

Submandibular gland excision: From external surgery to robotic intraoral and extraoral approaches

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Abstract

Submandibular gland excision is generally performed through a transcervical approach, a safe procedure that, however, carries few neurological, functional and aesthetic drawbacks. Intraoral approach to the submandibular gland has been described many years ago but it has been newly proposed in recent years thanks to endoscope-assisted and robot-assisted surgical procedures. The main purpose of intraoral approaches is to avoid cosmetic sequelae and to reduce the risk of marginal nerve injury although the recent introduction of retroauricular, postauricular, facelift and transhairline neck incisions has overcome the need for an alternative to traditional transcervical approach. Different surgical approaches (transoral versus transcervical) to the submandibular gland as well as different type of cutaneous incisions will be illustrated and discussed in the light of advancement of endoscope-assisted and robot-assisted procedures.

KEYWORDS

salivary gland, submandibular sialadenectomy, transoral robotic submandibular sialadenectomy, transoral robotic surgery

1 | INTRODUCTION

Several disorders involving submandibular gland such as chronic sialadenitis, sialolithiasis and salivary gland tumours can require a surgical excision. Submandibular gland excision is generally performed through a transcervical approach, a safe procedure that, however, carries few drawbacks. In particular, postoperative skin scar can be cosmetically unappealing, especially in young patients and degenerate into keloid formation. Other possible complications include marginal mandibular branch of the facial nerve, lingual nerve and hypoglossal nerve injuries with an incidence of 1%–7.7%, 1%–4% and 2.9%, respectively (Berini-Ayres & Gay-Escoda, 1991; Ellies,

Laskawi, Arglebe, & Schott, 1996; Goh & Sethi, 1998; Papaspyrou, Werner, & Sesterhenn, 2014).

In order to avoid cosmetic alteration and to reduce the risk of marginal nerve injury, intraoral surgical techniques have been proposed in the past. However, several authors reported the relatively frequent occurrence of lingual nerve paresis and limitation of tongue movement due to scar contracture. Moreover, intraoral dissection appears to be challenging in chronically inflamed disorders of the submandibular gland with severe adhesion often requiring a conversion to a combined or transcervical approach (Hong & Yang, 2008; Kauffman, Nettekville, & Burkey, 2009; Smith, Elahi, Kawamoto, Lorenz, & Hedrick, 2000; Weber, Wax, & Kim, 2007).



The introduction of video-assisted and transoral robotic surgeries has recently been changing surgeons' preferences allowing a better visualization of anatomic structures and an easier manipulation of soft tissues (De Virgilio et al., 2012; Komatsuzaki, Ochi, Sugiura, Hyodo, & Okamoto, 2003).

The aim of this review is to describe the available surgical techniques and present their outcomes in order to obtain a deep understanding of our armamentarium for the treatment of submandibular gland conditions.

2 | TRANSCERVICAL SURGERY

Trans-cervical techniques, generally performed under general anaesthesia, are certainly the most commonly chosen procedures among head and neck surgeons. All the variants (Figure 1) share some fundamental surgical steps (Torrioni, Mustazza, Bartoli, & Iannetti, 2007):

1. Cervical incision through the skin, subcutaneous tissue and platysma muscle. In the classic technique, the cut is preferably performed 2.5–3.5 cm below the lower edge of the mandibula and parallel to it in order to protect from possible injury to the marginalis mandibulae nerve;
2. The pulling up of the distal ends of the tied facial vessels to guarantee the protection of the facial nerve;
3. A blunt dissection of the gland from back to front (sharp dissection in case of adhesions);



FIGURE 1 Different types of cutaneous incision during trans-cervical approach to submandibular gland (blue line—traditional sialadenectomy; yellow line—endoscope-assisted; red line—submental incision; black line—postauricular or facelift incision; green line—robot-assisted transhairline incision [Colour figure can be viewed at wileyonlinelibrary.com]

4. Identification of lingual nerve, Wharton's duct and hypoglossal nerve (eased by pulling forward the mylohyoid muscle);
5. Tying and cutting of the Wharton duct;
6. Removal of the gland;
7. Haemostasis and suture.

Some authors have focused their attention on the type of incision, proposing more cosmetic solutions. Roh et al. prospectively compared conventional transcervical surgery with a retroauricular approach reporting a significantly higher satisfaction among patients undergoing the newly proposed technique. The skin incision should be made along the postauricular sulcus and hairline, starting from the lower end of the postauricular sulcus and moving upward to the middle or upper third point of the sulcus and then smoothly angulating downward to 0.5–1 cm inside the hairline. The same author highlights that retroauricular approach might require a longer operative time and result in a narrower operative field than the conventional transcervical technique thus being contraindicated for malignant lesions and >5 cm benign masses; however, no mayor complications were recorded in the author's series (Roh, 2006).

Another study by the same author proposed a submental access and compared it to the conventional approach showing a better cosmetic outcome. This technique consists of a horizontal incision on the submental skin slightly anterior to the submental-cervical crease at the hyoid midline and an anterior–posterior dissection of the gland. For Roh et al., submental technique might be superior to traditional approach in terms of marginalis mandibulae preservation, not requiring the tracing of the nerve. Moreover, even though the incision is slightly wider, the operation time is significantly shorter in comparison with video-assisted endoscopic techniques (Roh, 2008).

Video-assisted endoscopic submandibular gland removal has also been proposed with the aim of performing smaller transcervical incisions (around 2 cm) and reducing tissue damages. Some authors reported on cold dissection, others on use of ultrasound scalpel or bipolar diathermy (Baek & Jeong, 2006; Chen, Su, Tsai, & Chang, 2006; Hamza & Khalil, 2009; Komatsuzaki et al., 2003; Meningaud, Pitak-Arnnop, & Bertrand, 2006).

Other authors applied the principles of minimally invasive video-assisted thyroidectomy (MIVAT) by Miccoli et al. (2001) to submandibular gland removal with satisfactory cosmetic outcomes, reasonable operative time and no need for conversion (Parente Arias, Fernández Fernández, Varela Vázquez, & Diego Munoz, 2016). This procedure implies the use of angled endoscope (30°–45°) and ultrasonic scalpel, two instruments providing magnification of the surgical field and excellent haemostasis.

The most recent step forward regarding transcervical technique is certainly the introduction of robotic sialoadenectomy via a retroauricular/facelift approach by De Virgilio et al. This technique was performed on 5 patients with benign diseases (two pleomorphic adenoma, two sialolithiasis, one ranula) with satisfactory outcomes and no complications. In order to avoid facial nerve injury, the dissection was firstly performed above the platysma and once reached the salivary gland was extended below the muscle. The three-dimensional

vision and the human-like articulated joints of the robotic with their wide range of movement achievable are considered the main advantages of the use of surgical robot (De Virgilio et al., 2012).

Yang reported on a series of 24 patients (11 pleomorphic adenoma, 12 sialolithiasis, one malignancy) undergoing robotic sialadenectomy via a transairline approach (Yang, 2018; Yang, Li, Holsinger, & Koh, 2019). This specific incision was already proposed by Woo, Park, Kwon, and Kim (2017) for their endoscope-assisted technique showing its feasibility. Yang et al criticize the length of facelift incision (>8 cm) while highlight the benefit of performing a <5 cm transairline incision in terms of cosmetic outcomes, and the reduced risk of causing necrosis of the flap tip and injury of the auricular branches of the sensory nerves. No need of conversion to open surgery and no recurrences are reported in the paper. These authors however underline that the restricted working space obtained with transairline approach appears not indicated for submandibular gland lesions with large sizes or severe adhesion. The series include also a patient affected by adenoid cystic carcinoma, successfully treated with a margin-free surgery (Yang, 2018; Yang et al., 2019).

3 | INTRAORAL SURGERY

The need of moving towards intraoral surgeries arises from cosmetic concerns and also functional issues (Figure 2). In fact, nerves injuries, residual Wharton's duct inflammation and residual cysts in the floor of the mouth are possible complication of transcervical surgeries, especially in case of chronic sialadenitis (Berini-Aytes & Gay-Escoda, 1991; Blatt, 1966; Eichel, Bray, & Kaplan, 1981).

Hong and Yang (2008) report on the largest series of patients ($N = 77$) treated with intraoral submandibular sialadenectomy for chronic sialadenitis and benign lesions.

Intraoral sialadenectomy by Hong and Yang (2008) consists of an incision through the mucosa of the lateral floor of the mouth from

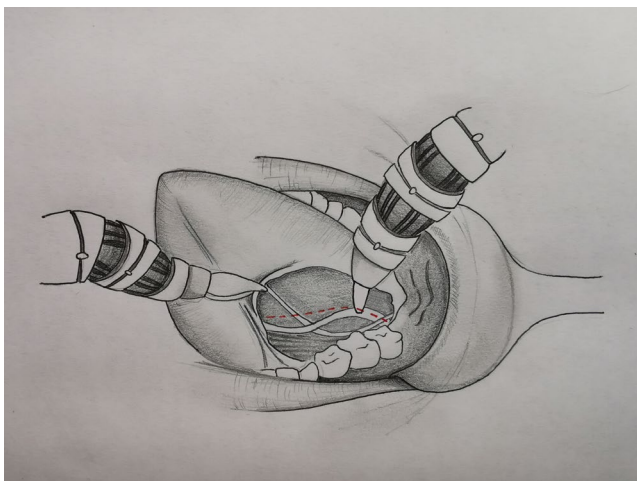


FIGURE 2 Mucosal incision during traditional transoral approach to submandibular gland or transoral robotic submandibular sialadenectomy (red dashed line) [Colour figure can be viewed at wileyonlinelibrary.com]

the orifice of Wharton's duct to the lingual side of the retromolar region. For these authors, sublingual gland must be dissected and totally removed with the isolation of Wharton's duct and preservation of the lingual nerve. The duct is then cut and ligated at the orifice of Wharton's duct. Medial retraction of the tongue and floor of the mouth including the lingual nerve and lateral retraction of the mylohyoid muscle allows the visualization of the submandibular gland. Facial artery and arterial branches to the gland are noted by blunt dissection and must be ligated or clipped. After removal of the submandibular gland, the hypoglossal nerve should be identified.

The major advantages described by Hong et al. are the avoidance of an external scar and of injury to the mandibular branch of the facial nerve or the hypoglossal nerve. On the other hand, high percentage of patients temporarily complained temporary lingual nerve impairment. Moreover, the authors underline that demonstrating and ligating the facial artery during an intraoral approach might not be easy without sufficient experience (Hong & Yang, 2008).

The same surgical principles may be applied with the aid of transoral robotic surgery (TORS). To date, only two case reports have been published in literature (Lin, Liang, Shao, & Han, 2019; Prosser, Bush, Solares, & Brown, 2013).

However, the experience of robotic surgeons has been recently expanding towards the treatment of several salivary diseases, such as for the removal of hilo-parenchymal salivary stones (Capaccio et al., 2019). Current management of submandibular stones is based on interventional sialendoscopy (all mobile stones and stones < 5 mm) and sialendoscopy-assisted transoral surgery (larger duct stones and palpable stones located in the hilum and parenchyma) (Capaccio, Gaffuri, Rossi & Pignataro, 2017). Residual indication of transcervical submandibular sialadenectomy for obstructive disease is the presence of an unpalpable symptomatic parenchymal stone or multiple parenchymal stones with recurrent purulent sialadenitis or a iatrogenic hilar stenosis as a consequence of a conservative transoral approach (Capaccio, Torretta, & Pignataro, 2009).

The generic benefits of robotic surgery have already been discussed. On the other hand, the main drawback of robotic intraoral approaches appears to be the increased operative time, due to the narrow surgical field and the size of robotic arms, with prolonged retraction and its possible consequences such as tongue oedema and lingual nerve paresis. However, Prosser et al. (2013) did not experience any mayor complications. We recently started our experience with transoral robotic submandibular sialadenectomy (TORSS) and, in line with other author's results, we did not observe any major complication; a persistent tingling of the tip of the tongue was described by the patient three months after the robotic procedure (Figure 3) (Capaccio et al., 2020).

4 | DISCUSSION/CONCLUSION

The recent technological developments and the growing need for mini-invasive surgeries have certainly changed the surgeons' approach to the removal of the submandibular gland.

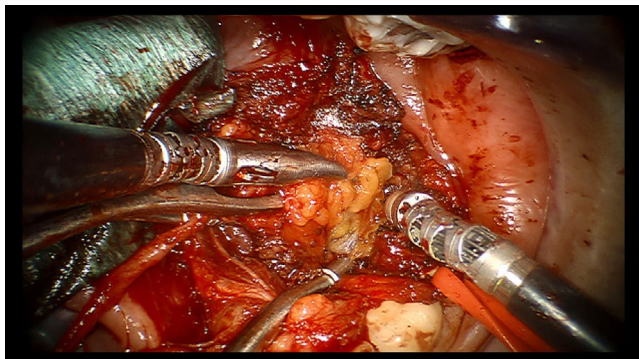


FIGURE 3 Tracking of the hilum of the submandibular gland before its removal by Maryland forceps and spatula during transoral robotic submandibular sialadenectomy (TORSS) [Colour figure can be viewed at wileyonlinelibrary.com]

Some authors carried out comparative studies concluding that intraoral procedures should substitute transcervical surgeries as primary choice for the treatment of benign salivary diseases thanks to the better cosmetic outcome, the reduced risk of marginal mandibular nerve injury and the shorter hospital stay (Chang, Kao, Lin, & Lee, 2013; Çukurova, Arslan, Bulğurcu, & Demirhan, 2015).

However, intraoral surgery requires a certain level of experience considering the narrow surgical field and the sometimes-difficult ligation of the facial artery. In this sense, we believe that the application of TORS might allow an easier haemostatic control. Moreover, thanks to the three dimensional and enhanced depth perception of the oral floor, the robotic approach allows the course of the lingual nerve and the hypoglossal nerve to be followed, and for the submandibular duct to remain healthy until the gland removal with ligation at the proximal third, thus preserving the function of the sublingual gland. On the other hand, a proper robotic docking, aiming at obtaining a satisfactory visualization of the mouth floor anatomic structures and a safe manipulation of robotic arms, is not always possible.

An adequate clinical (the gland has to be easily moved up towards the oral floor with no adherence) and radiological (no inflammation or adherence visible at ultrasonography (US) and MRI) evaluation is mandatory to identify patients suitable for such intraoral approach; these patients would have a mobile gland and symptomatic unpalpable single or multiple parenchymal stones, a chronic or recurrent inflammation of the gland with a sclerotic or atrophic pattern and clear margins in the US and MRI, and small benign neoplasms with adequate healthy tissue from the superficial layer of the gland.

In our opinion, head and neck surgeons should be able to perform both intraoral and transcervical techniques in order to manage correctly inflammatory disorders as well as benign and malignant diseases. In particular, the majority of malignancies, often-requiring neck dissection, and bulky benign tumours should be treated by means of a transcervical excision. In these cases, video-assisted techniques, submental and retroauricular incisions and intraoral approaches appear contraindicated although particular attention should be done in the near future to the oncological results of the robot-assisted dissection of the submandibular gland and the neck

through the modified postauricular facelift approach (Lee et al., 2014). In this regard, the initial preclinical study with the novel flexible single-port surgical robotic system to remove the submandibular gland via the transairline approach is welcome (Yang et al., 2019).

Surgeons must be ready to convert their technique in order to achieve a satisfactory outcome. Precise informed consent is mandatory in order to explain the risks of complications and the possibility of surgical conversion especially when opting for an intraoral approach.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

All authors listed have made substantial, direct and intellectual contribution to the work and approved it for publication.

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