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Minimally Invasive Tryroidectomy: Alternative Surgical Techniques

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Abstract: **Traditional thyroid and parathyroid surgeries have conventionally been conducted through a cervical incision, exposing the thyroid gland. Despite the safety and low complication rates associated with experienced surgeons, some patients are left with noticeable neck scars. Recent technological advancements have enabled surgeons to perform thyroid removal from distant locations, thus avoiding visible neck scars.**

The minimally invasive video-assisted technique introduced by Miccoli et al. is the most commonly employed. However, advancements have led to the emergence of innovative approaches that eliminate the need for neck scars. These include the endoscopic and robotic transaxillary retroauricular and transoral approaches, which have demonstrated safety and effectiveness across diverse international populations.

This article provides an overview of these surgical techniques to help inform surgeons about the surgical procedures of these new minimally invasive thyroid approaches.

Keywords: **thyroidectomy, minimally invasive surgery, video-assisted surgery, endoscopic surgery, robotic surgery.**

1. INTRODUCTION

Over the last three decades, there has been a rapid rise in the occurrence of differentiated thyroid carcinoma (DTC) worldwide, making it one of the most prevalent forms of cancer among women (Bray et al., 2018). The primary surgical approach employed at present is the conventional open thyroidectomy (SOT), performed through a standard Kocher mid-cervical incision (Jacobs et al., 2020). However, this method has been associated with noticeable postoperative scarring on the neck, leading to a notable decline in the patients' health-related quality of life (HRQOL) scores (Kurumety et al., 2019). This effect is particularly pronounced in African and Asian patients who are prone to hyper-pigmentation and excessive scar formation (Son & Harijan, 2014).

A minimally invasive video-assisted thyroidectomy (MIVAT) was initially introduced in 1999 and has gained widespread adoption for treating low- and intermediate-risk DTC cases (Miccoli et al., 2020). Despite the MIVAT procedure's small 2 cm incision, a significant number of patients still experience hypertrophic scarring in the cervical area (Sahm et al., 2019). It's worth noting that reducing the size of the neck incision did not necessarily result in higher patient satisfaction (Kim et al., 2015).

In an effort to achieve better aesthetic outcomes, various approaches such as robotic or endoscopic thyroidectomy through axillary, postauricular, or transoral routes have been developed over the past two decades (Tae et al., 2019). This review aims to provide an overview of the surgical procedure of each technique.

Minimally Invasive Video-Assisted Thyroidectomy (MIVAT) was initially introduced by a group of surgeons in Pisa, Italy, in 1998 (Miccoli et al., 1999). It gained rapid global acceptance due to its true minimally invasive nature, facilitated by the use of an endoscope that provided surgeons with an enlarged view of the operative area. Unlike some other endoscopic procedures, MIVAT is often considered a hybrid technique, combining elements of both open and laparoscopic surgery (Miccoli et al., 2016). The procedure generally involves general anesthesia, although regional anesthesia using bilateral deep cervical plexus block can also be employed (Scerrino et al., 2019).

The MIVAT procedure commences with a 1.5-cm midline incision placed approximately 2 cm above the sternal notch. This incision is extended longitudinally for about 3–4 cm to allow separation of the strap muscle. A blunt dissection is then employed to separate the strap muscle from the thyroid. An external retractor, managed by an assistant, is utilized to create and sustain the operative field. Subsequently, the surgical process transitions to an endoscopic or video-assisted approach.

A 5-mm 30° telescope is introduced, aiding in the identification and preservation of the external branch of the superior laryngeal nerve through optical magnification. The vessels of the superior lobe are either clipped or divided using ultrasonic shears. The superior lobe is gently pulled and delivered through the incision. The remainder of the procedure is executed in a manner not dissimilar to a conventional thyroidectomy. The opposite lobe is excised and delivered in a comparable fashion. Typically, the use of a drain is unnecessary, and the skin is sutured closed using subcuticular stitches and sealant.

Transoral Endoscopic Thyroidectomy Thyroidectomy with Vestibular Approach (TOETVA) was initially introduced by Richmon et al. (2011), and it was later refined by Anuwong and colleagues (Jongekkasit et al., 2019), who performed over 800 procedures in 2019. The primary goal of this approach was to develop a technique that leaves no visible scars, achieved by accessing the thyroid through a natural orifice via the shortest route, thereby minimizing the extent of dissection (Rossi et al., 2021).

The following approach has been delineated using both endoscopic (TONS-E) and robotic (TONS-R) methods. The patient can be intubated either through nasotracheal or traditional endotracheal positioning. A 10-mm incision is made in the gingivobuccal sulcus above the frenulum. This incision is infiltrated with a solution of saline and epinephrine, and then dissected bluntly over the midline mandible into the submental subplatysmal plane. Two 5-mm incisions are made lateral to each canine in the sulcus near the level of the lip, and these incisions are also infiltrated. Ports are inserted into all three incisions, with the camera placed in the central port. A subplatysmal plane is opened to the level of the sternal notch, and the median raphe is identified. The isthmus of the thyroid is then divided, and soft tissue around the targeted lobe is dissected bluntly. A retraction stitch may be placed on the sternothyroid to improve visualization of the superior pole, which is developed bluntly through hand-over-hand dissection. The vessels of the superior pole are secured using endoclips or other thermal ligation methods. The recurrent laryngeal nerve is located near its insertion point, and the remaining portion of the thyroid lobe is removed. This approach provides clear visibility of the parathyroid glands. Additionally, central neck dissection is facilitated by visualizing the recurrent laryngeal nerve and the central neck region. A drain can be placed via a separate incision in the lateral neck, or a transaxillary approach can be used for drain placement when necessary. Some teams recommend using this drain site as a potential access point for an additional instrument if needed during the operation. However, it's important to note that drain placement does require a visible incision, albeit a small one (Russell et al., 2016).

Currently, it has been demonstrated that the transoral approach is feasible, effective, and safe for thyroidectomy, while also providing excellent cosmetic outcomes. Nevertheless, proper patient selection and further studies are crucial to verify its viability and determine its role in the future surgical landscape of thyroid procedures (Moreno Llorente et al., 2021).

The trans-axillary approach provides a favorable cosmetic outcome as the axillary incision can be concealed by the patient's clothing. It also eliminates the need for unnecessary dissection around the areolar region. This technique was initially described by Ikeda et al. in 2000 and has been employed in over 1,500 patients to our knowledge (Wong & Lang, 2013).

The procedure involves the patient being placed under general anesthesia and positioned in a supine stance. The neck is gently extended, and the arm on the same side as the procedure is elevated and secured at the shortest distance between the axilla and the front of the neck. A vertical incision measuring 4 to 6 centimeters is made along the outer border of the pectoralis major muscle. The skin flap is raised above the pectoralis fascia and directed toward the anterior neck. The avascular space between the sternal and clavicular heads of the sternocleidomastoid (SCM) muscle is developed. The front portion of the thyroid is detached from the strap muscles, and a skin-lifting device is employed to elevate the skin flap.

A 10-mm trocar and a 5-mm trocar are positioned at either end of the axillary incision. Another 5-mm trocar is inserted into the chest area. Careful dissection of the inferior pole of the thyroid is conducted to isolate the recurrent laryngeal nerve (RLN) and parathyroid glands. Vessels are divided using clips or ultrasonic shears. The thyroid is then drawn medially.

Berry's ligament is dissected and separated. For hemithyroidectomy, the isthmus is divided using ultrasonic shears. In the case of contralateral thyroid resection, a medial approach would be necessary. The specimen is retrieved through the axillary incision, and the surgical site is irrigated. Prior to closing the incision, a drain is placed. Notably, this approach avoids any scarring on the neck. The proximity between the incision and the thyroid requires minimal subcutaneous dissection. However, dissecting the contralateral side can be challenging due to limited working space, often leading to instrument collision (Chang et al., 2009; Duncan et al., 2007; Jung et al., 2007; Kang et al., 2009; Witzel, 2007).

The Robotic Facelift Thyroidectomy (RFT) approach was first reported by Terris et al. in 2011, involving a series of 14 patients who underwent a total of 18 RFT procedures. The concept behind this technique combines the improved access of a superiorly based approach with the cosmetic benefits of a modified facelift incision (Russell et al., 2016).

In the RFT procedure, the incision is made adjacent to the postauricular crease, extending to the occipital hairline, thus being hidden by the ear. The patient is positioned supine with the head turned approximately 30 degrees away from the side of the thyroid lobectomy. The surgical dissection is initiated by sequentially identifying structures, beginning with the sternocleidomastoid muscle (SCM). The dissection plane can be either superficial or deep to the platysma muscle. It remains superficial to the great auricular nerve following identification. The omohyoid muscle is repositioned ventrally to access the superior pole of the thyroid gland. A customized retractor is positioned beneath the strap muscles to maintain the operative space, while a Greenberg retractor is used to retract the SCM. The da Vinci robotic surgical system (Intuitive Surgical Inc.) is then deployed. Typically, three robotic arms are employed due to the confined space in the surgical area. Dissection continues along the superior pole of the thyroid gland, progressing in a step-wise manner (Hosam et al., 2022; Russell et al., 2016).

The Robotic Facelift Thyroidectomy approach seeks to provide a balance between surgical access and cosmetic outcomes, utilizing advanced robotic technology to enhance precision and control during the procedure.

2. CONCLUSION

While the traditional cervical incision has demonstrated excellent results, remote-access surgical approaches present a compelling option for patients seeking enhanced cosmetic outcomes.

Ongoing research efforts will likely lead to further advancements in surgical techniques, resulting in improved outcomes that could potentially drive greater demand for these procedures. At present, there is no universally preferred approach, and the decision between different approaches appears to be influenced by the surgeon's experience and the patient's individual preferences. As the field continues to evolve, patients can anticipate a broader array of choices for thyroid surgery that cater to their cosmetic and medical needs.

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