Case Series

Assessment of rhomboid flap scars: A patient reported outcome study. A case series

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A B S T R A C T

Introduction and importance: Local skin flap techniques, including rhomboid flap, have been developed to reconstruct cutaneous defects. Rhomboid flap advantages include easy design, excellent contour, texture, thickness, color match, and long-term good cosmesis. There is no patient reported outcome study in literature detailing patients' perception of appearance and satisfaction of scar appearance.
Methods: We studied 100 consecutive rhomboid flaps performed in 73 patients by a single surgeon. After at least one year from flap completion, a validated published Patient Scar Assessment Questionnaire (PSAQ) by Durani et al. was completed for each flap.
Results: The median age was 73 years, with a range of 21 years–94 years. Gender breakdown was 65 flaps in males and 35 flaps in females. For appearance, there were significantly greater frequency of "very well-matched scar" patients compared to "well-matched scar" patients ($p < 0.001$). There were no "a little matched" or "poorly matched" patients. For satisfaction of appearance scores, there were significantly greater frequency of "very satisfied" patients compared to "satisfied" patients ($p < 0.001$). There were no "dissatisfied" or "very dissatisfied" patients. Although *size* of primary defect was not statistically significant (p 0.071), there was a trend towards better appearance scar match and scar satisfaction for smaller defects. *Age* was not statistically significant (p 0.086), there was a trend towards better appearance scar match and scar satisfaction among older patients. There was no significant difference in appearance match and satisfaction scores based on the *gender* (p 0.733). There were no post-operative complications.
Conclusions: Our study confirms, in experienced hands, the long-term patient perception of well-matched scar appearance and scar satisfaction with rhomboid flap technique. A significantly greater frequency of patients were "very satisfied" than "satisfied", with no "dissatisfied" patients. There was no statistically significant difference based on age, gender, and size of the primary defect.

1. Introduction

Globally, one hundred million patients develop scars annually including 55 million from elective procedures [1,2]. Scar revision was the fourth most performed plastic surgery procedure in the United States in 2017 [3] making scar treatment market is a multibillion-dollar industry [4].

The rhomboid flap is a popular local flap used to reconstruct defects in most parts of the body [5]. These are full-thickness cutaneous local flaps, relying on dermal–subdermal plexus blood supply [5,6] and rotate around a pivot point into an adjacent defect [5,7].

Its major benefit over primary closure is better distribution of tension [8]. This decreases the risk of distortion of adjacent anatomic architecture. The "broken" scar also makes it less noticeable [9] (Fig. 1).

The premise was that rhomboid flap leads to good healing and good quality of scars. Although objective assessment of scars by experienced clinicians is important, the subjective perception of our patients is equally important. But to date no rhomboid flap patient reported outcome studies have been published in English literature.

We conducted a literature search for patient scar assessment tools using National Center for Biotechnology Information (NCBI) at the U.S. National Library of Medicine (NLM) and PubMed. We found several scar assessment scales that assess the appearance and symptoms of scars including the Vancouver Scar Scale (VSS) [10] and Patient and Observer
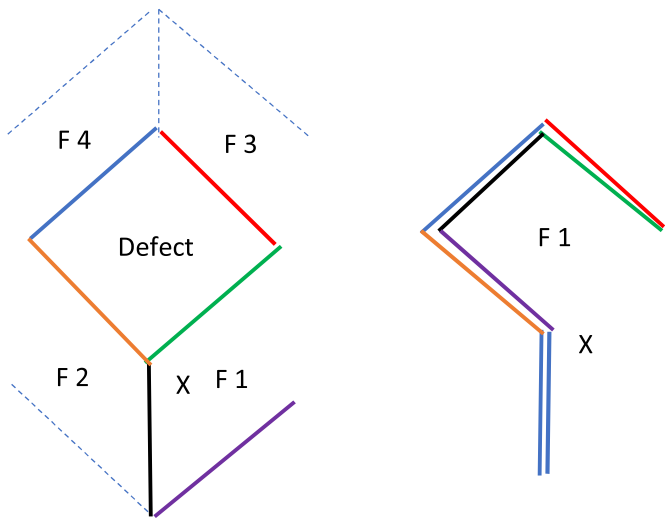

Fig. 1. The design is a rhombus with two angles of 120° and two angles of 60°. All sides are equal. A. Several possible flap designs exist for any defect. Four possible flaps, F 2, F 3, F 4 (broken lines), and F 1 (solid lines) are shown. B. Flap F 1 is chosen and rotated across the pivot point, X, superiorly to reconstruct the defect.

Scar Assessment Scale (POSAS) [11,12]. In 2009, Durani et al. published a new scar assessment tool, called the Patient Scar Assessment Questionnaire (PSAQ), meant to be administered exclusively to scar patients, and focused on quantifying patient-centered outcome measures related to scar appearance, symptoms, consciousness, and satisfaction [13].

We chose PSAQ because its rigorously validated with proven high internal consistency and reliability. Subscales could be used independently of each other to allow assessment of scar change in specific domains. The results would help guide our discussions with future patients and set scar expectations.

2. Study design and methods

Ethical approval was obtained from the Institutional Review Board at University of Pittsburgh Medical Center, Pittsburgh, PA. In accordance with the Declaration of Helsinki, this study was registered with International Standard Randomized Controlled Trial Number (ISRCTN) number 12112103. https://www.isrctn.com/ISRCTN12112103.

A retrospective chart review of all consecutive records from September 01, 2019, through January 21, 2020, was completed to identify patients who underwent cutaneous excision followed by rhomboid flap closure. We contacted each patient and obtained a verbal consent to participate in the study. A telephone interview was conducted with each patient and questions from a prospective validated PSAQ questionnaire were asked. All lesions and scars were visible to the patients. Furthermore, all patients had good vision and were mentally alert to understand and answer the questions appropriately.

The results were entered into an Excel spreadsheet. Data collected included date of diagnosis, age, gender, race/ethnicity, location of flap/ scar, size of primary cutaneous defect, and common postoperative wound complications such as bleeding, infection, dehiscence, flap loss, need for scar revision (Appendix 1).

PSAQ is a completely patient-centered scar evaluation tool which uses a series of 39 questions to evaluate the patient perception of their scars. The original questionnaire reported five subscales (i.e., Appearance, Symptoms, Consciousness, Satisfaction with Appearance, and Satisfaction with Symptoms) with multiple categorical response items. Since subscales can be used independently of each other to allow assessment of scar change in specific domains, we focused on appearance and satisfaction with appearance (Appendix 2).

Each subscale consisted of a set of questions with 4-point categorical

responses, scoring 1 to 4 points (where 1 point was the most favorable response and 4 was least favorable). It aims to capture patients' assessment of the physical and symptomatic features of their scars as well as their subjective experience.

The appearance subscale captures patient observations of scar size, color relative to surrounding skin, height, radiance, and texture. The satisfaction subscale targets the same features as the appearance but instead focus is on patients' satisfaction regarding those attributes. The following range of scores is possible for each subscale, with higher scores reflecting a poorer perception of the scar related to the domain being evaluated:

Based on Lipman et al.'s publication, the appearance and satisfaction with appearance subscales were each divided into four levels based on cumulative score [11].

Inclusion criteria: All consecutive patients 18 years and older who underwent reconstruction of cutaneous defect using a rhomboid flap between 9/1/2019-01/31/2020 by primary author. We estimated 100 patients who underwent rhomboid flap reconstruction during this period.

Exclusion criteria: Rhomboid flap performed in patients aged under 18 years, patients with incomplete data, deceased patients, and with non-rhomboid flap reconstruction.

Potential risks and likelihood: There were no adverse events or alternative treatments as this was a retrospective chart review.

Secondary outcome measured included the relationship of these scores with gender, ethnicity, and size of defect. We also measured the incidence of common complications, specifically bleeding, infection, dehiscence, flap loss and need for scar revision. Statistical analyses were performed a statistician at Gannon University, Erie, PA. Mann Whitney *U* test, Pearson's correlation and binomial test were conducted on the collected data. This case series has been reported in line with the PROCESS Guideline [14].

3. Results

We approached 80 patients to participate in the study, out of which 73 acquiesced. 100 consecutive rhomboid flaps were performed in 73 patients. The indication for each defect was reconstruction of cutaneous defects. Age, gender, race, location, size, site of operation, appearance score, satisfaction score, and postoperative complications were recorded.

65 flaps were completed in males and 35 flaps were completed in female patients (Table 3). 99 flaps were performed in Caucasians and 1 flap in African American patient. The location of flap reconstruction was face 41% (Fig. 2), extremity 28%, trunk 22% and scalp 9%. The flaps were performed in office 98% and surgery center 2%. The size of the primary defect ranged from 0.5 cm × 0.5 cm–4.5 cm × 4.5 cm.

The median age was 73 years and mean age was 71.1 year with a range of 21 years–94 years. (Table 4) (see Table 1). For the purposes of this survey, an appearance score of 9 was termed "very well-matched", and satisfaction score of 8, was termed "very satisfied", appearance score of 18 was termed "well-matched", and satisfaction score of 16, was termed "satisfied", and appearance score of 36 was termed "poorly matched", and satisfaction score of 32, was termed "very dissatisfied" (Table 2). For appearance scores, 90% of patients reported "very well-

Table 1

Appearance and Satisfaction subscales.

Subscale	Number of Scored Items	Minimum Score	Maximum Score
Appearance: How well does the scar match the surrounding skin?	9	9	36
Satisfaction with Appearance: How satisfied are you with way the scar?	8	8	32

Table 2
Levels of appearance and satisfaction with appearance subscales.

Subscale	Level	Score
Appearance	Very well matched	9
	Well matched	18
	A little matched	27
	Poorly matched	36
Satisfaction with appearance	Very Satisfied	8
	Satisfied	16
	Dissatisfied	24
	Very dissatisfied	32

Table 3
Frequencies for gender. 65% of responders were males and 35% were females.

Sex	Frequency	Percent	Valid Percent	Cumulative Percent
Female	35	35	35	35
Male	65	65	65	100
Total	100	100		

matched scar", 10% were "well-matched", 0% "little-matched" and 0% "poorly-matched" (Table 5). For satisfaction of appearance score, 90% of the patients were very satisfied, 10% of the were satisfied, 0% "dissatisfied" and 0% "very dissatisfied" (Table 6).

3.1. Effect of size of primary defect with appearance and satisfaction of appearance score

For appearance, the scores were lower, mean 9.6, (denoting higher matched scar) for smaller primary defect (<1 cm × 1 cm) than larger primary defect (>1 cm × 1 cm) mean score 10.7 (Table 7). Mann-Whitney U test was used to examine if the average appearance and satisfaction scores were significantly different for those with smaller primary defect than larger defect. Mann-Whitney U was used instead of Student's t because the data was not normally distributed. In general, the smaller the W number, less likely that it would have occurred by chance. Mann Whitney statistic was 842.0 with a p value was 0.071. This signifies that although there was a trend towards better matched scar appearance with smaller primary defects, but it was not statistically significant (Table 8). Similarly, for satisfaction, the mean score was also lower (denoting higher satisfaction) for smaller (8.5) wounds than larger (9.5) wounds (Table #5). However, the W was 842.00 and p value was

again 0.071 and not statistically significant.

3.2. Effect of gender with appearance and satisfaction score

Mann Whitney U test was also used for examining the effect of

Table 4
Age, appearance, and satisfaction scores. Median age was 73 years and mean were 71.1 years.

	Age (years)	Appearance	Satisfaction
Median	73.0	9	8
Mean	71.1	9.9	8.8
Standard Deviation	13.0	2.7	2.4
Minimum	21.0	9	8
Maximum	94.0	18	16

Table 5
Frequency Table for appearance score levels.

Appearance	Level	Frequency	Percent	Valid Percent	Cumulative Percent
9	Very well-matched	90	90	90	90
18	Well-matched	10	10	10	100
27	Little-matched	0	0	0	100
36	Poorly-matched	0	0	0	100
Total		100	100		

Table 6
Frequency Table for satisfaction with appearance score levels.

Satisfaction	Level	Frequency	Percent	Valid Percent	Cumulative Percent
8	Very Satisfied	90	90	90	90
16	Satisfied	10	10	10	100
24	Dissatisfied	0	0	0	100
32	Very Dissatisfied	0	0	0	100
Total		100	100		

Fig. 2. A, B and C. Reconstruction of anterior thigh defect with rhomboid flap. A. Appearance of the cutaneous defect prior to excision. B. Appearance of the "broken" scar one day after excision. C. Appearance of the scar 1 year after excision. At one year, the scar is very well-matched and difficult to see.

Table 7

Size of primary defect and appearance and satisfaction scores.

	Group	N	Mean	SD (Standard Deviation)	SE (Standard Error)
Appearance	<1 cm × 1 cm	74	9.6	2.2	0.3
	>1 cm × 1 cm	26	10.7	3.6	0.7
Satisfaction	<1 cm × 1 cm	74	8.5	2.0	0.2
	>1 cm × 1 cm	26	9.5	3.2	0.6

Table 8

Comparison of small vs large sized primary defect on appearance and satisfaction scores, Mann-Whitney *U* test.

	W (Mann-Whitney Statistic)	p (probability value)
Appearance	842.00	0.071
Satisfaction	842.00	0.071

gender on scores. For appearance, the mean score for women was 10.02 and for men it was 9.8 (Table 9). However, the W (Mann-Whitney Statistic) was 1162.5 and difference was not statistically significant. the p value was 0.733 (Table 10). For satisfaction with appearance, the mean score for women was 8.9 and for men it was 8.7 (Table 9). However, the W (Mann-Whitney Statistic) was 1162.5 and difference was not statistically significant. p value was 0.73 (Table 10). This signifies that the patient's gender did not have any effect on the appearance and satisfaction scores.

3.3. Effect of age with satisfaction and appearance score

Pearson's correlation was used to determine effect of age with appearance and satisfaction scores. Appearance and Satisfaction scores show a perfect correlation (r = 1.0, p < 0.01). This means that all responders who reported very well-matched scar appearance were also very satisfied with the scar. Age is almost significantly negatively correlated with appearance (r = −0.173, p = 0.086). But Pearson's correlations suggest a p value of 0.086 (Table 11). Although not statistically significant, the trend suggests that older patients were more likely to report better matched scar appearance and higher satisfaction with the scar.

Two binomial tests were used to determine if patients scoring "9" for appearance ("very well-matched") were significantly different from those scoring "18" ("well-matched"). Similarly, if patients scoring "8" for satisfaction (very satisfied) was significantly different from those scoring "16" (satisfied). The results prove a highly significant difference (90% versus 10%, p < 0.001) proving a significantly higher frequency of "very well-matched scar' appearance than "well-matched" scar appearance. Also, a significantly higher frequency "very satisfied" patients than even "satisfied" patients (Table 12).

Finally, patients were asked about common post-operative complications, specifically bleeding, infection, flap loss, dehiscence or need for scar revision. And out of 100 flaps, there were no instances where a post-operative complication was reported (Table 13).

Table 9

Gender and appearance and satisfaction scores.

	Group	N	Mean	SD (Standard Deviation)	SE (Standard Error)
Appearance	Female	35	10.0	2.9	0.5
	Male	65	9.8	2.6	0.3
Satisfaction	Female	35	8.9	2.5	0.4
	Male	65	8.7	2.3	0.3

Table 10

Effect of gender on appearance and satisfaction scores, Mann-Whitney *U* test.

	W (Mann-Whitney Statistic)	P (probability value)
Appearance	1162.5	0.73
Satisfaction	1162.5	0.73

Table 11

The correlation of age with appearance and satisfaction scores. The linear correlation between two sets of data examined by Pearson's correlation coefficient.

	Group	Appearance	Satisfaction	Age (years)
Appearance	Pearson's r	–		
	p-value	–		
Satisfaction	Pearson's r	1.0	–	
	p-value	<0.01	–	
Age (years)	Pearson's r	−0.17	−0.17	–
	p-value	0.086	0.086	–

Table 12

Two binomial tests to determine if the number of "very well-matched scar appearance" and "very satisfied" patients was significantly different from the number of "well-matched scar appearance" and "satisfied" patients, respectively.

Variable	Score	Level	Number	Total	Proportion	P
Appearance	9	Very well-matched	90	100	0.90	<0.001
	18	Well-matched	10	100	0.10	<0.001
Satisfaction	8	Very Satisfied	90	100	0.90	<0.001
	16	Satisfied	10	100	0.10	<0.001

4. Discussion

We believe that reconstruction of each defect should be tailored to the unique characteristics of the defect, patient expectations, and surgeon's experience [15]. At times, primary closure and skin grafts may result in distortion, contour deformity, or unacceptable scarring making local flaps the preferable option [16]. In addition, fusiform (elliptical) excision with primary closure may leave a central depression with a flat contour and "dog ear" peaks on both ends [17]. To avoid this dog-ear deformation, an incision length-to-width ratio of 3:1 may be required, creating a longer linear scar and in the process, relatively large portions of healthy skin around the defect may have to be sacrificed [18]. Local flaps such as Rhomboid flaps do not have these limitations [19]. A meta-analysis revealed a lower relative risk of dehiscence and wound infection for rhomboid flaps compared with primary closure [20].

A patient's perception of scar quality is especially important in Plastic Surgery. A survey involving plastic surgery procedures revealed that 91% of all postoperative patients are dissatisfied with their final scars and would value minor improvement [21]. However, there is no patient reported outcome study in literature detailing patients' perception of appearance and satisfaction of Rhomboid flap scar.

The initial scar assessment scales such as VSS, Visual Analog Scale (VAS), Manchester Scar Scale [22], Stony Brook Scar Evaluation Scale [23] did not include patient's perceptions [24].

Ultimately, PSAQ represented a shift from clinician-centered to patient-centered scar assessment and demonstrated external validity, internal consistency, high level of sensitivity, and stability over time. It

Table 13

No post-operative complications reported.

Number of flaps	Postoperative Complication
100	0

offers the ability to select individual subscales without affecting reliability or validity. Economopoulos et al. elected to include only the appearance, symptoms, and consciousness subscales in their questionnaire [25]. Similarly, we chose two subscales, appearance, and satisfaction with appearance, to limit the time required of respondents and enhance the response rate.

Since the remodeling phase of skin wound healing lasts up to one year [26], we waited at least one year after the flap reconstruction for questionnaire completion. The mean age was 71.1 year with a range of 21 years–94 years. Although not statistically significant, older patients were more likely to report better matched scar appearance and higher satisfaction with the scar. Most flaps were performed in an office setting under local anesthesia with the size of primary defect ranging from 0.5 cm × 0.5 cm–4.5 cm × 4.5 cm. Statistical analysis revealed there was a trend towards better matched scar appearance for smaller primary defects than larger defects, but this was not statistically significant. Similarly, there was a trend towards better satisfaction for smaller defects than larger defects but again not statistically significant.

Out of 100 flaps, approximately two-thirds were males and 99% of the flaps were performed in Caucasians. Data analysis signified that the patient's gender did not have any effect on the appearance and satisfaction scores. The face was the most common location followed by extremity, trunk and finally the scalp was the least common area.

All patients who reported very well-matched scar appearance were also very satisfied with the scar. For appearance, a significantly higher "very well-matched" (90%) scores than well-matched" scores were reported. Similarly, a significantly higher (90%) patients were highly satisfied than satisfied (10%) of patients. There were no dissatisfied or very dissatisfied patients. The patients did not report any common postoperative complications, specifically, bleeding, infection, dehiscence and need for scar revision. The possible explanation is that all procedures were elective, office-based procedures and were performed by the senior author who has personally performed thousands of similar procedures with well-developed post-procedure instructions and follow-up.

4.1. Limitations

This study is a single center retrospective study with a relatively small study group, which may affect the generalizability of the results. But there is no similar study reported in the English literature. Furthermore, 99% flaps were performed in Caucasians. Even though this is based on our region's demographics and referral patterns, majority of cutaneous malignancies do occur in Caucasians. However, the ethnical diversity of the world may affect the applicability of the results. The authors believe that in expert hands, these results may be reproducible in diverse populations, but further studies are needed. The mean age of our cohort is 71.1 years but again, cutaneous malignancies are seen more commonly in older individuals. Although any surgical procedure has potential for complication. Individuals with lesser experience may not see similar results. It takes a very long time to administer PSAQ, increasing user frustration and demotivation. This was the reason we chose two subscales, to shorten the time it took to complete the questionnaire. Finally, there is no control group. But this is a patient reported outcomes study and the aim is to evaluate patient's own perception of their rhomboid scar.

4.2. Future

Larger patient reported outcome studies are needed to validate the findings of this study. In addition, more patient-centered tools are needed to understand the reasons of a patient's dissatisfaction with their scar and help direct treatment options to improve patient experience.

5. Conclusion

Scar appearance and satisfaction are important in plastic surgery patients. Durani's PSAQ is a validated, reliable, scar assessment tool for conveying patients' opinion. We found, regardless of size of defect, location on the body, gender and age of the patient, a rhomboid flap reconstruction performed by an experienced surgeon results in a scar which in long term is very well matched to surrounding skin and results in very high patient satisfaction. We believe patient rhomboid scar perceptions may help physicians improve communication, education, and medical decisions.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.103328.

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