

ANALYSIS OF THE USE OF SURGICAL INSTRUMENTS MARKING TAPES: INTEGRATIVE REVIEW*

Análise do uso de fitas de marcação de instrumentais cirúrgicos: revisão integrativa

Análisis del uso de cintas adhesivas de marcación de los instrumentos quirúrgicos: revisión integradora

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ABSTRACT: Objective: Identify articles related to the use of surgical instruments marking tapes and describe best practices for their use. **Method:** Integrative literature review of articles hosted on the Virtual Health Library (BVS), with research on the website and group of online discussions of the *Association of periOperative Registered Nurses* (AORN) and use of reverse search of publications. Written studies in Portuguese, English, and Spanish, with no specific time frame, which present information related to the use of instrumental marking tape and had their full texts online accepted. **Results:** Thirteen articles that addressed risks and benefits concerning the use of marking tapes were found. **Conclusion:** The integrative review highlighted studies are scarce and the few existing articles show low levels of scientific evidence, not offering strong enough degrees of recommendations to support the decision making process. **Keywords:** Surgical instruments. Equipment and supplies labeling. Sterilization.

RESUMO: Objetivo: Identificar artigos relacionados ao uso de fitas de marcação de instrumental cirúrgico e descrever boas práticas para o seu uso. **Método:** Revisão integrativa da literatura de artigos hospedados na Biblioteca Virtual em Saúde (BVS), com pesquisas no site e grupo de discussão *online* da *Association of periOperative Registered Nurses* (AORN) e utilização da busca inversa de publicações. Foram aceitos estudos escritos nos idiomas português, inglês e espanhol, sem recorte temporal, que apresentassem informações relacionadas ao uso da fita de marcação de instrumental e que dispunham seus textos completos via *online*. **Resultados:** Foram encontrados 13 artigos que abordaram o perigo e os benefícios quanto ao seu uso. **Conclusão:** A revisão integrativa permitiu evidenciar que os estudos são escassos e os poucos trabalhos existentes possuem níveis de evidências científicas baixos, não oferecendo graus de recomendações fortes o suficiente para auxiliar a tomada de decisão prática. **Palavras-chave:** Instrumentos cirúrgicos. Rotulagem de equipamentos e provisões. Esterilização.

RESUMEN: Objetivo: Identificar los artículos relacionados con el uso de las cintas adhesivas de marcación de los instrumentos quirúrgicos y describir las buenas prácticas para su uso. **Métodos:** Revisión integradora de la literatura de los artículos alojados en la Biblioteca Virtual en Salud (BVS), con búsqueda en el sitio y en los grupos de discusión de la Asociación de Enfermeras Registradas de Peri-operación (AORN), y el uso de búsqueda inversa de las publicaciones. Fueron aceptos estudios en los idiomas portugués, inglés y español, sin un exacto período de tiempo, los cuales presentaban información relacionada con el uso de la cinta adhesiva de marcación instrumental y que tenían sus textos completos a través de la Internet. **Resultados:** Se encontraron 13 artículos que abordan los riesgos y los beneficios del su uso. **Conclusión:** La revisión integradora ha puesto de relieve que los estudios son escasos y los pocos trabajos existentes tienen bajos niveles de evidencia científica, y por eso no ofrecen grados de recomendaciones suficientemente fuertes para ayudar a la toma de decisiones práctica.

Palabras clave: Instrumentos quirúrgicos. Etiquetado de equipos y suministros. Esterilización.

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INTRODUCTION

The material and sterilization center (MSC) is described as a processing unit (cleaning, disinfection, preparation, and sterilization) of health products serving various sectors within the hospital setting¹. Among the activities carried out in the MSC, the process of traceability of processed materials is a *sine qua non* condition. This process is even determined by Brazilian legislation for quality assurance and safety of care, even if indirectly, legally endorsing the MSC as a way to demonstrate that best practices were applied¹⁻⁴. The first global challenge for patient safety focused on the prevention of infections related to health care; the second challenge, with the theme "Safe Surgery Saves Lives", further strengthens this requirement that the MSC will guarantee the supply of products for health free of pathogens, corroborating with the objective of a patient free from infections⁵.

There are many ways of promoting the traceability of the instruments efficiently, but what they have in common is the need for a methodical and well-structured system⁶. Some methods allow, through computerization of the process, the rapid and efficient traceability of the instruments. However, the cost may be too high when compared to manual tracing of data⁷. An example is the use of DataMatrix, a two-dimensional graphical representation code that stores information much smaller than the conventional bar code spaces⁷. Manual process of identification allows little confidence in traceability of the instruments; however, the cost is much lower. The advantage is that in both cases, rules and regulations are fully met⁷.

Being the possibility of using the tool for computerized traceability a distant reality to the MSCs in the national territory⁷, one of the traceability systems widely used is the marking of surgical instruments using identifying elements, such as colorful ribbons. Such identification is physically held in the instruments, tape involving a small portion of them, coding them by color. Thus, it is possible to segregate each instrumentation group or boxes/kits by different color labels, visually facilitating the manual count and assembly of boxes/appropriate kits. However, there are anecdotal reports of dissatisfaction with this product from everyday practice users, such as difficulty of standardization and frequency of change of these tapes, since there is the ease of drying and fading of the tapes over time, which may favor

the accumulation of dirt and even increase the risk of detachment, allowing them to fall in the surgical area. Existing information is vague and do not please MSC nurses. Therefore, in view of that, even though being widely used and marketed, there is no scientific data on Brazilian literature showing recommendations on the use of the tapes, which raised the following question: Are the surgical instruments marking tapes safe to be used in the daily practice of the MSC?

This article proposes to identify studies related to the use of surgical instruments marking tapes, supporting the practice in Brazilians MSCs which use the coding by tapes methodology on surgical instruments.

OBJECTIVE

Identify studies in the literature related to the use of tapes used for marking surgical instruments and the evidence in relation to the risks and good practices of their use.

METHOD

This is an integrative literature review, which seeks to synthesize information from various published studies to provide evidence for clinical practice⁸. This study was conducted in six stages, following the recommendations already well established in the literature, namely: elaboration of guiding question, preparation of data search criteria, definition of information to be extracted from selected studies, evaluation of the included studies, interpretation of results, and synthesis of knowledge⁸. To find studies, a search was performed for scientific articles hosted on the Virtual Health Library (BVS), which provides high scientific research content arising from reference databases in different areas of health such as Latin American Literature in Health Sciences in Latin America and the Caribbean (LILACS), Spanish Bibliographic Index of Health Sciences (IBECS), International Literature in Health Sciences (MEDLINE), Cochrane Library, Scientific Electronic Library Online (SciELO), and a Database of Nursing (BDENF). To this end, descriptors in Portuguese via Descriptors in Health Sciences (DeCS) were utilized, obeying the following combinations: labeling of equipment and supplies AND surgical

instruments; risk management AND surgical instruments; bacterial infections AND surgical instruments; foreign bodies AND surgical instruments; color AND surgical instruments, equipment and supplies AND surgical instruments; sterilization AND surgical instruments; color AND sterilization were used.

Separately, the website of the *Association of periOperative Registered Nurses* (AORN) has been consulted to find studies not identified in the initial search. In addition, there are discussion groups and other publications that are not disclosed in MEDLINE in that website. Thus, to further expand the search results, a search was conducted in the AORN website (AORN Journal and discussion forums). Initially, the DeCS in Portuguese was used to perform the search, but due to the difficulty in finding results, the following descriptors in English not registered in DeCS, but that relate to the theme, were chosen: *instrument tape AND marking tape; instrument tape AND sterilization; instrument tape AND color-coded tape*.

To complement the search, a survey was conducted in the online editions of SOBECC Journal, official publication of the Brazilian Association of Nurses of Surgical Center, Anesthesia Recovery and Materials and Sterilization Center. Still, a reverse search in which its selecting method was analyzing references of articles previously included was performed.

Data collection was conducted from August to November 2015 by a reviewer who assessed the title and then the abstract of the articles. As a selection criteria, articles published in Spanish, English, and Portuguese, with no specific time frame, which presented information related to the use of surgical instruments marking tapes, and had their full texts *online*, available for free or not, were accepted. Articles published in another foreign language and that had no correlation with the theme of the study were excluded.

Initially, there was a primary search through selection of article title and those that related to the theme were included, so their abstracts were analyzed. Proving the connection of the abstract with the objectives of the research, these articles went through a complete scan, and then data were transcribed into a data collection form. We opted for a data collection form already validated for this type of research methodology^{8,9} to be able to stratify important information.

Critical evaluation of studies was performed by use of classification table for grading the level of scientific

evidence by type of study of the *Oxford Center for Evidence Based Medicine*¹⁰. For the presentation of results, a table summarizing the information was elaborated.

RESULTS

Search strategy provided a total of 2,639 references. From this result, 218 articles were excluded by the criteria of language. Of the 2,421 studies included by language, 2,355 studies were excluded by the title, leaving 66 publications to be evaluated by the summary, of which 16 publications were included. From this result, studies have undergone an evaluation by the other inclusion criteria, and 13 publications have been accepted for this review, because they met all specifications.

Search sources that tested positive were: search on the BVS site (of 2,135 articles identified, 5 were included), search on the AORN site (270 studies identified, seven were included), and the reverse search methodology (45 references evaluated, one was included). Chart 1 presents a summary of the studies found. Regarding their characteristics, 12 articles were published in English and one in Spanish. Year of publication ranged from 1983 and 2013; however, it is noted that one publication did not mention this information. The methodological design was not mentioned in eight publications. Of the articles that clearly elucidated the methodological design, two of them used experimental design (case-control) and three used case report.

Some publications were extracted from studies or reports published by AORN. Regarding the content, two articles provide information about the benefits of using instruments marking tape. One article assessed whether a sterilization method is suitable for the safe use of the tape. Three studies reported adverse events. Six publications reported the opinion of AORN on questioning of nurses, and one publication was didactic material to be used for employees' training in the area. Sample of studies obtained did not include the best levels of scientific evidence: three articles were classified as grade of recommendation C (evidence level 4), two studies were classified as level B recommendation (evidence level 3B), and eight publications obtained classification D (evidence level 5). However, because there are controversial issues and they portray exactly the same issue of this study, they were inserted.

Chart 1. Summary of the studies included in the integrative review on the use of tape for identifying surgical instruments.

Degree of recommendation (level of evidence)	Journal (year)	Objective	Methodology	Results
C (4)	Journal of Oral and Maxillofacial Surgery (1993)	Presenting the risks produced by the use of tape with color code for marking instruments	Case report	Four of six patients undergoing vestibuloplasty, using instruments marked with surgical tape showed postoperative subcutaneous abscess, with positive cultures similar to those found in the instruments with tapes. In another case, after an oroantral fistula closure surgery, a piece of tape arising out of a misplaced tape in one of antral curettes was found after removal of dressing ¹¹
C (4)	British Journal of Surgery (1987)	Report the danger of the use of colored plastic tapes to mark surgical instruments	Case report	Four days after the completion of a tracheostomy without complications, the patient began to present bleeding through a tracheostomy tube, and in-depth investigation identified a blood clot. After its removal, a piece of plastic marking tape was identified next to it ¹²
B (3B)	Journal Healthcare Materials Management (1993)	Assess whether the flash sterilization is suitable for instruments identified with color-coded tapes	Experimental, control case	All control group disks containing <i>Bacillus stearothermophilus</i> spores that were in contact with the instruments but not subjected to sterilization were positive for growth, as expected. But none of the disks that were in contact with the instruments and with the tape after sterilization in flash cycle showed any growth ¹³
D (5)	AORN Journal (1996)	Clarify the question if, in the sterilization flash cycle for 3 min, the instruments marked with tape are actually sterilized	Without scientific methodology. Nurses questions answered by AORN	AORN does not recommend the use of color coding tapes in surgical instruments. Color coding tapes wear out quickly, and ensuring sterility of these coding tapes can be difficult. A 10 min sterilization cycle is required when combining porous and nonporous items. It would be better to consider another method for "coding" of surgical instruments and instruments sets ¹⁴
D (5)	AORN Journal (1996)	Without a purpose set	Without scientific methodology	Color code has made screening, organization, and identification work of instruments a more manageable task for perioperative nurses and members of the support staff who may be less familiar with surgical instruments ¹⁵
D (5)	AORN Journal (1998)	Clarify whether or not the use of marking surgical instruments with tape is a concern	Without scientific methodology. Nurses questions answered by AORN	The tape should be both permeable to vapor and ethylene oxide gas to ensure sterility. The area under the nonpermeable tape is considered nonsterile; Therefore, a tape not permeable to vapor becomes worn and breaks, which can exposed it If it is difficult to establish and monitor a program to deal with these concerns, another method of "coding" should be considered ¹⁶
D (5)	AORN Journal (2003)	Clarify whether flash cycle for 3 min is acceptable if there are no porous items on the tray	Without scientific methodology. Nurses questions answered by AORN	The instrument tape must be porous and permeable to vapor or gas. Whenever there is tape on load, the load contains porous articles and flash sterilizing must be used with the cycle recommended for porous items. If using a gravitational autoclave, the correct cycle is 10 min at 132–133°C. If using a prevacuum autoclave, the correct cycle is 4 min at 132–133°C ¹⁷
D (5)	AORN Journal (2004)	Clarify whether it is acceptable a flash cycle for 3 min in a pan with instruments both marked and unmarked with tape	Without scientific methodology. Nurses questions answered by AORN	Knowing that the marking tape is porous, surgical instruments must be sterilized as porous items. AORN recommends using the flash cycle for porous articles ¹⁸

Continue...

Chart 1. Continuation.

Degree of recommendation (level of evidence)	Journal (year)	Objective	Methodology	Results
B (3B)	Children's Medicine (2008)	To investigate whether the marking tapes can avoid the risk of exchange of elements of the surgical case and reduce their preparation time	Experimental, control case	There was a decrease in the time of preparation of cases and reduction of irregularities in the organization of surgical cases when instruments marking tapes were used ¹⁹
D (5)	AORN Journal (2010)	Clarify the question of whether factors should be considered in the use of instruments marking tapes and if flash sterilization for 3 min is acceptable for instruments marked with tape	Without scientific methodology. Nurses questions answered by AORN	Marking system must be validated with the types of sterilization methods used and should be permeable to allow the sterilant contact with the surface beneath the tape. As the marking tape with color code wears out, the piece of tape may break up and be left in a surgical wound. Continuous monitoring of marking tapes is advisable to detect any degradation. As for flash sterilization of a porous and nonporous product combined, the porous sterilization time parameter should be used. See manufacturer's specific instructions. They should be carefully followed to determine the correct cycle ²⁰
C (4)	Patient Safety in Surgery Journal (2013)	Check if it is true that the practices of identifying surgical instruments using tape may expose patients to a <i>never event</i>	Case report	The fragmentation of tape during surgery can end up as a "foreign" object in the patient. During surgery, a fragmentation of the tape was not detected by the surgical team. But in this case, at the end of the procedure, the surgical team accidentally found and recovered a foreign body in the wound before closing. Inspection of the foreign object identified that it was the marking tape of surgical scissors ²¹
D (5)	AORN Journal (2013)	Clarify the question of how and what factors should be considered for surgical instruments to be marked to identify which group they belong	Without scientific methodology. Nurses questions answered by AORN	About instrumental marking tape, the benefits: the tape is easy to apply and there is no outsourcing process. The risks: repeated sterilization cycles can make the tape move or become brittle, falling into the operative field and become a foreign body. The tape may not be permeable to all types of sterilizing agents, restricting the method of sterilization. And color-blind individuals working in sterile processing department may be unable to determine the correct color tape. Regarding costs, it is low, but as the tape is a porous material, the processing time of a sterilization load may need to be increased ²²
D (5)	Aesculap Academy (not reported)	Review the benefits of marking instruments and describe common methods of marking instruments	Without scientific methodology. Is a didactic material of the Aesculap Academy	The use of tape is a fast, simple way to mark an instrument. The varieties of colors available allow employees to easily know which box the instrument belongs. For example, instruments marked in red belong to cardiology sets. The marking is not a permanent coding solution. Over time, the warmth of the sterilizer will cause the tape to become brittle, and then it will be necessary to recode the instrument. When the tape starts to curl, it must be completely removed ²³

AORN: Association of periOperative Registered Nurses.

DISCUSSION

By the evidence already published, discussion on the use of surgical instruments marking tapes is old and remains a controversy today. Both positive and negative information related to the use of the tapes have been identified.

Negative aspects

After various reprocesses, marking tapes may show changes in their coloring^{14,16}. In addition, this discoloration will result in exposure of adhesive tape residue, which is difficult to remove¹⁶. However, employees who work in the MSC may present difficulties in differentiating between certain colors of tapes, especially the colorblind, which could lead to errors in the assembly of the surgical cases²².

Another negative point is changes in tape positioning on the instrument, which may also occur due to repeated sterilizations^{18,20,22}. When this happens, the tape adhesive residue will be exposed on the surface of the instrument, making it difficult to remove^{18,20,22}.

However, a bigger concern is drying of the marking tape, which is a process that occurs in reprocessing of the marked instrument. Over time, heat of repeated cycles of sterilization can make the tape fragile, allowing it to break or peel^{22,23}. A guideline concerning the limit of cycles of sterilization that the tape would support was not found in the literature. It was only mentioned that such making tapes wear out quickly^{16,18}. One of the main concerns involved in these aspects is related to risk of lodging of microorganisms below loose or moved tapes¹¹.

Another issue is that dryness raises possibility of pieces of tape to detach from the instrument during surgery. If not identified by the surgical team, this pieces may remain missing in the surgical wound, exposing the patient and the surgical team to the risk of retained foreign body^{11,14,16,18,20-23}. Another aspect to be highlight concerning a retained tape is its radiolucent characteristic, so that once inside, it may escape radiographic detection pattern²¹. Thus, a marking tape fragment when retained in the patient's body may be undetectable and expose it to the risk of local inflammatory reactions²¹. Three articles presented adverse event reports concerning the retention of marking tape fragments in the research carried out. In one of the reports, during the end of a

procedure, prior to closing of the surgical wound, the surgical team accidentally found and recovered a fragment of the marking tape of a surgical scissors. Fortunately, the foreign body was recovered²¹. However, it is doubtful that every piece of detached tape has been recovered. Of course, the team will recover the fragment that could be visualized, but will not know in how many parts the tape was fragmented.

In another study, there was a report of a patient with a serious complication subsequent to a tracheostomy that was carried out uneventfully. After four days, there was a major bleeding through the tube of the tracheostomy. In the clinical assessment, a blood clot was identified, and beside it was a piece of instruments marking tape¹². In a different article, six patients undergoing vestibuloplasty in which surgical instruments marked with tape were used, four patients presented postoperative subcutaneous abscess. The four patients cultures were harvested and all tested positive for the same etiological agent, *Staphylococcus epidermidis*, suspecting that the source for these infections was common. By distrust of surgical instruments used in surgery, cultures were also obtained from them. Results of the tips of the instruments were negative. However, cultures of the handles of the instruments, in which there were marking tapes, were positive.

In addition to this, there is a report of another surgery in which a marking tape fragment was found. Oroantral fistula closure surgery presents a difficult surgical field to be viewed due to inaccessible areas for a direct visual inspection. After a few days, to surprise, in removing the bandage, a 1.0x0.5 cm marking tape piece was stuck. Examination of the surgical instruments found that the fragment had detached from one of antral curettes. There was no postsurgical complications in this case, but a fistula closure failure could occur if the fragment had remained trapped in the cavity¹¹.

Another negative aspect is that the marking tape may not be permeable to all types of sterilizing agents, restricting the method of sterilization²². Regarding the characteristic of the marking tape, it must be porous to the vapor of sterilant gas. Therefore, if the tape is not porous, the sterilant will not penetrate the tape and will not sterilize under it^{18,20,22}. An article from 1993¹³ included in this research studied whether it is possible to sterilize with the flash cycle (3 minutes in 135°C heat) the

area below the marking tape when it is attached to surgical instruments. Motivation of this study came from a letter published in the AORN Journal, which stated that the area beneath the tape could not be sterilized. However, this conclusion was derived from intuitive reasoning, not an experimental evidence. In the experiment, *Bacillus stearothermophilus* spores discs were placed between the tape and the instruments. Since these spores are extremely resistant to heat, the lack of spores after sterilization would indicate that conditions are appropriate for complete sterilization. Instruments for the control and experimental groups were segregated. In the control group, the instruments have not gone through sterilization and, as expected, all spore discs that were in contact with the instruments and tape were positive for growth. In the experimental group, in which instruments were sterilized, no discs showed no growth¹³. However, this study has a degree of recommendation B (evidence level 3B).

Finally, on the acceptability of the use of the tapes, we found no positioning of SOBECC. On the other hand, AORN does not recommend nor condemns the use of these tapes, but provides good practices for the institution that opt for this method^{16,20}.

Positive aspects

Varied colors of marking tape are available on the market and this allows various combinations in the classification of surgical instruments. For example, instruments marked in red belong to the set of cardiology, and those marked with blue tape belong to the obstetrics boxes²³. This positive aspect provides the organization of instrumental by box, by group of surgery, by surgeon, by department, etc. The scalability in the use of the tape is proportional to the creativity of the combinations that the nurse's management unit manages to obtain.

In general, the codification of instruments by means of marking with tape has made the job of sorting, organizing, and identifying instruments a task more manageable for both the nurses involved and for the support team, which may be less familiar with the surgical instruments¹⁵. Even employees who are not familiar with the instrumental can prepare efficient surgical boxes for sterilization¹¹.

In the survey, an article that specifically aimed at evaluating the marking tape functionality to avoid the

risk of exchange of instruments of surgical cases and reduce their preparation time was found. For this, 15 surgical cases that had their surgical instruments identified with colored ribbons and 15 surgical cases that did not have the instruments identified with any method were used. The results were positive for the cases that had instruments marked with tape. There was a decrease in the time of preparation of cases and irregularities in the organization of them. Rapid identification of surgical instruments for its specialty facilitates their preparation and organization¹⁹. These benefits ultimately generate greater employee performance and optimization of working time spent at the stage of preparation of the surgical cases¹⁹.

Regarding marking of surgical instruments with the tape, it is easy to be performed and it is not necessary to send the instrumental to a contractor to perform this service. Thus, there is a reduction of cost and downtime of the instruments, when compared to another method of labeling²². However, the benefits derived during the preparation of instruments are negligible when the patient is unnecessarily exposed to the risk of retention of a fragment of the tape¹¹.

On the analysis of risk, benefit and cost for use of marking tape, cost of tape has a low investment compared to other instruments' marking methods. As the tape is considered a porous material, time of sterilization may be increased, leading to an increase in the cost and time of inactivity of the instrument. Furthermore, the tape should be inspected so there is no risk to patients, and this will increase the time of decontamination and replacement of tapes, and thereby increasing the cost of labor²².

Progress of studies related to the theme of this integrative review was not sufficient to affirm or deny that the use of tape for marking of surgical instruments is safe. Identified studies have low levels of evidence (some are old and without methodological rigor) and therefore cannot make recommendations as to the marking tapes use. New study proposals should be conducted to demystify the use of the tapes.

CONCLUSION

This integrative review allowed identifying that studies on the theme are scarce and the few existing articles

on the marking of surgical instruments through tapes have low levels of scientific evidence. Thus, they do not offer strong enough degrees of recommendation to support the decision-making process. Publications studied indicate that there are still differences between favorable and unfavorable studies. There are benefits arising from the use of instruments marked with tapes; however, there is also evidence indicating adverse events related to their fragmentation.

Considering safety as a fundamental condition for health practice, the results of this research show that more investment in rigorously constructed studies on the practice of using instrumental marking tapes are

needed to contribute to the findings of this research. An institution that chooses to use the marking tapes as a method of managing the surgical instruments should adopt a constant supervision of the work attitude of each employee who works in the operating room, because the fragility of the process requires constant inspection at each stage of processing of materials as well as in the operating room. Such supervision work reflects and directly influences the feasibility of safe practice to surgical patients, even if indirectly, and allows identifying flaws in the process and developing preventive actions, resulting in quality and safety to surgical patients, something that has been pursued in our midst.

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