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Aesthetic Comparison of Two Different Types of Webspace Reconstruction for Finger Syndactyly

Frank Yuan, MD¹ [Research Fellow], Lin Zhong, MD, MPH² [Clinical Research Coordinator], and Kevin C Chung, MD, MS³

¹Department of Surgery, Section of Plastic Surgery, University of Michigan Medical School

²Department of Surgery, Section of Plastic Surgery, University of Michigan Health System

³Professor of Surgery, Department of Surgery, Section of Plastic Surgery, Assistant Dean for Faculty Affairs, University of Michigan Medical School

Abstract

Background—Syndactyly reconstruction incorporates techniques of applying skin grafts or dorsal advancement flaps without the use of skin grafts. Comparative outcome studies of these two approaches are lacking. Our study compares the long-term aesthetic outcomes of these two flap techniques.

Methods—Forty-five patients were included in our study. The methods of reconstruction used were a dorsally-based rectangular flap with skin graft from the groin and a dorsal pentagonal advancement flap without skin grafting. Eighteen independent raters completed a Visual Analogue Scale (VAS) as well as a unique classification scale to subjectively assess aesthetic outcomes. We used univariate analyses to determine which variables significantly influenced the outcome score. We then used multivariable regression models to compare the two flap types.

Results—Dorsally-based rectangular flaps with skin graft had statistically significantly better VAS scores and greater odds of receiving an ‘Excellent’ rating when compared to dorsal pentagonal advancement flaps.

Conclusions—Despite the use of skin graft and their associated donor-site morbidity, dorsal rectangular flaps may offer better overall aesthetic outcomes for patients. Future comparative studies should incorporate functional and patient-reported outcomes to better assess the optimal reconstruction type.

Syndactyly is the most common congenital hand malformation, affecting approximately one in 2000 live births, with up to 50% of cases occurring bilaterally.¹ Owing to failure of interdigit tissue to undergo apoptosis during early gestation, digits become joined by skin and soft tissue with or without underlying bony fusion.^{2,3} Syndactyly is classified as either

Corresponding Author: Kevin C. Chung MD, MS, Section of Plastic Surgery, University of Michigan Health System, 2130 Taubman Center, SPC 5340, 1500 E. Medical Center Drive, Ann Arbor, MI, 48109-5340, Kecchung@med.umich.edu, Phone 734-936-5885, Fax 734-763-5354.

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simple involving digits fused by skin and soft tissue only, or complex, involving bony fusion or anomalies of form, size, number, or position of the digits. Depending on the extension of the affected webspace, syndactyly is also classified as partial, if the web terminates proximal to the fingertips, or complete, if the web extends to the fingertips.⁴

Correction of syndactyly is achieved by surgical separation, resulting in functionally independent and aesthetically satisfactory digits.⁴ Several variations of local skin flaps have been described for syndactyly web space reconstruction, including the dorsal rectangular flap, dorsal triangular flap, or the interdigitating V-flap, among others.^{3,5-10} However, these procedures require skin grafting to the resultant defect and donor scars. Modifications of flap design, such as with the dorsal pentagonal advancement flap, incorporate more dorsal skin and thus, do not require a skin graft and, ultimately, decrease surgical time. The pentagonal flap is an attractive alternative to traditional methods of web space reconstruction using skin grafts and is an increasingly popular alternative procedure.^{2,11}

It is unclear whether skin graft-sparing web space reconstruction with dorsal pentagonal advancement flaps offers better aesthetic outcomes than dorsal rectangular flaps with skin grafting. Comparative studies of aesthetic outcomes between these two techniques are lacking.¹² The aim of this study is to compare the aesthetic outcomes of skin graft-sparing dorsal pentagonal flaps with the traditional method of dorsal rectangular flaps with skin grafting. Understanding these outcomes will facilitate improvements in surgical planning and patient satisfaction.

PATIENTS AND METHODS

In this retrospective study, we used the University of Michigan electronic database (CareWeb) and current procedural terminology (CPT®) codes – 26560, 26561 and 26562 – to identify all patients treated by the senior author who underwent syndactyly repair from 1998 to 2013. Patients were included if they had a primary elective repair of simple or complex syndactyly (complete and incomplete) using either a proximally-based dorsal rectangular flap (Figure 1A) with full-thickness skin graft or a dorsal pentagonal flap without skin grafting (Figure 1B). Patients were excluded if (1) they were treated with other methods of flap reconstructions, (2) their postoperative follow-up was less than one year, and (3) they had complicated syndactyly (e.g. congenital hand malformations associated with Apert syndrome, amniotic constriction bands, cleft hand, etc). This study was approved by IRBMED.

All patients treated at our center had preoperative, intraoperative, and postoperative photographs as standard procedures for documentation and educational purposes. A still postoperative photographic image of each patient's hand was taken using a Canon PowerShot SX500 IS 16.0 megapixel point-and-shoot digital camera under standard lighting conditions, camera settings, and a green background. To maintain standardization, we included those patients with photographs with a minimum of two year follow-up. The images were subsequently transferred to a computer for independent evaluation by members of an assessment panel, which consisted of 18 individuals (six males and 12 females) – one hand fellowship-trained plastic surgeon, two current hand surgery fellows, one plastic

surgery resident (chief year), four international hand surgery fellows, five occupational therapists who work exclusively with these patients postoperatively, and five lay persons, all of whom were female with children of their own, which we felt would provide a maternal perspective when evaluating outcomes. Panel members were instructed to score each image using two grading systems on paper. The first method was a visual analogue scale (VAS) with a 10-cm line, with 0 being the best and 10 being the worst. The second method was a grading system that incorporated color, surface shine (or matte), and skin distortion to classify outcomes into 'Excellent', 'Very good', 'Good', or 'Poor' (Figure 2 and 3A-D). Examples of each grade were given to the evaluators for reference (Figures 3A-D). This grading system was based on the Manchester Scar Scale, which has shown good construct validity, inter-rater reliability, and feasibility when used to assess surgical scars.¹³⁻¹⁵ We chose not to use patient-reported outcome (PRO) instruments or questionnaires because not only are our patients too young to adequately answer questionnaires, there are generally no validated questionnaires available for these outcomes.

Statistical Analysis

The two study outcomes are (1) a numeric visual analogue scale (VAS) score and (2) a categorical grading scale rating. To examine the inter-rater reliability among the 18 raters, we used Kappa statistics for categorical grading. We divided the 18 raters into 4 groups – lay persons, international hand surgery fellows, occupational therapists, and surgeons – and calculated inter-rater reliability within each group and all 18 raters using Fleiss' Kappa. We then examined inter-rater reliability between two raters among the 18 raters using Cohen's Kappa. We calculated the intra-class correlation coefficient (ICC) for VAS among each group for the inter-rater reliability. For the intra-rater reliability, we calculated Kappa statistics for grading and ICC for VAS for each of the 18 raters.

The primary predictor of the study cohort was the type of flap reconstruction (i.e. dorsal rectangular or dorsal pentagonal flap). We performed descriptive analyses on our study cohort for the distribution of each patient characteristic by type of flap received. We performed Fisher's exact test for the association between flap type and categorical patient variables (i.e. type of syndactyly, patient age, patient sex, right vs. left hand, type of rater, webspace, and revision) and Wilcoxon Rank Sum Test for continuous patient variables (i.e. patient age and number of years of follow-up).

To examine the correlation between VAS and each patient characteristic, we performed simple linear regression models for each patient characteristic as the predictor. Given that we had grading by 18 raters, we added a random intercept for each type of flap in each model to control for the intercorrelation of repeated measures. We had a total of 810 data points given that each of our 18 raters reviewed 45 patients total ($n=18*45=810$).

To control for patient characteristics that significantly influenced VAS, we then performed a multivariable linear regression model with random intercept for each surgical reconstruction using the type of flap as the primary predictor. We used all characteristics with significant associations with VAS selected from our simple linear regression models as the covariates into the multivariable linear regression model; the final multivariable models were established by maximum likelihood. We reported adjusted mean VAS and 95% confidence

intervals for each patient group. Using the same strategy, we performed univariate analysis on patient characteristics and the binary outcome 'Excellent' vs. 'Not excellent' (which includes very good, good or poor) using a simple logistic regression model with random effect on each type of flap reconstruction. We used binary outcomes to ensure less stratification of our results and more power. We then performed multivariable logistic regression with random effect using type of flap as the primary predictor while controlling for those patient characteristics that had significant associations with each grade. We reported odds ratios (OR) of being 'Excellent' for each patient characteristic (compared to the reference group) and 95% confidence intervals.

RESULTS

A total of 45 patients were reviewed: 13 female and 32 male patients (Table 1). Patients who had dorsal pentagonal flap reconstruction were evaluated at a longer duration of follow-up compared to those patients who had dorsal rectangular flaps (1.6 vs. 2.3 years, $p=0.03$). There was no significant difference in the distribution of other patient characteristics between the two different types of flap reconstruction. Sixteen patients underwent dorsal pentagonal flap reconstruction and 29 patients underwent dorsal rectangular flap with full-thickness skin graft (FTSG). The majority of patients across both flap types had simple complete syndactyly. The third web space was the most commonly affected web space between both surgical groups. Twenty-five percent of patients required revision surgery after pentagonal flap, while only 10% required revision surgery after rectangular flap reconstruction.

For grading between 'Excellent' and 'Not excellent', Fleiss' Kappa among the four groups of raters ranged from 0.40 to 0.42; Fleiss' Kappa for all 18 raters was 0.38 ($p<0.001$). The Cohen's Kappa when comparing two raters' grades ranged from 0.07 to 0.69, with p values ranging from <0.001 to 0.433. The intra-class correlation coefficient (ICC) among our four groups of raters ranged from 0.52 to 0.65; ICC for all 18 raters was 0.56 ($p<0.001$). For grading between 'Excellent' and 'Not excellent', Kappa values among all of raters ranged from 0.16 to 0.76. The ICC among all of our raters ranged from 0.40 to 0.91. These values indicate that the raters generally agreed across all ratings.

Overall, the affected web space, patient age at follow-up, and length of follow-up were significantly associated with mean VAS values (Table 2). The mean VAS among patients who had fourth web space reconstruction was 1.64 compared to 3.36 among those who had second web space reconstruction ($p=0.012$), regardless of flap type. With one more year of follow-up, the average VAS decreased by 0.36 ($p=0.003$) across both flap types. Four patients with pentagonal flaps required revision surgery; three patients had web creep and one patient had a scar contracture. Three patients with rectangular flaps required revision surgery; two patients had scar contractures and one patient had web creep.

After controlling for the significant variables found in our univariate analysis (i.e. affected web space, patient age, and length of follow-up; Table 2), multivariable analysis revealed that patients who had dorsal rectangular flap reconstruction had significantly lower VAS

values, indicating better results, than patients who had dorsal pentagonal flap reconstruction (3.12 vs. 4.24, $p=0.025$; Table 3).

Table 4 shows that overall, the odds of getting an 'Excellent' rating were significantly associated with web space and number of years of follow up. For example, the OR of getting an 'Excellent' rating among patients who had second web space reconstruction compared to patients who had fourth web space reconstruction was 0.06 (95% CI: 0.01-0.59). With one more year of follow-up, the odds of getting an 'Excellent' rating increased 1.85 times (95% CI: 1.21-2.84).

Again, after controlling for significant variables (i.e. affected web space and length of follow-up; Table 4), patients who had dorsal pentagonal flap reconstruction had significantly lower odds of getting an 'Excellent' rating compared to patients who had dorsal rectangular flap (OR 0.20, 95% CI: 0.05-0.83, $p=0.032$) (Table 5).

DISCUSSION

To date, no studies have compared long-term outcomes between skin graft and non-skin graft techniques in syndactyly reconstruction.^{6, 12} Both proximally-based dorsal rectangular flaps and dorsal pentagonal advancement flaps have been successfully utilized at our institution. In our study, we compared the long-term aesthetic outcomes between these two forms of web space reconstruction. Our study shows that rectangular flaps with groin skin grafting result in better long-term aesthetic outcomes when compared to pentagonal flaps.

Numerous methods of syndactyly reconstruction have been proposed. All methods employ a common set of techniques that any surgeon must be comfortable with before attempting a repair, e.g. use of full-thickness flaps to resurface the web space, preservation of vascular supply to the digit, and a meticulous approach to reconstruction with attention to preserving anatomic proportions and details.^{2,3} Achieving aesthetically pleasing fingers is likely just as important to a child as achieving fully functional digits. Traditional methods of syndactyly reconstruction utilize full-thickness skin grafts, often from the groin region, to facilitate a tension-free closure between separated digits.^{2,3,5} However, these techniques require postoperative immobilization and bandaging, which can be cumbersome in a young active child, and can lead to scar contracture or graft failure.^{2,3,5,16} Moreover, case series have reported high incidences of hair growth in the grafted areas, resulting in revision of the grafted area, epilation, and trimming of the excessive skin. Recently, there has been a trend toward reconstruction without the use of skin grafts. However, extensive defatting of the interdigital space is often required, which can lead to nerve injury, venous congestion, and a withered finger appearance.^{2,3,5,16,17}

From our review of the patients, the main reason patients underwent revision surgery after pentagonal flap reconstruction was web creep, although scar contracture was the impetus for revision surgery after rectangular flap reconstruction. A recent systematic review by Sullivan et al. revealed that techniques using skin grafts resulted in higher rates of web creep and revision surgery compared with those using only dorsal advancement flaps. In their review, they mention that revision rates may not be a valid comparative measure, however, for

several reasons, such as surgeon threshold, patient preference, or even change of surgeon.¹² Thus, our revision results may be underestimated if patients were not willing to undergo reoperation (e.g. they were satisfied with their results even with a certain level of web creep or scar contracture).

This investigation has several limitations. First, the use of photographs as the only means of evaluating aesthetic outcomes is limited by the quality of the photographs. The distinction between different grades was made primarily based on color mismatch and skin distortion; matte was found to be difficult to assess in photographs. However, we did maintain consistency across all photographs used, as they were all taken with standardized views, backgrounds, camera settings, and lighting. Additionally, even though our classification systems were based on distinct criteria, the evaluation of these criteria (e.g. skin distortion and matte) is completely subjective. Second, although our total sample size was sufficiently powered, we were not able to stratify our patients into syndactyly type due to small respective sample sizes. Third, our study only focused on aesthetic outcomes as we felt that the majority of our patients would be too young to fully participate in functional testing (e.g. strength tests). Additionally, future studies should incorporate patient-reported outcomes (PROs) if possible, which would provide further insight into patient satisfaction and effects on daily life activities. Lastly, we did not use a standardized follow-up period at the time of photographic assessment. Patients with longer follow-up periods at the time of their photograph may have better aesthetic outcomes solely because their scars have had a longer time to heal and remodel.

Our study is unique in that it offers long-term comparative outcomes between syndactyly reconstruction with skin grafts and dorsal advancement flaps without skin grafts. The majority of previous studies are case series that only report outcomes of particular flap techniques, with the majority among patients with simple syndactyly.^{6,12} We found that our classification system was easy to use even by non-surgeon observers, who are usually unaware of the details of different syndactyly release procedures. Interestingly, our results also showed that fourth web space reconstructions fared better in both classification systems, particularly when compared against second web space reconstructions, regardless of flap technique. These findings may be attributed to the smaller surface area of the fourth web space, thus requiring less graft for coverage, less manipulation of the graft (e.g. defatting), and a more tension-free closure. Moreover, our classification system properly captures the principle that as scars continue to heal, their appearance becomes more normalized compared to surrounding tissue.

The results from our study can serve as important discussion points when counseling patients on the types of syndactyly reconstructions available and adequately managing their postoperative expectations. Specifically, despite the fact that rectangular flaps utilize skin grafting with some donor site morbidity, overall outcomes may still be better than advancement flaps. Additionally, further attention should be made towards the technical aspects of these surgeries, particularly the liberal use of skin grafts to accomplish tension-free closure and minimize the risk of web creep. Future prospective comparative studies are needed that incorporate both functional and subjective criteria, with collection of both pre- and postoperative data.

References

1. Tonkin MA. Failure of differentiation, part 1: Syndactyly. *Hand Clin.* 2009; 25:171–193. [PubMed: 19380059]
2. Oda T, Pushman AG, Chung KC. Treatment of common congenital hand conditions. *Plast Reconstr Surg.* 2010 Sep; 126(3):121e–33e.
3. Goldfarb CA, Steffen JA, Stutz CM. Complex syndactyly: aesthetic and objective outcomes. *J Hand Surg Am.* 2012 Oct; 37(10):2068–73. [PubMed: 22939825]
4. Malik S. Syndactyly: phenotypes, genetics and current classification. *Eur J Hum Genet.* 2012 Aug; 20(8):817–24. [PubMed: 22333904]
5. Lumenta DB, Kitzinger HB, Beck H, Frey M. Long-term outcomes of web creep, scar quality, and function after simple syndactyly surgical treatment. *J Hand Surg Am.* 2010 Aug; 35(8):1323–9. [PubMed: 20638200]
6. Goldfarb CA. Congenital hand anomalies: a review of the literature, 2009-2012. *J Hand Surg Am.* 2013 Sep; 38(9):1854–9. [PubMed: 23683863]
7. Tuma P Jr, Arrunategui G, Wada A, Friedhofer H, Ferreira MC. Rectangular flaps technique for treatment of congenital hand syndactyly. *Rev Hosp Clin Fac Med Sao Paulo.* 1999 Jul-Aug; 54(4): 107–10. [PubMed: 10779816]
8. Yildirim C, Sentürk S, Keklikci K, Akmaz I. Correction of syndactyly using a dorsal separated V-Y advancement flap and a volar triangular flap in adults. *Ann Plast Surg.* 2011 Oct; 67(4):357–63. [PubMed: 21301304]
9. Jose RM, Timoney N, Vidyadharan R, Lester R. Syndactyly correction: an aesthetic reconstruction. *J Hand Surg Eur Vol.* 2010 Jul; 35(6):446–50. [PubMed: 20237190]
10. Wafa AM. Hourglass dorsal metacarpal island flap: a new design for syndactylized web reconstruction. *J Hand Surg Am.* 2008 Jul-Aug; 33(6):905–8. [PubMed: 18656764]
11. Gao W, Yan H, Zhang F, Jiang L, Wang A, Yang J, Zhou F. Dorsal pentagonal local flap: a new technique of web reconstruction for syndactyly without skin graft. *Aesthetic Plast Surg.* 2011 Aug; 35(4):530–7. [PubMed: 21359993]
12. Sullivan MA, Adkinson JM. A systematic review and comparison of outcomes following simple syndactyly reconstruction with skin grafts or a dorsal metacarpal advancement flap. *J Hand Surg Am.* 2017 Jan; 42(1):34–40.e6. [PubMed: 28052826]
13. Beausang E, Floyd H, Dunn KW, Orton CI, Ferguson MW. A new quantitative scale for clinical scar assessment. *Plast Reconstr Surg.* 1998 Nov; 102(6):1954–61. [PubMed: 9810991]
14. Durani P, McGrouther DA, Ferguson MW. Current scales for assessing human scarring: a review. *J Plast Reconstr Aesthet Surg.* 2009 Jun; 62(6):713–20. [PubMed: 19303834]
15. Vercelli S, Ferriero G, Sartorio F, Stissi V, Franchignoni F. How to assess postsurgical scars: a review of outcome measures. *Disabil Rehabil.* 2009; 31(25):2055–63. [PubMed: 19888834]
16. Dao KD, Shin AY, Billings A, Oberg KC, Wood VE. Surgical treatment of congenital syndactyly of the hand. *J Am Acad Orthop Surg.* 2004; 12(1):39–48. [PubMed: 14753796]
17. Bates SJ, Hansen SL, Jones NF. Reconstruction of congenital differences of the hand. *Plast Reconstr Surg.* 2009; 124(1 suppl):128e–43e.

Figure 1.
(**top**) Proximally-based dorsal rectangular flap design. (**bottom**) Dorsal pentagonal advancement flap design.

Grade	Description	Color	Matte	Distortion
Excellent (E)	Equal appearance to surrounding skin in color, matte, and no skin distortion	Perfect	Matte	None
Very good (VG)	Similar appearance to surrounding skin with mild skin distortion	Slight mismatch	Matte	Mild
Good (G)	Shiny appearance compared to surrounding skin with moderate skin distortion	Obvious mismatch	Shiny	Moderate
Poor (P)	Obvious scar with severe skin distortion	Gross mismatch	Shiny	Severe

Figure 2.
Categorical grading system.

Figure 3.

A: Example of an 'Excellent' grade. (*Dorsal rectangular flap with skin graft from the groin*)

B: Example of a 'Very Good' grade. (*Dorsal pentagonal advancement flap*)

C: Example of a 'Good' grade. (*Dorsal pentagonal advancement flap*)

D: Example of a 'Poor' grade. (*Dorsal pentagonal advancement flap*)

Table 1

Characteristics of the study cohort by type of reconstruction received (n=45)

Variables	Pentagonal Flap	Rectangular Flap	p value*
Syndactyly type			0.09
Complex complete	2 (12%)	5 (17%)	
Complex incomplete	0	2 (7%)	
Partial incomplete	1 (6%)	0	
Simple complete	12 (75%)	13 (45%)	
Simple incomplete	1 (6%)	9 (31%)	
Sex			0.32
Female	3 (19%)	10 (34%)	
Male	13 (81%)	19 (66%)	
Hand			1.00
Left	9 (56%)	17 (59%)	
Right	7 (44%)	12 (41%)	
Web space			1.00
2 nd	4 (25%)	8 (28%)	
3 rd	10 (62%)	17 (59%)	
4 th	2 (12%)	4 (14%)	
Revisions			0.22
No	12 (75%)	26 (90%)	
Yes	4 (25%)	3 (10%)	
Average age at follow-up (years)	4.2 (2.3)	3.3 (2.1)	0.11
Average follow-up (years)	2.3 (1.6)	1.6 (2.1)	0.03

* The p values for the association between flap type and categorical variable was calculated using Fisher's exact test and the p values for the significance of the difference of average age of follow up and years of follow up between patients who had different flap types were calculated with Wilcoxon Rank Sum Test.

Table 2Univariate analysis for Visual Analogue Scale (VAS) ratings (n=810[◆])

Categorical Variables	Predicted mean of VAS	p value
Type of flap		0.154
Dorsal pentagonal advancement flap	3.79 (3.02 - 4.57)	
Dorsal rectangular flap with skin grafting	3.08 (2.51 - 3.66)	
Syndactyly type		0.695
Complex complete	3.83 (2.67 - 5.00)	
Complex incomplete	2.67 (0.48 - 4.85)	
Partial incomplete	4.61 (1.52 - 7.70)	
Simple complete	3.13 (2.51 - 3.74)	
Simple incomplete	3.51 (2.53 - 4.49)	
Sex		0.597
Female	3.53 (2.66 - 4.41)	
Male	3.25 (2.70 - 3.81)	
Hand		0.401
Left	3.16 (2.55 - 3.78)	
Right	3.57 (2.85 - 4.29)	
Whether the rater is a surgeon		0.600
No	3.32 (2.85 - 3.80)	
Yes	3.38 (2.88 - 3.89)	
Web space		0.012
2 nd	3.36 (2.53 - 4.18)	
3 rd	3.70 (3.15 - 4.25)	
4 th	1.64 (0.47 - 2.81)	
Revisions		0.141
No	3.18 (2.68 - 3.69)	
Yes	4.15 (2.98 - 5.32)	
Numerical variables	Avg difference in VAS with 1 more year of follow-up	p value
Average age at follow-up (years)	-0.22 (-0.43 - (-0.02))	0.04
Average follow-up (years)	-0.36 (-0.59 - (-0.14))	0.003

* The least square means of VAS and p values were calculated from mixed linear regression model with random intercept for each surgical reconstruction (VAS was rated by 18 raters for each surgery) and single covariates.

◆ Total of 810 data points based on 18 raters and 45 patients – 18*45=810.

◆ Interpretation: Of all variables examined, three variables – affected webspace, average age at follow-up, and average length of follow-up – were significantly associated with mean VAS values.

Table 3Multivariable analysis for VAS (n=810[◆])

Categorical Variables	Average difference in VAS [†]	Predicted means of VAS [‡]	p value
Type of flap			
Dorsal pentagonal advancement flap	0.95 (0.15 - 1.76)	4.24 (0.35 - 2.81)	0.025
Dorsal rectangular flap with skin grafting *	0	3.12 (0.27 - 2.02)	
Web space			
2 nd	1.60 (0.33 - 2.86)	4.22 (0.38 - 2.68)	0.018
3 rd	1.99 (0.84 - 3.13)	4.36 (0.25 - 3.33)	0.002
4 th *	0	2.93 (0.53 - 0.78)	
Numerical variables			
Average follow-up (years)		Average difference in VAS with 1 more year of follow-up	p value
		-0.40 (-0.60 - (-0.20))	<0.001

* Reference group

[†] Average difference in VAS was beta-coefficients from mixed linear regression models with random intercept for each surgery reconstruction.

[‡] Least square means were calculated from mixed linear regression models with random intercept for each surgery reconstruction with all the variables in this table as the covariates.

◆ Total of 810 data points based on 18 raters and 45 patients – 18*45=810.

❖ Interpretation: After controlling for the significant variables found in Table 3, dorsal rectangular flaps scored better VAS ratings compared to dorsal pentagonal flaps.

Table 4Univariate analysis for Grade (n=810[◆])

Categorical Variables	Odds ratio of getting 'Excellent' [†]	Predicated probability of getting 'Excellent' [‡]	p value
Type of flap			
Dorsal pentagonal advancement flap	0.33 (0.07 - 1.64)	0.09 (0.03 - 0.28)	0.18
Dorsal rectangular flap with skin grafting *	1	0.23 (0.10 - 0.44)	
Sex			
Female	0.80 (0.14 - 4.45)	0.15 (0.04 - 0.44)	0.80
Male *	1	0.18 (0.08 - 0.36)	
Hand			
Left	2.12 (0.45 - 10.01)	0.22 (0.09 - 0.44)	0.35
Right *	1	0.12 (0.04 - 0.31)	
Whether the rater is a surgeon			
No	0.57 (0.33 - 0.96)	0.15 (0.07 - 0.28)	0.040
Yes *	1	0.24 (0.12 - 0.43)	
Web space			
2 nd	0.06 (0.01 - 0.59)	0.18 (0.05 - 0.47)	0.021
3 rd	0.03 (0.00 - 0.22)	0.09 (0.04 - 0.21)	0.002
4 th *	1	0.80 (0.35 - 0.97)	
Revisions			
No	4.29 (0.51 - 35.80)	0.20 (0.10 - 0.37)	0.19
Yes *	1	0.06 (0.01 - 0.31)	
Numerical variables			
Odds ratio of getting 'Excellent' with 1 more year of follow-up [†]			p value
Average age at follow-up (years)		1.36 (0.96 - 1.91)	0.09
Average follow-up (years)		1.85 (1.21 - 2.84)	0.007

* Reference group

[†] Odds ratios of getting excellent result were calculated from mixed logistic regression models with random intercept for each surgery reconstruction with single covariate.[‡] Least square means were calculated from mixed logistic regression models with random intercept for each surgery reconstruction with single covariate.[◆] Total of 810 data points based on 18 raters and 45 patients – 18*45=810.[⚡] Interpretation: Of all variables examined, two variables – affected webspace and average length of follow-up – were significantly associated with receiving an 'Excellent' rating.

Table 5Multivariable analysis for Grade (n=810)

Categorical Variables	Adjusted odds ratio of getting 'Excellent' [†]	Predicted probability of getting 'Excellent' [‡]	p value
Type of flap			
Dorsal pentagonal advancement flap	0.20 (0.05 - 0.83)	0.16 (0.05 - 0.39)	0.032
Dorsal rectangular flap with skin grafting [*]	1	0.48 (0.26 - 0.70)	
Whether the rater is a surgeon			
No	0.56 (0.33 - 0.95)	0.23 (0.12 - 0.41)	0.037
Yes [*]	1	0.35 (0.18 - 0.58)	
Web space			
2 nd	0.07 (0.01 - 0.57)	0.18 (0.06 - 0.44)	0.017
3 rd	0.03 (0.00 - 0.20)	0.09 (0.04 - 0.19)	<0.001
4 th [*]	1	0.76 (0.35 - 0.95)	
Numerical variables			
Odds ratio of getting 'Excellent' with 1 more year of follow-up		p value	
Average follow-up (years)		2.05 (1.34 - 3.12)	0.002

^{*} Reference group

[†] Odds ratios of getting excellent result were calculated from mixed logistic regression models with random intercept for each surgery reconstruction.

[‡] Least square means were calculated from mixed logistic regression models with random intercept for each surgery reconstruction with all the variables in this table as the covariates.

Total of 810 data points based on 18 raters and 45 patients – 18*45=810.

Interpretation: After controlling for the significant variables found in Table 5, dorsal rectangular flaps had a higher OR of getting an 'Excellent' rating.