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Original Research Article

The Impact of Surgical Techniques on Spinal Accessory Neuropathy: A Comparative Analysis of Neck Dissections at a Single Tertiary Care Center

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Abstract:

Background: In high-risk areas like India, head and neck cancers are a huge global health burden. Squamous cell carcinomas can develop in a variety of head and neck regions as a result of prolonged exposure to risk factors like alcohol, tobacco, and viral infections. Unique demographic and healthcare issues in India make it more difficult to manage this malignancy, including delayed diagnoses, poor access to care in rural areas, and side effects from treatment such shoulder weakness. By examining the effects of various neck dissection methods on spinal accessory neuropathy, we can learn more about its prevalence, risk factors, clinical signs, and functional results.

Methods: At one tertiary care facility in India, 48 patients with head and neck cancer who undergone various neck dissections participated in a prospective study. Preoperatively and at 1 and 3 months after surgery, clinical evaluations comprising arm abduction tests (ABT) and electromyography (EMG) were carried out. The correlation between surgical methods, lymph node involvement, tumour invasion, and shoulder disability was evaluated statistically.

Results: Across all surgical methods, postoperative EMG readings significantly decreased, indicating nerve dysfunction (p = 0.005). Necks with nodes were stiffer and showed more severe nerve dysfunction (p 0.001). These findings were supported by ABT scores, with stiffness patients reporting more significant postoperative decreases (p 0.005). Increased tumour invasion and positive lymph node counts were associated with worsening shoulder impairment (p 0.05).

Conclusion: Shoulder dysfunction is significantly impacted by various neck dissection techniques, with node-positive necks and severe nodal involvement providing increased hazards. It is crucial to customise surgical methods to reduce nerve and muscle stress. For patients having neck dissections, additional research might result in improved surgical approaches and rehabilitation procedures.

Keywords: Neck Dissection, Spinal Accessory Neuropathy, Electromyography, Arm Abduction Test, Surgical Techniques.

Introduction

Particularly in nations like India, where common risk factors like cigarette use, alcohol consumption, and viral infections are common, the incidence of head and neck cancers is a serious public health concern.[1] Squamous cell carcinomas are the most often identified type of head and neck cancer, and they can affect the paranasal sinuses, oral cavity, nasopharynx, oropharynx, hypopharynx, and larynx. Premalignant lesions and ultimately head and neck cancer can develop as a result of prolonged exposure to chemicals in these locations.[2]

Due to its distinct demographics, pervasive risk factors, and dietary practises, India stands out because head and neck cancer is especially common there. Beyond its obvious physical affects, this illness has a significant impact on a person's appearance, communication skills, and social relationships. Additional difficulties in the treatment of head and neck cancer exist in India, such as the problem of patients who are lost to follow-up, which has a detrimental effect on the results of clinical trials and the general wellbeing of patients.[3]

Due to delayed diagnosis, poor access to healthcare in rural regions, and expensive treatment, oral cancer in particular poses a serious concern in India. The effectiveness of treatment is frequently decreased by delayed discovery, which often causes oral cancer to advance. The situation is further complicated by postoperative problems, such as shoulder dysfunction brought on by the manipulation of the spinal accessory nerve during neck dissection.[4]

Clinical tests and electromyography (EMG) are frequently used by clinicians to evaluate the function of the trapezius muscle following surgery. These evaluations involve gauging arm abduction as well as gauging pain, stiffness, and numbness. This study compares preoperative and postoperative outcomes to evaluate trapezius muscle function in patients who have undergone neck dissection using both clinical and EMG approaches.[5]

The typical surgical procedure in the past has been called "radical neck dissection," which included the removal of nodes from numerous levels as well as accompanying tissues like the sternocleidomastoid muscle, internal jugular vein, and spinal accessory nerve. This procedure commonly results in discomfort and shoulder dysfunction despite being effective against malignancy.[6]

The idea of functional neck dissection originated in response to these difficulties in the late 1960s, concentrating not only on oncological outcomes but also on maintaining patients' quality of life (QOL). Although neck dissection techniques have improved, little is known about patients' quality of life (QOL) after neck dissection.[7] When deciding on neck dissection techniques, surgeons continue to struggle with striking the right balance between attaining the best oncological results and protecting crucial structures like the spinal accessory nerve.[8]

Despite the growing popularity of modified radical neck dissections with spinal accessory nerve preservation, difficulties still exist in reliably finding and protecting this nerve. The pursuit of surgical advancements that guarantee both efficient cancer therapy and conformity to predetermined therapeutic standards continues to be of the utmost importance.[9]

Our work explores spinal accessory neuropathy after neck dissections, and it was carried out at a single tertiary care facility in India.[10] By looking at the prevalence, risk factors, clinical symptoms, and functional outcomes connected to this disorder, we want to offer useful insights into the treatment of head and neck cancer.[11]

We also compare the effects of various surgical techniques on spinal accessory neuropathy, which can help future treatment plans and improve the general quality of life for patients having neck dissections.[12]

Materials and Methods

Study Setting: The present study was conducted in the Department of Oto-rhino laryngology at JNU IMSRC, Jaipur, Rajasthan, India

Study Design: This study employed a hospital-based prospective design to assess spinal accessory neuropathy in patients undergoing neck dissection as part of head and neck surgery.

Study Period: Data collection and analysis took place between

Sample Size: The minimum sample size required to achieve a 95% confidence level with a 15% absolute error was determined to be 48 cases. This sample size was chosen to verify the expected 70% incidence of spinal accessory neuropathy in different neck dissections.

Sampling Technique: A total of 48 eligible Head & Neck cancer patients were selected for the study on a first-come, first-served basis.

Inclusion Criteria: Patients included in this study met the following criteria:

1. Had undergone neck dissection as part of head and neck surgery.

Exclusion Criteria: Patients were excluded from the study if they met any of the following criteria:

1. Previous head & neck surgery.
2. Previous irradiation and/or chemotherapy.
3. Presence of neurological diseases (CVA, MS, MND).
4. Recent involvement in a road traffic accident (RTA).
5. History of previous breast or shoulder joint surgery.
6. Diagnosis of diabetes mellitus.

Clinical Examination: Prior to surgery, all patients underwent a clinical examination to evaluate shoulder function, particularly arm abduction. The functional evaluation of the spinal accessory nerve was conducted using electromyography. Assessments were made preoperatively and at 1 month and 3 months post-surgery. Clinical examination included:

- Assessment of pain, stiffness, numbness.
- Arm abduction test (ABT), scored as follows:
- Up to 180° without pain or effort (5)
- Up to 180° but with pain or effort (4)
- Up to more than 150° but less than 180° (3)
- Up to more than 90° but not less than 150° (2)
- Up to less than 90° (1)

Electromyography (EMG): Variation in the amplitude of the motor action potential at 1 month post-surgery was studied to assess the degree of immediate postoperative reduction. This reduction in amplitude could indicate neuroapraxia or axonotmesis, with neuroapraxia showing quicker conduction recovery and axonotmesis having longer-lasting impairment. Assessments at 3 months post-surgery aimed to detect any spontaneous activity after denervation by electromyographical study. EMG examinations involved:

- Patient seated, with two electrodes affixed to the skin over the upper muscle belly of the trapezius.
- Recording of action potentials during maximum isometric muscle contraction (MIMC) in three five-second series, with a five-second interval between each series.
- Data presented in microvolts (μV) after applying a band pass filter of 20 to 500 Hz.

Statistical Analysis: Qualitative data were analyzed using the Chi-square test, while quantitative data were analyzed using Student's't' test. Pre- and post-operative means were compared using Split ANOVA test. The level of significance for all statistical analyses was set at 95%.

Results

Table 1: Electromyography

Surgical Procedure	Pre-Op (Mean±SD)	Post-Op after 1 month (Mean±SD)	Post-Op after 3 month (Mean±SD)
RND (N=1)	132.0±0.0	11.90±0.0	13.60±0.0
MND (N=14)	114.1±17.91	49.56±12.09	52.30±11.73
SOND (N=32)	121.0±17.86	77.67±23.45	80.10±22.95
JND (N=1)	117.3±0.0	84.2±0.0	89.1±0.0

In electromyography, the mean value of radical neck dissection, modified neck dissection, supra-omohyoid neck dissection & jugular neck dissection was 132.0±0.0, 114.1±17.91, 121.0±17.86 & 117.3±0.0 respectively pre-operatively. After first & third month postoperatively, in different surgical procedure, mean EMG value was significantly decreased as compared to EMG values pre-operatively.

Table 2: Comparison between Clinical nodal staging (cN) v/s arm abduction test (ABT)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
ABT * cN	4.521	2	2.260	12.524	.000
Error(ABT)	16.604	92	.180	19.967	.000
cN	11.281	1	11.281		
Error	25.990	46	.565		

Mean ABT score was reduced at post-operative follow up and this difference was statistically significant. F (2,92)=12.524 (P=0.000) There is significant difference noted between patients with clinically positive vs negative neck nodes across three different time points (preop, first post-op month and third post-op month)F(1,46)=19.967(P=0.000)

Table 3: Comparison between pathological nodal staging v/s EMG values at preop, postop first and third month

Pathological Nodal Staging	Time	Mean	Time	(I) Pathological Nodal Staging	(J) Pathological Nodal Staging	Mean Difference (I-J)	Sig.(A)
N0	1	120.231	*1	N0	N1	-10.202	1.000
	2	77.491			N2a	3.741	1.000
	3	80.003			N2b	-2.969	1.000
N1	1	130.433		N1	N2a	13.943	1.000
	2	32.533			N2b	7.233	1.000
	3	35.567		N2a	N2b	-6.710	1.000
N2a	1	116.490	**2	N0	N1	44.957	.008
	2	54.800			N2a	22.691	.038
	3	57.370			N2b	34.541	.212
N2b	1	123.200		N1	N2a	-22.267	.769
	2	42.950			N2b	-10.417	1.000
	3	45.900		N2a	N2b	11.850	1.000
			***3	N0	N1	44.436	.008
					N2a	22.633	.034
					N2b	34.103	.208
				N1	N2a	-21.803	.779
					N2b	-10.333	1.000
				N2a	N2b	11.470	1.000

1-preoperative EMG value 2-postoperative EMG value after 1 month 3- postoperative EMG value after 3 month.

On pair wise comparison between pathological nodal staging at different time points. On preoperative comparison between different sub groups, mean difference was not significant.

** At first postoperative month, on comparison between pathological nodal staging (N0 to N1, N0 to N2a) mean difference (44.957µV, 22.69 µV) was Statistically Significant P<.05

*** Similarly at third postoperative month (N0 to N1, N0 to N2a) mean difference was Statistically Significant.

Mean difference of Post-operative EMG values between cases with N0 to N+ node was found to be Statistically Significant except between cases with N0 to N2b.

Table 4: Comparison between Pains in shoulder v/s arm abduction test (ABT)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
ABT * PAIN	**4.669**	**2**	**2.335**	**13.052**	**.000**
Error(ABT)	**16.456**	**92**	**.179**		
PAIN	**8.855**	**1**	**8.855**	**14.334**	**.000**
Error	**28.416**	**46**	**.618**		

Mean ABT score was reduced at post-operative follow up this difference was statistically significant. F (2,92)=13.052(P=0.000). There is significant difference noted between groups where pain in shoulder present vs absent across three different time points (preop, post-op1monthand post-op3month) F (1,46)=14.334(P=0.000).

Table 5: Comparison between stiffness in shoulder v/s EMG values

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Time * Stiffness	5792.359	2	2896.179	14.506	.000
Error(Time)	18367.645	92	199.648		
Stiffness	7855.467	1	7855.467	8.586	.005
Error	42087.646	46	914.949		

Significant interaction was noted between time and stiffness in shoulder F(2,92)=14.506(P<0.001) Comparison was done between subjects where stiffness was present vs absent across three different time points and it was found to be statistically significant F(1,46)=8.586 (P=.005)

Discussion

Neck dissection in oncological surgery aims for clean margins and lymph node management. But it frequently results in nerve damage, notably to the spinal accessory nerve, which impairs shoulder function. This includes soreness, a dip in the shoulder, and restricted movement.[13]

In order to define this dysfunction, which involves persistent pain, shoulder tilt and drop, and restricted shoulder movement, the phrase "shoulder syndrome" was first used in 1952. Various surgical techniques, such as modified neck dissection, have been suggested to lessen this.[14] In patients undergoing various neck dissections, we looked at shoulder dysfunction.48 patients participated in our study, which was carried out in the ENT and Head Neck Surgery Department.

The majority (85%) were men and Hindus (79%), which reflected regional demographics.[15] Electromyography (EMG) measurements showed a significant postoperative decline when compared to preoperative levels (P=0.000). Less shoulder impairment was observed in patients with clinically node-negative necks (N0) and those lacking level V dissection. 62.5% of neck cases with nodes present reported stiffness, compared to 25% of node-negative cases (P=0.004).[16]

All time points saw a substantial decline in EMG values in neck instances with nodes (P 0.005), indicating more severe nerve damage. EMG levels and stiffness had a significant interaction (P 0.001). Postoperatively, EMG values significantly decreased in patients with stiffness.[17]

Scores on the Arm Abduction Test (ABT) backed with these conclusions. Postoperative ABT ratings significantly decreased in patients who reported stiffness (P=0.005). More discomfort was also associated with stiffness (P=0.005), highlighting the influence of stiffness.[18]

The number of lymph nodes that were all positive (pN+) was associated with more shoulder stiffness, discomfort, and numbness.

These problems are also strongly connected with deeper tumour invasion. This shows that a shoulder problem is exacerbated by significant nodal involvement and tumour invasion.[19]

Conclusion

Our study's result emphasises the important influence of various neck dissections on shoulder dysfunction. Patients who have deeper tumour invasion, substantial nodal involvement, and node-positive necks are more susceptible. It is essential to design neck dissection procedures to reduce nerve and muscle injuries. For these patients, improved surgical methods and rehabilitation plans may result from additional study.

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