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(CASE REPORT)

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Complications from laser Endolift use: Case series and literature review

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Abstract

Introduction: The endolift technique has become known for using a laser beam with a 1470 nm wavelength emitted through an optical fiber inserted into the subdermal tissue with the aim of reducing subcutaneous fat and/or toning the skin through neocollagenesis. In Brazil it became popular and commonly called endolaser or endolift laser, as in addition to 1470 nm it also uses a length of 980 nm with the same therapeutic goals. Few complications have been previously reported, most of which include mild and transient erythema, edema, ecchymosis, and nerve palsy. However, the incidence of most serious cases has increased in Brazilian territory.

Objective: This study aimed to describe the authors' experience through several cases of complications resulting from endolift or endolaser technique application in Br0061'zil, and which brought to light to some important complications after the procedure. Also, it brings a brief review of the world literature on the subject.

Materials and methods: It was carried out exploratory research presented in a narrative review, to highlight the action of the endolift (1470 nm) or endolaser (980 nm) technique used in the treatment of aesthetic dysfunctions. The review explored scientific articles published and available in the following databases: MEDLINE (Online Medical Literature Analysis and Recovery System), PubMed (National Library of Medicine), SCIELO (Scientific Electronic Library Online), LILACS (Latin American Literature and of the Caribbean in Health Sciences), and Google Schoolar. Furthermore, it was were added to this study a series of complications cases from the using endolift/endolaser technique which happened in Brazil in a multicentric manner and developed with the use of various commercially available devices.

Results: It was found that the endolift laser technique has the potential to cause important injuries during and after its use when used without suitable criteria for antisepsis, dosimetry and skin temperature controlling. The most common complications described in this study are peripheral neuropathies, burns, local infection and steatonecrosis, the latter considered the main one. However, it was also identified general complications such as hematoma, edema, hyperchromia and optic fiber breaks.

Conclusion: Despite the few reports in the world literature, serious secondary complications to the use of subdermal laser using fiber optics (1470 nm and/or 980 nm) are totally possible of happening and have become common in Brazil. Therefore, deserving full attention to the adoption of appropriate application techniques to minimize such complications, among them: greater dosimetric control, adoption of appropriate instruments to better control skin

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temperature, and greater rigor regarding biosafety measures (mainly antisepsis) when handling the required instrument to perform the technique.

Keywords: Endolift; Endolaser; Endolifting; Laserlipolysis; Complications; Seroma; Steatonecrosis

1. Introduction

Laser technology for treating skin disorders has been described since the 1960s, as well as the complications of its use [1]. Constant innovations in light energy technology and the improvement of devices available for use have enabled new equipment to be developed to meet the growing demands of clients and professionals for safer and more effective laser treatments [2].

The Endolift™ technique (LASEMAR1500™ machine, Eufoton s.r.l.) has become known worldwide for using a laser beam with a wavelength of 1470 nm emitted through an optical fiber inserted into the subdermal tissue with the aim of reducing subcutaneous fat and/or tone the skin through neocollagenesis [3-5]. In Brazil it became popular and is commonly called Endolaser, because in addition to 1470 nm, it also uses a wavelength of 980 nm with the same therapeutic objectives [6-8].

It is considered a non-invasive [9-12] or minimally invasive [13-15] technique, and might be used to improve texture and tone skin, leaving it firmer. In addition, minimizing sagging and facial wrinkles mainly those glabellar and nasolabial expression lines, unsightly appearances of the mandibular border and “marionette lines” [5, 9, 10, 16], periorbicular changes of the eyes [17] etc. It is also treats acne vulgaris and acne scars [11, 14], as well as rosacea [4], and finally various lipodystrophies such as localized adiposities and cellulite [13, 18, 19] as well as “double chin” [16].

Subdermal laser utilization through optical fiber (endolift or endolaser) has become extremely popular in Brazil, and many professionals use it to treat many aesthetic conditions with great success. However, despite this great success, the lack of standardization regarding to procedure through a wide variety of treatment protocols has led to the incidence of several post-operative complications’ treatment. Most of the time, such protocols are applied with no support on current literature.

This study aimed to describe the authors' experience through several cases of complications resulting from endolift or endolaser technique application in Brazil, and which brought to light some important complications after the procedure. Also, it brought up a brief review of the world literature on the subject.

2. Methodology

This study is characterized by exploratory research, presented through a narrative review, to highlight the action of the endolift (1470 nm) or endolaser (980 nm) technique used in the treatment of aesthetic dysfunctions and their possible adverse effects and/or complications. The review explored scientific articles published between 2000 and 2023 which were available in the following databases: MEDLINE (Medical Literature Analysis and Retrieval System Online), PubMed (National Library of Medicine), SCIELO (Scientific Electronic Library Online), LILACS (Latin American and Caribbean Literature in Health Sciences), and Google Schoolar.

As inclusion criteria, it was selected sources that mentioned the unsightly condition treated by the endolift or endolaser techniques, or described their mechanism of action and iatrogenic effects. Also, were discarded all sources that did not present a summary, those which were not allocated to scientific journals and did not address the topic of the study, as well as those that did not support the collection of reliable data.

The bibliographic survey was carried out in Portuguese, English, Spanish and Italian, using the following descriptors: Endolift, Endolaser, Endolifting, Laserlipolysis, complications, seroma and steatonecrosis. In addition to the literature review, this study included a survey of considerable cases which ended up in health complications after endolift/endolaser technique application in order to describe the authors' experience in approaching and managing these adversities after treatment of various facial and body aesthetic conditions using various commercially available equipment. These cases took place in Brazil in a multicentric manner.

3. Results and Discussion

3.1. Endolift Fundamentals (Endolaser)

The Endolift™ method (LASEMAR1500™ machine, Eufoton s.r.l.) emerged in 2005, developed by an Italian doctor called Roberto Dell'Avanzato, who performed care in more than 4000 cases using a 1470 nm diode laser; The method was characterized as a simple and safe procedure, with immediate results and easily reproducible. The technique was also known as the "Dell'Avanzato Technique" [20].

It is known that the pioneering spirit of Doctor Dell'Avanzato helped the Endolift™ method emerge from the foundations of Laser Assisted Liposuction (LAL), which is the use of a high-power laser in association with liposuction. In 1991, a study was carried out to determine whether the addition of a laser-emitting optical fiber within a standard liposuction cannula would decrease blood loss and thus improve postoperative recovery [21]. Over the years, it was discovered that the action of this type of laser during the liposuction surgical procedure could liquefy adipose tissue, coagulate small blood vessels, induce neocollagenesis with remodeling and tightening of the dermal tissue [22-24].

Some authors compared classic liposuction with LAL. The results showed a significantly higher tissue contraction rate on the laser-treated side than on the liposuction-alone side. On the side without laser treatment, mean skin tightness and tightening showed no statistically significant difference compared to the untreated side. Three months after treatment, skin tightness and tightening were significantly greater on the laser-treated side [25].

Laser-assisted liposuction evolution ended up in the emergence of the non-surgical endolift laser, thus, this laser procedure became popular throughout the world, and the market adopted the diode laser with a wavelength of 1470nm as the "standard gold" for performing Endolift™, mainly in terms of safety and effectiveness. And is therefore used without the liposuction procedure, in other words, only with fiber optics, thus the technique has become less aggressive, but maintaining its effectiveness in reducing tissue subcutaneous tissue and skin toning (Figure 1) [6, 17, 18, 26].

Figure 1 Endolift procedure in the abdominal and submental region using 600 micron optical fiber and 1470 nm diode laser

Although the term endolaser, popularly used in Brazil, it refers to the Endolift™ method and its aesthetic benefits, is also associated with the use of laser in varicose veins. Since from 1998, Spanish phlebologist Carlos Boné applied and reported about a new method to treat varicose veins and trunk veins with laser energy administered intravenously using fiber-optic laser radiation (Endoluminal Therapy) [27]. Currently, the literature associates the term endolaser with aesthetic lesions [6-8], varicose lesions [28-29], and ophthalmological lesions [30-31].

Still about the Brazilian market, the term "endolifting" has also become popular being associated with the use of the 1470 nm wavelength to treat aesthetic dysfunctions similarly and with the same goal of aesthetic treatment as the Endolift™ method [16]. Despite the popularization of this technique, authors [32] attested to the need for greater scientific evidence of the procedure with a wavelength of 1470 nm, mainly with well-designed randomized clinical trials.

The main argument for using laser in the endolift technique is the heat production in the subcutaneous tissue of the entire treated region, including the skin (photothermal effect). However, due to the great affinity of the 1470nm laser for water [33], many believe that its effect is greater on the skin than on adipose tissue, generating discussion between professionals and companies that produce lasers with wavelengths other than 1470 nm.

Nevertheless, authors reported that the 1470 nm diode laser is capable of penetrating deeply into tissues due to its high affinity for fat and water, and the richer a tissue is in water and fat, the better this laser transmission and the lower will be its dispersion [26]. Furthermore, fat is particularly rich in glycerol, which further facilitates the effectiveness of the laser on this tissue [13].

Temperature control during the use of the endolift is the main way of obtaining the intended therapeutic effects, as well as avoiding injuries and complications. Currently, LAL studies, where temperature was controlled during the procedure [34-37], serve as the basis for endolift procedures, which seek controlled and safe heating of the target area of treatment.

Using a mathematical model, it was demonstrated that the photothermal effect in the use of LAL can occur when the temperature inside the adipose tissue reaches 48 °C to 50 °C, while on the surface of the skin the maximum temperature should reach 41 °C [34, 35]. In another study [36], the internal temperature ranged between 45 °C and 47 °C, while externally it varied between 40 °C and 42 °C, providing skin tightening. According to Kamamoto et al. [37], the mean temperature that may cause skin burns is 45°C, and a safety range in the thermoguided laser liposuction technique was set between 36 °C and 40 °C.

Therefore, while the heat generated by laser irradiation induces lipolysis of fat cells, collagen and elastin in the dermis are also stimulated resulting in tightening and accentuated retraction of the skin. It can occur both immediately and late, due to collagen stimulation [34, 35]. However, it is emphasized that when performing the endolift technique, strict control of the local temperature is necessary both to avoid complications and to avoid underdosing the energy, and thus, generating poor results. As in our clinical practice we have seen that when the appropriate temperature is not reached in the skin (40 °C to 42 °C) there is no change in collagen. and, on the contrary, whether the temperature recorded on the skin is around 44 °C to 45 °C the risk of thermal injury is high.

We also highlight the aspect related to thermal confinement with the utilization of subdermal lasers (heat concentration close to the laser irradiation source or the tip of the optical fiber), since different wavelengths might show different ways of dissipating or accumulating internal heat. Authors compared the thermal effect of three wavelengths on subdermal tissue (1064 nm, 1320 nm and 1444 nm), at a depth of 10 mm, and observed that there was a minimum thermal diffusivity at 1444 nm, in other words, heat dissipation through of tissues was much smaller with this wavelength compared to the others. Inversely, thermal confinement was highest at 1,444 nm, intermediate at 1,064 nm and minimum at 1,320 nm [31]. The authors also found that greater thermal confinement caused greater structural damage to the irradiated adipose tissue.

Still in this context, during body contouring treatment, some authors reported that significant thermal injuries far away from the area irradiated with subcutaneous lasers are unlikely with wavelengths in the range of 1444 nm, since these are places in which there may be large volumes of fat and where vital structures are relatively distant. In contrast, the potential for undesirable thermal injury to areas collateral to laser irradiation areas is likely greatest when treating facial structures (e.g., nasolabial folds and jowls), as subcutaneous fat volumes are much smaller and where delicate structures are anatomically close to the irradiation source (mainly nerves) [38].

Corroborating with some authors [31], it is understood that a certain number of complications such as neuropathies, steatonecrosis, etc., caused by using wavelengths in the 1470nm range, what is typically of endolift, are possibly related to thermal confinement. It takes place since it generates an accumulation of thermal energy in depth and little heat dissipation to the skin. However, although these two phenomena are simultaneously present during the endolift, authors [39] reported that both can be influenced by the laser wavelength, the power used (Watts), and the total laser energy accumulated in the treatment area (Joules), pulse duration, as well as target tissue composition and its water content.

Still about the temperature generated during the endolift, regarding Brazil, many professionals do not use any resource to control skin temperature during the endolift procedure. Other use the infrared thermometer, commonly utilized to control temperature in radiofrequency procedures, but it is important to emphasize that these thermometers commonly do not have emissivity control and, therefore, can be inaccurate in measurement. Furthermore, due to the lack of images of the heated area, this type of equipment makes it difficult to locate hot spots. And also exposes the professional to errors or delays in correctly measuring the local temperature, increasing the risk of thermal injuries to the skin.

In our clinical practice, we recommend severe control of the external temperature using infrared thermography equipment (Figure 2) in order to provide greater vision of the thermal environment through specific thermal imaging, greater precision in temperature measurement and, thus, ensuring greater surveillance over the hottest areas. Currently, are used cameras that track the hottest points in the thermal image, this assures greater control and safety during the procedure, as it does not need to constantly move the camera to search for the highest temperature locations.

However, some authors [39] reported during the use of the subdermal laser there is no need for internal or external temperature monitoring, as the constant optical fiber movement during laser emission and the adequate distribution of laser energy in the target area decreases errors in controlling thermal confinement.

Figure 2 Thermographic camera utilization to control skin temperature during the endolift procedure

There are many questions about the control of internal temperature during the endolift procedure on an outpatient clinic, once it is unfeasible to adopt endogenous thermal control instruments for this purpose (something possible only in a surgical environment). Therefore, dosimetric protocols are normally adopted and they estimate the amount of energy in Joules to be accumulated in the target area enough to damage the adipose tissue and heat (or not) the skin of the treated area. Authors [40] when treating the periumbilical region, flanks and culottes, used power of 6 to 9 Watts, pulsed mode of emission (pulse duration 25 ms, pause time 75 ms), and distributed an average of 7000 Joules of energy in the subdermal tissue with 1470nm laser. Sadoughifar et al. [41] used a power of 2 Watts on the eyelid, pulsed mode (pulse duration 25 ms with a 50 ms pause), with an average accumulation of 100 - 130 Joules in each eyelid. In the forehead region, authors [10] deposited 600 to 800 Joules of energy.

As there is still no rule that guides the choice of accumulated energy (in Joules) during the endolift procedure, mainly when the goal of the treatment is not aimed at skin retraction (commonly on the flanks or culottes), many professionals find themselves disoriented regarding the control of this energy. And often, they end up exceeding limits considered safe (excessive thermal confinement) leading to severe complications.

Currently, clinical practice in Brazil has directed the endolift procedure to use the continuous mode of energy delivery in most treatments including on the face. Many professionals are unaware of the use of pulsed mode in their equipment, and this, combined with the lack of reliable instruments for controlling skin temperature during the procedure has strongly contributed to the occurrence of injuries. It because energy delivery in continuous mode takes place more quickly, and the lack of ability to deal with this fast speed increases the risk of intercurrences and complications,

especially on the face. In our clinical practice, we adopted the pulsed mode for almost all regions of the face, exceptions may occur in the cheek and submental region.

3.2. Complications and adverse effects

Publications about endolift are very succinct with regards to complications or adverse effects. The technique is considered by many authors as safe and with few or no complications. Authors [42] reported that the side effects noticed were minimal, such as redness (99%), swelling (92%), hematoma (62%), paresthesia (21%), nervous stupor (0.35%). All side effects disappeared within 2 to 7 days.

We also found reports of mild post-treatment edema and erythema, which resolved within a few hours or up to 3 days [3, 4, 10, 42]. Three patients reported acne breakouts 7 to 10 days after treatment, which resolved within a few days [14]. Five women developed small bruises, that disappeared after 3 to 7 days [13]; and three other patients also presented discrete hematomas in the pertussis area that were resolved spontaneously within thirty days [6].

A patient who was treated for acne scars had mild hypoesthesia in the cheek area, which resolved within seven days. The pain experienced by patients was considered mild to moderate (average score of 3.1 out of 10) [43].

Authors [44] reported that out of 261 patients seen for treatment of the eyelid region, there were nine cases of transient hypoesthesia (3.45%) and three of thermal burns to the skin (1.15%). They further reported that these complications were not observed after decreasing energy delivery to values below 500 Joules for each lower eyelid.

Despite these reports, some authors did not observe any adverse effects or residual pain in any of their patients during treatments performed with a 980 nm Endolaser [15, 18], as well as no cases of burns, vascular injury, pain or paresthesia during 4 years of care with this technique [6].

For this study, some cases of complications or intercurrences that occurred in Brazil in the year 2023 were selected in a multicentric manner. Upon admission for treatment with endolift (1470 nm), all patients reported here signed the pre-procedure informed consent form and authorized publishing their images, as long as they did not tarnish their honor through inappropriate exposure.

3.2.1. Peripheral neuropathy

One of the most injured nerves when using the endolift is the marginal mandibular branch of the facial nerve. Anatomically, in 80% of cases it runs deep to the platysma, along the body of the mandible while in approximately 20% of cases it goes to one to two centimeters below the mandible. This branch superficializes on the anterior edge of the masseter muscle, located anterior to the region where the facial artery crosses the mandible [44].

Neuropathy may occur, resulting from the temporary conduction of nerve impulses and motor function cutoff, and is the originated of trauma from the nerve fibers without disruption of the nerve [45]. Therefore, thermal attacks on the areas covering the marginal mandibular nerve on the anterior mandible face can generate peripheral neuropathy [46, 47].

Although the literature about endolift does not address nerve injury as something common, there have been many cases of neuropathy related to the marginal mandibular nerve, causing paresthesia, paresis and even muscle paralysis. It is understood that performing the endolift using very high powers are the main causes of nerve damage in the face, and it happens generating intense local heating associated with a lack of care with the selection of the region where optical fiber will deliver the laser energy (very deep or perinervous regions), aggravated by anatomical variations, disregarding the effect of thermal confinement. In figures 3 and 4 it is noticed some cases where the use of the 1470 nm subdermal laser caused thermal damage to nervous structures, causing paresis and/or paralysis of muscles in the perioral region (Zygomatic branch of the facial nerve).

Figure 3 Asymmetry of the perioral region when smiling; sequelae arising from the use of subdermal laser with 1470 nm aiming at a facial lifting

Figure 4 Asymmetry of the perioral region when contracting the orbicularis oris muscle (when pouting), after using the 1470 nm subdermal laser for the treatment of facial aesthetic dysfunction

Based on clinical practice from authors, for this type of condition, it is recommended physiotherapeutic treatment based on low-power laser therapy (830 nm), microcurrents, electrical stimulation, kinesiotherapy, ozone therapy (ear and local), etc. Authors [48, 49] recommended the use of local injection of ozone in the path of the facial nerve (concentrations ranging from 10 to 20 μg/ml) for the treatment of chronic paralysis of facial muscles with excellent therapeutic results.

Besides physiotherapeutic treatment, the use of pharmacological agents are widely utilized in the treatment of this type of injury, such as anti-inflammatory drugs (Prednisolone)[50]; neurorepairs (Cytidine monophosphate) [51]; and Vit B1 and B12 supplementation [51, 52].

3.2.2. Burns

Some cases of obvious burns to the skin have also emerged in the clinical practice of endolift in Brazil. Facing the current situation, authors believe that the lack of control over the accumulation of local energy (thermal confinement), generating excess heat, is largely responsible for this type of adversity (Figure 5). Authors [53] reported that 1.5% of their patients presented thermal burns to the eyelid skin when the local energy deposit was greater than 500 Joules. Added to this, it is seen many professionals neglecting to control skin temperature, causing occasional burns along the

route where the optical fiber is moved, as well as when introducing it. It has also been reported [37] that if the average skin temperature reaches around 45°C, the risk of burns is imminent.

Figure 5 Burns on both neck sides and in the submental region after using a 1470 nm subdermal laser

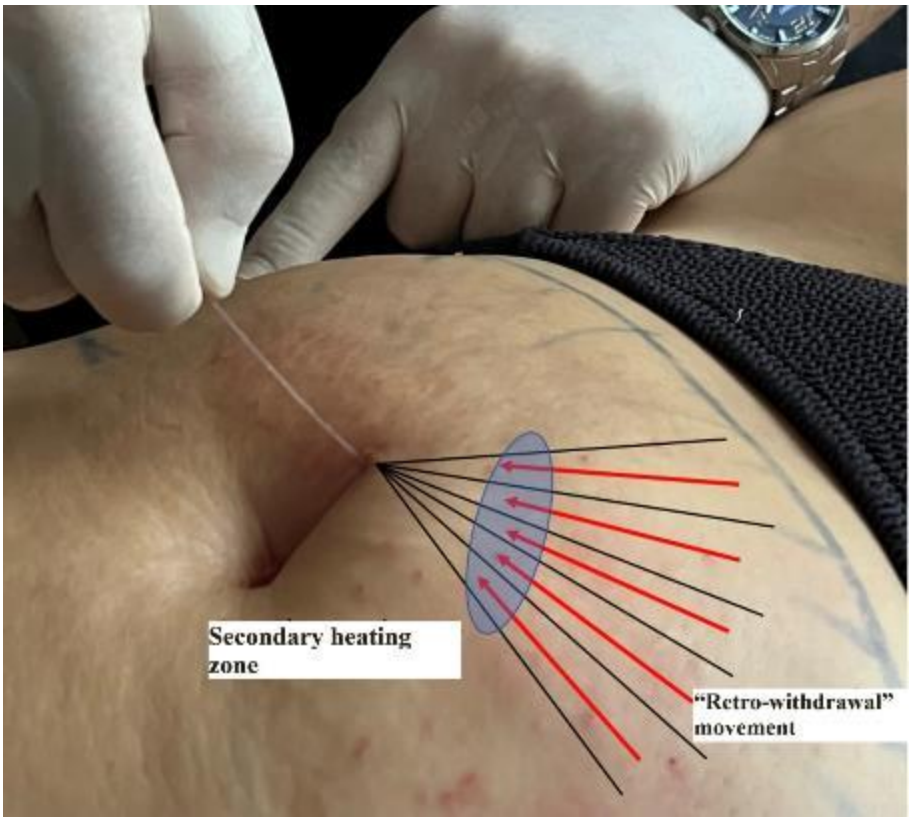

Figure 6 Vector map indicating the treatment region (black), direction of the convergent "retro-withdrawal" movement of the optical fiber during treatment with subdermal laser (red arrows), and representation of the secondary heating zone close to the route (blue circle)

Therefore, skin temperature rise, without the use of appropriate thermal control instruments (Figure 2) is the main cause of skin burns throughout the treatment area. The region close to the introduction' route of the optical fiber is the which suffers most, as this is where the "retro-withdrawal" of optical fiber movement converges during laser emission, following the direction of the vectors towards the target, and generating a large accumulation of thermal energy (Figure 6).

It was also seen that the error in handling the optical fiber at performing the retro-withdrawal movement. As the professional recklessly extracts the optical fiber from the skin with the laser emission activated, might also cause burns in the entry port (Figure 7).

Another mistake that may be observed is regarding the depth and/or fiber angulation during its introduction and manipulation, as there was a case of intraoral mucosa burn due to deep insertion and slight angulation of the optical fiber, pointing the laser beam towards the oral cavity (Figure 8).

Figure 7 Post-treatment fat burn located on the "Mount of Venus" where the optical fiber was extracted from the orifice with the activated laser

Figure 8 Intraoral thermal injury due to deep insertion and slight angulation of the optical fiber during the use of a subdermal laser

When managing burns, authors recommend the use of ozone therapy (local injection of gas (concentration of 10 micrograms), ozone bag, ozonized oil, rectal insufflation, etc.); low power laser (670nm); Red and blue LEDs; microcurrents; ultrasound etc. Depending on the condition, special care may be required for the burned area, such as debridement which may be mechanical (Figure 9), or chemical, in this case, using hydrogel with alginate for dry lesions

and fiberglass. alginate for wet lesions. Additionally, it is important that the devitalized tissue is removed as it represents a relevant source of contamination besides delaying healing.

Regarding pharmacological treatment, authors [54] recommended the use of silver sulfadiazine to avoid infection; analgesics (Paracetamol, Dipyrone); collagenesis or bromalin + Papain; and the region can be kept protected with a moist dressing with gauze and saline solution.

Anti-inflammatory and healing ointment use for the mucosa (triamcinolone 1mg/g) can also be included in the treatment.

Figure 9 Burn in the abdominal region that required mechanical debridement to accelerate tissue repair

3.2.3. Local infection

Cases of infection have frequently occurred in procedures related to endolift in Brazil.

Cases of infection in aesthetic procedures were described by Dieckmann et al. [55] who identified 67 cases of serious bacterial infection complications after intradermal deposition of exogenous pigments (tattoos), published between 1984 and 2015. In aesthetic procedures using lasers as the main technology, authors [56] cited infection as one of the complications, among other problems.

Authors [57] reported that in clinics for non-invasive and minimally invasive aesthetic procedures in Brazil, the autoclave was used to sterilize materials and instruments in 66% of the clinics. It was found by microbiological methods that in 85% of collected samples there was bacterial growth. Coagulase-negative staphylococci were the most prevalent genera found and 16% of them were resistant to cefoxitin, erythromycin and clindamycin. Four isolates were positive for mecA by PCR.

In the year 2023, several cases of bacterial infection were identified after procedures using the 1470 nm subdermal laser in different locations throughout Brazil, and in different treatment areas. Also, were identified that inadequate antiseptic measures are the main causes of infection, among which we highlight contamination of the optical fiber during the therapeutic procedure, inadequate skin antisepsis, use of contaminated instruments (gloves, needles, microcannulas, etc.), reuse of the optical fiber without efficient sterilizing measures, etc.

In figures 10 to 12 it is seen cases of post-treatment infection that evolved with accumulation of purulent secretion, which were treated with puncture and drainage maneuvers to extract the infected content, in addition to ozone therapy and antibiotic therapy.

The bactericidal and disinfectant power of ozone is widely described in the literature [58-60] with its action directed towards the bacterial membrane. In our clinical practice, ozone was applied with a concentration of 10 micrograms

immediately after the endolift procedure in order to control inflammation, pain and edema, besides avoiding outbreak of bacteria that could lead to infection cases. If there is infection and purulent collection, concentration is increased to 30 to 40 micrograms and must be injected immediately after extracting the purulent content through puncture and/or drainage handling.

Antibiotic therapy has been reported [8, 11, 40, 61] as part of post-endolift procedures in order to minimize the risks of infection after the procedure.

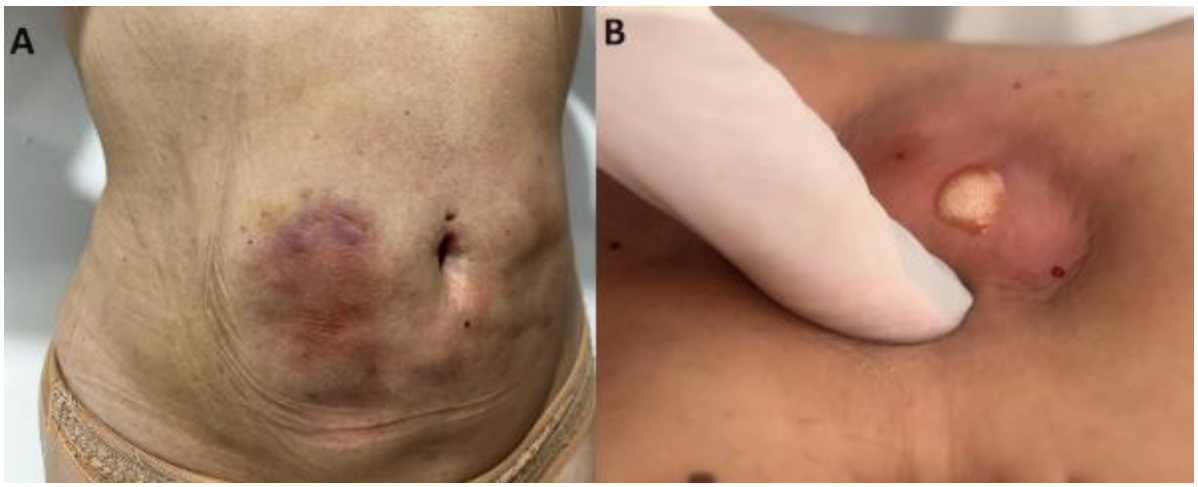

Figure 10 Infection in the right abdominal region after subdermal laser use to treat post-liposuction fibrotic sequelae (A), with the presence of purulent collection (B). It was treated with puncture and drainage of the infected content and ozone therapy

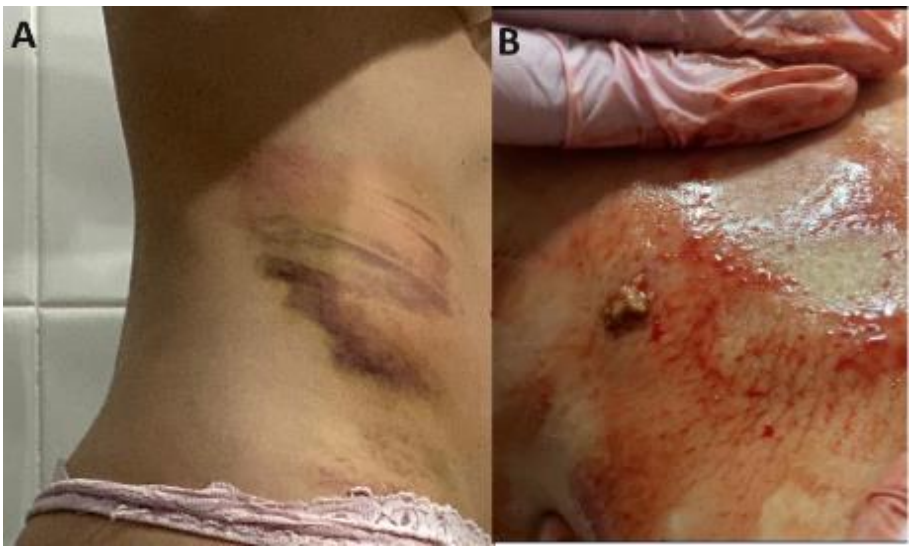

Figure 11 Infection in the right flank region after use of contaminated optical fiber. It evolved with a purulent collection (A), treated with puncture and ozone therapy

Figure 12 Infection sited in the ventral part of the arm which appeared within two days (A). She was treated in hospital with antibiotic therapy (B)

3.2.4. Steatonecrosis

It was found that steatonecrosis is the most common complication in Brazilian clinical practice and is characterized by a common benign condition that can be asymptomatic or manifest as a palpable mass, pain or other associated findings. It can be commonly seen after any trauma to the breast, including surgery, or after lump resection and radiotherapy for breast carcinoma. It is a complication that occurs with some frequency in breast surgeries, mainly in breast reconstructions, in conservative surgeries, characterized, initially, by hardening of a region that evolves into a nodulation of varying sizes, in any breast region, with oily cysts and posterior fibrosis [62].

The evolution of steatonecrosis to encapsulation has been described since 2001 [63], and this nodular appearance began to catch the attention of several professionals in Brazil when it started to appear in 2022, but only in the following year with the growing demand for care with endolift/endolaser, the proportion of cases became alarming.

The pathophysiology of steatonecrosis is described as trauma or interruption of blood flow in fatty tissue. It may lead to adipose tissue infarction, subsequent inflammation involving local release of pro-inflammatory cytokines, increased macrophage activity after the initial damage that creates fibrotic threads that separate the injured necrotic tissue from the surrounding healthy tissue [56]. Lately, the global fibrocellular response leads to the formation of a fibrous capsule and a cleavage plane between the lesion and the surrounding adipose tissue [63].

On radiological imaging, visible suppression of fat is seen in cystic images with an irregular or partially defined contour (Figure 13). Regarding physical examination, it was noticed single or multiple subcutaneous nodules (Figure 14) that may be painful [64, 65]. Nodules are generally mobile in areas with more adipose tissue and generally range in size from 1 to 35 mm [63].

Nodules may be accompanied by large volumes of liquid (Figure 15), generating the need for adequate puncture to speed up the recovery process. In the clinical practice from this work, after puncture, it was immediately identified cases where there was a collection of yellowish serous fluid, a purulent collection (figures 10 and 11) and a collection of bloody fluid.

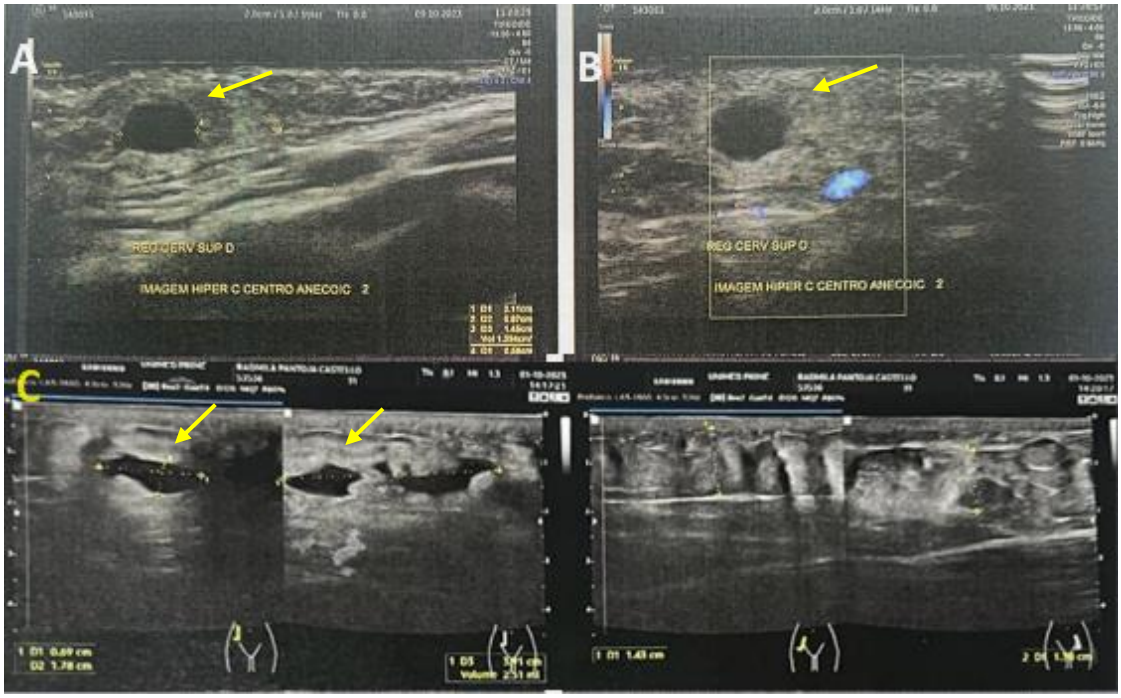

Figure 13 In images A and B (arrows), visible fat suppression is noted in oval cystic images with a partially defined contour without detectable internal vascularization and without a significant increase in peripheral vascularization. In image C (arrows) you can see fat necrosis characterized by seromatous cystic formations with an estimated volume of 2.5 mL

Figure 14 Two distinct cases of steatonecrosis in the submental region

Figure 15 Three distinct cases of steatonecrosis in the abdominal region that progressed to the incidence of large nodulations accompanied by intense fluid volume

In our analysis, we identified two causes for the incidence of steatonecrosis. One of them is the use of very high powers in body regions (over 10W) using 1470 nm laser equipment, generating an accumulation of thermal energy extremely damaging to the subcutaneous tissue. Associated with this, it was also seen a heterogeneous distribution of energy in the subcutaneous tissue (both on the surface and in depth) creating more energy accumulation in some locations compared to others (thermal confinement).

When managing this problem, it is suggested the use of therapeutic sound waves (ultrasound, ultracavitation, etc.). The use of high-power ultrasound for the treatment of seromatous encapsulation was described by Silva et al, in 2018, as an effective resource for this type of condition [66].

In the clinical practice from authors, if there is liquid collection, it is punctured/drained, and soon after or later we use stationary or dynamic ultrasound in order to soften the nodular structure and favor its absorption/resolution (Figure 16). They can also be associated with ozone therapy (mainly in cases of infection) and radiofrequency (heating the region up to 37 °C) with the aim of local tissue softening.

Figure 16 Ultraplace® stationary ultrasound (Medical San, Brazil) use in the dorsal region for the treatment of nodulations arising from steatonecrosis (3MHz, pulsed, 100Hz/50%, 4.3 W/cm^2, for 20 minutes)

3.2.5. General complications

In addition to what was reported here, it was also verified the incidence of less serious and fewer complications, that also caught attention for.

Figure 17 Case of severe post-treatment hematoma of localized abdominal fat (A); case of hyperchromia associated with hematoma in the culotte region (1470 nm laser) (B); Significant facial edema after facial lifting treatment with endolaser (980 nm) (C)

Bruises are common, and most often occur due to physical trauma to the microcannulas used to inject the tumescent solution. Hyperchromia was also noticed, and may be related to post-inflammatory hyperpigmentation. Still, edema is also one of these general complications, and their severity is directly related to the individuality of each client treated, however using prednisolone immediately after the procedure has helped in the quick resolution of edematous conditions (Figure 17).

Another uncommon but existing complication is the optical fiber breakage in the subdermal tissue during the endolift procedure. We identified that this occurs when poor quality fibers are used or when the professional inappropriately "peels" the fiber (cladding removal), exposing a large amount of the core, and since it is more fragile, easily breaks in the process inside the subcutaneous tissue.

4. Conclusion

The popularization of endolift/endolaser in Brazil has led to a growing demand for using this technology in several aesthetic care centers throughout the country. Added to this, it was identified a lack of fundamental knowledge, besides to suitable devices to perform the technique by many professionals from various areas of aesthetic activity. It was understood that these are the main reasons for incidences of complications and intercurrences with the use of this technique.

As a conclusion, despite the few reports in the world literature, serious secondary complications to the use of subdermal laser using fiber optics (1470 nm and/or 980 nm) are totally possible of happening and have become common in Brazil. Therefore, deserving full attention to the adoption of appropriate application techniques to minimize such complications, among them: greater dosimetric control, adoption of appropriate instruments to better control skin temperature, and greater rigor regarding biosafety measures (mainly antisepsis) when handling the required instrument to perform the technique.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare there are no conflicts of interest in the publication of this article.

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