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Translation and validation of the ELPO for Turkish population: Risk assessment scale for the development of pressure injuries due to surgical positioning

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ABSTRACT

Aim of the study: This study was conducted to translate the ELPO risk assessment scale for the development of pressure injuries due to surgical positioning to Turkish and to test its validity and reliability in the Turkish Population.

Materials and methods: The data were collected using the patient identification form, the risk assessment scale for the prevention of injuries due to surgical positioning, and the Braden Scale. This scale consisted of a total of seven items, each of which contained five sub-items. It is rated between 1 and 5 in the Likert type. The total score of the scale ranges between 7 and 35. The risk of developing pressure injuries increases in patients as the score increases.

Results: A total of 184 patients were included in the study sample. The mean age of the group was 55.96 ± 17.90, and the content validity index was 0.944. The sensitivity of the test was 60%, the specificity was 66%, and the accuracy was 66%. There was a negative, weak, statistically significant correlation between the total scores of the risk assessment scale for the prevention of injuries due to surgical positioning and the Braden scale. The mean total score of the scale was 18.45 ± 2.96 (12–26) and 35.9% (n = 66) of the group were at high risk.

Conclusions: The ELPO, which includes the risks specific to patients during surgery, can be used as an assessment scale for the development of pressure injury due to surgical positioning for Turkish population.

1. Introduction

The European Pressure Ulcer Advisory Panel (EPUAP), National Pressure Injury Advisory Panel (NPIAP), and Pan Pacific Pressure Injury Alliance (PPPIA) describe a pressure ulcer as a localized injury to the skin and/or underlying tissue, usually over a bony prominence, they result from pressure, or pressure in combination with shear, and are characterized by nonblanchable erythema (Stage 1), partial thickness skin loss (Stage 2), full thickness skin loss (Stage 3), full thickness tissue loss (Stage 4), or unstageable and suspected deep tissue injury (depth unknown) [1]. In particular, patients are at high risk of developing pressure injuries during surgical procedures [2] and this risk appears as one of the complications that occur after surgery [3]. In the literature, it is reported that the rate of pressure injury in the intraoperative period in patients during surgical procedures varies between 12% and 66% [2]. In the study conducted by Ramezanpour et al. [3], they found the incidence of a postoperative pressure injuries to be 17.8% and emphasized that pressure injury continued to be an important health problem in the postoperative period [4]. The high risk of pressure injuries in the surgical process is attributed to various factors associated with the surgery such as the patient's fasting period, position during surgery, and moist skin surface resulting from skin preparation [5]. It is indicated that the pressure injuries occurring within the first 72 h after surgical procedure in patients were probably developed during the surgery [6]. The developing pressure injury leads to many negative consequences such as pain, requiring additional treatment, longer stay in hospital, deformity and scarring on the body, increased morbidity, increased medical costs [4] and increasing the nursing workload by more than 50% [5]. Furthermore, it was determined that the occurrence of pressure injury due to surgical procedures increased the cost per patient by 3–4 times

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[6]. Furthermore, it is well known that pressure injury is a major cause of morbidity and leads to a lower quality of life for both patients and caregivers [7]. In accordance with this information, it is extremely important to identify the patients at risk of pressure injuries for the implementation of cost-effective and evidence-based preventive measures. Since pressure injury is a preventable complication [8–10], it also becomes important for nurses to be able to evaluate these risk factors. In particular, nurses can perform a comprehensive and systematic pressure injury risk assessment and can take preventive measures in the early period. In conclusion, the incidence of pressure injury in the patient can also be reduced in this way [4].

There are several general pressures injury risk assessment tools in the literature although the tools that specifically measure pressure injury risk assessment during surgical intervention are quite limited [8]. Furthermore, the most commonly used Braden Scale has been found to have a low predictive validity for the risk of pressure injury in surgical patients [11]. Therefore, nurses need valid and reliable tools with proven psychometric properties in order to evaluate the risk of developing pressure injuries in patients undergoing surgical intervention [11, 12]. The ELPO (Escala de Avaliação de Risco para o Desenvolvimento de Lesões Decorrentes do Posicionamento Cirúrgico) was conducted to evaluate the risk assessment scale for the development of pressure injuries due to surgical positioning [12]. The ELPO was developed by Lopes et al. to evaluate the risk of developing pressure injury due to surgical positioning as a gross score in patients during surgery [2]. In clinical practice, the ELPO may be an applicable scale as a tool to guide nurses in making the best decision about care for surgical patients related to positioning [12].

2. Materials and methods

2.1. Aim and study design

This study was designed as a descriptive cross-sectional study to translate the ELPO risk assessment scale for the development of pressure injuries due to surgical positioning to Turkish and to test its validity and reliability in the Turkish population.

2.2. Settings, participants, recruitment and sample size

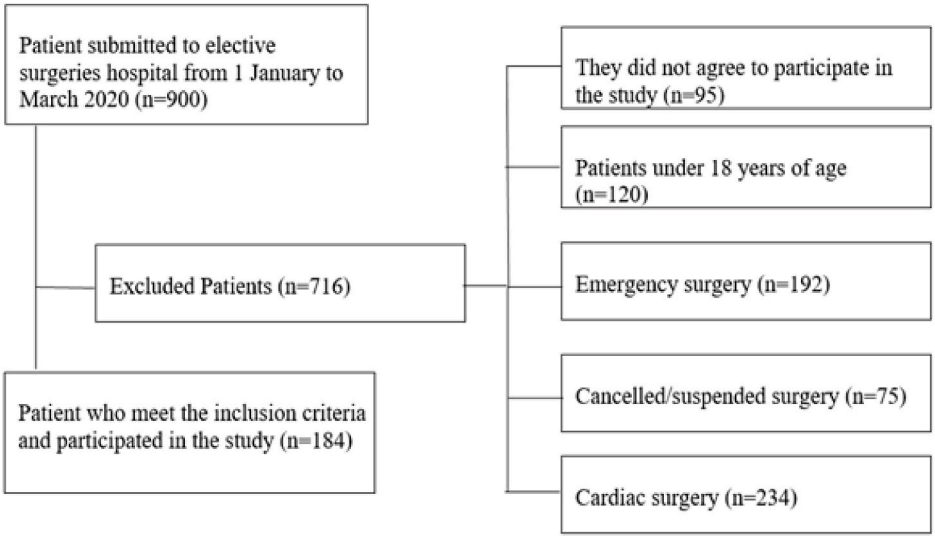
The patients with surgical procedures in the operating room of a private foundation hospital, where an average of 300 surgical operations are performed per month, constituted the population of the study. The inclusion criteria for the study were patients who would undergo elective surgery, being 18 years and older and volunteering to participate in the study. Based on the sample in the original study in which the scale was developed, patients who deliberately underwent heart surgery with hypothermia during the surgical procedure, whose weight and height measurements were not taken in the pre-operative period, or for whom at least one of the descriptive characteristics of the patients was not recorded, and patients who underwent emergency surgery were excluded from the study. Different methods are used to calculate the sample size. One of them is the inclusion of 5–20 people per statement in the sample [13]. The sample size was reached between 01.01.2020 and 31.03.2020, during which the study was conducted, however, the study was completed with 184 patients by considering the possible losses (Flow chart 1).

2.3. Data collection procedure

The data were collected using the patient identification form, the ELPO risk assessment scale for the development of pressure injuries due to surgical positioning and the Braden Scale. Preoperative risk assessment was performed on the patients by two certified wound, ostomy (WO) nurses, and it was checked whether pressure injury occurred immediately after the end of the surgery and when they were taken to the service. Sociodemographic variables (age, gender, weight, height, etc.) were obtained with the information provided by the patients during their admission to the hospital in the early preoperative period. The Braden scale was used as an equivalent form and their scores were recorded. In the intraoperative period, the patients were monitored from their entrance to the surgery room until their transfer to the post-anesthetic recovery room. While patients with a scale score of 19 were classified as at lower risk of developing perioperative pressure injuries, the patients with a scale score of ≥20 were considered to be at higher risk [12]. Finally, the skin examination of the patients was performed in detail using the inspection and palpation method, in the immediate postoperative period and within the first 72 h. The European Pressure Ulcer Advisory Panel (EPUAP), National Pressure Injury Advisory Panel (NPIAP), and Pan Pacific Pressure Injury Alliance (PPPIA) practice guidelines were used to stage the pressure injury correctly.

2.4. Data collection tools

The patient identification form (individual characteristics of the patients (age, gender, laboratory findings, vital signs), *the Braden Scale, and*



Flow chart 1. Systematic follow of the selection of patients submitted to elective surgeries.

the risk assessment scale for the development of injuries due to surgical positioning (ELPO) were used to collect the data.

Patient identification form: It consisted of questions such as gender, age, body weight, height, type of surgery performed, the occurrence of pressure injury (yes or no), anatomical location and stage of pressure injury.

Braden Scale: The reliability and validity study of the scale, which was developed by Bergstrom and Braden et al. [14], in Turkey was performed by Pınar and Oğuz [15] in 1998. The scale has six parameters, including the perception of the stimulus, humidity, activity, motility, nutrition, friction and irritation. The total score of the scale varies between 6 and 23. According to the total score, 9 or less are considered very high risk, 10–12 points are considered high-risk, 13–14 points are considered at risk, 15–16 points are considered low risk, and 15–18 points are considered low risk for people over 75 years old, and between 14 and 18 was chosen as the best cut-off value [14–17].

Risk assessment scale for the prevention of injuries due to surgical positioning (ELPO): It was developed by Moraes-Lopes et al., in 2016 [12]. It consisted of seven items, each of which contained five sub-items, organized according to the anatomical and physiological implications of surgical positions on the patient's body. The type of surgical position, duration of surgery, type of anesthesia, support surface, limb position, and comorbidities and patient age are examined on the scale, and it is rated between 1 and 5 in the Likert type. The total score of the scale ranges between 7 and 35 points. While the patients scoring up to 19 points are classified as lower risk for the development of injuries due to surgical positioning, the patients scoring 20 or higher are classified as higher risk. The cut-off value for ELPO is 19 and the risk of pressure injury increases in patients as the score increases.

2.5. Psychometric measurements

In the validity and reliability study performed to determine the suitability of the risk assessment scale for the prevention of injuries due to surgical positioning in Turkish patients:

1. The scale was translated into Turkish by two people who know Turkish and English well for language validity, and the statements in the Turkish form were compared and reviewed. The most suitable option was determined for each item and a single Turkish form was created. The Turkish form was translated back to the original language by a person independent of the individuals who made the first translation, and it was submitted to the recommendation of the person who developed the scale. In accordance with the recommendations, the scale was finalized for expert opinion.
2. The content of the scale was evaluated by calculating the content validity index (CVI) at the item level and at the general scale level based on expert opinions. Expert opinions were evaluated using the Davis technique. Davis technique grades expert opinions as (a) suitable, (b) item should be slightly reviewed, (c) item should be seriously reviewed, and (d) item is not suitable. In this technique, the content validity index of the item is obtained by dividing the number of experts who mark the options (a) and (b) by the total number of experts [18]. We asked the experts to rate each item on the scale in terms of its relevance to the underlying structure. While ratings c and d indicated "invalid content", ratings a and b were considered as valid content. Then, the CVI was calculated for each item. In the analysis based on the expert opinions, the content validity index (CVI) was determined as 0.944.
3. After the language and content validity was done, the criterion-based validity test was performed for the construct validity of the scale. The concurrent scale validity method was used within the scope of criterion-based validity.
4. After the language and content validity was done, the scale was applied to a group of 10 people and a pilot study was conducted.

3. Data analysis

SPSS (Statistical Package for the Social Sciences) 21 program was used. The demographic data were presented as number, mean ± SD and percentage (%). The parameters conforming to normal distribution were tested by an independent sample *t*-test, and the correlation between scale scores was determined by the correlation analysis. P value < 0.05 was considered statistically significant.

4. Ethical considerations

Before starting the study, written permission was obtained from Moraes-Lopes to adapt the risk assessment scale for the prevention of injuries due to surgical positioning and to use its adapted version in Turkey. Permission was obtained from Koç University Ethics Committee (No:2019.339.IRB3.174). Furthermore, the aim of the study was explained to the nurses who participated in the study, their written consent was obtained, and anonymity and confidentiality were ensured.

5. Results

5.1. Demographic characteristics of the study group

A total of 184 patients were included in the study sample. The mean age of the group was 55.96 ± 17.90, 57.1% (n = 105) of them were female (Table 1).

5.2. Validity

The content validity rates calculated for the answers of 12 experts for the validity of the scale ranged from 0.833 to 0.999, and the content validity index was 0.944. Table 2 includes the content validity index.

The sensitivity of the scale was 0.60, the specificity was 0.66, and the accuracy rate was 0.66. The positive predictive value of the scale was 4.80 and the negative predictive value was 0.98. The positive likelihood ratio was 1.79, negative likelihood ratio was 0.60. The area under the ROC curve was 0.484.

5.3. Reliability

The concurrent Braden scale was used for reliability analysis. The total score of the risk assessment scale for the prevention of injuries due to surgical positioning and the total score of the Braden scale were compared. There was a negative, weak, statistically significant correlation between the total scores of the risk assessment scale for the prevention of injuries due to surgical positioning and the Braden scale ($r = -0.357$, $p < 0.000$) (Table 3).

It was determined that while 56.5% (n = 104) of the patients were

Table 1
Sociodemographic characterization of patients.

Variables:			
Age	Mean ± SD 55.96 ± 17.90 Min = 18, Max = 93	n	%
Gender		105	57.1
Female		79	42.9
Male			
Body mass index		2	1.1
Underweight		66	35.9
Normal or Healthy Weight		116	63.0
Overweight			
Smoking		32	17.4
Smoker		109	59.2
Non-smoker		43	23.4
Quitted			

Table 2
Content validity index of the scale items.

Items	d) Number of experts indicating that the item is unnecessary and not suitable and should be removed	c) Number of experts indicating that the item should be seriously reviewed	b) Number of experts indicating that the item is necessary and should be slightly reviewed	a) Number of experts indicating that the item is necessary and Totally suitable	Items CVI
1	0	0	1	11	0.999
2	0	0	1	11	0.999
3	0	0	1	11	0.999
4	0	1	2	9	0.833
5	0	1	4	7	0.833
6	0	0	3	9	0.999
7	0	0	0	12	0.999
Mean CVI = 0.944					

Table 3
Results of Concurrent validity.

	Mean ± SD	Min-Max (Median)	p r
ELPO scale	18.45 ± 2.96	12-26 (18)	-.357
Braden scale	18.36 ± 3.24	8-23 (19)	.000

placed in the supine position during the surgery, the duration of surgery of 32.6% (n = 60) of them was between 2 and 4 h, 91.9% (n = 169) of them were administered with general anesthesia, and the legs of 81.5% (n = 150) of them were in the anatomic position during the surgery. The total score of the scale was 18.45 ± 2.96 (12–26) and 35.9% (n = 66) of the group were at high risk (Table 4).

Pressure injury developed in 2.7% (n = 5) of the patients after the end of the surgery. Stage 1 (n = 2) pressure injury on the forehead/cheek and under the right/left shoulder and stage 1 (n = 3) pressure injury in the gluteal, left thoracic and right inner leg were observed. When the patients were evaluated postoperatively, pressure injuries were observed in 3 patients, including stage 1 (n = 2) on the left heel and coccyx and stage 2 (n = 1) in the left gluteal region on postoperative day 1. The mean scale score of the patients who developed pressure injuries immediately after the end of the surgery was 19.20 ± 3.34, those who did not developed had a mean scale score of 18.43 ± 2.95, and there was no statistically significant difference between them. While the mean scale score of the patients who developed pressure injuries within the first 72 h after surgery was 19.33 ± 2.08, it was 18.44 ± 2.97 for those who did not develop, and there was no statistically significant difference between them (Table 5).

6. Discussion

Pressure injury is a problem which includes many intrinsic and extrinsic factors, and when specific patient characteristics are added, it becomes an inevitable complex problem [19]. With optimal nursing care, it may be possible to prevent pressure injury and take protective measures [20]. Nevertheless, nursing interventions implemented based on evidence-based practices and the evaluation of these interventions are particularly important [21]. Therefore, the use of specific risk assessment scales for the assessment of pressure injuries, especially in the perioperative period, may help nurses to objectively identify patients who are at risk [12]. By using this risk assessment tool, nurses can ensure that effective solutions are applied to the patient both during and after the surgery (with the use of effective pressure support surfaces) to prevent pressure injuries due to surgical positioning [21–23]. When the literature is reviewed, it is observed that there is no specific risk assessment scale for the development of pressure injuries due to surgical

Table 4
Distribution of patients submitted to elective surgeries according to variables present in the Risk Assessment Scale for Perioperative Pressure Injuries (ELPO).

Items		n (%)
Type of surgical position		
Supine		104 (56.5)
Lateral		28 (15.2)
Trendelenburg		7 (3.8)
Prone		14 (7.6)
Lithotomy		31 (16.9)
Duration of surgery (hours)		
Up to 1 h		30 (16.3)
From 1 h to 2 h		33 (17.9)
From 2 h to 4 h		60 (32.6)
From 4 h to 6 h		39 (21.2)
More than 6 h		22 (12.0)
Type of anesthesia		
Local		1 (0.5)
Sedation		1 (0.5)
Regional		7 (3.8)
General		169 (91.9)
General + Regional		6 (3.3)
Support surface		
Viscoelastic surgical table mattress + viscoelastic cushions		–
(Conventional) Surgical table foam mattress + viscoelastic cushions		–
(Conventional) Surgical table foam mattress + foam cushions		13 (7.1)
(Conventional) Surgical table foam mattress + cushions made out of sterilization wraps		171 (92.9)
No use of support surface or rigid support without padding or narrow leg supports		–
Limb position		
Anatomic position		150 (81.5)
Opening <90° of upper limbs		2 (1.1)
Knees raised <90° and opening of lower limbs <90° or neck without sternal alignment		31 (16.9)
Knees raised >90° or opening of lower limbs >90°		1 (0.5)
Knees raised >90° and opening of lower limbs >90° or opening of upper limbs >90°		–
Comorbidities		
No comorbidities		131 (71.2)
Vascular diseases		8 (4.4)
Diabetes Mellitus		41 (22.3)
Obesity or malnutrition		3 (1.6)
Pressure injury or previously diagnosed neuropathy or deep venous thrombosis		1 (0.5)
Patient age		
18–39		41 (22.3)
40–59		53 (28.8)
60–69		45 (24.4)
70–79		34 (18.5)
>80		11 (6.0)
	Mean ± SD (min-max)	
Scale score	18.45 ± 2.96 (12–26)	
19 and below (low risk)	16.60 ± 1.63 (12–19)	118 (64.1)
20 and above (high risk)	21.77 ± 1.56 (20–26)	66 (35.9)

Table 5
Scale scores of the patients with and without pressure injury (n:184).

	Pressure injury		T	p
	Yes Mean ± SD Min-Max	No Mean ± SD Min-Max		
Immediately after the end of the surgery n = 5	19.20 ± 3.34; 14-22	18.43 ± 2.95; 12-26	0.568	0.903
within the first 72 h after surgery n = 3	19.33 ± 2.08; 17-21	18.44 ± 2.97; 12-26	0.516	0.322

positioning [21–24].

In this study, the Risk Assessment Scale for the Prevention of Injuries due to Surgical Positioning, which was developed by Moraes-Lopes et al. was adapted to Turkish. The scale was applied to 184 patients in a private foundation hospital to ensure the reliability, content and construct validity of the Turkish version. To this end, the examination of the accuracy and cultural appropriateness of the translation constituted the most critical steps in the trans-cultural adaptation of the scale. In our study, the use of expert opinions for the forward-backward procedure and content validity was successfully carried out. In the literature, with regard to content validity, it was indicated that it was necessary to determine to what extent the scale as a whole and each item in the scale served the purpose [25]. Therefore, the opinions of the relevant experts were obtained to evaluate the scale items in the study. While the content validity index of the scale in the original study was 0.88, it was found to be 0.944 in this study. Content validity refers that whether the content of the scale is related to the condition intended to be measured [26], and it is reported that an appropriate CVI should be greater than 0.70 to verify the acceptability of items on a scale. This result indicates that the Risk Assessment Scale for the Prevention of Injuries due to Surgical Positioning can be used as a valid tool to evaluate the patient's risk for the development of pressure injuries.

One of the criteria used to evaluate the power of tests/scales in making the right decision is the "Area under the ROC Curve". The area under the curve can take a maximum value of "1". The smallest value it can take practically is "0.50" [27]. The result of this study was below the expected value. Although both sensitivity and specificity were found above 50% in the current study, the specificity of the scale, that is, the ability of the test to distinguish healthy from true healthy people is higher.

The positive predictive value is how many of all positive findings are true positives; the negative predictive value determines how many of all negative findings are true negatives. It is reported that as the value approaches 100, the 'gold standard' is approached [28]. It is pleasing that the negative predictive value of this scale is quite high. When we examine the negative likelihood ratio, the smaller this ratio, the better the true healthy individuals can be distinguished [29]. The negative likelihood ratio in the study is quite low. When we look at the results of the diagnostic tests in general, we can say that this scale may be more meaningful in diagnosing patients who will not develop pressure injuries.

In the study, as the scores of the patients obtained from the scale increased, the Braden Scale scores decreased. While an increase in the score obtained from the scale indicates an increased risk of PIs, an increase in the score obtained from the Braden Scale indicates that the risk of pressure injuries is reduced. Therefore, the presence of a negative correlation indicates that there is compliance between the two results, but the level of compliance was found to be low. The presence of a significant correlation between the patients' scores on two scales indicated that the results were compatible and that this scale, which was adapted to Turkish, was valid in measuring the desired feature, however, this level of correlation was below the desired value. However, although the Braden Scale has been confirmed to be useful in most care settings, it does not include perioperative conditions (e.g., time of immobility in the surgical room bed, type of anesthesia, body temperature) that increase the risk among patients undergoing surgery [30]. When a scale is applied in a similar field, the correlation between the two measurement results is estimated to be stronger.

In this study, approximately two-thirds of the patients had a scale score of 19 and below and were at low risk for developing a pressure injury. The type of surgical position of the patient during surgery was the mostly supine position, and the limb position was in the anatomic position. In the literature, pressure injuries were mostly observed especially on the occiput (back of the head), hips, sacrum/coccyx and heels [31,32]. In their study, Lumbley et al. retrospectively investigated the factors causing pressure injury during surgery and found that 189 (85%) of 222 patients in the supine position developed pressure injuries [33]. In the supine position, complications may occur not only in cases where the patient is placed inappropriately and carelessly or remains in the supine position for a long time, but also by increasing the resistance of the surgical stretcher to the pressure points of the body [30,33]. In particular, supine position was also indicated to be a critical risk factor in the development of pressure injuries [30,33]. Another type of position that may pose a risk is the lithotomy position, which is frequently used in surgical operations and procedures, and it was determined that the risk of complications was quite high. The lithotomy position is a great risk for patients about the development of pressure injuries on the occiput, scapulae, hips, sacrum/coccyx, and heels [33]. On the other hand, the ratio of patients with pressure injuries in the prone position used in surgical operations varies between 5% and 66% [34]. In accordance with the common results of these studies, it can be said that the positioning of the patient during surgical procedures is an important evaluation criterion in terms of the risk of developing pressure injuries in intraoperative nursing care [35].

In the study, when the duration of surgery and the type of anesthesia were evaluated, it was found that most of the surgeries took two to 4 h and that general anesthesia was mostly distributed. The duration of the surgical operation or procedure is one of the most important risk factors for pressure injuries in the perioperative period. Because long periods of inactivity and exposure to pressure may disrupt the supplying of the tissue and may cause skin damage [19]. Even 1 h of surgery may increase the risk of pressure injuries in the patient [35]. Surgeries exceeding 2 h may impair the oxygenation of tissues exposed to pressure and may increase the risk of pressure injuries [35]. In two meta-analysis study, the risk of developing pressure injuries in the operating room in patients who underwent cardiovascular surgery was 1.296 for a 60-min increase, 600 times, and 13.344 for each 1-min increase [35,36].

The administration of general anesthesia to the patient is another risk factor that increases the development of pressure injuries in the intraoperative period [11,37]. Anesthesia affects the depression of pain receptors and the relaxation of muscles [37]. The patients under general anesthesia cannot feel numbness or pain and cannot change position to reduce local pressure [11,37]. Thus, the patient's defense mechanisms cannot protect against pressure, which may increase susceptibility to pressure injury [37]. In conclusion, patients undergoing surgery have a higher risk of developing pressure injuries due to many factors such as long periods of inactivity, factors related to the duration of surgical procedures, and pre-existing medical conditions [7,11,38]. The type of anesthesia should be considered as a risk factor for the development of pressure injuries, which is important in making nurses think critically about it.

In the results of the study, the most commonly used support surfaces were surgical table foam mattress and cushions made out of sterilization wraps. In the correct and safe positioning of the patient, the use of support surfaces, soft bandages, paying attention to height when raising the legs, and especially the use of adequate support surfaces play a significant role [39]. Support surfaces consist of pressure redistribution, control of shear or frictional forces on the tissue, maintenance of microclimate, mattresses or other integrated systems. In particular, these systems to be used should be determined according to the special needs of the patient and the duration of surgery [40]. In the literature, it is emphasized that the non-use of support surfaces in the intraoperative period increases the risk of pressure injuries in the perioperative period [12,30,39,40].

Concerning the presence of comorbidities in the scale results, many patients had no comorbidities, and only the number of patients with diabetes mellitus (DM) was below average. DM is considered to be a risk factor for pressure injuries in the perioperative period since it causes changes in tissue perfusion, a decrease in blood flow, and longer recovery [41,42]. In the literature, it was demonstrated that patients with a history of diabetes had a 49% higher risk of developing pressure injuries compared to patients without comorbidity [43]. Since patients

have different individual characteristics, nurses are responsible for applying protective measures to prevent complications in the patient before surgery during the surgical procedures performed. In their study, Shaw et al. demonstrated that the age of the patient, the type of anesthesia, surgical position and the type of surgery were also related to the development of pressure injuries [4]. Ramezanpour et al. determined that there was a significant correlation between the incidence of pressure injury and the variables of over 70 years of age, history of hypertension, history of heart disease, Braden score <15, type of surgery (elective or emergency) (P = 0.003) and anesthesia (spinal or general) according to the multivariate logistic regression model [3].

In accordance with the data in our study, both the low number of patients with pressure injuries and the low scale scores may constitute very important evidence in determining and evaluating the risk factors for the development of pressure injuries in the perioperative period and the situations that threaten patient safety. Accordingly, this scale can be a very important key for nurses to develop a strategic plan with protective measures that can be taken against the risk of developing pressure injuries. These results suggest that the scale can be used to predict pressure injuries, however, the data should be evaluated by using the scale in more studies.

7. Study limitation

The first limitation of this study was that it included a relatively small sample of patients undergoing elective surgery assessing their status at risk of developing pressure injuries in Turkey. Because there is no specific scale used to determine the risk of pressure injuries in surgical patients. Second, microclimate (skin temperature and moisture) was not evaluated. Another limitation of this study was that the nurses received feedback on the difficulty in filling out some items of the scale, especially the support surface and limb position. Furthermore, the development of a very small number of pressure injuries during the perioperative period may be due to the presence of two certified WO nurses in the hospital, where the study was conducted, and the continuous in-service training. Therefore, the application of the ELPO scale in hospitals without very good conditions suggests that pressure injuries may be observed at a higher rate in the perioperative period and that the risk scores obtained from the scale evaluation may be higher. In addition, when test items consist of few and/or heterogeneous items, the reliability of the cronbach coefficient can calculated lower than its true value. Therefore, in this study, we did not specified the cronbach α value as in the original article.

8. Conclusion

This study contributes to the interventions for nurses to evaluate the risk of pressure injuries and take protective measures during the perioperative period of patients for whom elective surgery is planned. Nurses' use of a specific scale with psychometric properties to prevent perioperative complications plays a key role in the pressure injury risk assessment processes of patients. Perioperative pressure injury risk assessment should be performed with risk assessment scales that are valid, reliable, determine risk factors and have psychometric features. Accordingly, this scale, which includes the risks specific to patients undergoing surgery, can be a tool to assess the risk of developing pressure injuries and can provide great support in evidence-based decision mechanism in the interventions to prevent pressure injuries due to surgical positioning.

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Contributions

The authors have confirmed that all authors met final approval of the version to be published.

Declaration of competing interest

The authors declare that they have no none declared conflict of interest.

Items	Score				
	5	4	3	2	1
Type of surgical position	lithotomy	prone	trendelenburg	lateral	supine
Duration of surgery	over 6h	more than 4h and up to 6h	more than 2h and up to 4h	more than 1h and up to 2h	up to 1h
Type of anesthesia	general+regional	general	regional	sedation	local
Support surface	no use of support surface or rigid support without padding or narrow leg supports	(conventional) surgical table foam mattress+cushions made out of sterilization wraps	(conventional) surgical table foam mattress +foam cushions	(conventional) surgical table foam mattress+ viscoelastic cushions	viscoelastic surgical table mattress +viscoelastic cushions
Limb position	knees raised >90° and opening of lower limbs >90° or opening of upper limbs >90°	knees raised >90° or opening of lower limbs >90°	knees raised <90° and opening of lower limbs <90° or neck without sternal alignment	opening <90° of upper limbs	anatomic position
Comorbidities	Pressure ulcer or previously diagnosed neuropathy or deep venous thrombosis	obesity or malnutrition	diabetes mellitus	vascular disease	no comorbidities
Patient age	>80 years	between 70 and 79 years	between 60 and 69 years	between 40 and 59 years	between 18 and 39 years

Risk assessment scale for the development of injuries due to surgical positioning (ELPO)

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References

[1] Sengul T, Karadag A. Determination of nurses' level of knowledge on the prevention of pressure ulcers: the case of Turkey. J Tissue Viability 2020;29(4):337–41. https://doi.org/10.1016/j.jtv.2020.06.005.
[2] Primiano M, Friend M, Mcclure C, Nardi S, Fix L, Schafer M, et al. Pressure ulcer prevalence and risk factors during prolonged surgical procedures. AORN J 2011;94(6):555–66. https://doi.org/10.1016/j.aorn.2011.03.014.
[3] Ramezanpour E, Zeydi AE, Gorji MAH, Charati JY, Moosazadeh M, Shafipour V. Incidence and risk factors of pressure ulcers among general surgery patients. J Nurs Midwifery Sci 2018;5(4):159–64. https://doi.org/10.4103/JNMS.JNMS_23_17.
[4] Shaw LF, Chang PC, Lee FC, Kung HY, Tung TH. Incidence and predicted risk factors of pressure ulcers in surgical patients: experience at a Medical Center in Taipei, Taiwan. BioMed Res Int 2014:416896. https://doi.org/10.1155/2014/416896.
[5] Gao L, Yang L, Li X, Chen J, Du J, Yang H. Risk factors for intraoperative pressure ulcers in surgical patients. Int J Clin Exp Med 2018;11(7):7429–35.
[6] Primiano M, Friend M, McClure C, Nardi S, Fix L, Schafer M, Savochka K, McNett M. Pressure ulcer prevalence and risk factors during prolonged surgical procedures. AORN J 2011;94(6):555–66.
[7] Aloweni F, Ang SY, Fook-Chong S, Agus N, Yong P, Goh MM, Soh RC. A prediction tool for hospital-acquired pressure ulcers among surgical patients: surgical pressure ulcer risk score. Int Wound J 2019;16(1):164–75. https://doi.org/10.1111/iwj.13007.
[8] Pressure ulcer risk assessment and prevention: clinical practice guidelines. Royal College of Nursing; 2001. https://rnao.ca/sites/rnao-ca/files/Risk_Assessment_and_Prevention_of_Pressure_Ulcers.pdf. [Accessed 3 May 2021].
[9] Risk assessment & prevention of pressure ulcers registered nurses' association of ontario nursing best practice guidelines program. www.rnao.org/bestpractices. [Accessed 3 May 2021].
[10] Pressure ulcers: the prevention and treatment (Quick reference guide). National Institute Healty and Clinical Excellence; 2005. https://www.vmorthotics.co.uk/wpcontent/uploads/2018/07/Pressure_Ulcers_NICE_guidelines.pdf. [Accessed 3 May 2021].
[11] Gul A, Sengul T, Yavuz HO. Assessment of the risk of pressure ulcer during the perioperative period: adaptation of the Munro scale to Turkish. J Tissue Viability 2021;30(4):559–65. https://doi.org/10.1016/j.jtv.2021.06.009.
[12] Lopes CM, Haas VJ, Dantas RA, Oliveira CG, Galvão CM. Assessment scale of risk for surgical positioning injuries. Rev Lat Am Enfermagem 2016;24:e2704. https://doi.org/10.1590/1518-8345.0644.2704. Published 2016 Aug 29.
[13] Özdemir Z. Development of a Likert Type attitude scale in health sciences. HUHEMFAD-JOHUFON 2018;5(1):60–8. https://doi.org/10.31125/hunhemsire.431132.
[14] Bergstrom N, Braden BJ, Laguzza A, Holman V. The Braden Scale for predicting pressure sore risk. Nurs Res 1987;36(4):205–10.
[15] Pınar R, Oğuz S. Norton ve Braden Bası Yarası Değerlendirme Ölçeklerinin yatağa bağımlı aynı hasta grubunda güvenirlik ve geçerliğinin sınanması. *Uluslararası Katılımlı VI. Ulusal Hemşirelik Kongresi, Kongre Kitabı*. Ankara. 1998:172–5.
[16] Guideline: braden scale for predicting pressure ulcer risk in adults & children/infants. British columbia provincial nursing skin and wound committee guideline: braden scale for predicting pressure ulcer risk in adults and children. Assess date: 01.01.2022.
[17] Gouveia Santos VLC, Serpa LF, Cordero GML, Gamboa SG, Campos HH, Castaneda OC. In: Romanelli M, Clark M, Gefen A, Cipranti G, editors. Risk assessment in pressure ulcers. 2th edition. United Kingdom: Springer; 2018. p. 57–78.
[18] Davis LL. Instrument review: getting the most from a panel of experts. Appl Nurs Res 1992;5(4):194–7. https://doi.org/10.1016/S0897-1897(05)80008-4.
[19] Gul Ş. Prevention of pressure ulcers in patients undergoing surgery. J Hacettepe Univ Facul Nurs 2014:54–61.
[20] Lyder CH, Preston J, Grady JN, et al. Quality of care for hospitalized medicare patients at risk for pressure ulcers. Arch Intern Med 2001;161(12):1549–54. https://doi.org/10.1001/archinte.161.12.1549.
[21] Gorecki C, Brown JM, Nelson EA, et al. Impact of pressure ulcers on quality of life in older patients: a systematic review. J Am Geriatr Soc 2009;57(7):1175–83. https://doi.org/10.1111/j.1532-5415.2009.02307.x.
[22] Spruce L. Back to basics: preventing perioperative pressure ınjuries. AORN J 2017;105(1):92–9. https://doi.org/10.1016/j.aorn.2016.10.018.
[23] Ursi ES, Galvão CM. Ocorrência de úlcera por pressão em pacientes submetidos a cirurgias eletivas. Acta Paul Enferm 2012;25(5):653–65. https://doi.org/10.1590/S0103-21002012005000023.
[24] Scarlatti KC, Michel JL, Gamba MA, de Gutiérrez MG. Úlcera por pressão em pacientes submetidos à cirurgia: incidência e fatores associados [Pressure ulcers in surgery patients: incidence and associated factors]. Rev Esc Enferm USP 2011;45(6):1372–9. https://doi.org/10.1590/s0080-62342011000600014.
[25] Karakoç F, Dönmez L. Basic principles of scale development. Tıp Eğitimi Dünyası. 2014;13(40):39–49. https://doi.org/10.25282/ted.228738.
[26] Acemoğlu H, Aktürk Z. Reliability and validity in medical research. Dicle Med J 2012;39(2):316–9. https://doi.org/10.5798/diclemedj.0921.2012.02.0150.
[27] Kılıç S. ROC analysis in clinical decision making. J Mood Disord 2013;3(3):135–40.
[28] Shreffler J, Huecker MR. Diagnostic testing accuracy: sensitivity, specificity, predictive values and likelihood ratios. In: *StatPearls*. Treasure island (FL). StatPearls Publishing; 2021. March 3.
[29] Attia J. Moving beyond sensitivity and specificity: using likelihood ratios to help interpret diagnostic tests. Aust Prescr 2003;26:111–3. https://doi.org/10.18773/austprescr.2003.082.
[30] Putnam K. Minimizing pressure ulcer risk for surgical patients. AORN J 2016;103(4):7–9. https://doi.org/10.1016/s0001-2092(16)30009-6.
[31] Lopes CM de M, Galvão CM. Surgical positioning: evidence for nursing care. Rev Lat Am Enfermagem 2010;18(2):287–94. https://doi.org/10.1590/S0104-11692010000200021.
[32] Fawcett DL. Positioning the patient for surgery. In: Rothrock JC, editor. Alexander's Care of the Patient in surgery - E-book. 16. Edition. Elsevier Health Sciences; 2018. p. 497–594.
[33] Lumbley JL, Ali SA, Tchokouani LS. Retrospective review of predisposing factors for intraoperative pressure ulcer development. J Clin Anesth 2014;26(5):368–74. https://doi.org/10.1016/j.jclinane.2014.01.012.
[34] Bithal PK, Ravees J, Daniel WV, Samar E, Alaa AT, Yanbawi AA. Incidence of pressure-related skin injuries in patients operated for spine surgery in prone: a retrospective analysis of 307 patients. Anesth Essays Res 2020;14(1):33–7. https://doi.org/10.4103/aer.AER_11_20.
[35] Huang HY, Chen HL, Xu XJ. Pressure-redistribution surfaces for prevention of surgery-related pressure ulcers: a meta-analysis. Ostomy/Wound Manag 2013;59(4):36–48.
[36] Chen HL, Shen WQ, Liu P, Liu K. Length of surgery and pressure ulcers risk in cardiovascular surgical patients: a dose-response meta-analysis. Int Wound J 2017;14(5):864–9. https://doi.org/10.1111/iwj.12722.
[37] Kim JM, Lee H, Ha T, Na S. Perioperative factors associated with pressure ulcer development after major surgery. Korean J Anesthesiol 2018;71(1):48–56. https://doi.org/10.4097/kjae.2018.71.1.48.
[38] Boyko TV, Longaker MT, Yang GP. Review of the current management of pressure ulcers. Adv Wound Care 2018;7(2):57–67. https://doi.org/10.1089/wound.2016.0697.
[39] Chalian AA, Kagan SH. Backside first in head and neck surgery? Preventing pressure ulcers in extended length surgeries. Head Neck 2001;23(1):25–8.
[40] de Oliveira KF, Nascimento KG, Nicolussi AC, Chavaglia SRR, de Araújo CA, Barbosa MH. Support surfaces in the prevention of pressure ulcers in surgical patients: an integrative review. Int J Nurs Pract 2017;23(4). https://doi.org/10.1111/ijn.12553.
[41] Saraiva IL, Paula M de FC, Carvalho R de. Pressure ulcer in the transoperative period: occurrence and associated factors. Rev SOBECC 2014;19(4):207–13.
[42] Miranda AB, Fogaça AR, Rizzetto M, Cuvello Lopes LC. Surgical positioning: nursing care in the transoperative period, vol. 21; 2016. p. 52. https://doi.org/10.5327/Z1414-4425201600010008. 1.
[43] Tschannen D, Bates O, Talsma A, Guo Y. Patient-specific and surgical characteristics in the development of pressure ulcers. Am J Crit Care 2012;21(2):116–25. https://doi.org/10.4037/ajcc2012716.