Breast and abdominal scarring after DIEP flap breast reconstruction: An exploration of patient-reported scar quality

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Abstract *Purpose:* This research aimed to explore factors associated with patient-reported breast and abdominal scar quality after deep inferior epigastric perforator (DIEP) flap breast reconstruction (BR).

Material and Methods: This study was designed as a descriptive cross-sectional survey in which women after DIEP flap BR were invited to complete an online survey on breast and abdominal scarring. The online survey was distributed in the Netherlands in several ways in order to reach a diverse population of women. Outcomes were assessed with the Patient Scale of the Patient and Observer Scar Assessment Scale (POSAS). Additional items were assessed with a numeric rating scale (NRS).

Results: A total of 248 women completed the survey. There was a statistically significant worse POSAS scar appraisal for the abdominal scar compared with the breast scar. The vast majority of women reported high scores on at least one scar characteristic of their breast scar or abdominal scar. Overall, color, stiffness, thickness, and irregularity scored higher than pain and itching. Women were only moderately positive about the size, noticeability, location, and the information provided regarding scarring.

Conclusion: It is crucial to address the inevitability of scars in patient education before a DIEP flap BR, with a particular focus on the abdominal scar, as women experience abdominal

scars significantly worse than their breast scars. Providing more information on the experience of other women and the expected appearance will contribute to having realistic expectations while allowing them to make well-informed decisions.

Introduction

The number of women who undergo breast reconstruction (BR) surgery after a mastectomy to restore psychological well-being, body image, self-esteem, and satisfaction with appearance, has grown increasingly[1,2]. Various reconstructive techniques exist for BR, varying from implant-based to autologous procedures. The deep inferior epigastric perforator (DIEP) flap has become one of the most widely used techniques for autologous BR[3].

Women's motives for choosing DIEP flap BR are mainly focused on regaining a breast that resembles their lost breast, and to benefit from the advantages of using autologous tissue. Clinical factors that contribute to the decision-making for BR type are as follows: previous radiation therapy precluding implants or the availability of donor tissue for autologous BR. Another motive could be the beneficial abdominoplasty effect of a DIEP flap procedure after closure of the donor site[4].

Compared with other autologous reconstruction techniques, the DIEP flap patients have the highest level of satisfaction[5]. Nevertheless, scarring is an inevitable outcome after surgery. Compared to other reconstruction methods, the DIEP flap has the most extensive donor site scar, i.e., abdominal scar[6]. Both breast[1,7] and abdominal scars[8] can influence the overall satisfaction after BR. Nevertheless, little is known about how women appraise their breast and abdominal scars after DIEP flap BR. Based on our previous research on scarring after breast surgery[9], scar characteristics such as pain, stiffness, movement restrictions, noticeability, location, and size, determine scar appraisal. Furthermore, it is unknown how factors such as patient characteristics (e.g. BMI, age), surgery characteristics (e.g. the timing of DIEP flap reconstruction, complications), and satisfaction about provided information are associated with the patient-reported scar quality.

As there is a need for knowledge about how women experience breast and abdominal scarring and which factors are associated with this scar quality, a cross-sectional survey was conducted. Our study aimed to explore factors associated with the patient-reported scar quality after DIEP flap.

Methods

Design

This study was designed as a descriptive cross-sectional survey in which women after DIEP flap BR were invited to complete an online survey on breast and abdominal scarring.

According to the reporting items stated in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)[10].

Setting

The online survey was distributed between February 17th and May 5th, 2019, in several ways in order to reach a diverse population of women who had undergone a DIEP flap BR. Women were invited directly from two hospitals (Radboudumc and Maastricht UMC+, the Netherlands), 516 women who had previously given their consent to participate in scientific research, were approached by e-mail. In addition, women were invited indirectly through social media.

Participants

Women were eligible when they had undergone a DIEP flap BR at least six weeks ago with a maximum of 10 years, a prophylactic or curative, uni- or bilateral, total or skin-sparing BR. Inclusion criteria were: being over 18 years old and being able to read and answer the Dutch survey. Women were asked to participate regardless of the presence, the degree, or type of scar symptoms, irrespective of whether they had (had) additional therapy for the scar(s). Any chemotherapy and/or radiation should have been completed.

Data collection

The survey consisted of items regarding patient- and surgical characteristics, patient-reported breast, and abdominal scar symptoms and satisfaction.

The patient-reported scar quality was assessed using the Dutch version of the validated patient scale of the Patient and Observer Scar assessment scale (POSAS) 2.0[11,12] for both the breast and abdominal scars. The POSAS consists of six items on scar characteristics: pain, itching, color, thickness, irregularity, stiffness. Items were scored on a 10-point scale, with '1′ indicating normal skin (normal pigmentation, no itching, etc.) and '10′ indicating the worst possible scar[13]. The 'total score' of the POSAS ranges between 6 and 60, where 60 corresponds to most scar complaints. Subsequently, the patients' overall opinion of the scar is assessed with one stand-alone item, where '10′ corresponds to the worst imaginable scar[13]. Furthermore, scar symptoms numbness, stinging/tingling sensations, tightness, and movement restrictions, were assessed on a numeric rating

scale (NRS) based on our previous research[9]. The items were scored on a 10-point scale, where 1= 'no, not at all' and 10= 'yes, very much'.

Satisfaction regarding noticeability, location, and size of the scar and satisfaction about provided information were scored on a 10-point-scale, whereas 1= 'very dissatisfied' and 10= 'very satisfied'. The item satisfaction with provided information could be answered with: 'I don't know'. Women with multiple breast scars were instructed to choose the worst scar when completing the survey.

Ethics

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of the Radboudumc Nijmegen The Netherlands (registration number 2018-4916). Participants have been explicitly asked for their consent after reading the information. The anonymity of the participants was guaranteed.

Statistical analysis

The primary outcome of patient-reported scar quality was analyzed using descriptive statistics. The POSAS outcomes were divided into three categories:

1. 1= Low score, no differences with normal skin: POSAS score 1;
2. 2= Intermediate scores, minor differences with normal skin: POSAS scores 2 or 3;
3. 3= High scores, major differences with normal skin: POSAS item score ≥ 4[14].

Scar characteristics measured with the POSAS and additional NRS items to assess scar quality and satisfaction were reported in mean values ($\pm$SD). Paired t-test was used to assess the statistical difference ($p \leq 0.05$) between the POSAS scores of the breast and abdominal scar.

In order to explore the association between the dependent variables (POSAS total scores breast and abdominal scarring) and independent variables (patient characteristics, surgery characteristics and satisfaction about provided information), two multiple linear regression analyses were performed. A limited number of candidate variables, based on clinical expertise, scientific evidence, and practical feasibility were first assessed univariate. Variables assessed univariate were age at the time of the survey, BMI[15], Fitzpatrick skin type (1,2 vs. ≥ 3)[15,16], cup size ($<$ D vs. $\geq$ D), history of breast cancer or not (preventive incl. pre-breast cancer). Surgery characteristics were: time since DIEP flap reconstruction, direct or indirect reconstruction, laterality, surgical complications[14,15], radiation in the breast area[17] and currently experienced symptoms in the breast or abdominal scar area. The mean of the four items regarding satisfaction on the information provided was entered into the model, when the respondents answered the option 'I don't know' they were handled as missing data. The significance criterion for inclusion in the multiple regression analyses was set at $p < 0.3$[18].

Preliminary analyses were conducted to test the assumption of normal distribution and multicollinearity. The analyses suggested that there was no violation of normality. Histograms were symmetrical and approximately bell-shaped, indicating normal distribution. The variance inflation factor (VIF) was $+/-$ 1, suggesting that multicollinearity was not present[19-21]. Complete case analysis was used in case of missing data. SPSS Statistics, version 25.0 (IBM Corp., Armonk, New York) was used for the analyses.

Results

Participants

A total of 252 women completed the questionnaire; four women did not meet the inclusion criteria and were therefore excluded. Participants had an average age of 52. On average, it was 2.6 years ago as the participants had their BR. The majority of women (75%) had a history of breast cancer (Table 1).

Overall opinion of scarring after DIEP flap

There was a statistically significant difference in the POSAS overall opinion of the breast scar ($M = 4.2$) and abdominal scar ($M = 5$), $p < 0.001$. In line with this, the POSAS total score, was significantly lower for the breast scars ($M = 22.6$), compared to the abdominal scars ($M = 25.9$); $p < 0.001$ (Table 2).

About 10% of the participants assessed their breast and abdominal scar as the most beautiful scar possible (overall opinion POSAS = 1). However, 48% of the participants reported high scores (POSAS ≥ 4) for their breast scar, and 65% reported high scores for the abdominal scars, indicating major differences between the scars and their normal skin.

Patient-reported scar characteristics and symptoms

The majority of women reported high scores on the POSAS (≥ 4) on at least one scar characteristic of their breast scar (79%) or abdominal scar (83%). A large proportion of these women expressed high scores on both scars (70%). A small proportion of women experienced major differences with normal skin on all six scar items on their breast scar (8.9%) and a slightly larger proportion on their abdominal scar (16.5%) (Figure 1 and 2). Only a small proportion of women experienced no symptoms for both scars at all.

Considering the various scar characteristics assessed with the POSAS, we found that color, stiffness, thickness and irregularity were scored relatively higher than pain and itching. In line with the low scores on average, more than half of the women did not experience pain or itching on their breast scar or abdominal scar. Remarkably, over 50% of the women reported high scores on color, stiffness, thickness, or irregularity. The color of the scar was scored worst for both the breast and the abdominal scar. All six POSAS scar characteristics were statistically significantly lower for the breast

Table 1 Patient characteristics.

N = 248	Mean	(±SD)
Age (year)	51.8	(8.95)
Time since DIEP (year)	2.6	(1.86)
BMI (kg/m^2)	27.1	(3.49)

	n	%
Respons[1]		
Invited direct by hospitals	159	64
Invited indirect by social media	91	37
Cup size		
< D	150	60
≥ D	98	40
Fitzpatrick Skin type		
1, 2	148	60
3-5	100	40
Time of reconstruction[2] (n = 247)		
Direct	68	28
Indirect	179	72
Laterality		
Unilateral	140	56
Bilateral	108	44
History of breast cancer[3]		
Breast cancer history	187	75
No breast cancer history	61	25
Radiation[4]	99	40
Self-reported complications[5]		
Breast	105	42
Abdomen	105	42
Self-reported current symptoms[6]		
Breast	110	44
Abdomen	94	38

[1] More answers possible, some women were invited by the hospital and social media.

[2] 1 missing due to incorrect data entry for date.

[3] The category 'No breast cancer history' includes women with pre breast cancer and prophylactic surgery.
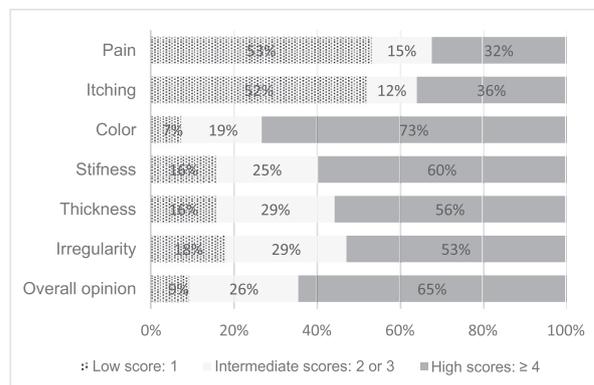
[4] 43 participants had a bilateral prophylactic mastectomy, no radiation was indicated.

[5] Breast: Infection 12%, seroma 5%, wound dehiscence 17%, fat or flap necrosis 12%, other 27%. Abdomen: Infection 10%, seroma 5%, wound dehiscence 21%, necrosis 4%, abdominal hernia 6%, other 12%.

[6] Breast: Edema 22%, (nerve)pain 21%, radiation damage 13%, other 9%.Abdomen: edema 8%, nerve pain 7%, other 19%.
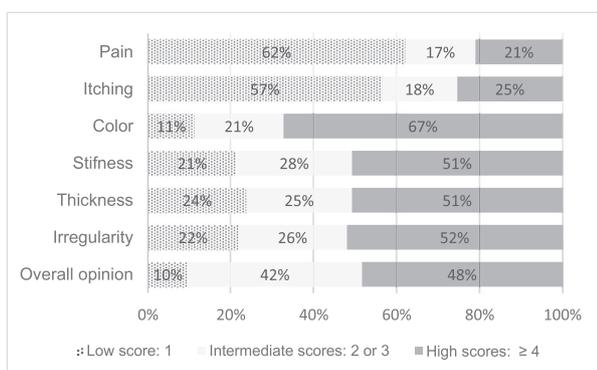
Figure 2 Abdominal scar: Percentage of women with low, intermediate or high scores on the POSAS.
Note Figure 1 and 2:
1= Low score, no differences with normal skin: POSAS score 1;
2= Intermediate scores, minor differences with normal skin: POSAS scores 2 or 3;
3= High scores, major differences with normal skin: POSAS item score ≥ 4[14].

scars than the abdominal scars ($p \leq 0.05$) (see Table 2; Figures 1 and 2).

Of the additional assessed scar symptoms, numbness was scored highest for both scars, reflecting a higher degree of numbness. On the contrary, the presence of stinging sensations, tightness, and movement limitations were scored relatively low. Only the tightness of the abdominal scar was experienced significantly worse than the breast scar. The other symptoms were not experienced significantly different (see Table 2).

Satisfaction with noticeability, location, and size

Concerning the satisfaction of with the scars, women were moderately positive. Women were most satisfied with the location of the scar for both the breast and the abdominal scars ($M = 6.8/M = 6.6$). The noticeability and the size of the scars were scored significantly worse for abdominal scars ($M = 5.5/M = 5.4$) (see Table 2).

Satisfaction with the information provided

Participants were only moderately positive about the information provided about the scars that would occur after the DIEP flap BR. The mean rating ranged from 5.8 to 6.5 on a scale of 10. They were least satisfied with the information provided about possible symptoms of both scars. Most women were satisfied with the information provided about the appearance of the breast scar (see Table 2).

Variables associated with patient-reported scar quality

After univariate regressions, aimed at exploring factors associated with breast scar quality, the set of variables: age, time since DIEP flap BR, BMI, laterality, complications,

Figure 1 Breast scar: Percentage of women with low, intermediate or high scores on the POSAS.

Table 2 Breast and abdominal scar quality: POSAS and survey responses.

POSAS	Breast scar Mean	(± SD)	Abdominal scar Mean	(± SD)	p
Pain	2.2	(2.1)	2.9	(2.6)	<0.001
Itch	2.6	(2.3)	3.2	(2.8)	<0.001
Color	5.1	(2.6)	5.7	(2.7)	.001
Stiffness	4.3	(2.8)	4.9	(2.8)	<0.001
Thickness	4.2	(2.8)	4.7	(2.9)	.003
Irregularity	4.2	(2.8)	4.6	(2.9)	.042
POSAS total score	22.6	(12.5)	25.9	(13.4)	<0.001
Overall opinion	4.2	(2.4)	5.0	(2.6)	<0.001

Note: POSAS= Patient and Observer Scar assessment scale, 1= Normal skin; 10= Worst imaginable scar or sensation.

Scar symptoms					
Numbness	5.8	(3.4)	5.6	(3.3)	.195
Stinging and tingling sensations	2.9	(2.7)	2.8	(2.5)	.212
Tightness	3.0	(2.8)	3.8	(3.1)	<0.001
Movement restrictions	2.9	(2.8)	3.2	(2.9)	.236

Note: 1= No, not at all; 10= Yes, very much

Satisfaction					
Noticeability	6.3	(2.6)	5.5	(2.9)	<0.001
Location of the scar	6.8	(2.6)	6.6	(2.8)	.401
Size of the scar	6.4	(2.8)	5.4	(2.8)	<0.001

Note: 1= Very dissatisfied 10= Very satisfied

Satisfaction provided information:					
Expected appearance[1]	6.5	(2.8)	6.3	(2.6)	.267
Possible symptoms[2]	5.8	(2.8)	5.8	(2.7)	.974
Prevention of possible symptoms[3]	6.4	(2.8)	6.2	(2.7)	.195
What to do in case of symptoms[4]	6.2	(2.7)	6.0	(2.7)	.080
Mean satisfaction[5]	6.2	(2.4)	6.0	(3.4)	.056

Note: 1= Very dissatisfied 10= Very satisfied. Because satisfaction with information could be answered with 'I don't know', the calculation were made with the cases who did scored on the 10-point-scale. [1] n = 241/ n = 240, [2] n = 233/n = 236, [3] n = 238/n = 239, [4] n = 232/n = 232, [5] n = 215/n = 220

current symptoms, and satisfaction about information regarding scarring has been entered into the multiple regression model (Table 3). This set of variables is significantly associated with the POSAS total score, $p < 0.001$, $R^2 = 0.23$. This model indicates that experiencing current symptoms in the breast area is associated with a worse scar appraisal. A better scar appraisal by women in our study population is associated with a longer time since surgery and an increase in satisfaction about the information provided about their breast scars. The variables age, BMI, laterality, and complications, did not make a statistically significant unique contribution to the equation (Table 3).

After univariate regressions for abdominal scar quality, the set of variables: age, time since DIEP flap reconstruction, skin type, complications, current symptoms, and satisfaction about information regarding scarring has been entered into the multiple regression model (Table 4). This set of variables is significantly associated with the POSAS total score, $p < 0.001$, $R^2 = 0.34$. This model indicates that complications after surgery and current symptoms are associated with a worse abdominal scar appraisal. A better scar appraisal is associated with an increase in age, an increase in time after surgery, and a higher degree of satisfaction regarding the provided information. The variable 'skin type'

did not make a statistically significant unique contribution to the equation (Table 4).

Discussion

Whereas previous research has already stated that both breast[1,7] and abdominal scars[8] can influence the overall satisfaction after BR, this is the first study exploring factors associated with the patient-reported scar quality after DIEP flap BR.

Our results indicate that scar appraisal is an essential outcome after DIEP flap BR, which aims to restore the breast and obtain the best esthetic result. The vast majority of women reported high scores (POSAS item ≥4) on at least one scar characteristic of their breast scar or abdominal scar. The overall abdominal scar appraisal of the women in our study was worse compared with the only other DIEP flap study reporting the POSAS overall opinion[22]. Compared with scarring after abdominoplasty, the women in our study appraised their abdominal scar worse[23]. This difference could be explained by the challenge of the DIEP flap procedure, where sufficient abdominal soft tissue is needed to create the volume for the reconstructed breast(s) while respecting underlying perforator anatomy. DIEP flap donor site closure

Table 3 Factors associated with patient-reported breast scar quality.

POSAS total score breast scar

Univariate Regression				Multivariate Regression				
	B	β	p	B	β	p	95% BI	
(Constant)				28.317		.001	11.498	45.137
Age	−0.249	−0.178	.005	−0.115	−0.080	.229	−0.302	.073
Time since DIEP	−1.858	−0.275	<0.001	−1.784	−0.255	<0.001	−2.665	−0.904
BMI	.239	.066	.299	.465	.124	.051	−0.002	.931
Cup size (< D vs. ≥ D)	.046	.002	.978					
Skin Type (1,2 vs. 3,4,5)	−0.025	−0.001	.988					
Direct or Indirect	.416	.015	.816					
Laterality (uni- vs. bilateral)	2.983	.118	.063	1.671	.065	.320	−1.630	4.972
History of breast cancer	.384	.013	.836					
Complications (No/Yes)	3.792	.150	.018	.546	.021	.742	−2.717	3.808
Current symptoms (No/Yes)	5.582	.221	<0.001	3.780	.148	.021	.579	6.981
Radiation (No/Yes)	−0.001	−0.004	.950					
Satisfaction information	−1.749	−0.324	<0.001	−1.597	−0.294	<0.001	−2.271	−0.924

Note: B= Unstandardized beta, β= Standardized beta coefficient. The significance criterion for inclusion in the multiple regressions was set at $p < 0.3$. A higher POSAS total score indicates a worse perceived scar. Multiple regression n = 214: due 1 missing on time since DIEP and missing values on satisfaction with information provision.

Table 4 Factors associated with patient-reported abdominal scar quality.

POSAS total score abdominal scar

Univariate Regression				Multivariate Regression				
	B	β	p	B	β	p	95% BI	
(Constant)				48.945		<0.001	38.463	59.428
Age	−0.298	.093	.002	−0.260	−0.169	.003	−0.432	−0.089
Time since DIEP	−1.813	−0.252	<0.001	−1.715	−0.229	<0.001	−2.557	−0.872
BMI	−0.102	−0.027	.678					
Cup size (<D vs. ≥D)	1.176	.043	.499					
Skin Type (1,2 vs. 3,4,5)	2.679	.099	.122	1.502	.055	.328	−1.519	4.523
Direct or Indirect	1.705	.057	.371					
Laterality (uni- vs. bilateral)	0.991	−0.037	.564					
History of breast cancer	−0.439	−0.014	.824					
Complications (No/Yes)	7.898	.293	<0.001	4.098	.151	.009	1.054	7.143
Current symptoms (No/Yes)	10.407	.379	<0.001	6.170	.224	<0.001	2.838	9.501
Satisfaction information	−2.183	.352	<0.001	−1.622	−0.288	<0.001	−2.304	−0.941

Note: B= Unstandardized beta, β= Standardized beta coefficient. The significance criterion for inclusion in the multiple regressions was set at $p < 0.3$. A higher POSAS total score indicates a worse perceived scar. Multiple regression n = 220: due missing values on satisfaction with information provision.

can result in a more tighter and higher scar location than an abdominoplasty[24]. In the absence of data into scarring after BR, we found that women in our study population appraised their breast scars similar to women who had undergone a breast augmentation[25] and better than women after a reduction mammoplasty[26]. As no previous research on scarring after DIEP flap BR has been conducted, a thorough interpretation of the clinical relevance of our POSAS scores remains difficult. Thereby, the interpretation of the POSAS scores remains arbitrary in the absence of commonly used and clinically relevant cut-off points[14].

The most relevant finding in this study is that abdominal scarring is appraised statistically significantly worse on the POSAS than the breast scar. The donor site scar on the abdomen causes dissatisfaction after BR, which was previously revealed in qualitative studies[27,28]. However, in these studies, women after DIEP flap reconstruction were not included. Although one of the main appeals for women opting for a DIEP flap BR is the possibility of an 'abdominoplasty' like improvement of their abdomen[4,24], it is plausible that women who wish to have BR are primarily focused on restoring the breast, instead of an additional consequence such as the large abdominal scar. The worse scar appraisal of the abdomen could be explained by the dissatisfaction with the size and noticeability of this scar, which women in our study rated significantly worse than the breast scar. In line with these findings, although relatively scored high for both scars, the more visible scar characteristics: color, stiffness, thickness, and irregularity were scored significantly worse for the abdominal scars.

Also noteworthy was the relative moderate satisfaction about the provided information. Our results indicate that

a higher degree of satisfaction regarding the provided information is associated with a better patient-reported scar quality. The fact that women after BR are dissatisfied with the provided information was identified in previous studies[29,30]. It is important to realize that satisfaction with provided information can vary between hospitals[31]. Thereby, there is a discrepancy between information that care professionals report they provide and information received by women, who find it inadequate for decision-making[32]. This underlines the importance of explicit education on scarring after the DIEP flap, with a special emphasis on the abdominal scar. Sufficient and clear information about the various possible symptoms and what the scars will look like, will contribute to women have having realistic expectations[27], while allowing them to make informed decisions[30,32], and they will therefore be more satisfied with the outcome of surgery[29].

Although this study provides concrete insights regarding scarring after BR, which could be implemented in clinical practice, a limitation of this study is the cross-sectional design and the lack of a prospective design. To reach a diverse group, women with DIEP flap BR were asked to fill in the survey regardless of the presence, the degree or type of scar symptoms, and whether they had (had) additional therapy for the scar(s). There was a wide variety of participants in stages of scar maturation. To reduce the risk of participation bias, we shared our survey across a range of platforms. However, we could not assess and adjust for non-response bias due to this type of design and sampling. Perceived scar quality of non-respondenders might differ from the perceived scar quality of respondents, where it is plausible that women with scar complaints are overrepresented in this study.

In conclusion, our study shows that it is important to address the inevitability of scars in patient education before a DIEP flap BR, with a special focus on the abdominal scar, as women experience abdominal scars significantly worse than their breast scars. Providing specific information on noticeability, size, and location of the scars and scar characteristics as color, stiffness, thickness, and irregularity will contribute to women having realistic expectations about scarring, allowing them to make informed decisions and, eventually, being more satisfied with the outcome of surgery.

Declaration of Competing Interest

None.

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