J Maxillofac Oral Surg 8(3):224–229

COMPARATIVE STUDY

Assessment of shoulder function after functional neck dissection and selective neck dissection (Levels I, II, III) in patients with carcinoma of tongue: a comparative study

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Received: 07 February 2008 / Accepted: 15 May 2009

Abstract
Background and objectives To compare shoulder function with respect to pain and disability in patients who have undergone nerve sparing neck dissection i.e. selective neck dissection (levels I, II, III) and functional neck dissection as a part of their treatment modality for carcinoma tongue on a follow up of minimum six months.
Material and methods A total of 100 patients were selected for this study. 50 patients who had undergone selective neck dissection (levels I, II, III) and 50 who underwent functional neck dissection as a part of their treatment modality for squamous cell carcinoma of the tongue from January 2005 to January 2007 were asked to participate in this study. A standardized questionnaire was used to assess pain and disability. Pain and disability scores were then compared between the two nerve sparing dissections.
Results 100% of the patients in Selective Neck Dissection (SND) (levels I, II, III) group and in Functional Neck Dissection (FND) groups complained of pain. Though there is pain present in both the treatment groups, no significant difference in the pain values was found between FND and SND (levels I, II, III) in any of the pain parameters. Disability was present in both the treatment groups. However patients who have undergone FND had significantly higher severity of disability when compared to SND (levels I, II, III) especially during activities which involve shoulder abduction like dressing, doing heavy household work, hair wash and washing clothes/dishes (5.18, 5.22, 5.5, 4.88 in FND and 2.26, 4.08, 4.58, 2.2 in SND (levels I, II, III) respectively. Disability perceived during other activities like doing heavy household and facial care was 2.08 and 1.84 in both the treatment groups respectively.
Interpretation and Conclusion Degree of shoulder morbidity is much higher in patients who have undergone FND as compared to SND (levels I, II, III) as a treatment modality for carcinoma tongue, even though both the treatment options are nerve preserving.

Keywords Nerve sparing · Neck dissections · Shoulder morbidities · Shoulder abduction

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Introduction

Worldwide head and neck cancer ranks as the sixth most common [1,2], making it a major health problem. Although the term 'head and neck cancer' refers to tumors of myriad origins and histological type, >90% of these tumors are squamous cell carcinomas arising from the epithelium of the upper aero digestive tract (oral cavity, oropharynx, hypo pharynx, and larynx).

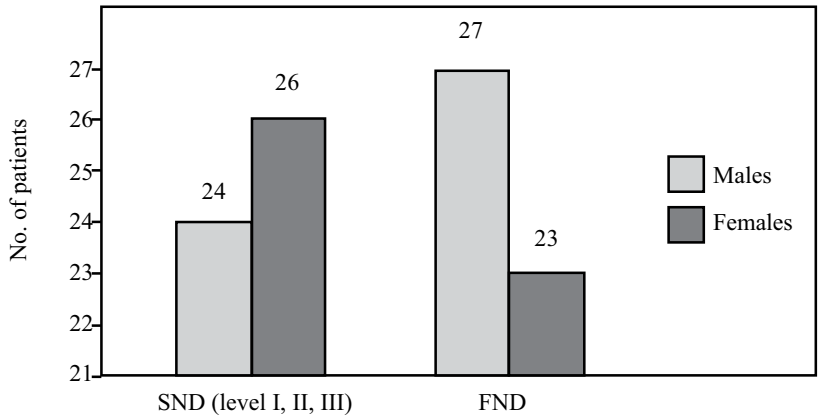
It is well known that head and neck cancers localized to the primary site without regional lymph node involvement have excellent cure rates with either surgery or radiotherapy as the primary modality. However, once metastasis to the cervical

lymph nodes has occurred, the cure rate for all sites is cut approximately in half [3]. Thus, despite major advances in diagnostic techniques and the use of combination therapies, the most important prognostic indicator in patients with squamous carcinoma of the head and neck remains the status of the cervical lymph nodes.

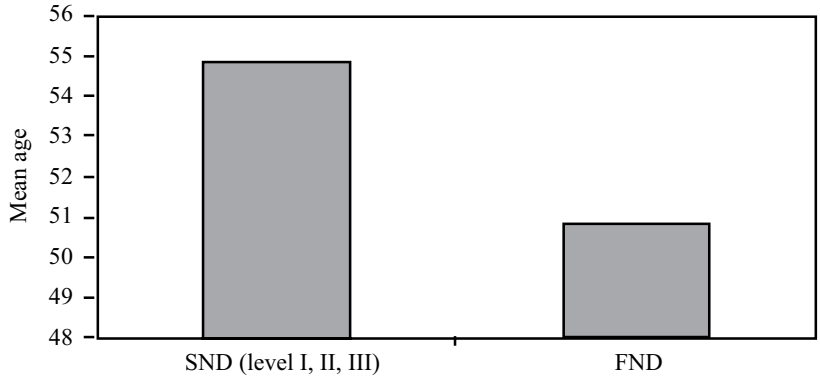
Butlin [4] was the first surgeon to systematically address the cervical lymph nodes by surgically excising the nodal tissue of the submandibular triangle in continuity with the primary lesion in cancer of the tongue. However, this technique did not remove all of the lymphatic tissue in the neck that was at risk for metastasis. It was not until the Radical Neck Dissection (RND) described by Crile [5] and later popularized by Martin [6,7] that systematic removal of all of the lymphatic tissue in the lateral neck became routine. RND is not without its price, however, and results in a cosmetic deformity of the neck and (to varying degrees) in shoulder dysfunction, particularly concerning pain and the decreased ability to abduct the arm beyond 90°. This constellation of shoulder disability has been called the shoulder syndrome [8]. In an effort to lessen the morbidity of classical RND, various modifications have been proposed that preserve structures that are normally sacrificed during this procedure but remove all of the nodal bearing tissue on that side of the neck to retain its oncologic effectiveness [9]. All the modifications include preservation of the spinal accessory nerve (SAN) and can also involve preservation of the internal jugular vein (IJV) and/or the sternocleidomastoid muscle (SCM). Whether these modifications actually reduce the morbidity of RND is ambiguous. Some studies have shown that the range of motion and strength are improved and that shoulder pain is reduced by preservation of the SAN [10]. However, when these patients are compared with those having classical RND, they did not return to their preoperative work activities with any greater frequency [11].

More recently, further modifications of RND have been proposed that not only spare the non lymphatic structures in the neck (SAN, IJV, SCM), but do not remove all of the lymphatic tissue on the involved side of the neck [12]. These dissections, which have been termed selective or limited neck dissections, are based on observations that cancers of the head and neck tend to metastasize in predictable patterns based on the location of the primary tumor. Therefore, only the nodal tissues that are at risk for metastatic cancer are excised. The proponents of selective neck dissection argue that these operations result in improved postoperative function and cosmesis because the SAN, IJV, and SCM are routinely preserved.

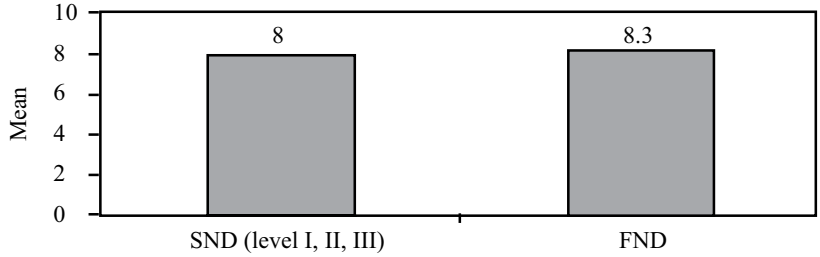
Graph - 1 Gender distribution between SND (level I, II, III) and FND



Graph - 2 Mean age in years between SND (level I, II, III) and FND



Graph - 3 Mean follow up in months



The data collected was subjected to statistical analysis to compare the difference in pain and disability, if any between the two treatment group

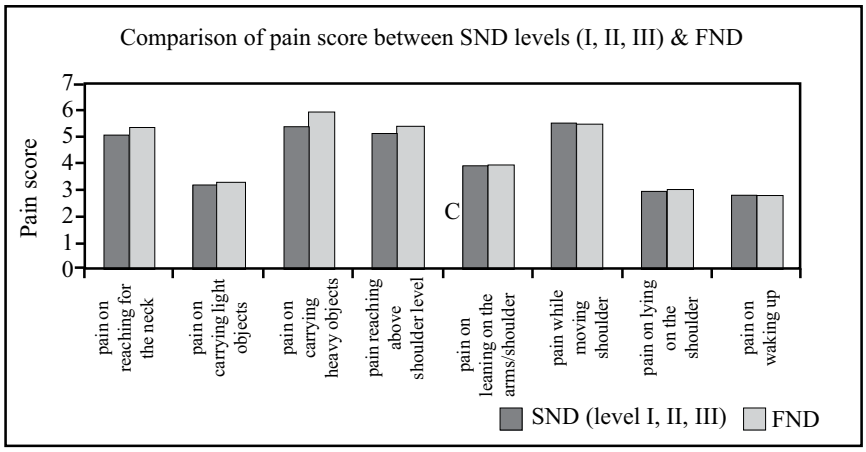
Aims

To evaluate and compare shoulder function with respect to pain and disability in patients who have undergone nerve sparing neck dissection i.e. selective neck dissection (levels I, II, III) and functional neck dissection as a part of their treatment modality for carcinoma tongue on a follow up of minimum six months.

Material and method

Patients who had a selective neck dissection (levels I, II, III) and functional neck dissection by Head and Neck Division of Surgical Oncology Department at Regional Cancer Centre and Department of Oral and Maxillofacial surgery (AB Shetty Memorial Institute Of Health Sciences) during the period January 2005 to January 2007, were

Graph 4 Pain parameters -comparison



Graph 5 Disability parameters- comparison

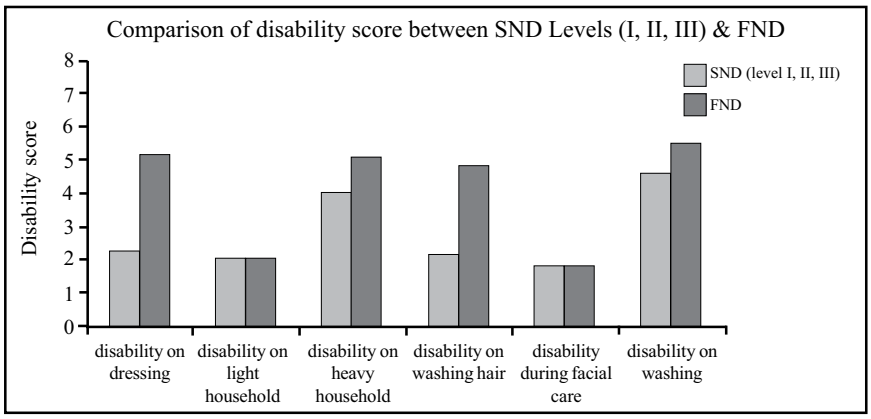


Table 1 Group statistics

	Treatment	N	Mean	Std deviation	Std. Error mean
Pain on reaching for the neck	A	50	5.06	2.26	.32
	B	50	5.34	2.10	.30
Pain on carrying light objects	A	50	3.18	1.57	.22
	B	50	3.28	1.47	.21
Pain on carrying heavy objects	A	50	5.42	2.74	.39
	B	50	5.92	3.08	.44
Pain on reaching above shoulder level	A	50	5.20	2.46	.35
	B	50	5.40	2.52	.36
Pain on leaning on the arm/shoulder	A	50	3.90	2.12	.30
	B	50	3.92	1.95	.28
Pain while moving shoulder	A	50	5.50	2.85	.40
	B	50	5.48	2.87	.41
Pain on lying on the shoulder	A	50	2.96	1.94	.27
	B	50	3.02	1.77	.25
Pain on waking up	A	50	2.78	1.47	.21
	B	50	2.82	1.79	.25

invited to participate in the study. A week before they visited the hospital for a regular follow-up appointment, all patients were sent a letter telling them about the study. After giving written informed consent they were included in the study. All patients had a follow up of at least 6 months after neck dissection. From the medical record, the following data were retrieved: date of operation, type of resection, type of neck dissection, and whether they had preoperative or postoperative radiotherapy, and physiotherapy. Neck dissections were classified as described by Robbins et al. [13].

A standardized questionnaire was used to assess pain and disability. Patients operated upon bilaterally were asked to refer to the painful shoulder only. The questionnaire was a combination of two valid and reliable questionnaires: the Shoulder Disability Questionnaire (SDQ) (van-der Heijden et al., 2000) [14] and the Groningen activity restriction scale (GARS) (Suurmeijer et al.1994) [15]. From these two questionnaires only questions assessing typical shoulder functions were selected. Patients who perceived shoulder pain and/or disability completed the whole questionnaire. The questionnaire assessed: waking up because of shoulder pain, pain when lying on the affected shoulder, pain when moving the shoulder, pain when leaning on the arm or elbow, pain when reaching above shoulder level, pain when carrying heavy and light objects, and pain when reaching for the neck. The severity of the pain was assessed on the 100mm visual analogue scale with 0 marking indicating no shoulder pain and the 100 marking indicating worst shoulder pain imaginable.

Disability perceived during daily activities was also assessed. The following daily activities were assessed: dressing, washing, washing hair, light and heavy household activities and facial care. The severity of the disability was assessed on the 100mm visual analogue scale with 0 marking indicating no shoulder disability and the 100 marking indicating worst shoulder disability imaginable.

Comparison of the pain and disability scores was statistically analyzed using SPSS 10.0 T - test for independent samples

Inclusion criteria

Patients who have undergone selective neck dissection (levels I, II, III) or functional neck dissection as a part of their treatment modality for squamous cell carcinoma of the tongue.

Patients with a minimum follow up 6 months.

Exclusion criteria

Patients with recurrent disease within 6 months. Patients indicated for radical neck dissection.

Incomplete questionnaire.

Patients lost to follow up.

Patients who have undergone postoperative shoulder physiotherapy.

Patients with history of shoulder pain/ dysfunction pre operatively.

Patients with reconstructive procedure done to close the primary defect.

One hundred and twenty five patients were asked to fill up the questionnaire. Of them sixty had had undergone SND (levels I, II, III). Of these, only fifty six patients returned the questionnaire of which six were excluded from analysis because of missing data. Thus 50 questionnaires (24 males, 26 females, mean 54.2 years, SD: 12.424) and an average follow up of 8 months (SD 3.081103) could be analyzed.

Of the fiftyfive patients who had undergone FND as a treatment modality for carcinoma tongue; five patients were excluded due to missing data. Thus in FND group, a total of fifty questionnaires were filled (27 males, 23 females, mean 53.13, SD 11.319) and an average follow up of 8.3 (SD 3.395615) months.

With an average follow up of 8 months (SD 3.081) in SND (levels I, II, III) and 8.3 months (SD 3.395615) in FND group, all the patients in both the groups complained of pain. Pain perceived by the patient in both the treatment groups was judged using eight parameters.

Activities which typically provoked pain as judged by their mean average scores were :- pain on reaching for the neck, reaching above shoulder level, carrying heavy objects and moving the shoulder.

Table 2 Pain parametres – independent samples t-test

	t-test for equality of means					
	t	df	p-value	Mean difference	95% confidence interval of the difference	
					Lower	Upper
Pain on reaching for the neck	-.642	98	.522	-.28	-1.15	.59
Pain on carrying light objects	-.328	98	.743	-.10	-.70	.50
Pain on carrying heavy objects	-.858	98	.393	-.50	-1.66	.66
Pain on reaching above shoulder	-.402	98	.688	-.20	-1.19	.79
Pain on leaning on the arm/shoulder	-.049	98	.961	-.02	-.83	.79
Pain while moving shoulder	.035	98	.972	.02	-1.12	1.16
Pain on resting on the shoulder	-.162	98	.872	-.06	-.80	.68
Pain on waking up	-.122	98	.903	-.04	-.69	.61

Table 3 Disability parametres – group statistics

	Treatment	N	Mean	Std deviation	Std. Error mean
Disability on dressing	A	50	2.26	1.66	.24
	B	50	5.18	2.17	.31
Disability on light household	A	50	2.08	1.03	.15
	B	50	2.08	.78	.11
Disability on heavy household	A	50	4.08	1.97	.28
	B	50	5.22	2.76	.39
Disability on washing hair	A	50	2.20	1.16	.16
	B	50	4.88	1.36	.19
Disability during facial care	A	50	1.88	.80	.11
	B	50	1.84	.79	.11
Disability on washing	A	50	4.58	4.67	.38
	B	50	5.50	1.83	.26

Table 4 Disability parametres – independent samples t-test

	t-test for equality of means					
	t	df	p-value	Mean difference	95% confidence interval of the difference	
					Lower	Upper
Disability on dressing	-7.545	98	.000	-2.92	-3.69	-2.15
Disability on light household	.000	98	1.000	.00	-.36	.36
Disability on heavy household	-2.380	98	.019	-1.14	-2.09	-.19
Disability on washing hair	-10.577	98	.000	-2.68	-3.18	-2.18
Disability during facial care	-2.51	98	.802	.04	-.28	.36
Disability on washing	-2.011	98	.047	-.92	-1.83	-.01

Results

Though there is pain present in both the treatment groups, no significant difference in the pain values was found between FND and SND (levels I, II, III) in any of the parameters.

Activities which require strength or more shoulder mobility like reaching for the neck, reaching above shoulder level, moving shoulder and carrying heavy objects provoke more pain in both the treatment groups whereas activities like carrying light objects, waking up, reclining, leaning on the shoulder does not provoke as much pain. However on a comparative basis the severity of the pain perceived between the two groups is almost the same.

On a comparison, patients who have undergone FND have significantly higher severity of disability when compared to SND (levels I, II, III) especially while dressing, hair washing, doing heavy household and washing dishes/clothes.

In all these parameters the average pain score in SND group was 5.06, 5.42, 5.2, 5.5 whereas the average value in FND group was 5.34, 5.92, 5.4 and 5.48 respectively. Activities which involve the abduction of the shoulder typically gave a higher score, however the difference between the two groups was insignificant.

There was a considerably lower average score for parameters like carrying light objects, pain on waking up, leaning on the affected shoulder and pain on resting on the shoulder.

According to this study, disability was present in both the treatment groups. However the severity of the disability greatly varied between the two groups.

Disability in FND group was very significant in the following parameters: Dressing, hair washing and doing heavy household chores.

Disability while washing dishes/clothes was significant.

The difference in the average score in parameters of facial care and light household work was minimal and statistically not significant.

Degree of shoulder morbidity after FND as a treatment modality for carcinoma tongue is significantly higher than SND (levels I, II, III), even though both of the

treatments are nerve sparing by nature and the SAN in both modalities is anatomically preserved.

Discussion

The spinal accessory nerve is a motor nerve, innervating the sternocleidomastoideus muscle and the trapezius muscle. After loss of nerve function, paralysis of both muscles occurs and to trapezius denervation the loss of sternocleidomastoideus muscle activity is secondary importance with respect.

It is assumed that shoulder complaints are due to the sacrificing of the accessory nerve during the neck dissection, which results in paralysis of the descending and transverse part of the trapezius muscle in most patients [16]. Theoretically, neck dissection sparing SAN should result in no or slight shoulder dysfunction and pain, although this is not always the case. In fact both retrospective and prospective studies have shown that some patients with severe nerve injury to the SAN did not have the degree of dysfunction expected [17].

When the accessory nerve is not sacrificed, as in functional or modified neck dissections, shoulder complaints are still reported by 31% to 60 % of the subjects [18,19,20]. In our study all 50 patients (100%) had shoulder pain after FND. Even after selective neck dissections shoulder complaints have been reported in approximately 29% to 39% of the patients [3, 21]. However in the current study all 50 patients had pain of varying degrees.

The exact source of the postoperative shoulder pain is unknown. Many suggestions of the possible cause have been made: secondary frozen shoulder (Patten and Hillel, 1993) [22], hypertrophic sternoclavicular joint (Cantlon and Gluckman, 1983) [23], and excessive stretching of the rhomboid and levator scapulae muscle (Nori, et al. 1997) [24]. Postoperative shoulder pain is not always caused by spinal accessory nerve dysfunction; Saunders et al. (1975) [25] found a weak relationship between trapezius muscle dysfunction and subjective symptoms of shoulder pain (Saunders et al., 1975) [25]. Cutting of cutaneous sensory nerves, causing neuropathic pain, or neuromata may also cause shoulder pain (Brown et al., 1988) [26]. The chance for microtraumata may be more likely because of the anatomical variations in the course of the nerve, particularly in the passage of the sternocleidomastoid muscle, which may lead to more extensive damage [27,21]. But with an intact spinal accessory nerve and trapezius muscle function still shoulder complaints may arise which are interpreted as neuropathic pain or myofascial pain [28].

According to van Wilgen [29] almost 14% of the patients have temporary shoulder complaints, mostly after MRND, in the first postoperative year. If shoulder complaints are the result of neurapraxis of the spinal accessory nerve, recovery of this neuropraxis might occur even long after surgery [30].

Prevalence of shoulder disability after FND in high. Reasons for this high prevalence may be that a FND is more extensive (levels I, II, III, IV, V) compared to SND (levels I, II ,III) and the spinal accessory nerve and cervical plexus are manipulated more extensively, especially in level V.

The significant difference in the disability parameters in FND may be due to the extensive manipulation of the nerve and cervical plexus in the posterior triangle which may inadvertently affect the trapezius muscle. This can be explained by traction, skeletonization and devascularization of the SAN in the posterior triangle, or more frequently of its fine branch directed to the upper trapezius [31].

Looking into the course of the nerve, the most important levels are II and V. At level V the C3 and C4 branches may be damaged by the surgeon, and preservation of level V is probably the main reason why SND levels (I, II, III) causes less morbidity of the nerve. The preservation of the cervical plexus may decrease the incidence of shoulder pain in 25% [32].

Hence while doing nerve sparing neck dissection it seems worthwhile not only to detect, and to preserve the SAN but also the branches of the cervical plexus, and to try to spare or damage these branches as little as possible. This sparing mainly consists the preparation of level V in which the branches of C3 and C4 are located.

Shoulder syndrome should not be underestimated even when the SAN has been anatomically preserved during surgery physical therapy course should be planned to reduce postoperative morbidity. It is important to recognize the functional status of the shoulder as early as possible by clinical evaluation using an adequate questionnaire that may reflect the impact of neck dissection on the postoperative dysfunction. Head and neck disease specific questionnaires have also been demonstrated to be effective for shoulder evaluation [30].

Postoperative impairment of the upper trapezius muscle should be managed by an appropriate physical therapy program, including exercises that patients can perform by themselves at home, contributing to maintaining a sufficient range of motion of the shoulder joint before fibrosis occurs, causing secondary glenohumeral adhesion, scapulohumeral girdle muscle weakness and postoperative forced immobility. The rationale is to prevent any restriction of passive mobility caused by stiffness of capsular structures and ligaments during the first few postoperative months to allow more rapid recovery of active motility once the upper trapezius muscle completely recovers its dynamic properties [31].

Acknowledgement

I would like to express my sincere thanks, to Professor Dr. Paul Sabastian, HOD, Surgical Oncology. Regional Cancer Centre, Trivandrum.

Dr.B.Rajendra Prasad, Senior Professor, and Principle, A.B.Shetty Memorial Institute of Dental Sciences and Dr Nidarsh Hegde, Dr Muralee Mohan.

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Source of Support: Nil, **Conflict of interest:** None declared.