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Review

Robotic-assisted selective and modified radical neck dissection in head and neck cancer patients

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HIGHLIGHTS

- Neck dissection is standard treatment for surgically treated head and neck cancer.
- Conventional, open neck dissection leaves a lengthy, visible scar on the neck.
- Robotic neck dissection is supposed to give equal oncological and functional outcomes with better cosmesis.

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ABSTRACT

Introduction: Recently, several authors introduced various methods and published feasibility studies on novel robotic-assisted neck dissection techniques for head and neck cancer patients. Cosmesis and general appearance have become important concerns of cancer patients today. Especially in the head and neck area, a conspicuous scar can reduce patient satisfaction after surgery. With conventional neck dissection techniques, a long scar in the neck is unavoidable. Therefore, the development of robotic assisted neck dissection provides the patients with a scarless neck in these situations. However, there are some limitations of the application of these techniques in their current stage of development.
Methods: This study was performed using a systematic literature review.
Results: The reviewed clinical studies show that robotic-assisted neck dissection yields similar functional and early oncologic outcomes to that of conventional neck dissection, as well as excellent cosmetic satisfaction of patients. Despite these benefits, some disadvantages can be observed, in terms of longer operation times as well as higher procedure costs.
Conclusion: Besides the similar oncologic and functional outcomes compared with the open procedure so far, more prospective, controlled, multicenter studies are required to establish robotic-assisted neck dissection as an alternative standard and to justify its added costs beyond the cosmetic advantages.

1. Introduction

Conventional, open lateral neck dissection is the standard and most widespread surgical treatment for the regional lymph nodes in head and neck cancer patients. The purpose of neck dissection is the reliable prediction of the N-status with the highest possible sensitivity and specificity, achieved by histo-pathological examination, as well as the removal of all potentially involved lymph nodes from the neck to reduce the overall tumour burden. In addition, cosmesis and general appearance have become more important for cancer patients today. Especially in the head and neck area, a conspicuous scar can significantly reduce patient satisfaction after surgery. However, with the conventional open technique, a long scar on the neck is unavoidable.

The adaptation of endoscopic techniques [1] and recently the da Vinci surgical system (Intuitive Surgical, Inc., Sunnyvale, CA, USA) to the head and neck area, along with the development of robotic-assisted neck dissection techniques, may provide an appropriate answer to this dilemma in well selected patients [2].

In South Korea, there is a high demand for scarless neck surgery in thyroid cancer, the latter being a highly prevalent disease in young females. Therefore, robotic assisted total thyroidectomy (TT) and central compartment neck dissection (CCND) were first

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described as technically feasible and safe by various authors from that part of the world, and are now performed routinely in South-East Asia [3–5]. Due to the fact that papillary thyroid carcinoma frequently metastasize to the lateral neck nodes [6], lateral neck dissection was included in their robotic surgery portfolio and first described by Kang et al., in 2010 [7].

Kim et al. introduced robotic-assisted lateral neck dissection for head and neck squamous cell carcinoma (HNSCC) first in 2012, and were able to show excellent cosmetic results without compromising the surgical completeness and the oncologic outcomes of a comprehensive neck dissection [2].

Subsequently, various surgical robotic techniques have been introduced in the head and neck, and most reports have demonstrated the feasibility, safety, efficacy and the cosmetic benefit of robotic-assisted neck dissection in patients with head and neck squamous cell carcinoma as well. However, in head and neck surgery, these remote access techniques are challenging because of the deep operative field and close localization of vital structures in a narrow, not preformed space [8].

This review provides detailed information on the published studies of patients with head and neck cancer, with particular regards to their cosmetic, operative/functional, and oncologic outcomes. An overview of the benefits and limitations of robotic-assisted neck dissection is presented.

2. Material and methods

For this review, current reports on lateral neck dissection in patients with head and neck cancer were screened. A systematic review of the literature was performed using the PubMed database as well as references in review articles. Cadaver studies, and studies investigating only central compartment neck dissection, were excluded.

3. Results

From 2010 to present, 18 articles reported on robotic-assisted lateral neck dissection, performed via different approaches, either in combination with primary tumour surgery or as a staged procedure before or after primary tumour resection. In total, 177 patients were treated with robotic-assisted neck dissection in these studies, all using the da Vinci Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA, USA). Neck dissections were performed either in a selective (SND, including only specific levels) or in a comprehensive (mRND, all levels) manner. Table 1 provides an overview of the results of the primary procedure and neck dissection performed. Table 2 gives information on the surgical outcome of all cited studies. Within these 18 studies, eight matched their robotic group to another group of patients undergoing open neck dissection, in order to get a direct comparison of the oncologic, functional and cosmetic outcomes. Table 3 lists the results of these comparative studies. In 17 studies, patients exclusively from South-East Asia (South Korea) were included. One single study was conducted in the United States. In total, eight studies investigated robotic lateral neck dissections for differentiated thyroid cancer (DTC). Eight studies included only HNSCC patients and two reported about patients suffering from cancer of the salivary glands.

3.1. Cosmetic outcomes

In order to provide the patients with a scarless situation in the neck, several approaches have been described to reach the lateral neck nodes with the current robotic system. Most studies included self-reported outcome questionnaires to define cosmetic outcome scores and to assess the satisfaction of cosmesis after different neck approaches.

3.1.1. Transaxillary approach

The 6–7 cm vertical skin incision is placed in the axilla along the anterior axillary fold and behind the posterior aspect of the lateral border of the pectoralis major muscle. The scar of the axillary incision is completely hidden postoperatively, when the arm is in neutral or in anatomic position [8]. The transaxillary (TARS) approach is also known as the gasless unilateral axillary approach (GUA), described by three authors treating patients with papillary thyroid cancer with clinically apparent lateral neck node metastasis (cN1b) [7,9,10]. In the study by Lee at al., 74.2% of the robotic patients were extremely satisfied with their scar compared to only 33.3% in the open neck group ($p < 0.0001$) at six months postoperatively [10].

3.1.2. Modified facelift approach

The incision begins behind the auricle starting from just beneath the earlobe and moving upwards, then angulated downwards 0.5 cm inside the hairline. The incision may be extended from the retroauricular section into the natural preauricular crease to be continued behind the tragus [11]. In total, six studies discussed the modified facelift (MFL) approach [12–14] and three of them were arranged as a comparative investigation [15–17]. Lee et al. performed a selective neck dissection in levels I, II and III on three cN0 oral squamous cell carcinoma (OSCC) patients to achieve a scar satisfaction score of 4 (satisfied) at three months after the operation, which was statistically significantly better ($p = 0.001$) than the comparable open neck group with a score of 2.2 (dissatisfied) [15].

3.1.3. Retroauricular (RA) and postauricular facelift approach (PAFL)

These are basically the same incisions, with slightly different descriptions from different authors. The retroauricular (RA) incision is designed to run around the origin of the earlobe and along the retroauricular sulcus and the hairline. At about the level of the tragus, the RA incision may be extended posteriorly and then may be curved in the occipital direction, just below the hairline [18]. Six studies reported of robotic neck dissections using the RA approach [13–16,18,19]. Kim et al. chose the RA approach for a selective neck dissection (levels I–III) in six submandibular gland cancer patients, simultaneously performing a submandibulectomy included in level I, and described all patients being satisfied with their scar [18]. The postauricular facelift incision (PAFL) is made in the postauricular sulcus, curved around posteriorly at the upper third of the auricle and continued along the occipital hairline [20]. All OSCC patients ($n = 4$) in the study by Tae et al. undergoing a selective neck dissection in levels I to III were also satisfied with their scars [21].

3.1.4. Transaxillary and retroauricular approach (TARA)

This approach combines the transaxillary and the retroauricular incisions, having been described by diverse authors as a technical modification when applying the robotic system to neck dissections in HNSCC [2,13,22]. In a comparative study including 47 PTC patients treated with robotic or open neck dissection, the satisfaction score of 3.9 (average) in the robotic group was significantly better than that of 2.8 (dissatisfied) in the open group ($p < 0.001$) [23].

3.1.5. Gasless unilateral axillo-breast (GUAB) and bilateral axillary breast approach (BABA)

There are two other approaches to the neck using an extra periarreolar incision in one or both breasts for an extra instrument arm or for the camera arm, the unilateral (gasless unilateral axillo-breast, GUAB) and the bilateral transaxillary incision (bilateral axillary breast approach, BABA). Tae et al. reported excellent