

The Utility of Quantitative Preoperative Peroneal Vessel Assessment in Fibula Free Flap Surgery

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Objectives

Fibula free flap (FFF) surgery complications can arise from vascular disease within the donor peroneal artery.¹⁻⁴

Computed Tomography Angiography (CTA) has become standard for preoperative evaluation.^{5,6}

- However, current methods rely on qualitative assessments to determine surgical eligibility.

We aim to improve preoperative FFF risk evaluation by implementing two complementary quantitative scoring systems: The Bollinger Score (BS) and Lower Limb Arterial Calcification Score (LLACS).^{7,10}

Bollinger Score⁷

- Quantifies the current degree of stenosis in a vascular segment.
- Uses contrast-enhanced CTA.
- Validated for predicting severe outcomes including limb ischemia, amputation, and cardiovascular events.⁷⁻⁹

Lower Limb Arterial Calcification Score¹⁰

- Quantifies arterial calcification using the Agatston method.
- Uses non-contrast phase of CTA.
- Associated with greater risk of amputation and cardiovascular morbidity and mortality.¹⁰⁻¹²

Both

- Assess lower limb vascular status.
- Utilize CTA imaging for evaluation.
- Provide quantifiable scores for clinical decision-making.

Methodology

A retrospective review was conducted on all head and neck microvascular FFF procedures performed at a university-affiliated tertiary care center between August 2021 and March 2023.

Data collected included patient demographics, medical history, operative details, and postoperative complications within 90 days.

Peroneal Bollinger and crural segment LLAC scores were calculated from routine preoperative CTAs.

Results

Table 1: Baseline Patient Characteristics

Characteristic	Overall N = 117 ¹	No Complication N = 57 ¹	Complication N = 60 ¹	p-value ²
Age (years)	56.8 (18.2)	55.0 (19.2)	58.5 (17.2)	0.439
BMI (kg/m ²)	27.0 (6.7)	27.3 (7.1)	26.7 (6.4)	0.847
Sex				0.441
Male	60 (52.6%)	31 (56.4%)	29 (49.2%)	
Female	54 (47.4%)	24 (43.6%)	30 (50.8%)	
Race				0.945
Caucasian	59 (52.2%)	28 (50.9%)	31 (53.4%)	
Black	24 (21.2%)	13 (23.6%)	11 (19.0%)	
Asian	17 (15.0%)	8 (14.5%)	9 (15.5%)	
Other	13 (11.5%)	6 (10.9%)	7 (12.1%)	
Ethnicity				1.00
Non-Hispanic	109 (96.5%)	53 (96.4%)	56 (96.6%)	
Hispanic	4 (3.5%)	2 (3.6%)	2 (3.4%)	
Smoking Status				0.551
No	67 (58.8%)	34 (61.8%)	33 (55.9%)	
Former	28 (24.6%)	14 (25.5%)	14 (23.7%)	
Active	19 (16.7%)	7 (12.7%)	12 (20.3%)	
Diagnosis Type				0.142
Benign	30 (25.6%)	19 (33.3%)	11 (18.3%)	
Malignant	68 (58.1%)	31 (54.4%)	37 (61.7%)	
Other	19 (16.2%)	7 (12.3%)	12 (20.0%)	
ASA Classification				0.255
1	3 (2.6%)	1 (1.8%)	2 (3.3%)	
2	44 (37.6%)	26 (45.6%)	18 (30.0%)	
3	69 (59.0%)	30 (52.6%)	39 (65.0%)	
4	1 (0.9%)	0 (0.0%)	1 (1.7%)	
Charleston Comorbidity Index	4.0 (1.9)	3.8 (1.9)	4.1 (1.8)	0.315

¹Mean (SD); n (%)
²Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test

There were no statistically significant differences in baseline demographics or clinical characteristics between those who experienced complications and those who did not.

Table 2. Complications and Clinical Outcomes

Characteristic	Overall N = 117 ¹
Any Complication	42 (35.9%)
Infection	28 (23.9%)
Hematoma	4 (3.4%)
Seroma	2 (1.7%)
Fistula	5 (4.3%)
Dehiscence	10 (8.5%)
Flap Failure	4 (3.4%)
Length of Stay	11 [8, 15]

¹Mean (SD); n (%); median [range]

²Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test

Results

Table 3. Regression Analysis of Clinical Outcomes

Complication	Unadjusted			Adjusted		
	OR/Beta /IRR ¹	95% CI ¹	p-value	OR/Beta/ IRR ¹	95% CI ¹	p-value
Bollinger Score Peroneal						
Any Complication	2.10	1.08, 4.36	0.029	2.23	1.05, 5.13	0.044
Infection	1.25	0.57, 2.48	0.547	1.08	0.45, 2.43	0.857
Hematoma	2.77	0.75, 8.90	0.083	5.25	0.97, 39.3	0.061
Seroma	NA	NA	0.997	NA	NA	0.998
Fistula	2.77	0.75, 8.90	0.083	3.49	0.69, 23.1	0.132
Dehiscence	2.29	0.89, 5.32	0.060	1.94	0.66, 5.42	0.206
Flap Failure	3.38	1.00, 11.2	0.035	N/A	0, NA	0.997
Death	1.00	0.00, Inf	1.00	1.00	0.00, Inf	1.00
Length of Stay	1.33	1.19, 1.49	<0.001	1.27	1.12, 1.44	<0.001
LLAC Score Crural						
Any Complication	1.06	0.91, 1.22	0.441	1.00	0.84, 1.19	0.998
Infection	0.88	0.64, 1.07	0.301	0.86	0.60, 1.10	0.288
Hematoma	1.13	0.81, 1.46	0.345	1.29	0.83, 2.11	0.238
Seroma	0.07	NA	0.997	0.16	NA	0.998
Fistula	1.25	0.99, 1.58	0.045	1.69	1.09, 3.42	0.053
Dehiscence	1.11	0.88, 1.35	0.309	1.02	0.75, 1.35	0.898
Flap Failure	1.00	0.00, Inf	1.00	1.00	0.00, Inf	1.00
Death	1.00	0.00, Inf	1.00	1.00	0.00, Inf	1.00
Length of Stay	1.02	0.99, 1.05	0.2	1.00	0.96, 1.04	>0.9

¹OR = Odds Ratio for binary outcomes, Beta = regression coefficient for continuous outcomes, IRR = Incident Rate Ratio for ordinal outcomes, CI = Confidence Interval, LLAC = Lower Limb Arterial Calcification

Higher BS were significantly associated with increased risk of complications and longer hospital stays.

Table 4. Regression Analysis of Complications using Optimal BS and LLACS Receiver Operating Characteristic Cut Points

Characteristic	OR ¹	95% CI ¹	p-value
Bollinger Score Peroneal			
Any Complication	3.95	1.26, 13.8	0.022
LLAC Score Crural			
Any Complication	2.85	0.58, 15.5	0.194
Risk Category			
Any Complication			0.030
Low risk	—	—	—
Moderate risk	0.00	NA	
High risk	8.36	1.15, 169	

¹OR = Odds Ratio, CI = Confidence Interval, LLAC = Lower Limb Arterial Calcification

A Bollinger Score above 0.5 was significantly associated with nearly 4 times higher odds of complications.

Patients with both scores above cutoff values had over an 8-fold increase in the odds of complications.

Conclusions

Preoperative vascular assessment of donor vessels is critical for optimizing free flap survival and minimizing postoperative complications.

This study is the first to explore the utility of quantitative preoperative risk assessment in FFF surgery.

Our findings suggest that quantitative assessment of the peroneal vessel can improve risk stratification for patients undergoing fibula free flap surgery.

These scoring systems offer an objective framework that may enhance patient selection and guide strategies to reduce postoperative complications.

Notably, integrating multiple vascular scoring systems may offer a more comprehensive and reliable approach to preoperative decision-making.

Combining scores may enhance risk stratification and help identify patients who would benefit from modified surgical planning or additional preoperative optimization.

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