REVIEW

COMBINED USE OF MANDIBULAR MINI-IMPLANTS AND MASSETERIC BOTULINUM TOXIN FOR LOWER FACIAL ENHANCEMENT: A NARRATIVE REVIEW AND PROPOSED MULTIDISCIPLINARY PROTOCOL

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Abstract: The aesthetics of the lower facial third depend on the interaction between skeletal mandibular support, the vertical dimension established by the dentition or its prosthetic replacement, and the soft-tissue envelope, in which the masseter muscle is the principal determinant of width and contour. Two minimally invasive techniques address complementary components of this region: mandibular mini-implants, which restore skeletal and occlusal support and re-establish lower facial height in resorbed or edentulous jaws1–3, and botulinum toxin type A (BoNT-A) injected into the masseter, which reduces muscle volume and corrects width excess or asymmetry4. Methods. This narrative review synthesizes the current evidence on each modality, examines patient selection, anatomical considerations, surgical and injection protocols, treatment sequencing and complications, and proposes a multidisciplinary protocol for their combined use in lower facial enhancement. Results. Although direct evidence for the combined protocol remains limited and largely extrapolated from functional and therapeutic studies, both interventions are individually supported by favorable long-term outcomes and acceptable safety profiles. Conclusions. A staged, prosthetically and anatomically guided protocol, delivered by a coordinated prosthodontic–surgical–aesthetic team, offers a rational pathway toward predictable facial harmony.

Keywords: mini implants, botulinum toxin type A, masseter muscle, overdentures, lower facial aesthetics.

1. Introduction

The lower third of the face contributes disproportionately to perceived facial balance, framing the chin–jawline contour and the transition between the cheeks and the neck. Its appearance is governed by three superimposed layers: the mandibular skeleton and its alveolar support, the vertical dimension of occlusion maintained by the natural or prosthetic dentition, and the overlying musculature and soft tissue. When teeth are lost, residual ridge resorption begins almost immediately after extraction and is progressive and chronic in the mandible, frequently producing a narrow or knife-edged ridge, loss of occlusal vertical dimension, and a collapsed, prematurely aged lower face [1]. Conventional implant rehabilitation can reverse much of this loss, but the surgical burden, cost, and anatomical limitations of standard-diameter implants exclude many older or medically compromised patients [2,3].

Mini-implants (reduced-diameter implants, generally up to 3.0 mm) have emerged as a minimally invasive alternative that can be placed flaplessly in atrophic ridges, frequently with immediate loading, restoring prosthesis retention, masticatory function, and lower facial support with a low biological cost [1,2]. At the same time, the muscular layer of the lower face is increasingly addressed with BoNT-A, which produces a dose-dependent, reversible reduction in masseter volume and is used both to relieve parafunctional overload and to refine the width and symmetry of the jawline [4]. These two techniques act on different but interdependent strata of the same anatomical region; addressing one in isolation may leave the other as the limiting factor in the final aesthetic result.

This interdependence has consequences that extend beyond aesthetics alone. The clinical burden of lower facial collapse is not merely cosmetic: edentulism in the mandible is frequently accompanied by diminished masticatory efficiency, altered speech, and a measurable decline in oral health-related quality of life, and these functional deficits are compounded, rather than caused independently, by the visible loss of facial support [3]. Patients who receive mini-implant-retained overdentures consistently report substantial and sustained improvement across these domains, suggesting that the perceived benefit of the intervention extends well beyond prosthesis retention alone [3]. This is clinically relevant because the population most affected by mandibular atrophy (older adults, often with reduced bone volume, systemic comorbidities, or limited tolerance for extensive surgery) is precisely the population for whom conventional standard-diameter implant rehabilitation is least accessible [1,3]. Mini-implants therefore occupy a specific therapeutic niche: they are not a substitute for conventional implantology where it is feasible, but a minimally invasive option that extends the benefits of implant-supported rehabilitation to patients who would otherwise be excluded from it.

The evidence supporting mini-implants has matured considerably in parallel with this clinical need. Pooled survival estimates from systematic reviews, and meta-analyses now approach those historically reported for standard-diameter implants, with mandibular survival for immediately loaded devices

 DOI: 10.58179/RJDR3204

reaching approximately 97% at one year and remaining above 90% at seven years in single-arm cohorts [1,2]. Comparative analyses confirm that, while survival is somewhat lower than for standard implants, the difference is modest and clinically acceptable given the reduced surgical morbidity [5-9]. At the same time, biomechanical and clinical research has clarified how implant number, spread, angulation, and macrodesign influence long-term outcomes, allowing treatment to be individualized rather than applied uniformly [7,10-14]. This body of evidence has shifted mini-implants from a compromise solution to a defensible first-line option in appropriately selected patients.

The muscular layer of the lower face has undergone a comparable evolution in clinical use. The aesthetic use of BoNT-A in the masseter has moved from an occasional adjunct to a recognized technique for jawline refinement, paralleling its longer-established therapeutic role in bruxism and myofascial pain [4,6]. Its appeal lies in its reversibility, low procedural burden, and dose-dependent, titratable effect, which allows the clinician to correct volume and asymmetry incrementally rather than committing to an irreversible surgical result. However, the literature on BoNT-A remains heterogeneous: reported doses, injection points, and follow-up intervals vary considerably between operators and indications, and systematic reviews addressing its therapeutic use in temporomandibular and masticatory-muscle conditions describe mixed outcomes, reflecting both the subjectivity of pain-based endpoints and inconsistent protocols [4,6]. This heterogeneity underscores the need for anatomically grounded, depth-controlled injection technique, particularly given the proximity of the masseter to adjacent neurovascular and perioral structures [15].

What is largely absent from the literature, however, is any explicit consideration of how these two interventions interact when applied to the same patient. Restoring occlusal vertical dimension with mini-implants measurably alters masticatory muscle behavior, including masseter activity [11], which implies that the muscle's resting volume and contour—the very target of BoNT-A—cannot be reliably assessed until the skeletal and occlusal reconstruction has stabilized. Conversely, unaddressed masseteric hypertrophy or asymmetry may persist as a visible aesthetic limitation even after optimal prosthetic rehabilitation, undermining the perceived success of a technically adequate implant treatment. Despite this functional interdependence, no existing guidance addresses patient selection, sequencing, or safety considerations for the combined use of these techniques, leaving clinicians to extrapolate from single-modality evidence. This gap motivates the present review, which aims to synthesize the evidence on each modality and to propose an integrated, minimally invasive, multidisciplinary protocol for their combined use in lower facial enhancement.

2. Materials and method

This work was conducted as a narrative review. The literature relevant to the two component interventions and to the anatomy of the region was identified and appraised, covering three thematic domains: (i) prosthetic and surgical rehabilitation of the atrophic or edentulous mandible with mini-implants; (ii) the use of BoNT-A in the

 DOI: 10.58179/RJDR3204

masticatory musculature, including its effect on masseteric hypertrophy and facial symmetry; and (iii) the functional and topographic anatomy of the masseter and the supporting mandibular bone.

The evidence base assembled for synthesis spanned several study types and levels. Systematic reviews and meta-analyses provided pooled estimates of implant survival and of BoNT-A efficacy and safety [1,2,4–6]; randomized and prospective clinical trials and cohort studies informed implant number, retention behavior, and electromyographic outcomes [7–11]; in-vitro and finite-element analyses addressed the biomechanics of implant number, distribution, angulation, and macro design [12–14]; and anatomical and ultrasonographic studies defined safe injection parameters for the masseter [15]. Findings from these sources were extracted and organized thematically and are reported below; their interpretation, integration, sequencing, and translation into a combined protocol are addressed in the Discussion.

3. Results

Anatomical and functional basis

The muscles of mastication—the masseter, temporalis, and the medial and lateral pterygoids—are innervated by the motor division of the trigeminal nerve and together govern both the function and the external contour of the lower face [6]. The masseter is the most superficial of these muscles over the ramus and angle of the mandible, and its volume is the dominant soft-tissue contributor to lower facial width. Ultrasonographic studies place the mean superficial masseter thickness at approximately 10 mm, beneath a skin and subcutaneous layer of similar magnitude, with predictable anatomical landmarks that allow accurate, depth-controlled injection while avoiding deeper neurovascular structures [15].

On the skeletal side, the interforaminal region of the anterior mandible offers dense, predictable bone for mini-implant placement even in advanced atrophy and is the standard site for two- to four-implant overdenture support [3,7]. The biomechanical behavior of these implants is closely tied to their number and three-dimensional distribution: a wider anteroposterior spread of the supporting implants increases bite force and masticatory performance [10], while implant angulation and macrodesign modulate the way occlusal stress is transferred to the surrounding bone [14]. Restoring occlusal support in turn normalizes masticatory muscle activity; electromyographic studies show that fixed implant-supported rehabilitation can re-establish masseter and temporalis activity comparable to that of dentate individuals [11]. The skeletal and muscular components of the lower face are therefore functionally coupled.

Outcomes of mandibular mini-implant rehabilitation

Most mini-implants are one-piece designs with an integral ball/O-ring attachment, placed using a flapless, self-tapping technique under local anaesthesia, frequently with immediate functional loading when adequate primary stability is achieved [1]. Reported survival is high: pooled mandibular survival for immediately functionally loaded mini-implants reaches roughly 97% at one year [1], and a single-arm systematic review reported a seven-year cumulative survival of

 DOI: 10.58179/RJDR3204

approximately 91% with low long-term marginal bone loss [2]. Comparative meta-analysis confirms that mini-implants are a viable alternative to standard-diameter implants for overdenture retention, with somewhat lower but clinically acceptable survival [5].

Implant number and distribution govern function. For the edentulous mandible, four mini-implants provide higher retention and less attachment wear than two, whereas no meaningful difference is observed between two and three [12]; a five-year randomized trial nonetheless found that three and four mini-implants yield comparable success and marginal bone-level outcomes, allowing the number to be tailored to anatomy and cost [7]. Maximizing the anteroposterior spread improves functional loading [10], and attachment retention can be re-established by periodic O-ring replacement, which restores baseline retention force even at ten years [9]. Patient-reported outcomes are consistently favorable, with marked, sustained improvement in oral health-related quality of life [3]. Where posterior support is required in a partially dentate jaw, mini-implants placed in the premolar–canine region can stabilize free-end removable partial dentures with five-year success above 93% [8], and the same family of devices, used as orthodontic temporary anchorage, can upright or reposition drifted posterior teeth to optimize the occlusal framework before definitive loading [13].

Outcomes of masseteric botulinum toxin

Chemodenervation of the masseter produces a reversible, dose-dependent reduction in muscle activity and volume, narrowing the lower face and softening a square or asymmetric jawline. Reported masseteric doses range broadly—from about 10 to 30 units per side for symptom control, with higher cumulative doses used in some bruxism protocols [4]. In therapeutic cohorts, BoNT-A reduced electromyographic masseter activity and pain, and a notable subset of patients with masseter-hypertrophy-related facial asymmetry achieved measurable improvement, with the cosmetic benefit becoming apparent by the fourth month [4]. The injection targets the inferior, most prominent portion of the muscle; because the superficial masseter is only around 10 mm thick beneath a comparable layer of skin and subcutaneous tissue, controlled needle depth—confirmed by ultrasound in difficult or asymmetric cases—keeps the toxin within the target muscle and away from adjacent structures [15].

The evidence base carries caveats. Systematic reviews of BoNT-A for temporomandibular and masticatory-muscle conditions report mixed and sometimes conflicting results, partly because pain is subjective and protocols are heterogeneous, and conclude that the toxin is not yet first-line therapy [6]. For the aesthetic indication specifically, the predictability of volume reduction is better established than its standardization, and dose, injection points, and follow-up intervals still vary between operators [4].

4. Discussions

The findings above describe two interventions acting on coupled layers of the same region. Their combined, deliberate use—rather than the isolated application of

 DOI: 10.58179/RJDR3204

either—is the central proposition of this review. The Discussion considers who should be treated, how the techniques are integrated and sequenced, how complications are managed, a concrete protocol, and the limitations of the current evidence.

Patient selection and indications

Ideal candidates present with two concurrent features: deficient skeletal or occlusal support of the lower face (an edentulous or terminally dentate atrophic mandible, or loss of vertical dimension) together with excess or asymmetric lower facial width attributable to masseteric hypertrophy. The mini-implant component is indicated where bone volume precludes standard implants, where surgical morbidity must be minimized, or where cost and treatment time are decisive—circumstances common in older adults who nonetheless derive substantial quality-of-life benefit from improved prosthesis retention [3,5]. The BoNT-A component is indicated for masseteric hypertrophy, bruxism-associated overload, and the asymmetry that frequently accompanies it [4]. Relative contraindications include neuromuscular disease, pregnancy and lactation, hypersensitivity to the toxin, active peri-implant or oral infection, uncontrolled systemic disease affecting healing or osseointegration, and unrealistic expectations. Because the goal is harmony rather than maximal change, baseline photographic and, where appropriate, ultrasonographic assessment of masseter thickness and symmetry is recommended [15].

Integrated surgical and injection protocol

Planning begins with cone-beam computed tomography to determine ridge width, height, and density and to position implants within the interforaminal region with maximal feasible anteroposterior spread [10]. The chosen implant number is tailored to anatomy and cost within the evidence that four implants maximise retention while three perform comparably to four on success and bone-level outcomes [7,12]. For the muscular component, BoNT-A is delivered at several points per side within the safe quadrant bounded by the anterior border of the muscle, the posterior border of the mandible, and a line from the tragus to the corner of the mouth, with injections kept below this line and at controlled depth to protect the perioral musculature; conservative, symmetry-matched dosing with the option of later top-up is preferred over a single large dose [4,15]. The visible reduction in volume develops over several weeks and peaks roughly the second to fourth month [4].

Treatment sequencing

Because the two interventions act on coupled layers, sequencing matters. A rational order is to establish the skeletal and occlusal foundation first: place and, where appropriate, immediately load the mini-implants, deliver the definitive prosthesis, and allow function and the musculature to adapt. Electromyographic evidence indicates that masseter activity can normalize rapidly—often immediately after fixed prosthetic loading and stably thereafter [11]. Re-establishing occlusal vertical dimension also alters the resting length and volume of the

 DOI: 10.58179/RJDR3204

masseter, so the muscle should be re-evaluated after prosthetic rehabilitation rather than treated on the basis of pre-treatment appearance.

BoNT-A is therefore best administered after the prosthetic result has stabilized, both to allow accurate assessment of residual width excess and asymmetry and to use masseteric relaxation to reduce parafunctional loading on the new reconstruction [4]. In patients where severe pre-existing hypertrophy or bruxism threatens primary stability, an initial conservative dose before or shortly after implant placement may be considered to lower occlusal force during early healing, followed by definitive aesthetic dosing once the prosthesis is in service. Long-term maintenance of both components is required: attachment retention is restored by periodic O-ring replacement [9], while masseteric contour is maintained by repeated, progressively lighter injections [4].

Complications and their management

Mini-implant complications are predominantly mechanical and biological. Most failures occur in the first year, and reduced diameter is associated with a risk of implant fracture and, in some series, greater marginal bone loss than standard implants [2]; technical complications such as wear or loss of the attachment matrix and, less commonly, prosthesis fracture are frequent enough to require a structured maintenance programme [2,9]. Careful control of occlusal load through adequate implant number, wide distribution, and favorable angulation and macro design reduces peri-implant stress [10,14], and peri-implant mucositis and peri-implantitis warrant routine monitoring, particularly in older patients with compromised hygiene [3].

BoNT-A complications are generally mild and transient, including injection-site pain and, with higher doses or imprecise placement, unwanted changes in smile or masticatory sensation; in one bruxism trial using a high cumulative dose, cosmetic changes to the smile occurred in about 15% of patients [4]. These risks are minimized by conservative, symmetry-matched dosing, accurate depth control, and avoidance of the perioral musculature, supported by ultrasonographic guidance in difficult cases [15]. Excessive masseteric weakening could theoretically reduce bite force while a patient is adapting to a new implant-retained prosthesis, a further argument for staging the aesthetic injection after prosthetic stabilization.

Proposed multidisciplinary protocol

A coordinated protocol delivered by a prosthodontist, an oral or maxillofacial surgeon, and a clinician experienced in facial chemodenervation may be summarized in four phases.

1) **Assessment**: facial and dental analysis, cone-beam computed tomography of the mandible, and baseline documentation of masseter thickness and symmetry, photographically and ultrasonographically where indicated [15].
2) **Skeletal/occlusal reconstruction**: placement of an anatomy-appropriate number of mini-implants in the interforaminal region with maximal feasible anteroposterior spread, immediate or early loading where primary stability permits, and delivery of

 DOI: 10.58179/RJDR3204

the definitive prosthesis, with adjunctive orthodontic temporary anchorage if posterior teeth require uprighting [7,10,12,13].

3) **Muscular refinement**: once occlusion and prosthesis have stabilized and masticatory adaptation is confirmed [11], conservative, symmetry-matched BoNT-A injection of the masseter to correct residual width excess or asymmetry [4].
4) **Maintenance**: scheduled prosthetic recall with attachment replacement to preserve retention [9], peri-implant monitoring [3], and progressively lighter BoNT-A top-ups to sustain the aesthetic contour [4].

Limitations

The principal limitation is the absence of studies evaluating the combined protocol directly; the recommendations here are synthesized and extrapolated from functional, prosthetic, and therapeutic literature rather than derived from outcome data for the combined aesthetic indication [4,6]. As a narrative rather than systematic review, this synthesis is also subject to selection bias, and the heterogeneity of BoNT-A dosing and of mini-implant designs across the source studies limits direct comparison. Prospective, outcome-based clinical study of the combined protocol is required before firm recommendations can be made.

5. Conclusions

Mandibular mini-implants and masseteric botulinum toxin address complementary layers of the lower facial third—skeletal/occlusal support and muscular contour, respectively. Each is independently supported by favorable long-term functional outcomes and an acceptable safety profile [1–5,7,9], and the two are functionally coupled through the relationship between restored occlusion and masticatory muscle behavior [11]. Direct, high-level evidence for the combined aesthetic protocol is still lacking [4,6]. A staged, prosthetically and anatomically guided, multidisciplinary protocol nonetheless offers a coherent and minimally invasive pathway toward predictable lower facial harmony, and should be the subject of prospective, outcome-based clinical study.

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Author contributions

Authors read and approved the final manuscript. All authors have equally contributed to this work.

Acknowledgements

Not applicable.

Funding information

Not applicable.

Conflict of interest statement

No potential conflicts of interest concerning this study.

Data availability statement

Will be provided on request.

Ethics statement

Not applicable.

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How to cite:
Cojocaru L, Chioran D, Novac AC, Negruțiu ML, Mostovei A, Amăricăi EC, Sinescu C. *Combined use of mandibular mini-implants and masseteric botulinum toxin for lower facial enhancement: a narrative review and proposed multidisciplinary protocol.* Rom J Dent Res. 2026;3(2):48-57.