Original Article

Infrahyoid myocutaneous flap for reconstruction in head and neck cancer patients

ABSTRACT

Background: Reconstruction of head and neck defects following tumor excision is one of the most challenging surgeries due to multiple reasons, such as associated cosmetic and functional impairments. The three-dimensional aspect of the defect makes it more difficult. Although in modern settings, microvascular surgery is preferred in many conditions, it requires the presence of resources and expertise. Locoregional flaps are workhorse flaps in head and neck reconstruction. In this article, we present an uncommonly used flap with high acceptability and success rate in head and neck reconstruction.

Aim: To find outcomes of using infrahyoid flap reconstruction in head and neck defects following cancer excision.

Materials and Methods: The retrospective study was conducted in the surgical oncology department of our institute. Patients with squamous cell carcinoma of the oral cavity, clinically T1–T3 and N0–N1 stage, with anticipated defects of small to medium defects were included in the study. The study was conducted from July 2020 to June 2022, including a follow-up of 1 year. A total of 14 patients were included in the study. All patients had squamous cell carcinoma of the oral cavity involving different subsites. Patients were operated on by a single surgeon, using the same technique.

Result: A total of 14 patients were included with a male-to-female ratio of 11:3 and age between 45 and 60 years. None of the patients underwent revision surgery, and none of the patients had total flap loss. Four patients had minor flap complications, of which three patients had partial, superficial skin necrosis of the flap which was managed conservatively and epithelized later. None of the patients developed major complications, oro-cutaneous fistula, or radiation necrosis. None of the patients developed recurrence after 1 year of surgery.

Conclusion: The infrahyoid myocutaneous flap (IHF) is a fairly reliable and easy-to-perform flap for small- and medium-sized defects of the oral cavity, without requiring additional incisions and donor site reconstruction.

Keywords: Cancer, flap reconstruction, head and neck, infrahyoid flap

INTRODUCTION

According to GLOBOCAN 2020, oral cancers amount to 10.3% of the total cancer burden in India. A cosmetically and functionally good reconstruction is a major challenge in the treatment of such cancers. Free flaps are gaining priority over various traditional workhorse flaps for reconstruction but are associated with disadvantages, such as prolonged operating time, need for microvascular setup and expertise, prolonged hospitalization, chances of revision/exploration surgeries, and donor site morbidities. In the era of free flaps, pedicled flaps are often overlooked, which are reliable, easy to perform, and have consistent anatomy.

Access this article online	
Website: www.njms.in	Quick Response Code
DOI: 10.4103/njms.njms_55_24	

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Received: 04 April 2024, **Revised:** 25 April 2024, **Accepted:** 11 June 2024, **Published:** 16 November 2024

How to cite this article: Sharma V, Singhal A, Pandey S, Ajeet G. Infrahyoid myocutaneous flap for reconstruction in head and neck cancer patients. Natl J Maxillofac Surg 2024;15:410-6.

Introduced first by Wang and Shen in 1980, the infrahyoid myocutaneous flap (IHF) is a versatile and reliable flap used in reconstruction for small- and medium-sized defects following resection of head and neck cancers. The main advantages of an infrahyoid flap include its low surgical complexity and ease of harvest. Also, when compared to a free flap, an infrahyoid flap has a shorter operating time, shorter hospital stay, low cost, lesser postoperative complication, and lesser donor site morbidity. Other added advantages are that the infrahyoid flap is relatively hairless, can be easily raised along with neck dissection, and can be easily incorporated into the oral cavity from the same neck incision. The myocutaneous paddle is outside of the lymphatic drainage area; hence, the risk of nodal recurrence is absent. Like any other flap, complications of IHF are mainly because of compromised venous drainage, which may range from 3% to 47%.[1]

However, various contraindications of IHF include previous thyroid surgery, neck dissection, and the presence of N3 neck metastasis, high face defects, and large-sized defects.[2-4]

Here, we present our experience in the management of oral cancer with IHF reconstruction at the tertiary care center.

ANATOMY OF INFRAHYOID FLAP

Infrahyoid flap is a composite flap consisting of skin and subcutaneous tissue, platysma, and underlying muscles, which include sternohyoid, sternothyroid, and superior belly of omohyoid. The vascular basis of this flap is the superior thyroid artery, which is a branch of the external carotid artery. Venous drainage occurs via the anterior jugular vein and superior thyroid vein. The flap can be designed either vertically or horizontally oriented. The medial border of the flap corresponds to the midline of the neck, from the thyroid cartilage to the sternal notch. The flap can be extended laterally as much as possible to allow primary closure of the donor site. The maximum dimension of the harvested flap is up to 10-12 cm × 6-8 cm.[5,6]

Following are the challenges and problems associated with this flap.

The flap territory is situated in close proximity with the neck dissection. Care should be taken during neck dissection in order to avoid damage to the flap territory and damage to the vascular pedicle. Damage to superior laryngeal nerve is a great concern. Superior laryngeal nerve should be meticulously preserved while elevating the flap. Flap delivery to the oral cavity should be controlled and gentle. Stretching and kinking of the vascular pedicle in the tunnel is one of the most common reasons of flap failure. Venous congestion is one of the most common problems associated with this flap. This should be avoided by meticulous flap dissection, by preservation of venous drainage, and by avoiding shearing of flap components during the elevation process.

MATERIALS AND METHODS

The study was conducted in the surgical oncology department of our institute. Patients with squamous cell carcinoma of the oral cavity, clinically T1–T3 and N0–N1 stage, with anticipated defects of small to medium defects were included in the study. However, patients with larger tumor size, advanced nodal stage, recurrent tumor, prior radiation, prior neck dissection, and prior thyroid surgery were excluded from the study. Formal review and waiver for the study were taken from the Institute's Ethics Committee IEC No- 137/23, dated 15.03.24. The study was conducted from July 2020 to June 2022, including a follow-up of 1 year. A total of 14 patients were included in the study. All patients were thoroughly evaluated and planned for surgery after informed consent. All patients had squamous cell carcinoma of the oral cavity involving different subsites. Patients were operated on by a single surgeon, using the same technique.

Surgical technique

The design of the flap was marked incorporating the incision for neck dissection [Figure 1]. The upper limit of the flap was kept at the level of the hyoid bone, the lower limit at the suprasternal notch, and the medial limit at the midline. The lateral limit was decided based on the size of the defect and the feasibility of closing the donor site primarily. Flap harvest was conducted after the completion of lymph node dissection. Special care was taken during neck dissection to preserve the superior thyroid pedicle at its origin from the internal jugular vein and external carotid artery. The skin

Figure 1: Flap marking, before neck dissection

incision is taken along the marked dimensions of the flap. The anterior jugular vein is identified distally and included in the flap. Sternohyoid and sternothyroid muscles were divided at the suprasternal notch and included in the flap. The superior belly of the omohyoid was divided at the level of IJV and also included in the flap. The flap was then progressively raised cranially in the avascular plane over the thyroid capsule till the upper pole of the gland was reached. Here, the superior thyroid artery was identified with all its branches. Multiple tiny branches from the superior thyroid artery entering the infrahyoid muscle were carefully preserved. Posterior branches supplying the thyroid artery were cut and ligated, and the main trunk of the artery was taken along with the flap. The Sternothyroid muscle was detached from the thyroid cartilage, and the cricothyroid artery was cut and ligated at the midline of the neck and included with the flap. The external branch of the superior laryngeal nerve was carefully preserved in all cases during this step. Once the flap was made freely mobile after detaching the hyoid insertion of the sternohyoid muscle, it was transferred to the defect in the oral cavity [Figure 2]. The flap is used primarily for the defect of the oral cavity. However, the defects having communication between oral cavity and neck were repaired during flap inset. The neck drain was kept, and all patients were extubated after completion of surgery. Patients were managed postoperatively with antibiotics, analgesics, and other symptomatic drugs. All patients were regularly followed for a period of 1 year. During the follow-up period, patients were advised to visit the outpatient department. All patients were assessed clinically for features of recurrence. None of the patients showed tumor recurrence during 1-year follow-up period [Figures 3 and 4].

Cosmesis was assessed in two ways. One was scar characteristics, and another was distortion of oral commissure. Scar characteristics were assessed by thickness, pliability, pigmentation, and scar contracture. None of the patients showed scar hypertrophy or hyper-pigmentation. All patients had soft and supple scar, without the formation of contractures. All patients had soft and supple scar, without the formation of contractures. Oral commissure was assessed in terms of symmetry and competence. None of the patients showed lip and oral commissure asymmetry or oral incompetence, which is often seen in patients operated by other flaps, such as pectoralis major myocutaneous (PMMC) flap.

RESULTS

A total of 14 patients were included in the study. In all patients, tumor excision, neck dissection, and infrahyoid flap were conducted. The male-to-female ratio was 11:3. The age of patients ranged between 45 and 60 years.

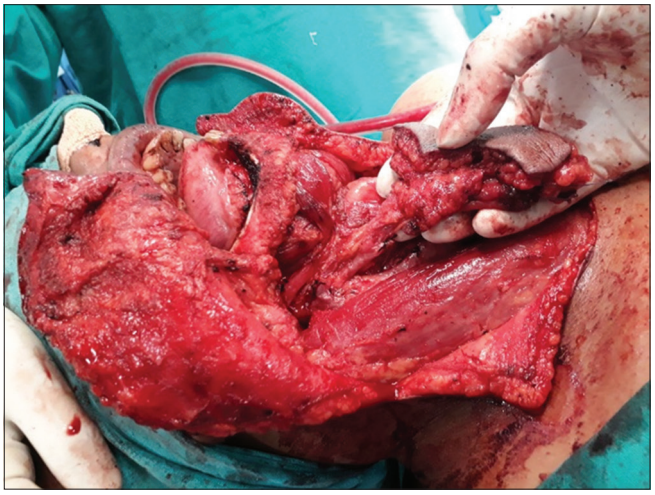

Figure 2: Intraoperative image showing harvested flap

Figure 3: Post operative image showing flap

Figure 4: Showing follow-up with well-healed donor site

The T stage of the tumor in all patients was T2 to T3, whereas the N stage of the tumor in all patients was N0 to N1. The largest defect size after the excision of the primary tumor was 11 × 6 cm. The duration of the surgery was 3–4 hours.

None of the patients suffered major complications in the postoperative period, and the average hospital stay was 4–7 days.

In all patients, donor site healed well, with a soft and supple scar. None of the patients suffered donor site morbidity [Figure 4].

None of the patients underwent revision surgery, and none of the patients had total flap loss. Four patients had minor flap complications, of which three patients had partial, superficial skin necrosis of the flap which was managed conservatively and epithelized later. Only one patient had complete epidermal necrosis of the skin of the flap, which eventually healed by conservative measures.

None of the patients developed major complications, oro-cutaneous fistula, or radiation necrosis. None of the patients developed recurrence after 1 year of surgery [Table 1 showing the patient's demographic profile, characteristics of the tumor, and flap].

DISCUSSION

Head and neck reconstruction is always one of the most challenging reconstructions, because of cosmetic as well as functional needs. The choice of reconstructive procedure depends on the location of the defect, size of the defect, components of the defect, potential physiological implications, availability of resources, and patient's fitness/affordability for advanced procedures. Traditionally, pectoralis major myocutaneous (PMMC) flap is a non-microsurgical workhorse pedicled flap for head and neck reconstruction. However, disadvantages include poor cosmesis, donor site morbidity, compromised oral competence, and complications related to gravitational pull. Also, PMMC flap is often found to be bulky and cumbersome for small to medium defects.[7,8]

Recently, free flaps have been preferred at various centers. Free fibula flap is the choice of reconstruction for bony defects; however, free anterolateral thigh and free radial forearm flaps are the choice for soft tissue defects. Various limitations associated with free flap surgery include prolonged operative time, prolonged and monitored postoperative care, prolonged hospital stay, donor site morbidity, and high cost and availability of microvascular setup. Hence, it may not be possible for centers to have heavy patient load and limited resources.[9-11]

Apart from workhorse flaps, several flaps have been used from time to time and are best suited for small- to medium-sized defects. Submental flap, nasolabial flap, supraclavicular flap, and infrahyoid flap are ideal for small to medium defects of head and neck cancer.

Quality of life following oral cancer surgeries depends on the choice of reconstruction used. Points of consideration include minimum to nil donor site morbidity, cosmetic appearance, the inclusion of hair-free skin in the oral cavity, the ability to maintain oral competence, and adequate flap bulk to withstand radiation necrosis.

Claremont and Conley[12] published the first case report of the infrahyoid flap in 1977 for small- and medium-sized defects, and Wang *et al*.[13] published the first case series in 1986.

The length of the IHF pedicle and hence its reach depends on the level of bifurcation of the carotid artery. The pedicle length based on the superior thyroid artery ranges from 3 to 4 cm. Hence, given the relatively short pedicle length, IHF is ideally suited for defects in the lower part of the oral cavity.[14] The flap is used primarily for the defect of the oral cavity. However, the defects having communication between oral cavity and neck were repaired during flap inset.

The advantage of IHF includes simultaneous neck dissection through the same incision, is less time-consuming, and gives esthetically good results at the defect site. The main disadvantage of the flap is it is not suitable for higher face defects due to shorter pedicle length.[15,16]

The flap can be modified to sensate the flap by preserving the nerve supply, which is derived by ansa cervicalis. This technique has twofold benefits, the flap is converted into to sensate the flap, and also, underlying muscles can withstand ischemic changes after radiotherapy.[17]

Venous congestion is the most common complication of this flap in the postoperative period. Major venous drainage of the infrahyoid area is through the anterior and external jugular system, and minor drainage is through the perforators of the superior thyroid vessel. Hence, preservation of venous drainage, avoidance of undue stretching over the pedicle, maintenance of flap laxity, and postoperative positioning of the patients are very important to avoid flap failure.[18,19]

When IHF is harvested, drainage is only via the perforator system. Minor shearing or pressure during harvest could easily damage the perforators, making the flap susceptible to skin necrosis. In their 1986 series including 112 patients,

Table 1: Patient's demographic profile and characteristics of tumor and flap

Age/ sex	Tumor charac teristics	Defect parameters	Surgery	Flap (cm)	Duration of surgery (Hr)	Adjuvant therapy	Flap compli cation	Repeat surgery	Donor site morbidity	Recurrence
60/M	Tongue, T2N1M0	6 × 4 cm, left lateral tongue	WLE + MRND	7 × 3.5 myocutaneous	3	Radiation	No	No	No	No
47/M	Tongue, T2N1M0	5 × 3 cm, left tongue ventral aspect	WLE + MRND	6 × 3 myocutaneous	3	Radiation	Partial skin loss	No	No	No
53/M	Lower alveolus, T2N0M0	5 × 3 cm, left lower alveolus	WLE with marginal mandibulectomy + SOND	6 × 3.5 myocutaneous	3.5	No	No	No	No	No
55/F	Tongue, T1N1M0	4 × 3 cm, left lateral tongue	WLE + MRND	6 × 3.5 myocutaneous	3	Radiation	Partial skin loss	No	No	No
60/F	Tongue, T2N1M0	6 × 4 cm, right lateral tongue	WLE + MRND	8 × 3.5 myocutaneous	3.5	Radiation	No	No	No	No
45/M	Lower GBS, T2N0M0	6 × 4 cm, right lower alveolus, buccal mucosa	WLE with marginal mandibulectomy SOND	7 × 4 myocutaneous	3.5	Radiation	No	No	No	No
47/M	Lower GBS, T1N0M0	5 × 3 cm, left lower alveolus	WE with marginal mandibulectomy + SOND	6 × 3.5 myocutaneous	3	No	No	No	No	No
51/M	Lower gingivobuccal sulcus, T2N1M0	7 × 4 cm, right lower alveolus, buccal mucosa	WE with marginal mandibulectomy + MRND	9 × 4.5 myocutaneous	3.5	Radiation	No	No	No	No
53/F	Tongue, T2N1M0	11 × 6 cm, right anterior tongue	WLE + MRND	8 × 4.5 myocutaneous	3	Radiation	Partial skin loss	No	No	No
59/M	Lower GBS, T2N1M0	7 × 3.5 cm, left lower alveolus	WE with marginal mandibulectomy + MRND	8 × 3.5 myocutaneous	4	Radiation	No	No	No	No
54/M	Lower GBS, T2N0M0	6 × 3 cm, left lower alveolus	WE with marginal mandibulectomy + SOND	7 × 3.5 myocutaneous	3.5	No	No	No	No	No
60/M	Tongue, T2N1M0	5 × 3 cm, left lateral tongue	WLE + MRND	7 × 3.5 myocutaneous	3	Radiation	No	No	No	No
56/M	Tongue, T2N1M0	6 × 4 cm, left lateral tongue	WLE + MRND	7 × 4 myocutaneous	3	Radiation	Full epidermal loss	No	No	No
50/M	Tongue, T2N1M0	8 × 4 cm, left lateral tongue	WLE + MRND	9 × 3.5 myocutaneous	3	Radiation	No	No	No	No

Wang *et al*.[13] reported no total flap losses, only partial skin necrosis in 11 patients. In our study, also none of the patients had total flap necrosis.

The results of our study showed that IHF is quite reliable for reconstruction post-oral cancer resection. Most flap losses were only partial skin necrosis. Only one flap suffered complete skin necrosis. In all cases, the defect healed by secondary intention, and a second surgical intervention was not required in any of the patients. None of the patients had a complete flap loss. None of the patients suffered donor site complications.

Some studies mention modified radical neck dissection (MRND) as a contraindication for IHF, and some studies recommend only SOND if IHF is planned. Gangloff *et al*. did not consider MRND a contraindication, and in our series also, the majority of patients underwent MRND without compromising the blood supply of the flap.[20-22] Figure 5 shows algorithm for using infrahyoid flap in oral cavity reconstruction after tumor excision.

CONCLUSION

The IHF is a fairly reliable and easy-to-perform flap for small- and medium-sized defects of the oral cavity,

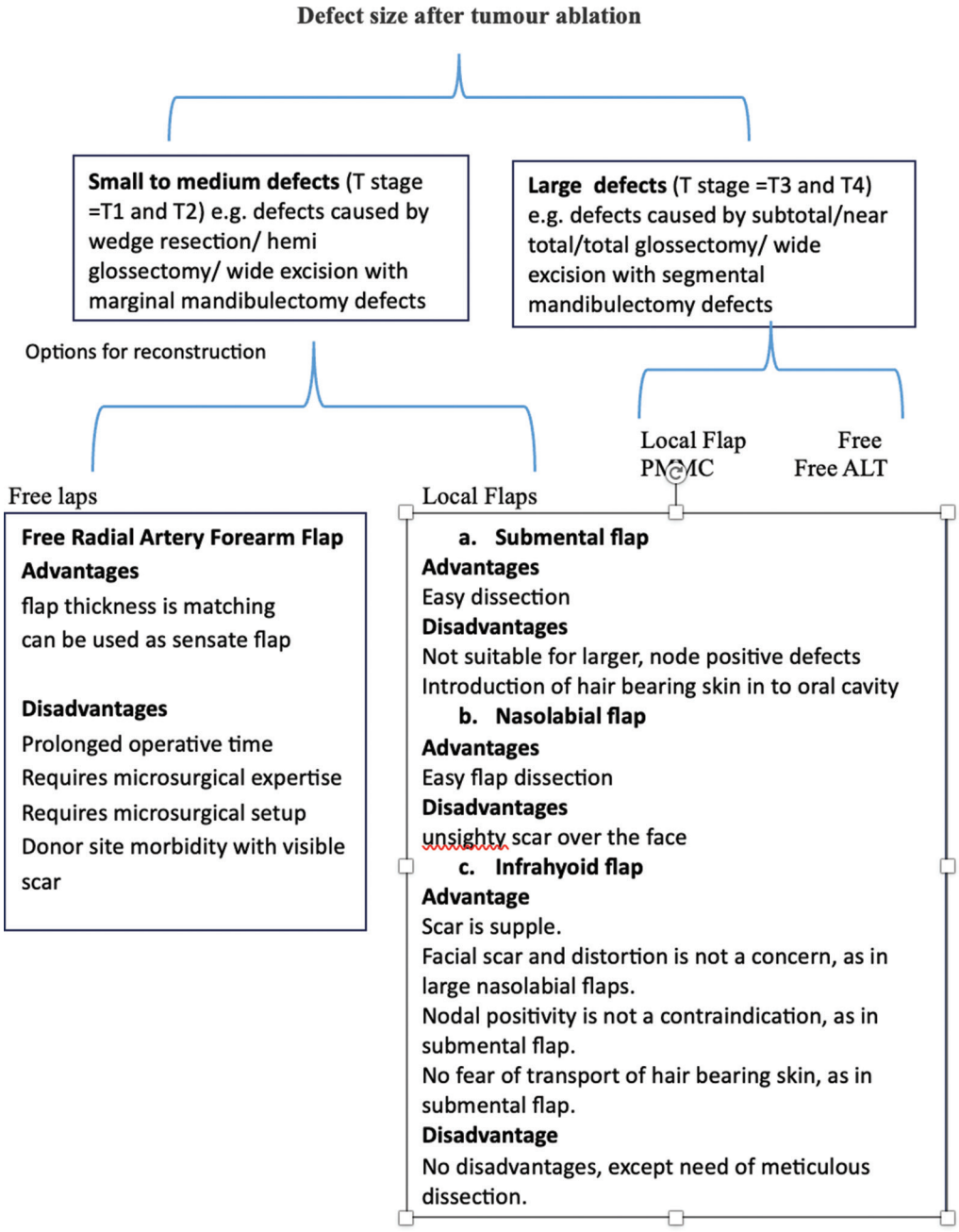

Figure 5: Algorithm for utility of infrahyoid flap

without requiring additional incisions and donor site reconstruction.

Declaration of patient consent

The authors declare that they have obtained consent from patients. Patients have given their consent for their images and other clinical information to be reported in the journal. Patients understand that their names will not be published and due efforts will be made to conceal their identity but anonymity cannot be guaranteed.

Acknowledgement

The authors sincerely acknowledge the work of Mr. Zia-Ul for efficiently assisting in the surgery.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Wang HS, Shen JW. Preliminary report on a new approach to the reconstruction of the tongue. Acta Acad Med Prim Shanghai 1980;7:256-9.
2. Magrin J, Kowalski LP, Santo GE, Waksmann G, Di Paula RA. Infrahyoid myocutaneous flap in head and neck reconstruction. Head Neck 1993;15:522-5.
3. Zhao YF, Zhang WF, Zhao JH. Reconstruction of intraoral defects after cancer surgery using cervical pedicle flaps. J Oral Maxillofac Surg 2001;59:1142-6.
4. Deganello A, Leemans CR. The infrahyoid flap: A comprehensive review of an often overlooked reconstructive method. Oral Oncol 2014;50:704-10.
5. Eliachar I, Joachims HZ, Marcovich A, Harshai Y, Lindenbaum E. Reconstruction of the larynx and trachea with hyoid transposition. In Bernstein L, editor. Plastic and Reconstructive Surgery of the Head and Neck. New York: Grune and Stratton; 1981. p. 259-65.
6. Eliachar I, Marcovich A, Har Shai Y, Lindenbaum E. Arterial blood supply to the infrahyoid muscle, an anatomical study. Head Neck Surg 1984;7:8-14.
7. Koh KS, Eom JS, Kirk I, Kim SY, Nam S. Pectoralis major musculocutaneous flap in oropharyngeal reconstruction: Revisited. Plast Reconstr Surg 2006;118:1145-9.
8. Kruse AL, Luebbers HT, Obwegeser JA, Bredell M, Grätz KW. Evaluation of the pectoralis major flap for reconstructive head and neck surgery. Head Neck Oncol 2011;3:12.
9. Hsiao HT, Leu YS, Lin CC. Tongue reconstruction with free radial forearm flap after hemiglossectomy: A functional assessment. J Reconstr Microsurg 2003;19:137-42.
10. Wei FC, Seah CS, Tsai YC, Liu SJ, Tsai MS. Fibula osteoseptocutaneous flap for reconstruction of composite mandibular defects. Plast Reconstr Surg 1994;93:294-304.
11. Yu P, Robb GL. Pharyngoesophageal reconstruction with the anterolateral thigh flap: A clinical and functional outcomes study. Plast Reconstr Surg 2005;116:1845-55.
12. Clairmont AA, Conley JJ. Surgical technique - The strap muscle flap. J Otolaryngol 1977, 6:200-2.
13. Wang HS, Shen JW, Ma DB, Wang JD, Tian AL. The infrahyoid myocutaneous flap for reconstruction after resection of head and neck cancer. Cancer 1986;57:663-8.
14. Laxmi V, Kaur K, Chhabra P. Superior thyroid artery: Its origin, length, relations and branches. Int Ann Med 2017;1:110.
15. Lockhart R, Menard P, Chout P, Favre-Dauvergne E, Berard P, Bertrand JC. Infrahyoid myocutaneous flap in reconstructive maxillofacial cancer and trauma surgery. Int J Oral Maxillofac Surg 1998;27:40-4.
16. Rojananin S, Suphaphongs N, Ballantyne AJ. The infrahyoid musculocutaneous flap in head and neck reconstruction. Am J Surg 1991;162:400-3.
17. Wang H. 10 years experience on the infrahyoid myocutaneous flap. Zhonghua Er Bi Yan Hou Ke Za Zhi 1991;26:332-4.
18. Meguid EA, Agawany AE. An anatomical study of the arterial and nerve supply of the infrahyoid muscles. Folia Morphol 2009;68:233-43.
19. Ouyang D, Su X, Chen WC, Chen YF, Men QQ, Yang AK. Anatomical study and modified incision of the infrahyoid myocutaneous flap. Eur Arch Otorhinolaryngol 2013;270:675-80.
20. Bier J, Schlums D, Metelmann H, Howaldt HP, Pitz H. A comparison of radical and conservative neck dissection. Int J Oral Maxillofac Surg 1993;22:102-7.
21. Moncrieff M, Sandilla J, Clark J, Clifford A, Shannon K, Gao K, *et al*. Outcome of primary surgical treatment of T1 and T2 carcinomas of the oropharynx. Laryngoscope 2009;119:307-11.
22. Gangloff P, Deganello A, Lacave ML, Verhaeghe JL, Lapeyre M, Maire F, *et al*. Use of the infrahyoid musculocutaneous flap in soft palate reconstruction. Eur J Surg Oncol 2006;32:1165-9.