Comprehensive Evaluation of Facial Aesthetics after Rhytidectomy

Avaliação abrangente da estética facial após ritidoplastia

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Abstract

Introduction The advancement in technologies applied to facial rejuvenation provides increasingly promising aesthetic outcomes. Although the therapeutic arsenal is growing, we need a more comprehensive study of quantitative and qualitative variables on the long-term outcomes of rhytidectomy associated or not with supplementary procedures. The present study retrospectively assessed rhytidectomy surgeries performed in a reference center.

Materials and Methods We evaluated the photographic record of patients operated on from 2021 to 2022 using Crisalix (Crisalix S.A.), Facetool, and FaceTag (Minical, Inc.) software to obtain quantitative values of symmetrization, proportion, and volumization. To assess qualitative variables, we applied the Facial Assessment and Cosmetic Enhancement Quality of Life Questionnaire (FACE-Q) to patients and an expert professional. We compared the qualitative variables from the questionnaires (translated into Rasch tables) with quantitative variables provided by the software to confirm their level of correlation.

Results We found that although different tools evaluated the same parameters (the symmetry and volume of key anatomical points in facial rejuvenation), the weight of these parameters is smaller than the final absolute value of each processing. Linear regression revealed no statistically significant correlation between values. During the study, different variables were identified that hinder the interface with technologies and questionnaires.

Conclusion We concluded that determining a single postoperative evaluation parameter correlated with an expert assessment was not feasible in our sample.

Keywords
- cohort studies
- facial asymmetry
- rhytidoplasty
- software
- surgery
- plastic

Resumo

Introdução O avanço das tecnologias aplicadas ao rejuvenescimento facial proporciona resultados estéticos cada vez mais promissores. Embora estejamos vivenciando um crescente aumento no arsenal terapêutico, os resultados no longo prazo de ritidoplastias associadas ou não a procedimentos complementares carecem de um estudo mais abrangente focado em variáveis tanto quantitativas quanto qualitativas. O

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estudo propõe avaliar retrospectivamente as cirurgias de ritidoplastia realizadas em centro de referência.

Materiais e Métodos Avaliamos o registro fotográfico de pacientes operadas entre 2021 e 2022 com os *softwares* Crisalix (Crisalix S.A.), Facetool e FaceTag (Minical, Inc.) para obter valores quantitativos de simetrização, proporções e volumização e avaliamos qualitativamente com questionários referentes ao Facial Assessment and Cosmetic Enhancement Quality of Life Questionnaire (FACE-Q) aplicados aos pacientes e um especialista na área. Comparamos as variáveis qualitativas dos questionários traduzidas pelas tabelas Rasch com as variáveis quantitativas obtidas com os *softwares* para confirmar o nível de correlação entre as mesmas.

Resultados Encontramos que embora os mesmos parâmetros sejam avaliados pelas diferentes ferramentas (simetria e volumização de pontos anatômicos chave no rejuvenescimento facial), o peso desses parâmetros é pequeno quando se obtém o valor absoluto final de cada processamento. Tais valores demonstraram não possuir correlação estatística entre eles após serem submetidos a regressão linear. Destacam-se também diferentes variáveis identificadas durante o estudo que prejudicam a interface com as tecnologias e questionários.

Conclusão Conclui-se que determinar um parâmetro único de avaliação do pós-operatório que seja correlato com a avaliação de um especialista não foi possível na amostra estudada.

Palavras-chave
- assimetria facial
- cirurgia plástica
- estudos de coortes
- ritidoplastia
- software

Introduction

Although the concept of aging evokes the notion of advanced age, its biological process begins at birth, becoming more prominent during adulthood due to changes in skin quality, tissue ptosis, and volumetric depletion from bone reabsorption.[1] In different cultures and historical moments, aging marks were symbols of experience and respect. Today, especially after the advances in plastic surgery techniques, aging marks have been considered increasingly undesirable and often stigmatizing.[1–3] The demand for aesthetic procedures to delay the appearance or treat signs of aging has grown, resulting in the emergence of new strategies and technologies to meet such demand.[2]

Even though the growing increase in the therapeutic arsenal for treating rhytids, skin quality, or ptotic facial structure positioning follows the demand according to technological evolution, scientific advancement in this area still lacks relevant levels of evidence.[2]

The lack of quality scientific evidence for a comparative evaluation of these new technologies or techniques for approaching the superficial musculoaponeurotic system (SMAS) leads doctors to focus on offering their treatment to the detriment of better understanding of the meaning of beauty and the motivation of their patients to restore or achieve such beauty.[3] The philosophical, artistic, and scientific fields debated the definition of beauty but with no precise description or required standardization. The challenge of studying this subject is understandable due to the inherent limitations of plastic surgery. Some factors, including ethnicity, symmetry, and the interface with new technologies, are natural barriers to the quantitative evaluation of beauty.[3]

Software assessment of facial landmarks in 3 (3D) or 2 dimensions (2D) has generated a new commercial demand for doctors' offices. Today, although the software has not shown improvements in procedure quality or patient satisfaction, it seems that this tool only increases the surgery conversion rate.[4] It is worth highlighting the lack of a current standardized or ideal evaluation methodology in 2D or 3D in the public domain.

Another area still little studied and equally challenging to understand is the medical judicialization in Brazil. As in other countries, medical judicialization has been growing significantly, mostly in surgical centers.[5] Few low-evidence studies analyzed the impact of 2D or 3D facial assessment on legal action rates. However, it is common sense that the more informed the patient is about the procedure, the lower the chance of legal action.[5,6] In this current scenario, it would be interesting to study and create validated tools to objectively quantify the surgical success of plastic surgeries instead of relying on the subjective evaluation of other professionals not directly involvement in each facial rejuvenation process.

Objective

The present study aims to retrospectively evaluate outcomes from rhytidoplasty surgeries performed from 2021 to 2022 in the plastic surgery service of Hospital Federal dos Servidores do Estado (HFSE), Rio de Janeiro, Brazil, by comparing the combined use of software and questionnaires with the opinions of expert surgeons.

Materials and Methods

This retrospective cohort, an epidemiological observational study with previous data collection, selected all patients who underwent facial surgeries at the hospital from 2021 to 2022 ($n = 122$). Next, we selected patients who underwent rhytidectomy using the modified Baker technique (superficial musculoaponeurotic system [SMAS] plication) with no associated blepharoplasty or fat grafting ($n = 48$). We excluded patients unavailable for contact or who failed or refused to sign the informed consent form, leaving 16 subjects. Of these patients, we excluded 6 who did not have a photographic record accepted by the minimum software settings or within the appropriate postoperative time, that is, preoperative and 6-month postoperative photos with similar lighting and incidence. Thus, this evaluation included 10 patients.

Pre- and postoperative photographic record analysis used Facetool, FaceTag (Minical, Inc.), and Crisalix (Crisalix S.A.) software. The software measured anatomical points classically associated with golden proportion, symmetry, and volumization.

The FaceTag software evaluated the symmetry between anatomical points and compared points according to the golden ratio. It also calculated point relationships, generating an equivalent qualitative assessment ranging from 0 to 100.

The Facetool software confirmed the key anatomical landmarks used in the FaceTag software to determine the accuracy in measuring the relationships between two different points in the same photograph.

The Crisalix software assessed facial volumization alone in the presumably positive and negative areas of the face, along with their postoperative modification (►**Fig. 1**).

We contacted patients to sign the informed consent form and answer questionnaires regarding their overall satisfaction with the outcome, including a qualitative assessment, a visual age perception scale, and satisfaction with the decision to undergo surgery. We converted the qualitative responses into Rasch tables to quantitative scores ranging from 0 to 100.

An expert surgeon with over 10 years of experience in rhytidoplasty, a reference in the field, analyzed preoperative and postoperative photographs. This surgeon had no conflicts of interest with the proposing institution and completed the Facial Assessment and Cosmetic Enhancement Quality of Life Questionnaire (FACE-Q) scores regarding general satisfaction and visual age perception. We grouped the FACE-Q answers for each patient and paired them with the evaluator's responses.

The expert's FACE-Q overall assessment, the patient's FACE-Q age and overall evaluations, and the final FaceTag software assessment balance underwent linear regression with the expert assessment as the dependent variable.

The ethics committee/study center of HFSE approved the present study, which is in Plataforma Brasil under registration number 73878523.4.0000.5252.

Results

The patients' results ranged from 71 to 87, with a mean value of ~ 77 of the FaceTag software coefficient (►**Table 1**). The software evaluated the ratios between the middle and lower thirds, the relationship between the width and height of the middle and upper thirds, the width of the jaw about the face, the distance between the medial corners and the facial width, the height and length of the eyes, the positioning of the eyebrows, and the relationship between the philtrum and the jaw.

This software compared facial relations with the golden ratio, and the patient's facial symmetry indicated a significant increase in these parameters, that is, surgery resulted in higher symmetry, closer to the ideal proportion. Numerically, mean values were 76.7 before and 77.2 after surgery.

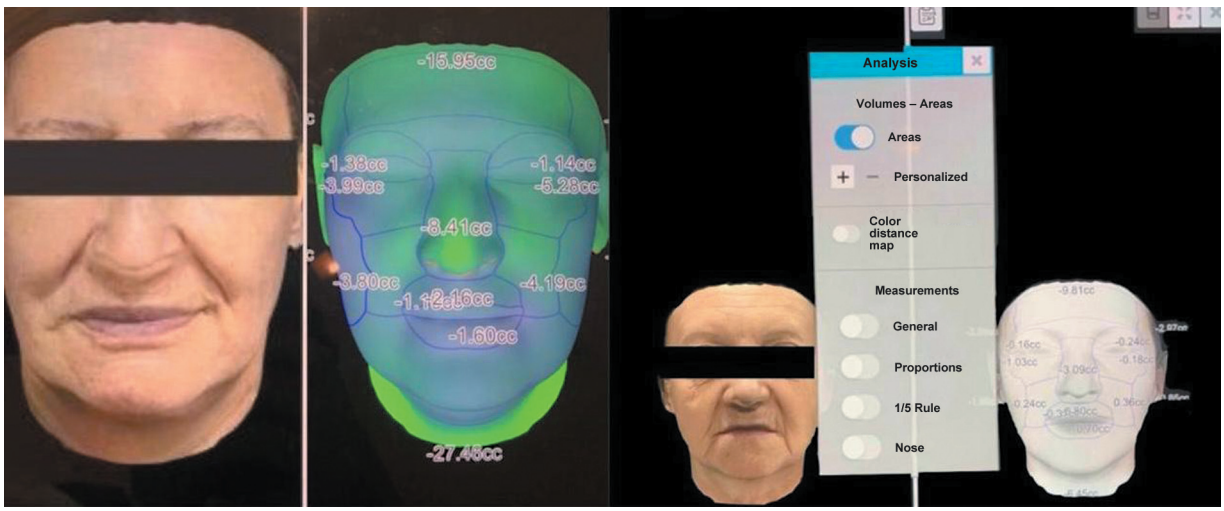

Fig. 1 Crisalix software analysis The Crisalix software uses three-dimensional (3D) images to assess facial volumization in presumably positive and negative areas of the face. It also performs a numerical, objective analysis of topography and texture. In the present study, it compared preoperative and postoperative findings. The image demonstrates the interface presented to the evaluator and the volumization assessment by facial areas.

Table 1 Summary of results from the FaceTag software

	Preop FaceTag	Postop FaceTag	FaceTag balance	Expert balance	Preop expert	Postop expert	Age expert
CSS	76	79	3	(+20)	40	60	10
CDS	79	78	-1	(+5)	50	55	0
CG	86	87	1	(+10)	40	50	3
ELA	75	77	2	(+5)	40	45	0
MDO	82	75	-7	(+20)	60	80	0
SB	78	81	3	(+20)	40	60	2
MJF	75	72	-3	(+5)	40	45	0
L	73	71	-1	(+5)	40	45	0
ZM	72	78	4	(+5)	50	55	0
TPP	71	74	3	(+10)	40	50	5
	Mean: 76.700	Mean: 77.200	Mean: 0.4	Mean: 0.8	Mean: 44	Mean: 54.5	
	SD = 4.667	SD: 4.661	SD: 3.438				

Abbreviations: Preop, preoperative; Postop, postoperative; SD, standard deviation.

Individually, the difference between the final and initial scores ranged from -7 to 4, with a mean value of 4. Overall, the mean increased 0.4 points from the preoperative to the postoperative periods (►**Table 1**).

Regarding facial volumization areas, we selected the Crisalix software to evaluate the positive and negative areas of the face and their degree of postoperative modification. ►**Tables 2–4** summarize the findings on the malar,

Table 2 Results from the Crisalix software regarding the malar region

Crisalix	Malar (right)	Malar (left)	Difference	Percentual difference
ELA	-232	-294	-062	+26%
MDO	-386	-345	041	-10%
SB	-028	-086	-058	+207%
MJF	-082	-216	-134	-163%
L	260	340	08	+30%
ZM	-38	-41	-03	+789%
TPP	450	270	-18	-40%
CDS	-024	036	06	+250%
CG	-15	-26	-11	-73%

Note: In this table, + and - signs in the last column indicate a percentage increase or decrease, respectively.

Table 3 Results from the Crisalix software regarding the masseteric region

Crisalix	Masseteric region (right)	Masseteric region (left)	Difference	Percentual difference
ELA	-721	-879	-158	+2,191%
MDO	-743	-485	258	-34.72%
SB	-189	085	274	+14,497%
MJF	-589	-344	245	-41.59%
L	589	360	-229	-38.87%
ZM	-49	-38	11	-22.44%
TPP	630	490	-140	-22.22%
CDS	-199	-085	114	-57.28%
CG	-32	-55	-23	-71.87%

Table 4 Results from the Crisalix software regarding the periorbital region

Crisalix	Periorbital region (right)	Periorbital region (left)	Difference	Percentual difference
ELA	-252	-207	045	-1,785%
MDO	-460	-432	028	-6.08%
SB	-101	-109	-008	+792%
MJF	-034	-177	-143	+42,058%
L	434	420	-014	-322%
ZM	-39	-52	-13	+3,333%
TPP	480	320	-16	-3,333%
CDS	-103	-018	085	-8,252%
CG	-34	-24	10	-2,941%

masseteric, and periorbital regions, respectively. It is worth highlighting that this analysis assessed nine patients. One subject did not present the required conditions and participated in other metrics.

These initial results demonstrate a significant variation between patients, reinforcing our premises on conceptualized symmetrization metrics combined with symmetrization in a single subject. For the malar region, the changes between the 2 sides of the face after surgery range from 7.89 (equation relating the postoperative difference to the preoperative value) to 250%. In the masseter, the variation was from 21.91 to 144.97%. In the periorbital region, the minimum and maximum percentage differences were 3.22 and 420.58%. Thus, this region simultaneously had the smallest and largest variation.

Despite the large value range, these results are not significant; therefore, they do not determine facial asymmetries. In a T-test model analysis, the *p*-value, which reflects the statistical relevance of the data, was higher than 0.25, indicating low significance. Moreover, volumization assessment is complex and, as it relies on photographic processing, it is subject to variables that influence the outcome.

In this context, it is worth discussing in greater depth some images used for volumization evaluation by the Crisalix software. Since the present study had 10 patients, we selected 2 as representatives of the group to allow a more detailed analysis.

►**Fig. 2** compares the outcomes in the 56-year-old patient, MDO, before and after surgery. The image demonstrates the symmetry achieved by the procedure. Reinforcing these findings, the analysis indicated excellent symmetry (►**Table 5**).

Percentage data ranged from 6 to 34%, with a mean value of 16.93, indicating symmetry. In addition, to reinforce this finding, the masseteric region, the site with the greatest discrepancy, did not present differences visible to the naked eye (►**Fig. 2**).

The patient ELA, 64-year-old, had satisfactory symmetrization outcomes, while MDO had good outcomes (►**Fig. 3**).

For ELA, the software's absolute results were usually higher compared with MDO. However, the mean percentage values of -26%, 21.91%, and 17.85%, are not so far apart, corresponding to 21.92%.

Fig. 2 Photographic records from patient MDO for software symmetrization.

It is worth noting that this patient is older than the first; even so, she presented satisfactory symmetrization outcomes, with no visible asymmetries (►**Table 6**).

Table 5 Symmetrization of the patient MDO using the Crisalix software

	MDO
Malar region (right)	-386
Malar region (left)	-345
Difference (malar region)	041
Percentual difference (malar region)	-10%
Masseteric region (right)	-743
Masseteric region (left)	-485
Difference (masseteric region)	258
Percentual difference (masseteric region)	-34.72%
Periorbital region (right)	-460
Periorbital region (left)	-432
Difference (periorbital region)	028
Percentual difference (periorbital region)	-6.08%

Fig. 3 Photographic records from patient ELA for software symmetrization.

Table 6 Symmetrization of the patient ELA using the Crisalix software

	ELA
Malar region (right)	-232
Malar region (left)	-294
Difference (malar region)	-062
Percentual difference (malar region)	+26%
Masseteric region (right)	-721
Masseteric region (left)	-879
Difference (masseteric region)	-158
Percentual difference (masseteric region)	+2,191%
Periorbital region (right)	-252
Periorbital region (left)	-207
Difference (periorbital region)	045
Percentual difference (periorbital region)	-1,785%

We evaluated the data using linear regression to compare the results from questionnaires, the software, and the examiner. This model allows inferences based on previous information. Integrated data processing revealed that, in a simplified way, the results were not comparable.

In the present analysis, the dependent variable was the expert's assessment. As the software, patient-related FACE-Q, and age-related FACE-Q results were independent variables, this is a multi-modal regression model (►**Table 7**).

The equation was lm(formula = log.expert ~ software + face q-o + face q-age, data = data), in which "lm" indicates the modal regression model, "log.expert" is the logarithm value of the dependent variable (expert's assessment), and the symbol ~ separates the dependent variable from the independent variables, as the first is a function of the second. In F-statistics, the predictive power of the independent variables was 0.2029. In an independent analysis, the p-value was 0.8907, denoting little statistical significance.

The results of FACE-Q ranged from 64 to 100, with a mean value of 86.6. Mode, that is, the most frequent value in a set, was 100, indicating significant patient satisfaction.

However, there was no correspondence between the individual sensations of the patients, the software findings, and the expert's assessment (►**Fig. 4**). To simplify the statistical analysis, ►**Table 7** shows the residual values, the difference between the expected and observed values (standard residuals), and the expected (fitted) values. The table demonstrates that the observed values are not close to the expected ones.

Discussion

The initial planning for any facial aesthetic procedure requires a thorough 3D evaluation of the changes in the different layers of the face.[7] We believe that software for assessing facial symmetry and volumization helps the surgical planning process. This tool may improve interaction with patients regarding areas with the greatest therapeutic requirements or asymmetry points feasible for surgical correction, facilitating their discussion. However, its role in

Table 7 Multi-modal regression model

Patient	Software	Face-Q-O	Face-Q-Age	Expert
CSS	(+3)	100	10	(+20)
CDS	(-1)	100	8	(+5)
CG	(+1)	79	3	(+10)
ELA	(+2)	87	7	(+5)
MDO	(-7)	100	10	(+20)
SB	(+3)	82	5	(+20)
MJF	(-3)	72	5	(+5)
L	(-1)	64	0	(+5)
ZM	(+4)	100	10	(+5)
TPP	(+3)	82	5	(+10)

Abbreviations: FACE-Q, Facial Assessment and Cosmetic Enhancement Quality of Life Questionnaire; Face-Q-O, FACE-Q overall assessment.
Note: The first column shows the patients, and the next three columns correspond to the independent variables. The last column refers to the expert's evaluation, that is, the dependent variable.

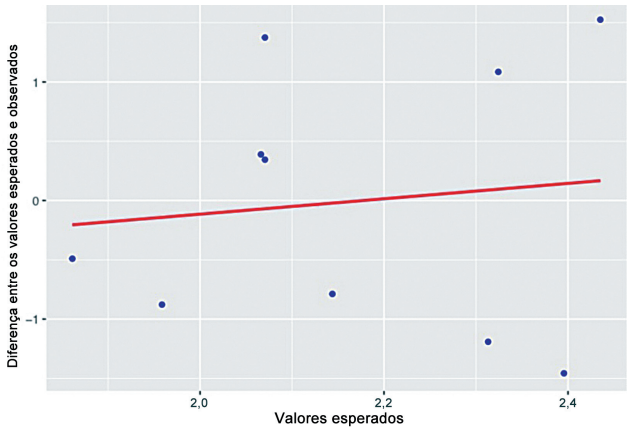

Fig. 4 Residual and fitted values.

postoperative assessment remains poorly understood and there is controversy about whether its results are enough to argue for a minimally satisfactory outcome after the procedure.

Facial rejuvenation evaluation considers many anatomical points to infer success, including volumization and malar projection.[8] In addition, studies demonstrated the current possibility of assessing preoperative and postoperative volumization differences with software using 3D stereophotogrammetry. In the present study, the areas requiring volumization to obtain a certain level of rejuvenation were the forehead, the temple, and the malar region. It is also worth highlighting areas presenting a negative postoperative balance, such as the nasolabial fold, thee marionette line, and the submental region.[9]

To assess satisfaction with facial aesthetic procedures, it is essential to standardize a comprehensive qualitative evaluation and use quantitative parameters to compare variables provided by software or experts. Different studies with similar proposals, including the HARMONY study, used the FACE-Q.[10] This questionnaire has been adapted and translated into Portuguese. It has several segments specifically addressing patient satisfaction with each outcome aspect during the follow-up week.[10]

According to the latest meta-analysis on recent recurrences after rhytidoplasty, the mean rate is 2.4% within 2 years after the procedure. As such, FACE-Q assessment must occur 1 year after surgery, when the current appearance of most patients will be a result of the surgery.[11]

The satisfaction results in the overall FACE-Q evaluation, although higher than the expert's assessment, had no statistical correlation nor the same correlation with the variables from the software. The lack of correlation between evaluations may result from multiple sources of error, as the present study refers to perceptions. The outcomes from combining fat grafting with rhytidectomy tend to be superior in terms of rejuvenation. The procedure is safe, just like other combinations.[12] Even though our patients underwent rhytidoplasty alone, without any associated procedures, the expert's perception, who already witnessed and obtained aesthetically-superior outcomes compared with this sample, may be underestimated.

It is worth highlighting the time between the photographic record and the satisfaction assessment using the questionnaire, which was at least 6 months (photographs were taken 6 months after the procedure). In addition, it is worth emphasizing that the light incidence (as photographs were taken in different environments) and the difference in muscle tone interfered with the expert's assessment, making photographic analysis challenging regardless of the incidence.

We attributed the lack of correlation between the software evaluation and other measurements to the differences in light incidence and values from each processed or evaluated unit. While the FaceTag software scores refer to fixed points and their correlations with each other, FACE-Q assesses and scores symmetry and other variables, such as age perception or volume distribution balance on the face. This difference in the weight of the value from these variables probably impacted the statistical difference between the quantitative scores from FACE-Q translated into Rasch tables and FaceTag.

Assessment with literature-validated volumization software requires technologies with a hardware infrastructure to obtain data from the patient at the office. We selected the Crisalix software for the present study because it needs only three incidences for the 3D reconstruction of the patient to calculate volumetric differences in each region. As such, it applies to previous photographic registration, lowering costs.

Although the processing is more practical and accessible, the volumization values obtained by the software presented no correlation between positive and negative areas. In addition to the lack of correlation between the values, the areas of facial demarcation for volumetric evaluation, although well defined, are not the same areas classically assessed in a subjective way neither by the patient nor by the expert plastic surgeon to check the subject's youthfulness, being useful for analyzing volumetric symmetrization alone.[13–16]

Conclusion

In our sample, there was no correlation between quantitative and qualitative variables from the different methods under evaluation. Therefore, further studies and adaptations are necessary to understand better the relationship between each method and the actual determination of surgical success.

Clinical Trials
None.

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Conflict of Interests
The authors have no conflict of interests to declare.

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