Revista Prevenção de Infecção e Saúde
The Official Journal of the Human Exposome and Infectious Diseases Network

ORIGINAL ARTICLE

DOI: https://doi.org/10.26694/repis.v10i1.5726

Assessment of liposuction cannulas' interior: insights from visual inspection using a borescope

Avaliação do interior das cânulas de lipoaspiração: insights da inspeção visual utilizando um boroscópio

Evaluación del interior de las cánulas de liposucción: perspectivas de la inspección visual utilizando un boroscopio

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How to cite this article:
Batista DS, Prado RT, Leone DRR, Carbogim FdaC, Paula VAAde, Oliveira ACde, Alvim ALS. Assessment of liposuction cannulas' interior: insights from visual inspection using a borescope. Rev Pre Infec e Saúde [Internet]. 2024;10:5726. Available from: http://periodicos.ufpi.br/index.php/repis/article/view/5726. DOI: https://doi.org/10.26694/repis.v10i1.5726

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ABSTRACT

Introduction: Alterations in liposuction cannulas compromise their use and patient safety in healthcare services. **Aim:** to evaluate the interior of liposuction cannulas through visual inspection aided by a borescope. **Design:** this is a descriptive, quantitative study conducted at a materials and sterilization center of a public hospital in Minas Gerais, Brazil, from October 2023 to January 2024. Liposuction cannulas were randomly selected, chosen systematically. Visual inspection assisted by a borescope was conducted, and the data were recorded in a semi-structured instrument, analyzed using descriptive statistics. **Results**: Liposuction cannulas of sizes 3.0 mm and 4.0 mm were evaluated with equal frequency, as they are reusable devices without control regarding the number of sterilizations they have undergone since acquisition. The majority exhibited alterations detected through the borescope (66.7%), with notable occurrences of oxidation, stains, and/or discoloration (60.0%), residues or debris (33.3%), and grooves (25.0%). **Implications**: Tracking of liposuction cannulas identified alterations that compromise their usage, observed with the assistance of a borescope. The findings call for changes in current legislation within sterilization centers due to the absence of indication of this equipment as mandatory for aiding visual inspection.

DESCRIPTORS

Surgical Instruments; Sterilization; Infection Control; Perioperative Nursing.

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Submitted: 2024-05-07
Accepted: 2024-02-09
Published: 2024-05-20

INTRODUCTION

The Central Sterilization and Materials Center (CME) is a support sector that ensures the integrity and functionality of critical, semi-critical, and non-critical Health Products (HP), aiming to enhance the quality of surgical and healthcare procedures.[1] Its activities involve the processing of HP, including pre-cleaning, reception, cleaning, drying, integrity, and functionality assessment, preparation, disinfection or sterilization, storage, and distribution to consumer units.[2]

Regarding the processing of critical and semi-critical HP, these encompass surgical instruments used in invasive procedures involving skin penetration, adjacent mucous membranes, subepithelial tissues, and the vascular system. Non-critical HP includes those in contact with intact skin or not with the patient, usually undergoing cleaning and disinfection in satellite units.[1]

Within the CME, the nursing team ensures the efficiency and safety of processes. Nurses and nursing technicians are responsible for tasks from reception to the distribution of HP to consumer units. A well-established structure, process, and outcome contribute to risk management, reducing incidents and adverse events. Integrated workflow dynamics, in compliance with regulations, favor the reduction of Healthcare-Associated Infections (HAIs).[3-6]

Visual inspection is crucial to ensure the quality of HP processing, aiming to detect residues, stains, and assess instrument functionality. The complexity of HP processing in the CME is exemplified by liposuction cannulas, which present challenges due to their narrow lumen, blind end, irregular surfaces, and propensity to retain organic matter, potentially facilitating the proliferation of microorganisms, such as *Staphylococcus aureus* biofilms.[7-8]

Liposuction is a prevalent aesthetic surgical procedure in healthcare services, particularly in Brazil, with approximately 231,000 cases of plastic surgery reported in 2019. Complications, including surgical site infections, underscore the need for the nursing team at the CME to implement safety-focused guidelines, including liposuction cannula processing strategies, to prevent adverse events.[9]

The science of processing HP, currently quite consistent, esteems this process as an initial and fundamental step to ensure subsequent disinfection and/or sterilization phases. Moreover, it asserts that cleaning reduces the initial microbial load by up to 99.9%, signifying a reduction of four logarithmic cycles of bioburden present in instruments, particularly liposuction cannulas.[7-9]

Given the challenges in inspecting liposuction cannulas and the limited availability of technologies for their safe inspection, this study aims to answer the question: does visual inspection using a boroscope aid in identifying alterations within the lumen of liposuction cannulas?

The objective of this study is to evaluate the interior of liposuction cannula lumens through visual inspection aided by a boroscope.

METHOD

Design

This study adopts a descriptive approach and was carried out at a materials and sterilization center. The research stages were developed following the guidelines of the Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0), which aim to enhance the quality, safety, and value of healthcare. Approval for this research was obtained from the Research Ethics Committee under opinion number 5.660.025.

Study Site

The study was conducted at a hospital located in Juiz de Fora, MG, within the Zona da Mata region of Minas Gerais state. This facility is a high-complexity institution exclusively serving users of the Brazilian Unified Health System (SUS). It provides care across various medical-surgical clinical specialties, with an annual surgical volume of 843 procedures, serving as a regional reference. As part

of its operations, the CME processes health products, handling an average of 8,957 HPs per month. The center is equipped with an ultrasonic washer and two autoclaves, operating in two shifts.

Population and Sample

Twelve liposuction cannulas out of 36 were randomly selected using a systematic approach based on a register maintained by the sector nurse, where daily information is recorded. Every second cannula, specifically the posterior one (third), was chosen, repeating the process until all HPs designated for liposuction procedures containing the instruments for this study were exhausted, considering 100% of the population. Inclusion criteria were cannulas from the inventory, post-sterilization, as the objective was to examine the integrity and potential alterations within the lumen of those ready for use. Cannulas lacking surface markings indicating the size of the lumen and/or those undergoing maintenance were excluded. In this facility, all these devices are reusable, and there is no control over the number of sterilizations they have undergone since acquisition.

Data Collection

The data collection occurred from October 2023 to January 2024. Before commencing the research, the researchers underwent training in the "Beyond Endoscopes: Visual Inspection of Surgical Instrument Lumens" course, provided by Ostead & Associates. The boroscope® (a flexible inspection camera), equipped with a probe allowing evaluation of liposuction cannulas starting from 3 mm in diameter, was connected to a Dell® Latitude 3420 Core i5 notebook, utilizing the ViewPlayCap software to aid in visual inspection.

Each liposuction cannula was directly observed for approximately fifteen minutes, during which the insertion depth of the boroscope was monitored throughout the process. Subsequently, the researchers recorded the diameter of the device, noting the presence (or absence) of alterations, which were categorized as oxidation, stains and/or discoloration, grooves, residues or debris, and deformations. In case of any deviations, the researchers documented them photographically, storing the images for inclusion in the results of this study. All cannulas were identified with the code LC followed by the respective diameter.

Data Analysis

The data were analyzed using simple descriptive statistics with IBM Statistical Package for the Social Sciences (version 21).

RESULTS

The liposuction cannulas of 3.0 mm and 4.0 mm were evaluated with equal frequency by the researchers. All were subjected to manual cleaning, followed by automated cleaning (100.0%) using an ultrasonic washer, and subsequently, sterilization by saturated steam under pressure. Table 1 shows that the majority of the inspected instruments exhibited alterations during visual inspection using the boroscope (66.7%).

Visual inspection identified the presence of oxidation, stains, and/or discoloration (50.0%), residues or debris (33.3%), and grooves (25.0%). No deformations were observed in the liposuction cannulas included in this study (Table 2).

Figure 1 highlights the primary alterations observed during visual inspection. Eight deviations were noted with the assistance of the boroscope out of the 12 (100%) cannulas included in this study. During evaluation, two or more categories were identified, with oxidation (60.0%), residues (33.3%), and grooves (25.0%) being the most prominent.

Table 1. Description of liposuction cannulas in relation to diameter and alterations observed with the assistance of the boroscope, Juiz de Fora, MG, Brazil (n=12)

Variables	n	%
Device		
Liposuction cannula 3.0 mm	05	41.6
Liposuction cannula 4.0 mm	05	41.6
Liposuction cannula 3.5 mm	02	16.8
Presence of alterations observed with the assistance of the boroscope?		
Yes	08	66.7
No	04	33.3

Source: authors (2024).

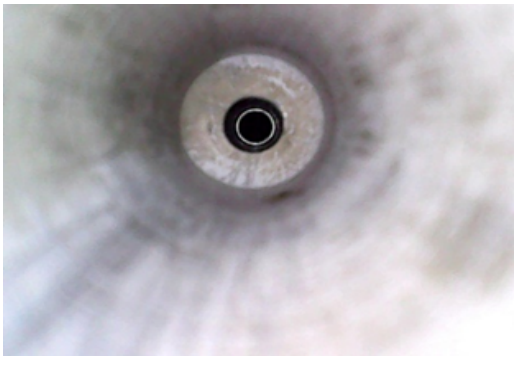
Table 2. Description of alterations observed by visual inspection with the assistance of the boroscope in liposuction cannulas, Juiz de Fora, MG, Brazil (n=12)

Liposuction cannula (diameter)	Oxidation, stains, and/or discoloration	Grooves	Residues or debris	Deformations
LC1 (3.0 mm)	Yes	Yes	Yes	No
LC2 (3.0 mm)	Yes	No	Yes	No
LC3 (3.0 mm)	Yes	No	No	No
LC4 (3.0 mm)	No	No	No	No
LC5 (3.0 mm)	Yes	No	Yes	No
LC6 (3.5 mm)	No	Yes	No	No
LC7 (3.5 mm)	No	No	No	No
LC8 (4.0 mm)	Yes	Yes	No	No
LC9 (4.0 mm)	No	No	Yes	No
LC10 (4.0 mm)	Yes	No	No	No
LC11 (4.0 mm)	No	No	No	No
LC12 (4.0 mm)	No	No	No	No

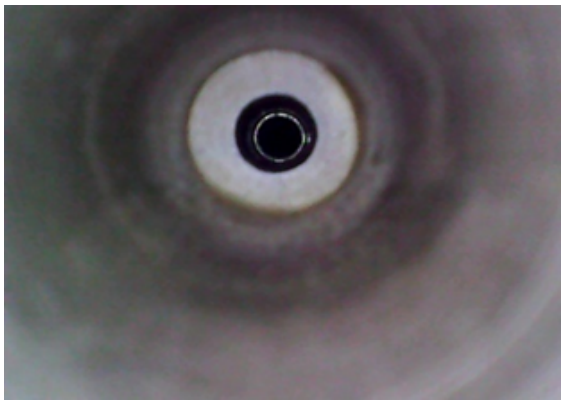
Source: authors (2024).

Figure 1. Photographic record of alterations observed in liposuction cannulas, Juiz de Fora, MG, Brazil (n=8)

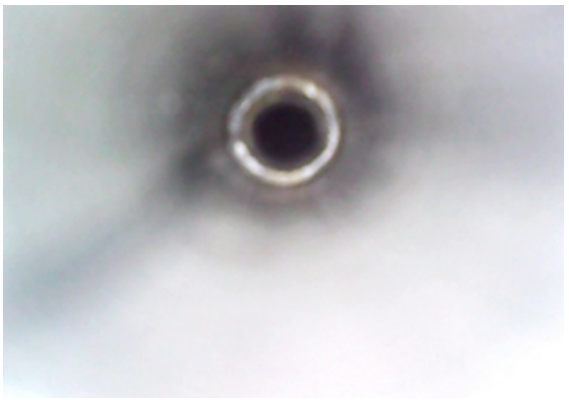
LC1 - Oxidation, grooves, and residues detected after 12 cm of boroscope insertion.



LC2 - Oxidation, stains, and residues detected after 10 cm of insertion.



LC3 - Oxidation detected after 14 cm of insertion.

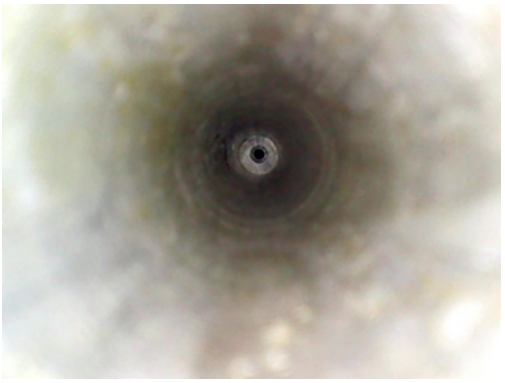


LC5 - Oxidation and residues detected after 16 cm of insertion.

LC6 - Grooves detected after 9 cm of insertion.

LC8 - Oxidation and grooves detected after 13 cm of insertion.

LC9 - Residues detected after 14 cm of insertion.



LC10 - Oxidation and discoloration detected after 6 cm of insertion.

DISCUSSION

Considering.Alterations in liposuction cannulas compromise their use and patient safety in healthcare services. Among these alterations, the presence of oxidation in 60% of the evaluated devices, organic matter residues, and grooves after sterilization stand out, indicating that they are ready for use.

In this context, the alterations present in these devices can pose serious risks to patients, including cross-transmission of microorganisms, favoring post-operative complications. Oxidation and grooves demonstrate a compromise in the integrity of

the instruments over time, reducing their lifespan and increasing costs associated with replacement and maintenance. Regarding the observed residues and debris, a study conducted in Brazil (2021) evaluating 14 4 mm liposuction cannulas provided by the CME identified a cleaning process failure rate of 42.9% concerning the presence of dirt, and all cannulas tested positive for microorganisms.[8]

Inspection using a boroscope has revealed the risks that HPs may present, even when all processing steps have been followed, but without a tool that allows for analyzing its structure specifically in devices with narrow lumens. In this regard, research conducted analyzing endoscope channels confirmed that 92% of the channels inspected with the boroscope showed similar alterations, indicating failures in the cleaning process.[10]

The boroscope, as an ancillary technology, plays a significant role in lumen inspection, enabling the identification of structural alterations and those related to the processing of the analyzed devices. The benefit of its use is emphasized, as visual inspection allows for identifying alterations that could interfere with the device's effectiveness, as evidenced in other realities outside Brazil.[11-12] However, it is important to reflect on the use of the boroscope in healthcare services in Brazil, as current legislation does not make its use mandatory in sterilization centers.[1]

Studies show the contribution of using the boroscope in CME and present significant results that justify the incorporation of this technology in Brazil, with the main one being the visualization of hard-to-reach areas, blind ends, and/or narrow lumens.[8,10-13] It is worth noting that the literature suggests visual inspection with the aid of image intensifier lenses and complementary chemical tests to ensure the quality of cleaning and sterilization of HP.[1,11,14]

Visual inspection can identify instruments with damage, residual dirt, and retained debris; however, there is little guidance from manufacturers and regulatory agencies on visual inspection inside lumens.[13-15] Thus, this study becomes necessary to emphasize the importance of visual inspection in the processing of HPs, especially those with complex designs. Allowing liposuction cannulas or any other instrument with processing failures to be used on patients puts the institution at odds with current legislation on patient safety, which aims to reduce incidents and adverse events associated with healthcare.[16]

However, it is essential to emphasize that the effectiveness of this technique, using the boroscope as a complementary resource, depends on financial investment due to its high cost, as well as the skill and training of the nursing team, especially the nurse, and the quality of the equipment used. Accurate interpretation of images captured by the equipment requires technical knowledge and experience to identify potential areas of concern and take appropriate corrective measures.

Hospitals, especially those with limited financial resources, may face challenges when attempting to invest in more advanced technologies, such as the boroscope, due to high initial acquisition and implementation costs. Additionally, ongoing expenses associated with maintenance and staff training can also pose an additional burden for these institutions. Therefore, it is crucial to consider alternative financing strategies, such as government grants, partnerships with academic institutions, or philanthropy, to overcome these barriers and ensure equitable access to cutting-edge technologies that promote patient safety and healthcare quality.[17-19]

Study Limitations

This study was limited to observing alterations without conducting analyses to verify the presence of biofilm or identify potential microorganisms present in the devices. The small sample size should also be considered, which could limit the generalizability of the findings; however, this did not prevent the study's objective from being

achieved, as the researchers systematically selected it randomly, exhausting all HP. Lastly, due to the boroscope's diameter limitation, some parts of the cannulas may not have been covered, especially those near the blind end.

Contributions to Clinical Practice

Advancements in knowledge involve the identification of alterations in liposuction cannulas using a technological resource with a detailed view of hard-to-reach areas. The data draw the attention of managers in sterilization centers to the identification of deviations and correction of issues that compromise the processing of health products. This includes an opportunity to present changes in national legislation to health authorities to make the visual inspection stage more stringent in healthcare services. Additionally, it informs health policies and supports training actions for the team.

CONCLUSION

This study evaluated the interior of liposuction cannula lumens, elucidating alterations such as oxidation, residues, and grooves, which raise concerns about the use of these health products with deviations that compromise patient safety. The use of the boroscope as an aid to visual inspection reinforced its relevance for detecting cleaning failures and/or verifying alterations inside the lumen, where visualization and cleaning are more complex. This fact necessitates changes in current legislation in sterilization centers due to the lack of indication of its mandatory use, suggesting the integration of boroscopes as an essential component of the processing of reusable medical devices.

RESUMO

Introdução: Alterações nas cânulas de lipoaspiração comprometem seu uso e a segurança do paciente nos serviços de saúde. **Objetivo:** avaliar o interior de cânulas de lipoaspiração por meio de inspeção visual auxiliada por boroscópio. **Delineamento:** estudo descritivo, quantitativo, realizado em um centro de materiais e esterilização de um hospital público de Minas Gerais, Brasil, no período de outubro de 2023 a janeiro de 2024. As cânulas de lipoaspiração foram selecionadas aleatoriamente, escolhidas de forma sistemática. Foi realizada inspeção visual assistida por boroscópio e os dados foram registrados em instrumento semiestruturado, analisados por estatística descritiva. **Resultados:** Cânulas de lipoaspiração de tamanhos 3,0 mm e 4,0 mm foram avaliadas com igual frequência, por serem dispositivos reutilizáveis sem controle quanto ao número de esterilizações a que foram submetidas desde a aquisição. A maioria apresentou alterações detectadas pelo boroscópio (66,7%), com ocorrências notáveis de oxidação, manchas e/ou descoloração (60,0%), resíduos ou detritos (33,3%) e sulcos (25,0%). **Implicações:** O rastreamento das cânulas de lipoaspiração identificou alterações que comprometem seu uso, observadas com auxílio de boroscópio. As conclusões apontam para mudanças na legislação vigente nos centros de esterilização devido à ausência de indicação deste equipamento como obrigatório para auxílio à inspeção visual.

DESCRITORES

Instrumentos Cirúrgicos; Esterilização; Controle de Infecções; Enfermagem Perioperatória.

RESUMEN

Introducción: Las alteraciones en las cánulas de liposucción comprometen su uso y la seguridad del paciente en los servicios de salud. **Objetivo:** evaluar el interior de cánulas de liposucción mediante inspección visual asistida por un boroscopio. **Delineación:** estudio descriptivo, cuantitativo, realizado en un centro de materiales y esterilización de un hospital público de Minas Gerais, Brasil, de octubre de 2023 a enero de 2024. Las cánulas de liposucción fueron seleccionadas al azar y elegidas sistemáticamente. Se realizó inspección visual asistida por boroscopio y los datos fueron registrados en un instrumento semiestructurado, analizados mediante estadística descriptiva. **Resultados:** Se evaluaron con igual frecuencia cánulas de liposucción de tamaños 3,0 mm y 4,0 mm, por ser dispositivos reutilizables sin control en cuanto al número de esterilizaciones a las que han sido sometidas desde su adquisición. La mayoría presentó alteraciones detectadas a través del boroscopio (66,7%), destacándose oxidación, manchas y/o decoloración (60,0%), residuos o escombros (33,3%) y surcos (25,0%). **Implicaciones:** El seguimiento de las cánulas de liposucción identificó alteraciones que comprometen su uso, observadas con la asistencia de un boroscopio. Los hallazgos exigen cambios en la legislación actual dentro de los centros de esterilización debido a la ausencia de indicación de este equipo como obligatorio para ayudar en la inspección visual.

DESCRIPTORES

Instrumentos Quirúrgicos; Esterilización; Control de Infecciones; Enfermería Perioperatoria.

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COLLABORATIONS

Conceptualization: DSB, ALSA. Methodology: DSB, RTP, DRRL, FCC, VAAP, ACO, ALSA. Validation: DSB, RTP, DRRL, FCC, VAAP, ACO, ALSA. Formal analysis: ALSA. Investigation: DSB, ACO, ALSA. Resources: DSB, RTP, DRRL, FCC, VAAP, ACO, ALSA. Data curation: ALSA. Writing-original draft preparation: DSB, ALSA. Writing-review and editing: DSB, RTP, DRRL, FCC, VAAP, ACO, ALSA. All authors have read and agreed to the published version of the manuscript. **All authors agree and are responsible for the content of this version of the manuscript to be published.**

ACKNOWLEDGMENTS

Not applicable.

AVAILABILITY OF DATA

The original data are the responsibility of the corresponding author (ALSA) and are available upon request.

FUNDING SOURCE

Not applicable.

CONFLICTS OF INTEREST

There are no conflicts of interest to declare.