JDHAB

Journal of Digital Health and Advanced Biomaterials
Vol. 1, No. 1, 2026
ISSN 3086-5972 (Online)
Open access - peer reviewed

REVIEW ARTICLE

Botulinum toxin type A for gummy smile: anatomical targeting, protocol variability, and reproducible outcome measurement

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Received 18 March 2026
Accepted 24 March 2026
DOI https://doi.org/10.67463/2pcxgv61
Revised 24 March 2026
Published 24 March 2026
Article type Review article

ABSTRACT

Objective: To critically reassess the use of botulinum toxin type A (BoNT/A) for gummy smile, with emphasis on anatomical targeting, protocol variability, and the conditions required for reproducible outcome measurement.

Data sources: Literature addressing etiologic phenotyping of gummy smile, elevator-muscle anatomy, BoNT/A formulation and preparation, targeted clinical application, and digital approaches to image-based outcome capture.

Eligibility criteria: Studies and technical sources were prioritized when they directly informed five linked domains: phenotype selection, anatomical rationale, product handling, delivery variables, and the reliability of endpoint documentation.

Methods of synthesis: Critical narrative review integrating anatomical, clinical, pharmaceutical, and measurement-oriented evidence relevant to the translational interpretation of BoNT/A therapy for gummy smile.

Main findings: The literature supports temporary gingival display reduction in selected muscular cases and offers a credible anatomical rationale for targeting the Yonsei region. However, universality of the point is not supported. Morphometric variation, heterogeneous smile-task architecture, non-equivalent product preparation, and incompletely reported dose-volume-depth relationships remain major interpretive barriers.

Conclusion: BoNT/A remains a defensible minimally invasive option for compatible muscular etiologies, but the field will mature only when anatomical targeting, product handling, dose-volume-depth architecture, smile-task definition, and digitally auditable outcome measurement are integrated within one reproducible protocol.

KEYWORDS
botulinum toxin type A; gummy smile; Yonsei point; digital workflow; facial imaging; outcome measurement.

How to cite: Silva D. Botulinum toxin type A for gummy smile: anatomical targeting, protocol variability, and reproducible outcome measurement. J Digit Health Adv Biomater. 2026;1(1):5-13. doi:10.67463/2pcxgv61.

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Introduction

Among minimally invasive options for gummy smile, botulinum toxin type A (BoNT/A) is attractive because it is reversible, rapid, and often effective in appropriately selected muscular phenotypes. Yet the apparent simplicity of the injection obscures the complexity of the therapeutic system: etiologic selection, landmark choice, formulation, dilution, injected volume, depth, symmetry, and image capture all influence the clinical results.[5-13,20,23]

That complexity is especially consequential in the perioral region. The therapeutic window is narrow, esthetic penalties are immediate, and small technical differences can be mistaken for biologic inconsistency. The result is a literature in which the treatment often seems more reproducible than the endpoint used to judge it.[10-13,23,27]

This review therefore addresses a more stringent question: not simply whether BoNT/A may reduce gingival exposure in selected muscular cases, but which variables determine whether the Yonsei point functions as a reproducible clinical target or remains an anatomical approximation with limited transferability.[14-19,22,26,27]

Review objective

This review critically reassesses BoNT/A for gummy smile from a translational standpoint. Rather than treating the Yonsei point as an isolated technical maneuver, it examines the interaction among phenotype, anatomy, pharmaceutical handling, and endpoint capture, asking where the current literature is genuinely robust and where it remains methodologically fragile.[10-13,20,23,27]

Review method and interpretive strategy

This manuscript was prepared as a critical narrative review rather than a systematic review or quantitative synthesis. The literature was selected for direct relevance to five linked domains: etiological phenotyping of gummy smile, upper-lip elevator anatomy, BoNT/A formulation and preparation, clinical performance of targeted injection strategies, and the reliability of imaging-based outcome capture.

Evidence was not weighted only by reported clinical effects. Additional interpretive value was assigned to studies that clarified how image acquisition, calibration, metadata structure, or computational post-processing affected endpoint trustworthiness.[10-13,23,27]

Thematic synthesis of the literature

Gummy smile is a clinical presentation, not a unitary diagnosis. Excessive gingival display may reflect vertical maxillary excess, dentoalveolar disproportion, altered passive eruption, lip hypermobility, or hyperactivity of the upper-lip elevator muscles. This distinction is not taxonomic only. It determines whether BoNT/A is mechanistically relevant and therefore whether clinical response can be interpreted as treatment success rather than diagnostic mismatch.[5-7,10-13] Polo's studies were important not only because they documented reduction in gingival display, but because they made patient selection central to the interpretation of response. Later prospective studies, controlled designs, and pooled analyses support short-term benefit in selected muscular cases, but they do not erase heterogeneity in indication, technique, or outcome capture.[5-13]

Anatomical basis of the Yonsei point

The Yonsei point was a major attempt to subject perioral injection to anatomical reasoning. In the foundational study, Hwang and colleagues mapped the levator labii superioris alaeque nasi, levator labii superioris, and zygomaticus minor, and proposed a single surface target corresponding to their zone of functional convergence. Its procedural simplicity, however, should not be mistaken for universality.[14-17]

Recent controlled evidence and expert consensus preserve the lateral alar targeting logic, but also show that injection plane, per-point volume, and measurement workflow must be treated as protocol-defining variables rather than as technical afterthoughts.[19,26,27]

FIGURE 1

Figure 1. Clinical-anatomical topography of the Yonsei point. The distances are shown as didactic references derived from the classical anatomical description, not as fixed universal coordinates.
Source: Author's clinical archive (consent obtained; de-identified, digitally modified).

Molecular and pharmacological basis of BoNT/A

Any clinical account of BoNT/A must begin with its modular protein architecture. Heavy-chain and light-chain domains mediate neuronal binding, internalization, translocation, and catalytic activity; after entry into cholinergic terminals, the light chain cleaves SNAP-25, blocks acetylcholine release, and produces temporary chemodenervation.[1,2]

This mechanistic basis matters because the toxin never reaches practice as an abstract molecule. It is used as a formulated, lyophilized, reconstituted, and injected product. Preparation conditions and physicochemical context may therefore contribute to variable clinical expression and should not be treated as negligible background variables.[3,4,20,21]

Clinical evidence and critical interpretation

The clinical literature supports, with moderate consistency, that BoNT/A can temporarily reduce gingival exposure in patients with a predominantly muscular component. What remains unresolved is not whether an effect can occur, but why effect size, symmetry, durability, and esthetic naturalness vary so widely across reports and patients.[6-13]

The translational problem is therefore not the absence of an anatomical hypothesis, but the persistent mismatch between anatomical plausibility and measurement rigor. Read together, contemporary studies support the Yonsei point as a useful anatomical shorthand, not as a definitive or universally transferable coordinate.[14-19,22]

Outcome measurement, digital validity, and translational priority

The relevant shift is from informal landmark-based documentation to digitally auditable clinical targeting.

If one bottleneck runs through this literature, it is outcome measurement. Systematic reviews and meta-analyses repeatedly identify non-equivalent photographic intervals, inconsistent smile tasks, and sparse reporting of calibration or repeatability.[10-13,23,27]

Contemporary workflows can link standardized capture, structured metadata, session-based point mapping, landmark

Key studies

Table 1. Key studies informing the anatomical rationale, clinical performance, measurement validity, and workflow traceability relevant to Yonsei-point use in gummy-smile management.

STUDY	DESIGN	MAIN CONTRIBUTION	CRITICAL RELEVANCE TO THE PRESENT MANUSCRIPT
Hwang et al., 2009	Anatomical study	Mapped LLSAN, LLS, and ZMi and proposed the Yonsei point as an area of functional convergence.	Foundational anatomical rationale supports the logic of precision, but does not authorize automatic universalization of the point.
Polo, 2008	Prospective study	Documented neuromuscular correction of gummy smile with marked short-term reduction in gingival exposure.	Key evidence for transient efficacy, but not sufficient to resolve anatomical or methodological comparability across techniques.
Mazzuco and Hexsel, 2010	Prospective study	Linked gingival exposure pattern to the muscular territory involved.	Important for shifting discussion from an isolated point to functional phenotyping of the smile pattern.
Al Wayli, 2019	Clinical study	Applied a single Yonsei-point strategy with favorable outcomes in selected muscular phenotypes.	Useful for clinical dissemination, but interpretation remains dependent on etiologic selection and photographic standardization.
Booysen et al., 2023	Population morphometric study	Tested standardization of the point in a White South African population and demonstrated topographic variability.	One of the strongest warnings against dogmatic use of the Yonsei point as a universal landmark.
Gong et al., 2024	Randomized controlled trial	Compared Yonsei-point injection with classical LLSAN targeting in a longitudinal design.	Signals movement toward more controlled anatomical comparison, but persistent variability in technique and measurement remains unresolved.
Ayaz et al., 2020	Measurement-reliability study	Compared 2D photography with 3D soft-tissue imaging and showed that protocolized 2D capture can be reliable, while 3D surface imaging generally provides lower error.	Supports the argument that endpoint technology is not neutral and that facial metrology should be treated as a core translational variable.
Gonçalves et al., 2026	Workflow/reporting study	Described a session-based web module for standardized clinical imaging and automated unit totalization in orofacial harmonization.	Illustrates how traceable digital documentation can bridge anatomical targeting and reproducible reporting in real-world injectable practice.
Myung et al., 2021	Narrative review	Synthesized study selection, smile induction, measurement site, and media heterogeneity across the gummy-smile BoNT literature.	Useful bridge between classical clinical reports and the present emphasis on standardized capture, scripted smile tasks, and reproducible measurement.
Rho et al., 2025	Expert consensus guideline	Recommended small bilateral dosing near the lateral alar region and discussed patient selection, philtrum length, injection depth, and severity-based adaptation.	Provides contemporary protocol nuance and reinforces that point location, plane, and risk architecture must be specified rather than assumed.

Abbreviations: LLSAN, levator labii superioris alaeque nasi; LLS, levator labii superioris; ZMi, zygomaticus minor.

FIGURE 2

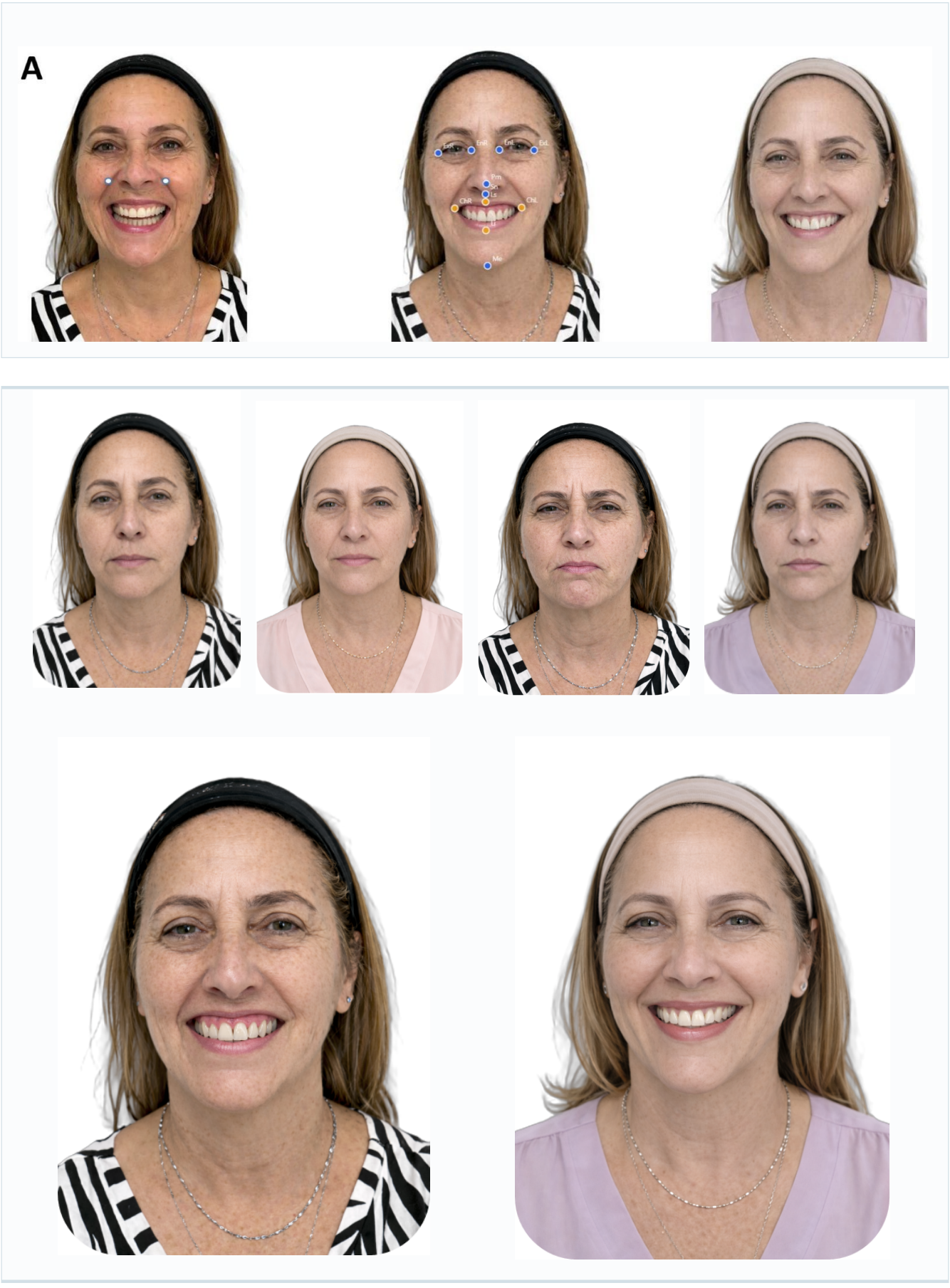

Figure 2. Illustrative auditable digital workflow for gummy-smile documentation. Panel A shows de-identified session capture, and Panel B shows landmark [23,24]

Source: Author's clinical archive (consent obtained; de-identified, digitally modified).

Minimum reporting checklist

Table 2. Proposed minimum reporting checklist for BoNT/A studies addressing gummy smile.

DOMAIN	MINIMUM ITEMS TO REPORT	WHY IT MATTERS
Phenotype and indication	Predominant etiology; inclusion criteria for muscular cases; whether vertical maxillary excess, altered passive eruption, or dentoalveolar factors were excluded or co-managed.	BoNT/A is mechanistically relevant only for compatible phenotypes; mixed etiologies distort apparent efficacy.
Anatomical targeting rationale	Point(s) selected; muscles intended to be modulated; side-to-side symmetry logic; whether the Yonsei point was used as fixed reference, adapted landmark, or comparator.	Named landmarks are not analytically interchangeable unless their anatomical logic is explicit.
Product and reconstitution	BoNT/A formulation; nominal vial size; reconstitution volume; resulting concentration; time from reconstitution to injection; relevant lot or traceability data when appropriate.	Preparation conditions affect delivered product behavior and are essential for cross-study comparability.
Injection map and dose logic	Units per side; volume per point; depth; needle or cannula details if relevant; number of points; whether low-dose-plus-retouch or fixed-dose strategy was used.	Dose alone does not describe delivery; volume, depth, and point architecture condition effect and diffusion behavior.
Capture protocol	Camera or focal-length equivalent; working distance; lighting and exposure conditions; background; head orientation; smile task; timepoints captured; file naming or session organization.	A weakly controlled facial endpoint can mimic or mask treatment effect.
Measurement protocol	Calibration method; software; landmarks or linear measurements used; whether analysis was 2D or 3D; operational definition of gingival display or lip-elevation endpoint.	Outcome definition determines whether the reported change is measurable, reproducible, and clinically interpretable.
Repeatability and quality control	Operator training; inter- or intra-operator agreement; intraclass correlation coefficient (ICC), technical error of measurement (TEM), or Bland-Altman analysis where applicable; post-registration error or QC rules for 3D pipelines; handling of unusable captures.	Measurement reproducibility validates the workflow itself and limits overinterpretation of visually persuasive but unstable endpoints.
Follow-up and safety	Exact follow-up intervals; retreatment policy; adverse events; asymmetry handling; whether photographs at later timepoints used the same capture rules.	Durability, symmetry, and safety cannot be interpreted when time-linked documentation is inconsistent.
Smile-task architecture	Exact expression state(s) requested; induction method; whether repeated capture or video-assisted frame selection was used for maximum smile; analytic frame-selection rule.	Non-equivalent smile tasks can create apparent treatment differences that are behavioral rather than pharmacologic.
Injection plane and needle geometry	Tissue plane (deep subcutaneous, superficial subdermal/intradermal, or intramuscular if justified); needle gauge/length; per-point volume and concentration.	Nominal units do not fully describe delivery architecture or diffusion risk in the perioral region.

Abbreviations: BoNT/A, botulinum toxin type A; ICC, intraclass correlation coefficient; TEM, technical error of measurement.

Minimum reporting checklist

This checklist is intended to support a relatively small field without unnecessary complexity. Its purpose is to condense into a single reporting framework the variables that determine interpretability: phenotype, targeting logic, product handling, capture conditions, calibration, repeatability, follow-up, and safety.

Repeatability should be documented with intra- and/or inter-operator agreement metrics, such as the intraclass correlation coefficient (ICC) for repeated continuous measurements, with technical error of measurement (TEM) or Bland-Altman analysis used where appropriate.

Knowledge gaps and practical research agenda

The key unresolved question is no longer whether BoNT/A may work in gummy smile, but why it works unevenly across patients and study designs. Future work should prioritize anatomically explicit cohort selection, full reporting of product preparation and delivery variables, and prospectively defined endpoints with documented repeatability.

A practical agenda is clear: standardized frontal and profile capture; explicit smile-task instructions; internal metric calibration when justified; validated 3D surface imaging where available; session-based injection mapping; and prospective comparisons between surface-landmark targeting and digitally enhanced localization strategies.[23,24]

Conclusion

Clinical relevance and indication.
BoNT/A is a defensible minimally invasive option for gummy smile when confined to compatible muscular etiologies and interpreted through a disciplined, anatomically informed protocol.

Evidence limits and protocol discipline.
Current evidence supports anatomical plausibility and short-term clinical usefulness in selected cases, but it does not justify anatomical universalization or tacit equivalence among protocols that differ in phenotyping, product handling, delivery, and endpoint capture.

Future perspective.
The field will advance most convincingly not by multiplying named target points, but by improving the precision of what is documented before, during, and after injection. The strongest next step is a framework that links phenotype classification, anatomically explicit targeting, full reporting of preparation and delivery variables, calibrated digital capture, structured metadata, and repeatable measurement within one auditable workflow.

Required statements

Ethics approval: Not applicable.

Consent to participate: Not applicable.

Consent for publication: Written informed consent was obtained from the participant for the publication of clinical images, diagnostic information, and workflow-related visual material in de-identified scientific form.

Competing interests: The author declares no competing interests.

Data availability: No new datasets were generated or analyzed for this review article.

Funding: This review received no external funding.

Code availability: Not applicable.

AI uses disclosure: A generative AI tool was used for language support, grammatical refinement, editorial organization, and creation of illustrative schematic figures intended solely for scientific communication. All technical interpretation, workflow development, engineering decisions, data analysis, and factual responsibility remain solely with the author.

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