Original Article

CENTRAL FACIAL SOFT-TISSUE DEFECT FOLLOWING SURGICAL RESECTION: AN ALGORITHM FOR RECONSTRUCTION

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ABSTRACT

Background: Central facial soft tissue defect poses a unique challenge for the reconstructive surgeon. The three-dimensional properties of the aesthetic facial subunit and its related function are the goals for reconstruction. Considering the prominent social role of the face, the procedure to achieve a good quality of life for patients may cost more than a single surgery. This single-center study presents an algorithm of treatment for central facial soft tissue defect and it's proposed classification according to the authors' experiences.

Methods: A retrospective review of medical records and photos of patients who underwent central facial soft tissue defect reconstruction in Cipto Mangunkusumo National Hospital, Jakarta, Indonesia, from 2009 to 2019. Patients who underwent free flap reconstruction were followed up, and the primary outcomes were assessed using the FACE-Q head and neck cancer (FACE-Q H&N) scale. A classification system for central facial soft tissue defect with seven subtypes (1–7) based on the facial subunit and its treatment was proposed.

Results: Twenty-five patients were included. The malignant tumor was the main etiology (88%), with basal cell carcinoma being the primary cancer pathology (64%). The average defect size was 120 cm² (32-416 cm²) and most defects fell into subtype 6 of the classification (32%). Anterolateral thigh free flap (ALT) was the main flap of choice (64%), followed by radial forearm free flap (36%), with 92% of flaps succeeding rate from this series. All of the patients underwent at least one ancillary procedure following the reconstruction, while the average was 2 (1-6) procedures. FACE-Q H&N outcomes, especially on the appearance and appearance distress scale, showed a low to moderate score with a 72% response rate.

Conclusions: Central facial soft-tissue defect continues to challenge reconstructive surgeons. While the advances in free tissue transfer might improve the general outcomes, the numerous and costly secondary procedures do not usually end up in the best appearance. This study displayed the need for modern reconstruction modalities that provide high satisfaction in aesthetic and functional outcomes with fewer secondary procedures. Vascularized Composite Allotransplantation (VCAT) might be the future choice.

Key Words: Central Facial Defect; Soft Tissue; Reconstructive

Latar belakang: Defek jaringan lunak wajah sentral menimbulkan tantangan unik bagi ahli bedah rekonstruksi. Properti tiga dimensi subunit wajah estetika dan fungsi terkaitnya adalah tujuan rekonstruksi. Mempertimbangkan peran sosial yang menonjol dari wajah, prosedur untuk mencapai kualitas hidup yang baik bagi pasien mungkin memerlukan biaya lebih dari satu kali operasi. Studi satu pusat ini menyajikan algoritme pengobatan untuk defek jaringan lunak wajah sentral dan klasifikasi yang diusulkan menurut pengalaman penulis.

Metode: Data diambil dari tinjauan retrospektif rekam medis dan foto pasien yang menjalani rekonstruksi defek jaringan lunak wajah sentral di Rumah Sakit Nasional Cipto Mangunkusumo, Jakarta, Indonesia, dari tahun 2009 hingga 2019. Pasien yang menjalani rekonstruksi flap bebas ditindaklanjuti, dan hasil primer dinilai menggunakan Skala kanker kepala dan leher FACE-Q (FACE-Q H&N). Sebuah sistem klasifikasi untuk defek jaringan lunak wajah sentral dengan tujuh subtipe (1-7) berdasarkan subunit wajah dan pengobatannya diusulkan.

Hasil: Dua puluh lima pasien dilibatkan. Tumor ganas merupakan penyebab utama (88%), dengan karsinoma sel basal sebagai patologi kanker utama (64%). Ukuran cacat rata-rata adalah 120 cm² (32-416 cm²) dan sebagian besar cacat jatuh ke dalam klasifikasi subtipe 6 (32%). Flap bebas paha anterolateral (ALT) adalah flap pilihan utama (64%), diikuti oleh flap bebas lengan bawah radial (36%), dengan 92% tingkat keberhasilan flap dari seri ini. Semua pasien menjalani setidaknya satu prosedur tambahan setelah rekonstruksi, sedangkan rata-rata adalah 2 (1-6) prosedur. Hasil FACE-Q H&N, terutama pada skala penampilan dan gangguan penampilan, menunjukkan skor rendah hingga sedang dengan tingkat respons 72%.

Kesimpulan: Defek jaringan lunak wajah sentral terus menantang ahli bedah rekonstruksi. Sementara kemajuan dalam transfer jaringan bebas mungkin meningkatkan hasil umum, prosedur sekunder yang banyak dan mahal biasanya tidak berakhir dengan penampilan terbaik. Studi ini menunjukkan perlunya modalitas rekonstruksi

modern yang memberikan kepuasan tinggi dalam hasil estetika dan fungsional dengan prosedur sekunder yang lebih sedikit. Vascularized Composite Allotransplantation (VCAT) mungkin menjadi pilihan masa depan.

Kata Kunci: Defek Wajah Sentral; Jaringan Lunak; Rekonstruksi

Conflicts of Interest Statement:
The author(s) listed in this manuscript declare the absence of any conflict of interest on the subject matter or materials discussed.

INTRODUCTION

The central face is a 3-dimensional, multi-layered structure that encompasses the orbit, nose, cheeks, and upper lip, which form the centrepiece of facial identity.[1] When defects involving the central face area simultaneously happen as a result of thermal injury, trauma, or tumor ablation, it can severely affect individual's appearance and function. [2, 3] Furthermore, these central facial defects represent significant reconstructive challenges for plastic surgeons as the goals are to achieve adequate function (e.g., visual, swallowing, speech) and aesthetics.[4]

Familiarity with the repair of such defects is essential; systematic identification of the location, size, and depth of the defect, critical facial landmarks, structural and soft tissue involvement, as well as aesthetic unit involvement are needed. In most of the cases, modalities such as conventional free tissue transfer are insufficient replacements for the original multi-layered structures and along with Gillies' principle, in which it is better to "bring something in than to take something away," a comprehensive approach is created to combine the reconstruction of the tissue loss using microvascular options as the first step and flap refinements and locoregional flap addition secondarily.[5]

Although central facial defect are common and numerous categories of central facial defect[6-8] and their stepwise approach to reconstruction are proposed,[1, 2, 4] to the best of our knowledge, there is no report regarding the central facial soft defect classification related to its treatment. We have developed a single-centre study algorithm to simplify the complex treatment for a central facial soft tissue defect and its proposed classification according to the authors experiences.

SUBJECTS AND METHODS

Study Design

This retrospective review study was carried out using medical records, surgical notes, and photos of the patients with central facial soft tissue defects who submitted to reconstruction at the Cipto Mangunkusumo National Hospital, Jakarta, Indonesia, between 2009 and 2019. Twenty-five patients were evaluated preoperatively by members of the surgical team consisting of plastic surgery in collaboration with either the surgical oncology or otorhinolaryngology departments. Resection and reconstruction procedures were intended for curative and palliative treatment.

A single surgeon (P.A.) was directed the flap harvests and reconstructions procedure. Inclusion criteria were patients with a central facial defect as a result of surgical resection of any etiologies who underwent primary reconstruction using free tissue transfer. Demographic data, defect characteristics, surgical procedures, complications, and outcomes were collected for further analysis. All living patients who underwent free flap reconstruction were followed up. As a primary outcome, functional and aesthetic results were assessed using the FACE-Q H&N scale.[9]

A novel classification system for central facial soft tissue defect based on facial aesthetic subunit and their reconstructive options with seven subtypes (1–7) is proposed: type 1a nasal unilateral, type 1b nasal bilateral; type 2a nasal and cheek unilateral, type 2b nasal and cheek bilateral; type 3a nasal and upper lip unilateral, type 3b nasal and upper lip bilateral; type 4a upper central facial unilateral, type 4b upper central facial bilateral; type 5a lower central facial unilateral, type 5b lower central facial bilateral; type 6 extensive hemifacial; and type 7 extensive facial.

Variables Analysed

The following variables were recorded: age (when primary reconstruction was done); gender; etiology (malignant, benign, or non-tumor); pathology (basal cell carcinoma, squamous cell carcinoma, adenoid cystic carcinoma, noma, or trauma); referral (plastic surgery, surgical oncology, or otorhinolaryngology); central facial defect classification (1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 5a, 5b, 6 or 7); defect size; primary flap type (ALT, or RFFF; flap size; flap success; amount of procedures; follow up; and total length of follow-up. The researcher evaluated the association between the central facial defect classification and the defect size and primary flap type modalities. Correlation analyses were performed between the FACE-Q H&N scale score and subtype classification. The average FACE-Q H&N scale score was also compared amongst the subtype.

Statistical Analysis

Data were analyzed using SPSS version 24.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were shown as mean ± standard deviation (SD) or median (min, max) based on data distribution. Categorical variables were presented as a number (percentage). The mean difference of defect size and FACE-Q H&N scale among subtype classifications was compared using the one-way analysis of variance (ANOVA) if the data distributions were normal or the Kruskal–Wallis test if the data were not normally distributed. Further post-hoc analysis was performed when appropriate. Statistical comparisons of primary flap type modalities between central facial defect classifications were done using either the Chi square test or Fisher's exact test. Correlation test was performed using Pearson correlation coefficient. A p value of < 0.05 was considered statistically significant.

RESULTS

Algorithm

The results of the seven subtypes of central facial reconstructive options were presented in Figure 1. In the presented algorithm, the suggested reconstructive modalities with respect to defect size, anatomical subunit involvement, and localization are described for each category.
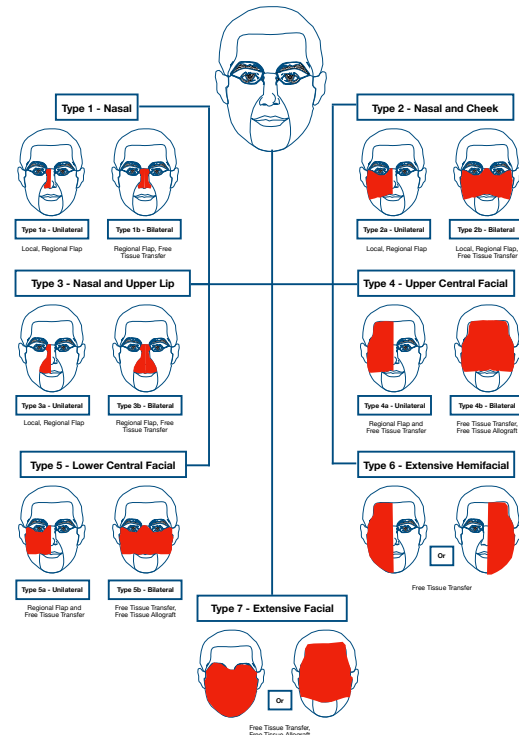

Figure 1. Classification and Algorithm for Central Facial Defect Reconstruction

Patients Characteristics

The analysis of the study sample comprised of twenty-five medical records of patients who submitted to primary reconstruction of a central facial soft tissue defect using free tissue transfer. The demographic and clinical details of the subjects were presented in Table 1. The average age was 50 (15–79) years, predominantly female patients (56%). The majority (88%) of the defect was due to malignant tumors; basal cell carcinoma subtypes (64%). Fifty six percent of patients were sourced from a reference of surgical oncology. The average defect size was 120 cm^2 (32–416 cm^2) and most defects fell into subtype 6 of the classification (32%). ALT was the main flap of choice (64%) followed by RFFF (36%); flap size was 96 cm^2 (24–676 cm^2) with a 92% flap success rate. All of the patients underwent at least one ancillary procedure following the reconstruction, while the average was 2 (1-6) procedures. On average, patients were followed up for 10 (1–84) months.

Table 1. Patients Demographic Characteristics

Variable	
Age (years), median (min, max)	50 (15, 79)
Gender, n (%)	
Male	11 (44)
Female	14 (56)
Etiology, n (%)	
Malignant tumor	22 (88)
Benign tumor	1 (4)
Non tumor	2 (8)
Pathology, n (%)	
Basal cell carcinoma	16 (64)
Squamous cell carcinoma	6 (24)
Adenoid cystic carcinoma	1 (4)
Noma	1 (4)
Trauma	1 (4)
Referral, n (%)	
Plastic surgery	5 (20)
Surgical oncology	14 (56)
Otorhinolaryngology	6 (24)
Central facial defect classification, n (%)	
1b	3 (12)
2a	2 (8)
2b	2 (8)
3a	2 (8)
4a	6 (24)
5b	2 (8)
6	8 (32)
Defect size (cm²), median (min, max)	120 (32, 416)
Primary flap type, n (%)	
ALT	16 (64)
RFFF	9 (36)
Flap size (cm²), median (min, max)	96 (24, 676)
Flap success, n (%)	
Flap success	23 (92)
Complete loss	2 (8)
Amount of procedure(s), n (%)	
1	11 (44)
2	5 (20)
3	7 (28)
6	2 (8)
Follow up, n (%)	
Not loss	18 (72)
Loss	7 (28)
Total length of follow up (months), median (min, max)	10 (1, 84)

Association between Central Facial Classification with Defect Size and Treatment Modalities

The associations of the central facial defect classification to the defect size and primary flap type modalities were shown in Table 2. Higher central facial classification was associated with larger defect sizes (p = 0.015). Treatment modalities of higher central facial classification were mostly ALT flap, in contrast to low classification grade with RFFF flap (p = 0.021).

Table 2. Association between Central Facial Classification with Defect Size and Treatment Modalities

Central facial defect classification	Defect Size* median (min, max)	RFFF** n (%)	ALT** n (%)
1b	40 (40–44) cm²	3 (100%)	0 (0%)
2a	65 (60–70) cm²	1 (50%)	1 (50%)
2b	37 (32–42) cm²	2 (100%)	0 (0%)
3a	72 (48–96) cm²	1 (50%)	1 (50%)
4a	162 (60–360) cm²	2 (33%)	4 (67%)
5b	199.5 (119–280) cm²	0 (0%)	2 (100%)
6	174 (56–416) cm²	0 (0%)	8 (100%)

* p value of Kruskal-Wallis test = 0.015
** p value of Chi-Square test = 0.021

Central Facial Classification and Algorithm System to FACE-Q Head and Neck Cancer Scale Scores

The response rate for FACE-Q H&N outcomes were 72%. FACE-Q H&N appearance and appearance distress scale showed low to moderate mean score of 48.80±18.45 and 41.64±11.4, respectively. Central facial had a significant negative correlation with both FACE-Q appearance (r = -0.645; p<0.001) and appearance distress scale (r = -0.470; p=0.018). Higher central facial classification grades were correlated with both lower FACE-Q H&N appearance and appearance distress scale. There were also significant differences in the mean score of the FACE-Q H&N appearance scale but not the appearance distress scale among different central facial classification grades, as shown in Table 3.

Table 3. Association between Central Facial Classification with FACE-Q H&N Appearance and Appearance Distress Scale

Central facial defect classification	FACE-Q appearance scale*	FACE-Q distress appearance scale**
1b	72.00±25.53	50.33±8.32
2a	62.50±17.67	52.50±16.26
2b	50.00	41.00
3a	50.00	41.00
4a	53.16±6.40	44.83±9.38
5b	44.50±14.84	26.50±20.50
6	33.87±17.75	37.37±10.25

* p value of one-way ANOVA test = 0.043
** p value of one-way ANOVA test = 0.180

DISCUSSION

The term of central facial defect is well known, frequently referred in the literature as "nasal and paranasal", "nasal and adjacent region", "composite facial defects", "complex facial defects"[1, 3, 10] This is a common condition that pose a significant reconstructive challenge as to recreate such anatomical complexity of multiple aesthetic subunits in symmetry and three-dimensionally while concomitantly restoring their functionality. Both the central facial defect classification and algorithm for reconstruction are widely available[6, 8, 11-14], in contrast, a specialized classification of the central facial soft tissue defect related to its treatment has not been described so far. Our intention is to provide a simplify treatment approach through the development of an algorithm by combining statistically evaluated data regarding the reconstructive outcomes.

Currently, free flaps are the modalities of choice and proven to be more effective to reconstruct complex and extensive defects compared to locoregional flap. Free tissue transfer options such as RFFF, ALT free flap, latissimus dorsi free flap, and rectus abdominis free flap were reported with an overall success rate as high as 94%.[3, 5, 6, 12, 14, 15] This study had 92% of flap success rate, utilized either RFFF or ALT free flap for defect reconstruction; RFFF has a thin and pliable tissues, robust blood supply with long vascular pedicle, and one of the area that can produce a large size flap while ALT provides an excellent alternative for extensive skin and soft tissue defect reconstruction with its reliable vascularity, tissue bulkiness, and large donor area.[3, 16] Based on the statistical analysis it was found that higher central facial classification was associated with larger defect sizes (p = 0.015) and the majority of treatment modalities in higher central facial classification were ALT flap, while lower central facial classification reconstructions were done using RFFF flap (p = 0.021). Authors recommendation is to opt for RFFF for smaller defect sizes and lower central facial classification such as type 1b and 2b defects, ALT for type 4a, 5b, 6 defects, and RFFF or ALT for type 2a and 3a defects.

Central facial complex structures creates the most prominent part of the face thus makes single flap modalities is rarely an optimal choice to close the entire defect. Defect reconstruction oftentimes requires more than a single surgery. A systematic and comprehensive approaches, allowing functional preservation and resulting in superior aesthetic result consist of multiple step-wise reconstructive procedures, were already proposed.[1, 3, 10] In line with those proposed studies, the authors performed primary microvascular reconstruction followed by flap refinements, graft or locoregional flap addition if needed as the secondary reconstruction procedures. In this particular study, the average number of the ancillary procedures was two and ranging from one to six procedures in order to achieve a good quality of life for the patient.

FACE-Q is a patient-reported outcome instrument that originally developed for patient undergoing aesthetic surgical and nonsurgical procedures. FACE-Q H&N scale questionnaires are one of the expansions for head and neck cancer patients undergoing surgical procedures.[9] This study used FACE-Q H&N scale questionnaires to determine patients' satisfaction with appearance and quality of life improvement. FACE-Q H&N outcomes were 72% and showed low to moderate mean score of appearance and appearance distress. Significant negative correlations between central facial defect classification and FACE-Q H&N scale were found in both appearance and appearance distress. Larger defect size involving more aesthetic subunits that are classified as higher subtypes in this categorization, which might need multiple and complex reconstructive procedures compared to lower subtypes in order to achieve a good aesthetic and functional outcome in the patient. This might be corelated with lower FACE-Q H&N scale among higher subtypes patients. The mean score of FACE-Q H&N appearance scale among central facial classification was significantly different, in contrast to appearance distress scale that displayed different result. A plausible explanation was the small number of the subject included in this study. The authors were fully aware that the statistical power of this presented study could be increased by examining a larger patient population and involving multicentre studies.

CONCLUSION

Central facial soft-tissue defect continues to challenge reconstructive surgeons; patient with central facial defect requires not only functional but also aesthetic reconstruction that might need numerous and costly procedures. While the advances in free tissue transfer might

improve the general outcomes, this study showed low average scores in FACE-Q H&N appearance and appearance distress score despite multiple and costly procedures done in 56% of the subjects to achieve afro mentioned goals. According to our knowledge, these classification and algorithm for central facial defect are novel and should assist plastic surgeons in planning the reconstructive treatments and predicting the outcomes. This study depicted the need for modern reconstruction modalities that provide high satisfaction in aesthetic and functional outcomes with fewer secondary procedures. Vascularized Composite Allotransplantation (VCAT) might be the future choice.

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