Technical Differentiation and Innovation in Contemporary Liposuction: A Critical Study of the Postoperative Period in Light of New Technologies

Diferenciação técnica e inovação na lipoaspiração contemporânea: Estudo crítico do pós-operatório frente a novas tecnologias

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Abstract

Plastic surgery is a medical specialty in constant transformation, driven by the introduction of new techniques and technologies. In recent years, there has been a notable increase in public interest in esthetic procedures targeting body contouring, particularly liposuction, which remains among the most popular options worldwide. An analysis of Google Trends data revealed the search behavior for *liposuction* throughout the past 12 months. Interest in this procedure remained high throughout the period, with relevance scores ranging from 50 to 100%. Furthermore, there was a notable increase in queries on liposuction technologies. The search for *Argoplasma technology* increased 400%, while the search for *high-definition liposuction* experienced a 200% growth.

This data reinforces the persistence of liposuction as a prominent procedure and indicates a clear trend toward the appreciation of advanced technological resources in the context of plastic surgery. In this scenario, it becomes essential to discuss the impacts of these innovations and to evaluate their contributions to the efficacy, safety, and quality of the outcomes of liposuction procedures in the contemporary clinical practice, particularly in terms of the postoperative management and its impact.

Keywords

- patient safety
- postoperative care
- lipectomy
- biomedical technology
- plastic surgery procedures

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Resumo

A cirurgia plástica é uma especialidade médica em constante transformação, impulsionada pela introdução de novas técnicas e tecnologias. Nos últimos anos, esse campo tem acompanhado um aumento significativo no interesse do público por procedimentos estéticos voltados ao contorno corporal, especialmente a lipoaspiração, que continua entre os mais procurados no cenário mundial.

Com base em dados obtidos por meio da ferramenta Google Trends, foi possível analisar o comportamento das buscas pelo termo *lipoaspiração* nos últimos 12 meses. O interesse por esse procedimento manteve-se elevado durante todo o período, com índices de relevância que variaram entre 50 e 100%. Além disso, observou-se um crescimento expressivo nas buscas relacionadas a tecnologias associadas à lipoaspiração. A *tecnologia de Argoplasma* apresentou aumento de 400% nas buscas, ao passo que a *lipoaspiração de alta definição* teve um crescimento de 200%.

Esses dados reforçam a permanência da lipoaspiração como procedimento de destaque, e também apontam para uma tendência clara de valorização de recursos tecnológicos avançados no contexto da cirurgia plástica. Diante disso, torna-se essencial discutir os impactos dessas inovações, e avaliar suas contribuições para a eficácia, segurança e qualidade dos resultados obtidos com os procedimentos lipoaspiratórios na prática clínica contemporânea, principalmente a condução pós-operatória e seu impacto.

Palavras-chave
- lipectomia
- tecnologia biomédica
- procedimentos de cirurgia plástica

Introduction

Techniques for abdominal and body contouring have benefited significantly from advances in new technologies, including laser-, ultrasound-, and radiofrequency-based devices, which promote greater contraction of fibrous septa and the dermis. In addition, fat-grafting techniques have emerged as important allies in the improvement of surgical outcomes, particularly with the development of new approaches for fat processing and enhanced integration into recipient tissues. Despite these promising advances, robust scientific evidence supporting the efficacy and safety of these innovations remains scarce. Furthermore, few studies have addressed technology-specific peri- and postoperative care. This gap highlights the need for more comprehensive investigations to validate these procedures and establish standardized clinical protocols.

Review

Vibration amplification of sound energy at resonance (VASER) technology has demonstrated significant advances in body contouring using liposuction. In a retrospective analysis of 175 consecutive cases,[1] all treated areas improved, with high levels of patient satisfaction. In the high-definition (HD) liposuction group, there was no need for fat grafting to achieve well-defined anatomical contours. For gynecomastia, the VASER technique enabled effective treatment with reduced tissue excision. Furthermore, postoperative recovery was generally uneventful, with a low incidence of reported complications.[1]

As an adjunctive technology to liposuction, Renuvion has shown promising clinical outcomes in promoting skin retraction. A clinical series involving 64 cases[2] noted significant improvements in skin quality and body contour definition, even in areas with marked laxity. The application of helium plasma resulted in visible immediate tissue contraction, with evidence of progressive collagen reorganization during the postoperative period. Moreover, it had a satisfactory safety profile, with a low rate of complications and rapid patient recovery.[2]

In a retrospective study, Tettamanzi et al.[3] evaluated the effectiveness of radiofrequency-assisted liposuction (RFAL) using BodyTite technology in arm-lifting procedures. The sample included patients presenting with upper-limb skin laxity who were not yet ideal candidates for conventional brachioplasty. The study demonstrated that BodyTite application resulted in significant dermal contraction and visible contour improvement, without the need for extensive incisions. The authors[3] reported high patient satisfaction from esthetic and functional perspectives. Moreover, the complication rates were minimal, and postoperative recovery was considered rapid and well-tolerated. This study supports the growing adoption of minimally-invasive technologies to treat skin laxity, particularly among patients seeking effective results with reduced morbidity. Bipolar radiofrequency proved to be a safe and efficient alternative for arm lifting, and it may replace traditional surgical procedures in properly-selected cases. It is key to consider incorporating this approach in clinical protocols aimed at achieving consistent esthetic outcomes with greater postoperative comfort.

The combination of the Morpheus8 (InMode) device with HD liposuction has emerged as one of the most promising approaches in modern plastic surgery to improve body contour with minimal invasiveness. The Morpheus8 integrates fractional microneedling with bipolar radiofrequency,

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promoting deep dermal and subcutaneous heating, which results in collagen stimulation and significant tissue contraction. Hoyos et al.[4] retrospectively analyzed 86 patients who underwent the dynamic definition liposculpture (HD2) technique combined with the Morpheus8 device, reporting effective skin retraction, high patient satisfaction, and minimal complications. The protocol included device application immediately after liposuction, enhancing the synergistic effect between the anatomical definition provided by HD techniques and the tightening effect of fractional radiofrequency. This technology demonstrated particularly favorable results in areas such as the abdomen, flanks, and arms, in which skin retraction is critical for esthetic outcomes. Furthermore, the authors[4] emphasized that the association of technologies such as the Morpheus8 contributes to greater durability of the results, reduces residual laxity, and enhances procedural safety. This technological integration represents a crucial advance in refining HD liposuction, and it is becoming an emerging standard in body-contouring procedures.

Argon plasma (Argoplasma) has gained prominence as an adjunctive technology in minimally-invasive esthetic procedures, particularly for skin retraction following liposuction. Despite the increase in liposuction procedures that use Argoplasma (which are the most sought-after, according to Google Trends [Alphabet Inc.] data) as a complementary technology, a significant scarcity of indexed scientific publications supporting its efficacy and safety under rigorous methodological criteria remains evident. In the esthetic practice, subdermal Argoplasma is primarily described in non-indexed materials and unpublished scientific presentations, highlighting the urgent need for randomized, controlled clinical trials with longitudinal follow-up to scientifically substantiate the benefits attributed to this technique in the context of postliposuction skin retraction.

A prospective, non-randomized clinical trial registered in April 2025 aims to investigate the effects of the Quantum RF (InMode) radiofrequency probe on subdermal retraction and skin rejuvenation in patients undergoing HD liposculpture. The protocol was registered on Clinical Trials.gov (NCT06958978).[5] The primary outcomes include objective assessments of skin elasticity, cutaneous reactivity, and patient satisfaction, measured at 1, 3, and 6 months postoperatively. Although promising, this technique still lacks published clinical evidence in peer-reviewed scientific journals. Therefore, completion of this trial and further studies are required, given the pioneering nature of this technology.

Thermal-induced skin retraction has been studied extensively in plastic surgery and orthopedic rehabilitation due to its potential for tissue remodeling. Controlled heat application promotes the partial denaturation of collagen fibers, leading to the immediate contraction of existing collagen. Next, it stimulates fibroblasts and neocollagenesis, a fundamental process for skin firmness and regeneration. An experimental study by Hayashi et al.[6] showed that thermal heating of the glenohumeral joint capsule resulted in significant changes in the length and histological properties of collagen. The authors observed tissue retraction associated with the reorganization of collagen fibers and the subsequent biological healing response, with evidence of new collagen synthesis. These findings reinforce the therapeutic applicability of heat in esthetic and medical procedures aimed at skin retraction and improvement of dermal quality through the reorganization of the collagenous framework. Therefore, controlled therapeutic heat is a promising tool to induce contraction and regeneration of the extracellular matrix, contributing to positive clinical results in medical esthetics and deep tissue physical therapy.[6]

Hayashi et al.[6] also demonstrated that the thermal response of the articular capsular tissue depends on the temperature increase, with significant changes starting at 65 °C. The experiment showed that groups exposed to 70 °C, 75 °C, and 80 °C presented a statistically significant reduction in the length of the articular capsule after treatment, indicating effective collagen contraction. A histological analysis further revealed collagen hyalinization, a clear sign of denaturation and fibrillar reorganization, in groups exposed to 65 °C, 70 °C, 75 °C, and 80 °C. These data confirm that temperatures $\geq$ 65 °C induce marked structural alterations in collagen fibers, with progressively-greater effects at higher temperatures. The correlation between the degree of physical contraction and histological hyalinization reinforces the understanding that the efficacy of thermal heating for tissue contraction strongly depends on temperature. Such evidence is fundamental to standardize clinical protocols to use therapeutic heat, be them via radiofrequency, ultrasound, or laser, to achieve safe and effective skin contraction and collagen induction in esthetic and reconstructive treatments.

The literature contains comprehensive discussions on thermal safety in surgical settings, particularly regarding the prevention of perioperative hypothermia and the strict environmental control required in operating rooms. In a narrative review, Ji et al.[7] highlighted that temperatures below 21 °C significantly increase the risk of intraoperative hypothermia, emphasizing the need for precise monitoring of the patient's core temperature through esophageal, nasopharyngeal, or tympanic routes, as well as the use of active warming methods during procedures.[7] Moreover, in a systematic review, Katz[8] consolidated key recommendations from entities such as the Centers for Medicare and Medicaid Services (CMS), the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Joint Commission, and the American Society of Anesthesiologists (ASA), which advocate maintaining operating room temperatures between 20 and 23 °C, relative humidity from 20 to 60%, positive pressure, and at least 20 air changes per hour, thereby reducing infection risk and ensuring greater intraoperative thermal stability.[8]

The thermal-guided technique for lipolysis and skin contraction using a 980-nm diode laser represents a significant advancement in minimally-invasive procedures, combining clinical efficacy with intraoperative thermal safety. Kamamoto et al.[9] observed that the use of an infrared thermometer for continuous monitoring of the cutaneous surface temperature during laser application in the operating

room enabled the skin to be maintained below 42 °C, significantly reducing the risk of dermal burns and thermal injury to adjacent tissues. In addition to direct thermal control over the patient, the surgical environment was kept within strict technical parameters, with room temperature ranging from 20 to 23 °C, relative humidity between 30 and 60%, and a ventilation system with at least 20 air exchanges per hour, in accordance with Brazilian Health Regulatory Agency (Agência Nacional de Vigilância Sanitária, ANVISA, in Portuguese) regulations (Resolution of the Collegiate Board [Resolução da Diretoria Colegiada, RDC, in Portuguese] number 50/2002).[10] These environmental factors are crucial to ensure thermal stability during laser use, as they contribute to the safe dissipation of generated heat while maintaining thermal comfort and biosafety. The standardization of thermal control in the skin and the environment, combined with the surgeon's experience, constitutes a critical factor in preventing burns, particularly in anatomical areas with thinner subcutaneous tissue. Thus, thermoguidance consolidates itself as a valuable tool in the body-contouring technological arsenal, promoting selective fat destruction and skin contraction with high predictability and low complication rates.

Taha et al.[11] analyzed the necessity and effectiveness of postoperative drains in 50 male patients who underwent liposuction assisted by Lipomatic (Euromi S.A.) and VASER technologies after tumescent infiltration. The mean age of the patients was 35 years (range: 21–50) years, and the mean body mass index, 29 (range: 28–33) kg/m^2. The patients were divided into two groups: group A consisted of 25 subjects who did not undergo adjunctive drainage procedures, and group B comprised 25 patients who underwent postoperative drainage. Follow-up was performed every other day for 3 weeks to detect seromas. The results indicated that the routine use of drains correlates with a significant reduction in the incidence of seromas, hematomas, or infections when compared to no drains, provided that other effective strategies, such as proper compression and manual lymphatic drainage, were employed. However, drain use was associated with greater discomfort and prolonged hospital stay. The authors[11] suggest a tailored drain indication according to the extent of the treated area and the clinical evaluation, rather than its systemic application. Additionally, they emphasize that HD liposuction requires technical rigor from the surgeon and patient compliance to optimize the esthetic outcomes. When indicated, drainage procedures and drain placement are effective in minimizing seroma formation, accelerating recovery, and improving outcomes, highlighting the significance of personalized postoperative protocols for this technique.[11]

Chi et al.[12] conducted a trial with 20 patients undergoing abdominoplasty combined with liposuction, divided into a control group and an experimental group, the latter undergoing, immediately after surgery, lymphatic taping in a fan pattern over the surgical areas, assessing the presence of ecchymoses in different regions of the abdomen and flanks on postoperative days 3, 7, and 14. The results demonstrated that the experimental group exhibited a significant reduction in ecchymosis formation compared with the control group, particularly in the right flank, epigastric, and hypogastric regions. This finding suggests that the technique promotes lymphatic return and decreases blood extravasation into tissues. Accordingly, the use of lymphatic taping after abdominal surgeries may represent an effective and noninvasive strategy to reduce complications such as ecchymoses, contributing to the esthetic and functional recovery of the patients.[12]

Conclusion

Robust studies establishing effective and standardized postoperative protocols in plastic surgery remain scarce, particularly given the increasing incorporation of new technologies in the field. Although technological advancements offer evident benefits, it is essential that the attending professional conducts the clinical practice with critical and careful judgment, performing a thorough evaluation of the patient's skin. This assessment is crucial, as the skin may exhibit early signs of potential burns resulting from the high temperatures employed for collagen contraction. Even with the safety measures in place, increased thermal exposure can trigger a more significant inflammatory response, which may lead to greater edema and potentially heighten the risk of complications such as seroma and fibrosis. Therefore, careful clinical management becomes indispensable to minimize these adverse effects and optimize postoperative recovery, underscoring the urgent need for research that validates and standardizes safe and effective protocols for the use of these technologies in plastic surgery.

Data Availability

Data will be available upon request to the corresponding author.

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Conflict of Interests

The author has no conflict of interests to declare.

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