# Influencing Factors and Nursing Advances in Intraoperative Pressure Injury (Postprint)

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## Abstract

This article reviews the influencing factors for intraoperative pressure injury occurrence and the advances in preventive nursing care, aiming to provide reference and guidance for reducing the incidence of intraoperative pressure injuries, improving patient comfort, decreasing medical costs, and ensuring patient care safety.

## Full Text

## Preamble

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**Title:** Influencing Factors and Nursing Progress of Intraoperative Pressure Injury
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## Abstract

This article reviews the influencing factors of intraoperative pressure injury and the progress of preventive nursing, aiming to provide reference and guidance for reducing the incidence of intraoperative pressure injury, improving patient comfort, decreasing medical costs, and ensuring patient safety.

**Keywords:** intraoperative pressure injury; operative position; evaluation tool; care bundles

## 1. Influencing Factors of Intraoperative Pressure Injury

Surgery is widely used as a primary treatment modality in clinical practice. However, due to prolonged operative times or special intraoperative positioning requirements, some surgical patients develop pressure ulcers in various locations. Intraoperatively acquired pressure injury, also known as intraoperatively acquired pressure ulcer (IAPI), results from multiple factors and refers to skin damage occurring during surgery. Currently, there is no clear or universally accepted definition of IAPI [1]. In China, IAPI is defined as intraoperative pressure injury—pressure damage occurring within days after surgery due to compression of skin tissues during the operation, with an incidence rate of [2]. Surgical patients represent a high-risk population for hospital-acquired pressure injuries. Once pressure ulcers occur, they not only affect surgical outcomes but also increase medical expenses, diminish patient trust in the hospital, and trigger medical disputes. Research by Demarre et al. [3] demonstrates that preventing pressure ulcers costs significantly less than treating them. Therefore, effective prevention of intraoperative pressure injury is crucial. This study reviews the main influencing factors and preventive advances regarding intraoperatively acquired pressure injury both domestically and internationally in recent years.

Surgical approach, operative time, patient age, nutritional status, and perioperative treatments are all contributing factors to pressure ulcer development, specifically including the following aspects.

**Surgical Time:** Pressure injury is associated with prolonged local tissue compression. Sustained tissue pressure exceeding mm Hg for more than hours can cause irreversible damage. Studies indicate that operative time exceeding hours is a risk indicator for pressure ulcers, with each additional minutes increasing pressure ulcer risk by % [4]. Song Wenjing et al. [5] found that operative time exceeding hours increases pressure ulcer risk by times. Chen Zheying et al. [6] reported that among patients, % developed pressure injury. Evidently, as operative time extends, the incidence of pressure injury rises, warranting special attention for patients undergoing lengthy procedures.

**Surgical Position:** Intraoperative pressure injury is closely related to forced surgical positioning, which determines the primary pressure-bearing areas of the patient. According to the Association of periOperative Registered Nurses (AORN), position-related pressure injuries rank fourth among operating room safety hazards [7]. In the lateral position, reduced body contact with the operating table surface increases pressure per unit area, predisposing patients to pressure injury [8], with an incidence rate of % [9]. At ° lateral position, peak pressure on compressed areas can reach mm Hg, compared to only mm Hg in supine position [10]. Under the collaboration of NPIAP, EPUAP, and the Pan Pacific Pressure Injury Alliance (PPPIA), the "Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline" (hereinafter "New Guideline") was released in , addressing mm Hg [11].

**Nutritional Status:** The New Guideline emphasizes comprehensive nutri-

tional assessment and individualized nutritional care planning for patients at risk of or with existing pressure injury, upgrading recommendation strength from weak to strong positive, highlighting that nutritional issues require clinical attention [12]. Under perioperative conditions, influencing factors for intraoperative pressure injury should be identified early. Pang Yuling [13] used logistic regression analysis to determine that surgical patients with preoperative serum albumin below g/L, even with operative time of hours, developed more severe pressure ulcers than those with normal albumin levels.

**Age:** With advancing age, elderly patients experience physiological decline and reduced tissue tolerance, making them susceptible to pressure injury. Data show that individuals over years are a high-risk population, with pressure injury incidence increasing proportionally with age [14]. Shine et al. [15] reported that patients older than years face increased pressure ulcer risk.

**Nurse-Related Factors:** The incidence of pressure injury in surgical patients is an important indicator of operating room nursing quality [16]. Nurses' awareness of pressure ulcer prevention and risk assessment capabilities also influence intraoperative pressure injury occurrence. Literature reports indicate insufficient awareness among nursing staff regarding surgical pressure ulcer prevention, failure to recognize the significance of risk assessment at different surgical stages, and inadequate knowledge of prevention measures [17]. In operating room nursing, Hu Meihua et al. [18] identified poor habits among surgical personnel (wrinkled draping, positioning patients while disinfectant remains wet causing skin moisture, improper positioning, improper placement of tubes and wires, and staff leaning on patients) as contributing factors. Additionally, operating room nurses' inadequate understanding of postoperative functional positioning and skin recovery of compressed areas represents another influencing factor. Regarding ward nursing, ward nurses often lack knowledge of intraoperative positioning, fail to adequately assess skin compression areas, and do not thoroughly hand over care with operating room nurses for early assessment and intervention [19]. Nursing-related factors including cognition, assessment, prevention, and intervention directly affect intraoperative pressure injury occurrence.

## 2. Nursing Measures for Preventing Intraoperative Pressure Injury

### 2.1 Strengthening Education and Training

Although pressure ulcer prevention and care have gradually gained attention in recent years, misconceptions and deficiencies persist due to lack of knowledge, insufficient experience and practical ability, and cognitive biases [20]. Yang Hui et al. [21] administered self-designed questionnaires, revealing that nurses who received pressure ulcer training scored significantly higher than those without training, and nurses who had rotated through high-risk departments scored higher than those without such experience. Therefore, standardized pressure

ulcer education enhances nurses' relevant knowledge. Studies also demonstrate that establishing stoma and wound liaison nurses [22] or pressure ulcer liaison nurses [23] to evaluate and consult on hospital pressure ulcer patients, develop prevention and treatment measures, track cases, and disseminate new nursing concepts can improve management quality effectively and warrant promotion.

### 2.2 Scientific Use of Assessment Scales to Improve Risk Evaluation

Currently, numerous pressure ulcer risk assessment scales are used clinically, with Braden, Waterlow, Norton, and Munro scales validated and recommended by guidelines [24]. Comparative studies of common scales show that among surveyed hospitals, used self-designed operating room pressure ulcer assessment forms while the rest used Braden scales, with many nurses considering Braden scales lacking specificity and comprehensiveness [25]. Wang Jiali [26] compared Braden, Norton, and Waterlow scales, concluding all have practical value but require revision, with Norton scale demonstrating superior detection, discrimination, and diagnostic value for intraoperative pressure injury. Wang Jiuqing et al. [27] used ROC curves to compare Waterlow and Norton scales in orthopedic surgery patients, with higher ROC values indicating better predictive value. Waterlow and Norton scales showed ROC areas under the curve of and respectively, suggesting Waterlow's inclusion of orthopedic-related risk factors makes it more suitable for orthopedic patients. Lan Xiaoyan et al. [28] applied Waterlow and Braden scales to liver transplant patients with positive results. Regarding self-designed scales, Zhang Xiaoyan et al. [29] used univariate and multivariate logistic regression to analyze influencing factors of pediatric intraoperative pressure injury, developing a prevention assessment scale and interventions through collaboration between operating room head nurses and surgical directors. Huang Weijian et al. [30] used the Delphi method with expert consultations to establish a pressure ulcer risk factor assessment index system for surgical patients, demonstrating reliable results and high expert consensus, though lacking specific scoring criteria and clinical validation data. Clinical application of intraoperative pressure injury scales remains poorly standardized, with inconsistent evaluation effectiveness related to complex surgical patient factors. Appropriate scales enable accurate, dynamic, comprehensive risk assessment, but the lack of a surgical-specific pressure ulcer risk assessment scale may contribute to persistently high intraoperative pressure injury rates [31].

### 2.3 Proper Positioning and Use of Protective Devices

Due to surgical field exposure and sterile field maintenance requirements, intraoperative position changes for pressure relief are limited, making preoperative positioning and device protection essential. The 2019 *Operating Room Nursing Practice Guidelines* [32] clearly state that positioning should minimize physiological impact while fully exposing the surgical field, maintain normal physiological curvature and axes, preserve joint functional positions, disperse pressure, and prevent prolonged local compression to protect skin integrity [33]. Zhao Kuaile

et al. [34] applied computer terminal devices for supine patients to scientifically adjust operating table segments for optimal positioning, demonstrating that curvilinear supine positioning effectively reduces sacral and heel pressure ulcers. Regarding protective devices and dressings, new dressings help prevent intraoperative pressure injury but lack authoritative guidelines. Wen Zhen et al. [35] designed a novel latex water bag position pad using soft, elastic mm thick latex, showing clear advantages over traditional pads in preventing pressure ulcers for supine patients. Xu Shuhua et al. [36] found that combining Comfeel exudate-absorbing patches with Inditherm constant temperature blankets significantly reduced pressure ulcer incidence in craniocerebral surgery compared to using patches alone. Ge Jingwu [37] reported that Saifurun liquid dressing combined with foam dressings and gel position pads reduced pressure ulcer incidence in posterior thoracolumbar surgery, effectively decreasing Stage I pressure ulcer risk and preventing forehead pressure ulcers. Research [38] found that combining gel position pads with wound dressings in posterior spinal surgery buffered skin pressure, absorbed sweat, prevented moisture-related skin irritation, and significantly reduced pressure injury risk.

### 2.4 Bundle Care Measures

Bundle care is an evidence-based nursing approach combining a series of interrelated interventions with empirical support. Typically including 3-5 clear, operational evidence-based measures that are clinically acceptable and more effective when implemented together than individually [39], bundle interventions have been widely applied across nursing domains in recent years [40]. Hou Xiaomin et al. [41] applied bundle care to neurosurgical patients, Zhi Hongxiao et al. [42] to adult cardiopulmonary bypass patients, and Zhu Donglin et al. [43] to general surgery patients, all demonstrating significantly reduced pressure ulcer incidence and improved patient satisfaction. Zhang Chunhua [44] applied bundle care to interventional surgery patients with favorable outcomes.

## 3. Summary

With rapid advances in modern surgical technology, increasing numbers of complex procedures, special-position surgeries, and elderly surgical patients have made procedure-related pressure injury a clinical priority. Intraoperative pressure injury results from multiple coexisting factors with complex mechanisms, primarily including extrinsic factors (operative time, surgical position, nurse-related factors) and intrinsic factors (age, nutritional status). Understanding these factors, conducting proper nursing assessment, and implementing targeted interventions are crucial for prevention. Clinical staff can prevent intraoperative pressure injury through effective training, establishing stoma/wound liaison nurses, proper use of risk assessment scales, appropriate positioning and protective devices, and bundle care measures. Currently, specialized assessment scales for surgical pressure injury are lacking, and while numerous risk factor studies exist, authoritative application guidelines for procedure-related pressure injury

remain absent. Future research should develop comprehensive surgical pressure injury assessment tools to enable scientific, precise pressure ulcer prevention.

**Conflict of Interest Statement:** The authors declare no conflicts of interest.

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*Note: Figure translations are in progress. See original paper for figures.*