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Outcomes in Head and Neck Resections That Require Multiple-Flap Reconstructions
A Systematic Review

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IMPORTANCE Complex head and neck cancer defects that require multiflap reconstructions are technically feasible, but the morbidity and patient outcomes of such large-scale head and neck operations have yet to be systematically reviewed.

OBJECTIVE To systematically review existing literature to characterize the outcomes of large-scale head and neck resections that require multiple-flap reconstructions (defined as defects that require >1 flap [free, pedicled, or combinations thereof]).

EVIDENCE REVIEW Two authors independently searched PubMed, Embase, and the Cochrane Review databases for English-only texts published on any date. Included studies examined patients who underwent complex head and neck surgical resections that required multiple simultaneous flaps for reconstruction. Included studies reported results on at least one of the following outcomes: functional and aesthetic, patient survival, or cost (estimated by operating room time, length of stay, and/or complications). Methodological Index for Non-Randomized Studies (MINORS) criteria for bias and modified Oxford Centre for Evidence-Based Medicine recommendations were used to assess study quality.

FINDINGS Twenty-four studies published from November 1, 1992, through September 1, 2016, met the final inclusion criteria, with a total of 487 patients (370 male [79.4%]; mean [SD] weighted age, 55.1 [4.1] years). Sixty-two of 250 patients (24.8%) were partially or fully dependent on feeding tubes at follow-up. Twenty-two of 75 patients (29.3%) had poor postoperative oral competence, causing moderate to severe drooling. Nineteen of 108 patients (17.6%) had unintelligible speech. Nine of 64 patients (14.1%) were unsatisfied with their aesthetic outcome. The mean (SD) reported survival was 2.36 (1.39) years. The mean (SD) length of stay was 24.5 (12.2) days in 219 patients. Eighty-eight minor complications (eg, partial flap necrosis, donor site complications) and 185 major complications (eg, surgical reexplorations, flap loss, or cardiopulmonary complications) were reported in 380 patients. Mean (SD) MINORS scores were 16.0 (3.2) for comparison studies and 11.4 (1.8) for noncomparison studies.

CONCLUSIONS AND RELEVANCE Because of limited patient life expectancies, modest functional and aesthetic outcomes, and significant associated costs, surgeons should weigh the curative potential and palliative benefits for individual patients with a comprehensive view of the overall outcomes of extensive head and neck resections and reconstructions. Realistic expectations should be emphasized during preoperative discussions with patients.

+ Invited Commentary
+ Supplemental content

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With health care expenditures reaching historic proportions of the annual US gross domestic product but health outcomes and life expectancies in the United States lagging behind other high-income nations, health care reform has increasingly emphasized rewarding value over volume.[1] Value is assessed as patient outcomes achieved relative to financial costs incurred, and to achieve high-value care, it is important to pursue interventions with favorable patient outcomes over narrowly pursuing cost reductions. Trimming the costs for an intervention with unsatisfactory outcomes may increase its cost-effectiveness, but the intervention will still not be worthwhile for the patient.

One particular population with complicated and often poor outcomes is patients undergoing head and neck surgery with extensive resections that require multiflap reconstructions (including pairs of free flaps or pedicled flaps and combinations thereof). These patients can have significant morbidity and quality-of-life limitations after these challenging operations.[2-5] The operations themselves are also resource intensive and time consuming, often requiring 2 surgical teams, extended hospital stays, and further care for associated medical and surgical complications.[6-8]

The morbidity and patient outcomes of such large-scale head and neck resections and multiflap reconstructions have, to our knowledge, yet to be systematically reviewed. Previous reports[9-11] on this topic evaluated smaller cohorts and addressed limited outcomes, such as oral competence. In this study, we sought to pool a more comprehensive view across multiple patient outcomes.

Key Points

Question What are the patient outcomes for adults undergoing head and neck resections that require multiple-flap reconstructions?

Findings In this systematic review of 24 studies comprising 487 patients, patients undergoing head and neck resections that required multiple-flap reconstructions experienced poor functional and aesthetic outcomes, limited patient survival, extended hospital stays, and considerable associated perioperative complications.

Meaning Surgeons should weigh the curative potential and palliative benefits for individual patients with a comprehensive view of the overall outcomes of extensive head and neck resections that require multiflap reconstructions; realistic expectations should be emphasized during preoperative discussions with patients.

Methods

We performed a systematic review of studies published from November 1, 1992, through September 1, 2016, that examined adult patients who underwent large head and neck surgical resections with simultaneous reconstructions. A large resection was defined as any resection with a resulting defect that required more than 1 rotational or free flap to reconstruct. This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (eFigure 1 in the Supplement).

Search Methods

The studies were selected from a broad search of the PubMed, Embase, and Cochrane Review databases for English-only texts published on any date. Two authors (R.W.G. and B.A.N.) independently selected studies for inclusion using predetermined criteria, and discrepancies were resolved by another author (E.L.R.). The initial search covered any articles that included discussion of *head and neck* AND [*multiple flap* OR *double flap* OR *combined flaps*] and related synonyms. Studies that met final inclusion criteria were published in peer-reviewed journals and examined at least 2 adult patients undergoing head and neck surgery for any indication with a resulting defect that required multiple flaps to reconstruct. The reconstructions were performed simultaneously with the primary resection. Individual case reports were excluded because of concern for bias from outliers. Studies that did not report results on at least 1 of the following functional outcomes were also excluded: aesthetic results, patient survival, operating room time, length of stay, or perioperative complications.

The following variables were extracted from full-text articles: study authors, publication year, patient demographics, and follow-up time. Additional variables that varied by study were as follows: functional outcomes (speech intelligibility, oral competence, and/or postoperative diet), aesthetic outcomes (patient and/or physician satisfaction), patient survival, operating room time, length of perioperative hospital stay, and complications. The studies often reported these variables using different methods, and the results were grouped into more general categories for our analysis. A meta-analysis was not performed because of the heterogeneity of outcome measures in the included studies.

Quality Assessment

The Methodological Index for Non-Randomized Studies (MINORS) criteria for bias were calculated for each study[12] (eFigure 2 in the Supplement). Each criterion was scored as 0 if not reported, 1 if reported but insufficient, and 2 if reported and adequate. Noncomparison studies were considered to be at high risk for bias if they scored less than 10, moderate risk if they scored 10 through 14, and low risk if they scored 15 or 16. Comparison studies were considered to be at high risk for bias if they scored less than 18, moderate if they scored 18 through 22, and low risk if they scored 23 or 24.

Modified Oxford Centre for Evidence-Based Medicine ratings of individual studies were also used to assess study quality. Levels of evidence were as follows: 1, randomized clinical trials and meta-analysis; 2, nonrandomized clinical trials and prospective comparative cohort trials; 3, case-control studies and retrospective cohort studies; 4, case series and cross-sectional studies; and 5, case reports.

Statistical Analysis

All summative means were weighted by the number of patients in each study. Weighted means (SDs) were calculated using the number of patients per study as the correction factor using Microsoft Excel 2015 (Microsoft Corporation).

Results

The search produced 459 results with 15 additional records identified through gray literature sources. A total of 395 records remained after duplicates were removed, and 81 records were excluded by title. A total of 325 abstracts were screened, and 255 records were excluded. A total of 59 full-text articles were assessed for eligibility, and 24 studies met full inclusion criteria (**Figure**).

The 24 studies published from November 1, 1992, through September 1, 2016, met the final inclusion criteria. Of the 20 noncomparison studies, 17 were scored as moderate risk of bias and 3 were scored as high risk. Of the 4 comparison studies, 2 were scored as moderate risk and 2 were scored high risk (eFigure 2 in the Supplement). The quality rating using the modified Oxford Centre for Evidence-based Medicine levels of evidence showed 2 level 2 studies (8.3%) (1 nonrandomized trial and 1 prospective cohort study) and 22 level 4 studies (91.7%) (all case series).

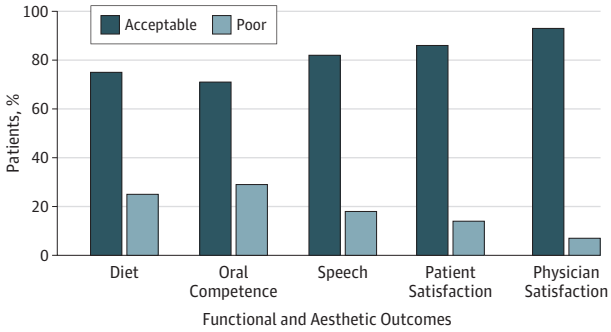
The studies included a total of 487 patients (**Table 1**). Of the 466 patients for whom sex was reported, 370 (79.4%) were male and 96 (20.6%) were female. The mean (SD) weighted age was 55.1 (4.1) years. In 464 patients, the indication for the initial resection was reported; 446 patients (96.1%) underwent surgery for a malignant tumor, 6 (1.3%) for a functional indication, and 12 (2.6%) for osteoradionecrosis. The resection defects were mostly oromandibular (346 of 417 defects [83.0%] reported). Other defect locations included the pharynx and/or larynx (43 [10.3%]), nasal cavities and sinuses (12 [2.9%]), maxilla (10 [2.4%]), and other (6 [1.4%]).

A total of 978 flaps were performed in the 487 patients. A total of 907 of 956 reported flaps survived, for a flap survival rate of 94.9%. Of the 476 patients for whom the flap combinations were reported, 387 (81.3%) received 2 free flaps, 73 patients (15.3%) received 1 pedicled and 1 free flap, and 16 patients (3.4%) received an alternate combination of flaps, such as 3 flaps or 2 pedicled flaps. The most common combination of 2 free flaps was the fibula osteocutaneous and the anterolateral thigh myocutaneous pair in 166 patients (42.9%), followed by the fibula osteocutaneous and radial forearm fasciocutaneous pair in 94 patients (24.3%) and the fibula osteocutaneous and rectus abdominis myocutaneous pair in 25 patients (6.4%). A more detailed overview of the included studies is given in **Table 2**.

Outcome 1: Functional and Aesthetic Outcomes

Twenty studies[9-11,13,14,16-19,21-31] reported functional or aesthetic outcomes with a total of 318 patients (eFigure 3 in the Supplement). Of the 250 patients whose postoperative feeding tube dependence was assessed, 62 patients (24.8%) were partially or fully dependent on a feeding tube at the time of follow-up and 188 patients (75.2%) were able to have a fully oral diet (**Table 3**). Patients who were fully or partially dependent of a feeding tube were considered to have a poor outcome. A total of 128 of the patients who had a partially or fully oral diet were further assessed for their tolerance of different diet consistencies. Forty-eight (37.5%) tolerated a diet with normal-consistency food, 73 (57.0%) remained on a soft diet, and 7 (5.5%) relied on a liquid diet (eFigure 3 in the Supplement). Seventy-five patients were assessed at follow-up for oral competence. Twenty-two patients (29.3%) had moderate to severe drooling and were classified as having a poor outcome. Fifty-three patients (70.7%) had minimal to no drooling. Nineteen of 108 patients (17.6%) assessed for speech function had unintelligible speech and were considered to have a poor outcome. Eighty-nine (82.4%) had intelligible speech, of whom 44 patients had excellently intelligible, 44 had moderately intelligible speech, and 1 was unrated. Of the 64 patients surveyed about their satisfaction with the aesthetic results of their surgery, 9 (14.1%) were unsatisfied, and 55 (85.9%) were satisfied. In 30 patients, the physician rated the aesthetic results of the operation, and the surgeons were unsatisfied in 2 (6.7%) patients and satisfied in 28 (93.3%).

Figure. Functional and Aesthetic Outcomes



Twenty studies that involved 318 patients reported functional and aesthetic outcomes. Partial or complete feeding tube dependency, oral incompetence, unintelligible speech, patient dissatisfaction with aesthetic results, and physician dissatisfaction with aesthetic results were all considered to be poor outcomes.

Table 1. Patient Demographics and Flap Characteristics

Characteristic	Finding[a]
Sex	
Male	370/466 (79.4)
Female	96/466 (20.6)
Age, mean (SD), y	55.1 (4.1)
Flap combinations	387/476 (81.3)
2 Free flaps	166/387 (42.9)
Fibula and anterolateral thigh	94/387 (24.3)
Fibula and radial forearm	25/387 (6.5)
Fibula and rectus abdominis	102/387 (26.4)
Other	89/476 (18.7)
1 Pedicled and 1 free flap	73/89 (82.0)
Other combination	16/89 (18.0)
Flap survival	907/956 (94.9)

[a] Data are presented as number/total number (%) of patients unless otherwise indicated. The study included 24 studies, 487 patients, and 978 flaps.

Outcome 2: Patient Survival

Sixteen studies[9-11,15,16,18,20,22,24-27,29-31,33] reported on patient survival or patient survival status at follow-up, with a total of 320 patients (eFigure 4 in the Supplement). The mean (SD) weighted length of follow-up was 23.0 (17.0) months. At the time of follow-up, 119 of 197 patients (60.4%) for whom follow-up time was reported were alive. Mean (SD) reported postoperative survival was 28.3 (16.7) months.

Outcome 3: Perioperative Outcomes

Twenty-three studies[9-11,13-22,24-33] reported on operating room time, length of stay, and/or postoperative complications in a total of 476 patients (eFigure 4 in the Supplement). The mean (SD) weighted oper-

Table 2. Detailed Overview of Included Studies

Study	Study Design	No. of Patients	No. of Men	Mean (SD) Age, y	No. of Flaps	Most Common Flap Combinations	Indication	Defect Locations
Posch et al,[9] 2007	Prospective cohort	12	9	62.8	24	Fibula and ALT (n = 10)	Cancer (n = 7), ORN (n = 5)	Oromandibular (n = 11), maxilla (n = 1)
Andrades et al,[10] 2009	Case series	30	19	61.1	60	Fibula and RF (n = 13), jejunal and RF (n = 10), fibula and RA (n = 2)	Cancer	Oromandibular (n = 17), pharynx and esophagus (n = 12), maxilla (n = 1)
Hanasono et al,[11] 2008	Case series	39	34	54.6	79	Fibula and ALT (n = 25), fibula and RF (n = 7), ALT and RF (n = 2)	Cancer (n = 35), ORN (n = 4)	Oromandibular (n = 34), maxilla (n = 5)
Nakatsuka et al,[13] 1992	Case series	17	14	54.1	34	RF and iliac (n = 12), scapula and RF (n = 5)	Cancer (n = 11), functional (n = 4), ORN (n = 2)	Oromandibular
Freije et al,[14] 1997	Case series	3	1	61.3	6	Fibula and RF (n = 3)	Cancer	Maxilla
Blackwell et al,[15] 1997	Case series	16	14	57.4	34	RF and pectoralis (n = 3), iliac and cervical (n = 3)	Cancer (n = 15), ORN (n = 1)	Oromandibular (n = 11), pharynx and esophagus (n = 4), nasal cavity (n = 1)
Serletti et al,[16] 1998	Case series	13	7	55.2	26	Fibula and RF (n = 13)	Cancer	Oromandibular (n = 12), sinus (n = 1)
Wei et al,[17] 1999	Case series	36	33	49	72	Fibula and RF (n = 20), fibula and RA (n = 11)	Cancer	Oromandibular
Bianchi et al,[18] 2003	Case series	10	7	51.6	20	Fibula and RF (n = 8)	Cancer	Oromandibular
Gabr et al,[19] 2004	Case series	23	17	59.2	46	Iliac and ulnar (n = 23)	Cancer[a]	Oromandibular
Frodel and Ahlstrom,[20] 2004	Case series	2	2	54.5	4	Scalp (n = 2)	Cancer	Scalp
Jeng et al,[21] 2005	Case series	10	NR	51.7	20	Fibula and ALT with TFL (n = 10)	Cancer	Oromandibular
Bianchi et al,[22] 2008	Case series	30	20	64.5	60	Fibula and cervicopectoral (n = 4), ALT and cervicopectoral (n = 3)	Cancer	Oromandibular
Bianchi et al,[23] 2010	Case series	11	NR	NR	22	NR	Cancer	NR
Guillemaud et al,[24] 2009	Case series	35	11	57.7	70	Fibula and RF (n = 22), fibula and ALT (n = 6)	Cancer (n = 33), functional (n = 2)	Oromandibular (n = 19), nasal cavity (n = 8), pharynx (n = 6)
Lin et al,[32] 2009	Nonrandomized clinical	56	55	-	110	Fibula and ALT (n = 56)	Cancer	Oromandibular
Lee et al,[25] 2010	Case series	10	9	48.8	20	Fibula and ALT (n = 10)	Cancer	Oromandibular
Balasubramanian et al,[26] 2012	Case series	21	17	50.2	42	Fibula and ALT (8), fibula and RF (n = 5), ALT and RF (n = 3)	Cancer	Oromandibular (n = 19), skull base (n = 2)
Chen et al,[27] 2012	Case series	8	5	56.4	16	Supraclavicular island and trapezius (n = 8)	Cancer	Oromandibular
Chien et al,[33] 2012	Case series	59	58	52.5	121	Fibula and ALT (39), RF and ALT (7), bilateral ALT (4)	Cancer	NR
Miyamoto et al,[28] 2012	Case series	11	11	52.6	22	Fibula and RA (n = 10)	Cancer	Oromandibular
Mo et al,[29] 2014	Case series	12	6	54.7	24	Fibula and ALT (10)	Cancer	Oromandibular (n = 10), sinus (n = 2)
Henn et al,[30] 2015	Case series	2	2	49	4	Fibula and ALT (n = 2)	Cancer	Oromandibular
Zhang et al,[31] 2016	Case series	21	19	44.8	42	Jejunal and pectoralis (n = 14), ALT and pectoralis (n = 7)	Cancer	Pharynx and larynx

Abbreviations: ALT, anterolateral thigh; ORN, osteoradionecrosis; RA, rectus abdominis; RF, radial forearm; TFL, tensor fascia lata.

[a] Gabr et al[19] examined both single and double flap reconstructions and reported resection indications as a pooled characteristic.

ating time (which includes the reconstruction) was 684 (110) minutes. The mean (SD) weighted length of stay was 24.5 (12.2) days. A total of 88 minor complications and 185 major complications were reported. Minor complications included partial flap necrosis, dehiscence, and donor site complications. The most common minor complications were donor site complications (20 [22.7%] of all minor complications) and partial flap necrosis (19 [21.6%]). Major complications included surgical reexploration for any indication, total flap failure, fistulas, infections and/or abscesses, hematomas, and major medical morbidities. The most common major complications were surgical reexplorations (48 [25.9%] of all major complications), infections (45 [24.3%]), and total flap losses (28 [15.1%]) (eFigure 4 in the Supplement).

Table 3. Patient Outcomes Reported by Study

Study	No. of Functional Outcomes			No. of Aesthetic Outcomes		No. of Survival Outcomes			No. of Perioperative Outcomes		
	Tube Dependent	Oral Incompetence	Unintelligible Speech	Patient Unsatisfied	Physician Unsatisfied	Mean Follow-up, mo	Alive at Follow-up	Mean Survival, mo	OR Time, min	Length of Stay, d	Complications
Nakatsuka et al,[13] 1992	2/17	NR	0/17	NR	NR	NR	NR	NR	NR	NR	9
Blackwell et al,[15] 1997	NR	NR	NR	NR	NR	8.6	7/16	11	NR	NR	15
Freije et al,[14] 1997	0/3	NR	0/3	NR	NR	NR	NR	NR	NR	NR	2
Serletti et al,[16] 1998	1/12	1/12	2/12	NR	NR	NR	8/13	NR	720	NR	2
Wei et al,[17] 1999	1/16	6/16	NR	1/16	NR	NR	NR	NR	730	45	23
Bianchi et al,[18] 2003	0/10	2/10	NR	NR	NR	NR	NR	17.5	NR	NR	8
Gabr et al,[19] 2004	NR	NR	10/14	4/14	NR	NR	NR	NR	NR	NR	41
Frodel and Ahlstrom,[20] 2004	NR	NR	NR	NR	NR	10.5	1/2	NR	NR	NR	1
Jeng et al,[21] 2005	0/10	1/10	0/10	NR	NR	NR	NR	NR	NR	NR	8
Posch et al,[9] 2007[a]	2/6	4/6	5/6	2/6	NR	NR	NR	NR	NR	NR	6
Andrades et al,[10] 2009[b]	NR	NR	NR	NR	NR	16.7	15/25	NR	588	13.3	16
Bianchi et al,[22] 2008	1/17	NR	1/17	1/17	1/17	63	17/30	11.5	NR	NR	10
Hanasono et al,[11] 2008	4/33	NR	NR	NR	NR	15.6	24/35	NR	828	11.5	18
Bianchi et al,[23] 2010	1/11	5/11	1/11	1/11	1/13	NR	NR	NR	NR	NR	NR
Guillemaud et al,[24] 2009	35/35	NR	NR	NR	NR	18.2	18/35	NR	790	20.7	3
Lin et al,[32] 2009	NR	NR	NR	NR	NR	NR	NR	NR	589	33.5	1
Lee et al,[25] 2010	1/8	1/8	0/10	NR	NR	16.1	8/10	NR	602	NR	39
Balasubramanian et al,[26] 2012	1/19	NR	NR	NR	NR	11	12/21	NR	840	NR	9
Chen et al,[27] 2012	0/8	NR	0/8	NR	NR	12.6	7/8	NR	328	NR	1
Chien et al,[33] 2012	NR	NR	NR	NR	NR	NR	NR	47.1	631	NR	32
Miyamoto et al,[28] 2012	2/11	NR	NR	NR	NR	NR	NR	NR	726	40.1	8
Mo et al,[29] 2014	5/11	NR	NR	NR	NR	NR	NR	11.1	660	30.8	15
Henn et al,[30] 2015	0/2	2/2	NR	NR	NR	NR	NR	NR	NR	NR	3
Zhang et al,[31] 2016	0/21	NR	NR	NR	NR	NR	NR	NR	NR	NR	8
No./total No. (%)	62/250 (24.8)	22/75 (29.3)	19/108 (17.6)	9/64 (14.1)	2/30 (6.7)	NR	119/197 (60.4)	NR	NR	NR	273
Mean (SD)	NR	NR	NR	NR	NR	23.0 (17.0)	NR	28.3 (16.7)	684 (110)	24.5 (12.2)	NR

Abbreviations: NR, not reported; OR, operating room.

[a] Posch et al[9] reported a mean 20-month survival for patients who underwent resection because of cancer and a mean 38-month survival for patients who underwent surgery primarily for osteoradionecrosis.

[b] Andrades et al[10] graded speech on a scale, and patients typically received an unintelligible grade.

Discussion

With rapidly advancing medical technology and the capability of performing more complex operations, physicians must increasingly evaluate whether these operations, although now performable, are worthwhile. Given the technical difficulty, patient morbidity, and high financial expenditure of large head and neck resections that require multiflap reconstructions, it is important to gain a better understanding of their value. This systematic review thus provides an

overview of patient outcomes from these complex operations that can begin and guide a conversation on patient value because these broader results are weighed against the potential benefits for individual patients.

Our review included 24 studies of 487 patients, which, to our knowledge, is the largest cohort studied to date on this subject. Given the lack of studies that examine multiple variables of value that we wished to explore (functional outcomes, aesthetic outcomes, patient survival, perioperative length of stay, and postoperative complications), we addressed each variable separately. As such, each variable has different combinations of included studies with comparable patient populations (eg, age and sex). Because the individual variables were critically pooled, this study calculated a more comprehensive estimate of patient value than previous studies.[10,24]

For outcomes in the immediate perioperative period, the overall outlook reflects the complexity of the surgery. Typically, patients must undergo an 11.4-hour surgery and spend more than 3 weeks in the hospital (which often includes at least 1 day in the intensive care unit). They may also experience a nontrivial number of postsurgical complications that could require further interventions and delay discharge. In 476 patients, a total of 273 complications were reported, 185 of which were classified as major complications (eg, surgical reexplorations and flap losses).

Another primary patient outcome was survival. Overall, absolute patient survival was poor and limited to 2.4 years, and almost half of patients had died by follow-up. Most patients (96.1%) included in this study underwent surgery for cancer resection, and minimal data were available on 5-year or progression-free survival. The comprehensive 5-year survival rate among patients with head and neck cancer from 2003 to 2006 was 77% for stage I, 61% for stage II, 57% for stage III, and 42% for stage IV according to the National Cancer Database.[34,35]

Within the limited postoperative life expectancy, patients also experienced reduced quality of life, assessed through functional and aesthetic results. Even after advanced reconstruction with multiple flaps, functional outcomes were fairly modest. Approximately one-quarter of patients lacked oral competence, were at least partially dependent on a feeding tube, or had unintelligible speech. The outcomes may be even poorer in general clinical practice because the included studies were likely to have been subject to publication bias that favored better outcomes, especially studies that aimed to demonstrate the feasibility of their authors' surgical techniques. However, we were unable to determine whether patients with 1 poor functional outcome (eg, unintelligible speech) had additional poor functional outcomes (eg, feeding tube dependence). In addition, although patients and surgeons were generally satisfied with the aesthetic results of the surgery, patients were twice as likely to be dissatisfied, suggesting that there is room for additional patient counseling on postsurgical expectations.

Limitations

Overall, the conclusions of our review must be considered in the context of its limitations. One limitation is the overall quality of evidence because the included studies were primarily observational and retrospective review studies and no randomized clinical trials were available. To account for study quality in a qualitative manner, we used the MINORS criteria scoring system; most included studies scored between 10 and 14 of 16, which was determined to be a moderate risk of bias. We sought to minimize this bias by including multiple databases and incorporating broad initial search terms. Because we defined large head and neck resections as resections that required at least 2 flaps to reconstruct, our search criteria centered around variations of the phrase *multiple flap*, and this method identified studies that primarily focused on the flaps and reconstruction with less emphasis on the primary resection and oncologic outcomes. As such, many of the included studies did not address oncologic markers, such as advanced cancer stage, presence of positive margins, or extracapsular extension, which are associated with poorer outcomes and may affect patient survival.

Furthermore, our study was unable to evaluate whether these patients would have had better or worse functional outcomes and survival without the extensive surgical resection and reconstruction. Alternatives to surgery, such as palliative chemoradiation or a more conservative resection focused on comfort and palliation, are possible options to discuss preoperatively with patients and their medical and radiation oncologists. We were also unable to assess whether patients who have received the resection and reconstruction were satisfied with their decision to undergo surgery at follow-up. Future assessments and research may address these aspects.

In addition, quality-of-life measures within the included studies were not always measured with validated instruments and lacked methodologic rigor. Given the subjectivity, we tried to account for this variability by grouping the functional and aesthetic outcomes into more general categories with more general assessments of outcomes, such as poor vs acceptable. Not all studies reported on every variable; thus, the number of denominators for each outcome varied.

On a broader note, this study also highlighted an outcome-centered approach to health care value. These conversations on value may be most helpful when driven by patient outcomes because prioritizing financial cost alone may be a reductive goal. Low-cost but minimally effective or undesirably morbid interventions do not promote value, whereas resource-intensive interventions with excellent patient outcomes may be of high value. Targeting outcomes can also help realign what is of value to the patient with what is of value to the health care system.

Discussion on health care value should center around creating value for patients, which necessitates examining patient outcomes through a holistic and critical eye and treating patient morbidity and postintervention quality of life as integral rather than secondary outcomes. Our study was limited by the small number of studies that reported on postoperative quality of life despite the high morbidity of these extensive head and neck resections and reconstructions and was additionally limited by the inconsistent reporting of this measure. Future research on health care value and interventions may consider exploring more comprehensive views on patient outcomes.

Conclusions

Given limited patient life expectancies, modest functional and aesthetic outcomes, lengthy hospital stays, and the high potential for perioperative complications, surgeons should weigh the curative potential and palliative benefits for individual patients with a comprehensive view of the overall outcomes and value of extensive head and neck resections that require multiflap reconstructions. Realistic expectations should be emphasized during preoperative discussions with patients.

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Study concept and design: Gao, Rosenthal.
Acquisition, analysis, or interpretation of data: Gao, Nuyen, Divi, Sirjani.
Drafting of the manuscript: Gao, Rosenthal.
Critical revision of the manuscript for important intellectual content: All authors.
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Administrative, technical, or material support: Gao.
Study supervision: Nuyen, Divi, Rosenthal.

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