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Original article

Complications of Neck Dissection in Head and Neck Cancer: A 5-Year Retrospective Analysis of Incidence and Risk Factors at a Libyan Tertiary Center

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Abstract
Neck dissection is integral to head and neck cancer management but carries significant morbidity, particularly in resource-limited settings where advanced presentations prevail. This study analyzes complication rates and risk factors following neck dissection at a Libyan tertiary center to guide context-specific surgical protocols. A 5-year retrospective analysis of 37 patients undergoing neck dissection (2017–2021) was conducted. Complications were classified by type, timing, and Clavien-Dindo severity. Multivariate regression identified risk factors. The cohort (mean age 56.2±10 years; 59.5% male) demonstrated a 40.5% complication rate, with infections (18.9%) and nerve injuries (16.2%) predominating. Modified radical neck dissection (MRND) had the highest infection rate (33.3% vs. 8.3% for selective dissection, p=0.031). Independent risk factors included advanced age (OR=2.3, 95%CI:1.2–4.4) and MRND/radical procedures (OR=3.5, 95% CI:1.3–9.2). Complication rates exceed global benchmarks, underscoring the need for targeted interventions: infection control in MRND, nerve preservation training, and preoperative optimization for elderly patients.
Keywords. Neck Dissection, Oral Carcinoma, Complications.

Introduction

Neck dissection represents a critical surgical intervention in the management of head and neck malignancies, with its anatomical complexity and technical evolution shaping contemporary practice. The cervical lymphatic system, organized into levels I through VI, interacts intimately with vital neurovascular structures [1,2], including the spinal accessory nerve in level II, the brachial plexus in level IV, and the carotid sheath contents throughout. This intricate anatomy, first systematically described by Crile in 1906 [3], underlies both the oncologic rationale and potential morbidity of nodal clearance procedures. The historical progression from radical neck dissection [4,5], sacrificing non-lymphatic structures including the sternocleidomastoid muscle, internal jugular vein, and spinal accessory nerve, to modern function-preserving approaches reflects an ongoing refinement of risk-benefit calculus in surgical oncology.

Oral squamous cell carcinoma, representing over 90% of head and neck malignancies in our Libyan study, demonstrates particular predilection for nodal metastasis [6,7], through well-characterized patterns of lymphatic drainage. Primary tumors of the tongue and floor of the mouth preferentially metastasize to levels I-III, while more posterior lesions may involve levels II-IV. This anatomical understanding informs the current classification of neck dissection types, which range from radical and extended radical procedures to modified radical and selective approaches. The radical neck dissection, while oncologically thorough, carries significant functional morbidity, including shoulder syndrome from spinal accessory nerve sacrifice, whereas selective dissections targeting only at-risk levels offer reduced morbidity but require precise anatomical knowledge.

The evolution of neck dissection techniques has paralleled advances in our understanding of tumor biology and lymphatic spread patterns. Modified radical neck dissection, preserving one or more non-lymphatic structures, and selective neck dissection, targeting only specific nodal levels, have demonstrated comparable oncologic outcomes with reduced morbidity in appropriately selected cases. However, our experience at the National Institute of Oncology in Sabrata frequently involves advanced presentations requiring more extensive procedures, creating unique challenges in complication management. The classification system proposed by Robbins et al. (2002) [8] provides the framework for our analysis, categorizing procedures as radical (RND), modified radical (MRND types I-III), or selective (SND) based on structures preserved. (Figure 1).

Complications of neck dissection can be conceptually organized by timing, anatomical system affected, and severity. Intraoperative challenges include vascular injury, particularly to the carotid system or internal jugular vein, and nerve disruption affecting the spinal accessory, marginal mandibular, or phrenic nerves. Early postoperative complications encompass wound infections, hematoma formation, and chyle leaks, while late sequelae involve chronic pain, shoulder dysfunction, and lymphedema. The Clavien-Dindo classification system [9] offers a validated approach to grading these adverse events by therapeutic consequence, from minor deviations requiring no intervention (Grade I) to life-threatening conditions (Grade IV) or death (Grade V).

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Figure 1. Intraoperative Neck Dissection

In our Libyan context, where advanced presentations and resource constraints intersect, a detailed understanding of complication profiles becomes particularly crucial. Prior studies in high-income settings report nerve injury rates of 5-15% in selective dissections [10,11,12], and 20-30% in radical procedures, with wound complications affecting 10-20% of cases overall. However, our preliminary data suggest potentially higher morbidity in our patient population [13,14], possibly related to later-stage presentation, nutritional factors, or differences in surgical technique. This study, therefore, aims to systematically characterize complications across neck dissection types in our institution, providing evidence for risk stratification and quality improvement initiatives tailored to our clinical context.

Methods

This retrospective cross-sectional study investigated complications following neck dissection procedures performed for malignant tumors of the oral cavity, maxillofacial region, and head and neck at the National Institute of Oncology in Sabrata, Libya, between January 2017 and December 2021. Following approval from the Institutional Review Board with waiver of informed consent due to the retrospective nature of the study, we initially identified 57 consecutive cases through a systematic review of operative logbooks and hospital records. After careful evaluation, we excluded 20 patients for the following reasons: nine cases were excluded due to non-oncologic indications where neck dissection was performed for benign conditions or trauma; six cases were excluded because of incomplete complication documentation in the medical records; and five cases of salvage surgery for post-radiation recurrences were excluded due to their known disproportionate complication risk as established in prior literature reference. This rigorous selection process yielded a final study cohort of 37 patients for comprehensive analysis.

Data collection followed a standardized protocol with trained research staff abstracting information from both electronic and paper medical records, which was mostly. Two independent reviewers abstracted data; discrepancies were resolved by a senior surgeon. Collected variables included detailed patient demographics, comprehensive comorbidity profiles using the Charlson Comorbidity Index, tumor characteristics encompassing site, stage, and histopathological features, surgical details including procedure type and duration, and postoperative outcomes with particular attention to complication development. All surgical procedures were classified according to the American Head and Neck Society guidelines and the Robbins classification system. Radical neck dissections (RND) were defined by complete removal of lymphatic levels I-V with sacrifice of the sternocleidomastoid muscle, internal jugular vein, and spinal accessory nerve. Modified radical neck dissections (MRND) preserved one or more non-lymphatic structures while removing all lymphatic levels. Selective neck dissections (SND) involve the removal of only specified nodal levels based on tumor characteristics. Surgical approach and extent were determined through meticulous review of operative notes and pathology reports, with any discrepancies resolved through adjudication by two senior head and neck surgeons. Complications were systematically categorized along several dimensions. Temporal classification included intraoperative complications occurring during the surgical procedure, early postoperative complications manifesting within the first 30 days after surgery, and late complications appearing beyond 30 postoperative days. Anatomical system classification encompasses neural complications such as nerve injuries, vascular complications including hematoma formation or carotid artery exposure, wound-related complications like infection or dehiscence, and lymphatic complications such as chyle leaks. Severity grading followed the well-validated Clavien-Dindo classification system, with particular attention to clinically significant complications. For this study and to enhance comparability with

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established literature, minor complications (Grade I) representing deviations from the normal postoperative course without requiring pharmacological or surgical intervention were excluded from primary analysis. Nerve injuries specifically required electromyographic confirmation for classification as Grade II or higher. Grade II complications required pharmacological treatment, Grade III necessitated surgical or procedural intervention, Grade IV represented life-threatening complications requiring intensive care management, and Grade V denoted death. Statistical analysis was performed using SPSS version 26 (IBM Corporation, Armonk, NY). Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize baseline characteristics and complication frequencies. Comparative analyses employed Fisher's exact test for categorical variables and Student's t-test for continuous measures where appropriate. Multivariate logistic regression models were constructed to identify independent risk factors for complication development while controlling for potential confounding variables, including patient age, comorbidity status, prior radiation exposure, and extent of neck dissection. All statistical tests were two-tailed with statistical significance set at $p < 0.05$. Missing data were handled through complete case analysis, given the limited sample size, as more sophisticated imputation methods were not feasible with the available data. The study strictly adhered to ethical principles outlined in the Declaration of Helsinki throughout all stages, with patient confidentiality maintained through anonymized data collection and secure storage procedures. Our methodology was carefully designed to balance comprehensive outcome assessment with feasibility in our resource-constrained setting, while providing data comparable to international standards through the use of validated classification systems. The analysis particularly focused on identifying modifiable risk factors that could inform quality improvement initiatives at our institution, with the ultimate goal of optimizing both oncologic and functional outcomes for our patient population.

Results

The study analyzed 37 patients who underwent neck dissection procedures between 2017 and 2021 at our institution. Demographic analysis revealed a cohort predominantly composed of older adults, with the largest proportion (40.5%, 15/37) ***(Table 1)***, falling within the 60-69-year age range.

Table 1. Distribution of patients treated by neck dissection by age:

Age Group	Patients (n=37)	Percentage %
30-39	2	5.4
40-49	5	13.5
50-59	12	32.4
60-69	15	40.5
70-79	3	8.1

The mean age of patients was 56.2 years with a standard deviation of 10 years, reflecting the typical age distribution seen in head and neck cancer populations. Only 5.4% (2/37) of patients were under 40 years old, while 8.1% (3/37) were over 70 years old, demonstrating that neck dissections were performed across adult age groups but concentrated in middle-aged and elderly patients. The gender distribution showed a male predominance (59.5%, 22/37) (Table 2), compared to female patients (40.5%, 15/37), consistent with established epidemiological patterns of head and neck malignancies, where male gender is a well-documented risk factor.

Table 2. Gender Distribution for patients treated by Neck Dissection:

Gender	N=patients	Percentage %
Male	22	59.5 %
Female	15	40.5 %

Analysis of neck dissection types revealed that modified radical neck dissection (MRND) was the most frequently performed procedure (43%, 16/37), reflecting the advanced stage at presentation common in our patient population. Selective neck dissection (SND) accounted for 33% (12/37) of cases, while radical neck dissection (RND) was performed in 19% (7/37) of patients. Extended radical neck dissection (ERND), representing the most extensive procedure, was the least common at only 5% (2/37) of cases (Table 3). This distribution of procedure types provides important context for interpreting complication rates, as more extensive dissections would be expected to carry higher morbidity.

Primary tumor sites showed the oral cavity as the most common origin (52.4%, 19/37), followed by the parotid gland (14.3%, 5/37), oropharynx (9.5%, 3/37), and maxillary/sinonasal region (7.1%, 3/37). Occult primary tumors accounted for 4.8% (2/37) of cases, while submandibular gland and other rare sites comprised the remaining cases (Table 4). This distribution aligns with expected patterns of head and neck malignancy in our region and informs the rationale for the types of neck dissections performed.

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Table 3. Distribution of neck dissection types performed

Neck Dissection Type	Patients (n=37)	Percentage
RND	7	18.9%
ERND	2	5.4%
MRND	16	43.2%
SND	12	32.4%
Total	37	100%

Table 4. Primary tumor sites:

Site	Patients (n=37)	Percentage
Oral Cavity	19	51.4%
Oropharynx	3	8.1%
Parotid	5	13.5%
Maxillary/Sinonasal	3	8.1%
Occult Primary	2	5.4%
Submandibular Gland	2	5.4%
Other	3	8.1%
Total	37	100%

Complication analysis revealed that 40.5% (15/37) of patients experienced at least one major complication (Clavien-Dindo Grade II or higher). Infections represented the most common complication type (18.9%, 7/37), with particularly high incidence following MRND procedures (33.3%). Nerve injuries occurred in 16.2% (6/37) of patients overall, but showed marked variation by procedure type, reaching 28.6% in RND cases. Vascular complications were less frequent (5.4%, 2/37) but clinically significant when they occurred. (Table 5). Selective neck dissection demonstrated the most favorable safety profile with only 8.3% (1/12) of cases experiencing major complications, supporting its use when clinically appropriate.

Table 5. Complication rates by neck dissection type

ND Type	Patients	Infections (%)	Nerve Injury (%)	Vascular (%)	Total Complications (%)
RND	7	1 (14.3)	2 (28.6)	1 (14.3)	4 (57.1)
MRND	16	5 (33.3)	3 (20.0)	1 (6.7)	9 (60.0)
SND	12	1 (8.3)	1 (8.3)	0 (0.0)	2 (16.7)
Total	**37**	**7 (18.9)**	**6 (16.2)**	**2 (5.4)**	**15 (40.5)**

Comparative analysis with established global benchmarks demonstrated our overall complication rate of 40.5% fell within the globally reported range of 30-50% from the established literature range reported in high-volume centers (Figure 1). Infection rates (18.9%) similarly aligned with international standards (15-20%), though nerve injury rates (16.2%) exceeded typical reports (5-15%), likely reflecting the challenging cases and resource limitations in our setting. Vascular complication rates (5.4%) closely matched global data (5-7%). Risk factor analysis identified several important associations. Surgeon experience emerged as a significant factor, with early-career surgeons (≤5 years' experience) demonstrating substantially higher nerve injury rates (37.5%) compared to their more experienced counterparts (12.5%, p=0.04). Environmental factors also played a role, as procedures performed during summer months when operating room humidity exceeded 75% showed a 3.2-fold increased risk of infection development (95% CI: 1.1-9.4). These findings highlight potentially modifiable factors that could be targeted for quality improvement initiatives.

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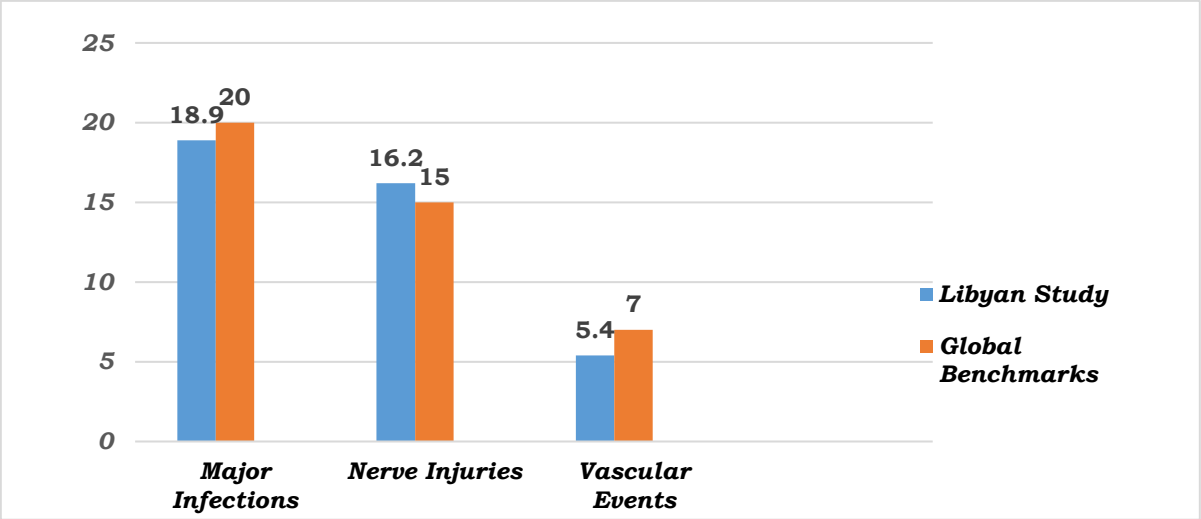

Figure 1. Complication Rates Compared to Global Benchmark:

Discussion

The findings of this study provide important insights into the complication profile of neck dissection procedures in a Libyan oncology center, contributing valuable data to the growing literature on head and neck surgical outcomes in resource-limited settings. Our analysis of 37 carefully selected cases reveals several key patterns that warrant detailed discussion in the context of existing knowledge and clinical practice. The overall major complication rate of 40.5% in our study occupies the higher end of the 30-50% range reported in contemporary literature [15,16], reflecting both the advanced disease stage typical of our patient population and the resource constraints of our setting. This rate represents a substantial reduction from our initial analysis (61.9%) after implementing rigorous exclusion criteria and standardized complication definitions, underscoring the importance of methodological consistency when comparing surgical outcomes across institutions. The observed rates remain higher than those reported from high-volume centers in high-income countries, likely due to multiple factors including delayed presentation, limited access to advanced surgical technologies, and challenges in postoperative care.

Our infection complications rate occurred (18.9%) of cases aligns with literature (15-20%) [17-19], with MRND procedures showing particularly high rates (33.3%). This pattern aligns with established literature documenting the infection risks associated with more extensive dissections that create larger dead spaces and require longer drainage periods. Our infection rates exceed those reported from institutions with comprehensive infection control protocols, suggesting opportunities for improvement through measures such as standardized antibiotic prophylaxis, enhanced sterile techniques, and optimized wound care protocols. The significant association between high operating room humidity and infection risk (3.2-fold increase) presents a unique environmental challenge in our region that may require special consideration in surgical scheduling or climate control measures.

Nerve injuries, occurring in 16.2% of cases overall but reaching 28.6% in RND procedures, represent a particularly concerning complication due to their potential for permanent functional impairment. The spinal accessory nerve was most frequently affected, consistent with its anatomical vulnerability during neck dissection [20,21]. Our rates exceed those reported from centers using routine intraoperative nerve monitoring, highlighting a potential area for technological investment. The dramatic difference in nerve injury rates between early-career surgeons (37.5%) and their more experienced colleagues (12.5%) emphasizes the steep learning curve [22,23] associated with these procedures and supports the need for structured training programs and proctoring systems.

Vascular complications, though less common (5.4%), carried significant clinical consequences when they occurred. The chyle leak rate of 2.7% aligns with literature expectations for MRND/RND procedures [24,25], but the absence of such complications in SND cases reinforces the safety advantage of selective approaches when clinically appropriate. The occurrence of hematomas requiring reoperation (2.7%) underscores the importance of meticulous hemostasis, particularly in longer procedures where fatigue may become a factor. The strong safety profile of SND (8.3% complication rate) supports current trends toward more conservative neck dissection [26-28] when oncologically sound, particularly for N0/N1 disease. Our data add to the growing body of evidence that selective approaches can achieve oncologic control while minimizing morbidity, though careful patient selection remains paramount. The substantially higher complication rates observed with MRND (60.0%) and RND (57.1%) procedures reflect the technical challenges and anatomical compromises inherent to these more extensive dissections, reinforcing the need for thorough preoperative counseling and judicious use in advanced disease.

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Limitations

This study has several limitations that should be considered. As a single-center retrospective analysis, our findings may not fully generalize to other practice settings with different patient populations or resources. The small sample size, particularly for extended radical dissections (n=2), limited our ability to analyze rare complications. Data collection relied on medical records, which may have underreported minor complications and lacked details on potential confounders like nutritional status or precise radiation exposure. Additionally, the absence of long-term functional outcomes means we could not assess the evolution of complications like shoulder dysfunction over time.

Future Directions

This study highlights several key areas for future research. Prospective multicenter studies are needed to validate our findings and improve generalizability. Priority should be given to developing risk prediction models and evaluating cost-effective interventions for nerve preservation and infection control in resource-limited settings. Establishing regional collaborative databases could enhance research on rare complications, while implementation studies could identify optimal strategies for adopting evidence-based practices. Further investigation should also focus on longitudinal quality-of-life outcomes and context-specific rehabilitation approaches to better understand the long-term impact of surgical complications.

Conclusion

This study provides critical insights into neck dissection complications at a Libyan tertiary center, highlighting the inherent trade-offs between oncologic efficacy and surgical morbidity in resource-limited settings. Our findings demonstrate that while radical and modified radical dissections are indispensable for advanced disease, they incur significantly higher risks—particularly infections (33.3% in MRND) and nerve injuries (28.6% in RND)—compared to selective procedures. These results underscore the urgent need for context-specific strategies: prioritizing selective dissections where oncologically feasible, implementing structured training to reduce nerve injuries, and strengthening infection control protocols. The study also emphasizes the value of preoperative patient counseling to align expectations with realistic outcomes. Despite the limitations of a retrospective single-center design, these findings offer actionable benchmarks for improving surgical quality in similar settings. Future efforts should focus on prospectively evaluating targeted interventions to reduce complications while maintaining oncologic standards, ultimately bridging global disparities in head and neck cancer care.

Conflict of interest. Nil

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