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The role of permanent makeup in visual correction of facial asymmetry

Taksanova Aida *

Permanent makeup master, beauty studio "First Lady", Barnaul, Russia.

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Abstract

Permanent makeup (PMU) is examined as a non-surgical instrument for perceptual rebalancing of mild facial asymmetry in brows and lips. The review synthesizes technical primitives of micropigmentation—hair-stroke microblading, line work, soft shading—with anthropometric targets derived from orbital–eyebrow morphometrics and perceptual thresholds for asymmetry detection. Safety boundaries are delineated using case evidence on infectious, granulomatous, pigment-interaction, and allergic events. The objective is to formalize a staged planning algorithm that couples mapping (eyebrow apex/ tail, vermilion border continuity) with conservative "sub-threshold" dosing and documented contingencies for color-correction or removal. Methods include comparative analysis and narrative synthesis across dermatology, craniofacial imaging, and psychoperception studies. Source material spans technique reviews, 3D-CT prediction of brow position, psychophysical detection of asymmetry, and complication reports for lips and eyebrows. The conclusion specifies indications and limits for PMU-based equalization and provides an operational pathway suited to clinical practice and training.

Keywords: Permanent Makeup; Microblading; Facial Asymmetry; Eyebrow Mapping; Vermilion Border; Micropigmentation; Perception Thresholds; 3D-CT Morphometrics; Pigment Interactions; Allergic Reactions.

1. Introduction

PMU redefines feature boundaries (shape cues) and modulates contrast (optical salience), enabling controlled left–right adjustments of brow head/apex/tail and labial outline without surgery when planning adheres to anthropometry and depth control. Empirical morphometric work on 3D-CT provides predictors for eyebrow position and curvature from orbital parameters, which constrain realistic targets and help avoid over- or under-correction during mapping. Perceptual research indicates uneven observer sensitivity to small deviations across facial zones and frequent divergence between lay self-ratings and professional assessments, favoring staged, sub-threshold corrections that prioritize first-glance cues (brow apex height, tail length, vermilion continuity). Complication literature establishes guardrails for periocular infection, granulomatous reactions including sarcoidosis at microbladed sites, paradoxical lip-tattoo darkening after Q-switched procedures, and refractory allergic responses to red pigments—each with management implications for asymmetry work.

Aim – to construct an evidence-based, perception-calibrated algorithm for PMU-assisted visual equalization of mild facial asymmetry in eyebrows and lips. Tasks:

- Systematize PMU techniques and mapping targets for brow and lip correction using orbital–eyebrow predictors and vermilion border logic.
- Integrate psychoperceptual thresholds and patient–clinician rating discrepancies to define conservative dosing and staging.

* Corresponding author: Taksanova Aida

- Delineate a safety envelope and contingency pathways (color-correction, selective removal) grounded in complication reports.

Novelty. The article unifies orbital-driven geometric targets, microblading stroke geometry, and perception-based tolerances into a single operational pathway with explicit risk controls and documented decision nodes for brow and lip asymmetry.

2. Material and methods

2.1. Materials (sources and their analytical contributions)

C.C. Akoh documented preseptal cellulitis after eyebrow microblading, framing infectious risk during periocular work [1]. M.I. Al-Jasser described paradoxical darkening of lip tattoos following Q-switched Nd:YAG hair removal, informing device-interaction counseling [2]. E. Basal quantified how vertical growth pattern conditions detection of lower-face asymmetry, supporting small first-pass corrections [3]. A.N. Botezatu analyzed self-perception of dento-facial asymmetry, highlighting patient–clinician rating gaps relevant to target setting [4]. A.S. Kerure synthesized indications, technique, and depth control in medical micropigmentation, grounding PMU primitives and asepsis [5]. Y.S. Kim established 3D-CT predictors linking orbital metrics to eyebrow shape/position for pre-pigmentation planning [6]. M.K. Marwah detailed microblading physics and semi-permanent durability, guiding stroke orientation and density selection [7]. W. Pióro presented a severe complication during PMU removal and a protocol, delimiting reversal strategies [8]. A. Spurr reported cutaneous sarcoidosis at microbladed eyebrows, shaping granulomatous surveillance [9]. S.A.S. van der Bent treated a refractory red-pigment lip allergy with methotrexate plus Q-switched laser, defining escalation options [10].

2.2. Methods

A narrative, comparative synthesis was conducted across the ten sources with targeted extraction of: (i) geometric targets for mapping, (ii) perceptual thresholds and self-report patterns, and (iii) adverse-event typologies with management pathways. Analytical procedures comprised structured source analysis, cross-domain triangulation (dermatology, imaging, perception), and construction of a stepwise algorithm for practice.

3. Results and discussion

Evidence from dermatology and oculoplastic literature indicates that permanent makeup (PMU)—including microblading for eyebrows, vermilion-border micropigmentation for lips, and peri-oculoplastic tattooing—can visually rebalance mild facial asymmetries through boundary redefinition (shape cues) and contrast modulation (optical salience). Technique families grounded in micropigmentation (manual hair-stroke simulation, line work, and soft shading) supply the geometric primitives that permit left–right adjustments without surgery, provided that planning honors anthropometry and perceptual thresholds for detectability of asymmetry [5-7].

Eyebrow asymmetry—mapping, target positions, and stroke logic. Microblading reproduces individual hair-strokes within the papillary dermis and lends itself to sub-millimetric manipulation of the brow head, apex, and tail. The reference framework relies on midline, medial canthus, lateral canthus, and alar references; within this scaffold, the

practitioner can lengthen or foreshorten segments on the shorter side, rotate the apex, or tune head height to reduce left–right deviation (see Figure 1) [7].

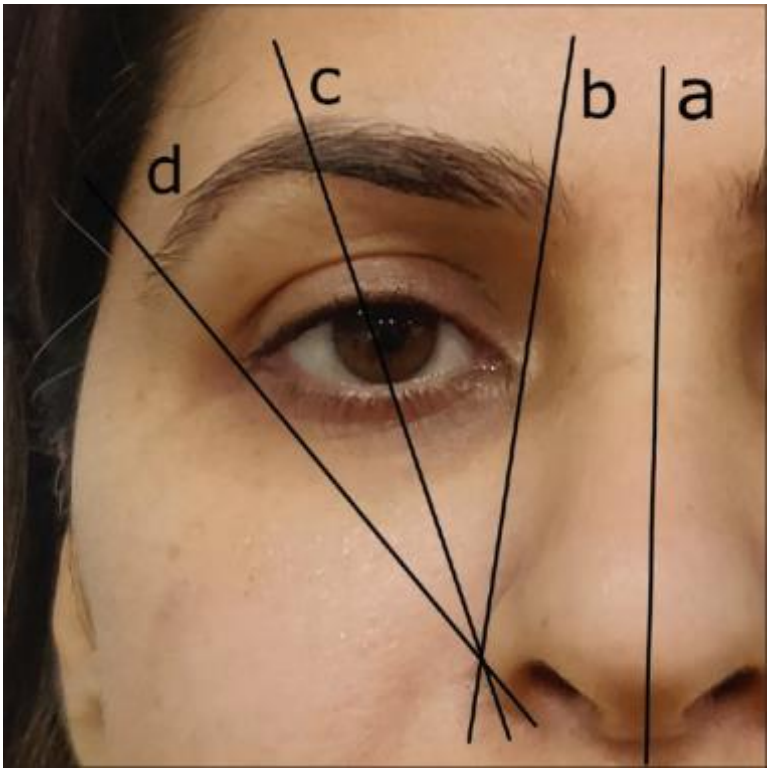

Figure 1 Eyebrow mapping lines used in PMU planning. The glabellar midline (a), medial line (b), apex line (c), and lateral extent (d) guide stroke orientation, apex migration, and tail length when equalizing brows [7]

Anthropometric and imaging studies complement this planning: 3D-CT work demonstrates predictable relationships between orbital morphology and brow position, supporting estimation of desirable apex location and curvature before pigment placement. Age- and sex-dependent shape shifts (e.g., relative behavior of medial vs. lateral segments across the lifespan) further delimit realistic targets and help avoid over-correction that would read as unnatural [6].

Perception-driven tolerances and asymmetry reduction. Observers do not penalize very small left–right deviations uniformly across features; detection varies with region, pattern of growth, and viewing conditions. Recent psychophysical and dental-facial studies show that tolerance bands differ across the lower face vs. periocular region and that self-assessment often diverges from external ratings. For PMU planning this implies favoring micro-adjustments that fall below typical noticeability while prioritizing features that dominate first-glance parsing (brow apex height, tail length, vermilion outline continuity) [3, 4]. Such a strategy reduces the perceived asymmetry without provoking "re-mapping" of the face by the observer.

Lips—border continuity and chroma/contrast balancing. For labial asymmetry, micropigmentation can contour the vermilion border to equalize curvature and commissure projection when skeletal or occlusal constraints are minimal. At the same time, pigment chemistry and interactions with energy-based devices require caution: exogenous chromophores in red pigments, iron oxides, and carbon blacks can darken or shift hue after third-party procedures (e.g., laser hair removal), altering symmetry cues by unintended contrast changes [2]. Allergic reactions to red cosmetic lip pigments have been documented, sometimes requiring systemic agents and device-assisted removal; these events highlight the need for patch testing and pigment selection protocols when planning border corrections [10].

Safety envelope for asymmetry-oriented PMU. Complication data relevant to eyebrow work include infectious events (preseptal cellulitis) following periocular cosmetic procedures and granulomatous reactions after microblading; such risks escalate if asepsis, depth control, or pigment quality are substandard [1, 9]. When removal or color-correction is necessary (e.g., to reverse an over-elongated tail on one side), case literature shows that outcomes vary with pigment composition and device parameters and that removal itself may induce scarring or dyschromia that worsen asymmetry if not staged conservatively [8]. A staged plan—photographic standardization, mapping, conservative first pass, delayed

reassessment after healing, and only then incremental additions or limited laser-assisted color tuning—aligns best with these safety data.

3.1. Operational synthesis—algorithm for visual correction.

Standardized frontal and three-quarter photographs with neutral brow position; annotate apex height, tail plumb line, head-to-midline distances, and vermilion border continuity. Screen for pigment allergies and prior energy-based treatments [5, 10].

Apply a reference grid (Figure 1) and define the short segments on the hypoplastic side; set a conservative apex migration target consistent with orbital constraints from imaging-based prediction norms [6, 7].

Use microblading hair-strokes to lift or lengthen the tail on the lower/shorter side; reserve soft-shade (powder) fills to normalize density when hair-stroke geometry alone cannot equalize visual mass [7]. For lips, employ fine line work to restore continuous border and restrained blush to harmonize chroma across sides [2, 10].

Limit first-session adjustments to sub-threshold changes suggested by perception studies, then reassess after complete healing; this prioritizes “invisible” corrections that reduce left–right discrepancy without noticeable artifice [3, 4].

If a prior PMU error amplifies asymmetry, consider selective fading/correction; removal case series emphasize pigment-dependent response, need for eye protection in periocular work, and the risk of paradoxical darkening with certain wavelengths [2, 8].

Collectively, current evidence supports PMU as a controlled, reversible-to-manageable tool for the visual correction of mild asymmetries in brows and lips, provided that mapping adheres to anthropometry, adjustments remain within perceptual tolerances, and risk controls for pigment biology and periocular safety are enforced.

Permanent makeup (PMU) functions as a perceptual equalizer for eyebrows and lips through two converging mechanisms: (i) boundary re-definition that adjusts the geometry observers use to parse feature shape and position, and (ii) contrast modulation that recalibrates visual salience across the left–right halves of the face [5], [7]. Evidence from dermatology and craniofacial imaging favors conservative, sub-threshold corrections that stay within commonly tolerated ranges of asymmetry while anchoring eyebrow planning to orbital morphology and lip work to continuous vermilion contours [3, 4, 6]. These principles align with the mapping logic previously summarized in Figure 1 and with the microblading depth/stroke model that produces hair-like cues in the papillary dermis [7].

Eyebrow correction—geometric targets constrained by orbital cues. Three-dimensional CT analysis demonstrates predictable relationships between orbital morphometry and the superior eyebrow margin; practitioners can exploit these relationships to set apex height and curvature before pigment placement, limiting over- or under-correction that would reintroduce disharmony [6]. When combined with microblading’s capacity for sub-millimetric stroke placement and tail/head lengthening, the framework enables targeted adjustments that remain visually natural at conversational distance [7]. Perceptual studies indicate that tolerance to asymmetry varies by region and growth pattern in the lower face; translating this to the periocular zone favors incremental, staged changes with post-healing reassessment rather than single, large shifts [3].

Lips—border continuity, chroma stability, and interaction with energy devices. For vermilion asymmetry, line-level contouring can re-establish border continuity and commisure symmetry provided skeletal/occlusal constraints are minimal [5]. Device interactions impose an added planning layer: case evidence documents paradoxical darkening of red lip tattoos following Q-switched Nd:YAG laser hair removal with later spontaneous improvement; counseling and deferral of such procedures around freshly pigmented areas reduce risk [2]. Refractory allergic reactions to red lip pigments have responded to a combined regimen of methotrexate with selective Q-switched 532 nm laser, but such rescue strategies require escalation pathways and informed consent that explicitly covers pigment chemistry and immune responses [10].

Safety envelope—what can worsen asymmetry if mismanaged. Infectious complications—including preseptal cellulitis—have been reported after eyebrow microblading; even when vision-threatening sequelae are avoided, edema, scarring, or color shifts may amplify left–right discrepancies if urgent care is delayed [1]. Granulomatous reactions such as cutaneous sarcoidosis at microbladed eyebrows illustrate a delayed hazard window extending more than a year after the procedure, underscoring the need for long-term follow-up and careful differential diagnosis of late papules/plaques in pigmented areas [9]. When prior PMU requires reversal to fix an asymmetric tail/height, removal itself introduces

risks; a recent case report of a severe complication during PMU removal and the accompanying management protocol highlights pigment-dependent responses and the potential for scarring or dyschromia if parameters and staging are suboptimal [8].

Patient-reported perception and prioritization of corrections. Cross-sectional evidence shows that individuals' self-perception of dento-facial asymmetry frequently diverges from professional assessments and that dissatisfaction clusters around highly salient features; structured pre-procedure dialogues and standardized photography help align targets with what patients actually notice first [4]. Growth-pattern–linked differences in detection further argue for staged, small-dose corrections and a preference for rebalancing dominant cues (brow apex height, tail length, vermilion continuity) over wholesale reshaping [3].

In routine practice, visual equalization proceeds as a reversible-to-manageable sequence: photographic standardization; mapping against orbital predictors; a conservative first pass using hair-stroke or powder techniques depending on the deficit; deferred reassessment after full healing; contingency plans for color correction or selective fading/removal if a prior error amplifies asymmetry [5-8]. Data extracted from peer-reviewed case reports and case-based protocols (see Table 1).

Table 1 Clinical safety signals relevant to asymmetry-oriented PMU [1, 2, 8-10]

Complication	**Site/Indication**	**Latency/Trigger**	**Management reported**	**Relevance to symmetry work**
Preseptal cellulitis after microblading	Periocular (eyebrows)	Post-procedure; acute presentation described in case report	Managed in dermatology setting with documented clinical improvement	Edema/pain can distort brow position during healing; requires deferral of further correction
Cutaneous sarcoidosis after microblading	Eyebrows	~1.5 years after microblading (histologically confirmed)	Dermatologic evaluation with biopsy; systemic evaluation recommended	Late granulomatous plaques may alter brow contour and color; treat before any corrective PMU
Lip tattoo darkening after laser hair removal	Lips (vermilion)	After Q-switched Nd:YAG LHR on hair-bearing skin	Spontaneous improvement reported on follow-up	Temporary chroma shift can exacerbate left–right contrast differences; avoid energy procedures near fresh PMU
Severe complication during PMU removal	Eyebrows	During attempted removal of prior cosmetic tattoo	Case-based protocol proposed; risk of scarring/dyschromia highlighted	Removal to fix asymmetric design carries independent risk; stage and parameterize conservatively
Refractory allergic reaction to red lip pigment	Lips	Persistent allergic reaction to red azo pigments	Methotrexate plus targeted Q-switched 532 nm laser led to improvement	Allergy-driven edema/erosions disrupt border symmetry; establish rescue pathway pre-procedure

Summaries reflect peer-reviewed studies and reviews that inform day-to-day planning (see Table 2).

Table 2 Design parameters and perception-driven constraints for PMU-based correction [2-7, 10]

Evidence domain	Practical takeaway for planning
Microblading physics and depth control	Hair-like strokes placed into the papillary dermis supply naturalistic geometry; durability is semi-permanent (≈12–18 months) and favors staged adjustments
Micropigmentation indications and technique	Medical tattooing supports camouflage and cosmetic PMU; procedural planning must account for pigment behavior and asepsis
Orbital–eyebrow morphometrics on 3D CT	Orbital parameters predict eyebrow position/shape; use as upper bounds for apex migration and tail rotation to avoid overcorrection
Detection of lower-face asymmetry by growth pattern	Detection thresholds differ by vertical growth pattern; adopt smaller first-pass corrections and prioritize high-salience cues
Self-perception vs external rating of asymmetry	Patients' self-ratings often diverge from experts; standardized photo review aligns targets with lived perception
Energy-device interactions with pigments	Q-switched treatments near cosmetic tattoos risk darkening or immune flares; schedule/coordinate devices with PMU timeline

The aggregated signal from technique reviews, perception studies, and case literature points to PMU as a controlled instrument for rebalancing mild brow and lip asymmetries when four constraints are enforced:

i) orbital-guided eyebrow targets and vermilion continuity goals grounded in patient-specific photographs;
ii) conservative first-pass dosing reinforced by evidence on human detection thresholds;
iii) pre-emptive counseling on pigment/device interactions and allergy risks with documented rescue plans;
iv) staged contingencies for removal or color-tuning that respect pigment composition and scarring risk.

4. Conclusion

Synthesis across technique reviews, imaging, and perception studies indicates that PMU reduces perceived mild asymmetry when geometric targets honor orbital predictors and lip border continuity, with sub-threshold first-pass dosing and staged reassessment after healing. Safety boundaries derive from documented risks: periocular infection, granulomatous reactions including sarcoidosis, paradoxical darkening after Q-switched procedures, and red-pigment allergies; counseling, asepsis, pigment selection, and defined escalation/rescue options limit complication-driven asymmetry. A pragmatic pathway emerges: standardized photography; mapping against orbital predictors; conservative hair-stroke/soft-shade deployment for brows and restrained border-focused work for lips; deferred evaluation; and, where prior errors amplify asymmetry, parameterized color-tuning or selective removal guided by pigment composition and complication protocols. The assembled evidence supports PMU as a controllable instrument for perceptual equalization under a documented algorithm, with indications confined to mild deviations and patient-specific perceptual priorities.

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