Internal Hemostatic Net: A Composite Surgical Technique for Hematoma Prevention in Facial Plastic Surgery

Rede hemostática interna: Técnica cirúrgica compósita para a prevenção de hematomas em cirurgias plásticas faciais

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Rev Bras Cir Plást 2026;41:s00461829096.

Abstract

In the pursuit of reducing complications in facial plastic surgery, in which hematoma is the most common postoperative complication, this study aimed to develop and validate a composite surgical technique. A composite technique is defined as the combination of two or more established techniques that, when associated, achieve better outcomes than when applied separately. The proposed approach combines procedures previously described in the literature but employs them in a distinct manner. This study describes the technique in detail, and also evaluates its outcomes in 356 cases where these author-proposed principles were applied. These results were compared with those of a control group of 205 patients who underwent traditional facelift surgery. The findings showed a reduction in hospitalization time, no need for surgical drains, and absence of postoperative hematomas among patients treated with the composite surgical technique. These results suggest that the internal hemostatic net is a simple, safe, and effective technique for reducing the risk of hematoma in facelift surgery.

Keywords
- facelift
- rhytidoplasty
- hematoma
- quilting sutures
- internal hemostatic net

Resumo

Na busca pela redução das intercorrências em cirurgias plásticas faciais, entre as quais o hematoma é a complicação mais comum, o presente trabalho buscou desenvolver e validar uma técnica cirúrgica "compósita". Essa técnica é definida pela associação de duas ou mais técnicas que, quando combinadas, têm um desempenho superior ao obtido quando utilizadas separadamente. A técnica proposta aliou procedimentos descritos na literatura, porém com uma abordagem diferenciada. Este trabalho descreve a técnica em detalhes, além de contemplar a análise de 356 casos em que se utilizaram os conceitos preconizados pelos autores. Esses resultados foram comparados aos de um grupo controle de 205 casos submetidos à técnica tradicional de *lifting*

Palavras-chave
- *lifting* facial
- ritidoplastia
- hematoma
- *quilting sutures*
- rede hemostática interna

Study performed at Mãe de Deus Hospital – Carlos Gomes Unit and at PlastiCare Clinic, Porto Alegre, RS, Brazil.

received
December 13, 2025
accepted
June 1, 2026

DOI https://doi.org/10.1055/s-0046-1829096.
ISSN 2177-1235.

Editor-in-Chief: Dov Charles Goldenberg

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Thieme Revinter Publicações Ltda., Rua Rego Freitas, 175, loja 1, República, São Paulo, SP, CEP 01220-010, Brazil

facial. Entre todos os casos analisados, o tempo de internação foi reduzido, não houve a necessidade de drenos e não ocorreram hematomas no grupo que empregou a técnica cirúrgica compósita. Os resultados sugerem que a rede hemostática interna é uma técnica de fácil aplicação, segura e eficaz na redução do risco de hematomas em *liftings* faciais.

Introduction

Hematoma is the most common complication following facial plastic surgery. Hypertension is one of the main causes of postoperative bleeding. In addition, the increasing use of facial fillers, biostimulators, and energy-based thermal technologies has altered facial anatomy and promoted increased peripheral vascularization, consequently contributing to greater intraoperative bleeding.

In this context, the present study sought to evaluate a technique that combines concepts derived from existing surgical approaches. To illustrate this concept, we borrowed a well-established principle from materials engineering: composite materials. Composite materials are created by combining two or more distinct materials to obtain a final product with enhanced quality and performance. Therefore, this study describes the combination of established surgical techniques but with a unique approach designed to minimize the incidence of hematoma in facial surgery.

Theoretical Background

Facelift surgery remains one of the most commonly performed aesthetic plastic surgery procedures.[1] One of its greatest challenges is the prevention of hematoma formation, which is the most frequently reported postoperative complication. The incidence of hematoma ranges from 0.5% to 8%, with an overall average of approximately 3%. Rates are higher in male patients and may reach 14% in this group.[2]

Several strategies to reduce the incidence of hematoma in surgical procedures have been investigated. The internal quilting suture technique was originally described as of to eliminate dead space in abdominoplasty and resulted in a significant reduction in seroma and hematoma formation.[3] In facelift surgery, the use of progressive tension sutures (PTS) has also been reported,[4] and one study described the use of external interrupted sutures for hematoma prevention.[5]

A reduction in hematoma incidence from 8.7% to 3.97% in male facelift patients has been reported through blood pressure control. This same study evaluated 985 cases over a 30-year period, demonstrating the importance of perioperative blood pressure management.[6]

The effectiveness of the hemostatic net technique has been consistently demonstrated.[7,8] A study conducted between 2009 and 2013 reported no hematoma formation in 405 patients treated with this approach.[7] Earlier, in 2012, the effectiveness of the external hemostatic net in preventing hematomas following rhytidoplasty was reported in a series of 366 patients, without a significant increase in ischemic or necrotic complications.[8] A similar study evaluating the external hemostatic net was published more recently.[9]

Overall, the available evidence suggests that prevention of postoperative hematoma remains one of the primary concerns in facial plastic surgery.

Methods

The objective of this study was to evaluate 356 facelift procedures that combined the Internal Hemostatic Net technique with progressive tension sutures and quilting sutures, aiming to ensure safe and effective tissue redistribution and closure of the surgical dead space. For comparison, a control group of 205 patients who underwent traditional facelift techniques involving Superficial Musculoaponeurotic System (SMAS) plication or SMASectomy was analyzed.

All patients were evaluated for hematoma formation during the first postoperative week. Hematoma was defined as a blood collection exceeding 30 mL that required surgical drainage in the operating room.[6]

All data were collected retrospectively under protocol number 89826425.0.0000.5328, which was approved by the Institutional Research Ethics Committee.

The mean postoperative follow-up period was 18 months. All patients provided informed consent, and all procedures were performed by the same surgical team in a private clinic and at Mãe de Deus Hospital – Carlos Gomes Unit.

Control Group

The control group consisted of 205 rhytidoplasty procedures performed between 2011 and 2017, for which the incidence of postoperative hematoma was evaluated.

During this period, facelift procedures were performed using a subcutaneous dissection technique combined with SMAS and platysma plication in some patients, while others underwent SMASectomy associated with platysma plication.

Vacuum drains (BioVac 3.2 mm, Medical Brazil) were used in all cases for a minimum of 24 hours. In addition, a compressive dressing was maintained for 24 hours postoperatively.

The mean length of hospital stay following surgery was 12 hours.

Study Group – Description of the Proposed Technique

The study group evaluated the occurrence of hematoma in 356 patients treated between 2018 and 2025 using the technique described below.

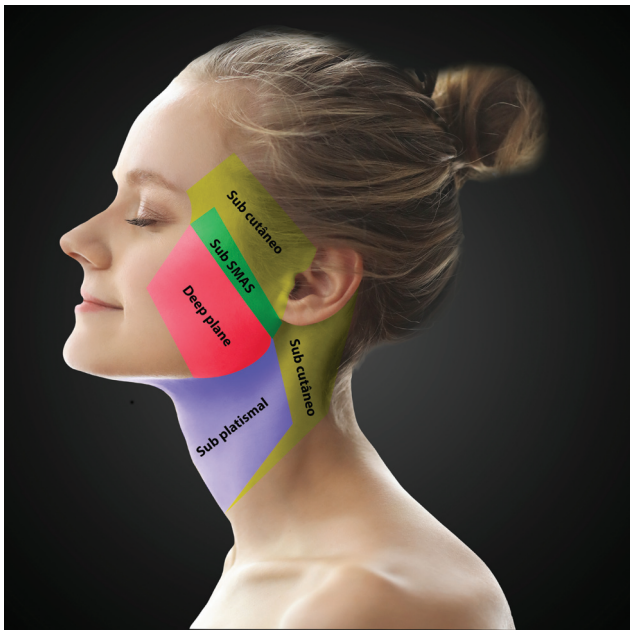


Fig. 1 Dissection regions.

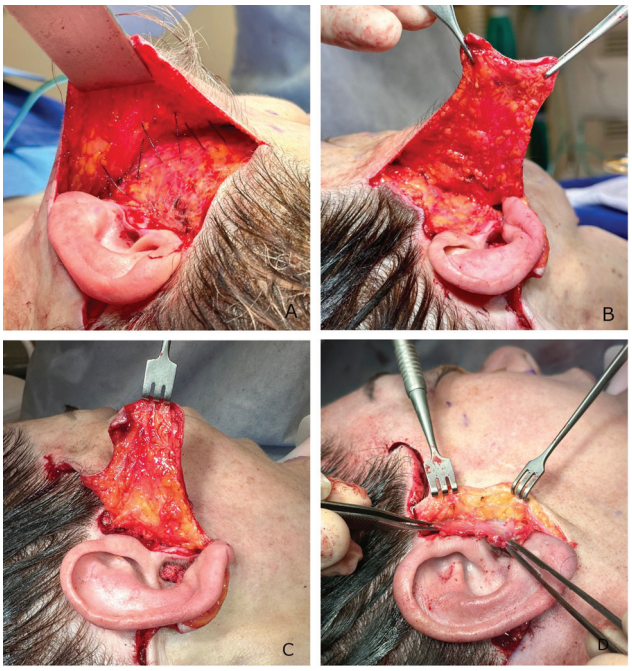


Fig. 2 (A, B, C, and D) Stages in the construction of the internal hemostatic net.

Facial dissection is divided into five regions, as illustrated in ►**Fig. 1**. The first area of subcutaneous dissection is defined and limited by the course of the frontal branch of the facial nerve. From this point, dissection proceeds to the second area, entering the sub-SMAS plane using Metzenbaum scissors (Black & Black Surgical, Atlanta, GA, USA) up to the marked entry point for the deep plane. Beyond this point, the third area is approached, where blunt dissection is performed using a Trepsat elevator (Marina Medical, Davie, FL, USA).

Hemostasis is achieved using bipolar electrocautery, followed by release of the zygomatic, masseteric, and mandibular retaining ligaments. We then proceeded to the retroauricular region, corresponding to the fourth area of dissection. In this region, subcutaneous dissection is performed using a number 10 scalpel blade, extending through the retroauricular compartment to the lateral cervical crease, where the course of the great auricular nerve is identified.

The fifth dissection region involves the subplatysmal plane. Cervical retaining ligaments are released up to 5 cm below the mandibular border using a number 10 scalpel blade directed toward the lower midline. Subsequently, a Trepsat elevator (Marina Medical, Davie, FL, USA) is used to continue the dissection to the level of the facial artery.

Two incisions are made in the platysma muscle to create a muscular flap. The first incision is positioned 1 cm below the mandibular border and extends 4 cm toward the midline, reaching the submandibular gland region. The second incision is located 5 cm below the mandibular border and extends 4 cm toward the midline. This creates a muscular flap measuring approximately 4×4 cm. The flap represents a modification of the extended deep-plane (hammock flap) technique[10] and is intended to achieve greater platysmal elevation.

At this stage, construction of the internal hemostatic net begins. The technique consists of two types of sutures: progressive tension sutures (PTS) and quilting sutures, as illustrated in ►**Fig. 2**.

Closure and fixation of the deep plane are performed using progressive tension sutures placed in a single line with four to six 2-0 Vicryl sutures (Ethicon, Inc., Somerville, NJ, USA). The sutures extend from the mandibular angle to the lateral canthus, following the deep-plane entry line, and are anchored to the mastoid and parotid fascia, thereby maximizing correction of the midface region (►**Fig. 2A**).

A second row of sutures is placed parallel to the first, approximately 1 cm more laterally toward the auricular region, following the same 45-degree traction vector and joining the SMAS to the parotid fascia, thereby closing all remaining spaces (►**Fig. 2B**).

The third row of sutures, using 3-0 Vicryl, is placed between the SMAS and the parotid fascia until virtually the entire area initially described as subcutaneous dissection has been eliminated. This allows the SMAS-platysma complex to be advanced to the wound closure margin along the entire anterior auricular region, leaving only a small area of subcutaneous dissection in the prehairline temporal region. In this area, quilting sutures are placed between the deep portion of the subcutaneous tissue (approximately 0.2 mm) and the anterior portion of the temporal fascia (►**Figs 2C**–**2D**).

The quilting sutures consist of an average of six sutures placed in a linear fashion from the earlobe to the lateral canthus. The average distance between sutures is approximately 1.5 cm, extending to within approximately 2 cm of the skin closure margin. As a result, nearly all of the area previously subjected to subcutaneous dissection is effectively eliminated.

As shown in ►**Fig. 3**, the SMAS-platysma complex is advanced to the closure margin without any residual subcutaneous dissection. The figure demonstrates the absence of

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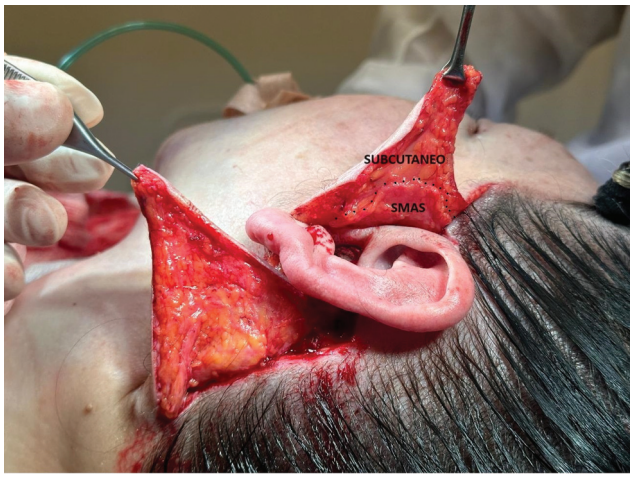


Fig. 3 Advancement of the sub- superficial musculoaponeurotic system (SMAS) flap to the suture line without subcutaneous dissection.

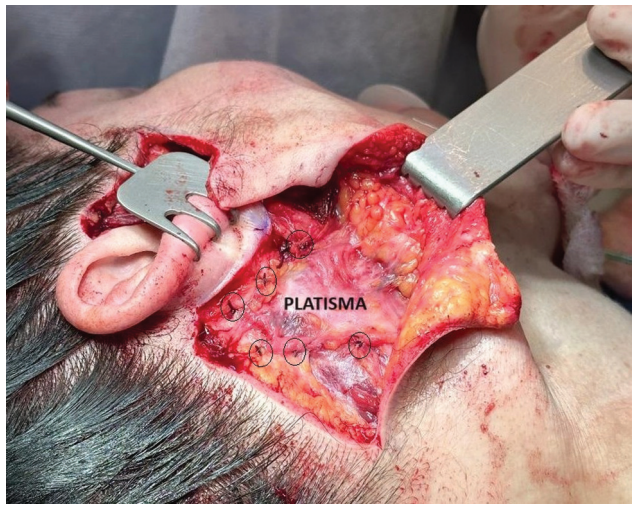


Fig. 5 Platysma fixation in the retroauricular region.

separation between the SMAS and the subcutaneous tissue, resulting in a thicker and more secure flap. The final row of sutures is placed using 4-0 Vicryl for refinement and appropriate flap positioning.

The internal hemostatic net proposed in this study employs the same underlying concept. However, because the dissection is performed in the sub-SMAS and subplatysmal planes, fixation in the anterior region is achieved between the SMAS or platysma and the deep plane. In the posterior retroauricular region, sutures are placed between the subcutaneous tissue and the muscular fascia, using either continuous or interrupted sutures.

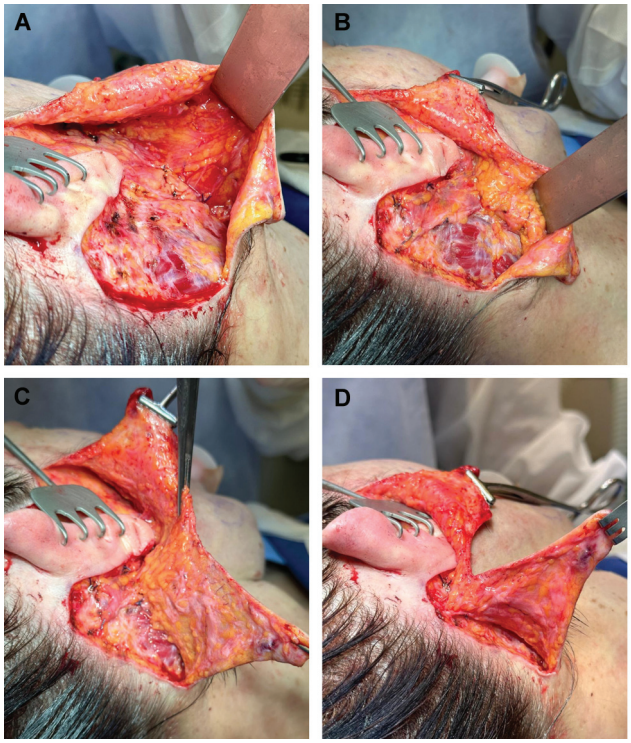


Fig. 4 (A, B, C, and D) Stages in the construction of the internal hemostatic net in the cervical region.

In the retroauricular and cervical regions, platysmal flap fixation sutures are initiated at the level of the submandibular gland.[11] The details can be better appreciated in ►**Fig. 4**. The internal hemostatic net is continued along a line parallel to the mandibular border, approximately 1 cm below it, where the platysma is refixed to the deep fascia, creating a well-defined mandibular contour. The distance between sutures ranges from 1.5 to 2 cm.

Upon reaching the previously described platysmal flap, the flap is tractioned toward the occipital region and secured with four to six anchoring sutures (►**Fig. 5**) using 2-0 Vicryl. This maneuver covers the entire infra-auricular compartment and a substantial portion of the retroauricular compartment (regions in which 76.4% of hematomas were observed in the control group), thereby completely closing the subplatysmal dissection space and leaving only the subcutaneous dissection area to be closed.

In this area, 3-0 Vicryl is used in either a continuous or interrupted fashion, joining the subdermal plane to the adjacent muscular fascia and over the previously described platysmal flap, thereby closing the entire retroauricular space. Quilting sutures are then placed with careful attention to avoid skin pinching and are spaced approximately 1.5 to 2 cm apart. As a result, the subcutaneous flap is completely fixed to the muscular fascia, with no tension on the skin closure line.

For better understanding, ►**Fig. 6** illustrates the regions where progressive tension sutures (PTS) and quilting sutures are placed, closing the entire potential space up to the margin of the incision closure.

Fisher's Exact Test was used to determine the statistical association between the use of the internal hemostatic net technique and the occurrence of hematomas in facial plastic surgery. The test evaluates the significance of the association between two variables by calculating the exact probability of observing the results under the assumption that the null hypothesis is true (i.e., that the variables are independent).[12]

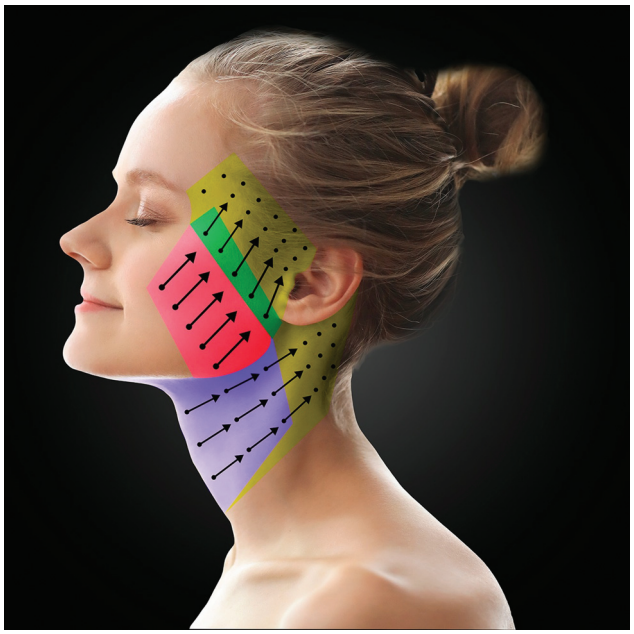


Fig. 6 Internal sutures site.

This test is essential for validating whether the observed association between the two groups is statistically significant rather than occurring by chance. For all analyses, a significance level (α) of 0.01 was adopted.

Results

Control Group

Among the 205 patients included in the control group, 29 were smokers, representing 14.1% of the sample, and 41 were hypertensive, corresponding to 20.0% of the total population.

In the control group, 12 hematomas were observed, corresponding to 5.9% of the reported cases, all of which required surgical evacuation in the operating room. Of all hematomas identified, 75% were located in the retroauricular and infra-auricular compartments, whereas only 25% occurred in other areas of the dissection.[8,11]

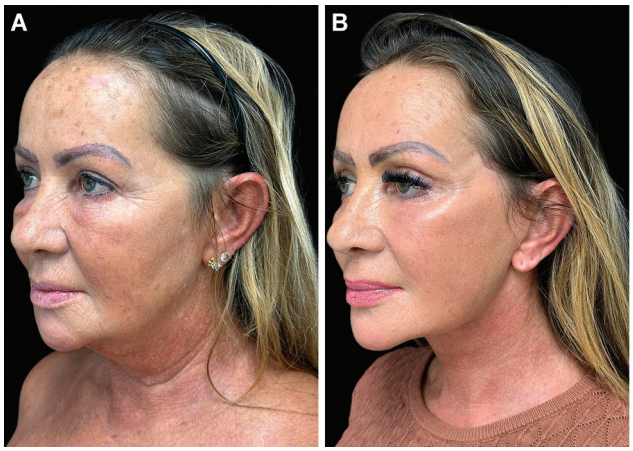


Fig. 7 (A and B) Preoperative and postoperative views at 6 months following facelift surgery combined with blepharoplasty.

It is noteworthy that the hematoma rate observed in this study falls within the range reported in the literature, which varies from 3.6% to 14.2%.[5–7]

Study Group

A total of 356 patients were assessed. Of these, 26 were smokers, corresponding to 7.3% of the cases, and 76 were hypertensive, representing 21.3% of the study population.

All patients underwent facelift surgery using the Internal Hemostatic Net technique, without the use of drains or compressive dressings. No cases of hematoma, seroma, or tissue necrosis were observed. The rate of transient paresis was 10.4%, and no cases of permanent paresis occurred during the 8-year study period.

►**Figs 7** through 9 present representative cases treated with the described technique, showing preoperative and postoperative results, including the immediate postoperative period (►**Fig. 8B**). This figure illustrates the internal hemostatic net immediately after its construction, highlighting the distinct appearance of this approach compared with the traditional hemostatic net technique.

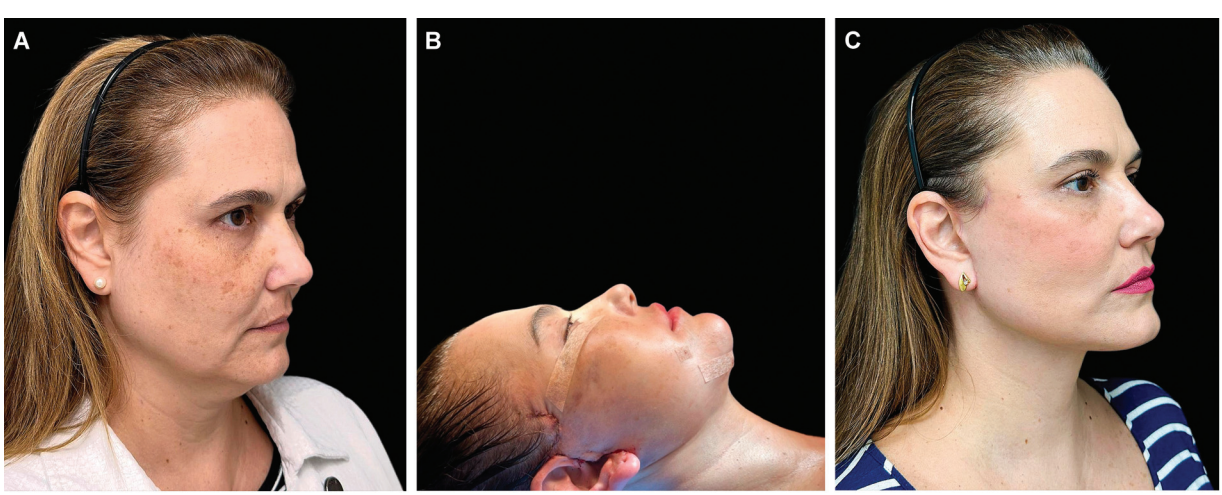


Fig. 8 (A, B, and C) Preoperative, immediate postoperative, and 4-month postoperative views following facelift surgery.



Fig. 9 (A and B) Preoperative and 30-day postoperative views following facelift surgery combined with blepharoplasty and endoscopic forehead lift.

Discussion

In the study group, a lower proportion of smokers was observed (−6.8%) compared with the control group. Conversely, the proportion of hypertensive patients was slightly higher (+1.3%), despite hypertension being considered by several authors to be one of the main risk factors for hematoma formation.[1,3]

In all cases, neither compressive dressings nor drains were used. This differs from the technique described by Hudson,[13] who performed quilting sutures while leaving an area of approximately 7 cm of residual dead space near the closure line and therefore used a drain in that region. The author reported one case of hematoma occurring in the area where quilting sutures had not been placed, supporting the importance of dead-space closure, which is the central principle of the technique developed in the present study.

The results of Fisher's exact test for the variables considered relevant to the study are presented as follows. Although hypertension and smoking were not response variables, they were analyzed to evaluate their statistical significance. Finally, hematoma occurrence was assessed as the primary outcome variable, demonstrating its relevance to the evaluation of the proposed technique.

The Fisher's exact test result for hypertension was 0.7468, indicating no statistically significant difference between the study and control groups. The Fisher's exact test result for smoking was 0.00117. According to the significance level adopted in this study ($\alpha = 0.01$), this result is statistically significant. Therefore, smoking status differed significantly between the control and study groups

Finally, Fisher's exact test was used to evaluate the significance of hematoma occurrence between the two groups. The resulting p-value was <0.00001, indicating a statistically significant difference. In other words, the absence of hematomas in the study group was statistically significant when compared with the control group.

To explain the efficiency of the Internal Hemostatic Net from a mechanical perspective, we may consider a square membrane with dimensions $a \times a$ subjected to a uniform pressure q. In this analogy, the pressure represents the patient's blood pressure, while the membrane represents the skin anchored at four points, beneath which blood could potentially accumulate and form a hematoma (►**Fig. 10**).

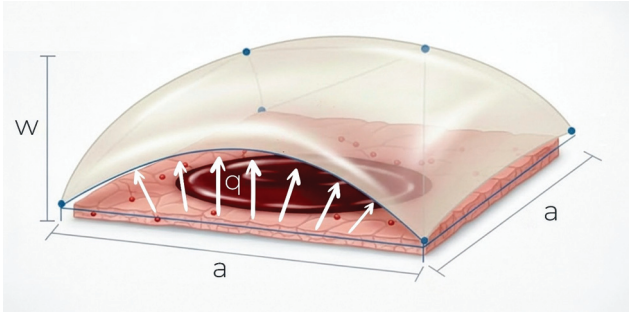


Fig. 10 Model illustrating the maximum displacement caused by blood pressure in skin anchored at four points, simulating a hemostatic net.

Theories developed for the analysis of membrane deformation[14–16] provide an analytical framework for this problem by considering a thin elastic membrane subjected to a uniform pressure (q), assuming small displacements (w) and negligible bending stiffness.

For the basic governing equation (Equation 1), the differential equation presented below is derived directly from force equilibrium in a differential membrane element.

$$T\left(\frac{\partial^2 \omega}{\partial x^2} + \frac{\partial^2 \omega}{\partial y^2}\right) = q \quad (1)$$

Where T is the tension per unit length of the membrane (assumed to be constant and uniform), $w(x,y)$ is the vertical displacement of the membrane at a point (x,y), and q is the uniform pressure acting on the membrane (force per unit area).

In this case, we considered a common and effective method for solving the membrane equation for a rectangular section with fixed boundaries: the method of separation of variables. This approach involves expanding the uniform pressure q into a double Fourier series that satisfies the boundary conditions. By integrating the solution to calculate the volume and considering $n = m = 1$ and $a = b$, expressions for the volume and the displacement at the center of the membrane are obtained:

$$V_{1,1} = -\frac{32\, qa^4}{\pi^6 T} \quad (2)$$

$$\omega_{1,1}\left(\frac{a}{2}, \frac{a}{2}\right) = -\frac{8qa^2}{\pi^4 T} \quad (3)$$

where the negative sign indicates that the deflection occurs in the direction opposite to the applied pressure.

As expressed in Equation 3, the vertical displacement w at the center of a membrane anchored at four points and subjected to a pressure p is proportional to a^2. Assuming that the membrane properties remain unchanged and that the pressure is uniform, reducing the span by half (a/2) decreases the central vertical displacement by a factor of four and reduces the enclosed volume by a factor of sixteen. This represents a substantial reduction in the volume available for blood accumulation and, consequently, in the potential for hematoma formation.

This relationship between membrane geometry and displacement is crucial for understanding the mechanism of hematoma formation. It implies that smaller structures are stiffer in response to a given pressure, resulting in less deformation. Thus, membrane theory provides a solid framework for understanding how small dimensional changes can have a significant impact on material behavior. The results observed in the present study suggest that the described technique contributes to the prevention and possibly even the elimination of hematoma formation, as it physically demonstrates the influence that reducing the free space between two points has on the available volume for blood and fluid accumulation.

Similarly to the hemostatic net described by Auersvald,[8] we may state that the mechanism responsible for this preventive effect is likely multifactorial, including dead-space closure, increased skin pressure, and flap stabilization, all of which ultimately result from reducing the space available for blood accumulation, as discussed previously.

In addition, the proposed technique does not require visible external sutures, which are often poorly accepted by patients because of their appearance. Skin-related complications, such as hyperpigmentation or hypopigmentation, are also avoided with the use of this technique.

Conclusion

Therefore, the internal hemostatic net consists of the combined application of established and well-recognized surgical techniques with the goal of achieving a safe procedure and an acceptable outcome from the patient's perspective.

Similar to the external hemostatic net, this technique prevents movement of one tissue plane over another, improves flap tension distribution, and facilitates redistribution of excess skin, resulting in a substantial reduction in the risk of hematoma formation and tissue necrosis. In contrast, it eliminates the poor patient acceptance associated with visible external sutures and avoids the risk of skin hypo- or hyperpigmentation.

The procedure herein described reduces hospitalization time, does not require the use of drains, and eliminates the need for mandatory postoperative visits within 24 to 48 hours for removal of compressive dressings. Consequently, it reduces the amount of postoperative follow-up care required. Hence, the technique does not require specialized equipment and is effective in reducing the risk of hematoma formation in facelift surgery.

Data Availability Statement
Data will be available upon request to the corresponding author.

Financial Support
The authors declare that they did not receive financial support from agencies in the public, private, or non-profit sectors to conduct the present study.

Conflict of Interests
The authors have no conflict of interests to declare.

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