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QUALITY OF LIFE AFTER NECK DISSECTION: A SYSTEMATIC REVIEW OF LITERATURE.

***[1]Dr. Jaspreet Singh Badwal, [2]Dr. Nitin Khunteta and [3]Dr. Prakhar Katta**

[1]Fellow Head and Neck Oncology in Department of Surgical Oncology at Sri Ram Cancer Centre, Mahatma Gandhi University of Health Sciences & Technology, Jaipur, Rajasthan, India.

[2] Unit Head, Department of Surgical Oncology, Sri Ram Cancer Center, Mahatma Gandhi University of Health Sciences & Technology, Jaipur, Rajasthan, India.

[3]MDS Oral and Maxillofacial Surgery. Currently Working as Senior Resident in Department of Surgical Oncology at Sri Ram Cancer Centre, Mahatma Gandhi Hospital, Jaipur, Rajasthan.

***Corresponding Author: Dr. Jaspreet Singh Badwal**
Fellow Head and Neck Oncology in Department of Surgical Oncology at Sri Ram Cancer Centre, Mahatma Gandhi University of Health Sciences & Technology, Jaipur, Rajasthan, India.

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ABSTRACT

Background: To review the literature on quality of life after neck dissection so as to help in practical decision making when faced with various clinical situations, such that the reader can comprehend the role of RND, MRND and SND in this current era and the indications for each, when judged in relation to quality of life after neck dissection. **Materials and methods:** An electronic search was conducted using the search terms "Head and Neck Neoplasms", "Neck Dissection", "Quality of Life" and "Postoperative". Clinical studies were retrieved from the electronic databases of PubMed, EMBASE and SCOPUS. **Results:** From a comprehensive review of the literature, it can be asserted that MRND and SND are the preferred procedures for early stage head and neck cancer. There is a paucity of well-designed prospective studies and randomised controlled trials that could provide level I evidence. **Conclusion:** Though most of the studies report better functional results for selective or modified radical neck dissections compared to radical neck dissection, it cannot be established that all the motor and sensory deficits associated with RND can be ascribed to sectioning of SAN.

KEYWORDS: Head and neck neoplasms, neck dissection, quality of life, postoperative.

BACKGROUND

Neck dissection was first described as a standard systematic procedure by George Crile in 1906,[1] who presented his data on Radical Neck Dissection. Thereafter, many surgeons across different continents presented their results of this procedure with highly variable survival outcomes. In the first half of twentieth century, Hayes Martin and his team conducted a long term study on Radical Neck Dissection (RND) for cancer of head and neck, the inferences of which were published in 1951.[2] This comprehensive publication in the classical journal Cancer, described the experience of 1450 cases of neck dissection performed at Memorial Hospital (New York) during the time period 1928 to 1950. The acceptance of this procedure at an institute of such high repute, made this department a tertiary care referral centre for Head and Neck Cancer, where hopeless patients from all over North America, found a ray of hope. In an era where treatment of cancer was the prime consideration rather than discomfort of neck and ipsilateral shoulder, Radical Neck Dissection was the only hope of life, rated far above quality of life in terms of associated discomfort.

In the later half of twentieth century, two surgeons from different continents, propagated the ideology of Modified Radical Neck Dissection (MRND). They were Suarez,[3] from Argentina and Bocca[4] from Italy. They proposed that the lymphatic system of the neck is contained inside a fascial envelope, such that on many occasions it can be removed by dissection without sacrifice of the spinal accessory nerve (SAN), internal jugular vein (IJV) and sternocleidomastoid muscle. Propagants of radical neck dissection questioned the usefulness of this procedure in presence of extranodal extension and large nodes adherent to these three anatomical structures, thus the actual purpose of the neck dissection being seriously undermined in terms of sound oncological clearance. Also, concerns were shared over the number of nodes in critical areas like upper end of the spinal accessory nerve, engulfing the nerve in an inseparable manner. Thus the debate continued and various schools of thought emerged amongst different medical centres and continents. If one reads this historical dilemma in an

unbiased manner, the most profoundly appropriate words to end the discussion would be – "Can we agree to disagree..?" Was radical neck dissection just a metaphor for an era of critical times and desperate measures..? Why then so many standard and renowned texts on oncologic surgery still describe it as the "Gold standard"..? It seems contemplation is more important than debate, even if some surgeons would call this procedure a "necessary evil'. Should something "life saving" be called "evil" or "ominous"..? These and other such questions may be answered through this text, if the reader decides to be impartial to the subject. No matter how eras have changed, cancer still takes many human lives and cases of recurrence are not very uncommon. Nevertheless, it is not my intention to prove one ideology superior to the other but only to lay stress on the fact that every ideology and procedure has its own importance and indications, thus one cannot be called superior to the other.

Since the commencement of 21st century, an overwhelming number of articles have appeared on morbidity and quality of life after neck dissection. Various scales and indices have been used for qualitative assessment of shoulder pain and discomfort after neck dissection, such as the Shoulder Disability Questionnaire (SDQ),[5,6] Constant Shoulder Scale,[7] the Short Form Health Survey (SF-36),[8] RAND36,[9] the Neck Dissection Impairment Index (NDII),[10] etc. Apart from these, various questionnaires have been developed for measuring quality of life scores in patients of head and neck cancer, such as the University of Washington QOL (quality of life) Questionnaire,[11] the EORTC H & N 35,[12] the EORTC HN 43,[13] HRQOL (health-related quality of life),[14] etc. Though most of these publications have implicated sacrifice of the spinal accessory nerve as the primary cause of morbidity after neck dissection, others have suggested that it is only one of the causes, as shoulder pain and discomfort is present only in about 50% of the cases where this nerve has been sacrificed, while shoulder syndrome may occur in cases of selective neck dissection also.[15] Thus, sacrifice of the spinal accessory nerve cannot be established as the only cause of morbidity after neck dissection.

Purpose

Excellent reviews have been published earlier on quality of life after neck dissection, where authors have given a wonderful overview of all published data, that shows a trend of transition from radical to more conservative neck dissections with time. As such, the present study does not intend to repeat or copy the same pattern and conclusions. Rather, the aim of this study is to help in practical decision making when faced with various clinical situations, such that the reader can comprehend the role of RND, MRND and SND in this current era and what are the indications for each, when judged in relation to quality of life after neck dissection. Also, the present paper will reveal the truth behind the fallacy, in relation to sacrifice of spinal accessory nerve and the consequent implications towards quality of life.

MATERIALS AND METHODS

An electronic search was conducted using the search terms "Head and Neck Neoplasms", "Neck Dissection", "Quality of Life" and "Postoperative". The search blocks used were **(1) Head and Neck Neoplasms** – [exp "Head and Neck Neoplasms"/ or ((head or neck).tiab,kw. and (exp Neoplasms/ or (neoplasm* or cancer* or malignant* or tumor* or tumour* or carcinoma*).tiab,kw.))]; **(2) Neck Dissection** – [exp Neck Dissection/ or "neck dissection*".tiab,kw.]; **(3) Postoperative complications or Quality of life** - exp Postoperative Complications/ or exp "Quality of Life"/ or (((postop* or "post operative*" or post-operative* or postsurgery* or post-surgery* or "after surgery" or "following surgery" or postanesthesia* or post-anesthesia*) and (complication* or contraindications* or complaints*)) or "adverse postoperative effect*" or "adverse postoperative event*" or "adverse effect*" or "adverse event*" or "quality of life" or "life quality").tiab,kw.]

Clinical studies were retrieved from the electronic databases of PubMed, EMBASE and SCOPUS. A total of 357 articles had been published till 2020 in English and other languages which included retrospective studies, prospective studies, SEER Database surveys, multicenter studies and smaller descriptive studies. 92 articles provided complete information in relation to morbidity and quality of life after neck dissection. References of the selected studies were further searched for important relevant studies. Apart from this, a search over the Google search engine was conducted to obtain related studies. In order to identify and remove heterogeneity, strict selection criteria were employed as per the recommendations mentioned by the working committee on PRISMA guidelines, such that only the studies on morbidity and quality of life after neck dissection, were included in the systematic review.

Inclusion and Exclusion criteria

All 357 articles were reviewed by two independent authors and final studies were included by consensus of both authors. Studies were included if they had reported range of motion of shoulder, strength, activity impairments, participation restrictions, period of follow-up, mode of measurement used and groups of patients studied. A total of 51 articles were selected for final inclusion. Studies focussed on physiotherapeutic rehabilitation and prevention of shoulder impairment were excluded.

RESULTS

From a comprehensive review of the literature, it can be asserted that MRND and SND are the preferred procedures for early stage head and neck cancer (Table 1). There is a paucity of well-designed prospective studies and randomised controlled trials that could

provide level I evidence. It is difficult to derive a cumulative outcome of results from all published data because the mode of measurement of quality of life is different in most of the studies. While most authors have used questionnaires based on subjective signs and symptoms, very few have carried out an objective evaluation. Most of the authors have ignored the fact that RND was used for advanced stage disease, where the morbidity is increased due to extensive resection and reconstruction, even if there was minimal loss of function of trapezius muscle. Also, the complex of symptoms called the shoulder syndrome, cannot be ascribed solely to sacrifice of the spinal accessory nerve during neck dissection and the features of eleventh nerve syndrome could be regarded as a complex interplay of disturbed sensory and motor plexus system along with disturbance of the muscle continuum that comprises the shoulder and back muscles.

Table 1: A collective overview of all published data on quality of life after neck dissection. Abbreviations : SND, Selective Neck Dissection; MRND, Modified Radical Neck Dissection; RND, Radical Neck Dissection; SDQ, Shoulder Disability Questionnaire; NDII, Neck Dissection Impairment Index; DASH, Disabilities of Arm, Shoulder and Hand Questionnaire; NPNPQ, Northwick Park Neck Pain Questionnaire; NPDS, Neck Pain and Disability Scale; UW-QOL, University of Washington Quality of Life Questionnaire; SPADI, Shoulder Pain and Disability Index; HN-QOL, Head and Neck Quality of Life; WORC, Western Ontario Rotator Cuff Questionnaire; "Own" refers to questionnaires devised solely for the study without application of any methodologic principles; ROM, Range of Motion; C, Cross-sectional; R, Retrospective; P, Prospective; mo, months; yrs, years.

Serial No.	Author	Year	Number of subjects (n)	Groups for comparison	Mode of measurement	Strength or ROM assessment	Follow up period	Type of study
1	Martin H[2]	1951	599	RND	Pain and Own	Strength and ROM	5 yrs	R
2	Nichols et al.[16]	1968	426	RND	Own	None	5 yrs	R
3	Thumfart et al.[17]	1977	200	RND	Own	Strength & ROM	3 mo to 10 yrs	R
4	Carenfelt et al.[18]	1981	53	RND vs MRND	Pain	Strength and ROM	2 to 7 yrs post-op	C
5	Leipzig et al.[19]	1983	109	MRND vs RND	Pain and own	Strength and ROM	0 mo post-op & 6 mo post-op	C
6	Schuller et al.[20]	1983	243	RND vs MRND	Own	No	Between 6mo & 5 yrs post-op	C
7	Short et al.[21]	1984	35	SND vs MRND vs RND vs patients with no ND	Own	Strength and ROM	>6 wks post-op	C
8	Saunders et al.[22]	1985	100	RND vs MRND vs RND with cable graft	Own	ROM	6 mo to 19 yrs ; mean of 6.2 yrs	C
9	Sobol et al,[23]	1985	35	SND vs MRND & RND	Own	ROM	Pre-op, mean 17 wks post op; range 11-39 wks	P
10	Remmler et al,[24]	1986	90	Pre-op vs post-op & SND vs MRND vs RND	None	Strength and ROM	Pre-op, 1 mo, 3 mo, 6mo, 12 mo post-op	P
11	Zibordi et al,[25]	1988	36	RND vs MRND & SND	None	Strength	>1 mo post-op	C
12	Hillel et al,[26]	1989	11	No comparison	Own	ROM	Mean of 22 mo post-op	R
13	Shone et al,[27]	1991	46	RND	Pain and own	ROM	>6 mo	C

14	Krause et al,[28]	1992	54	RND	Own	No	All >6 mo post-op, mean 29 mo post-op	C
15	Kuntz et al,[29]	1999	84	Pre-op vs Post-op & SND vs MRND vs RND	UW-QOL	No	Pre-op, 6 mo & 12 mo post-op	P
16	Terrell et at,[30]	2000	175	SND + MRND vs RND vs normal controls (no surgery)	HN-QOL	No	Not mentioned	C
17	Cheng et al,[31]	2000	21	Pre-op vs Post-op & SND vs MRND vs RND	None	Strength	1 & 6 mo post-op	P
18	Koybasioglu et al,[32]	2000	20	Pre-op vs Post-op & SND vs MRND	None	No	Pre-op, 3 wk to 3 mo post-op	P
19	Dijkstra et al,[33]	2001	177	SND vs MRND vs RND & operated vs non-operated side	Own	ROM	Mean of 13 days post-op	C
20	Shah et al,[34]	2001	51	SND vs MRND vs RND	Own	No	5-90 mo post-op	C
21	El Ghani et al,[35]	2002	59	SND vs MRND vs RND & operated vs non-operated side	Own	ROM	Between 4 mo & 5 yrs post-op	C
22	Chepeha et al,[36]	2002	54	SND vs MRND	Constant's Score	Strength & ROM	Mean of 34 mo post-op; all >11 mo post-op	C
23	Taylor et al,[37]	2002	54	SND vs MRND	NDII	No	Mean of 34 mo post-op; all >11 mo post-op	C
24	van Wilgen et al,[38]	2004	137	SND vs MRND	SDQ	No	>1 yr post-op	R
25	Erisen et al,[39]	2004	57	Pre-op vs Post-op & SND + MRND vs RND vs No surgery	None	ROM	Mean of 27 mo post-op	P
26	Laverick et al,[40]	2004	220	SND vs No ND	UW-QOL	No	Pre-op, 6 mo, 12 mo & >18 mo post-op	P
27	Cappiello et al,[41]	2005	40	SND vs MRND	Own	ROM	>1 yr post-op	R
28	Inoue et al,[42]	2006	74	SND vs MRND vs RND	Own	ROM	Mean of 36 mo; range of 12 mo to 23 yrs post-op	C
29	Tsuji et al,[43]	2007	54	Different types of SND & cervical nerve-sparing vs cervical nerve sacrificing	None	No	>21 days post-op	C
30	Orhan et	2007	21	Pre-op vs Post-	NDII, SDQ,	No	Pre-op & 9	P

	al.[44]			op & MRND vs RND	UW-QOL		mo post-op	
31	Rogers et al.[45]	2007	100	SND vs MRND & RND	NDII, SDQ, UW-QOL	No	Mean 12 mo, range 3-38 mo	C
32	Stuiver et al.[46]	2008	139	RND vs MRND vs SND	SDQ, RAND-36	Strength & ROM	Baseline, discharge, 4 mo	R
33	Selcuk et al,[47]	2008	26	Pre-op vs Post-op & SND vs MRND	SPADI	ROM	Pre-op; 6 wk & 6 mo post-op	P
34	Carr et al,[48]	2009	65	Different types of SND	DASH	None	>0.5 yrs post-op	R
35	Oz et al,[49]	2009	35	SND & MRND vs patients with no ND	NPDS & NPNPQ	ROM	>1 yrs post-op	R
36	Celik et al,[50]	2009	30	Pre-op vs Post-op	None	Strength & ROM	Pre-op, 21st day post-op, 6 mo post-op	P
37	Umeda et al,[51]	2010	90	SND vs MRND	No	ROM	3 mo post-op	C
38	Nibu et al,[52]	2010	224	Pre-op vs Post-op & SND vs MRND rehabilitation vs no rehabilitation	Own	ROM	1,3,6 & 12 mo post-op	P
39	Teymoortash et al,[53]	2010	98	Different types of SND	Own	Strength & ROM	Mean 2.6 yrs, range 0.5 – 9.1 yrs	R
40	Watkins et al,[54]	2011	34	SND vs Non-operated side and SND and adjuvant treatment	Modified Constant's score	No	>6 mo from surgery	C
41	Murer et al,[55]	2011	29	SND vs SNB	NDII & Modified Constant's Score	Strength & ROM	>1 yr	C
42	Lee et al,[56]	2013	25	SND & MRND	Pain and Own	Strength & ROM	Post-op 1 mo	R
43	Popovski et al,[57]	2017	165	RND vs SND vs MRND	SDQ , Constant-Murley Shoulder Score	Strength and ROM	Post-op 3 mo, 6 mo	C
44	Gane et al,[58]	2017	89	SND & MRND	Quick disabilities of arm, shoulder, hand; Neck Disability Index	Strength & ROM	3 yrs	R
45	Gane et al,[59]	2018	84	SND & MRND	NDII; Quick disabilities of arm, shoulder, hand; Neck Disability Index	Strength & ROM	< 5 yrs after neck dissection	C
46	Imai et al,[60]	2020	66	SND & MRND	WORC	Strength & ROM	Post-op 1, 3, 6, 9 & 12 mo	R

DISCUSSION

Ever since the last quarter of twentieth century, increasing number of publications have appeared in the English Language literature regarding the plethora of symptoms associated with shoulder discomfort after neck dissection. This symptom complex was first described in detail by Ewing and Martin,[61] who called it the "Shoulder Syndrome". They questioned and examined 100 patients who had undergone Radical Neck Dissection at Head and Neck Service of Memorial Hospital (New York). The specific features of the shoulder syndrome were identified as.[61,62] (1) Drooping of the shoulder, (2) limited forward flexion of the shoulder, (3) limited lateral abduction and (4) rotation of the scapula. However, as the authors,[61] summarized their conclusions at the end of this historical paper, they suggested – "A high proportion of the patients who are submitted to radical neck dissection (always assuming that they remain free from cancer meantime) continue without much difficulty to earn their living as before. The operation is certainly compatible with an active and independent life, even in the elderly." The authors,[61] further concluded – "Our study of the total disability following a neck dissection suggests that one need never hesitate to advocate radical neck dissection in the removal of cancer in this area." Though a great number of publications have quoted this intriguing study, no one has revealed these concluding remarks by the authors. One of the first few studies implicating radical neck dissection as the cause of the shoulder syndrome was presented by Shone et al. The authors emphasized, or may be overemphasized, that shoulder disability resulting from RND causes depreciation of quality of life and affects the social as well as occupational domains of the patients. Similarly, Kuntz et al,[29] compared quality of life scores in 84 patients who underwent different kinds of neck dissection and had completed pre-treatment and post-treatment University of Washington QOL questionnaires at 6 and 12 months. The MRND group reported greater shoulder disability at 6 months, compared to the selective neck dissection (SND) group but by 12 months, there was no difference between the two groups. Shoulder function for RND group was reported as inferior to SND group at 6 and 12 months.

These and other such studies have reported different incidences of shoulder disability for RND, MRND and SND. Prevalence of shoulder complaints after MRND range from 18 - 77 %,[18,19,21,22,31] while after RND range from 47 - 100%.[24,31,61] The prevalence after SND has been reported as 31 - 40%[63] in various studies. However, it is important to emphasize that there has been no randomised controlled trial reported in the literature that compares shoulder dysfunction for different forms of neck dissection. Thus the level of evidence presented in such studies is questionable. In contrast, Saunders and Hirata,[22] reported that resection of spinal accessory nerve does not always result in disability of shoulder function. The authors evaluated 100 consecutive patients who had undergone composite resection for head and neck cancer and examined them for function of Trapezius muscle. The results revealed that 67% of patients who underwent RND with sacrifice of SAN, had few negligible symptoms related to this deficit, although they showed profound atrophy of the trapezius muscle. Interestingly, 47% of patients who underwent MRND type I, with preservation of SAN, showed some signs of muscle atrophy and 20% showed little or no function of the muscle. These results were reinforced by Krause et al,[28] who suggested that shoulder function remained normal or close to normal in 25% of patients, as shown by EMG. Such findings have been related to subfascial innervation pattern of the spinal accessory plexus, which has a deep course in the neck. In fact, trapezius muscle has both superficial and subfascial anastomosis, such that preserving the anatomical integrity of the accessory nerve may not guarantee the satisfactory function of trapezius muscle.

Schuller et al,[20] conducted a multicentre study to define the impact of total treatment programs involving RND and MRND on patient's permanent disability. The study included a total of 243 patient responses. Comparative analyses between the treatment groups showed no advantage of one surgical technique over the other in return of patients to their pretreatment employment. Such contrasting results have prompted some authors to question the role of SAN in shoulder complaints after neck dissection. Van Wilgen et al,[15] have reported the results of their study to investigate relationship between shoulder morbidity (pain and range of motion) and the function of SAN. In total, 112 patients were included in the study with mean follow up period of 2 years. Five patients underwent radical, 43 modified radical, 48 supraomohyoid and 16 posterolateral neck dissections. 39 patients complained of shoulder pain of whom 51% had dysfunction of the SAN and 49% did not. The authors thus concluded that shoulder pain after neck dissection can be attributed to dysfunction of SAN in only 50% of the cases. In a major, often cited study, Patten and Hillel,[64] suggested that the symptom complex called Eleventh Nerve Syndrome can actually be attributed to adhesive capsulitis of shoulder joint. This explains the failure of full recovery from shoulder dysfunction secondary to neck dissection despite eletrophysiological improvement. The authors explained that the thickened and contracted joint capsule is strongly attached to the head of humerus and adheres to it like a plaster, thus correctly called "adhesive capsulitis", which may also be encountered in the immobilized upper extremity, hemiplegia, diabetes mellitus, myocardial infarction and cervical disc disease. A sedentary lifestyle after surgery has been proposed as a predisposing factor in emergence of shoulder symptoms.

It would be pertinent to state that every type of neck dissection has its own indications and importance. As such, specific criteria could be used to guide decision making in the light of cumulative evidence and seasoned judgement, along with therapeutic guidelines.

Henceforth, the indications for Radical Neck Dissection could be listed as following

1. Advanced stage head and neck cancer with involvement of spinal accessory nerve, deep tissues, carotid vessels and skin adjacent to tumour or node.[65]
2. When size of nodes at level II is larger than 2.5 cm.[66]
3. N staging for the neck is N2 to N3.[67]
4. Multiple nodes at level II which are adherent to the upper end of spinal accessory nerve.
5. Nodes along critical structures such as SAN, IJV or carotid vessels show extranodal extension on pretreatment imaging or adherence of large nodes to these structures.
6. Medullary thyroid cancer with advanced staging.
7. Recurrent neck disease.

However, Bocca,[68] suggested extended indications for functional neck dissection (MRND Type III) and concluded that the only contraindication to the use of this procedure is the presence of node fixation. Similarly, Byers,[69] published his results for 967 patients who were treated at the M.D. Anderson Cancer Center by "Modified Neck Dissection", which included "Functional" (MRND Type III) and Selective neck dissections, either alone or in combination. In this study, the number of neck nodes removed by functional dissection was 31 compared to 44 removed by radical neck dissection, though this sampling difference was reported as insignificant, as the modified dissection removed the nodes believed to be at highest risk. Functional neck dissection was usually reserved for necks with tumours staged N1 or higher and was often combined with selective neck dissection of contralateral side. The author concluded that functional neck dissection was effective treatment regardless of the stage of disease. The incidence of recurrence in neck was decreased with selective use of adjuvant radiation therapy in patients with multiple positive nodes. A node more than 3 cm in diameter or nodes with extracapsular invasion.

In disparity with these findings, Popescu et al,[65] suggested that RND should be the preferred procedure for N3 neck disease or advanced T staging. In their concluding remarks, the authors state that quality of life is a secondary issue when the tumour process is extremely advanced and the life of the patient is the main concern of the surgeon when dealing with such cases. The authors further suggested that we should not abandon sound oncological principles in favour of more conservative treatment.

Gane et al,[58] presented a systematic review on prevalence incidence and risk factors for shouder and neck dysfunction after neck dissection. Their results revealed that shoulder dysfunction depends upon type of surgery performed and measure of dysfunction used. Quality of life was better in patients who underwent MRND as compared to RND and superior in patients of SND as compared to MRND. Dijkstra et al,[33] conducted a multicentre study, involving 177 patients of mean age 60.3 years, to analyse the risk factors for shoulder dysfunction after neck dissection. Forward flexion was reduced by 21 degrees while lateral abduction showed a reduction of 47 degrees, compared with non-operated side. Risk factors for forward flexion were found to be sacrifice of the cervical plexus during neck dissection and reconstruction after resection. This was probably due to the greater extent of surgery that required reconstruction and the tunnelling of pectoralis muscle on the side of surgery. The risk factors for lateral abduction were sacrificing the cervical plexus, non-selective neck dissection and radical neck dissection. The risk factors for shoulder pain were non-selective and radical neck dissection. Also, the authors further explained that the impact of neck dissection on lateral abduction is greater than that on forward flexion as lateral abduction involves action of trapezius muscle while forward flexion involves action of serratus anterior muscle.

Van Wilgen et al,[38] presented their study on shoulder and neck morbidity in quality of life after surgery for head and neck cancer. The range of motion of shoulder was measured with an inclinometer. Sensibility was measured as per anatomic levels at the lateral side of head and neck, in accordance with method described by Saffold et al.[70] Pain was assessed using visual analogue scale. The RAND-36 questionnaire was used to assess the overall quality of life while the CES-D scale (Centre for Epidemiological Studies Depression Scale)[71] was used to analyse patients for psychological depression. This study included 155 patients, of which 16% had a score of 16 or higher on CES-D which might indicate depression. Further, shoulder abduction, neck pain, shoulder pain and age were significantly related to several domains of quality of life. More recently, Inoue et al,[42] reported their findings on quality of life after neck dissection. The authors concluded that patients who had undergone neck dissections that spared the SAN, had better shoulder function. Furthermore, when the SAN was preserved, patients without dissection of level IV and V nodes had better scores on measures related to pain and constriction of neck.

Multiple studies have thus implicated RND and sacrifice of the SAN as cause of shoulder dysfunction after neck dissection. However, there are many studies which have reported contradictory findings. In this regard, it is pertinent to mention the study by Brown et al,[72] who explored in depth the relations between spinal accessory nerve plexus, the trapezius muscle and shoulder stabilization after radical neck cancer surgery. The authors presented a wonderful correlation of clinical findings in 17 patients, who underwent 23 radical neck dissections, with their findings of anatomical dissections in 34 cadavers. Amongst their 17 patients, 8 suffered from unremitting pain. Seven of these 8 patients had poor functional results, when evaluated using a

functional evaluation scale. In contrast, 6 patients who underwent similar operations with loss of eleventh nerve, experienced no pain. However, similar to those with severe pain, these six patients suffered from limitation of motion and other activities to varying degrees. In their cadaveric anatomic dissections, the authors were able to explain the reasons for different responses of patients to sectioning of SAN during RND. The authors found that the eleventh nerve had direct or indirect communications with the greater auricular nerve, trigeminal nerve, facial nerve, the phrenic nerve, brachial plexus, hypoglossal nerve, the stellate ganglion and the second, third and fourth cervical nerves. They emphasized that the trapezius muscle is supplied by a Spinal Accessory Nerve Plexus, rather than the single trunk of spinal accessory nerve. This finding explains the varied presentations of sensory and motor loss associated with loss of function of the trapezius and sectioning of SAN. Also, the trapezius muscle itself shows many variations in its origin and insertion, such that the same individual may have asymmetric anatomy of the muscle on two sides. Furthermore, the trapezius is part of a "muscle continuum" which involves muscles of the neck, shoulder, arm, chest and back. This muscle continuum has variable motor and sensory innervation which could explain the different grades of functional loss and variable presentations of sensory deficits and pain in different individuals. Hence, while some individuals suffer from pain in the shoulder after radical neck surgery, others also feel pain in ipsilateral face and neck or upper arm or chest, while some others feel pain radiating to opposite side neck and chest as well. Conversely, there are patients who feel no pain at all after sectioning of SAN during RND. Similar findings have been reported for the loss of lateral abduction and forward flexion, whereby some patients report no subjective or objective loss of function.

The results of the study by Brown et al were supported by Soo et al,[73] who studied 24 patients with surgical section of the accessory nerve and/or its cervical contributions, as compared to 20 controls. Clinical and electrophysiological studies of the three portions of the trapezius revealed the existence of an undescribed motor nerve supply to the trapezius and of a motor input from the cervical plexus contributions via the accessory nerve. Further, Petrera et al,[74] have reported that injuries of SAN, without complete division of the nerve, are followed by spontaneous regeneration over a course of time, even after complete axonal degeneration. Baggi et al,[75] have shown that postoperative recovery of shoulder and neck function can be improved by early implementation of rehabilitation programmes, even when the patients are not supervised by physiotherapists after first session of exercise teaching. Herring et al,[76] have described a specialised rehabilitation protocol to hasten recovery of shoulder function in patients of RND.

It may be stated that though most of the studies report better functional results for selective or modified radical neck dissections compared to radical neck dissections, it cannot be proved that all these motor and sensory deficits can be ascribed to sectioning of SAN during RND. Also, the literature lacks well designed randomised controlled trials (RCTs) which could establish superiority of selective and modified neck dissections over RND. Another guarded truth, often hidden from due attention, is the fact that most of the studies comparing RND to MRND or SND fail to mention the differences in staging of disease, for which these different procedures were performed. RND is often selected for cases exhibiting advanced stage cancer, where the magnitude of resection and accompanying morbidity is high and the need for extensive reconstruction procedures further decreases the functional results in that patient cohort. In contrast, SND or MRND are often performed in early staged cancer where the accompanying morbidity of resection and reconstruction is comparatively low. Though there have been previous reviews on quality of life after neck dissection, many authors have ignored to discuss the topic of elective versus therapeutic neck dissection in relation to magnitude of surgery and the consequent implications towards quality of life. If elective neck dissection is done for N0 disease, the extent of lymph node removal will be smaller compared to therapeutic neck dissection done for node positive necks. Thus, selective neck dissection will suffice the case of N0 disease while, on the contrary, patients who were managed as per the "wait and watch" policy and later present with neck nodes at multiple levels, are more likely to require a comprehensive MRND or RND for adequate management of disease. This is in direct correlation with the fact that once a patient develops regional lymph node metastasis in the neck, chances of survival are reduced by about 50%.[77] Thus the patient will require a more extensive neck dissection, which is reported to be associated with less favourable quality of life outcomes. D'Cruz et al,[78] presented a randomised controlled trial that compared survival outcomes of 245 patients managed by elective neck dissection with those of 255 subjects managed by therapeutic neck dissection. The authors concluded that elective neck dissection provides more favourable survival outcomes (overall survival 80%) as compared to therapeutic neck dissection (67.5%) for patients managed by the "wait and watch policy".

CONCLUSION

It may be concluded that though most of the studies report better functional results for selective or modified radical neck dissections compared to radical neck dissection, it cannot be established that all these motor and sensory deficits can be ascribed to sectioning of SAN during RND. Also, the literature lacks well designed RCTs which show superiority of selective and modified neck dissections over RND. It would not be overemphasizing to say that RND still remains an important and life-saving procedure in the armamentarium of the surgeon dealing with head and neck cancer. However, as stated previously, all

procedures have appropriate indications and SND or MRND should be preferred when the cancer is not advanced in stage, as these procedures provide good quality of life.

Conflict of interests
The authors declare that there is no conflict of interests that could influence this work.

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