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Evaluation of Surgical Wound Healing in Orthopedic Patients with Impaired Tissue Integrity According to Nursing Outcomes Classification

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PURPOSE: To assess the surgical wound (SW) healing in orthopedic patients with Impaired tissue integrity according to the Nursing Outcomes Classification (NOC).
METHODS: A prospective longitudinal study performed with 24 patients. Data collection was performed through an instrument containing the NOC indicators.
FINDINGS: The indicators skin approximation, drainage, surrounding skin erythema, periwound edema, increased skin temperature, and foul wound odor presented a statistically significant increase when compared the means between the first and the last day of evaluation.
CONCLUSION: The NOC indicators allowed to monitor the SW healing indicating an improvement.
IMPLICATIONS FOR NURSING PRACTICE: The NOC can favor an earlier identification of the degree of commitment for each patient and enables implementation of care to achieve target outcomes.

Orthopedic surgeries are becoming procedures performed increasingly often in the recent years, specifically the total hip arthroplasty (THA). This increase is related to a longer life expectancy along with an active and independent elderly. The THA is a surgical procedure that uses a method of hip joint replacement by a prosthetic material. The replacement is considered primary when the patient is submitted for the first time to the procedure (North et al., 2016), or revision when any repair is needed (Munro, Masri, Duncan, & Garbuz, 2014).

THA is an elective procedure that aims to enhance the individual's quality of life; thus, a quick postoperative recovery is expected (Munro et al., 2014; North et al., 2016). Adequate surgical wound (SW) healing and absence of infection are important factors for optimal recovery of these patients. To perform a THA procedure, nonorganic implant materials are used, what literature indicates that is related to a higher infection risk. Thus, nursing plays a fundamental role in the recovery process, developing the nursing process aiming environment, hygiene and comfort control, perioperative infection prevention and control, medication administration, and incision site care (Ercole et al., 2011).

The evaluation of the SW healing is included in the professional nurse's competency. Therefore, the nurse must assess the SW healing, including the following: incision measurement, observation of wound tissue, with attention to re-epithelialization, suture line integrity, exudate that might drain, and incision palpation attending to collagen deposit (Silva & Crossetti, 2012). The applicability of standardized instruments may favor a precise diagnostic approach in the SW assessment.

Impaired tissue integrity (00044) is a Nursing Diagnosis (ND) commonly used for patients undergoing surgical procedures. This ND, according to the Nursing Diagnostic Classification *NANDA-International* (NANDA-I) is defined as

"*Damage to mucous membrane, corneal, integumentary, or subcutaneous tissues*." This ND had its last revision in 2013, when surgical procedure was included as a related factor (Herdman & Kamitsuru, 2018).

In a study carried out in a teaching hospital, the *Impaired tissue integrity* ND (00044) was identified in 92.8% of the sample, and all patients underwent invasive procedures, such as surgeries (Novaes, Torres, & Oliva, 2015). In another study that aimed to characterize the surgical patients ($n = 362$) with the same ND, findings indicated a median in-hospital length of stay of 5 days, mean age 52.51 ($\pm$ 18.51), and mostly female (53.52%). Further, the same study showed that more than 80% of the patients were admitted to undergo some kind of surgery, and the related factor *Mechanical Trauma* was the most frequent factor used for this ND (Panato, 2014).

The NANDA-I classification may be used in combination with other classifications, such as the *Nursing Outcomes Classification* (NOC). The relation between the NANDA-I and the NOC suggests some links between a patient's current problem or condition, and the aspects to be solved or improved through nursing interventions. The NOC is a classification system that describes nursing outcome (NO) using standardized language, which enables to oversee patient's recovery, worsening or stagnation during a period of care. The NOC taxonomic structure has three levels: domains, classes, and results. Each NO has a list of indicators that describe the patient's condition. Indicators are evaluated using a 5-point Likert scale. *Wound healing: Primary Intention* NO (1102) is defined as the "*Extent of regeneration of cells and tissues following intentional closure*"; therefore, this NO can be used by nurses to evaluate the SW healing (Moorhead, Johnson, Maas, & Swanson, 2012).

The NOC can be an auxiliary tool for nurses to evaluate and monitor the SW healing through the regeneration process of cells and tissues after intentional closure. In this way, the NOC can assist in the evaluation and characterization of the wound healing, through the evaluation of the NO indicators.

Purpose

The purpose of this study was to evaluate the SW healing of orthopedic patients with a ND of *Impaired tissue integrity* (00044) according to the NOC. The relevance of this study is based on the premise that the use of NANDA-I and NOC for the SW evaluation subsidize the planning and evaluation of nursing care as well as supporting clinical decision-making.

Design

This is a longitudinal prospective study with orthopedic patients diagnosed with the ND *Impaired tissue integrity* (00044) and followed proposed recommendations from the STROBE statement (Von Elm et al., 2008).

Setting

The study was conducted in surgical units of a large university hospital in southern Brazil between July 2015 and June 2016.

Sample

The sample was calculated for at least 17 patients, considering a sample calculation with 90% of power, an alpha error of 1%, and estimating a score improvement of nursing outcomes indicators of 0.5 per day evaluated. Adding 20% for potential loss of follow-up, 24 patients were included. Consecutive sampling was used in a way that patients were allocated to the study through admission to the surgical units.

Inclusion criteria were: patients submitted to THA with 18 years old or older, from both genders, who had a ND of *Impaired tissue integrity* (00044) established by the nurse and documented in the electronic health records, and who had at least two nursing evaluations. Exclusion criteria were patients with clinical, physical or psychological conditions that would make data collection impossible.

Method

Data collection was carried out simultaneously by two researchers through application of the data collection instrument; that means, conducting interviews with patients and the SW assessment. The indicators were evaluated using a 5-points Likert scale. For indicators measurement, propaedeutic methods of inspection and palpation were used, while adapted to conceptual and operational definitions. It should be emphasized that the SW assessment was not performed on the first postoperative day, because according to the institutional protocol for surgical wound care, bandages have to remain in place for 24 hr after surgery.

Data analysis was executed in Stata 14.0 Statistical Software. Continuous variables were expressed as mean and standard deviation for those with normal distribution, and median and interquartile range for the asymmetric ones. Categorical variables were expressed as percentages and absolute numbers. To compare the means between the first and last day of evaluation, the Student's *t*-test for paired samples was used. Cronbach's alpha was used in order to verify internal consistency of the NO evaluated. A $p \leq .05$ was considered statistically significant.

The study was approved by the Institutional Research Ethics Committee (#110601). Patients who agreed to participate in the study signed the informed consent form.

Main Research Variables

The data collection instrument was constructed through consensus between nurses with orthopedics clinical expertise and research experience using the NOC (Silva et al., 2018). The content consensus defined the clinical indicators

of *Wound healing: Primary Intention* NO that could better lead the SW healing, and its conceptual and operational definitions (Silva et al., 2018).

The clinical indicators evaluate by means the NOC scale None to Extensive were: (110214) Scar formation and (110201) Skin approximation. (110202) Purulent drainage, (110203) Serous drainage, (110204) Sanguineous drainage, (110205) Serosanguineous drainage, (110208) Surrounding skin erythema, (110209) Periwound edema, (110210) Increased skin temperature, and (110211) Foul wound odor, were evaluate using the NOC scale Extensive to None (Moorhead et al., 2012). In order to refine the selected clinical indicators evaluation derived from the consensus, the grouping of some indicators was performed with the objective of to reduce clinical assessment subjectivity, considering the magnitude of these NO scales (Moorhead et al., 2012; Silva et al., 2018).

The Scar Formation was evaluated by the surgical wound physical examination as well as the adjacent skin. This included the observation and wound tissue palpation with attention to re-epithelialization and suture line integrity, according to the cicatrization phases: inflammatory, proliferative, and restorative. The magnitude of the definition on the Likert scale stayed: (1) presence of flushing, heat, edema, pain, and serosanguineous secretion; (2) presence of at least one of the following characteristics: flushing, heat, edema, pain. Absence or little serosanguineous or serous secretion; (3) progressing red area for rose; (4) scar presence, pale pink tissue; (5) scar presence, gray or slightly elastic tissue (Moorhead et al., 2012; Silva et al., 2018).

The distance between wound edges, the presence of serous and bloody secretion were evaluate by means of the indicator (110201) *Skin Approximation*. According to the scale None to Extensive, from NOC, the magnitude were defined as: (1) wound dehiscence; (2) start of dehiscence with sanguineous or serosanguineous secretion; (3) suture with juxtaposed edges, with serosanguineous or sanguineous drainage; (4) suture with juxtaposed edges, with minimal serous drainage; (5) suture with juxtaposed edges, with no secretion presence (Moorhead et al., 2012; Silva et al., 2018).

The indicators related to *Drainage* were assembled into one single indicator, observating of amount and type of drainage from wound exudates, following magnitude for the operational definition: (1) abundant and purulent or piohematic drainage; (2) drainage in average quantity piohematic; (3) drainage in little or medium quantity, with presence of serosanguineous or sanguineous secretion; (4) low drainage, serous secretion; (5) no exudates presence (Moorhead et al., 2012; Silva et al., 2018).

The indicators (110208) *Surrounding skin erythema*, (110209) *Periwound edema*, (110210) *Increased skin temperature, and* (110211) *Foul wound odor* were aggregated into a single indicator, which was named *Inflammatory signs and Foul wound odor*, considering the presence of the described characteristics with the magnitude for the operational definition: (1) all characteristics; (2) three characteristics; (3) two characteristics; (4) one characteristic; and (5) no change (Moorhead et al., 2012; Silva et al., 2018).

Table 1. Sociodemographic and Clinical Characteristics of Patients Submitted to THA

Variable	Total $n = 24$
Age, years[a]	57 (± 14.8)
Sex, female[b]	13 (54.17%)
Body Mass Index (kg/m²)[a]	27 (± 4.8)
Education, years[b]	8.4 (± 3.7)
Do not live alone[b]	15 (62.50%)
Reason for surgical intervention	
Osteoarthritis[b]	16 (66.7%)
Fracture[b]	5 (21.0%)
Osteonecrosis[b]	1 (4.0%)
Others[b]	1 (4.0%)
Comorbidities	
Hypertension[b]	8 (33.3%)
Congestive heart failure[b]	2 (8.33%)
Diabetes mellitus[b]	4 (16.67)
Cerebral vascular accident[b]	2 (8.33%)
Tumors[b]	5 (20.83)
Primary THR[b]	21 (87.50%)
Evaluation time, 3 days[b]	21 (87.50%)

[a]Mean ± standard deviation.
[b]*n* (%).
Note. Source: Research Data.

The instrument was divided into two parts. The first one contained sociodemographic and clinical variables related to orthopedic patients. The second part was composed by the *Wound healing: Primary Intention* NO (1102) and a grid containing the seven following columns: listing of clinical indicators and their conceptual definition; operational definition of indicator describing evaluation procedure; operational definition magnitude stratified into five points; evaluation day; indicator scale from 1 to 5 in a 5-point Likert scale; column to document when "not applicable," and a space for comments.

The instrument was tested in a pilot study to observe variation of indicators' scores and to standardize data collection process. The evaluated patients during the pilot study were not included in the final sample. Finally, the instrument was computerized in Sphinx Software, and data collection was performed using tablets where data was automatically transferred to an online database.

Findings

Twenty-four patients participated in the study, where all had the ND and maintained until the end of the evaluations. Of these, 13 (54.17%) were female, mean age 57.1 ± 14.8 years old and 22 (92%) underwent primary THA. Osteoarthritis was the basal disease in most cases (Table 1).

From the 24 study participants, 21 patients were followed for 3 days and three patients were followed for 2 consecutive days, summing 84 evaluations. All *Wound healing: Primary Intention* (1102) indicators were daily measured and showed improvement in the patients' clinical evaluation, as summarized in Table 2.

Table 2. Indicators for *Wound Healing: Primary Intention* (1102) and their Daily Verification Means for Patients with *Impaired Tissue Integrity* ND (00044)

Indicators	First day	Second day	Third day
Scar formation (110214)	2.33 (± 0.48)	2.46 (± 0.59)	2.48 (± 0.51)
Skin approximation (110201)	3.14 (± 0.36)	3.88 (± 0.61)	4.10 (± 0.77)
Drainage (110202) (110203) (110204) (110205)	3.14 (± 0.35)	3.92 (± 0.65)	4.19 (± 0.68)
Inflammatory signs and foul wound odor (110208) (110209) (110210) (110211)	3.38 (± 1.11)	3.42 (± 1.21)	4.14 (± 0.99)

Note. Numbers expressed in average (± standard deviation). Indicators followed by the codes suggested by NOC taxonomy.

Figure 1 displays the means for indicators that composed the nursing outcome *Wound healing: Primary Intention* (1102). When comparing the first and last day, the figure shows that patients had a progressive improvement in three indicators, namely: *Skin approximation*, *Drainage,* and *Inflammatory signs and Foul wound odor*. In the indicator *Scar formation* (110214), There was no significant change during clinical evaluations ($p = .0829$), remaining in the *limited* score according to the NOC Likert scale.

The rating scale for the *Wound healing: Primary Intention* NO (1102) presented a Cronbach's alpha coefficient of 0.82, with 95% CI [0.75, 0.88].

Discussion

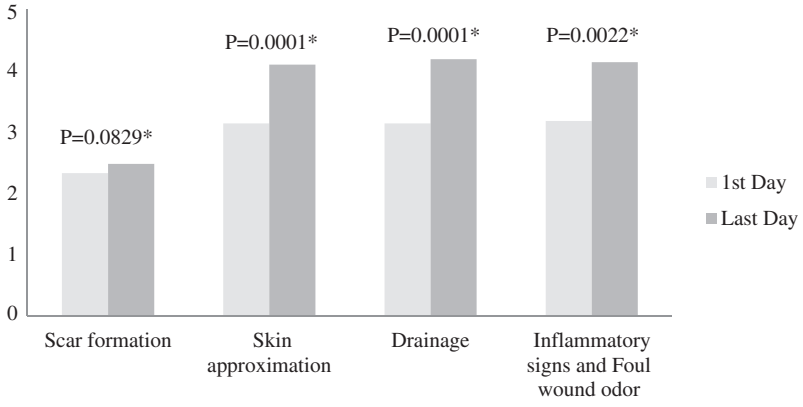
This was the first study that evaluated the ND of *Impaired tissue integrity* (00044) for the SW healing of patients that underwent THA, using the NOC. Although the short follow-up period (3 days), his study showed the progressive improvement of the *Wound healing: primary intention* NO (1102) indicators.

From the sociodemographic data, it can be inferred that patients who were participating in the study had a good prognosis. The majority had no related comorbidities, lived with at least one companion, had a Body Mass Index (BMI) slightly above ideal (BMI = 27.2), and a mean age of 57 years old (± 14.8). This data may have influenced the improvement of the results, since literature emphasizes that THA is a procedure that aims to improve individual's quality of life, therefore it is elective. Corroborating to the findings of this study, similar research showed evidence that BMI is a predictor for THA positive results (Slaven, 2012) and showed predominant mean age of patients around 59.17 ($SD = 14.7$) (Pinto et al., 2015). Literature suggests as negative factors associated to the postoperative recovery comorbidities, obesity and advanced age (Silva, Santos, Carvalho Júnior, & Matos, 2014), though this study showed a sample with opposite factors.

The epidemiological clinical profile of patients that underwent THA in this study demonstrated the main reason for THA: osteoarthritis, predominance of primary arthroplasty, and women. A previous retrospective cohort study, with the aim of to characterize arthroplasties, to calculate surgical infection rate and to identify related risk factors, showed osteoarthritis as the prevalent diagnosis, where 89.8% of the arthroplasty were primary and predominantly in female (57.8%). For instance, literature reports an increase in osteoarthritis during the postmenopausal period due to hormonal changes (Pinto et al., 2015).

The indicators selected to the SW healing showed, in the majority, statistically significant differences, despite the small changes in each of the evaluated scores. It is known that the SW healing is a highly complex process, involving several interdependent phases. Therefore, it is acceptable not to check major changes in its appearance over 3 days, which also makes it acceptable that the only indicator that did not present a statistically significant difference during data collection was *Scar formation* (110214) ($p = .0829$). The

Figure 1. Average of the Indicators from Nursing Outcome Wound Healing: Primary Intention on the First and Last Day of Evaluation.



Note: Source: Research Data. *Paired *t*-test

literature highlights that, between the third and fourth postoperative day, the granulation tissue overlaps in the SW and collagen deposition begins. Collagen synthesis begins hours after the injury, but it does not become significant until about a week after the incision. It should be noticed that collagen is an indispensable substance in the scar formation (Medeiros & Dantas Filho, 2016; Szwed & Santos, 2016). In this way, the scar formation would be better evaluated from this period and on; however, this study had just 3 days of follow-up, from the second to the fourth postoperative day.

In the *Skin approximation* (110201) ($p = .0001$) evaluation, the distance between wound edges and presence or absence of serous or bloody secretion were observed. Taking into consideration that the wound was not evaluated in the first 24 hr postoperatively, the statistical variation was observed between each of the other data collection days. This also applies to the *Drainage* ($p = .0001$), where was analyzed the aspect of the SW exudate. The exudate varies in characteristics and quantities, depending on the healing process stage. Immediately after surgery, it is bloody. However, within the first 48 hr, the drainage becomes serosanguineous, and later, serous. During this process, the exudate tends to gradually decrease (Dealey, 2013).

The first 24–48 hr of the healing process correspond to the inflammatory phase, which is determinant for the wound healing. During this period, platelets activation happens; thus, allowing hemostasis and subsequent growth factors activation along with leukocyte cellular infiltration (Laureano & Rodrigues, 2011; Medeiros & Dantas Filho, 2016; Szwed & Santos, 2016). Hence, during this phase, it is acceptable for the *Skin approximation* (110201) and *Drainage* indicators to remain at grade 3 ("moderate"), but with some average variation between days, reducing to grade 4 ("light") in the last day of data collection.

Up to the fourth postoperative day, the most important clinical finding is the identification of the scar inflammation. This finding may be detected as a noticeable increase in temperature by touch, in addition to erythema and edema around the scar. Therefore, at this stage, it is normal to observe inflammatory signs, such as heat, erythema or discoloration, pain, and edema at the surgical incision (Medeiros & Dantas Filho, 2016; Szwed & Santos, 2016). Regarding the indicator *Inflammatory signs and Foul wound odor* ($p = .0022$), as shown in Table 2, remained in grade 3, in the first and second day of collection, pointing to the presence of an average two characteristics in the SW. However, in the third day, the mean achieved grade 4 ("one characteristic").

Similar research that conducted content validation of NO for patients with *Risk of infection* ND demonstrated that the *Wound healing (primary intention and second intention)* NO was considered to be *extremely important*, with 19 (59.37%) indicators validated. Researchers concluded that, possibly, experts validated a high number of indicators because surgical incision is considered an important site for microorganism contamination and hospital infection development (Almeida, Seganfredo, Menna Barreto, & Lucena, 2014). Infections related to health care represent one of the most important public health issues in the world. Surgical site infections are the world's second most frequent cause of adverse events and the leading cause of morbid-mortality in postoperative patients worldwide. The World Health Organization focuses on surgical safety in health services emphasizing that "Safe surgeries Save lives" and highlighting the commitment to minimize the health care related risks of infections (World Health Organization, 2010). In Brazil, it is estimated that surgical site infection occurs in 11% of surgical procedures. This is a fact that prolongs hospitalization, usually from 7 to 10 days; thus, increasing morbid-mortality, health care costs, and more, increasing patient's discomfort (Barreto et al., 2009).

The indicators *Skin approximation, Drainage, Inflammatory signs, and Foul wound odor* presented a 3-day evolution from grade 3 to 4 in the 5-point NOC *Likert* scale, where the most desirable is to reach score 5. These findings demonstrate that, in spite of the limited follow-up time, it was possible to observe the postoperative recovery improvement of the SW using the NOC's indicators application. Hence, the NOC made it possible to measure the SW healing, which in this study was satisfactory. Further, findings showed SW good healing, as well as inflammatory and infectious signs decrease during the 3 days of follow-up (from the second to the fourth postoperative day).

Based on these study results, plan of care is essential to provide a more effective plan of action related to the indicators. The *Scar formation* indicator can also be evaluated at outpatient clinics for a better healing evaluation, as well as guiding self-care with the purpose of healing improvement.

The scales for the four indicators of *Wound healing: Primary Intention* NO presented internal consistency, with a Cronbach's alpha of ≥ 0.8. Therefore, the NOC scales are reliable to measure the recovery of patients with orthopedic problems. In this context, the evaluation of the SW healing for patients that underwent THA using the NOC favored the assessment of different skin characteristics through operational indicators.

An important limitation of this study is that the overall NO evaluation was compromised by the impossibility of removing bandage on the first postoperative day, that patients are discharged from the hospital around the fourth postoperative day, and the healing process requires a longer time for to evaluate its effectiveness. We also mentioned that the patient's clinical conditions, nutritional status, antimicrobial agents or another medications use were not statistically related to the outcomes investigated, which may have interfered with the findings. In methods, we modified the NOC tool, using conceptual and operational definitions, and combining indicators during clinical evaluation. However, this did not compromise the quality of findings, nor the purpose of the NOC (Silva et al., 2018). It is important to highlight the NOC proposition that outcomes and indicators selected for practice need to be those that are essential to the context in which they will be used, neglecting outcomes and nonessential indicators (Moorhead et al., 2012). In this way, outcomes

evaluation may become more objective and spend less time of the nurse (Almeida et al., 2014). In addition, the small sample size, the coverage of the NOC classification and the possibility of choosing the NO for different populations, turn difficult to validate the scales using psychometric criteria and/or another statistics tests, which limits the generalizability and extensive maximization of these findings.

Conclusions

In the evaluation of the SW healing of orthopedic patients with *Impaired tissue integrity* according to the NOC, all the indicators used in this study of the *Wound healing: Primary Intention* NO showed a progressive improvement of means during clinical follow-up. Only the *Scar formation* did not show statistically significant improvement. The diagnosis status included in this study was observed from the NO scores during each day evaluated. It was also possible to perceive the adequacy of the indicators in the chosen population.

It is suggested that future research do accompany patients with this diagnosis at home, because in a long-term care, other indicators may demonstrate different evolutions involving the patient's knowledge or self-care behaviors related to the SW healing. Furthermore, it is suggested to be appropriate to use these indicators to build an SW healing assessment scale. In teaching, it is recommended the use of these indicators in theoretical and practical courses regarding surgical wounds evaluation and bandage maintenance, since they are fundamental tools for nursing practice in surgical units.

Implications for Nursing Knowledge and/or Language Development

This research was performed with orthopedic patients; however, the *Wound healing: Primary Intention* NO and indicators used in this research can be used to evaluate the SW healing from other types of clean surgery and to verify the evolution according to the healing physiology.

As implications for clinical practice, it is recommended the construction and validation of conceptual and operational definitions before the NOC implementation, as well as the development of interest groups. These groups may be formed based on different surgical wounds that may benefit from the adoption of this NO, where the SW healing evolution may differ according to different patients' groups.

Knowledge Translation

Nursing has been investigating better clinical practice and innovative tools to support plan of care. This study was the pioneer in the NOC usage related to SW assessment in patients that underwent orthopedic surgery. Based on these findings, the NOC can favor an earlier identification of the degree of commitment for each patient and enables implementation of care to achieve targeted. Thus, aiming for a safer care and more accurate diagnostic evaluation, the NOC could become a standard in evaluating nursing care effectiveness.

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