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ORIGINAL RESEARCH

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Race and sex demographics in the surgical management of facial nerve palsy

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Abstract

Objective: Facial palsy affects patients of all backgrounds, yet no existing studies describe differences in its treatment patterns between demographic groups.

Methods: We used the National Surgical Quality Improvement Project database to investigate whether race and sex disparities exist in facial reanimation surgery. Patients were identified using CPT codes corresponding to facial-nerve procedures.

Results: Seven hundred sixty-one patients met criteria; 681 self-identified as White (89.5%), 51 as Black (6.7%), 43 as Hispanic (5.6%), 23 as Asian (3.0%), and 5 patients as other (0.61%). White patients were more than twice as likely to undergo brow ptosis repair than Non-White patients (OR 2.49, 95% CI 1.16–6.15, $p = .03$). After controlling for malignancy, men had longer operative times than women (480.2 vs. 413.9 min, $p = .04$) and higher likelihood of free tissue transfer (OR 4.1, 95% CI 1.9–9.8), fascial free tissue transfer (OR 10.7, 95% CI 2.1–195), and ectropion repair (OR 1.8, 95% CI 1.2–2.8).

Conclusion: Most patients undergoing facial reanimation surgery in the United States are White. Men have longer operative times and a higher likelihood of undergoing free fascial grafts and cutaneous and fascial free tissue transfer than women regardless of malignancy status.

Level of Evidence: 2c.

KEYWORDS
facial palsy, facial reanimation, racial disparities, sex disparities, surgical management

1 | INTRODUCTION

Facial palsy encompasses a wide range of facial nerve disorders with many distinct etiologies, including Bell's palsy, benign and malignant neoplasms, facial and temporal bone trauma, infection, congenital anomalies, and neurologic disease.[1,2] The clinical manifestation of these disease processes is a spectrum of flaccid facial paralysis and synkinesis with varying degrees of severity. The incidence of facial palsy appears to be evenly spread among all patient demographics; there is no current evidence to support that facial palsy disproportionately affects certain sexes, races, or ethnic groups.[1] However, disparities in the diagnosis and treatment of conditions that predispose facial palsy, such as head and neck cancer and facial trauma, have been well established, with an abundance of literature supporting late-stage diagnosis and less frequent surgical intervention in nonwhite patients.[3] Discrepancies in surgical management have

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significant implications for social justice given the morbidity of facial palsy and the high societal value placed on facial symmetry and movement.[4–7] There has yet to be a study that analyzes differences in treatment patterns of facial paralysis between demographic groups. This investigation aims to describe racial and sex disparities in the current surgical management of facial nerve palsy in the United States.

2 | METHODS

This study was exempt from institutional IRB approval given that all analysis was performed with deidentified, publicly available data. The ACC NSQIP database was used to retrospectively identify patients who underwent surgery for facial paralysis between 2008 and 2019 in the United States. This was achieved by filtering for encounters with *Current Procedural Terminology* codes corresponding to facial-nerve-specific diagnoses and procedures.[8] Relevant CPT codes are listed in Table 1.

Per a prior NSQIP analysis performed by Lu et al., patients who underwent surgical correction of iatrogenic facial paralysis were divided into three categories: nerve-type repairs, sling-type repairs, and free tissue transfer.[8] Nerve-type repairs included CPT codes 64716, 64864, 64868, 64885, 64886, 64910, and 64727. Sling-type repairs included free fascial or muscle grafting and ophthalmologic procedures; CPT codes included 15840, 15841, 15845, 67917, 67912, 67900. Free flap procedures were identified by CPT codes 15756, 15757, 15758, and 20969 (Table 1). A manual review of all patients was then conducted to remove patients who underwent any of these procedures for a primary diagnosis other than facial paralysis. Diagnosis codes coupled with manual review were used to categorize the primary indication for surgery. Patients were categorized broadly into White and Non-White race groups to ensure an adequately powered analysis.

Statistical analysis was performed using R.[9] A χ^2 test was performed to compare the proportion of White patients in our analysis cohort with that of the overall NSQIP database. A Fisher's exact test, Mann–Whitney *U* test, or χ^2 test was used when appropriate to compare baseline characteristics and differences in the overall rates of individual surgical procedures between White and Non-White groups and between the sexes. Univariable and multivariable logistic and linear regression tests were used to analyze the likelihood of patients in each sex and race category undergoing individual facial reanimation procedure. In our multivariable analysis, we included all five demographic variables available in the NSQIP: age, sex, race, smoking status, and presence of malignancy.

TABLE 1 CPT codes used to identify facial nerve-specific procedures.

Repair Category	CPT codes	Procedure in detail
Nerve type	64716	Neuroplasty with transposition of CN VII branches
	64864	Extracranial suturing of CN VII
	61590	Masseteric-facial nerve transfer via infratemporal fossa approach
	64868	Hypoglossal-facial neurorrhaphy
	64885	Nerve grafting; ≤4 cm in length
	64886	Nerve grafting; >4 cm in length
	64910	Nerve repair with synthetic conduit
	64727	Internal neurolysis of facial nerve
	42425	Facial nerve sacrifice
Sling type	15840	Free fascial graft for facial nerve paralysis (i.e., fascia lata suspension)
	15841	Free muscle graft for facial nerve paralysis
	15845	Regional muscle transfer for facial nerve paralysis
	67917	Ectropion repair, extensive
	67912	Repair of lagophthalmos (eyelid weight insertion)
	67900	Repair of brow ptosis (direct)
Flap	15756	Free muscle flap with microvascular anastomosis
	15757	Free skin flap or with microvascular anastomosis
	15758	Free fascial flap with microvascular anastomosis
	20969	Free osteocutaneous flap with microvascular anastomosis; other than iliac crest, metatarsal or great toe

3 | RESULTS

3.1 | Patient demographics

Seven hundred sixty-one unique patients with reported race and sex met inclusion criteria (Table 2). There were 681 White patients (89.5%), 51 Black patients (6.7%), 43 Hispanic patients (5.6%), 23 Asian patients (3.0%), and 5 patients that identified as other (0.61%). The proportion of White patients was significantly higher in the cohort of patients undergoing surgery for facial paralysis than in the overall NSQIP from 2008 to 2019 (89.5% vs. 70%, $p < .0001$). Non-White patients were found to be significantly younger with a mean age of 51.3 years, whereas White patients were 62.6 years on average ($p < .001$). Of the 761 patients in our analysis, 336 (44.2%) patients identified as female and 425 (55.8%) identified as male. The mean age of women at the time of surgery was 56.5, while men were on average 65.3 years ($p < .001$). The most common indications for facial nerve repair are listed in Figure 1. Facial palsy without further specification of etiology was the most coded indication for surgery (47.2%), followed by malignancy (32.1%), and Bell's palsy (14.6%). Trauma (3.7%), benign salivary gland disease (1.8%), and acoustic neuroma (0.7%) were the listed indications for surgery in the remaining patients.

3.2 | Race category analysis

White and Non-White patients underwent multiple procedures for facial paralysis (13.2% vs. 17.5% respectively, $p = .377$), and a similar

TABLE 2 Baseline characteristics of patients undergoing surgical management of facial palsy.

	Race category			Sex category		
	Non-White $N = 80$	White $N = 681$	*p*-Value	Female $N = 336$	Male $N = 425$	*p*-Value
Age	51.3 (15.9)	62.6 (16.4)	<.001	56.5 (16.1)	65.3 (16.1)	<.001
Sex			<.001			
Female	54 (67.5%)	282 (41.4%)				
Male	26 (32.5%)	399 (58.6%)				
White						<.001
No				54 (16.1%)	26 (6.12%)	
Yes				282 (83.9%)	399 (93.9%)	
Surgery for malignant disease	22 (27.5%)	222 (32.6%)	.425	73 (21.7%)	171 (40.2%)	<.001
Multiple surgeries	14 (17.5%)	90 (13.2%)	.377	39 (11.6%)	65 (15.3%)	.173
Surgical setting			.648			.003
Inpatient	43 (53.8%)	389 (57.1%)		170 (50.6%)	262 (61.6%)	
Outpatient	37 (46.2%)	292 (42.9%)		166 (49.4%)	163 (38.4%)	
Operative time	322 (247)	328 (217)	.832	292 (197)	356 (233)	<.001
Facial nerve sacrifice	9 (11.2%)	94 (13.8%)	.646	26 (7.74%)	77 (18.1%)	<.001
Primary anastomosis	23 (28.7%)	128 (18.8%)	.050	78 (23.2%)	73 (17.2%)	.047
Neuroplasty	5 (6.25%)	24 (3.52%)	.217	14 (4.17%)	15 (3.53%)	.791
Masseteric-facial nerve transfer	2 (2.50%)	17 (2.50%)	1.000	6 (1.79%)	13 (3.06%)	.377
Hypoglossal-facial nerve transfer	8 (10.0%)	38 (5.58%)	.133	28 (8.33%)	18 (4.24%)	.028
Nerve cable graft <4 cm	4 (5.00%)	22 (3.23%)	.341	7 (2.08%)	19 (4.47%)	.110
Nerve cable graft >4 cm	8 (10.0%)	52 (7.64%)	.601	24 (7.14%)	36 (8.47%)	.590
Free fascial graft	18 (22.5%)	162 (23.8%)	.906	67 (19.9%)	113 (26.6%)	.040
Free muscle graft	4 (5.00%)	26 (3.82%)	.545	20 (5.95%)	10 (2.35%)	.019
Regional muscle transfer	12 (15.0%)	81 (11.9%)	.534	43 (12.8%)	50 (11.8%)	.749
Ectropion repair	10 (12.5%)	130 (19.1%)	.198	44 (13.1%)	96 (22.6%)	.001
Lagophthalmos repair	22 (27.5%)	179 (26.3%)	.921	77 (22.9%)	124 (29.2%)	.063
Brow ptosis repair	7 (8.75%)	122 (17.9%)	.056	69 (20.5%)	60 (14.1%)	.025
Nerve conduit use	0 (0.00%)	4 (0.59%)	1.000	2 (0.60%)	2 (0.47%)	1.000
Muscular free flap	5 (6.25%)	51 (7.49%)	.861	21 (6.25%)	35 (8.24%)	.367
Cutaneous free flap	3 (3.75%)	50 (7.34%)	.336	9 (2.68%)	44 (10.4%)	<.001
Fascial free flap	1 (1.25%)	19 (2.79%)	.712	1 (0.30%)	19 (4.47%)	.001
Osteocutaneous free flap	1 (1.25%)	6 (0.88%)	.542	2 (0.60%)	5 (1.18%)	.473

percentage of procedures were done in the setting of malignancy in both groups (32.2% for White patients, 28.9% for Non-White patients, $p = .63$). Brow ptosis repair was more common in White patients (17.9% vs. 8.8% in Non-White patients); this was supported by multivariable regression analysis, which revealed that White patients were more than twice as likely to undergo brow ptosis repair than Non-White patients, even when controlling for age (OR 2.49, 95% CI 1.16–6.15, $p = .03$). White and Non-White patients were equally likely to undergo free fascial grafts, regional muscle transfer, and free tissue transfer. Surgical setting did not differ between groups.

3.3 | Sex category analysis

Women had higher rates of surgery after Bell's palsy than men (18.8% vs. 11.3%, $p = .005$); these women were younger on average than men with Bell's palsy (56.2 vs. 62.6, $p < .001$) but these values did not differ between men and women undergoing surgery for other indications. The rates of individual facial reanimation procedures did not differ between men and women with Bell's palsy. A significantly higher percentage of men underwent surgery for malignant disease (40.2% vs. 21.7%, $p < 0.001$). Men underwent multiple surgeries at a higher rate, with an average of 1.83 procedures per individual, compared to a

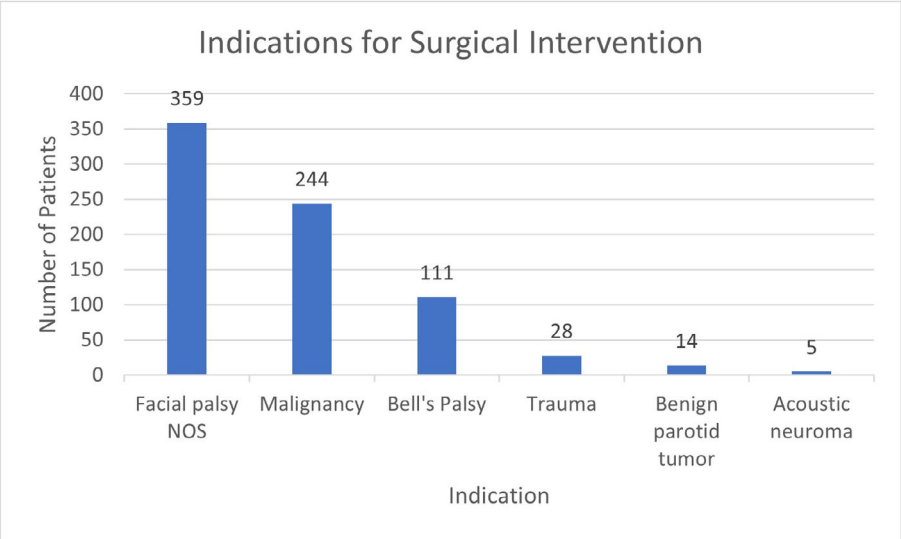

FIGURE 1 Indications for surgical intervention for facial nerve palsy.

mean 1.63 procedures per individual in women ($p < .001$). Surgical setting also differed between groups; 49.4% of women underwent surgery in the outpatient setting, compared to 38.4% of men ($p = .003$). Before controlling for malignancy, operative time per surgery was significantly longer in men, with an average of 356 min per case in men compared to 292 min in women ($p < .001$). Women had a significantly lower rate of facial nerve sacrifice than men (7.7% vs. 18.1%, $p < .001$). Female patients had higher rates of primary nerve repair or neurorrhaphy (23.2% vs. 17.2%, $p < .05$), hypoglossal-facial nerve transfer (8.3% vs. 4.2%, $p = .03$), free muscle tissue transfer (5.9% vs. 2.4%, $p = .02$), and brow ptosis repair (20.5% vs. 14.1%, $p = .025$). Masseteric-facial nerve transfer rates did not differ significantly between men and women (1.79% in females vs. 3.06% in males, $p = .377$). Men had significantly higher rates of free fascial grafting (26.6% vs. 19.9%, $p = .040$), ectropion repair (22.6% vs. 13.1%, $p = .001$), cutaneous free tissue transfer (10.4% vs. 2.7%, $p < .001$), and fascial free tissue transfer (4.5% vs. 0.3%, $p = .001$).

A subgroup analysis was then performed to determine if malignancy was a confounding factor in these significant differences in the surgical treatment of men and women. Despite controlling for the presence of malignancy, men were found to have consistently longer operative times than women (480.2 vs. 413.9 min, $p = .04$). Multivariable logistic regression analysis also revealed that male patients were four times more likely to undergo cutaneous free tissue transfer (OR 4.1, 95% CI 1.9–9.8), ten times more likely to undergo fascial free tissue transfer (OR 10.7, 95% CI 2.1–195) and nearly twice as likely to undergo ectropion repair (OR 1.8, 95% CI 1.2–2.8). Men were less likely to undergo brow ptosis repair (OR 0.62, 95% CI 0.41–0.93) or free muscle grafting (OR 0.41, 95% CI 0.17–0.93) (Table 3).

4 | DISCUSSION

In this analysis, we sought to describe differences in the surgical management of facial paralysis with respect to patient race and sex. Although facial paralysis affects patients of all backgrounds, anecdotal evidence has so far suggested that race and socioeconomic status heavily influence a patient's access to facial reanimation surgery. This warrants investigation, as multiple studies have demonstrated the importance of facial expression, the association of facial paralysis with depression and decreased quality of life, and the high societal value placed on facial reanimation.[4,6,7] This investigation does not promote the choice of any specific reanimation procedures; rather, it aims to raise awareness of current management trends given the morbidity of facial palsy.

We found that an overwhelming majority of patients who underwent surgical correction of facial paralysis in the United States between 2008 and 2019 were White. White patients accounted for 89.5% of our analysis cohort, a figure significantly out of proportion the overall NSQIP sample from 2008 to 2019 and to the United States census data. We found that only 70% of all NSQIP patients included in the 2008–2019 data sets were categorized as White, and according to the 2020 census, only 64% of Americans self-identified as White alone.[10] This suggests that White patients may undergo surgical correction of facial paralysis at significantly higher rates than Non-White patients.

The trend of White patients undergoing surgery at higher rates than Non-White patients has been well described in the literature, especially in the setting of malignancy and reconstruction. A study by Shavers et al. showed that while Black and White patients are equally likely to develop parotid malignancies, Black patients are more likely to be diagnosed with advanced stage disease and are less likely to undergo cancer-directed surgery.[3] Similarly, Restrepo et al. showed that White patients were more likely to receive breast reconstruction after mastectomy than Black patients.[11] As we found no significant difference in the number of White and Non-White patients who underwent surgery for facial palsy in the setting of malignancy, our data suggests that there is an alternative explanation for why White patients make up a disproportionately large percentage of the patients undergoing facial reanimation surgery. Factors including

TABLE 3 Multivariable analysis demonstrating the odds ratios of a male patient undergoing facial nerve-specific interventions (controlled for age, race, smoking status, presence of malignancy).

Intervention	Odds ratio for male patient	95% Confidence interval	*p*-Value
Facial nerve sacrifice	1.31	0.72–2.42	.369
Neuroplasty	2.26	0.52–16.1	.33
Extracranial FN suturing	0.88	0.46–1.75	.71
Masseteric-facial nerve transfer	1.64	0.56–5.34	.38
Hypoglossal-facial nerve transfer	0.63	0.17–2.49	.49
Nerve graft <4 cm	1.12	0.41–3.45	.82
Nerve graft >4 cm	0.95	0.41–2.36	.91
Neurolysis	1.81	0.25–3.68	.61
Nerve conduit	0.59	0.05–1.33	.68
Free fascial graft	2.53	1.18–5.92	.02
Free muscle graft	2.15	0.27–1.38	.1
Regional muscle transfer	4.03	0.74–7.52	.19
Ectropion repair	0.87	0.39–1.99	.73
Lagophthalmos repair	0.85	0.47–1.54	.59
Brow ptosis repair	1.34	0.49–4.34	.59
Muscular free flap	0.87	0.42–1.9	.73
Cutaneous free flap	2.85	1.05–9.36	.055
Fascial free flap	6.67	1.23–125	.08
Osteocutaneous free flap	1.21	0.13–28.2	.88

socioeconomic status, education level, and geographic setting have been shown to influence access to elective surgery and may have played a role in the demographic distribution of facial paralysis patients in this study.[12,13] However, as the NSQIP database lacks information on these demographic factors, their influence on the distribution of our patient cohort could not be further evaluated.

In our sex category analysis, we found significant differences in operative time, surgical setting, rates of surgery performed for malignancy, and in the individual procedures performed between men and women. Interestingly, we also found that women had a significantly higher rate of surgery after a diagnosis of Bell's palsy than men, although the rates of individual procedures did not differ between the sexes. Twice as many men underwent surgical correction of facial paralysis in the setting of malignancy compared to women. For this reason, our initial sex category analysis yielded significant differences in management between the sexes, with men twice as likely to have their facial nerve sacrificed during surgery and more likely to undergo longer surgeries in an inpatient setting. In our subgroup analysis of male and female patients undergoing surgery for malignancy, facial nerve sacrifice, masseteric-facial nerve transfer and hypoglossal-facial nerve transfer rates were comparable between men and women. However, we found that men remained more likely to have longer operative times and had a significantly higher likelihood of undergoing free fascial grafts, cutaneous free flaps, and fascial free flaps.

Our analysis revealed that men were four times as likely to undergo cutaneous free tissue transfer and ten times as likely to undergo fascial free tissue transfer than women. With the limited information available in our data set, we were unable to discern if the patients in our analysis cohort underwent surgery prior to the encounters recorded in the NSQIP. Furthermore, the classification of these procedures as cutaneous and fascial free tissue transfer without muscular involvement suggests that these may have been static procedures aimed at repairing facial volume and symmetry rather than dynamic reanimation surgeries intended to restore spontaneous smile, which may reflect diagnoses or issues not disclosed in the database.

Importantly, muscular free tissue transfer rates did not differ between men and women. In our analysis, 56 patients (8.2%) underwent muscular or myocutaneous free tissue transfer. This procedure was performed in 8.24% of men and 6.25% of women ($p = .37$), and in 7.49% of White patients and 6.25% of Non-White patients ($p = .86$). The equal distribution of this surgery among races and sexes is encouraging considering the abundance of data asserting gracilis free tissue transfer as the gold standard in restoring spontaneous smile after longstanding facial paralysis.[14–19]

The importance of pursuing equity in the surgical management of facial paralysis cannot be overstated; disparities in facial palsy management is a social justice issue given the morbidity of this disease and the high societal value placed on repair.[7] Su et al. showed that participants' willingness to pay for surgical facial reanimation increased nonlinearly with increasing severity of facial paralysis. They also found that participants perceived significantly decreased quality of life associated with increasing severity of facial paralysis.[7] A study by Faris et al. measured how laypersons perceive people with facial paralysis, and found that patients who had undergone facial reanimation procedures to restore facial symmetry were perceived by participants to have higher societal value than patients with flaccid paralysis.[20] These findings support that minimizing the differences in surgical management of facial paralysis between sexes and racial groups would have great overall societal benefit.

As a retrospective database study, this investigation has several inherent limitations. First, the NSQIP database contains limited demographic information available for multivariable analysis. We expect that socioeconomic status is a major confounding factor in the observed discrepancies in the surgical management of facial palsy given that these procedures are not always covered by insurance; however, the NSQIP database lacks information on patient income, income quartile, hospital identifier, insurance payer or zip code. The demographic factors available for our multivariable analysis were limited to race, sex, age, and smoking status. This investigation also did not examine perioperative outcomes such as surgical site infection, unplanned surgery, or unplanned 30-day readmissions. Next, it is it possible that the sample sizes of patients undergoing specific

procedures within this database were too small to detect significant differences in odds ratios. For example, we found a significant difference in the overall rate of regional muscle transfer between White and Non-White groups, but the associated odds ratios were found to be insignificant. The integrity of the data within the NSQIP also relies on accurate coding on the part of all contributing institutions, which predisposes our analysis to misclassification bias. Perhaps the most significant limitation in our analysis of racial and sex disparities in the management of facial paralysis is that the NSQIP database includes only patients who were recipients of surgery. Without information on patients who were managed nonsurgically, we cannot claim to present the full picture of management disparities between race and sex groups. Future investigations may include an analysis of the respective rates of nonsurgical versus surgical management of facial paralysis and inclusion of socioeconomic status in the analysis.

5 | CONCLUSION

White patients account for the vast majority of those who undergo surgery for facial paralysis in the United States. Rates of brow ptosis repair are higher among White patients with facial palsy than among Non-White patients. When controlling for the presence of malignancy, men had significantly longer operative times and a higher likelihood of undergoing free fascial grafts and cutaneous and fascial free tissue transfer than women.

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