Clinics of Oncology

Review Article ISSN: 2640-1037 | Volume 7

Experience with Three-Hole Endoscopic Thyroid Surgery Through the Near-Axillary Approach: The "Beacon" Value of the Omohyoid Muscle

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Received: 03 Aug 2023
Accepted: 25 Sep 2023
Published: 02 Oct 2023
J Short Name: COO

Citation:

He Z, Xu J, Experience with Three-Hole Endoscopic Thyroid Surgery Through the Near-Axillary Approach: The "Beacon" Value of the Omohyoid Muscle. Clin Onco. 2023; 7(2): 1-5

Keywords:

Thyroid surgery; Endoscope; Omohyoid muscle; Axillary approach

1. Abstract

The near-axillary approach three-hole endoscopic thyroid surgery is a full-endoscopic thyroid surgery, which has the advantages of smaller incision and less obvious scar. In this surgery, the separation path is through the surface of the pectoralis major, the front edge of the sternocleidomastoid muscle, the superior belly of the omohyoid muscle, the lateral margin of the sternothyroid muscle and other anatomical structures, and the omohyoid muscle is the key anatomical structure in this surgical method. The lateral border of the sternal thyroid muscle was found and separated after identification, separation and dissection, thus entering the operative area of the thyroid and the central area. A good command of this method can help to carry out and popularize this procedure successfully. This article introduces the "beacon" value of omohyoid muscle in the three-hole endoscopic thyroid surgery through the near-axillary approach and provides the experience of Nantong University.

Thyroid cancer is a common malignant tumor with low malignancy, good prognosis and high cure rate [1,2]. Despite the proven safety and efficacy of the conventional surgical approach, it is accompanied by a conspicuous neck scar that adversely impacts aesthetic outcomes. [3,4]. Considering the long-term survival rate of thyroid cancer, the treatment approach for this condition necessitates not only meticulous surgery but also an increasing emphasis on achieving higher cosmetic outcomes and facilitating better postoperative recovery, in line with patients' evolving expectations. Therefore, the increasing preference of patients for thyroid endoscopic surgery has been observed in recent years. [5,6].

Currently, gasless transaxillary endoscopic thyroid surgery is predominantly performed in China. Despite the utilization of a natural axillary fold incision and the exploitation of neck anatomy for cavity construction, there remains an approximately 4cm incision in the axilla that cannot be completely eliminated [7-9]. Since November 2020, our hospital's Thyroid and Breast Surgery Department has successfully treated 395 cases of radical resection of unilateral thyroid cancer using a three-hole endoscopy approach via a near-axillary route, resulting in extensive surgical experience accumulation. In this surgical technique, the omohyoid muscle, as a commonly encountered anatomical structure in the neck region, plays a crucial guiding role and provides effective assistance for achieving successful exposure of the thyroid gland. It assumes vital significance during routine operations. This paper aims to comprehensively elucidate the invaluable contribution of the omohyoid muscle as a "beacon" within this surgical method by combining surgical screenshots with 3D body anatomy software for peer reference.

2. Surgical Methods

2.1. Selection of Surgical Incision

Following successful administration of general anesthesia, the patient was positioned supine with a shoulder pad, and the electric

bed was adjusted to ensure horizontal alignment of the chest wall on the operative side. Preparation markings (Figure 1-1, Figure 1-2) included identification of tumor location on the affected side (T), plane of the thyroid cartilage (A), location of both clavicular heads (G), median cervical line, clavicular line (F), and anterior border of sternocleidomastoid muscle (B). An incision mark near the axillary fold on the affected side was designated as 1cm in length (D), while two additional marks were made approximately 0.5cm away from each other relative to the surgical area (C and E). These specific locations ensured optimal alignment along AC and GE lines. (Figure 1-3) shows the scar of the incision four months after surgery.

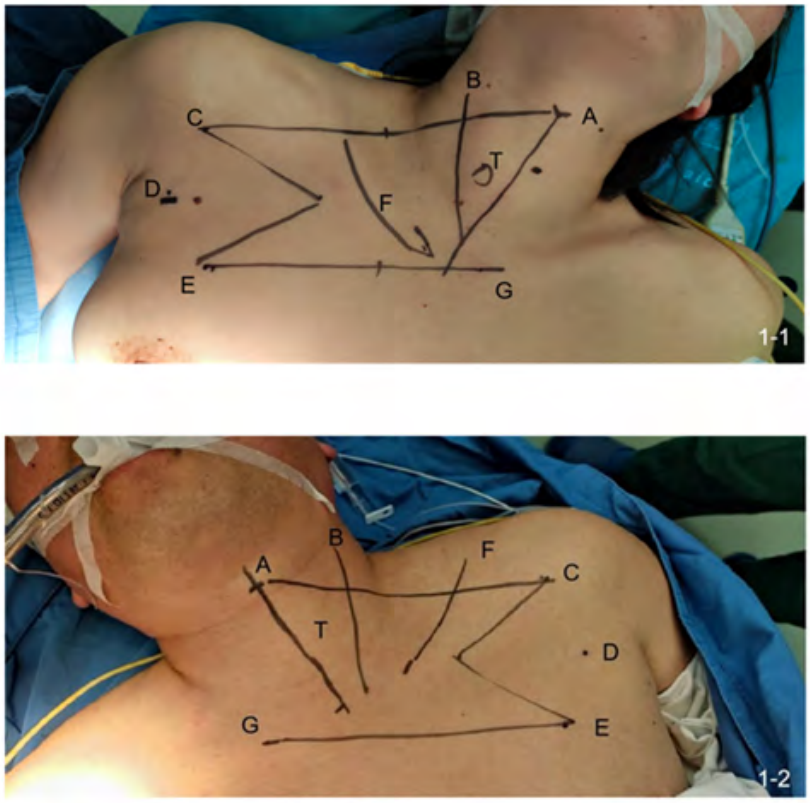


Figure 1: Preoperative body surface markers (1-1 right, 1-2 left).

Figure 1-3: Postoperative wound scarring.

2.2. Configuration of Dilatant Fluid

100ml normal saline + 2 ropivacaine + 10 drops of epinephrine

2.3. Space Establishment Mode

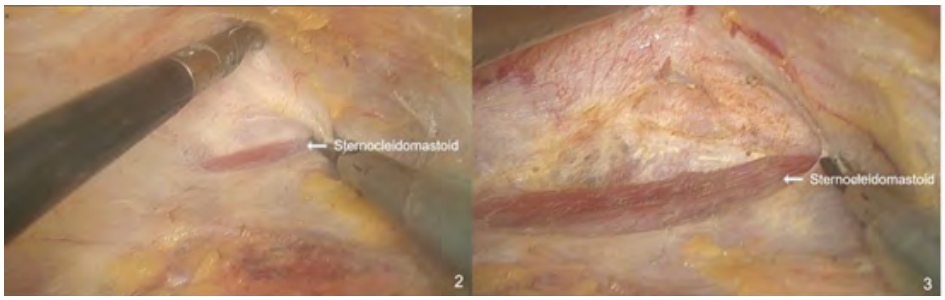
(1) Incisions were made at holes D, C, and E respectively, and appropriate incisions were supported with mosquito vascular forceps. The fat layer in the medial surgical area was injected with fluid using a water injection needle through this incision. The depth of the fluid injection layer should be adequate, while avoiding excessive fluid injection. After approximately 2-3 minutes of fluid injection, gauze rolls can be used to remove unabsorbed dilatant fluid from inside to outside the surgical wound through the incision (Reason: excessive water in the surgical area may generate more water vapor during surgery, thereby affecting lens clarity).

(2) A visual puncture device or a 1cm separation rod was inserted through hole D into the deep fat layer and on the surface of pectoralis major's sarcolepis to create a "nostril" shape puncture. Then, a 1cm trocar was placed in hole D and a 5mm trocar was placed in hole E for connection to CO2 pneumoperitoneum at a pressure

of 6mmHg. When separating deep wounds within the fat layer, constant reference should be made to skin markers while ensuring separation up to AC and GE boundaries without creating excessively large wounds. Medial separation continued after reaching the clavicular line (F line), paying attention to distinguish sternocleidomastoid's anterior margin (Figure 2) and separating it up and down towards the boundary of surgical surface (Figure 3).

(3) How can the thyroid and central region be exposed after fully exposing the sternocleidomastoid front? This is the main focus of our article. The superior belly of omohyoid muscle is completely exposed cephalad along the anterior border of the sternocleidomastoid muscle, where only a small portion of omohyoid muscle is visible in front of the sternocleidomastoid. Therefore, it needs to be carefully separated and identified for easy identification. Once confirmed (Figure 4), the medial, lateral, and deep surfaces of omohyoid muscle at the anterior edge of sternocleidomastoid are fully dissociated to prepare for exposure of sternothyroid muscle at the lateral edge of upper pole thyroid gland. By pulling outwards or inwards on omohyoid muscle (Figure 5), we can locate the lateral edge of sternothyroid muscle and then grasp it using separation forceps or non-invasive grip forceps. An ultrasonic knife was used to separate between thyroid gland and sterno-thyroid muscles layer, allowing access to perithyroid and central areas (Figure 6, 7).

(4) The simulation diagram from 3D body anatomy APP software demonstrates that muscles on superficial surface include sternohyoid, sternothyroid, and omohyoid muscles surrounding thyroid gland. Lateral to the sternohyoid muscle, the omohyoid muscle is a slender strap muscle, which is divided into the superior and inferior belly and is connected by the middle tendon located in the deep lower part of the sternocleidomastoid muscle (II). However, only a small amount of the superior belly is located in front of the sternocleidomastoid muscle (III), but it covers the sternothyroid , which is located deep to the sternohyoid muscle and closer to the thyroid gland (I). At the same time, because the sternocleidomastoid muscle is a muscle of outer upper oblique to inner lower, fully isolating the omohyoid muscle here is conducive to the exposure of the upper pole of the thyroid gland (IV, V). This was confirmed by software simulation, in which the lateral border of the sternothyroid muscle located in the upper pole of the thyroid gland could be more clearly exposed after the omohyoid muscle was concealed (VI).



Figures 2, 3: Exposure of the sternocleidomastoid muscle

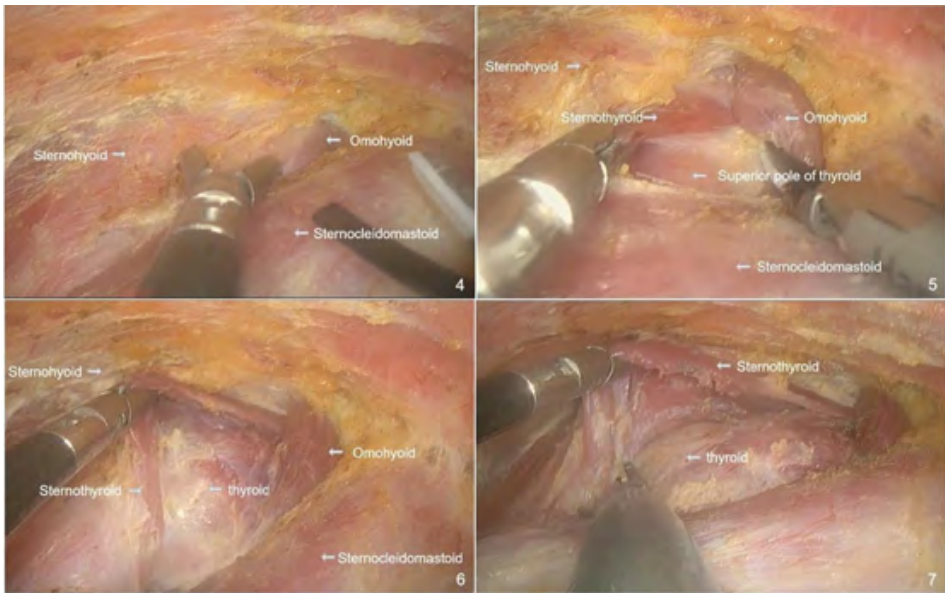


Figure 4: Exposure of the omohyoid muscle;
Figure 5: Separation of omohyoid muscle and sternothyroid muscle;
Figure 6: Exposure of the thyroid gland;
Figure 7: Separation around the thyroid gland.

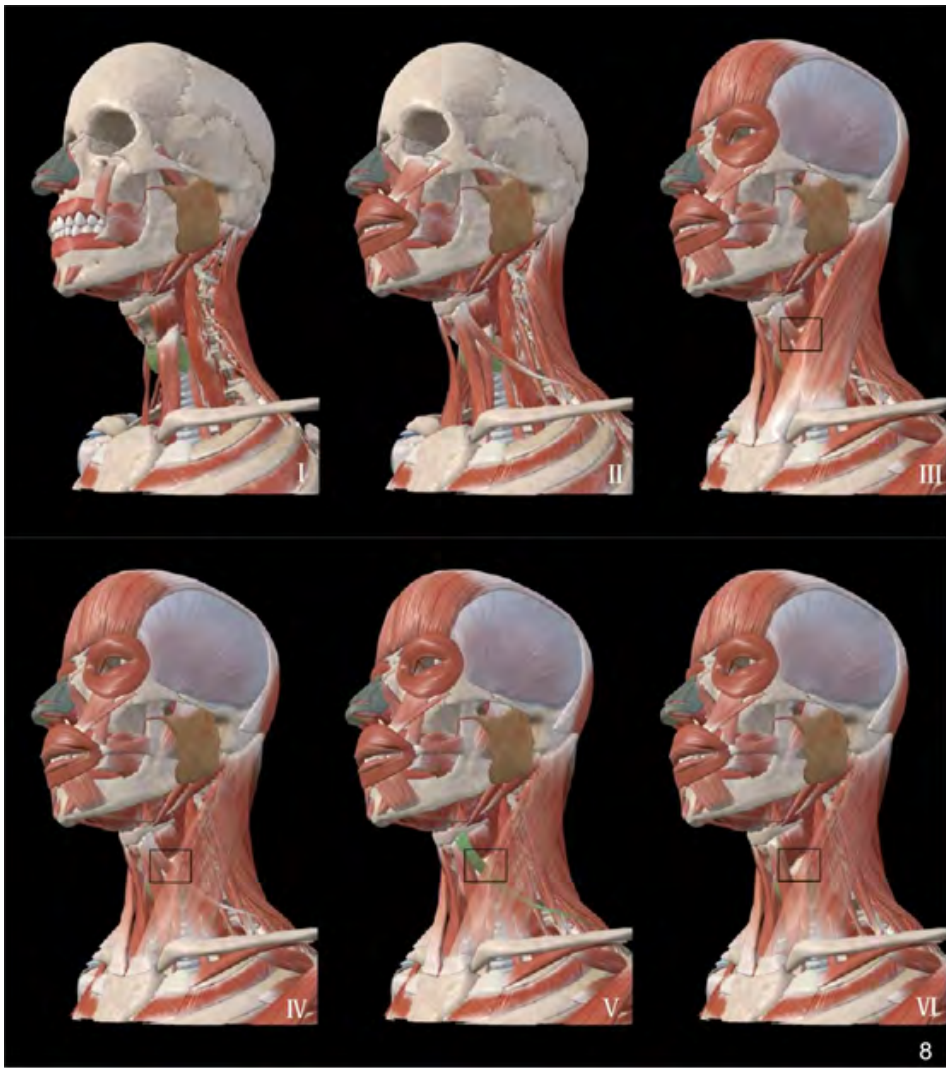


Figure 8: Simulation of 3Dbody app anatomy software.

3. Discussion

Three-hole endoscopic thyroid surgery through the near-axillary approach is a lateral cervical approach for endoscopic thyroid surgery, which is a total endoscopic surgery. As a type of thyroid cosmetic surgery far from the neck, how to use conventional surgical instruments instead of customized expensive hooks and suspensions for endoscopic thyroid surgery. How to safely and efficiently enter the thyroid region to complete thyroid surgery is the key to the success of this surgical method, and it is also the essence of using the narrow area of the superior belly of omohyoid muscle, the outer edge of the sternal thyroid muscle, and the upper pole of the thyroid to enter the thyroid region. Therefore, we compare the omohyoid muscle to a “beacon” and the outer edge of the sternal thyroid muscle located at the upper pole of the thyroid to a “gate”. The advantages of using this surgical method are as follows: firstly, the three-hole endoscopic approach through the near-axillary approach requires only a diameter of 1cm trocar for the longest incision D-hole, while the other two holes have a diameter of 5mm. Compared with other surgical methods through the axillary approach, it has obvious advantages such as smaller incision size and less obvious scars. If the patient is a female, the D-hole can be hidden outward in the armpit folds at the front of the armpit. However, if the patient is a male, due to the relatively tight skin and lack of breast mobility, the incision can be appropriately placed inward. However, in either case, an incision with a diameter of 1cm is acceptable [10-12]; Secondly, this surgical method can be completed using conventional endoscopic instruments without the need to purchase expensive customized instruments [8]. The cost of conventional surgery is relatively low, and after a detailed introduction of the surgical method and approach in this article, it can be carried out routinely through short-term learning and exploration, so it has the potential for promotion;Thirdly, the anatomical structure and operation are simple, with no important nerves or blood vessels entering the thyroid region through this pathway and layer. The anatomical structure and layer are clear, so for general surgeons or thyroid and breast surgeons with conventional endoscopic surgery techniques, it is easy to master this surgical method through the introduction in this article.

This article provides a detailed introduction to using the superior belly of omohyoid muscle located at the anterior edge of the ster-

nocleidomastoid muscle to find the lateral edge of the sternothyroid muscle located at the upper pole of the thyroid gland. Therefore, using this "beacon" to open the "gate" on the outer edge of the sternothyroid muscle successfully entered the thyroid region. This process is based on hundreds of cases of thyroid and breast surgery in our hospital over the past two years, and is a safe and effective mature experience. Proficient in this key step, the surgeon can provide assistance in mastering and promoting the three-hole endoscopic thyroid surgery through the near-axillary approach through short-term learning.

4. Conclusion

Three-hole endoscopic thyroid surgery through the near-axillary approach is a type of total endoscopic thyroidectomy with the advantages of smaller incision and less obvious scars. It utilizes the "beacon" function of the omohyoid muscle to open the "gate" of the lateral edge of the sternal thyroideus muscle and enter the thyroid region. This approach has a clear anatomical structure and simple operation. After short-term learning and proficiency in this step, one can master and carry out this surgical method, which is worth promoting.

5. Contributions

(I) Conception and design: J Xu, Z He; (II) Administrative support: J Xu, Z He; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data:None; (V) Data analysis and interpretation: None; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

6. Acknowledgments

None.

7. Conflicts of Interest

The authors have no conflicts of interest to declare.

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