Surg Endosc (2016) 30:2315–2320
DOI 10.1007/s00464-015-4427-z

Minimally invasive supraomohyoid neck dissection by total endoscopic technique for oral squamous carcinoma

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Received: 6 April 2015 / Accepted: 7 July 2015 / Published online: 29 December 2015

Abstract

Background and objective To study the feasibility of a total endoscopic technique for selective neck dissection in oral cancers and to compare the technique with conventional open technique with a long cervical scar.

Methods We included patients with early intraorally resectable squamous carcinomas and excluded patients whose primary lesion required reconstruction with microvascular flaps. We compared the following intraoperative parameters: cumulative length of the incision(s), duration of surgery, estimated blood loss, and intraoperative complications. The postoperative parameters included hospital stay, shoulder function, duration of analgesic use, and early postoperative complications. We used Shoulder Pain And Disability Index scores to assess shoulder function and assessed the oncologic outcome histopathologically by the number of nodes dissected.

Results The mean operative time for minimally invasive supraomohyoid neck dissection (MISOND) was 53.7 ± 29.8 min, which was significantly longer than 39.4 ± 5.0 min for the open technique. The estimated blood loss in the MISOND group was significantly lower compared with the open technique ($p < 0.001$), and there were no major intraoperative complications in either group. Postoperative recovery assessed by hospital stay and time to resume routine work was slightly shorter in the MISOND group but not statistically significant. There were no reported early postoperative complications such as haemorrhage, wound dehiscence, or chyle leakage in either group. The mean Shoulder Pain And Disability Index score assessed 2 weeks postoperatively for the MISOND group was 14.35 ± 0.71 %, which was significantly better than 44.14 ± 1.18 % for the open technique ($p < 0.001$). The number of nodes dissected showed no significant difference between groups.

Conclusions MISOND is a feasible and safe procedure with immediate oncologic outcomes comparable with those of conventional open SOND and provides better cosmetic and functional outcomes.

Keywords Minimally invasive neck dissection · Supraomohyoid · Oral squamous carcinoma

Introduction

Surgical techniques are continually being developed to improve aesthetic and functional outcomes in all surgical conditions including cases of malignancy. Intraoral resection of oral cancers is now preferred; so large cervical incisions for neck dissection are questionable, and two recent papers have discussed robotic-assisted neck dissection; however, high cost limits the use of this equipment. Endoscopic-assisted surgery is a more cost-effective alternative to robotic surgery [25]. We discuss minimally invasive supraomohyoid neck dissection (MISOND) for early oral squamous carcinomas using a total (pure) endoscopic technique with CO2 insufflation.

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Patients and methods

Patients

We included oral squamous carcinoma cases treated in the Bharat Cancer Hospital and Research Institute between January 2012 and December 2012. Surgery was performed by a single surgeon (Dr Ravindrasinh Raj), and the inclusion criteria for MISOND were Eastern Cooperative Oncology Group Performance Status Scale (ECOG) score $\leq$2, T1/T2 clinical stage of the primary lesion, and clinicoradiologically N0 in the neck.

We excluded cases in which excision of the primary lesion created an opening in the floor of the mouth, when frozen section revealed positive nodes requiring complete neck dissection, or when microvascular free flap reconstruction was planned. Other exclusion criteria were body mass index (BMI) $\geq$30 and patients with neck stiffness, as these can affect the quality of neck dissection and duration of surgery. Thirty-five patients underwent open SOND, and 22 patients underwent MISOND. We counselled patients preoperatively regarding the procedure, discussed conventional versus MISOND technique, and obtained informed consent for MISOND. This study was approved by our institutional ethics committee (ECR/401/Inst/GJ/2013) and met our governmental agency guidelines. We compared the following intraoperative parameters: cumulative length of the incision(s), duration of surgery, estimated blood loss, and intraoperative complications. The postoperative parameters were hospital stay, shoulder function, and early postoperative complications. We used SPADI (Shoulder Pain And Disability Index) to assess shoulder function and assessed the oncologic outcome histologically by the number of nodes dissected.

All data were pooled, and analysis was performed using PASW Statistics, version 18.0 (SPSS Inc., Chicago, IL, USA). Student's '*t*' test was used to compare the data for each group, and a p value < 0.05 was considered statistically significant.

Operative technique

Patients were placed in the supine position with arms fully adducted and the neck held in moderate extension using a shoulder bag. An approximately 2.5-cm incision was made at the suprasternal notch, and blunt dissection then proceeded along the subplatysmal plane. A tissue spacer bag was inserted and inflated to increase the space in the anterior triangle of the neck. A 10-mm 30° rigid scope (Karl Storz GmbH and Co. KG, Munich, Germany) was introduced, and skin sutures were placed around the port to prevent CO2 leakage. Insufflation was then initiated at a pressure of 12 mmHg and a flow rate 8–10 l/min). Two 5 mm working ports were introduced just lateral to the sternoclavicular joint, one on each side. Subplatysmal plane dissection continued to the boundaries of the supraomohyoid compartment of the anterior triangle of the neck and included partial dissection on the contralateral side to provide a larger working space. Care was taken to identify the marginal branch of the facial nerve using the facial artery and vein as a guide as well as the emergence of the nerve from the lower pole of the parotid gland as it coursed towards the angle of mouth. The nerve was pushed upwards from the field of dissection to prevent injury. Dissection then began at the level IA nodes beginning on the midline at the level of the hyoid bone. All of the fibrofatty tissues from the submental triangle between the two anterior bellies of the digastric muscles were then excised. We recommend sacrificing muscle fibres, if needed, to avoid leaving any of the fibrofatty tissue. This tissue was temporarily placed beside the plane of dissection, which then proceeded along the lower border of the mandible, hugging the bone. The facial artery was divided by harmonic curved shears, and the total length of the lower border of the mandible was revealed. Dissection then proceeded along the posterior belly of the digastric muscle. At this step, it is crucial to remember that the facial vein emerges anterior to the posterior belly of the digastric muscle and that the facial artery emerges posterior to the muscle. The facial artery and vein were dissected and skeletonised using blunt and sharp dissection and divided using a vessel-sealing device (Enseal, Johnson and Johnson, Cincinnati, OH, USA). Further dissection then proceeded along the mylohyoid muscle with retraction, as necessary, to retrieve all of the fibrofatty tissue from beneath the mylohyoid muscle. This also allows the surgeon to easily identify the lingual nerve. Care should be taken not to breach the deep fascia at this level to avoid injuring the hypoglossal nerve. All of the fibrofatty tissues along with the submandibular salivary gland were resected, which completed level IB dissection. Level IIA and level III dissection occurred together. We began the dissection at the apex of the supraomohyoid triangle where the anterior border of the sternomastoid and superior belly of the omohyoid muscles cross each other. The internal jugular vein (IJV) was identified, and careful blunt and sharp dissection were used to expose its anterior surface. We suggest decreasing the CO2 pressure slightly at this stage to allow the IJV to distend. Dissection then proceeded along the IJV by lifting the sternomastoid muscle, and level III nodes were dissected and retracted dorsally to reach the level IIA nodes. Next, the linguofacial venous trunk was secured using the vessel-sealing device. The dissection continued to the posterior belly of the digastric muscle along the IJV and then proceeded posteriorly along the posterior belly of the digastric muscle. Careful layer-by-layer dissection in this area helped to identify the spinal accessory nerve after which the posterior border of the IJV was cleared and level IIB nodes were then addressed taking care to avoid injuring the spinal accessory nerve. The inactive blade of the harmonic curved shears should be used on the side of the nerve to avoid collateral thermal damage to the nerve. All of the fibrofatty tissues from level IIB are resected, completing the supraomohyoid neck dissection. The surgical bed was irrigated with normal saline and haemostasis confirmed. The dissected tissues were then secured in a plastic bag and delivered through the suprasternal incision (camera port). Negative suction drainage was maintained through the working ports, and the suprasternal incision was sutured in a single layer using nonabsorbable sutures (Figs. 1, 2, 3).

Results

From January 2012 to December 2012, we performed 57 SONDs for early oral cancers, 35 using a standard open method and 22 using MISOND. Patients' demographics and clinical data are shown in Table 1. Comparing the two groups, 15 from the open group and 12 from the MISOND group had an ECOG score of 1 with an ECOG score of 2 in the remainder. Of the 57 SOND cases, 38 patients had a primary lesion in the tongue and 19 had a primary lesion in the buccal mucosa. MISOND was used in 18 cases of tongue carcinoma and 4 cases of buccal mucosa carcinoma, and in 11 cases on the right side and nine cases on the left side (Table 1).

The mean operative time for MISOND was significantly longer compared with the open technique (53.7 ± 29.8 vs. 39.4 ± 5.0 min). The estimated blood loss in the MISOND group was significantly lower compared with the open technique ($p < 0.001$), and no patients in either group experienced major intraoperative complications.

Postoperative recovery assessed by hospital stay and time to resume routine work was slightly shorter in the MISOND group but not statistically significant. There were no reported early postoperative complications such as haemorrhage, wound dehiscence, or chyle leakage in either group. The mean SPADI score assessed 6 weeks

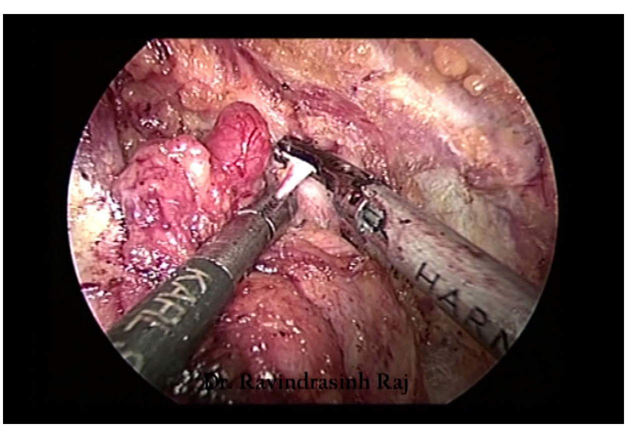

Fig. 1 Division of facial artery at lower border of mandible

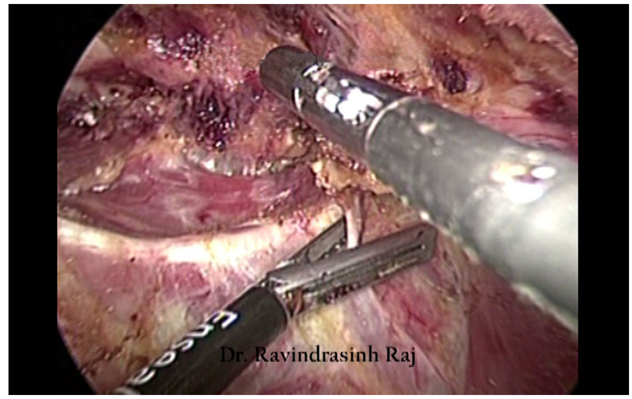

Fig. 2 Division of facial vein at confluence with internal jugular vein

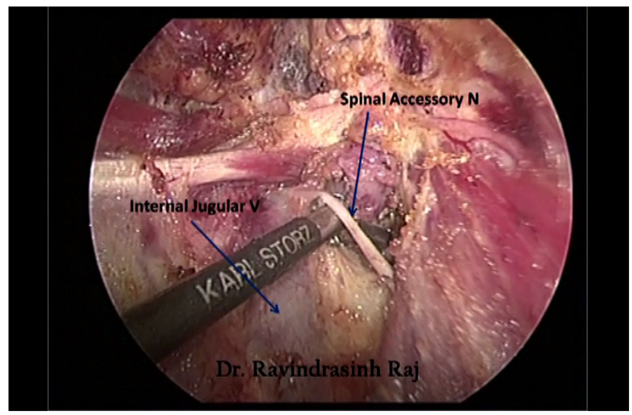

Fig. 3 Preserving spinal accessory nerve

Table 1 Clinical details

Clinical parameters	Open	MISOND	Total
Primary disease BM	15	4	19
Primary disease tongue	21	17	38
M/F ratio	33:3	14:7	47:10
T1 primary disease	15	12	27
T2 primary disease	21	9	30
T3 primary disease	0	0	0
T4 primary disease	0	0	0

postoperatively for the MISOND group was 14.35 ± 0.71 %, which was significantly better compared with 44.14 ± 1.18 % for the open technique ($p < 0.001$). No mortalities occurred in either group up to the 6-week follow-up.

The initial oncologic outcomes were comparable in both groups. The anatomical clearance, visual inspection of the surgical bed after completion of surgery, and the number of nodes dissected showed no significant difference between groups (Table 2).

Discussion

The well-defined avascular anatomical planes in the neck allow endoscopic surgeons to create a working space for surgical manipulation. Endoscopic neck surgery was first described in 1996 [1] and is becoming more widely used. The primary target organs have been the parathyroid and thyroid glands [2–9] although a small number of studies have reported this technique for other cervical structures, such as the submandibular glands and cervical spine [9, 10]. Endoscopic surgical approaches may be classified as total (pure) endoscopic (CO2 insufflation) [3–6], video-assisted endoscopic [11–14], and minimally invasive mini-incision [15–18].

We present the results of a scarless method of MISOND using total (pure) endoscopic techniques with CO2 insufflation for cases of early oral squamous carcinomas. No consensus exists on the ideal treatment for clinically N0 necks in patients with early oral squamous cancers. Elective neck dissection shows improved regional control and disease-specific survival, and when patient compliance for regular follow-up is not assured, elective neck dissection is always a better approach. Neck dissection provides confirmation of pathological N stage and determines the need for further treatment. Selective dissection of level I–III (SOND) is the procedure of choice for elective neck dissection [22]. In our institute, we perform SOND in the majority of clinico-radiologically N0 necks for cases of oral squamous carcinoma. We use a curvilinear skin incision following the natural skin crease from the mastoid tip to the midline; however, this procedure creates a disfiguring scar. Also the increasing trend of transoral surgery in early oral cavity cancers raises questions about adding neck dissection and an external cervical incision [19]. Because of this concern, we speculated that a surgical approach for SOND in which the scar could be avoided would be a better surgical option. Robot-assisted and endoscopic-assisted surgeries are examples of efforts to improve cosmetic outcome. Kang et al. first reported robot-assisted modified radical neck dissection in 2010 via a transaxillary approach [24], but difficulties in approaching level I, an important area for oral cavity cancer treatment, were encountered [25]. To overcome this limitation, neck dissection via a modified facelift or the retroauricular approach using robotic surgery was attempted by the same authors. Robot-assisted neck dissection has definite advantages, but its high cost is a problem for most patients. Endoscopic-assisted surgery is a more cost-effective alternative compared with robotic surgery [26]. This study was designed to investigate the safety and efficacy of minimally invasive techniques in SOND compared with conventional open SOND. Our data showed that the majority of perioperative outcomes and short-term measures of convalescence were better in the MISOND group than in the open SOND group. However, this is directly proportional to the surgeon's level of experience. Similar to minimally invasive techniques for other anatomical sites, learning new techniques in SOND takes effort and time. MISOND includes orientation difficulties in the surgical field and achieving traction–countertraction because of lack of space. Prolonged practice is required to overcome these problems, and we initially had to convert three cases to open surgery (excluded from the statistical analysis). In the first two cases, we found difficulty in getting into the right (subplatysmal) plane and so encountered superficial veins, causing excessive bleeding, and the further dissection with endoscopic method was not possible. The best solution to our opinion is to start the dissection through incision of camera port and get to one of the sternomastoid tendon and follow the loose

Table 2 Comparison of outcomes

Variables	Open		MISOND		*T* value	*P* value	Interpretation
	Mean	SD	Mean	SD			
Duration of surgery (min)	39.3889	5.0215	53.7143	29.5891	2.8529	0.0061	Significant
Blood loss (ml)	45.44	10.94	26.67	17.77	4.95	<0.001	Significant
Cumulative length of incision (cm)	25.4444	2.3838	4.0952	0.3748	40.6009	<0.001	Significant
Hospital stay (days)	2.9722	1.5944	2.381	0.4976	1.6478	0.1051	Not significant
No. of nodes in pathology	17.1944	2.6166	17.7619	2.3001	0.8246	0.4132	Not significant
Total SPADI score at 6 weeks postoperatively (%)	44.14	1.18	14.35	0.71	105.17	<0.001	Significant

areolar tissue above it. This manoeuvre takes surgeon into the subplatysmal plane easily. In the third case, we had to convert to open as we could not confidently identify and dissect internal jugular vein. We resolved this issue by lowering the CO_2 pressure at the step when we approach level III nodes at the apex of supraomohyoid triangle at the junction between superior belly of omohyoid and anterior border of sternomastoid muscles.

The mean operative time for MISOND was significantly longer than for the conventional open technique ($p = 0.006$) with an average operating time from the first to seventh cases of 89 min (maximum 126 min to minimum 62 min). This was 50 min higher than the mean of 39 min (maximum 50 min to minimum 25 min) required for open surgery; however, the average operating time was 35 min (maximum 48 min to minimum 25 min) for the last 15 cases.

The use of any new technique like MISOND must not result in patient injury. We encountered no major intra-operative complications such as injury to vein, artery, or nerves and no reported early postoperative complications in either group. Although the mean operative time in the MISOND group was higher than for the open technique, the amount of blood loss was much lower in the MISOND group compared with the open group (45.44 ± 10.94 vs. 26.67 ± 17.77 ml, respectively). This is attributed to the compression effect of CO_2 on neck vessels and the magnified view during MISOND. The advantages of MISOND compared with open surgery are better cosmetic results (no neck scar) and better shoulder function. In this study, the cumulative length of the skin incision in the MISOND group was significantly shorter than for open surgery (25.4 ± 2.4 vs. 4.1 ± 0.4 mm), $p < 0.001$. Patients in the MISOND group were satisfied with their small scars and better cosmetic results. The most significant outcome in our study was better shoulder function in the MISOND group. The total SPADI score assessed 6 weeks after surgery for the MISOND group versus the open group was 44.1 ± 1.2 versus 14.4 ± 0.7 %, respectively ($p < 0.001$). This was attributed to minimal handling of the spinal accessory nerve during dissection of level IIB nodes using MISOND compared with open SOND and the lack of traction applied to the nerve in MISOND. The long-term results of shoulder function will be assessed at the 3-year follow-up.

Maintaining oncologic principles is essential in the treatment of oral cancers regardless of approach and surgical technique. The principles of anatomical dissection following tissue planes with attention to lymphatic drainage were maintained in this MISOND series. There was no residual fibrofatty tissue in the supraomohyoid compartment of the anterior triangle of the neck in either group. The average number of harvested lymph nodes in the pathological examination was 17.2 ± 2.6 in the MISOND group versus 17.7 ± 2.3 in the open surgery group; however, this difference was not statistically significant ($p = 0.4$). All of the harvested nodes in both groups were negative histopathologically [cases with positive nodes requiring further neck dissection in both groups were excluded from the statistical analysis, as in both the groups, we converted to open method for completion neck dissection—modified neck dissection (MND)]. The number of assistants required for open surgery and MISOND is the same, but an experienced surgeon is needed to overcome problems such as difficulty of triangulation, CO_2 leakage, and instrument crowding. In future, customised equipment may reduce such problems; however, we used conventional laparoscopic instruments. An alert and efficient anaesthetist is also required to warn surgeons regarding carotid reflexes and air embolism. This study was limited by its small sample size and lack of randomisation and blinding. The estimated blood loss was measured by differences in dry versus wet gauze weight, which can create observational bias. We also did not assess the SPADI score preoperatively, which could affect results showing significant difference between the groups on postoperative assessment. We believe that this initial comparison study could lead to well-structured large randomised and prospective studies that address these limitations.

In conclusion, our results demonstrated that MISOND is a feasible and safe procedure with immediate oncologic outcomes comparable with those of conventional open SOND and that it provides better cosmetic and functional outcomes in the short term. MISOND also avoids additional expenditures compared with robotic surgery. Although a long learning curve is involved, MISOND could become standard of care in the future. Future, larger, randomised studies to confirm the feasibility and advantages as well as the long-term oncologic and functional outcomes are needed.

Acknowledgments Dr. Ravindrasinh Raj, Dr. Vikram Lotwala, and Dr. Piyush Anajwala have no conflict of interest or financial ties to disclose.

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