Original Research

Integrating microsurgical reconstruction in head and neck oncology: a collaborative learning curve experience

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Abstract

Background. Microsurgical head and neck reconstruction requires specialized expertise that can be challenging to develop in regional healthcare settings. This study documents the collaborative learning curve experience of establishing microsurgical capabilities through multidisciplinary team integration.

Methods. A retrospective case series analyzed 8 consecutive head and neck microsurgical reconstructions performed between October 2018 and October 2021 in Constanta, Romania. All procedures were performed by the same primary surgeon with systematic collaborative multidisciplinary support. Data included patient demographics, risk factors, collaborative team composition, operative metrics, outcomes, and learning curve progression assessment.

Results. Eight patients (5 male, 3 female) underwent reconstruction for squamous cell carcinoma (SCC, 50%), basal cell carcinoma (BCC, 25%), radiodermitis (12.5%), and iatrogenic facial palsy (12.5%). Procedures included mandibular reconstruction (37.5%), tongue/floor of mouth reconstruction (25%), facial reanimation (12.5%), nasal reconstruction (12.5%), and orbital coverage (12.5%). All cases utilized multidisciplinary teams averaging 3.4 members, with maxillofacial surgeons participating in 75% and general surgeons in 100% of cases. During the early learning phase, operative time decreased from 15 to 10 hours and surgeon confidence advancement from "Low" to "Medium-High" levels. Overall success rate was 62.5% with one partial success (12.5%) and two failures (25%). Risk factors were present in 75% of cases, with failures associated with cumulative risk factors and immunocompromised status.

Conclusions. Microsurgical head and neck reconstruction can be successfully integrated into regional healthcare systems through systematic collaborative learning approaches. The multidisciplinary model enabled safe skill acquisition while maintaining acceptable outcomes during the early learning phase. Key insights include avoiding cumulative risk factors during initial learning and ensuring comprehensive preoperative optimization. This collaborative framework describes an early institutional experience that may be informative for other centers initiating microsurgical programs.

Keywords: microsurgical reconstruction, head and neck reconstruction, facial palsy, collaborative care, free tissue transfer

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Background and aims

Head and neck cancer treatment requires a multidisciplinary approach that integrates oncological resection with immediate reconstruction to optimize both functional and aesthetic outcomes. Microsurgical free tissue transfer has become the gold standard for complex head and neck reconstruction, offering superior functional and aesthetic outcomes compared to regional flaps or prosthetic rehabilitation in many clinical scenarios [1–14]. However, the integration of microsurgical capabilities within existing head and neck oncology programs presents significant challenges, particularly in developing healthcare systems.

The learning curve for microsurgical reconstruction has been rigorously analyzed in recent literature. Han et al. (2022) used cumulative sum (CUSUM) analysis to demonstrate that competency in free-flap head and neck reconstruction typically stabilizes after approximately 20 cases [15]. Other studies have explored learning curves across different flap types [16–18] and emphasized structured training programs in experimental microsurgery to optimize skill acquisition [19–21]. These benchmarks provide guidance for programs developing microsurgical capabilities, though most published series originate from established Western centers with abundant resources and experienced mentorship networks. Contemporary studies continue to emphasize the importance of systematic learning curve assessment in achieving optimal patient outcomes [16,17].

Eastern European and other resource-constrained healthcare systems face unique challenges in developing advanced reconstructive capabilities, including limited technical infrastructure, personnel, and mentorship [18,19]. Recent literature demonstrates that successful microsurgical programs can be established in diverse healthcare environments, but limited published data exist specifically addressing the collaborative learning curve experience in these settings.

The integration of plastic surgeons within multidisciplinary head and neck oncology teams is essential to prevent treatment compromise. When reconstructive options are limited due to lack of ability to perform microsurgical reconstruction, there is a documented risk of offering suboptimal treatment—such as avoiding adequate wide local excision due to closure concerns and defaulting to radiotherapy instead [19]. Recent mortality studies demonstrate that microsurgical head and neck reconstruction, when properly executed, carries acceptably low risk with 30-day postoperative mortality rates below 2% [4].

This study presents the collaborative learning curve experience of establishing microsurgical head and neck reconstruction in Constanta, Romania. By analyzing the first 8 cases from a broader 27-case microsurgical experience performed between 2018 - 2021, we aim to describe our early institutional experience and highlight practical considerations relevant to centers developing similar capabilities, while emphasizing the essential role of plastic surgeons in multidisciplinary head and neck oncology teams.

Methods

Study design and setting

This retrospective case series analyzed microsurgical head and neck reconstruction procedures performed between October 2018 and October 2021 in Constanta, Romania. Cases were performed at two general hospitals: Clinic Județean de Urgență "Sf. Andrei" Clinical Emergency County Hospital Constanta and "Alexandru Gafencu" Emergency Military Hospital Constanta. This study represents a retrospective analysis of patients treated during routine clinical practice.

Patient selection

From a total of 27 consecutive microsurgical procedures performed during the study period, 8 cases involving head and neck reconstruction were selected for analysis. Seven of the 8 cases were performed by the same primary surgeon with extensive collaborative multidisciplinary support. The consistent primary surgeon presence throughout all cases allowed for systematic learning curve assessment.

All included cases involved primary reconstruction performed during the same operative session as oncologic resection or functional defect creation.

All reconstructions were performed only after confirmation of clear surgical margins. Intraoperative frozen section analysis was used to verify that margins were negative. Reconstruction proceeded immediately after confirmation, ensuring that oncological safety was prioritized over reconstructive timing.

Collaborative learning model

All procedures were performed within a comprehensive collaborative framework involving:

- *Plastic Surgery Support:* Senior plastic surgeons from Constanta and other Romanian cities
- *General Surgery:* Local general surgeons assisting.
- *Subspecialty Support:* ENT (Ear-Nose-Throat) surgeons and maxillofacial surgeons for the wide local excisions
- *Training Integration:* Residents from plastic surgery and general surgery programs (local and external)
- *Anesthesiology Team:* Specialized anesthetic management for prolonged microsurgical procedures
- *Nursing Support:* Experienced surgical nurses familiarizing with microsurgical requirements
- *Educational Component:* Medical students participating in learning process

This collaborative model enabled knowledge transfer, skill development, and safety optimization throughout the learning curve progression.

Inclusion criteria

• Adult patients (≥18 years) undergoing primary microsurgical reconstruction following head and neck oncologic resection or functional defect creation.

• Complete medical records with a minimum follow-up of 6 months

Exclusion criteria

• Pediatric patients (<18 years)

• Regional flap reconstructions without microvascular anastomosis

• Incomplete medical records or lost to follow-up <6 months

Data collection

All patients included in this study provided informed consent for the use of their medical data and images for research and publication purposes, as part of the standard hospital admission process. Institutional approval for retrospective analysis of patient records was obtained from both participating hospitals**.** Patient data were retrospectively collected from medical records and included:

• Demographics (age, gender)

• Underlying pathology and indication for reconstruction

• Defect location and size

• Flap type and donor site

• Risk factors (smoking, alcohol use, prior radiotherapy, comorbidities)

• Postoperative complications

• Flap survival and functional outcomes

Outcome measures

The primary outcome was flap survival and reconstructive success. Outcomes were operationally defined as follows:

• Success: complete flap survival without partial or total necrosis, with the flap fulfilling the intended reconstructive purpose and no need for flap revision or replacement.

• Partial success: partial (marginal) flap necrosis or wound-related complications requiring local revision or prolonged wound care, but not necessitating total flap removal.

• Failure: total flap loss requiring complete flap removal and/or secondary reconstructive procedures.

Secondary outcomes included postoperative complications and the need for additional surgical interventions.

Learning curve progression was assessed through chronological analysis of case complexity and collaborative team development.

Statistical analysis

Descriptive statistics were used to summarize patient demographics, procedural characteristics, and outcomes. Given the small sample size and retrospective nature, no inferential statistical testing was performed.

Results

Patient Demographics and Clinical Characteristics: 8 patients (5 male, 3 female) with a mean age of 64.6 years (range 55-73 years) underwent head and neck microsurgical reconstruction between October 2018 and October 2021. The most common indication was squamous cell carcinoma (4 cases, 50%), followed by basal cell carcinoma (2 cases, 25%), radiodermitis (1 case, 12.5%), and iatrogenic facial palsy following schwannoma resection (1 case, 12.5%).

Table I. Patient demographics and case characteristics for head and neck microsurgical reconstruction cases. All procedures were performed between October 2018 and October 2021 using collaborative multidisciplinary teams. Team size represents total number of surgical team members including the primary surgeon.

Case	ID	Age	M/F	Diagnosis	Defect location	Flap Type	Risk Factors	Operative time	Team size	Outcome
1	BC	55	M	SCC	Right mandible	Free fibular	Smoker/drinker	13	5	Success
2	CM	73	F	Radiodermitis	Central mandible	Free fibular	Radiotherapy	12	4	Success
3	PF	61	F	SCC	Left tongue	Free radial	None	8	3	Success
4	DD	61	M	SCC	Floor of the mouth	Free radial	None	8	3	Success
5	IM	68	M	SCC	Left mandible	Free scapular	Radiotherapy	15	5	Partial
6	DA	62	F	Facial palsy	Face-left	Free gracilis	Myelofibrosis	13	2	Failure
7	VV	69	M	BCC	Nasal ala	Free radial	Smoker, drinker, cardiovascular	10	2	Failure
8	SD	72	M	BCC	Right orbit	Free Latissimus Dorsi (LD)	Former smoker	10	3	Success

Reconstruction types and flap selection

Mandibular reconstruction was the most frequent procedure (3 cases, 37.5%), utilizing fibular [1,9,10,23,24] osteocutaneous flaps (2 cases) and scapular [13,23,24] osteocutaneous flap (1 case). Soft tissue reconstructions included tongue/floor of mouth reconstruction with radial forearm [2,3,22-25] fasciocutaneous flaps (2 cases), facial reanimation with free gracilis muscular flap [23,24,26-28] (1 case), nasal reconstruction with radial forearm fasciocutaneous flap (1 case), and orbital coverage with musculocufasciocutaneous latissimus dorsi flap [13,23,24] (1 case). All procedures involved microvascular anastomoses with an average of 2 anastomoses per case.

Risk factor analysis

Risk factors were present in 6 of 8 cases (75%). Prior radiotherapy was identified in 2 cases (25%). In both patients, radiotherapy had been delivered to the primary tumor bed and adjacent cervical region. The interval between completion of radiotherapy and reconstructive surgery was 18 months in one case and 36 months in the other. Smoking and alcohol use were present in 3 cases (37.5%), and significant medical comorbidities, including myelofibrosis following polycythemia vera, were present in 1 case (12.5%). Two patients had no identifiable major risk factors.

In this series, flap failure was attributable to patient-related and infectious factors rather than intraoperative technical errors

Collaborative team composition

All cases utilized multidisciplinary collaborative teams with an average of 3.4 members per procedure (range 2-5). Maxillofacial surgeons participated in 6/8 cases (75%), general surgeons in all cases (100%), and residents (plastic surgery or general surgery) in 3/8 cases (37.5%). Specialized ENT support was utilized in 1 case for nasal reconstruction. The collaborative model demonstrated consistent multidisciplinary integration throughout the learning curve.

Learning curve progression

Operative times showed improvement over the study period, with early cases (2018-2019) requiring 12-15 hours compared to later cases (2020-2021) averaging 10-13 hours. Surgeon confidence levels, assessed retrospectively, progressed from “Low” in initial cases to “Medium-High” in later procedures, reflecting skill acquisition and improved case selection. Case complexity evolved from basic mandibular reconstructions to advanced procedures including facial reanimation.

Clinical outcomes

Overall success rate was 62.5% (5/8 cases), with one partial success (12.5%) and two failures (25%). Successful cases included both mandibular reconstructions with fibular flaps, both tongue/floor of mouth reconstructions, and orbital coverage. The partial success involved a mandibular reconstruction using a scapular flap in which the flap survived but subsequent local tumor recurrence adversely affected the long-term reconstructive outcome, without representing a technical failure of the microsurgical procedure. Failures occurred in two cases. One failure followed facial reanimation using a free gracilis flap in an immunocompromised patient with myelofibrosis, complicated by late methicillin-resistant Staphylococcus aureus (MRSA) infection leading to total flap loss. The second failure occurred after nasal reconstruction with a radial forearm flap in a patient with cumulative risk factors (active smoking, prior radiotherapy, and cardiovascular comorbidities), resulting in flap necrosis and subsequent flap removal.

Complications and risk factors

Minor complications occurred in 4/8 cases (50%) and included wound dehiscence, donor site sensitivity, and small areas of necrosis. Major complications leading to failure occurred in 2 cases and were associated with patient-specific risk factors: immunocompromised status with myelofibrosis and cumulative risk factors including continued smoking, radiotherapy history, and cardiovascular comorbidities.

Table II. Learning curve progression metrics demonstrating evolution of surgical efficiency, confidence, and case complexity over the study period. Early period success rate reflects simpler case selection, while later period demonstrates advancement to complex procedures including facial reanimation and high-risk patients.

Time period	Cases (n)	Mean operative time	Confidence level	Success rate	Mean team size	Key developments
2018-2019	5	11.2 (8-15)	Low-medium	80% (4/5)	3.6	Basic mandible/tongue reconstruction, larger collaborative teams
2020-2021	3	11.0 (10-13)	Medium-High	33% (1/3)	2.4	Advanced procedures (facial reanimation, nasal), smaller focused teams
Overall	8	11.1 (8-15)	Low → Medium-High	62.5%	3.4	

Clinical insights and lessons learned

Key clinical lessons identified through the collaborative learning experience included: patient selection optimization (avoiding cumulative risk factors), importance of preoperative patient optimization in immunocompromised individuals, wound healing challenges in previously irradiated tissues, and the critical need for negative oncological margins before reconstruction. These insights contributed to improved case selection and risk stratification in later cases.

Discussion

This study describes an early collaborative experience in establishing microsurgical head and neck reconstruction within a regional Romanian healthcare setting. The 8-case series demonstrates that successful microsurgical program development is achievable through systematic multidisciplinary collaboration, even in resource-constrained environments.

Learning curve progression and benchmarking

Our learning curve progression aligns with established literature benchmarks while demonstrating unique collaborative advantages. Han et al. (2022) identified competency stabilization after approximately 20 cases using rigorous cumulative sum (CUSUM) analysis [15]. Operative times showed improvement over the study period, with early cases (2018-2019) requiring 12-15 hours compared to later cases (2020-2021) averaging 10-13 hours. Surgeon confidence levels, assessed retrospectively, progressed from "Low" in initial cases to "Medium-High" in later procedures. This early-phase documentation provides valuable insights for other centers initiating similar programs.

The 62.5% success rate in our initial 8 cases compares favorably with published learning curve series, particularly considering the inclusion of complex cases such as facial reanimation and the presence of significant risk factors in 75% of patients. Recent literature demonstrates that microsurgical head and neck reconstruction carries acceptably low mortality risk (<2%) when properly executed [4], supporting our collaborative safety approach.

The success rate decreased from 80% in the early phase to 33% in the later phase. This reflects progression to more complex procedures, including facial reanimation and nasal reconstruction, and the inclusion of patients with multiple risk factors such as prior radiotherapy, smoking, cardiovascular comorbidities, and immunocompromised status. Thus, the reduction in success rate does not indicate a decline in surgical skill, but rather an increase in case difficulty and patient complexity during the later learning phase.

Collaborative model innovation

The multidisciplinary collaborative framework employed in this study reflects an early institutional approach to managing the microsurgical learning phase. In contrast to formal, centralized mentorship models described in the literature, this approach relied on distributed expertise from multiple specialties and institutions. The consistent involvement of maxillofacial surgeons (75% of cases) and general surgeons (100% of cases) facilitated knowledge sharing and procedural support during the early learning phase.

Within the limitations of a small case series, this collaborative approach helped mitigate some resource constraints commonly encountered in regional healthcare settings. The average team size of 3.4 physician members per procedure illustrates a focused allocation of expertise, while the integration of residents from multiple specialties (37.5% of cases) provided additional educational exposure and opportunities for supervised skill development.

Risk factor analysis and patient selection

Our experience confirms established risk factors while providing practical insights for patient selection optimization. Prior radiotherapy (25% of cases) was associated with wound healing complications, consistent with contemporary literature [16,29,30,31]. Both patients with prior radiotherapy had received treatment to the tumor bed and cervical region, a factor known to adversely affect wound healing and microvascular outcomes. The failure of cases with cumulative risk factors (smoking, radiotherapy, cardiovascular comorbidities) emphasizes the importance of comprehensive preoperative risk assessment.

The clinical lessons learned through this collaborative experience provide actionable guidance: immunocompromised patients require extensive preoperative optimization, cumulative risk factors should guide case selection during the learning curve, and oncological margin adequacy must be confirmed before reconstruction commitment. Key observations from this early experience highlight practical considerations that are not always emphasized in traditional case series.

Regional healthcare context

This study addresses a significant gap in Eastern European microsurgical literature. While most published learning curve series originate from established Western centers with abundant resources [15,16], our experience demonstrates successful program development in a regional Romanian setting. The collaborative model utilizing expertise from multiple cities reflects the reality of resource distribution in developing healthcare systems.

The integration of this clinical experience with established Romanian microsurgical training protocols [18] demonstrates continuity between experimental training foundations and clinical application. This progression from laboratory-based learning to collaborative clinical implementation provides a descriptive example of an early institutional approach that may inform other regional centers.

Clinical integration and oncological principles

Our experience reinforces the essential role of plastic surgeons in multidisciplinary head and neck oncology teams. The partial success case, in which tumor recurrence affected the long-term reconstructive outcome, illustrates the critical importance of confirming oncological margin adequacy before reconstruction. In this series, intraoperative frozen section analysis was used to verify negative margins prior to reconstruction, ensuring that oncological resection was not compromised. This approach supports the principle that fear of complex reconstruction should never influence the extent of oncologic surgery.

Study limitations

This study has several limitations. The small sample size (n=8) limits statistical analysis and generalizability. The retrospective design and single-surgeon experience may introduce bias. Confidence level assessment was retrospective and subjective. Long-term functional outcomes and patient satisfaction data were not systematically collected. Despite these limitations, the detailed documentation of collaborative learning progression provides valuable insights for program development. Given the small sample size, this study is exploratory in nature; all metrics are descriptive, and the findings should not be interpreted as validated learning-curve benchmarks or generalizable models.

Future directions

This initial experience establishes the foundation for continued program development and outcome assessment. Future studies should include larger patient cohorts, standardized outcome measurements, and long-term functional assessment. The collaborative model described here could be replicated and studied in other regional centers to validate its effectiveness for microsurgical program development. As highly skilled microsurgeons are rare, this model can help increase awareness about reconstructive options and create a basis to develop reconstructive centers with dedicated specialized teams.

Practical implications for other centers

This early experience offers several actionable insights for centers initiating microsurgical head and neck reconstruction programs:

1. Collaborative team integration: Establishing a structured multidisciplinary team, including plastic surgeons, maxillofacial/ENT surgeons, anesthesiologists, and residents, supports both patient safety and skill acquisition. A flexible team size (3–5 members) can balance resource limitations with adequate expertise.

2. Learning curve management: Early cases should focus on less complex reconstructions to allow skill development, with progressive inclusion of high-risk or complex procedures. Documenting operative times, team composition, and confidence levels can help track learning progression.

3. Patient selection: Avoid cumulative risk factors (e.g., prior radiotherapy, smoking, comorbidities) in initial cases. Immunocompromised patients require additional preoperative optimization to minimize complications.

4. Oncological principles: Confirm negative margins intraoperatively (e.g., frozen section) before reconstruction to ensure oncological safety is prioritized over reconstructive convenience.

5. Educational component: Integrating residents or trainees provides valuable learning opportunities without compromising patient outcomes, especially in resource-constrained settings.

6. Data documentation: Detailed prospective or retrospective documentation of cases, outcomes, and complications is essential to refine institutional protocols and guide future program development.

7. Scalability: While this series describes an early institutional experience, the principles of multidisciplinary integration, risk stratification, and progressive complexity can inform other centers seeking to establish microsurgical capabilities.

Conclusions

Microsurgical head and neck reconstruction can be successfully integrated into regional healthcare systems through systematic collaborative learning approaches. This 8-case experience demonstrates quantifiable learning curve progression with operative time improvements (15 to 10 hours) and enhanced surgeon confidence development. The multidisciplinary collaborative model, averaging 3.4 team members per procedure, enabled safe skill acquisition while maintaining a 62.5% success rate during the critical early learning phase.

Key clinical insights include the importance of avoiding cumulative risk factors during initial learning, optimizing immunocompromised patients preoperatively, and ensuring adequate oncological margins before reconstruction commitment. This collaborative framework reflects the authors' institutional experience and should be interpreted as descriptive rather than prescriptive. Plastic surgeons must be integral members of multidisciplinary head and neck oncology teams to prevent treatment compromise due to reconstruction concerns. The systematic documentation of collaborative learning progression offers practical guidance for centers establishing similar microsurgical programs.

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