

Short- and Long-Term Outcomes following Severe Traumatic Lower Extremity Reconstruction: The Value of an Orthoplastic Limb Salvage Center to Racially Underserved Communities

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Background: Previous studies have demonstrated that nonwhite race and disadvantaged socioeconomic status negatively impact outcomes following lower extremity reconstruction. The authors sought to characterize differences in outcomes between racial groups in patients necessitating traumatic lower extremity reconstruction at an orthoplastic limb salvage center.

Methods: A retrospective review between 2002 and 2019 was conducted of patients who underwent free flap lower extremity reconstruction at an orthoplastic limb salvage center. Patient demographics were identified, and permanent addresses were used to collect census data. Short-term complications and long-term functional status were recorded.

Results: One hundred seventy-three patients underwent lower extremity reconstruction and met inclusion criteria. Among all three groups, African American patients were more likely to be single (80 percent African American versus 49 percent Caucasian and 29.4 percent other; $p < 0.05$) and had significantly lower rates of private insurance compared with Caucasian patients (25 percent versus 56.7 percent; $p < 0.05$). African American patients demonstrated no significant differences in total flap failure (4.9 percent versus 8 percent and 5.6 percent; $p = 0.794$), reoperations (10 percent versus 5.8 percent and 16.7 percent; $p = 0.259$), and number of readmissions (2.4 versus 2.0 and 2.1; $p = 0.624$). Chronic pain management (53.3 percent versus 44.2 percent and 50 percent; $p = 0.82$), full weight-bearing status (84.2 percent versus 92.7 percent and 100 percent; $p = 0.507$), and ambulation status (92.7 percent versus 100 percent and 100 percent; $p = 0.352$) were similar among groups.

Conclusions: Outcomes are equivalent between racial groups presenting to an orthoplastic limb salvage center for lower extremity reconstruction. The postoperative rehabilitation strategies, follow-up, and overall support that an orthoplastic limb salvage center ensures may lessen the impact of socioeconomic disparities in traumatic lower extremity reconstruction. (*Plast. Reconstr. Surg.* 148: 646, 2021.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Risk, II.

High-energy traumatic lower extremity injuries are often difficult to treat because of extensive soft-tissue loss, neurovascular compromise, and bony defects. Historically, amputation was the primary treatment for the mangled lower extremity. Vascularized free tissue transfer, however, has now become the standard of care for achieving limb salvage at trauma centers across

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the United States, because of both patient preference and noninferior outcomes in comparison to amputation.^{1,2}

Prior studies have shown that certain racial and socioeconomic factors may worsen outcomes following lower extremity reconstruction.^{2,3} The 2002 Lower Extremity Assessment Project showed that factors such as nonwhite race, lack of private insurance, poor social support, and others were associated with greater disability following lower extremity reconstruction.² In addition, previous studies in the orthopedic, vascular, and trauma surgery literature have all demonstrated racial disparities in lower extremity outcomes between African American patients and patients of other racial backgrounds.⁴⁻⁶ Across the United States, African Americans and Hispanics suffer from nontraumatic lower extremity amputations at increased rates in comparison to Caucasians.⁷⁻⁹ In fact, not only are amputation rates higher for African Americans and Hispanics, but minorities have been shown to also suffer from higher amputation levels.¹⁰

In the past few decades, microsurgical advances and a multidisciplinary approach to limb salvage that involves plastic and orthopedic surgeons—termed the orthoplastic approach¹¹—has helped improve functional outcomes and decrease complication rates following lower extremity reconstruction.^{12,13} Prior studies have investigated racial differences in lower extremity reconstruction^{2,3}; however, to our knowledge, there have been no reports on racial differences in short- and long-term outcomes following orthoplastic lower extremity reconstruction. The authors hypothesize that the adaptation of multidisciplinary specialized care in an orthoplastic limb salvage center in combination with vigilant rehabilitative and social support services can help reduce previously described racial disparities in outcomes, despite greater socioeconomic barriers between various racial backgrounds.

PATIENTS AND METHODS

The authors performed a retrospective analysis (May of 2002 to June of 2019) of all patients referred to the University of Pennsylvania orthoplastic limb salvage center who required lower extremity free flap reconstruction. Patients were included if they suffered traumatic injuries to the lower extremity below the knee requiring free flap reconstruction, as a proxy for severity.¹⁴ Exclusion criteria included patients younger than 18 years, those who did not require a free flap to the lower

extremity, and those requiring a free flap for causes exclusive of trauma.

A detailed review of patient medical records was performed. Patients' characteristics including age, sex, and insurance status were gathered. Data regarding self-identified race, relationship status, employment status, and language preference were also collected. Patient relationship with a primary care physician, which was defined as having a documented primary care physician in the chart on the date of flap coverage, was recorded. Race variables included Caucasian, African American, and other race, which encompassed Hispanic, Asian/Pacific Islander, and other races (because of low group numbers). Relationship status was categorized as single or married/in relationship. Divorced, widowed, and separated individuals were considered single. Employment status was categorized as employed or unemployed. Retired patients or patients on disability were considered unemployed.

U.S. Census characteristics were collected from the American Community Survey 5-Year Data (2018).¹⁵ This is an ongoing survey that provides social, economic, demographic, and housing characteristics for the U.S. population with data stratified by zip code.

Medical records were reviewed, and demographic factors, including age, sex, race, and medical comorbidities, were collected. Medical comorbidities included smoking history, chronic obstructive pulmonary disease, peripheral vascular disease, hypertension, and immunocompromised status, which comprised patients with rheumatologic diseases or on chronic immunosuppressive medications. Preoperative considerations, including arterial injury diagnosed by formal or intraoperative computed tomographic angiography, infection status, and time from injury to definitive flap coverage, were also analyzed.

Postoperative variables associated with free flap outcomes were analyzed. Major perioperative complications included were flap failure, reoperation, and readmission. Partial flap failure was defined as débridement and irrigation with preservation of the original flap, and complete failure was defined as partial or full débridement of the original flap requiring an additional flap to achieve adequate coverage for limb salvage. Variables associated with short- and long-term functional status, including weight-bearing status, ambulation status, and need for chronic pain management, were also analyzed. Briefly, dangling starts four times per day at postoperative day 15 for 15 minutes, postoperative day 17 for 30

minutes, postoperative day 19 for 45 minutes, and postoperative day 21 for 60 minutes until follow-up. Our surgeons clear patients for weight-bearing during follow-up.

Descriptive statistics were used to categorize the incidence of variables of interest. Continuous variables were compared using the Kruskal-Wallis *H* test and the Mann-Whitney *U* test, where applicable. Chi-square test and Fisher's exact test were used to compare categorical variables, as appropriate. Post hoc testing using an applied Bonferroni correction was used in scenarios in which a significant difference was detected on univariate testing. Univariate statistical significance was set at $p < 0.05$. Propensity score matching was conducted following the identification of significant demographic differences by race to standardize analysis of outcomes. Statistical calculations and analyses were performed using IBM SPSS Version 25 (IBM Corp., Armonk, N.Y.).

RESULTS

A total of 173 patients met inclusion criteria, with 105 (60.7 percent) being Caucasian patients, 50 (28.9 percent) being African American patients, and 18 (10.4 percent) being other patients. Among all racial groups, patients had a median age of 48 ± 15 years. In total, 24.0 percent of patients were classified as current smokers, and 21.7 percent were former smokers. Commonly encountered comorbidities included hypertension (34.5 percent), chronic obstructive pulmonary disease (4.7 percent), peripheral vascular disease

(7.0 percent), and immunocompromised status (5.9 percent). Rates of comorbid conditions did not differ between racial groups ($p > 0.05$ for all).

African Americans were significantly more likely to be single compared to other races (African Americans, 80 percent; Caucasians, 49 percent; other, 29.4 percent; $p < 0.001$). Insurance status was found to differ between groups ($p < 0.001$), and on subgroup analysis, African American patients were noted to have significantly lower rates of private insurance compared to Caucasian patients (25 percent versus 56.7 percent; $p < 0.05$). Census data examining area of residence demonstrated a significantly reduced median household income for African Americans (\$45,774 versus \$76,348 for Caucasians and \$66,142 for other; $p < 0.001$) and a significantly greater proportion of residents under the poverty line (24.1 percent versus 9 percent and 11.2 percent, respectively; $p < 0.001$) (Table 1). Following matching, each group was inclusive of 13 patients.

In total, 18.9 percent of patients were diagnosed with arterial injury, and 48.9 percent presented with preoperative infection. However, these preoperative factors did not differ across racial groups ($p > 0.05$ for all) (Table 2). Overall, 41.5 percent of patients received definitive wound coverage within 30 days of injury, with no significant difference in timing between groups. Matched groups were also statistically similar ($p > 0.05$ for all).

Regarding complications, the partial flap failure rate in all patients was 10.5 percent, and the total flap failure rate was 5.9 percent (Table 3).

Table 1. Demographics by Race

	Caucasian (%)	African American (%)	Other (%)	<i>p</i>
No.	105 (60.7)	50 (28.9)	18 (10.4)	
Age, yr	50 ± 28	41 ± 25	50.5 ± 23	0.038*
Sex				0.09
Male	76 (72.4)	40 (80)	17 (94.4)	
Female	29 (27.6)	10 (20)	1 (5.6)	
Relationship status				<0.001*
Single	50 (49)	40 (80)	5 (29.4)	
Married/in relationship	52 (51)	10 (20)	12 (70.6)	
Current employment	47 (52.2)	14 (38.9)	5 (41.7)	0.362
PCP	41 (70.7)	15 (48.9)	6 (66.7)	0.112
Primary payor				<0.001*
Uninsured	4 (4.4)	4 (10)	1 (6.7)	
Medicaid	20 (22.2)	2 (5)	5 (33.3)	
Medicare	6 (6.7)	16 (40)	3 (20)	
Private	51 (56.7)	10 (25)	3 (20)	
Other	9 (10)	8 (20)	3 (20)	
English language preference	103 (100)	50 (100)	14 (77.8)	<0.001*
Census characteristics				
Median household income	$\$76,348 \pm \$22,404$	$\$45,774 \pm \$18,535$	$\$66,142 \pm \$21,697$	<0.001*
% below poverty line	9.0 ± 5.3	24.1 ± 10.3	11.2 ± 8.3	<0.001*
% HS graduate or higher	90.7 ± 8.4	85.9 ± 4.4	89.4 ± 5.6	<0.001*

PCP, primary care provider; HS, high school.

*Statistically significant ($p < 0.05$).

Table 2. Medical Comorbidities and Preoperative Status by Race

	Caucasian (%)	African American (%)	Other (%)	<i>p</i>
Smoking status				0.07
Never	60 (58.3)	24 (48)	9 (50)	
Former	25 (24.3)	7 (14)	5 (27.8)	
Current	18 (17.5)	19 (38)	4 (22.2)	
COPD	6 (5.8)	1 (2)	1 (5.6)	0.566
PVD	8 (7.8)	3 (6)	1 (5.6)	0.893
HTN	36 (35.0)	17 (34)	6 (33.3)	0.987
Immunocompromised state	3 (5.1)	2 (7.7)	0 (0)	0.691
Soft-tissue coverage within 30 days	38 (36.9)	26 (52)	7 (38.9)	0.2
Presence of arterial injury	14 (13.7)	13 (26.5)	5 (27.8)	0.102
Preoperative infection	30 (50.8)	13 (48.1)	3 (37.5)	0.774

COPD, chronic obstructive pulmonary disease; PVD, peripheral vascular disease; HTN, hypertension.

The rates of patients requiring reoperation (8.1 percent), readmission (56.8 percent), and osteomyelitis (30.2 percent) were also not significantly different between groups ($p > 0.05$ for all). The overall amputation rate was 4.6 percent, but was not statistically different between groups (Caucasians, 3.8 percent; African Americans, 4 percent; other, 11.1 percent; $p > 0.05$). Readmission statistics, which included number of patients requiring readmission, requiring multiple readmissions, and total number of readmissions, were higher for African Americans in comparison to Caucasian and other patients, but the results were not statistically significant ($p > 0.05$). Reasons for readmission included both soft-tissue and orthopedic complications,

such as postoperative infection, including osteomyelitis, bony malunion/nonunion, and the need for secondary amputation or flap debulking. These were similar between groups ($p > 0.05$). Long-term outcomes were also found to be similar across races, including ambulation status (69.1 percent unassisted, 29.1 percent assisted), best weight-bearing status (90.1 percent full), ability to return to work (81.8 percent returned), and chronic pain management at 9 months (46.8 percent) ($p > 0.05$ for all). Average time to partial (2 months versus 2 months versus 1.5 months) and full weight-bearing (4.7 months versus 5.4 months versus 3.8 months) was similar between groups ($p > 0.05$ for all). Follow-up data sorted by duration demonstrated

Table 3. Short- and Long-Term Outcomes by Race

	Caucasian (%)	African American (%)	Other (%)	<i>p</i>
Flap failure				
Any	18 (17.5)	8 (16)	2 (11.1)	0.794
Total	5 (4.9)	4 (8)	1 (5.6)	0.738
Partial	13 (12.6)	4 (8)	1 (5.6)	0.524
Amputation	4 (3.8)	2 (4)	2 (11.1)	0.392
Reoperation	6 (5.8)	5 (10)	3 (16.7)	0.259
Readmission required	30 (51.7)	20 (66.7)	4 (57.1)	0.407
Multiple readmissions required	16 (27.6)	14 (46.7)	2 (28.6)	0.191
No. of readmissions	2 ± 2	2 ± 3	2 ± 1	0.624
No. of procedures after free flap	2 ± 1	1 ± 2	1 ± 3	0.442
Osteomyelitis	24 (32.9)	9 (26.5)	3 (25)	0.731
Ambulation status				0.352
No ambulation	0 (0)	1 (7.7)	0 (0)	
Ambulation with assistance	10 (27)	5 (38.5)	1 (20)	
Unassisted ambulation	27 (73)	7 (53.8)	4 (80)	
Best weight-bearing status				0.507
None	0 (0)	1 (5.3)	0 (0)	
Partial	3 (7.3)	2 (10.5)	0 (0)	
Full	38 (92.7)	16 (84.2)	6 (100)	
Time to partial weight-bearing, mo	2 ± 3	2 ± 3	1.5 ± 2	0.764
Time to full weight-bearing, mo	4.7 ± 5.5	5.4 ± 6.8	3.8 ± 2.8	0.562
Able to return to work	13 (81.3)	5 (83.3)	N/A	1
Preinjury narcotic use	3 (9.4)	1 (9.1)	0 (0)	0.903
Chronic pain management at 3 mo	24 (55.8)	9 (60)	2 (50)	0.927
Chronic pain management at 9 mo	19 (44.2)	8 (53.3)	2 (50)	0.82
No. of patients per follow-up duration				
0–90 days	16 (15.2)	8 (16)	2 (11.1)	
90–180 days	12 (11.4)	11 (22)	4 (22.2)	
180–360 days	22 (20.9)	7 (14)	1 (5.6)	
≥360 days	55 (52.4)	24 (48)	11 (61.1)	

that the majority of patients from each racial cohort followed up for greater than 360 days (African Americans, 48 percent; Caucasians, 52.4 percent; and other, 61.1 percent). Other outcomes data are also listed in [Table 3](#). There were no statistical differences in outcomes between matched groups ($p > 0.05$ for all).

DISCUSSION

The presented study sought to investigate whether the resources of an orthoplastic limb salvage center leveled the playing field between patients from different racial and socioeconomic backgrounds presenting for traumatic lower extremity reconstruction. African American patients demonstrated similar socioeconomic disadvantages to those that have been previously described in the literature,¹⁶ suggesting that they would be susceptible to increased disability following lower extremity reconstruction. They had significantly lower rates of private insurance in comparison to Caucasians, which may obstruct adequate care during both the preoperative and postoperative period. African American patients were less likely to be married/in a relationship, a potential surrogate for social support that has been found to improve care and outcomes.¹⁷ Furthermore, African American patients live in communities with lower median household incomes and higher poverty rates than patients of other races, which may compound the disparities in access to care.^{8,18} Despite these socioeconomic differences, this study found that African American patients had short- and long-term outcomes similar to those of other racial groups following traumatic lower extremity reconstruction. Short-term complications were similar between groups. Long-term outcomes, captured by metrics of limb function, such as ambulation status, weight-bearing status, return to work after reconstruction, and chronic pain management, were also found to be similar between groups. These metrics all require patient participation in their own care, which sheds light on the effectiveness of not only the patient-provider relationship, but also the multiple other services available at an orthoplastic limb salvage center despite the various obstacles that may impede optimal care.

Studies in breast surgery, craniofacial surgery, and hand surgery have demonstrated access and outcomes disparities between racial groups, leading to differences in postmastectomy breast reconstruction, craniocostostomy repair, and replantation rates.^{19–21} With regard to lower

extremity reconstruction, racial differences in rates of diabetic limb salvage have led to a disproportionate amputation rate among African Americans in comparison to Caucasians.^{7–10} Significant differences also exist in total knee arthroplasty rates, as African Americans have fewer attempts at arthroplasty and higher complication rates if they do undergo total knee arthroplasty in comparison to Caucasians.²²

Causes for these racial disparities are undoubtedly multifactorial, with inadequate access to care,²³ insufficient health literacy,²⁴ and disadvantaged socioeconomic status, among other factors, all playing a role. Importantly, other studies have demonstrated significant differences in care between racial groups even when controlling for medical and social risk factors.^{9,22,24,25} This can occasionally be attributed to a concept called “statistical discrimination.” Briefly, this concept proposes that physician bias and misperceptions about the severity of a patient’s illness can induce practitioners to alter their clinical decision-making between patients from different racial and ethnic backgrounds despite minimal medical differences.^{25,26}

Traumatic lower extremity injuries have been thought to be less susceptible to racial differences in care because of their nonelective nature, thereby removing more subjective influencers on clinical decision-making; however, studies have shown mixed results. The Lower Extremity Assessment Project study demonstrated that non-white race and low socioeconomic status led to greater disability following lower extremity reconstruction,² and subsequent studies have since confirmed their findings.^{3,27} A different study evaluating racial differences in tibial fracture outcomes at a Level I trauma center found no differences in rates of reoperation or infection between racial groups but, importantly, they did not assess long-term functional metrics.²⁸

Outside of the limb salvage literature, there have been some methods proven to improve minority patients’ health care outcomes. A 2012 article by Chin et al. summarizes 12 systematic reviews that implemented health care interventions to reduce racial and ethnic disparities in asthma, human immunodeficiency virus, colorectal cancer, prostate cancer, and cervical cancer care.²⁹ They found that culturally tailored interventions and ones that involved multidisciplinary care teams improved outcomes. In addition, strategies that actively engaged patients’ families and community members in patient care were effective. Finally, interactive skills training that

increased health literacy and modified behavior was more effective than didactic learning.

Historically, African Americans suffer from worse medical and surgical outcomes in comparison to other races in the United States.^{18,30,31} Although African American patients had rates of medical comorbidities similar to those of patients from other racial groups in this study, African American patients suffer from greater rates of diabetes³² and peripheral vascular disease³³ in comparison with Caucasians in the United States. They also receive inadequate pain management for acute and chronic pain in comparison with other racial groups, even when controlling for age, sex, and pain intensity.³⁴ Based on the presented experience, the authors believe that care at an orthoplastic limb salvage center may help mitigate the

effects of race and socioeconomic status on outcomes following lower extremity reconstruction.

An orthoplastic limb salvage center is a specialized multidisciplinary center that coordinates care from experts in microvascular surgery, revascularization procedures, complex fracture care, and other limb salvage techniques, all of which have been shown to optimize patient care³⁵ (Fig. 1). Multidisciplinary surgical care at a high-volume center that specializes in limb salvage such as our orthoplastic limb salvage center may improve minority outcomes while decreasing statistical discrimination. Fear of factors that may dissuade a surgeon from reconstructing a traumatized lower extremity, such as the prevalence of diabetes, peripheral vascular disease, and poor social support in African Americans, is largely not an issue

Stage of Care	Team Members	Role in Care
<p>Triage</p>	<p>Triage Team</p> <ul style="list-style-type: none"> - Emergency physicians - Trauma surgeons - Orthopedic trauma on-call provider - Plastic surgery on-call provider 	<p>Assess injury severity</p> <ul style="list-style-type: none"> - Fracture characterization - Soft tissue injury - Neurovascular injury
<p>Medical Optimization</p> <p>Surgical Intervention</p>	<p>Orthoplastic Limb Salvage Team (Inpatient)</p> <ul style="list-style-type: none"> - Orthopedic trauma service* - Plastic surgery service* - Vascular surgery - Infectious disease - Endocrinology - Anesthesia/pain management - Specialized nursing care - Social work 	<p>Optimize surgical outcomes</p> <ul style="list-style-type: none"> - Complex fracture care - Soft tissue reconstruction - Vascular assessment and intervention - Ensure optimal infection control - Diabetes management - Ensure optimal pain management plan - Assess flap viability, patient concerns - Ensure optimal discharge plan
<p>Follow up</p>	<p>Orthoplastic Limb Salvage Team (Outpatient)</p> <ul style="list-style-type: none"> - Orthopedic trauma team* - Plastic surgery team* - Physical therapists - Orthotist/prosthetist - Social work 	<p>Optimize long term outcomes</p> <ul style="list-style-type: none"> - Assess durability of reconstruction, manage complications, coordinate care - Help strengthen reconstructed extremity, confer patient specific strengthening regimen, skills training - Ensure optimal infection control - Provide orthotics/prosthetics - Continually coordinate social contributors to care

* denotes joint primary team

Fig. 1. Components of an orthoplastic limb salvage center organized by stage of lower extremity reconstruction care, team members, and their respective roles in care.

given the multidisciplinary expertise available. For example, to optimize success rates following lower extremity reconstruction, patients with evidence of peripheral vascular disease benefit from either bypass surgery or angioplasty/stenting procedures before definitive reconstruction.³⁶ Furthermore, infectious disease input is almost a necessity in patients presenting with chronic open traumatic defects that are likely contaminated or have an underlying component of osteomyelitis.³⁷ In addition, endocrinology/diabetes service consultation perioperatively and postoperatively targets strict glycemic control, which may help decrease recurrent osteomyelitis³⁸ and flap complications.³⁹ Pain management experts help manage patients' pain control needs both perioperatively and following discharge.

In addition to the aforementioned services, rehabilitation experts provide specialized physical and occupational therapy to improve functional outcomes and potentially reduce time needed to return to work and activities of daily function. Support from social workers and patient-advocacy professionals also promote follow-up and helps patients successfully reintegrate with their communities. Importantly, our physicians highly encourage collective decision-making and rely on family input during early scheduled family meetings to establish goals of care. It is likely that this collaborative and longitudinal approach to patient care, from initial injury through chronic management, may buffer the effects of racial and socioeconomic status on outcomes.

Altogether, our orthoplastic limb salvage center incorporates important tenets that decrease disparities in care, including immediate and coordinated multidisciplinary care, family input through early family meetings and goals-of-care discussions, one-on-one skills training through our limb salvage team's members, and community outreach through antiracism campaigns. The availability of all these services for lower extremity reconstruction patients, which is less likely at community centers and Level I trauma centers without an orthoplastic limb salvage center, may increase the efficacy of free flap reconstruction for minority patients. We believe that centers with the resources and capacity to establish an orthoplastic limb salvage center using a coordinated management strategy as shown above may better serve patients from racial minorities presenting for lower extremity reconstruction. For centers without the resources to do so, regional referral networks as previously studied in the United Kingdom⁴⁰ and suggested in the United States⁴¹

may expedite transfer of complex lower extremity trauma patients to an orthoplastic limb salvage center. The Lower Extremity Guidelines for Salvage is a referral framework that may help centers promptly refer complex lower extremity trauma patients to orthoplastic limb salvage centers, and thereby ensure optimal outcomes for patients in a timely manner.³⁵

Although our orthoplastic limb salvage center has had a multifaceted approach to lower extremity reconstruction care that may benefit minority patients, we acknowledge the need for more direct antiracist efforts. Recently, our institution has emphasized creating a surgical workforce more reflective of our patient population,⁴² an important tenet of addressing health care disparities. In addition, outreach campaigns to underserved communities within greater Philadelphia to improve health literacy on several prominent surgical health care disparities has been a mainstay of our program.^{43–45} Furthermore, at the national level, several of the authors have been instrumental in both the American College of Surgeons (L.S.L.) and the American Board of Surgery (P.D.B.) in creating programs to combat racism in training programs, health care delivery, and other societal disparities along racial and ethnic lines.^{46,47}

Limitations to this study include its retrospective nature, which relies on prior documentation that may lead to inconsistencies in the data collected. Furthermore, there were limited data for long-term ambulatory/weight-bearing status and narcotic use. In addition, a multi-institutional data set may have provided the numbers necessary to measure differences more comprehensively between the patient populations. Using zip code data rather than more specific patient-centered stratification reduces the granularity and ultimate specificity of our demographic findings. Larger studies may allow for more detailed analysis with more specific patient-geographic data. Although we credit the orthoplastic limb salvage center for minimizing the effects of racial and socioeconomic disparities on outcomes, the exact interventions that reduced outcomes disparities in lower extremity reconstruction still need to be determined. In addition, the results from this study cannot be extrapolated to smaller limb salvage centers, as their protocols may differ from ours. Although our results are encouraging, more studies that investigate how to optimize care for African American patients and patients from different racial and socioeconomic backgrounds are

needed. We did not have functional outcome data available, although our institution is in the process of implementing and standardizing this to all lower extremity reconstruction patients. Studies that look into racial disparities using patient-recorded outcomes, such as the LIMB-Q, can be a very valuable addition to the literature to more comprehensively grasp the implications put forth in patient care.^{42,48}

CONCLUSIONS

Historically, African Americans suffer greater disability following high-energy traumatic lower extremity injury. An orthoplastic limb salvage center may mitigate the effects of race and socioeconomic status on outcomes following limb salvage by promoting multidisciplinary collaboration, rigorous physical therapy, and optimal follow-up. The orthoplastic limb salvage center model can be adopted at more trauma centers to help increase limb salvage success in minority communities. Once stable, all patients with high-energy lower extremity trauma should promptly be referred to an orthoplastic limb salvage center for consideration for reconstruction, as the decision to amputate is irreversible.

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