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Facial Planning Protocol with Adipometry for Safe Application of Micro and Macrofocused Ultrasound: Validation with Imaging Ultrasound

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Abstract*: This study aimed to present a simplified and safe diagnostic evaluation protocol applicable to facial aesthetic procedures, with an emphasis on the integrated use of adipometry and imaging ultrasound as complementary exams. The protocol aims to support the personalized selection of micro- and macro-focused ultrasound tips, considering the anatomical depth of the tissues and the thickness of the subcutaneous fat. The proposal includes demonstrating the effectiveness of the method through the analysis of anatomical sections and its clinical applicability in cases of non-surgical facelifts.*

Through an anatomical study performed on a fresh cadaver, an innovative clinical methodology was developed and validated for the individualized planning of micro- and macro-focused ultrasound applications on the face. The technique is based on measuring tissue thickness through adipometry with manual clamping, using an adipometer in strategic anatomical regions, such as the submental region (double chin), the lower third of the face, and the upper eyelid. The skinfold thickness is interpreted as a 50% reference point for selecting the ideal tip (cartridge), correlating it with the required depth of action.

The methodology was validated through real-time ultrasound examinations, which allowed for the correlation between soft tissue thickness and the anatomical planes of energy action, such as the SMAS, deep dermis, and superficial dermis. Based on the integrated analysis of adipometry and ultrasound, a clinical reference table was developed to guide aesthetic healthcare professionals in the safe and personalized selection of tips, promoting greater predictability of results, therapeutic personalization, and clinical safety.
Key Word: *microfocused ultrasound, adipometry, SMAS, facial aesthetics, clinical planning, Dermatology, aesthetic technologies, cadaver facial dissection*

I. Introduction

Mitz and Peyronie describe the superficial musculoaponeurotic system (SMAS) (13), and since its publication, the SMAS has been considered a cornerstone of facial rejuvenation, where volumization and facelifts can be achieved through non-surgical treatment techniques (12). Pessa, J., even suggests that the SMAS is an evolutionary remnant of primate facial muscles (14).

Jacono et al., in their study, report a case series of complications in surgical facial rejuvenation and facelift treatments, including facial nerve injury; Rodrigues et al., report that the demand for non-invasive procedures with shorter recovery times has become the mainstay of aesthetic treatments, treatments that also have fewer complications (18,19).

Micro- and macro-focused ultrasound is a well-established technology in aesthetic clinical practice and is widely used in the treatment of facial and body sagging.

Its action occurs through the generation of focused heat at different tissue depths, promoting controlled thermal coagulation, tissue retraction, and stimulation of neocollagenesis (1,2). Despite its proven efficacy, in daily practice, the indiscriminate application of standardized protocols is observed, in which tips with depths of 4.5 mm, 3.0 mm, and 1.5 mm are systematically used, regardless of the individual anatomical characteristics of the patients (3,4).

This standardized approach disregards significant variations in facial tissue thickness between individuals, especially regarding the density and depth of adipose compartments. Patients with thinner facial structures, low subcutaneous volume, or a genetic predisposition to thinner fat may experience unfavorable results when subjected to deep ultrasound shots without prior evaluation. In these situations, hypodermal debulking is frequently observed, contributing to loss of facial volume and the appearance of residual sagging. This is not attributed to technology failure, but rather to compromised facial anatomical support (5,6).

Subcutaneous tissue plays a fundamental role in supporting the skin and maintaining facial contours. Unplanned destruction of adipose compartments can result in undesirable aesthetic changes, such as deep furrows, tissue sagging, and a premature aging appearance (7). This condition reinforces the importance of a personalized approach, based on an assessment of actual tissue thickness, for the safe selection of the microfocused ultrasound application depth.

In this context, this study proposes and describes a clinical methodology for individualized planning for the application of microfocused and macrofocused ultrasound to the face, based on skinfold thickness measurement using a clinical adipometer. The technique consists of measuring tissue thickness in strategic areas such as the submental region, the lower third of the face, and the upper eyelid region, using 50% of the measured value as the technical criterion for defining the ideal tip. The proposed methodology was validated using ultrasound, allowing for the correlation between clinical reasoning based on adipometry and the actual visualization of anatomical structures, such as the SMAS, the deep dermis, and the superficial dermis. As a result, a practical reference table was developed for clinical use, aiming to guide aesthetic and health professionals in choosing the personalized depth of injection, promoting greater safety and predictability in results.

1. Anatomy of the SMAS

The SMAS can be didactically separated into upper and lower facial components, this division being related to the position of the zygomaticocutaneous ligaments (15,16,17). With this definition of upper and lower, it is possible to obtain an imaginary line described by the authors as the malar equator (15,16,17).

Figure 1 illustrates the position of the SMAS in relation to the fat pads, bone tissue, retaining ligaments, and skin; and image 1 shows the marking of the malar equator in a patient.

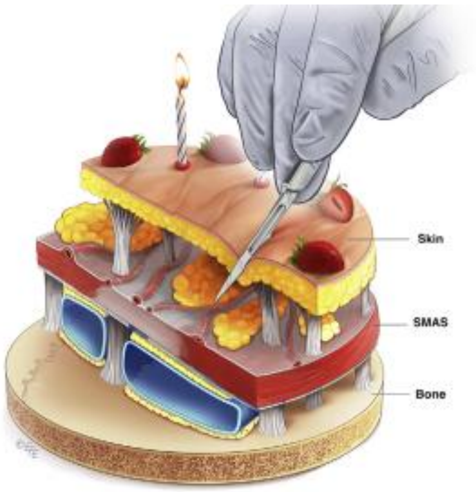

FIGURE 1: Illustrative figure of the anatomical position in depth related to bone tissue and skin. (13)

Image 1: marking of the malar equator in a female patient. (13)

II. The Importance of Anatomical Knowledge of the SMAS in the Application of Microfocused Ultrasound

The main objective of microfocused ultrasound technology is to achieve a non-surgical lifting effect through the retraction and anchoring of the SMAS (Superficial Musculo-Aponeurotic System).

Studies such as that by João Pantojo Neto and Fabio César Prosdócimi (CTA College, 2024), who performed anatomical dissections on fresh cadavers, confirm the complexity and continuity of the SMAS in facial regions—including the nasolabial fold, infraorbital fold, cheek, angle of the mouth, and nasal alae—revealing fibromuscular structures with dense collagen and elastic fibers of varying calibers.

This morphofunctional basis supports the precise use of microfocused ultrasound, as approximately 70% of the retraction promoted by the equipment is directly related to the repositioning of the SMAS, and not solely to the stimulation of superficial collagen. Therefore, knowing the anatomical areas and the exact depth of application is essential to correctly anchor the tissues, generate the desired lifting effect, and ensure procedure safety.

The SMAS, by involving muscles such as the orbicularis oculi, platysma, and occipitofrontalis, functions as an anatomical bridge between facial expressions and skin architecture. Therefore, when tensioned by technologies such as microfocused ultrasound, it provides improved facial contour, lifts ptosis structures, and a true anti-aging effect.

2.1 Use of the Adipometer in Advanced Aesthetics: Anatomical Basis and Integration with Microfocused Ultrasound

The adipometer is an anthropometric assessment instrument used to measure the thickness of the skinfold, composed of skin and subcutaneous adipose tissue. When performing the fold, the practitioner pinches the superficial layer of the skin along with the adipose tissue, preserving the deeper layers, such as the muscle fascia, the superficial musculoaponeurotic system (SMAS), and the internal fibrous septa (Durnin & Womersley, 1974; Jackson & Pollock, 1985).

The tissue pinched in the adipometric fold includes:
Epidermis and dermis (skin structures);
Hypodermis, especially the superficial and intermediate fat lobules.

Tissues that are not pinched (i.e., preserved during the measurement) include:
The SMAS (when on the face);
Deep muscle tissue;
Deeper vascular and nerve structures, which are not involved in the fold.

This anatomical understanding is essential for establishing accurate clinical reasoning when selecting tips and operating depths when using microfocused ultrasound (HIFU). By correlating the fold thickness with the available tips (e.g., 1.5 mm, 3.0 mm, 4.5 mm), it is possible to direct the ultrasound energy to the desired plane, whether dermal, subcutaneous, or SMAS, with greater safety and specificity, respecting the anatomical structure and physiological volume individually in each anatomical region of the face.

The combination of adipometry and focused ultrasound offers three fundamental clinical advantages:
Personalized protocol according to tissue thickness, promoting more effective results;
Avoids unwanted deflation, especially in areas of facial or body support, preventing side effects such as premature structural aging or post-treatment depressions;
Promotes safety, respecting anatomical risk areas and avoiding energy application at depths incompatible with the body type.

Furthermore, the use of adipometric fold as a clinical reasoning tool is in line with the current trend of evidence-based aesthetics and functional anatomy, favoring individualized and preventive treatments (Rzany & Wanitphakdeedecha, 2020).

III. Materials and Methods

Conventional clinical practice in the application of micro- and macro-focused ultrasound is still largely based on standardized protocols, with the frequent use of the 4.5 mm tip as the first therapeutic shot. This depth is associated with thermal contraction of the superficial musculoaponeurotic system (SMAS), and is considered ideal for promoting lifting and an immediate tightening effect (1). However, the indiscriminate adoption of this approach, without considering individual tissue thickness, can compromise the anatomical safety and efficacy of the procedure.

Faces with less subcutaneous tissue volume or more delicate anatomical features may not have sufficient thickness to justify the use of the 4.5 mm tip, which can lead to the ultrasound acting in deeper planes than desired, even reaching muscle or bone structures. This can result in exacerbated discomfort, undesirable anatomical changes, or even a lack of clinical results. Therefore, this study adopted a descriptive, cross-sectional, and technical validation approach to propose and evaluate a customized methodology for planning microfocused ultrasound application on the face. The proposal is based on measuring skinfold thickness using a clinical adipometer (Sanny® scientific adipometer, 0.1 mm accuracy) and calculating 50% of the measured value, considering that pinching involves two layers of subcutaneous tissue, as a clinical criterion for defining the ideal depth tip.

The measurements were taken at three strategic anatomical points: the submental region (double chin), the lower third of the face (mandibular line), and the upper eyelid region. At each point, bilateral skin pinching was performed with the patient at rest, maintaining standardized angle and pressure of the adipometer. The average of the measured folds was used to calculate 50% of the tissue thickness. The resulting value was correlated with the operating depth of the ultrasound equipment's tips.

Image 2: Measurement of the adipometry fold pinching of the upper face.

To validate the methodology, an imaging ultrasound system (Samsung Medison HS40®, 7.5 to 12 MHz multifrequency linear transducer) was used, which allowed real-time visualization of the dermal, subcutaneous, and SMAS layers. Ultrasound analysis was performed in the same pinched areas, with records of the actual depth of each anatomical layer.

Image 3: Photo of the capture of the ultrasound imaging areas in the comparison and validation of the use of the adipometry fold with the depth of the structural and anatomical areas.

Image 4 and 5: Research photo of the anatomical areas measuring the depth and thickness of the tissues with imaging ultrasound, mapping areas of the SMAS, subcutaneous, deep and superficial dermis.

The comparison between clinical reasoning based on adipometry (50% of the skinfold) and ultrasound findings allowed us to validate the method's accuracy in selecting the ideal tip. Based on these data, a reference table was constructed with average skinfold values and their respective indicated depths, including safety zones for clinical application. This table aims to assist aesthetic and healthcare professionals in safely and personalizedly planning microfocused ultrasound applications, based on objective and accessible data, reducing risks and optimizing results.

IV. Results

Three anatomical regions of the face were analyzed to assess the applicability of the proposed methodology: the submental region (double chin), the lower third of the face (mandibular line), and the upper eyelid region. The selection of these areas took into account the high clinical demand for sagging treatment and facial contour redefinition, as well as the anatomical complexity and variation in tissue depth in these locations (1,2). In each region, skinfold thickness was measured using a clinical adipometer, followed by a 50% calculation of the measured thickness to suggest the microfocused ultrasound tip most compatible with the desired anatomical plane.

The measurements revealed significant variations between individuals, highlighting the limitations of standardized protocols that use 4.5 mm tips as the universal standard for reaching the SMAS (3).

In the submental region, measured skinfolds ranged from 8 mm to 23 mm. In faces with less subcutaneous thickness, the 50% calculation indicated depths between 3 mm and 6 mm, which would place the 4.5 mm tip below the SMAS plane, in contact with muscle or even bone structures, compromising the efficacy and safety of the procedure. On average, only 42% of cases presented sufficient thickness to justify the safe use of the 4.5 mm tip in this region.

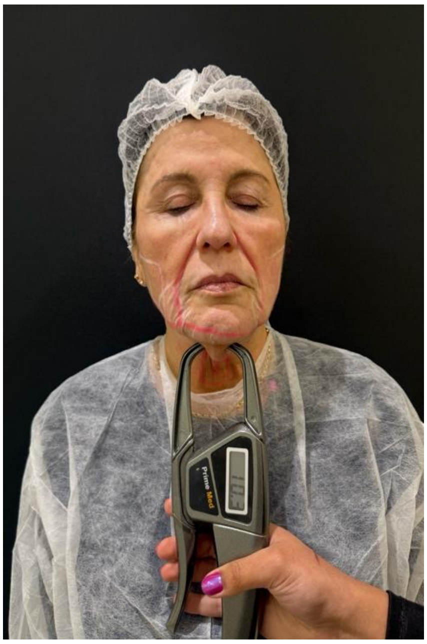

Image 6 – Submental skinfold assessment with an adipometer.

Demonstration of the total skinfold thickness in the submental region, using a manual adipometry technique with pinching between the thumb and index finger to measure subcutaneous tissue thickness. This procedure allows for the estimation of localized adipose volume, contributing to clinical rationale for treatment planning in patients with hypervolumization or accumulation of adipose tissue in the cervicofacial region.

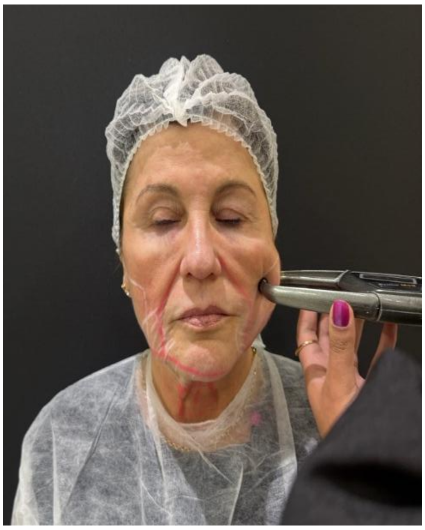

Image 7 – Skinfold assessment in the genial region.

Demonstration of the technique for measuring total skinfold thickness in the mid-genial region using digital adipometry. The device is positioned directly on the skin, applying standardized pressure to objectively measure the thickness of the cutaneous and subcutaneous tissue, without the need for manual finger pinching. This assessment provides quantitative data on superficial adipose volume, a relevant clinical parameter for planning therapeutic strategies, such as defining facial contours, volumetric harmonization, and localized fat reduction. Accurate measurement of tissue thickness contributes to clinical reasoning when choosing the tip and depth of application of microfocused ultrasound, respecting individual anatomy and promoting safety in the proposed protocol.

Image 8 – Skinfold assessment in the suprapalpebral region.

Demonstration of the total skinfold grasp in the suprapalpebral region, immediately inferior to the eyebrow arch. Manual pinching between the thumb and index finger allows for the estimation of dermal thickening and the degree of local tissue laxity, contributing to clinical reasoning in protocols for gaze elevation, tissue traction, and treatment of mild upper eyelid ptosis. This analysis is particularly useful for planning technologies such as microfocused ultrasound, fractional radiofrequency, and injectable biostimulators targeted at the upper third of the face.

In the lower third of the face, particularly at the mandibular line, skinfold values varied widely, especially between genders and age groups. The anatomical depth of the SMAS in this region ranged from 3.8 mm to 6.2 mm, with evidence that the application of the 4.5 mm tip, in more than half of the cases, exceeded the plane of therapeutic interest. This reinforces the idea that the indiscriminate action of ultrasound can reach deep fat compartments or muscle layers, causing adverse effects such as volume reabsorption and increased sagging (4,5).

Anatomical Dissection and Rationale for the Use of Microfocused Ultrasound in Strategic Plans for Non-Surgical Facelifts

To further explore the clinical rationale for the application of microfocused ultrasound (HIFU – High-Intensity Focused Ultrasound) in facial harmonization, we performed anatomical analysis in the laboratory on fresh cadaveric specimens, with an emphasis on the facial region. During the dissection procedure on the cadaver lab, we observed the reflection of successive tissue layers: skin, superficial fat, and deep fat, leading to direct exposure of the Superficial Musculo-Aponeurotic System (SMAS).

The visual identification and analysis of the layers allowed us to verify the thickness and quality of the tissues in different facial areas, as well as structural changes related to aging, such as sliding of the adipose compartments, ligamentous laxity, and loss of SMAS tone. This analysis reinforces the strategic and safe choice of microfocused ultrasound action plans, which aim to provide controlled thermal stimulation to promote retraction and non-surgical lifting.

Microfocused ultrasound works by depositioning thermal coagulation points (TCPs), concentrating energy at specific depths (1.5 mm, 3.0 mm, and 4.5 mm), depending on the tip used. The temperature reached at the focus points can range from 65°C to 70°C, which is sufficient to cause selective collagen denaturation, followed by neocollagenesis and tissue retraction, without compromising the superficial layers (19). The 4.5 mm plane is generally used for the SMAS and is primarily responsible for the lasting facelift effect. The 3.0 mm and 1.5 mm planes target superficial fat and the deep dermis, respectively, improving skin texture and firmness (19). Correct anatomical identification of these planes during dissection reinforces the importance of technical precision in choosing the tip based on clinically assessed tissue thickness, for example, through digital adipometry.

Therefore, the combination of practical anatomical knowledge (via dissection), personalized clinical assessment, and the use of microfocused ultrasound at anatomically appropriate depths forms the basis for safe and effective non-surgical facelift protocols. Selective stimulation of structural planes such as the SMAS ensures natural facial support and traction, with progressive and lasting results.

Image 9: Anatomical dissection of a cadaveric specimen demonstrating the SMAS, adipose compartments, and muscular plane.

Clear visualization of the overlapping superficial and deep fat pads and the separation between the subcutaneous and musculoaponeurotic planes.

Image 10: Sagittal section demonstrating multiple facial fat compartments and the SMAS plane.

The distribution of laminar structures and the continuity of fibroadipose tissue are highlighted, highlighting the importance of adipometry planning for clinical safety in deep injections.

Image 11: Reflection of the subcutaneous tissue, highlighting the transition between fat and the SMAS.

Demonstrates the three-dimensional anatomy involved in facial support and reinforces the importance of maintaining the ideal depth to avoid facial hollowing.

Image 12: Top-down view of the SMAS thickness in the lateral region

The image illustrates the clinical application of three-dimensional anatomical knowledge in planning the tip to be applied, especially in areas of critical thickness.

Image 13 – Photograph of an anatomical specimen dissected from the lower third of the face, with arrows indicating the SMAS, fat compartments, and muscles. Ideally, in lateral or sagittal view.

In the upper eyelid region, anatomical sensitivity is even greater. The measured skinfold thickness ranged from 3 mm to 7 mm, and in all cases, the recommended probe was the shallowest (1.5 mm), with energy and shot density adjustments. Ultrasound revealed the proximity of the orbicularis oculi muscle and the need for extreme care to avoid structural damage or functional alterations.

Images obtained by anatomical dissection of fresh cadavers demonstrated the natural variation in SMAS depth between individuals and reinforced the lack of a fixed standard for defining the ideal probe. Visual and photographic analysis of the anatomical planes confirmed the positioning of the structures measured clinically and by imaging, validating the use of adipometry as a safe and accessible clinical tool for microfocused ultrasound treatment planning. The triangulation of adipometry data, ultrasound imaging, and dissected specimen anatomy allowed the development of a clinical reference table, combining skinfold ranges by anatomical region and recommended probes, with safe depth zones for therapeutic intervention.

This table was developed as a clinical support tool for the assertive selection of the focused ultrasound probe, whether microfocused (focusing on superficial layers) or macrofocused (penetrating deeper planes for interaction with the subcutaneous tissue).

Selection is based on an assessment of the anatomical, facial, or body skinfold, which considers the thickness of the pinchable tissue (skin and subcutaneous tissue) and the analysis of sagging or fat accumulation in the region.

Skinfold Thickness (100%)	Tip Selection (50%)
Above 3.0 mm	1.5 mm Cartridge
Above 4.0 mm	2.0 mm Cartridge
Above 6.0 mm	3.0 mm Cartridge
Above 9.0 mm	4.5 mm Cartridge
Above 12.0 mm	6.0 mm Cartridge
Above 14.0 mm	7.0 mm Cartridge
Above 16.0 mm	8.0 mm Cartridge
Above 18.0 mm	9.0 mm Cartridge
Above 26.0 mm	13.0 mm Cartridge
Above 32.0 mm	16.0 mm Cartridge

Description of the Clinical Reasoning Table for Choosing the Micro- or Macrofocused Ultrasound Tip

4. Clinical Applications of the Methodology

The adoption of protocols based exclusively on fixed depths for the application of microfocused ultrasound, such as the 4.5 mm tip to target the SMAS, ignores individual anatomical variability and can compromise both safety and clinical results (1,2). The proposed methodology, based on skinfold thickness measurement with a clinical adipometer and validation by imaging ultrasound, offers a practical and scientifically based alternative for personalized therapy. Determining the classifications of thin face, normal face, or fat face in:

Thin face

Possible technical terms:
• Hypovolumized face
• Facial fat pad atrophy
• Facial volume deficiency
• Facial lipoatrophy (in pathological cases or associated with aging/disease monitoring)

Normal face

Possible technical terms:
• Face with balanced facial volume
• Preserved facial architecture
• Proportional facial volume
• Eutrophic face ("eutrophy" refers to good nutritional status and balanced anatomical structure)

Volumetric face

Possible technical terms:
• Hyperprominent face
• Facial adipose tissue hyperplasia
• Facial hypervolumization
• Face with localized adipose accumulation
• Hypertrophic facial lipodystrophy (when the context is clinical and there is disorganization of the adipose tissue)

The main clinical applications of this approach include:

1. Individualized therapeutic planning

Measurement of facial tissue thickness by adipometry allows you to define the ideal tip for each region, respecting the actual anatomical depth and avoiding exceeding the target plane. This reduces the risk of muscle or bone damage and enhances action in the correct plane (3,4).

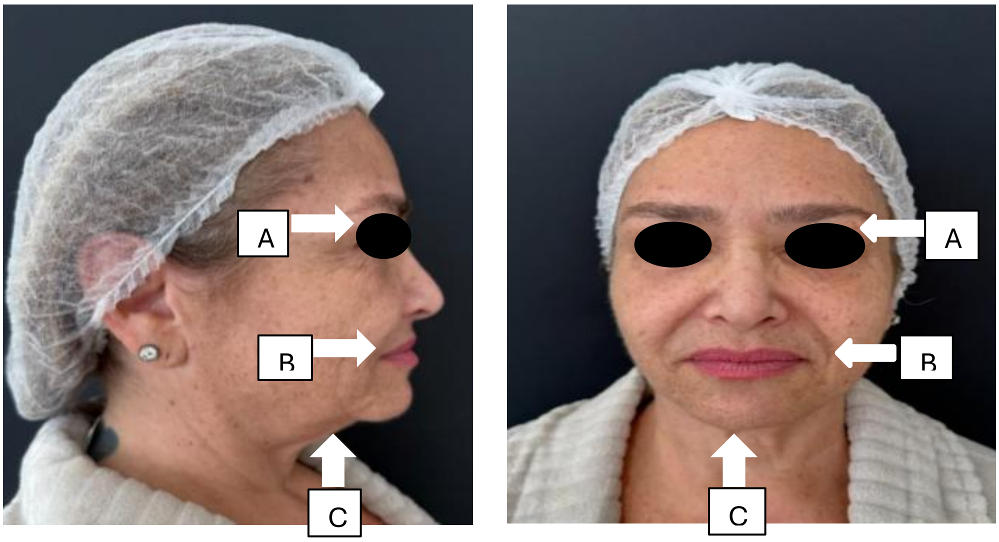

Image 14: Photo documentation of the frontal and lateral region, with the presentation of the 3 strategic areas for measurement with adipometry: A- upper eyebrow; B- Lateral third of the lower face (cheek); C- Submental (double chin).

2. Prevention of adverse effects and false sagging
In thin faces, application of the 4.5 mm tip can reach deep fat or muscle compartments, creating a hollowing effect and apparent sagging, often mistakenly attributed to equipment failure (5). Customization helps prevent this type of problem.
3. Application to specific anatomical areas
This methodology allows each facial region—such as the submental region, jaw, upper eyelid, and malar region—to be treated with the appropriate tip and energy, ensuring greater precision in heat delivery and better contour definition (6).
4. Training and evidence-based technical standardization
The use of a reference chart based on adipometry provides an educational and practical tool for professionals in training or clinical practice, raising technical standards and promoting anatomical safety (7).
5. Applicability to senile, emaciated, or previously treated faces
Patients who have already undergone thread lifts, fillers, or who have lipodystrophy require extra attention. The methodology allows us to assess whether there is sufficient volume to accommodate a given tip, thus avoiding complications (8).

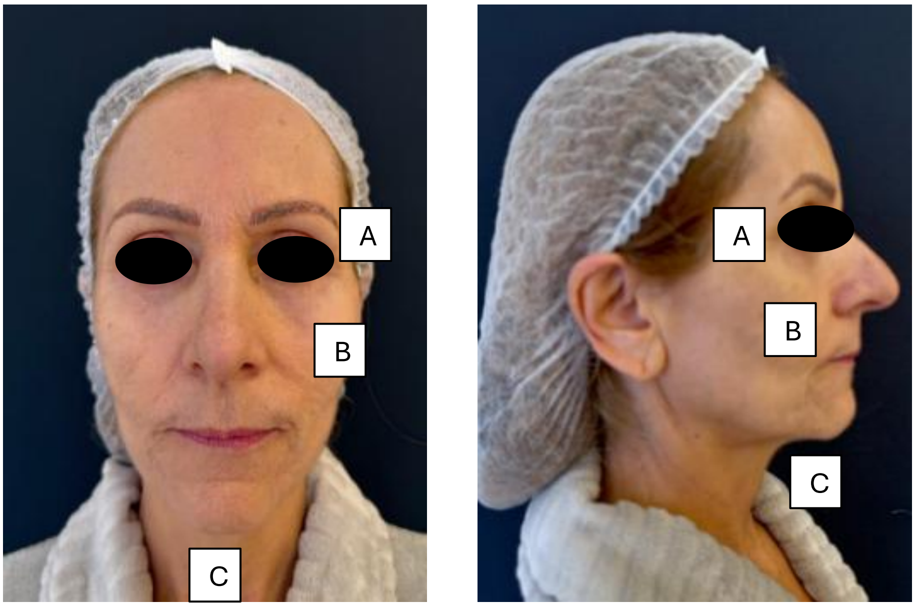

Image 15: Patient C.S.M., 58 years old, with a thin face, presenting adipometry fold: above the eyes 1.9 mm (A); lower side of the face 7.6 mm (B); submental 8.1 mm (C).

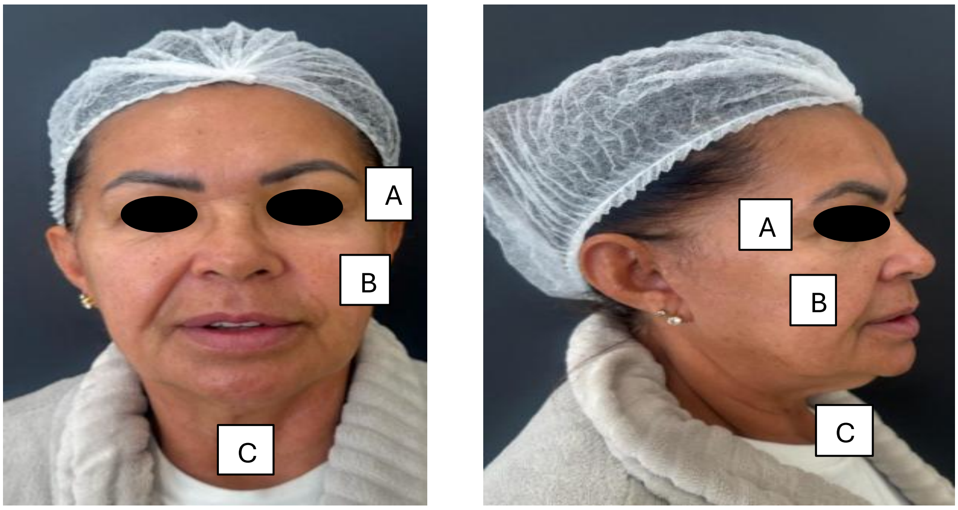

Image 18: Patient M.S., 57 years old, with mid-face showing adipometry fold: above the eyes 2.8 mm (A); lower side of the face 10.4 mm (B); submental 12.2 mm (C).

Image 19: Patient M.S., 23 years old, with mid-face showing adipometry fold: above the eyes 2.8 mm (A); lower side of the face 10.4 mm (B); submental 12.2 mm (C).

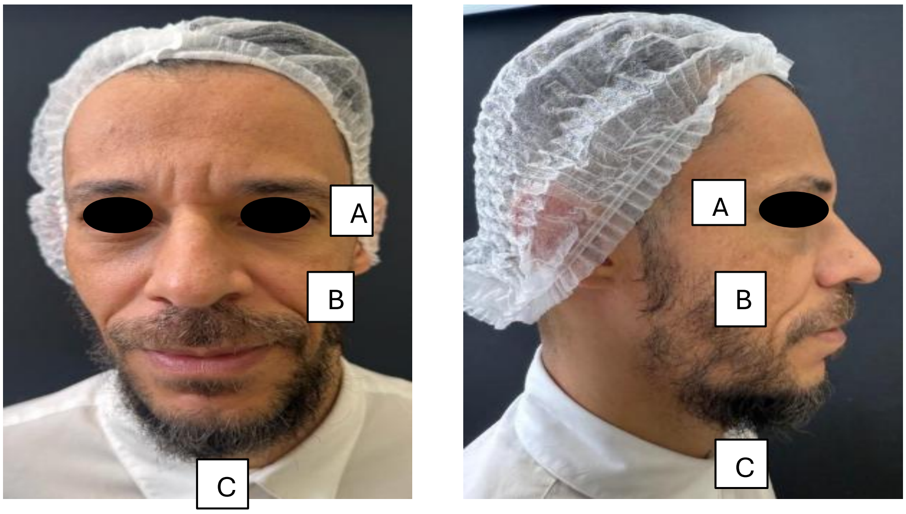

Image 20: 44-year-old patient with medium face showing adipometry fold: superior to the eyes 2.8 mm (A); inferior lateral of the face 10.4 mm (B); submental of 12.2 mm (C).

6. Technically Supported Clinical Documentation
Recording skinfold thickness and providing a technical justification for the choice of probe makes the clinical record more robust and defensible, especially in audit contexts or ethical-professional discussions (9).

7. Integration with Facial Ultrasound Imaging
Validation of structural depth using soft tissue ultrasound reinforces clinical reasoning, confirming the accuracy of the proposed methodology and encouraging the integration of technologies in aesthetic assessment (10,11).

V. Conclusion

The proposed methodology proved to be feasible, safe, and effective
Recommendation for adoption of the chart as a personalized clinical guide

Anatomical Region	Measured Skinfold (mm)	Estimated Depth (50%) (mm)	Recommended Tip (mm)	Technical Notes
Submental (Double Chin)	10 mm	5 mm	4.5 mm	Ideal for SMAS targeting in patients with cervical fat
Submental (Double Chin)	9 mm 6mm	4.5 mm 3mm	3.0 mm	When SMAS is more superficial or in a thin face
Mandibular Line (lower third)	9 mm 12mm	4.5 mm 6mm	4.5 mm	Evaluate lateral face thickness in men or women
Mandibular Line	5 mm 7mm	2.5 to 3.5 mm	3.0 mm	Thin face: adjust energy to avoid volume loss
Upper Eyelid	4 mm 6mm	2 mm 3 mm	1.5 mm	Superficial action with lower energy
Upper Eyelid	< 4	< 2 mm	1.5 mm with adjustment	Use reduced energy density for shots

Through anatomical studies performed on fresh cadavers, we developed a valid and innovative clinical methodology for individualized planning of micro- and macro-focused ultrasound applications on the face. The technique is based on measuring tissue thickness through adipometry with manual clamping, using an adipometer in strategic anatomical regions, such as the submental region (double chin), the lower third of the face, and the upper eyelid. The skinfold thickness is interpreted as 50% of the measurement as a reference for selecting the ideal tip (cartridge), correlating it with the required depth of action.

We validated the methodology through real-time ultrasound examinations, which allowed us to establish a correlation between soft tissue thickness and the anatomical planes of energy action, such as the SMAS, deep dermis, and superficial dermis. Based on a combined analysis of adipometry and ultrasound, we developed a clinical reference table to guide aesthetic healthcare professionals in the safe and personalized selection of tips, promoting greater predictability of results, therapeutic customization, and clinical safety.

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