

Retinacula Cutis of Facial Ligaments as Potential Injection Targets in Facial Rejuvenation

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ABSTRACT: The increasing demand for bioremodelling in aesthetic practice has highlighted the need for standardised anatomical frameworks to ensure reproducible and safe treatment outcomes. This manuscript presents a review of an injection-point framework that specifically targets the retinacula cutis (RC) and retaining ligaments (RL) to enhance soft-tissue support. These anatomical structures form a continuous multifibrillar network that compartmentalises facial fat and distributes mechanical forces across tissues. By stimulating both papillary and reticular fibroblasts, targeted injections may promote the production of collagen and elastin, thereby reinforcing the extracellular matrix (ECM) and improving skin firmness. Ultimately, this framework serves as a reproducible foundation for clinicians to achieve more precise, anatomically sound facial rejuvenation.

Keywords: Retinacula cutis, Retaining ligaments, Extracellular matrix, Biostimulators, Bioremodelling

INTRODUCTION

The increasing demand for bioremodelling reflects the growing emphasis on regenerative approaches in aesthetic practice. Numerous commercial products, including cell-based therapies such as platelet-rich plasma (PRP) and cell therapy; cell-free approaches such as growth factors, exosomes, wound dressings, and gene therapy; and tissue-engineering approaches such as biomaterials, bioengineered skin, hydrogels, and three-dimensional (3D) bioprinting, are designed to support tissue repair, regeneration, or remodelling of the extracellular matrix (ECM) [1].

The rapid expansion of injectable treatments has not been without challenges. Different manufacturers recommend product-specific injection techniques and treatment protocols, resulting in considerable variability in clinical practice. The absence of a unified anatomical framework may complicate education, research, and the reproducibility of treatment outcomes. This review presents a clinical perspective and proposes an injection-point framework targeting the retinacula cutis (RC) and retaining ligaments (RL), with the aim of providing an

anatomically informed approach to supporting facial soft-tissue architecture.

RETINACULA CUTIS AND RETAINING LIGAMENTS

Retinacula cutis (RC) constitute a complex fibrous septal network composed of branching connective tissue extensions that originate from fixed points of the periosteum or deep fascia, traverse the superficial musculoaponeurotic system (SMAS), and terminate within the dermis. Retaining ligaments (RL) are dense condensations of fibrous connective tissue that cross through multiple facial tissue planes, anchoring the periosteum or deep fascia directly to the dermis. Collectively, these structures confer structural support to the overlying skin and SMAS, contributing to the maintenance of facial contour and soft-tissue position, while also delineating the face into discrete superficial and deep fat compartments [2].

The facial RL system and RC are consistent anatomical structures identified on intra-tissue endoscopy. They are interpreted as part of a continuous body-wide multifibrillar network of interconnected fibres

that distributes and absorbs mechanical forces across specialized tissues [3]. In a skin ultrasound study, Schelke et al. demonstrated the presence of retacula superficialis and retacula profundus as fibrous tissue separating the superficial and deep fat pad compartments respectively [4]. Similarly, Dowlatshahi et al. described thin bands of irregular dense connective tissue extending between the dermis and underlying fascia, dividing the subcutaneous tissue into small adipose-filled compartments [5]. Facial RC and RL compartmentalise facial fat, maintain tissue structure and contribute to soft tissue support.

The relationship between facial sagging, skin biomechanical properties, and RC architecture using magnetic resonance imaging (MRI) has been investigated [6]. Their findings demonstrated that increased RC density was associated with lower facial sagging scores and improved skin elasticity. As RC density increased, the degree of tissue sagging decreased, suggesting that the RC may play an important role in maintaining facial support and skin quality [6].

Anatomical Structures of the Retinacula Cutis

Dowlatshahi et al. classified the RC into functional categories, including anchors, boundaries, animators, and an accordion (elastic-band) framework. Within this framework, the RL constitute the root structures from which the RC arises, forming the fibrous network through which these functions are clinically expressed. In the present review, emphasis is placed on animators, boundaries, and anchors, as these functions are particularly relevant to the role of facial RL in transmitting forces associated with facial expression, defining aesthetic subunits, and stabilising soft tissues [5].

Animator retinacula cutis

Animator RC are fibrous septal structures that connect the mimetic muscles to the overlying skin, allowing muscular contraction to be transmitted to the dermis and producing facial expression. Facial RL, which are well recognised by aesthetic and reconstructive surgeons, contribute significantly to facial contour by providing structural support, compartmentalising soft tissues, and maintaining the relationship between the skin and underlying facial skeleton.

a. Temporal ligamentous adhesion (TLA)

The TLA is located along the palpable temporal line, extending from the lateral brow toward the superior temporal region, and may also be identified approximately 2 cm diagonally from the lateral orbital rim. In a cadaveric study by Moss et al., the ligament measured approximately 20 mm in height and 15 mm at its base [7]. Histologically, it consists of dense fibrous reticular connective tissue that firmly anchors the temporal soft tissues to the underlying deep temporal

fascia and periosteum [7]. As one of the principal RLs of the upper face, the TLA provides important structural support to the lateral brow and temporal region.

Interestingly, ultrasonographic studies evaluating the ligaments that comprise the “line of ligaments” including the TLA, have demonstrated that these structures undergo minimal time-related dimensional changes. In contrast to adjacent fat compartments and bony structures, their retentive architecture appears to remain relatively stable with age, even as surrounding soft tissues progressively lose volume and support [8]. Beyond its anatomic role, the TLA also serves as an important clinical landmark. Together with the lateral orbital thickening (LOT), zygomatic ligament, and mandibular ligament, it forms a predictable vertical alignment known as the “line of ligaments” which is commonly used to delineate safe injection planes and guide lateral facial volumisation procedures [9,10].

Given its stability and key role within the facial RL framework, the TLA has emerged as a potential target for biostimulatory therapies aimed at enhancing ECM remodelling, improving tissue integrity, and reinforcing facial support structures. Consistent with this concept, supraperiosteal and subcutaneous calcium hydroxylapatite (CaHA), injections along the course of the ligament have been described as part of full-face biostimulatory lifting protocols [9,10].

b. Lateral orbital thickening (LOT)

The LOT is a specialised condensation of the orbicularis RL measuring approximately 7×10 mm and located immediately superolateral to the insertion of the lateral canthal tendon. It inserts into and stabilises the deep surface of the orbicularis oculi muscle fascia. Clinically, its surface landmark corresponds to the lateral orbital rim at the level of the lateral canthus. Together with the orbicularis RL and zygomatic ligament, the LOT contributes to maintaining the contour and structural integrity of the lateral periorbital region. Histologically, it consists of dense fibroconnective tissue rich in RC, providing strong dermal support and facilitating force transmission between deeper structures and the overlying skin [7]. Given its dense concentration of connective tissue elements, the LOT represents an important stabilising structure within the lateral periorbital region.

With ageing, attenuation of the LOT and the adjacent orbicularis RL reduces ligamentous support, allowing inferior displacement of the lower eyelid boundary and contributing to characteristic periorbital changes, including lower eyelid laxity and festoon formation [11]. These age-related changes have also established the LOT as a relevant anatomic landmark in canthopexy and lower-eyelid suspension procedures [11]. The structural role of the LOT in maintaining lateral periorbital support has generated interest in its potential as a target for biostimulatory therapies. By promoting ECM remodelling, neocollagenesis, and tissue

reinforcement, such approaches may help restore structural support and improve age-related changes in the lateral periorbital region.

c. Tear trough ligament (TTL)

The TTL is located along the medial infraorbital rim and extends laterally across the orbital rim as the orbicularis RL. Histological evaluation has confirmed its ligamentous nature, demonstrating well-organised, densely packed collagen bundles with features comparable to those of the zygomatic ligament [12]. Functionally, the TTL serves as a fixed osteocutaneous tether through its attachment to the underlying maxilla.

As facial ageing progresses, the surrounding soft tissues undergo characteristic changes, including atrophy of the deep medial cheek fat, descent of the malar fat pad, and maxillary bone resorption. Because the ligament remains relatively fixed while adjacent structures lose support and volume, a visible depression develops along its course, contributing to the tear trough deformity [13]. Recognition of the ligament's role in the pathogenesis of this deformity has important therapeutic implications. In surgical rejuvenation procedures, release of the tear trough–orbicularis RL complex is considered a key step for effective mobilisation and restoration of the midcheek [12]. Alternatively, the resulting volume deficiency may be addressed through minimally invasive soft-tissue augmentation using dermal fillers or autologous fat transfer, whereas more advanced cases may benefit from surgical ligament release combined with volume restoration as part of periorbital rejuvenation [14].

Boundaries retinacula cutis

Boundaries RC are fibrous septal structures that separate adjacent fascial planes and contribute to the formation of visible contour lines.

a. Buccal-maxillary ligament (BML)

The BML is located lateral to the upper nasolabial fold at the level of the pyriform aperture, where it serves as a fixed boundary between the mobile cheek tissues and the pyriform aperture. Histologically, it has been described as a fibrous septal condensation that separates the superficial medial cheek fat compartment from the nasolabial fat compartment. Although detailed histological characterisation remains limited compared with other facial RLs, it is consistently identified as a dense fibrous structure that delineates these adjacent fat compartments [15].

Functionally, the maxillary ligament acts as an important anatomical restraint that limits the mobility of surrounding soft tissues and maintains compartmental boundaries. As ageing occurs, progressive loss of soft-tissue supports and elasticity leads to descent of the malar fat pad and adjacent superficial cheek fat

compartments, while tissues anchored by the maxillary ligament remain relatively stable, creating differential tissue mobility between the cheek and paranasal regions. This differential pattern of movement creates a transition zone in which descending malar tissues drape over the more firmly supported paranasal region, contributing to the formation, accentuation, and progressive deepening of the nasolabial fold [16].

The biomechanical significance of this ligamentous boundary has important therapeutic implications. For example, barbed thread-lifting techniques utilise the maxillary and zygomatic ligaments as anchoring structures to reposition descended tissues toward the paranasal region and reduce the prominence of the nasolabial fold. Consequently, the maxillary ligament is increasingly recognised as a functional support structure and potential target for volumising and thread-based approaches to nasolabial fold correction [17].

b. Zygomatic ligament

The zygomatic ligament originates from the periosteum along the inferior border of the zygomatic arch and extends superficially to insert into the overlying dermis. It is distributed along the Frankfort horizontal plane, spanning from the lateral orbital region toward the infraorbital rim. Histologically, Duan et al. demonstrated that the ligament consists of a continuous fibroelastic tissue network extending from the periosteum to the skin of the anteromedial midface, supporting its classification as a true osteocutaneous RL [18].

Functionally, the zygomatic ligament plays a critical role in stabilising the midfacial soft tissues and maintaining cheek projection and contour. It helps preserve the structural relationship between the malar fat pads and the zygomatic framework by anchoring the overlying soft tissue envelope to the underlying skeleton. As ageing progresses, attenuation of adjacent soft tissues and progressive loss of support may alter the biomechanical balance maintained by the ligament, contributing to the descent of midfacial structures. These changes are associated with the development of characteristic ageing features, including malar mound formation, festoons, lower eyelid bags, and diminished cheek definition. Consequently, the zygomatic ligament represents a key anatomical structure in the evaluation of midfacial ageing and age-related contour changes.

The central role of the zygomatic ligament in facial support has also led to increasing interest in its therapeutic applications. In particular, placement of collagen biostimulators in proximity to the ligament has been proposed as a means of enhancing structural support and soft-tissue suspension. By reinforcing the ligamentous framework and promoting ECM remodelling, such treatments may attempt to help reposition the malar fat pads against age-related descent, thereby improving midface projection and reducing the appearance of jowling, nasolabial folds, and marionette lines [19].

c. Mandibular septum

The mandibular septum is located along the middle portion of the mandibular border, extending from the jowl region toward the mandibular angle and blending anteriorly with the mandibular ligament. Originally described as a posterior extension of the mandibular ligament arising approximately 1 cm superior to the mandibular border, subsequent cadaveric and histological investigations have provided an alternative interpretation, identifying a platysma-mandibular ligament that functions as a hammock-like structure limiting further descent of jowl fat into the neck. These differing observations highlight the ongoing debate regarding the precise anatomical and histological boundaries of this region [20].

Despite these variations in description, the mandibular septum is generally recognised as an important boundary structure that compartmentalises the lower facial soft tissues and contributes to the maintenance of jawline contour. It is also considered a key fixation point of the platysma to the mandible, playing a significant role in the structural relationships involved in jowl formation [20]. Age-related changes affecting the mandibular septum and surrounding support structures may alter the stability of the lower face. Attenuation, laxity, or dehiscence of this ligamentous framework can facilitate descent of adjacent soft tissues, contributing to the development of jowls in combination with volume loss, SMAS laxity, and mandibular bone resorption. As a result, the mandibular septum has become an important anatomical landmark in lower facial rejuvenation and jawline recontouring procedures [20]. However, more recent cadaveric studies have suggested that jowl formation may be driven predominantly by descent of the cheek fat compartments rather than by true laxity of the adjacent mandibular osteocutaneous ligament. This distinction has important implications for surgical planning and selection of appropriate corrective strategies [21].

Reflecting these anatomical considerations, therapeutic approaches are often tailored to the underlying mechanism of deformity. When ligament release is indicated, dissection is typically confined to the subcutaneous plane to address skin tethering while preserving deeper structural support. Alternatively, or in conjunction with surgical intervention, volumisation of the deflated prejowl sulcus has been proposed as an effective approach for restoring jawline continuity and improving jowl contour [21].

Anchor retinacula cutis

Anchor RC are dense attachments between the dermis and deep fascia or periosteum that act as semi-rigid anchoring points and support soft-tissue contours.

a. Auriculoplatysmal ligament

The auriculoplatysmal ligament (also referred to as the platysma-auricular ligament) arises from the SMAS at the posterior border of the platysma and is located inferior to the earlobe near the angle of the mandible. It functions as an anchoring structure, securing the platysma-SMAS complex to the dermis and fascial tissues of the inferior parotid and auricular regions. Cadaveric dissection and histological studies have demonstrated that the auriculoplatysmal ligament is anatomically distinct from the adjacent Lore's fascia, with both structures consistently identified as dense fibrous connective tissue suitable for fixation during platysmal suspension procedures [22].

Functionally, the auriculoplatysmal ligament serves as an important boundary ligament between the face and neck, contributing to stabilisation of the lateral jawline and upper cervical region through the transmission and distribution of mechanical forces, thereby helping to maintain the continuity and contour of the cervicomandibular junction. With ageing, progressive laxity of the surrounding soft tissues may diminish the effectiveness of this ligamentous support, contributing to blunting of the jawline and loss of cervical contour. Consequently, the auriculoplatysmal ligament has become increasingly relevant in the evaluation of age-related changes affecting the lower face and neck [23].

Given its strategic location and biomechanical function, this ligamentous region has also attracted interest as a potential therapeutic target. Interventions aimed at reinforcing the auriculoplatysmal ligament complex may help restore structural support, improve jawline definition, and enhance neck contour as part of comprehensive facial rejuvenation strategies [23].

b. Masseteric ligament

The masseteric ligament is a fibrous condensation arising from the parotidomasseteric fascia along the anterior border of the masseter muscle and extending superficially to connect with the SMAS and the overlying connective tissue network. Recent anatomical investigations have suggested that the upper and lower masseteric ligaments are more accurately classified as fascio-SMAS ligaments, as they primarily connect the parotidomasseteric fascia to the SMAS rather than inserting directly into the dermis. Dissection-based studies have demonstrated that these ligaments originate from the parotidomasseteric fascia and interweave within the thickness of the SMAS, distinguishing them from true osteocutaneous RL such as the zygomatic ligament [24].

Functionally, the masseteric ligament contributes to stabilisation of the lateral cheek and helps

define the transition between the mobile anterior cheek and the relatively fixed parotid-masseteric region. Through its integration with the SMAS and adjacent retinacular connective tissue network, it plays an important role in maintaining lateral facial contour and soft-tissue support. Unlike osteocutaneous RL, age-related changes affecting this region appear to be driven primarily by the combination of SMAS attenuation, progressive soft-tissue descent, and underlying skeletal remodelling rather than by intrinsic failure of the ligament itself. These changes may alter the balance between mobile and fixed facial compartments, contributing to the contour changes characteristic of facial ageing.

Accordingly, the masseteric ligament region is an important consideration in the assessment of age-related changes affecting the lateral face. Its anatomical relationship with the SMAS and surrounding connective tissue framework has also generated interest in potential therapeutic applications. In particular, biostimulatory injectables placed within this region may help strengthen the retinacular connective tissue network and support the SMAS, thereby contributing to improved structural support and restoration of lateral facial contour [24].

c. Mandibular ligament

The mandibular ligament is a true osteocutaneous RL that originates from the anterior border of the mandible and extends directly into the overlying dermis. It is typically located approximately 5 cm lateral to the facial midline and 1 cm superior to the inferior mandibular border. Cadaveric dissection and histological studies have characterised the mandibular osteocutaneous ligament as a thick fibrous structure arising from the mandible, with mean dimensions of approximately 51.1 ± 4.5 mm lateral to the midline and 9.1 ± 3.1 mm superior to the inferior mandibular border. Histological evaluation confirmed a direct ligamentous connection between the periosteum and the overlying dermis, supporting its classification as a true RL [19].

Functionally, the mandibular ligament provides critical structural support to the lower lip, chin, and prejowl region by anchoring the skin and superficial soft tissues to the underlying mandible. Through this attachment, it helps limit inferior displacement of the overlying tissues and contributes to preservation of jawline definition and lower facial contour. As facial ageing progresses, the interplay of soft-tissue descent, volume loss, and mandibular bone resorption alters the biomechanical environment of the lower face. In this setting, attenuation or laxity of the mandibular ligament may further reduce soft-tissue support, contributing to the development of jowls and progressive loss of jawline definition. These changes underscore the ligament's importance in maintaining lower facial architecture and contour.

Given its central role in lower facial support, the mandibular ligament serves as an important anatomical

landmark in lower facial rejuvenation and jawline contouring procedures [19]. Its strategic position within the RL framework has also led to its recognition as a potential therapeutic target in interventions designed to restore structural support, improve jawline definition, and address age-related changes of the lower face.

d. Mental ligament

The mental ligament is a true osteocutaneous RL located approximately 1 cm lateral to the midline and 1 cm superior to the inferior border of the mandible, extending from the mandibular periosteum to the overlying dermis. Histological evaluation of cadaveric specimens has confirmed its ligamentous nature, demonstrating a dense fibrous connection between the periosteum and the skin. Anatomically, the mental ligament is situated approximately 9.1 ± 2.8 mm lateral to the midline and 8.4 ± 3.8 mm superior to the inferior mandibular border, distinguishing it from the more laterally positioned mandibular osteocutaneous ligament [19].

Functionally, the mental ligament contributes to stabilisation of the chin, lower lip, and prejowl region by anchoring the skin and subcutaneous tissues to the underlying mandible. As part of the lower facial RL framework, it helps maintain the structural relationship between the soft tissues and the facial skeleton, thereby supporting lower facial contour and definition. With advancing age, progressive soft-tissue remodelling, volume loss, and skeletal changes may alter the supportive function of the mental ligament. Attenuation or laxity of this ligamentous attachment can facilitate soft-tissue descent, contributing to deepening of the labiomental crease, loss of chin support, and the development of prejowl fullness. These changes highlight the ligament's role in preserving lower facial architecture and contour.

In conjunction with the mandibular ligament, the mental ligament forms an integral component of the RC support system of the lower face. Consequently, it has become increasingly relevant in the assessment of lower facial ageing and in planning rejuvenation procedures targeting the chin and jawline. Its structural importance also makes it a potential target for regenerative and biostimulatory interventions aimed at restoring tissue support, improving contour, and enhancing lower facial definition [19].

Retinacula Cutis and Retaining Ligaments in Facial Rejuvenation

Certain strategic facial injection points may be used to target the RC and facial RL system, with the potential to improve facial contour, structural support, and the integrity of the ECM. This approach may target both papillary and reticular fibroblasts within the dermis, potentially stimulating collagen and elastin production while promoting tissue remodelling.

Papillary fibroblasts, characterised by the expression of NTN1, PDPN, and CCRL1, play a role in maintaining the rete ridge-like architecture of the dermal-epidermal junction (DEJ). Through the secretion of specialised ECM components, they support epidermal-dermal attachment and contribute to the regeneration of skin appendages during wound healing. On the other hand, the reticular fibroblasts express TGM2, ACTA2, MGP, and peroxisome proliferator-activated receptor gamma (PPAR- γ), which are involved in the production of collagen and elastin fibres that maintain dermal ECM homeostasis. In addition, they facilitate the early phases of wound healing and tissue repair, contributing to tissue remodelling and scar formation [25]. By potentially influencing both papillary and reticular fibroblast populations, treatment targeting the RC may contribute to improved dermal architecture, skin quality and firmness, while potentially providing additional structural support to the facial RL and contributing to facial rejuvenation and contour enhancement.

In facial surgery, specific anatomical structures such as the septa, adhesions, and RLs serve as anchoring points for tissue lifting and support. Similarly, subcutaneous injections of biomaterials may provide local support within the RC network and enhance soft-tissue support, while supraperiosteal injections may provide a deeper structural scaffold that supports these ligamentous attachments and contributes to facial lifting. Furthermore, targeting the RC and RL systems in conjunction with other treatment modalities may provide a more comprehensive approach to facial rejuvenation. While deep supraperiosteal injections address the underlying structural framework, treatment targeting the

RC may provide a superficial "anchor" that may contribute to resisting gravity and maintaining tissue position.

From a treatment-planning perspective, if volumisation is the primary treatment objective, biomaterials may be placed at the periosteal level. If improvement in skin quality is the primary objective, a biostimulatory filler may be considered within the superficial fat layer to target the RC network. By combining these approaches, clinicians may achieve synergistic effects, where deep volumisation and superficial treatment of the RC network work together to optimise both facial contour and skin quality.

Casabona et al. described the concept of the "line of ligaments" which consists of the temporal ligamentous adhesion, lateral orbital thickening, zygomatic ligament, and mandibular ligament. These structures represent key anatomical landmarks in facial rejuvenation. In general, treatment placed lateral to the line of ligaments has been described as being associated with a lifting effect, whereas treatment medial to this line primarily contributes to volumisation [26]. Building on this anatomical concept, we propose a structured injection-point framework that integrates the surface anatomy of the RC and RL system with strategic treatment points to facilitate more systematic and anatomically informed treatment planning. Surface anatomical landmarks corresponding to these structures are summarised in **Table 1**, while the proposed injection points are illustrated in **Figure 1**. Utilisation of these anatomical reference points may assist in standardising injection planning and identifying relevant anatomical structures.

Table 1. Surface anatomy of key facial RL and related structures.

Retinacula cutis	Points	Target ligament	Surface anatomy
Animator	1	Temporal ligamentous adhesion	Palpable temporal line extending from the lateral brow towards the superior temporal region, approximately 2 cm diagonally from the lateral orbital rim
	2	Lateral orbital thickening of the orbicularis retaining ligament	Lateral orbital rim at the lateral canthus
	3	Tear trough ligament	Medial infraorbital rim extending laterally across the orbital rim
Boundaries	4	Buccal maxillary ligament	Upper nasolabial fold and pyriform aperture region
	5	Zygomatic ligament	Straight line extending from the upper margin of the tragus to the infraorbital rim (Frankfort horizontal line)
	6	Mandibular septum	Mandibular border extending from the jawl towards the mandibular angle
Anchor	7	Auriculoplatysmal ligament	Below the inferior border of the earlobe, near the angle of the mandible
	8	Masseteric cutaneous ligament	Anterior border of the masseter muscle
	9	Mandibular ligament	Pre-jowl sulcus and anterior border of the jawl
	10	Mental ligament	Approximately 1 cm lateral to the chin midline and superior to the inferior mandibular border

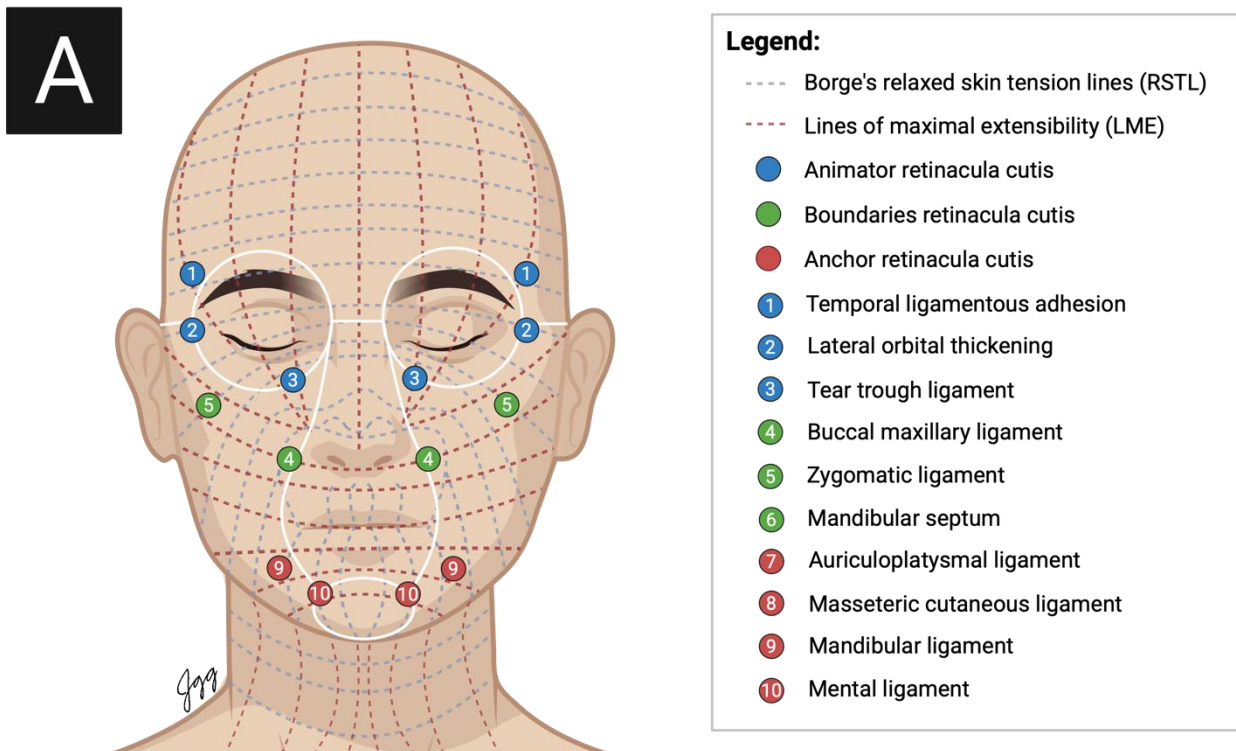
CLINICAL IMPLICATIONS OF THE PROPOSED ANATOMICAL FRAMEWORK

To translate the proposed anatomical framework into clinical practice, the selection of an appropriate biostimulatory agent should take into consideration the anatomical location, tissue plane, and physicochemical properties of the product. The proposed reference points may provide a systematic approach for treatment planning; however, the extent to which a biostimulatory agent can modify or reinforce the RC and RL network is likely to depend on its composition, rheological properties, biodegradability, and biological mechanism of action. Therefore, product selection should be tailored to the anatomical and structural characteristics of the intended treatment site.

Synthetic biodegradable materials include polymers such as poly-L-lactic acid (PLLA), poly-D,L-lactic acid (PDLLA), polydioxanone (PDO), and polycaprolactone (PCL), which undergo gradual degradation and may stimulate ECM remodelling and collagen production. In contrast, non-biodegradable materials, such as polymethyl methacrylate (PMMA), and

other formulations with distinct physicochemical characteristics, as well as ceramic-based agents such as CaHA, zirconia, and alumina, exhibit different degradation profiles and tissue interactions that may influence tissue integration, longevity, adverse event profiles, and the management of complications [27]. These factors are not only critical when navigating high-risk, anatomically delicate zones such as the periorbital/infraorbital, glabellar, and nasolabial regions, where the risks of product migration and vascular complications must be minimised, but are also important considerations when optimising the potential efficacy and safety of the specific injection points for facial rejuvenation proposed in this framework.

As illustrated in **Figure 1** and **Table 1**, each proposed strategic point corresponds to a specific ligamentous attachment or RC system. By selecting agents with rheological profiles that favour appropriate tissue distribution and integration, clinicians may potentially optimise product placement around the relevant ligamentous and RC structures while appropriately considering the safety requirements of high-risk facial regions.



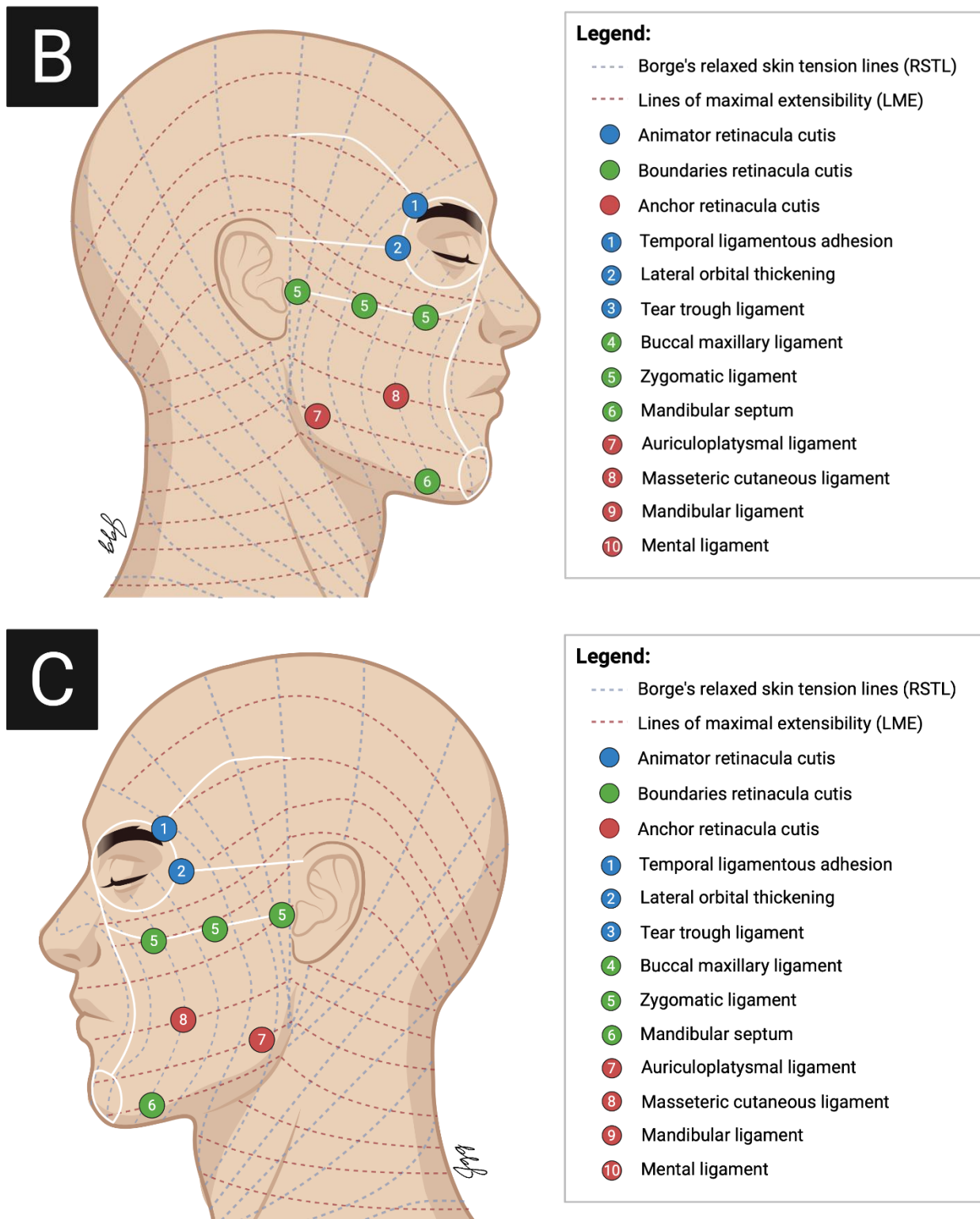


Figure 1. Schematic illustration of facial biomechanical vectors and key RL attachments in the frontal (A), right lateral (B), and left lateral (C) views. Blue dashed lines represent Borge's relaxed skin tension lines (RSTLs), indicating the natural orientation of resting skin tension, while red dashed lines denote the lines of maximal extensibility (LMEs), representing the direction of greatest skin stretch. The panels illustrate the frontal and lateral facial views, highlighting the regional distribution of RSTLs and LMEs across the face and neck. Numbered markers indicate the following structures: (1) temporal ligamentous adhesion, (2) lateral orbital thickening, (3) zygomatic ligament, (4) tear trough ligament, (5) buccal-maxillary ligament, (6) masseteric cutaneous ligament, (7) mandibular ligament, (8) auriculoplatysmal ligament, (9) mandibular septum, and (10) mental ligament. White contours delineate major facial aesthetic subunits and zones influenced by these RL. Understanding the relationship between skin tension lines and RL anatomy may inform surgical incision planning, flap design, scar camouflage, and facial rejuvenation procedures. Created in BioRender. Gatmaitan, J. (2026) <https://BioRender.com/4hl5d8t>

CONCLUSION

In conclusion, this manuscript presents a clinical perspective and proposes a new injection-point framework that targets the RC and RL to potentially enhance soft-tissue support and facial rejuvenation. By shifting the focus towards the anatomical support provided by this retinacula system, we propose a strategic approach to facial rejuvenation that prioritises anatomical anchoring over simple volumisation.

While numerous injectable products utilise these anatomical regions, respect for the underlying structures remains essential to ensure predictable outcomes and patient safety. Standardising techniques in aesthetic and procedural dermatology must be grounded in this practical anatomy. Specifically, clinicians should account for the RC and the RL system whenever performing volumisation or lifting treatments to optimise the “optical lift” and tissue integrity.

Future investigations should focus on quantifying the mechanical effects of interventions targeting these ligamentous structures, for instance, using high-resolution MRI to measure changes in RC density post-injection or 3D surface imaging to evaluate the longevity of the lifting effect. Furthermore, these studies could consider the contribution of age-related skeletal remodelling and bone resorption, as these deep structural changes may alter the tension of the RL and consequently influence the stability of the superficial and deep RC network. Ultimately, this framework may provide an anatomically informed foundation for clinicians to achieve more precise and anatomically sound facial rejuvenation.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest or patents associated with this research.

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REFERENCES

1. Dutra Alves NS, Reigado GR, Santos M, Caldeira IDS, Fernandes HDS, Freitas-Marchi BL, et al. Advances in regenerative medicine-based approaches for skin regeneration and rejuvenation. *Front Bioeng Biotechnol.* 2025;13:1527854. DOI: 10.3389/fbioe.2025.1527854.
2. Nam KI, Shin S, Song J. Anatomical importance of fat compartments in facial aging: a review. *Anat Biol Anthropol.* 2025;38(3):145-52. DOI: 10.11637/aba.2025.38.3.145.
3. Guimberteau JC, Sawaya ET, Armstrong C. New perspectives on the organization of living tissue and the ongoing connective tissue/fascia nomenclature debate, as revealed by intra-tissue endoscopy that provides real-time images during surgical procedures. *Life (Basel).* 2025;15(5):791. DOI: 10.3390/life15050791.
4. Schelke L, Harris S, Cerón Bohórquez JM, Lowrey N, Cartier H, Wortsman X, et al. Analysis of filler spread: facial retinacula play a prominent role. *Dermatol Surg.* 2026;52(5):e8-17. DOI: 10.1097/DSS.0000000000005088.
5. Dowlathshahi S, Francalancia S, Willard FH, Fudem G. Structural and functional anatomy of the retinaculum cutis: review and new insights. *Anat Sci Int.* 2026. DOI: 10.1007/s12565-026-00936-8.
6. Sakata A, Abe K, Mizukoshi K, Gomi T, Okuda I. Relationship between the retinacula cutis and sagging facial skin. *Skin Res Technol.* 2018;24(1):93-8. DOI: 10.1111/srt.12395.
7. Moss CJ, Mendelson BC, Taylor GI. Surgical anatomy of the ligamentous attachments in the temple and periorbital regions. *Plast Reconstr Surg.* 2000;105(4):1475-90.
8. Alghoul M, Codner MA. Retaining ligaments of the face: review of anatomy and clinical applications. *Aesthet Surg J.* 2013;33(6):769-82. DOI: 10.1177/1090820X13495405.
9. Sato M, Muniz M, Ferreira LRC. Treatment of mid-face aging with calcium hydroxylapatite: focus on retaining ligament support. *Clin Cosmet Investig Dermatol.* 2024;17:2545-53. DOI: 10.2147/CCID.S468447.
10. Hernandez C, Viscomi B, Faria G, Vasconcelos R, Schneider C, Moreno J, et al. Multilayer technique using calcium hydroxylapatite biostimulation with different dilutions in the lateral face. *Aesthet Surg J Open Forum.* 2024;6:ojae049. DOI: 10.1093/asjof/ojae049.
11. Muzaffar AR, Mendelson BC, Adams WP Jr. Surgical anatomy of the ligamentous attachments of the lower lid and lateral canthus. *Plast Reconstr Surg.* 2002;110(3):873-84.
12. Wong CH, Mendelson B. Extended transconjunctival lower eyelid blepharoplasty with release of the tear trough ligament and fat redistribution. *Plast*

- Reconstr Surg. 2017;140(2):273-82. DOI: 10.1097/PRS.0000000000003561.
13. Wong CH, Hsieh MKH, Mendelson B. The tear trough ligament: anatomical basis for the tear trough deformity. *Plast Reconstr Surg.* 2012;129(6):1392-402. DOI: 10.1097/PRS.0b013e31824ecd77.
 14. Atiyeh B, Hakim CR, Oneisi A, Ghieh F, Chahine F. Surgical correction of tear trough deformity (TTD) with orbicularis retaining ligament release and volume augmentation for periorbital rejuvenation: review of the literature. *Aesthetic Plast Surg.* 2023;47(1):199-214. DOI: 10.1007/s00266-022-03183-0.
 15. Hong GW, Wan J, Yoon SE, Wong IKJ, Kim SB, Yi KH. Anatomical considerations and technique for nasolabial fold thread lifting. *Plast Reconstr Surg Glob Open.* 2025;13(10):e7150. DOI: 10.1097/GOX.00000000000007150.
 16. Rohrich RJ, Pessa JE. The fat compartments of the face: anatomy and clinical implications for cosmetic surgery. *Plast Reconstr Surg.* 2007;119(7):2219-27. DOI: 10.1097/01.prs.0000265403.66886.54.
 17. Hong GW, Song S, Park SY, Lee SB, Wan J, Hu KS, et al. Why do nasolabial folds appear? Exploring the anatomical perspectives and the role of thread-based interventions. *Diagnostics (Basel).* 2024;14(7):716. DOI: 10.3390/diagnostics14070716.
 18. Duan J, Cong LY, Luo CE, Luo SK. Clarifying the anatomy of the zygomatic cutaneous ligament: its application in midface rejuvenation. *Plast Reconstr Surg.* 2022;149(2):198e-208e. DOI: 10.1097/PRS.00000000000008716.
 19. Durairaj KK, Yambao M, Linnemann-Heath J, Dhiman A. Sculpting the midface and lower face: a novel biostimulatory technique using hyperdilute calcium hydroxylapatite. *Aesthet Surg J Open Forum.* 2025;7:ojaf104. DOI: 10.1093/asjof/ojaf104.
 20. Reece EM, Pessa JE, Rohrich RJ. The mandibular septum: anatomical observations of the jowls in aging-implications for facial rejuvenation. *Plast Reconstr Surg.* 2008;121(4):1414-20. DOI: 10.1097/01.prs.0000302462.61624.26.
 21. Minelli L, Yang HM, van der Lei B, Mendelson B. The surgical anatomy of the jowl and the mandibular ligament reassessed. *Aesthetic Plast Surg.* 2023;47:170-80. DOI: 10.1007/s00266-022-02996-3.
 22. O'Brien JX, Rozen WM, Whitaker IS, Ashton MW. Lore's fascia and the platysma-auricular ligament are distinct structures. *J Plast Reconstr Aesthet Surg.* 2012;65(9):e241-5. DOI: 10.1016/j.bjps.2012.03.007.
 23. Kang MS, Kang HG, Nam YS, Kim IB. Detailed anatomy of the retaining ligaments of the mandible for facial rejuvenation. *J Cranio-Maxillofac Surg.* 2016;44(9):1126-30. DOI: 10.1016/j.jcms.2016.06.018.
 24. Mirontsev A, Andruschenko O, Vasil'ev Y, Verbo E, Kolesova L, Blinova E, et al. Clinical anatomy of the ligaments of the face and their fundamental distinguishing features. *Medicina (Kaunas).* 2024;60(5):681. DOI: 10.3390/medicina60050681.
 25. Tan PC, Zhou SB, Ou MY, He JZ, Zhang PQ, Zhang XJ, et al. Mechanical stretching can modify the papillary dermis pattern and papillary fibroblast characteristics during skin regeneration. *J Invest Dermatol.* 2022;142(9):2384-94.e8. DOI: 10.1016/j.jid.2021.11.043.
 26. Casabona G, Frank K, Koban KC, Freytag DL, Schenck TL, Lachman N, et al. Lifting vs volumizing-the difference in facial minimally invasive procedures when respecting the line of ligaments. *J Cosmet Dermatol.* 2019;18(5):1237-43. DOI: 10.1111/jocd.13089.
 27. Prajapati SK, Jain A, Jain A, Jain S. Biodegradable polymers and constructs: a novel approach in drug delivery. *Eur Polym J.* 2019;120:109191. DOI: 10.1016/j.eurpolymj.2019.08.018.