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Research Article

Facial Masculinization Surgery: A Narrative Review on Principles and Advanced Surgical Techniques

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Abstract

Background: As the demand for facial gender confirmation surgery grows, there is an increasing need for established guidelines defining both aesthetic ideals and surgical techniques. While facial feminization procedures are well-documented and standardized, information on facial masculinization remains sparse. This article offers a comprehensive review of the current literature on male facial aesthetic standards and the surgical methods used to achieve them.

Findings: Systematic searches were conducted using PubMed, Cochrane Central, EMBASE, and Web of Science, with additional resources drawn from relevant books.

Conclusions and Relevance: A distinctive feature of this study is its inclusion of absolute aesthetic values alongside the relative differences between female and male facial structures. While this review provides a framework for planning and performing facial masculinization procedures, it also highlights the need for further research to support existing practices, as current data is limited and high-quality scientific studies in this domain remain scarce.

Keywords: Face; Facial Masculinization; Gender Dysphoria; Masculinity; Maxillofacial Surgery; Sex Reassignment Surgery; Transgender Persons

Introduction

The DSM-5 estimates the prevalence of gender dysphoria at approximately 5 to 14 per 100,000 natal adult males and 2 to 3 per 100,000 natal adult females [1]. However, this likely underestimates true prevalence, as not all individuals with gender dysphoria seek hormonal treatment or gender confirmation surgery through specialized clinics. The primary aim is to be recognized as one's identified gender. While facial feminization surgery is well-documented, facial masculinization is less described, partially due to the concealing effect of beard growth on the jawline, induced by hormonal therapy, which can reduce the demand for surgical intervention [2,3]. Although there is an increasing interest in facial masculinization, current literature lacks an objective framework outlining the distinct anatomical differences between male and female faces [4,5]. Descriptions of male and female facial distinctions in the medical literature generally include broader jaws and more prominent chins in males; however, specific measurements to achieve these differences are rarely provided. Since the spatial relationships between facial features are crucial to perceived facial proportions and overall appearance, we propose a reference guide that integrates objective measurements of male facial structures with the surgical techniques required to achieve these aesthetic goals.

Materials and Methods

An extensive review of the literature was performed until May 2025. The following bibliographic databases were searched: PubMed, Cochrane Central and EMBASE. The search string used was: ((virilism) OR (masculinity) OR (female-to-male) OR (masculinization)) AND ((maxillofacial surgery) OR (facial surgery) OR (gender confirmation facial surgery) OR (surgical technique) OR (surgery)). Inclusion criteria focused on masculine facial features and masculinization procedures of the face, in both transgender men and cisgender men. Exclusion criteria included

masculinization resulting from endocrinologic disorders. All types of studies were considered. The included articles were reviewed, with the information organized according to masculine features and surgical masculinization techniques for the upper, middle and lower third of the face, as well as the neck.

Results

Anthropometric differences between male and female: definition of the male face

Head in general

Leslie G. Farkas conducted groundbreaking studies on the anthropometric differences of head structures, identifying several significant distinctions between boys and girls of 6 to 18 years old [6]. In subsequent research, he extended his measurements to young Caucasian adults from 19 to 25 years old [7], with these later measurements serving as reference values in this article. Bannister et al. found similar measurements when analyzing 3D face scans of 1573 people identifying as male or female [8]. These results were not correlated by age. Figure 1 illustrates the key measurement points, defined in Table 1. Tables 2 and 3 present the measurements with significant gender-based differences described below as published by Farkas for male and female subjects.

In males, dimensions such as skull size, forehead width, bizygomatic distance, and bigonial distance are generally larger, with greater height observed in the upper, middle, and lower facial thirds compared to females [7]. Masculine facial characteristics include a broader, square-shaped jaw; wider forehead, nose, and mouth; presence of facial hair; and a prominent supraorbital ridge [9]. The male face typically exhibits a slightly higher width-to-height ratio than the female face, although the ratios between bitemporal, bizygomatic and bigonial distances will often approach 1:1:1 [10]. Additionally, it is notable that a broader male face is often perceived as less attractive than a more angular, narrower male face [11].

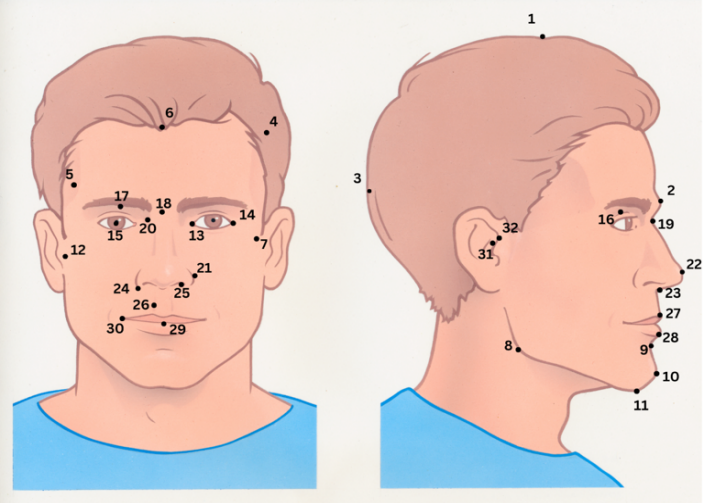

Figure 1: Landmarks: 1. vertex, 2. glabella, 3. opisthocranion, 4. eurion, 5. frontotemporale, 6. trichion, 7. zygion, 8. gonion, 9. sublabiale, 10. pogonion, 11. menton, 12. condylion laterale, 13. endocanthion, 14. exocanthion, 15. pupil, 16. palpebrale superius, 17. orbitale superius, 18. nasion, 19. sellion, 20. maxillofrontale, 21. alare, 22. pronasale, 23. subnasale, 24. subalare, 25. alar curvature point, 26. crista philtri, 27. labiale superius, 28. labiale inferius, 29. stomion, 30. cheilion, 31. porion, 32. tragion

Term	Abbreviation	Definition
vertex	v	highest point of the head when the head is oriented in the FH
glabella	g	most prominent midline point between the eyebrows and is identical to the bony glabella on the frontal bone
opisthocranion	op	point situated in the occipital region of the head and is most distant from the glabella; that is, it is the most posterior point of the line of greatest head length
eurion	eu	most prominent lateral point on each side of the skull in the area of the parietal and temporal bones
frontotemporale	ft	point on each side of the forehead, laterally from the elevation of the Linea temporalis
trichion	tr	point on the hairline in the midline of the forehead
zygion	zy	most lateral point of each zygomatic arch and is identified by trial measurement, identical to bony zygion of the malar bones
gonion	go	most lateral point on the mandibular angle close to the bony region

sublabiale	sl	determines the lower border of the lower lip or the upper border of the chin
pogonion	pg	most anterior midpoint of the chin, located on the skin surface in front of the identical bony landmark from the mandible
menton (or gnathion)	gn	the lowest median landmark on the lower border of the mandible, is identical to bony gnathion
condylion laterale	cdl	the most lateral point on the surface of the condyle of the mandible
endocanthion	en	point at the inner commissure of the eye fissure
exocanthion	ex	point at the outer commisure of the eye fissure
center point of the pupil	p	determined when the head is in the rest position and the eye is looking straight forward
palpebrale superius	ps	highest point in the midportion of the free margin of each upper eyelid
orbitale superius	os	highest point on the lower border of the eyebrow, close to the highest bony point of the upper margin of each orbit
nasion	n	point in the midline of both the nasal root and the nasofrontal suture
sellion (subnasion)	se	deepest landmark located on the bottom of the nasofrontal angle
maxillofrontale	mf	at the base of the nasal root medially from each endocanthion, close to the bony maxillofrontale of the medial margin of each orbit, where the maxillofrontal and nasofrontal sutures meet
alare	al	most lateral point on each alar contour
pronasale	prn	most protruded point of the apex nasi, identified in lateral view of the rest position of the head
subnasale	sn	midpoint of the angle at the columella base where the lower border of the nasal septum and the surface of the upper lip meet
subalare	sbal	point at the lower limit of each alar base, where the alar base disappears into the skin of the upper lip
alar curvature (or alar crest) point	ac	most lateral point in the curved baseline of each ala, indicating the facial insertion of the nasal wingbase
crista philtri landmark	cph	point on each elevated margin of the philtrum just above the vermillion line
labiale superius	ls	the midpoint of the upper vermilion line
labiale inferius	li	midpoint of the lower vermilion line
stomion	sto	the imaginary point at the crossing of the vertical facial midline and the horizontal labial fissure between gently closed lips, with teeth shut in the natural position
cheilion	ch	point located at each labial commissure
porion (soft)	po	the highest point on the upper margin of the cutaneous auditory meatus
tragion	t	the notch on the upper margin of the tragus

Table 1: Definitions of measurement points by Leslie G. Farkas (5).

Measurements in mm	**Male**			**Female**			**P-value**
	N	**Mean**	**SD**	N	**Mean**	**SD**	
HEAD							
eu-eu	109	151.1	5.7	200	144.1	5.1	<0.0001
ft-ft	109	115.9	5.2	199	111.5	4.4	<0.0001
t-t	109	146.8	5.6	200	138.3	4.9	<0.0001
v-n	109	111.3	6.9	199	108.9	6.3	0.0022
v-en	109	121.3	6.8	198	118.7	6.1	0.0007
v-sn	109	164.3	7.7	198	159.4	7.2	<0.0001
v-gn	109	229.4	7.3	200	215	7.9	<0.0001
tr-g	109	57	7.4	200	52.7	6	<0.0001
tr-n	109	67.1	7.5	200	63	6	<0.0001
g-op	109	197.4	6.7	199	186.8	6.8	<0.0001
FACE							
zy-zy	109	139.1	5.3	200	130	4.6	<0.0001
go-go	109	105.6	6.7	200	94.5	5	<0.0001
tr-gn	109	187.2	12.1	200	173.3	7.8	<0.0001
n-gn	109	124.7	5.7	200	111.4	4.8	<0.0001
n-sto	109	76.6	4	200	69.4	3.2	<0.0001
sn-gn	109	72.6	4.5	200	64.3	4	<0.0001
sto-gn	109	50.7	4	200	43.4	3.1	<0.0001
sl-gn	109	33.1	3	200	27	2.5	<0.0001
tr-prn	109	115.3	9.3	197	106.4	8.1	<0.0001
prn-gn	109	91.7	5.6	200	81.4	4.6	<0.0001
en-gn	109	117.7	5.6	200	102.7	5.1	<0.0001
g-sn	109	67.2	4.9	200	63.1	4.4	<0.0001
t-g-t	109	336.7	16.7	193	194.8	11.8	<0.0001
t-sn-t	109	302.2	9.9	200	280.2	9.4	<0.0001
t-gn-t	109	336.7	16.7	193	294.8	11.8	<0.0001
go-cdl right	35	67.1	5.3	40	61.6	5	<0.0001
go-cdl left	35	67.1	5.3	40	62. 2	4.7	<0.0001

ORBITS							
en-en	109	33.3	2.7	200	31.8	2.3	<0.0001
ex-ex	109	91.2	3	200	87.8	3.2	<0.0001
en-ex right	109	31.3	1.2	200	30.7	1.2	<0.0001
en-ex left	109	31.3	1.2	200	30.7	1.2	<0.0001
en-se right	109	25.6	2.1	199	21.9	1.6	<0.0001
en-se left	109	25.3	2.1	199	22	1.5	<0.0001
pupil-se right	40	33.5	2	40	31.2	1.8	<0.0001
pupil-se left	40	33.4	2	40	31.4	1.8	<0.0001
ex-go right	109	103.9	4.7	198	93	4.5	<0.0001
ex-go left	109	103.6	4.5	198	92.4	4.4	<0.0001
pupil-os left	40	24.4	3.3	40	22.9	3.3	0.0455
en-ex sagittal right	41	5.1	1.6	45	3.6	1.7	<0.0001
en-ex sagittal left	41	5.1	1.6	45	3.6	1.7	<0.0001
ps-os right	40	11.2	2	40	12.6	2.6	0.0085
ps-os left	40	11.2	2	40	12.6	2.6	0.0085
NOSE							
mf-mf	109	19.6	1.9	200	18.4	1.9	<0.0001
al-al	109	34.9	2.1	200	31.4	2	<0.0001
ac-ac	86	32.8	2.3	45	30.5	2.2	<0.0001
sbal-sbal	85	21	2.4	45	19.9	1.9	0.0087
n-sn	109	54.8	3.3	200	50.6	3.1	<0.0001
n-prn	109	50	3.6	200	44.7	3.4	<0.0001
LIPS AND MOUTH							
cph-cph	108	10.4	1.4	200	9.7	1.5	<0.0001
ch-ch	109	54.5	3	200	50.2	3.5	<0.0001
sn-sto	109	22.3	2.1	200	20.1	2	<0.0001
sn-ls	109	15.9	1.9	199	13.8	4.6	<0.0001
ls-sto	109	8	1.4	200	8.7	1.3	<0.0001
li-sl	109	11.9	2.2	200	10.7	2.1	<0.0001
sto-sl	109	19.7	2.1	200	17.8	4.7	<0.0001

ch-ls-ch	109	79.3	4.4	187	70.1	4.9	<0.0001
ch-li-ch	109	71.6	4.5	187	64	4.8	<0.0001

Table 2: Findings by Leslie G. Farkas (6): distances between facial landmarks.

Angles in degrees (°)	**Male**			**Female**			**P-value**
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	
HEAD							
Inclination forehead	109	-9.8	4.4	200	-5.9	5.2	<0.0001
FACE							
Inclination sn-pg	109	-10.6	5.3	200	-13.3	4.5	<0.0001
Inclination li-pg	109	-15	6.6	200	-19.4	6.9	<0.0001
Inclination chin	109	16.7	10.4	45	9.1	9.6	<0.0001
Inclination g-pg	109	-3	3.4	200	-4.1	3	0.0036
Mentocervical angle	40	78.3	7.9	42	83.9	9.3	0.0044
ORBITS							
En-ex inclination right	50	2.1	1.9	50	4.1	2.2	<0.0001
En-ex inclination left	50	2.1	1.9	50	4.1	2.2	<0.0001
NOSE							
Inclination nasal tip	67	61.7	7.1	45	34.3	11.2	<0.0001
Glabellonasal angle	44	146	11.4	45	164.9	5.6	<0.0001
Nasofrontal angle	109	130.3	7.4	200	134.3	7	<0.0001
Nasal tip angle	109	71.7	7.4	45	67.4	7.4	0.0013
Ala-slope angle	42	63.9	5.8	45	59.4	5.3	0.0003
Nasolabial angle	109	99.8	11.8	200	104.2	9.8	0.0005
LIPS AND MOUTH							
Labiomental angle	44	113.5	20.7	45	121.4	14.4	0.0392

Table 3: Findings by Leslie G. Farkas (6): angles between facial landmarks

Upper third

In males, the upper third of the face is distinguished by a more prominent bone structure relative to the cranial base [7]. This includes frontal bossing in the supraorbital region, with eyebrows positioned more anteriorly in relation to the eyes and typically flatter and straighter in shape [9] . Structurally, this translates to a more prominent orbital rim, paramedian prominence of the frontal bone, marked frontal bossing, and a deeper frontonasal angle [12]. The ideal frontonasal angel for males is 130°, with an acceptable range of 120 to 133° [13]. While the distance from the hairline to the vertex does not significantly differ between men and women, there is a notable difference in the distance from the hairline to the glabella and nasion [14]. Therefore, it is primarily forehead height, rather than hairline position, that distinguishes male from female faces [7,15]. Additionally, the male hairline often forms an M-shape, contrasting with the rounded hairline more common in females [12]. The male forehead also has a steeper slope, accompanied by a sharper nasofrontal and glabello-nasal angle [6,7].

Middle Third

The male face displays a flatter malar region with reduced anterior bony projection but higher lateral projection, resulting in a less heart-shaped facial structure compared to the female face [15,16]. Regarding soft tissue, the male face generally has lower concentrations of fatty tissue in the temporal and malar regions, further diminishing the anterior projection in the zygomatic area [17]. In terms of orbital dimensions, men generally have a greater orbital width, though orbital height remains consistent between genders. Men exhibit a broader intercanthal distance at both the medial and lateral canthi, and the distance between the medial and lateral canthus is larger, contributing to a more elongated eye shape. Differences in eyelid morphology are primarily seen in the upper eyelid, where women have a greater distance between the brow and the rim. Additionally, the female eye demonstrates a more pronounced difference in the sagittal plane between the medial and lateral canthi, along with a higher inclination, producing a characteristic “cat eye” appearance.The male midface is more prominent, indicated by a larger maxillary arch and more pronounced paranasal fullness [8]. The nose, as a central facial feature, significantly influences facial aesthetics. According to the findings by Farkas, the male midface features a larger nose in all dimensions, with greater width at the root, alae, and alar insertions, as well as a longer dorsum [6,7]. Although the columella inclination remains similar between genders, the tip projection in men is less pronounced. The nasolabial angle in men also tends to be more acute than in women [7,12]. Ideally, the width of the nasal bony base should range from 70-80% of the alar base width [18]. Men typically have a wider bony base, with a relatively straight dorsum. In Caucasian men, the alar flaring in relation to the alar base is around 3 mm [5]. While a slight supratip break is considered aesthetically desirable in women, it is generally less preferred in men. The angle formed by nasion, supratip breakpoint, and nasal tip should fall between 178° and 182° for men, compared to 167° to 171° for women [19]. Male noses also tend to have a broader, more bulbous tip with less rotation, as indicated by the more acute nasolabial angle, resulting in reduced nostril show [18]. Nasion in men is typically positioned slightly higher, at the level of the upper lid crease, whereas in women it aligns with the pupil, contributing to a longer nasal appearance in males [20].

Lower Third

The aesthetic contour of the lower third of the face is characterized by the lips, mandible, and chin. Women typically exhibit a more posterior inclination of the lower face compared to men. In men, the mandible is more prominent relative to the cranial base and wider at the gonion [7]. Conversely, women have a less prominent mandible and chin.To assess the ideal projection of the male chin, one can draw a vertical line from a point at half the ideal nasal length that is tangential to the vermilion of the upper lip. The female chin should ideally sit 2-3 mm behind this line [21]. Additionally, the male chin features more developed lateral tubercles, contributing to a squarer appearance [22]. The mentocervical angle is also smaller in men, which, when combined with the longer mandibular ramus, results in a square-shaped jaw. Furthermore, the masseter muscle is often more developed in men, adding volume to the mandible.The ideal intergonial width should be 10% less than the zygion-zygion distance [23]. In the anterior view, the jawline inclination of the corpus mandibulae should be equal to or 15° wider than the line connecting the lateral canthus to the ipsilateral ala [16]. In profile view, this angle should be approximately 65-75° to the Frankfort horizontal plane. The jaw angle should align with the corners of the mouth without being lower than the lower lip border, while the ideal gonial angle - between the ramus and corpus mandibulae -should be around 130° [16]. The jaw angle should distinctly define the boundary between the face and neck without being overly prominent.While extensive research exists on the female lip, literature on lip masculinization is limited. Generally, the male lip is longer and wider at the philtrum and mouth corners [7]. A typical youthful male lip is between 18 to 20 mm and a typical elderly male lip is between 20 and 22 mm long [24]. Men have a higher skin portion, typically 4:1 with the vermilion height, while women exhibit greater vermilion height with a 2:1 proportion [25,26]. There is no significant difference in the vermilion height of the lower lip, although the skin portion is slightly taller in men. A ratio of lower lip vermilion to skin portion of 1:4 is considered both most masculine and most attractive [25]. The inclinations of the upper and lower lips are similar between

sexes. Due to a longer upper lip, men display less tooth show both at rest and while smiling [27]. In both male and females, the lipcomplex is considered most attractive when the philtrum length: lower lip vermilion-gnathion proportion is 1:2. It is considered most masculine when the proportion is 1:3 [25]. The width of the lips is considered most attractive and most masculine when the proportion between intercommissural and bigonial distance is 1:2.5 [25].

Neck

The primary differences between male and female necks are based on anatomical composition. The male neck has a higher muscle volume (32% compared to 25% in females) and less subcutaneous fat, contributing to a bulkier appearance. Additionally, men have a larger submandibular gland, enhancing neck volume [28]. The reduced subcutaneous fat in males also allows for better muscle definition, and the prominence of the thyroid cartilage is greater in men [29]. One study found the thyroid protrusion to be approximatively 126% larger in men than their female counterparts. Neck width was found to be approximatively 20%-24% larger [30].

Surgical techniques

Upper third

Forehead and supraorbital rim volume augmentation can be achieved using malleable synthetic materials, bone grafts, or patient-specific implants [3,9]. The most conservative methods include hyaluronic acid fillers and botulinum toxin injections [31]. Botulinum toxin can be injected into the frontalis muscle just above the brow to lower the brow position and reduce lateral arching [15]. This can be complemented by filler injections to enhance the supraorbital rim, although precise techniques for filler application in this area remain rare [31,32]. Fillers are often used for rejuvenation of the temporal area. They could therefore be used to augment the bitemporal distance in masculinization of the face [33]. Surgical methods for forehead masculinization typically require a bicoronal approach or a semi-endoscopic approach. Polymethylmethacrylate (PMMA) is commonly used, as promoted by Ousterhout et al. [34,36], but caution is needed due to the exothermic reaction during polymerization, which can cause bone necrosis if not properly irrigated. Other potential complications include seromas and conjunctival irritation from residual PMMA particles [37]. Van der Wel et al. published a case report where a patient-specific Polyetheretherketone (PEEK) implant was designed for facial masculinization based on a statistical shape model of the male face. The statistical shape model was made with the CBCT's of 40 males out of the radiology archives, and the CBCT of the brother of the patient. The area's where additional volume was needed were assessed and used for the 3D manufacturing of the PEEK implant. [38] Calvarial bone grafting is another augmentation option, harvested via the same approach and secured to the glabella with osteosynthesis screws, followed by recontouring. A recent meta-analysis by Oberoi et al. indicated that autologous heterotopic cranial bone grafts have the lowest complication and failure rates compared to PEEK, titanium, and PMMA implants [39]. High Density Polyethylene (HDPE) implants are also reported for forehead augmentation through a semi-endoscopic approach [40]. A central 3 cm incision allows for the implant insertion, whereas two temporal incisions are 1 cm to allow endoscope and instrument insertion. The implant is fixated to the bone with monocortical screws through two small incisions in the lateral brow.Lowering of the brows can be done with transverse frontalis myotomies through the same approach used for forehead augmentation [41].

Middle Third

The middle third of the face includes the maxilla, nose, upper lip, and cheekbones. Whereas cheekbone augmentation is often desirable in both men and women, the vector of added volume is of great difference. For masculinization, the volume should be added mainly in the latero-lateral vector and not the antero-posterior vector. This can be done using patient-specific implants or with fat grafting [38]. Ideally, the buccal fat pad can beremoved transorally and grafted in the lateral portion of the zygomatic area, combining both reduction of the malar lower proportion and addition to the bizygomatic distance [40]. Maxillary augmentation for cosmetic purposes has been described using hydroxyapatite granules, typically applied in the paranasal region via an intraoral approach [42]. While the study reported satisfactory aesthetic outcomes, it did not address effects on gender dysphoria or gender perception. A Le Fort I-type advancement osteotomy could theoretically achieve paranasal fullness and a wider alar base, but the use of orthognathic surgery for facial masculinization remains undocumented [9]. A masculine nose is generally longer and wider than a female nose, with a less concave dorsum and a more prominent skeletal base, resulting in a smaller nasofrontal angle when combined with frontal bossing [3,9]. Conservative augmentation techniques using hyaluronic acid fillers can enhance a concave dorsum and can widen the junction of the bony dorsum and nasal bones [31]. Features such as a nasal hump, low tip rotation, and a boxy tip are considered aesthetically undesirable, regardless of gender, and may be addressed to improve facial aesthetics [20]. The primary surgical techniques in male rhinoplasty focus on dorsal hump reduction, tip modification, and osteotomies [18,43]. One article described specifically masculinization rhinoplasty, with dorsal augmentation, tip derotation and tip broadening. The added volume is made from diced autologous cartilage mixed with fibrin

glue or caudal septal extension grafts [40].

Lower Third

Prominent and well-defined jaw angles and chin are characteristics of masculinity [9]. Jaw angles can be enhanced through semi-permanent or permanent dermal fillers or surgically with fat grafts, bone grafts or implants [3,28]. Autologous bone augmentation can occur between the masseter muscle and the mandible's cortex or between the spongious bone and lateral cortex, both via an intraoral approach [34]. In these cases, the graft is not fixed with plates or screws, as the masseter muscle provides sufficient support. Up to 6 mm of bone has been added to the gonial angle using this technique [44]. Hydroxyapatite granules can also be used for volume addition but are associated with higher complication rates, including seromas and infections [42]. Facial contour changes can also be achieved through fat grafting, which, despite its unpredictability in long-term volume retention, can yield aesthetically pleasing results [9]. Augmentation can involve either generic or patient-specific alloplastic materials, with MEDPOR implants (Stryker, Kalamazoo, USA) being the most used generic option and custom-made titanium or PEEK implants available [45]. For volumetric chin augmentation, hyaluronic acid fillers are effective. It is recommended to inject botulinum toxin into the mentalis muscle two weeks prior to filler application for optimal results [31]. For more permanent solutions, the same volume augmentation techniques used for jaw angles can be applied [44]. Chin implants primarily enhance the horizontal dimension rather than the vertical [9]. A sliding genioplasty can address all dimensions simultaneously. This procedure is typically performed through an intraoral approach, with the chin's new position secured by osteosynthesis plates. A sliding genioplasty offers greater prominence in the anteroposterior direction, while a two-piece genioplasty can widen the bony chin in the horizontal plane, often requiring additional osteosynthesis for stability [34].

Neck

Deschamps-Braly et al. reported a case of thyroid cartilage masculinization [23]. Access was achieved through a submental incision and supra-platysmal dissection to the strap muscles surrounding the cartilage. A vertical incision through these muscles allowed access to the perichondrium, which was also dissected from the underlying cartilage. The cartilage graft was harvested from the rib via an incision in the inframammary crease, utilizing the scar from a previous mastectomy while avoiding pleural violation. The authors emphasized that the graft should be full-thickness and at least 3 cm long. It was then reshaped in the operating field to resemble anatomical male thyroid cartilage, forming a narrow oblique pyramid with a base approximately 75% the size of the patient's existing thyroid cartilage. Finally, the graft was secured to the thyroid cartilage with non-resorbable sutures, and the platysma and skin were closed per standard procedures.

Discussion

The overall tendency when comparing the female and male facial anatomy measured by Leslie G. Farkas is the greater volume in men [5]. When analyzing the measurements for the head in general, one would have to add approximatively 7 mm of thickness at the parietal bones, smoothing out to an addition of 4,4 mm at the linea temporalis to make the female skull more masculine. Additionally, the vertex should be heightened about 2,5 mm. While these additions are technically possible, in contrary to the difference in width of approximatively 8,5 mm at the level of the tragion between men and women, their effect on the perception of masculinity would most probably not be noticeable. Therefore, the less invasive surgical technique of lipofilling would be most advised if these changes are wished for. The placement of an implant would require a coronal approach. If on the other hand, one would also want to create frontal bossing, a coronal approach is justifiable to address all changes at once. The average difference in circumference between men and women, measured between both tragi with the midpoint at the glabella, is 141,9 mm. The surgical option of a patient specific implant placement seems more suitable, given the significant volume required as well as the heightened visibility of potential deformities caused by fat resorption or inaccuracies in cement placement. To address the difficulty of predicting the resorption rate of autogenous tissue transfer, 3D modelling techniques are arising to define targets for the manufacture of patient-specific implants [46]. Despite several notable differences between male and female eyes, the surgical options for achieving a distinctly "male eye" are limited. The most impactful alteration that can influence the perception of masculinity is a lowering of the eyebrow by approximately 1.5 mm. When combined with the enhancement of the supraorbital rim's prominence, the skin's laxity becomes a critical consideration. Volume augmentation may counteract the desired outcome by elevating the eyebrow position, which runs contrary to the intended masculinization.Creating a male nose is possible with the current rhinoplasty techniques.The width of the nasal root would be approximatively 1mm wider in men, keeping in mind that it should still be in harmony with the distance between both endocanthi, which is also 1,5 mm further apart in men than in women. The alae could flare approximatively 3,5 mm wider in men than in women, with the facial insertion being approximatively 2,3 mm more apart. While the upper lip in men shows approximatively 2 mm more skin and 1 mm less vermillion, lengthening of the upper lip whilst decreasing the vermillion height is not surgically achievable without creating scars. The distance between both mouth corners is approximatively 4,3 mm wider in men, which could potentially be done surgically. The effect on

perception of masculinity is presumed absent.The main differences can be found in the bony aspects of the lower two thirds of the face [47]. By adding approximatively 9 mm at the bizygomatic level, 11 mm at the bigonial level and 5 mm in gonial height, one has already created a masculine lower jaw. Combined with the addition of approximatively 7 mm of height at the chin, the effect should be harmonious. There is no reference for the ideal width of the chin, making this a feature that must be based on the surgeon's experience. One should aim for a balanced outcome. The addition of volume in these anatomical entities has been described for cosmetic purposes, giving the surgeon multiple possibilities going from hyaluronic acid fillers, lipofilling, autologous to allogeneic transplants. There is no guideline available as to which technique has the best results.When examining the two components of this research side by side, it becomes evident that existing literature on facial masculinization often lacks objective outcome measures to inform intervention goals. Much of the current understanding is derived from expert opinion, generalized notions of gender differences, and the surgeon's personal experience.

This gap in data may be attributed to the lower prevalence of transgender males seeking treatment at specialized clinics or the greater ease of camouflaging natal female features as male. Unlike facial feminization surgery, there is no established set of features to target in masculinization [48]. While we have established the objective measures of the male face and the surgical techniques available to achieve them, several studies were published regarding the perception of masculine gender by third parties. Springer et al. found that a male nose, when isolated from other facial features, cannot be adequately recognized as such. They concluded that nasal shape alone does not indicate a person's gender [20]. Similarly, Nuyen et al. determined that no nasal shape predicts masculinity [49], suggesting that this feature may not be a priority in facial masculinization efforts. Villavisanis et al. found that the nasal width ratio, defined by the ratio of nasal width to bizygomatic width, is predictive for masculinity. They also identified that increased representation of upper and lower third of the face is correlated with perception of masculinity and male sex [50]. A study by Gilani et al. identified the jaw and chin as significant predictors of extremely masculine faces, while eyes, mouth, and cheeks were more indicative of extremely feminine faces [51]. This indicates that jaw and chin enhancement may be paramount in masculinization procedures, as they appear to be key determinants of perceived masculinity. Mundinger published that lower third masculinization is the most requested alteration in his practice for facial masculinization surgery [52]. Furthermore, an analysis of the changes in personality perception before and after cosmetic procedures revealed that only neck lifts significantly enhanced perceptions of masculinity [53]. Chin augmentation alone did not correlate with increased masculine perception.

The effectiveness of the neck lift can be attributed to the enhanced definition of neck muscles resulting from the removal of sagging skin, which aligns with the typically lower subcutaneous fat in men compared to women. It is crucial to recognize that distinction between female and male gender arises from the combination of different features, rather than one key feature alone [54]. Techniques for facial gender confirmation surgery are often borrowed from the aesthetic surgery, which primarily aims to rejuvenate a face. Surgeons must bear in mind that these techniques are not always accurate for facial masculinization, as often a face appears more masculine as it increases in age [55]. The relatively lower demand for surgical facial masculinization may also be linked to the changes brought about by testosterone therapy [56,57]. Mackenzie et al. demonstrated that adult female-to-male transgender individuals receiving testosterone therapy alone solicited increased perceptions of masculinity in photographs [58]. Notably, 72% displayed a wider midface post-transition, 76% a broader upper jaw, and 52% a wider lower jaw. These changes were attributed primarily to fat redistribution and increased muscle mass. The emergence of beard growth, male-pattern baldness, and coarse skin texture further contributed to the perceived masculinity of the subjects. Thus, one could argue that testosterone therapy alone significantly enhances congruence with masculinity, potentially reducing the necessity for surgical intervention. Cronin et al. found that transmasculine and non-binary patients show less preference for strong masculine features than transfeminine patients for strong feminine features [13]. This emphasizes the need to evaluate each patient's needs separately. Deschamps-Braly et al. commented on the efficacy of conservative treatments, such as fillers, botulinum toxin injections, and fat grafting, for facial feminization and masculinization [58,60]. They noted that while these methods can complement surgical approaches, their predictability and impact are considerably less than those achieved through surgical procedures. Facial gender confirmation surgery fundamentally alters the proportions of the face, involving volume addition in female-to-male transitions or volume reduction in male-to-female transitions. Therefore, the effectiveness of conservative measures must be critically assessed concerning the necessary adjustments for individuals to achieve congruence with their identified gender.

Conclusion

We propose guidelines for the facial measurements and proportions to target during planning for facial masculinization surgery. Our findings indicate that the jaw and chin play a crucial role in the perception of masculinity, whereas nasal shape does not. It is essential to consider the entire face and the harmony between its structures rather than focusing on isolated features. While surgical enhancements in these areas can effectively

accentuate masculine traits, testosterone therapy has been shown to significantly enhance perceptions of masculinity by inducing changes in facial structure and secondary sexual characteristics. Although conservative treatments such as fillers and botulinum toxin injections offer benefits, they are generally less effective than surgical interventions for facial gender confirmation. Therefore, a personalized approach that combines hormonal and surgical treatments is necessary to achieve the desired gender congruence. Additionally, further research into facial masculinization is needed to standardize surgical techniques and treatment protocols.

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