X, Ma Q, Yang Y, Wang Z, Yu W, et al. Risk factors for intraoperative pressure injuries in patients undergoing digestive surgery: a retrospective study. *J Clin Nurs.* 2019;28(7-8): 1148-55. doi: 10.1111/jocn.14712.
13. Aloweni F, Ang SY, Fook-Chong S, Agus N, Yong P, Goh MM, et al. A prediction tool for hospital-acquired pressure ulcers among surgical patients: surgical pressure ulcer risk score. *Int Wound J.* 2019;16(1):164-75. doi: 10.1111/iwj.13007.
14. Oster KA, Oster CA. Special needs population: care of the geriatric patient population in the perioperative setting. *AORN J.* 2015;101(4):443-56; quiz 457-9. doi: 10.1016/j.aorn.2014.10.022.
15. Zhou F, Wu Z, Yu Y, Xu L. Establishment and application of pressure injury assessment module in operating room based on information management system. *J Healthc Eng.* 2022;2022: 1463826. doi: 10.1155/2022/1463826.
16. Barrell K, Smith AG. Peripheral neuropathy. *Med Clin North Am.* 2019;103(2):383-97. doi: 10.1016/j.mcna.2018.10.006.
17. Joyce P, Moore ZE, Christie J. Organisation of health services for preventing and treating pressure ulcers. *Cochrane Database Syst Rev.* 2018;12(12):CD012132. doi: 10.1002/14651858. CD012132.pub2.
18. Stanton C. Guideline for positioning the patient. *AORN J.* 2022;115(5):P5-P7. doi: 10.1002/aorn.13680.
19. Basic principles of patient positioning. *AORN J.* 2016;103(3):P10-2. doi: 10.1016/s0001-2092(16)00139-3.
20. Shakibamehr J, Rad M, Akrami R, Rad M. Effectiveness of tragacanth gel cushions in prevention of pressure ulcer in traumatic patients: a randomized controlled trial. *J Caring Sci.* 2019;8(1):45-9. doi: 10.15171/jcs.2019.007.

21. Preventing pressure injuries in patients placed on a spinal table. *AORN J.* 2019;109(5):P11-P13. doi: 10.1002/aorn.12706.
22. Guideline summary: positioning the patient. *AORN J.* 2017;106(3):238-47. doi: 10.1016/j.aorn.2017.07.006.
23. Link T. Guideline implementation: prevention of venous thromboembolism. *AORN J.* 2018; 107(6):737-48. doi: 10.1002/aorn.12146.
24. Ren W, Duan Y, Jan YK, Li J, Liu W, Pu F, et al. Effect of intermittent pneumatic compression with different inflation pressures on the distal microvascular responses of the foot in people with type 2 diabetes mellitus. *Int Wound J.* 2022;19(5):968-77. doi: 10.1111/iwj.13693.
25. Guo Y, Zhao K, Zhao T, Li Y, Yu Y, Kuang W. The effectiveness of curvilinear supine position on the incidence of pressure injuries and interface pressure among surgical patients. *J Tissue Viability.* 2019;28(2):81-6. doi: 10.1016/j.jtv.2019.02.005.
26. Bates-Jensen BM, McCreath HE, Harputlu D, Patlan A. Reliability of the bates-jensen wound assessment tool for pressure injury assessment: the pressure ulcer detection study. *Wound Repair Regen.* 2019;27(4):386-95. doi: 10.1111/wrr.12714.
27. Prasungsit C. Tool to measure wound healing [Internet]. Mahidol University; 2016 [cited 2021 Feb 22]. Available from: http://www.si.mahidol.ac.th/Th/Th/division/nuring/NDivision/N_APN/admin/download_files/8_100_1.pdf. (in Thai).
28. Ma L-Y, Chen H-L, Gu H-Y, Hua L, Gao X-M. Analysis of the clinical features and risk factors of device-related pressure injuries in the operating room. *Int Wound J.* 2023;20(3):706-15. doi: 10.1111/iwj.13912.
29. Fred C, Ford S, Wagner D, Vanbrackle L. Intraoperatively acquired pressure ulcers and perioperative normothermia: a look at relationships. *AORN J.* 2012;96(3):251-60. doi: 10.1016/j.aorn.2012.06.014.
30. Hewson DW, Bedfordth NM, Hardman JG. Peripheral nerve injury arising in anaesthesia practice. *Anaesthesia.* 2018;73 Suppl 1:51-60. doi: 10.1111/anae.14140.
31. Prielipp RC, Morell RC, Butterworth J. Ulnar nerve injury and perioperative arm positioning. *Anesthesiol Clin North Am.* 2002;20(3):589-603. doi: 10.1016/s0889-8537(02)00009-3.
32. Harada Y, Tanaka JI, Umemoto T, Sekine RI, Wakabayashi T, Kijima K, et al. Toward standardized patient positioning to avoid peripheral nerve injury during laparoscopic colorectal surgery: application of a protocol and study of the resulting relationship between total rotation time and contact pressure at the shoulder. *Asian J Endosc Surg.* 2019;12(3):269-74. doi: 10.1111/ases.12645.