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Level of Postoperative Pain as it Relates to Patients Undergoing Robotic and Open Thyroidectomy Surgery

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LEVEL OF POSTOPERATIVE PAIN AS IT RELATES TO PATIENTS UNDERGOING ROBOTIC AND OPEN THYROIDECTOMY SURGERY

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Abstract

Background: With the growing popularity of robotic surgery, more research should be performed to compare the outcomes with the conventional, open approaches. In particular, comparison of postoperative pain is needed as it has significant implications for nursing practice.

Purpose: The purpose of this critical review of the literature is to examine evidence on postoperative pain scores between the robotic thyroidectomy and the open approach.

Results: Eighteen articles were identified for review and were analyzed using the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal tool (Dang & Dearholt, 2018). The literature revealed no significant differences in postoperative pain and discomfort between the robotic and open thyroidectomy groups. Using Margaret Dossey's Theory of Integral Nursing (Tracy & DiNapoli, 2012), the nurse is encouraged to create a healing environment while developing a personalized pain management plan of care for the individual patient based on knowledge of the different surgical approaches (p.32).

Conclusion: The literature review revealed very similar postoperative pain and discomfort between patients undergoing the robotic thyroidectomy and the conventional, open approach. The studies also maintain the robotic thyroidectomy as an acceptable, alternative method for the open thyroidectomy.

Implications for Research and Practice: Recommendations for nursing research include a literature review and analysis of major findings on pain management interventions and analgesic regimens specific to thyroid surgery. As technology advances and surgical approaches continue

to evolve, the Theory of Integral Nursing will guide the nurse in recognizing each patient as an individual with his or her own distinctive pain experience, while developing effective pain management interventions (Tracy & DiNapoli, 2012).

Keywords: robotic thyroidectomy, open thyroidectomy, postoperative pain

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Chapter One: Introduction

The conventional, open approach for the thyroidectomy is considered the traditional method for surgical removal of all or part of the thyroid gland (Fregoli et al., 2017). This approach requires the surgeon to make an anterior incision in the center of the neck. Even though it is well-tolerated and considered a very safe surgical method with patients experiencing a low level of pain and a short hospital stay afterward, it results in a visible, permanent neck scar, which has demonstrated to be cosmetically concerning for some individuals. Introduced in 2007 in Korea, the robotic-assisted thyroidectomy is a surgical approach that uses the assistance of the da Vinci robot to reach the thyroid gland through several small incisions in the underarm and chest area (Lee et al., 2010). Three-dimensional vision with magnification along with computer-controlled movement, allows the robot to use wrist-articulated instruments to operate in small spaces, increasing the operating capacity (Fregoli et al., 2017). While the robotic approach has become available to patients as a treatment option, examination is needed as skepticism still remains concerning the effectiveness and favorability of the outcomes over the traditional, open approach. The focus of this practice question is: Is there a difference in the level of pain among patients who undergo the robotic thyroidectomy versus those who undergo the conventional, open approach?

Purpose

Song et al. (2015) describes the robotic approach as gaining increasing popularity, as it is cosmetically more appealing, and in contrast to the open approach, only leaves several concealable scars under the arm. Despite the fact that the robotic thyroidectomy has been

reported to be safe with many surgical advantages over the open approach and greater patient satisfaction, the wider dissection plane, requiring tunneling from the axilla through the anterior chest to the neck area, leaves the postoperative pain experience still questionable. The longer operating time of the robotic thyroidectomy, along with the debatable invasiveness and fear of severe postoperative pain results in many surgeons still unwilling to perform the robotic approach (Song et al., 2015).

Need for Critical Review and Significance to Nursing

Numerous research studies since 2008 have reported the robotic thyroidectomy is as effective as the conventional, open approach for thyroid surgery, but according to Song et al. (2015), clear evidence of the pain experience is still lacking, and real benefit has not been identified. The robotic thyroidectomy is not minimally invasive, leading to uncertainty of the actual advantage over the open approach. Amongst the controversy, no definitive indication for the robotic thyroidectomy has been reached (Song et al., 2015). The evidence and knowledge of this topic is critical information for patients when considering the two approaches, as well as for nurses when choosing appropriate pain-relieving strategies during the intraoperative and postoperative periods. Inadequate knowledge of the differing approaches to thyroid surgery and the associated impact on the patient, reduces the nurse's ability to effectively manage pain and promote healing (Tracy & DiNapoli, 2012).

Theoretical Framework

Tracy and DiNapoli (2012) relate that pain is a familiar symptom among patients and, undoubtedly, common after any surgery. Subjective and different for every patient and

experience, pain continues to be a difficult phenomenon for nurses to understand, and adequately manage. Margaret Dossey's Theory of Integral Nursing (Tracy & DiNapoli, 2012) serves as a guide to pain management and clinical practice by utilizing a nurse-patient relationship approach, which surpasses objective and subjective data. It focuses on healing and wholism, successfully intervening in the patient's pain experience. Dossey's theory is based on the belief that there are four dimensions of reality within pain management that are all linked to each other and need to be thoroughly addressed: personal, physiological, shared/cultural, and systems/structures. The Theory of Integral Nursing couples with the well-known meta-paradigm of nursing (person, environment, health, and nursing), to identify the interrelated, continuous circle of relationships between the four dimensions that are needed for wellness and healing. Integral Nursing urges the nurse to develop a healing environment and wholistic plan of care, based on the four concepts of nursing and four dimensions of reality. This theory creates the opportunity for the nurse to recognize his or her patient as an individual who has their own distinctive pain experience, allowing the nurse to create a wholistic personalized plan of pain relief. Dossey's theory is especially applicable to the differing approaches to thyroid surgery. It is necessary for the nurse to have a knowledge base of each surgical approach and personal desire to modify his or her practice as needed, in order to develop and implement an individualized pain management plan of care (Tracy & DiNapoli, 2012). This theory challenges the nurse to advance pain management, replacing the "habitual, task-driven ways of managing care" with patient-and relationship-centered, self-directed nursing interventions (Tracy & DiNapoli, 2012, p. 32).

Summary

In this chapter, the background and purpose of the critical review of literature was described. The focus of the practice question was introduced. The significance to nursing was discussed and a theoretical framework for this review was identified.

Chapter Two: Methods

The second chapter describes the critical review of literature to examine evidence related to postoperative pain scores between the robotic thyroidectomy and the open approach. Search strategies, inclusion and exclusion criteria, and types of articles are discussed. Finally, the criteria used to evaluate each article is explained.

Search Strategies

To gather evidence on the postoperative pain experiences after the robotic thyroidectomy versus the conventional thyroidectomy, a literature search was conducted using the CINAHL, PubMed, Medline, and Science Direct databases. Keywords used were "robotic thyroidectomy", "pain", "discomfort", "open thyroidectomy", and "postoperative complications". The range of years was 2010 to present.

Inclusion and Exclusion Criteria

Eligibility for articles selected included ones comparing the robotic thyroidectomy with the open thyroidectomy. The idiom 'robotic thyroidectomy' included axillo-bilateral breast approach, bilateral axillo-breast approach, and trans-axillary approach. Articles detailing specific outcomes, such as postoperative pain, sensory disturbance and discomfort, operating time, and length of hospital stay were selected. A variety of studies were sought, which included randomized control trials, quasi-experimental studies, review articles, and articles reporting the measure of variance. Articles detailing the transoral thyroidectomy, robotic neck dissection, or robotic neck cosmetic procedures were excluded from selection. Of the 18 articles identified, 11

were quasi-experimental studies, three were experimental, and four were systematic reviews. The studies used self-reporting as the method and either a Visual Analog Scale or questionnaire as the instrument to measure pain scores; two of the systematic reviews did not specify a method or instrument. Pain and discomfort were measured at varying postoperative times and days.

Number and Types of Articles

Eighteen articles were identified meeting inclusion criteria. The selection of articles was reviewed using the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal tool (Dang & Dearholt, 2018) and the level of evidence was assigned to each. The 11 quasi-experimental studies were rated as Level II and good quality. The three experimental studies were randomized control trials (RCT's), rated as Level I, and high quality. The remaining systematic reviews were a combination of RCT's, quasi-experimental, and non-experimental, three of which were with meta-analysis. These articles were rated a Level II or III and good quality. See Table 1 for the level and quality of the included articles in this review.

Table 1: Table of Level and Quality of the Included Articles

Level of Evidence	Number of Articles	Quality A	Quality B
Level I	3	3	
Level II	12		12
Level III	3		3
Total	18		

Criteria for Evaluating the Studies

All articles were reviewed using the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal tool (Dang & Dearholt, 2018). The quality of each article was determined using the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal tool (Dang & Dearholt, 2018), and evidence, ratings, and quality were placed in a matrix for access. The 11 quasi-experimental studies were rated as Level II with good quality because of selection bias and ethical issues, barring an RCT to be feasible. Recommendations were consistent. The three experimental studies were rated as Level I because they were strong, randomized studies that supported the practice question with control. The systematic reviews were rated a Level II or III because of only some control, across a widespread literature review that proved consistent results (Dang & Dearholt, 2018).

Summary

In this chapter, the search strategies were described. The inclusion and exclusion criteria were identified. The types of articles and the review process for level of evidence and quality were defined.

Chapter Three: Literature Review and Analysis

The third chapter describes the major findings of the literature review, organized by level of evidence according to the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal tool (Dang & Dearholt, 2018). Strengths and weaknesses of the studies are discussed. Finally, the matrix (see Appendix A) summarizes the research articles.

Synthesis of Major Findings

Level I Evidence: Yoo et al. (2013), in a prospective, randomized double-blind study of 170 women undergoing conventional open thyroidectomy (n = 85) and robotic-assisted thyroidectomy (n = 85), revealed decreased mean pain scores in the robotic group during the 6-24-hour postoperative period (2.8 ± 1.8 vs 3.8 ± 1.8, P = <0.05). They noted an increased anesthesia time and operating time in the robot group. He et al. (2016) studied one-hundred patients randomly assigned to the robotic group (n = 50) and conventional open group (n = 50), where decreased postoperative pain scores were also reported in the robotic group (2.1 ± 1.0 vs 3.8 ± 1.2, P = <0.05). The robotic group experienced increased operating time. Kim et al.'s (2016) double-blind study, where 112 robotic and 117 open group patients were selected through block randomization, concluded no significant difference in postoperative pain scores (0.18 ± 0.05 vs 0.16 ± 0.05, P = .848).

Level II Evidence: Paek et al. (2016) reported significantly higher pain scores after open thyroidectomy (P = 0.048). In Song et al.'s (2015) quasi-experimental study, postoperative pain scores were similar between the robotic group (n = 123) and open group (n = 170), except for a higher pain score at one-week post-surgery in the robotic group (P = 0.057). Lee et al. (2010)

found the robotic thyroidectomy resulted in lower postoperative discomfort. In the quasi-experimental study by Aliyev et al. (2012), pain scores were similar on postoperative day one (2.7 ± 0.4 vs 3.1 ± 0.6; $P = .573$), but significantly lower in the open group versus the robotic group (0.4 ± 0.3 vs 2.4 ± 0.5; $P = .001$) on postoperative day 14.

Lee et al. (2013) concluded no significant differences in neck pain scores among robotic and open groups ($P = .3587$). In the quasi-experimental study by Cho et al. (2016), no significant differences were also reported between the two groups ($P = 0.669$). Fregoli et al. (2017) noted low pain scores during the entire postoperative period in their study, and any differences between the two groups were declared clinically irrelevant. Arora et al (2016) completed a study which also revealed similar postoperative pain scores, except for one isolated difference at three months, where the robotic group reported a lower pain score ($P = 0.05$).

In the quasi-experimental study by Chai et al. (2016), postoperative pain scores for the throat, neck, and back were not significantly different between the robotic group and open group. Of note, pain scores for the chest were considerable in the robotic group (absent for the open group), but decreased to minimal levels at postoperative day 14. Song et al. (2014) studied 118 robotic patients and 176 conventional open patients. Postoperative neck discomfort scores were increased immediately after surgery, but the scores did not differ between the groups from one day to18 months. Postoperative chest discomfort was significantly increased in the robotic group from one day to 12 months. At 18 months there was no significant difference. Ha et al. (2018) reported significantly higher postoperative neck pain in the robotic group ($P = 0.026$). In the systematic review with meta-analysis by Sun, Peress, and Pynnonen (2014), no significant

differences in postoperative neck pain scores were noted, although the robotic group reported increased chest pain scores which later resolved.

Level III Evidence: Kandil et al. (2015) conducted a meta-analysis which noted decreased postoperative pain in the robotic group after 24 hours. Lang et al. (2014) also completed a meta-analysis and systematic review. Similar pain scores were reported, while chest paresthesia was significantly worse in the robotic group before returning to normal at three months postoperative. Adam et al. (2014) reviewed all thyroid cancer patients more than 18 years of age who had robotic or open thyroid surgery in 2010 or 2011 in the United States. This review detailed increased chest paresthesia in the robotic group.

Strengths and Weaknesses

The findings from many of the research studies describe longer operating times and wider dissection plane in the robotic group, yet no significant differences in postoperative pain and discomfort between the groups. One of the studies supporting this conclusion was a high quality, randomized controlled trial (RCT) with a large sample size and consistent results. In this study, Kim et al. (2016) concluded the robotic thyroidectomy is an acceptable, alternative method for the open thyroidectomy, yielding comparable postoperative pain scores. The other studies supporting this conclusion are of good or high-quality evidence according to the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal tool (Dang & Dearholt, 2018).

Weaknesses were identified in the research studies. Only three of the studies were RCTs, as randomized control studies for this subject are difficult to implement. Surgical cost and patient preference undoubtedly introduced self-selection bias. Some of the studies had small

sample sizes and short follow-up periods. Many of the studies were performed outside the United States, raising the question of whether medical systems or surgeons' learning experiences between countries may impact different patient outcomes. Finally, evaluation of postoperative pain was measured subjectively with varying versions of the Visual Analogue Scale, leading to potential bias in self-reported data.

Summary

The critical review of literature included 18 research articles. In this chapter, evidence on postoperative pain scores between robotic and open thyroid groups was reviewed. The matrix (see Appendix A) summarizes the research articles. Each research article was organized by source, purpose, quality level, sample, design, results, conclusion, author recommendations, and implications. The synthesis of major findings was examined according to the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal tool (Dang & Dearholt, 2018). Strengths and weakness in the research studies were discussed.

Chapter Four: Discussion, Implications, and Conclusions

The fourth chapter answers the practice question and describes trends and gaps in literature. Implications for nursing practice and recommendations for nursing research are explained. Finally, integration of Margaret Dossey's Theory of Integral Nursing (Tracy & DiNapoli, 2012) is presented.

Answer to the Practice Question

The research articles reviewed reveal very similar postoperative pain and discomfort between patients undergoing the robotic thyroidectomy and the conventional, open approach. Several studies did identify higher pain levels in one or group or another, but based on the critical review of literature, the conclusion is supported that there are no significant differences in postoperative pain and discomfort between the robotic and open groups. The studies also maintain the robotic thyroidectomy as an acceptable, alternative method for the open thyroidectomy, yielding comparable postoperative pain scores.

Trends and Gaps

One of the trends in literature is the frequent and repeated grading of postoperative pain, from varying hours, days, months, and years. Although this is an imperative element of the research study, it is difficult to equivalently compare pain scores among the two groups without uniform follow-up time periods. The chosen time periods seem to be facility specific.

One of the gaps in literature is a mutually agreed upon instrument to subjectively measure postoperative pain levels. The articles reviewed employed varying versions of the Visual

Analogue Scale (VAS), questionnaires, or surveys as the method of self-report. The chosen instruments may be facility-specific, or perhaps, cultural.

Implications for Nursing Practice

Pain and pain management are worrisome subjects for both the patient and the nurse, and also remain the most frequent reason for nursing intervention (Tracy & DiNapoli, 2012). For effective and efficient intraoperative and postoperative pain management, nurses must understand the differing approaches to thyroid surgery and the subsequent impact on the patient. Evidence in this critical review on postoperative pain scores between robotic and open thyroid surgeries support the nurse in treatment of pain with the purpose of developing effective and appropriate pain management interventions and practice.

Bucknall, T., Manias, E., and Botti, M. (2001) describe several necessary components to effective pain management. First, the nurse must involve the patient in decision-making and development of an individualized pain management plan. Then, the nurse must accurately assess both objective and subjective indicators of pain. Third, successful collaboration of the health-care team is needed, in order to improve communication and accountability, resulting in more effective pain management for the patient. Next, identifying and addressing organizational management factors, such as staff availability, will encourage the patient to speak up about pain concerns. Beyond organizational management, education is another component of effective pain management. Here, increased education on pharmacology and non-pharmacological interventions, as well as attitudes and beliefs, are stressed. Lack of understanding or fear of overdosing, for example, can significantly impact the nurses' attitudes or beliefs towards pain

relief interventions. Knowledge of pain management goals, pain relief options, and pain assessments are equally important areas to increase education in during the postoperative period. Evaluation of pain management relief and interventions is the final component (p. 270). Utilizing these key components in nursing practice and pain management will ensure individualized, effective, and patient-centered care (Bucknall, T., Manias, E., & Botti, M., 2001).

Recommendations

Recommendations for nursing research include a literature review and analysis of major findings on complications and infection rates between robotic and open thyroid surgeries. This additional evidence would be meaningful to nursing practice, as well as preoperative counselling and standardized postoperative care protocols. Secondly, future research to determine the most effective and appropriate pain management interventions and analgesic regimens specific to thyroid surgery would be advantageous, as pain management remains problematic for both the patient and the nurse.

Integration of Theoretical Framework

Margaret Dossey's Theory of Integral Nursing (Tracy & DiNapoli, 2012) combines the four dimensions of reality within pain management (personal, physiological, shared/cultural, and systems/structure) with the meta-paradigm of nursing (person, environment, health, and nursing) to establish patient-centered care and healing. Patients undergoing similar surgeries may experience very different levels of pain. Integral Nursing recognizes each patient as an individual with his or her own distinctive pain experience. This theory guides the nurse in creating a wholesome, healing environment while encouraging the development of a uniquely,

personalized plan of care and pain relief for each individual patient. Dossey's theory is particularly applicable to thyroid surgery. It is necessary for the nurse to relate his or her knowledge of the differing surgical approaches of thyroid surgery to focus on the patient and implement an individualized pain management plan of care. In the words of Tracy and DiNapoli (2012), "the theory of integral nursing holds much promise, and it is up to us to apply it in practice as we refocus the humanity of nursing care in this technological age" (p.32).

Summary

In this chapter, the practice question was answered. The critical review of literature supported the robotic thyroidectomy as an acceptable, alternative method for the open thyroidectomy. Recommendations for future nursing research and implications for nursing practice were discussed.

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Appendix A: Evidence Synthesis Matrix

<table>
<tr><td colspan="4">Source: Paek, S.H., Kang, K.H., Kang, H., & Park, S.J. (2016). Comparison of postoperative surgical stress following robotic thyroidectomy and open thyroidectomy: A prospective pilot study. Surgical Endoscopy, 30, 3861-3866. doi:10.1007/s00464-015-4689-5</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instruments)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
Compare surgical stress of robotic thyroidectomy with open thyroidectomy

Sample/Setting:
15 robotic patients
14 open approach patients

Setting not listed

Johns Hopkins Evidence Appraisal

Level of Evidence:
Level II

Quality:
B</td><td>Quasi- experimental
Method:
Self- report
<u>Pain scores:</u>
Instrument:
0-10 visual analog scale (VAS) where 0 = no pain & 10 = worst imaginable pain
Pain was reported at postop 2h, 1d, & 3d
<u>Surgical stress scores:</u>
Method:
biophysiologic/blood samples
Instrument:
SPI (surgical plethysmographic index) objective multivariate index tool measuring serum IL-6 levels, serum WBC count, & CRP levels

Blood samples were 1d prior to surgery, postop 2h, 1d, 3d</td><td>VAS scores in open group higher than robotic group

Intraop SPI difference was borderline

Mean operative time longer in robotic group

Conclusion:
Postop pain scores higher after open than after robotic

No significant difference among surgical stress markers; robotic thyroid may have less systemic stress response</td><td>Strengths:
Robotic & open surgeries performed by same surgeon

Limitations:
Non- randomized

Selection bias
Based on patient preference

Small sample size</td></tr>
<tr><td colspan="4">Author Recommendations:
A larger sample size at multiple settings with additional surgeons is needed.</td></tr>
<tr><td colspan="4">Implications:
Robotic thyroidectomy may not cause increased surgical stress or pain for patients.</td></tr>
</table>

Source: Song, C.M., Ji, Y.B., Bang, H.S., Kim, K.R., Kim, H., & Tae, K. (2015). Postoperative pain after robotic thyroidectomy by a gasless unilateral axillo-breast or axillary approach. *Surgical Laparoscopy Endoscopy & Percutaneous Techniques, 25*(6), 478-482. Retrieved from https://journals.lww.com/surgical-laparoscopy/pages/default.aspx			
Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: Compare pain after robotic thyroidectomy versus open thyroidectomy **Sample/Setting:** 123 robotic thyroidectomy (RT) patients 170 open thyroidectomy (OT) patients Hanyang University Hospital, Seoul, South Korea **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level II **Quality:** B	Quasi- experimental **Method:** Self- report **Instrument:** 0 to 10 visual analogue scale Pain was measured on the day before surgery & postop day 1, day 3, week 1, month 1	Operating time longer & drainage amount great in RT Pain scores were similar among RT and OT; 1 week postop = higher pain score in RT than OT Amount of parenteral analgesics given were similar in RT and OT **Conclusion:** Postop pain and amount of analgesics are similar in RT and OT	**Strengths:** All patients on identical analgesic protocol Larger sample size **Limitations:** Non- randomized Pain was not measured objectively
Author Recommendations: A randomized study with objective measurement is needed.			

Implications:
Postop pain and amount of analgesics are similar in robotic and open groups.

Source: Lee, J., Nah, K.Y., Kim, R.M., Ahn, Y.H., Soh, E., & Chung, W.Y. (2010). Differences in postoperative outcomes, function, and cosmesis: Open versus robotic thyroidectomy. *Surgical Endoscopy, 24,* 3186-3194. doi:10.1007/s00464-010-1113-z

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: Compare outcomes for patients undergoing robotic thyroidectomy versus open **Sample/Setting**: 41 robotic thyroidectomy patients 43 open thyroid patients No setting listed **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level II **Quality:** B	Quasi- experimental **Method:** Self- report **Instrument:** Questionnaire based on symptoms; asked to grade postop pain in neck & anterior chest as none, very slight, slight, moderate, or severe 24h after surgery Questionnaire asked about presence of hyperesthesia & paresthesia in neck, anterior chest, & shoulder at 1 week & 3 months after surgery	Robotic operating time longer Postop neck discomfort & swallowing symptoms slightly higher in open group 41 of 43 patients in open group reported hyperesthesia/ paresthesia in the neck 1wk postop **Conclusion:** Postop pain levels & complications were comparable in both groups; unclear if robotic thyroidectomy offers real benefits in quality of life	**Strengths:** Two groups were similar age, gender, type of operation, and final diagnosis Analgesics given using identical protocol Same surgeon for all surgeries **Limitations:** Non- randomized Selection bias Based on patient preference Small sample size Short follow-up period

Author Recommendations:
A larger study with a longer follow-up period is needed.

Implications: Robotic thyroidectomy may result in less postoperative discomfort.

Source: Aliyev, S., Taskin, H.E., Agcaoglu, O., Aksoy, E., Milas, M., Siperstein, A., & Berber, E. (2012). Robotic transaxillary total thyroidectomy through a single axillary incision. *Surgery, 153*(5), 705-710. doi:10.1016/j.surg.2012.10.013			
Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: Evaluate feasibility & safety of robotic transaxillary thyroidectomy w/ focus on postop pain, morbidity, & oncologic factors in comparison to open **Sample/Setting:** 16 robotic transaxillary neck procedure patients 30 open thyroid patients Division of Endocrine Surgery, Cleveland Clinic **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level II **Quality:** B	Quasi- experimental **Method:** Self- report **Instrument:** 0-10 visual analogue scale (VAS) by nursing staff on POD 1 & POD 1	Operating time was less in conventional group EBL (estimated blood loss) similar in both groups Similar analgesic use between both groups VAS was similar on POD 1, but lower in open group vs robotic group on POD 14; patients complained of pain around clavicle **Conclusion**: Robotic procedure is feasible & safe, but takes longer	**Strengths:** Patients matched for tumor size, type, & BMI Postop pain managed the same way for all patients **Limitations:** Non- randomized Selection bias Based on patient preference Small sample size Short follow-up Very selective in offering robotic thyroidectomy option to patients

Author Recommendations:
Long- term follow-up is needed.

Implications:
Robotic procedure is not less invasive and takes longer; POD14 pain lower in open group.

Source: Lee, J., Kwon, I.S., Bae, E.H., & Chung, W.Y. (2013). Comparative analysis of oncological outcomes and quality of life after robotic versus conventional open thyroidectomy with modified radical neck dissection in patients with papillary thyroid carcinoma and lateral neck node metastases. *Endocrine Care, 98* (7), 2701-2708. doi:10.1210/jc.2013-1583

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: Compare oncological outcomes & quality of life in patients undergoing robotic versus open procedures **Sample/Setting:** 62 robotic patients 66 open thyroid patients Severance Hospital **Johns Hopkins Evidence Appraisal** **Level of Evidence**: Level II **Quality:** B	Quasi- experimental **Method:** Self- report **Instrument:** Questionnaire based on pain of surgical scar and presence of hyperesthesia & paresthesia of neck & anterior chest 6 months after surgery, graded as minimal, moderate, or severe	Operation time in robotic group was longer Hospital stay & postop complications similar in both groups No significant differences in surgical scar pain & neck pain between both groups **Conclusion:** Robotic thyroidectomy is as effective as open surgery	**Strengths:** Both groups had similar age, BMI, tumor, nodes, metastases stage, tumor size, frequency of extrathyroidal extension, and multiplicity & bilaterality of tumors **Limitations:** Non- randomized Selection bias Based on patient choice & cost Small sample size Short follow-up time

Author Recommendations: More perioperative assessment of oncological outcomes; larger, randomized study to confirm findings with longer follow-up time.
Implications: Robotic and open thyroid surgeries result in similar outcomes and safety.

Source: Cho, J.N, Park, W.S., Min, S.Y., Han, S., & Song, J. (2016). Surgical outcomes of robotic thyroidectomy vs. conventional open thyroidectomy for papillary thyroid carcinoma. *World Journal of Surgical Oncology, 14*(181), 1-7. doi:10.1186/s12957-016-0929-y			
Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: Compare surgical outcomes of robotic thyroidectomy (RT) using bilateral axillo-breast approach (BABA) with conventional open thyroidectomy (OT) in papillary thyroid carcinoma patients **Sample/Setting:** 109 patients in RT group and 109 patients in OT group Kyung Hee University Medical Center, Seoul, South Korea. **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level II	Quasi- experimental **Method:** self-report **Instrument:** 11-point visual analog scale Pain score reported 1h postop & 1/day until discharge	No significant difference between the two groups in the postoperative pain score Operation time longer in RT Hospital cost higher in RT **Conclusion:** RT is safe technique	**Strengths:** Sufficient sample size All surgeries completed by same surgeon **Limitations:** Non-Randomized Selection bias -patient preference -cost may be factor of preference

Quality: B			
Author Recommendations: More evidence needed to verify both surgical & oncological safety.			
Implications: BABA RT is safe and surgically complete; no significant difference in pain scores.			

Source: Fregoli, L., Materazzi, G., Miccoli, M., Papini, P., Guarino, G., Wu, H., & Miccoli, P. (2017). Postoperative pain evaluation after robotic transaxillary thyroidectomy versus conventional thyroidectomy: A prospective study. *Journal of Laparoendoscopic & Advanced Surgical Techniques, 27,* 146-150. doi:10.1089/lap.2016.0461			
Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**

Purpose: Compare pain after robotic assisted transaxillary thyroidectomy (RT) versus open thyroidectomy (OT) **Sample/Setting:** 124 patients undergoing total thyroidectomy 62 in RT group 62 in OT group University Hospital of Pisa Endocrine Surgery **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level II **Quality:** B	Quasi- experimental **Method:** Self- report **Instrument:** 11 point visual analog scale (VAS) from 0-11 Pain was assessed in recovery room, first postop day at 8am & 8pm, postop day 2 at 8am, and at 7 days after surgery	Longer operative time/hospital stay in RT group Immediately after surgery, patients in RT group had less pain than OT group Pain experienced during remaining hospitalization was not statistically different 1 wk after surgery, patients in OT group experienced less pain than RT group **Conclusion:** Both techniques showed low postop pain scores in entire period RT has greater persistence of pain	**Strengths:** All patients were women Two groups were matched for age, thyroid volume, nodule diameter, & BMI All procedures performed by same surgeon As postop analgesia, all patients received ketorolac (30mg every 8 hours) **Limitations:** Non- randomized Selection bias Based on patient preference Small sample size
Author Recommendations: Further studies are need to explore outcomes of RT in a European population.			
Implications: Postoperative pain was not statistically different between the two groups.			
Source: Arora, A., Garas, G., Sharma, S., Muthuswamy, K., Budge, J., Palazzo, F., Darzi, A., & Tolley, N. (2016). Comparing transaxillary robotic thyroidectomy with conventional surgery in a UK population: A case control study. *International Journal of Surgery, 27,* 110-117. doi:10.1016/j.ijsu.2016.01.071			
Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**

Purpose: Compare the technique of transaxillary robotic thyroid surgery (RT) with open thyroidectomy (OT) **Sample/Setting:** 16 robotic patients versus 16 open patients St. Mary's Hospital & Hammersmith Hospital, London, UK **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level II **Quality:** B	Quasi- experimental **Method:** Self-report **Instrument:** 0 to 100 visual analogue scale (VAS) where 100 represented worst imaginable pain Pain was measured preoperatively, postoperative day 1, week 2, month 3, month 6, month 12, year 2, & year 3	No difference in the mean postoperative pain score at 1 day, 2 weeks, 6 months, & 12 months Isolated significant difference at 3 months with the RT group demonstrating a lower mean pain score RT took 3 times longer than OT **Conclusion:** No significant difference in postoperative neck or anterior chest pain between RT & OT RT is both feasible & safe in UK population	**Strengths:** RT completed by same robotic console RT & OT performed by same surgical team Both groups matched in terms of mean BMI, anthropometry, age, gender, size of nodule Long-term follow-up Long-term prospective **Limitations:** Non- randomized Selection bias Based on patient preference Small sample size (32)
Author Recommendations: A randomized clinical study is needed to verify RT versus OT.			
Implications: Transaxillary robotic thyroid surgery is an acceptable alternative; no significant difference in pain scores.			

Source: Chai, Y. J., Song, J., Kang, J., Woo, J., Song, R., Kwon, H., Kim, S., Choi, J. Y., & Lee, K. E. (2016). A comparative study of postoperative pain for open thyroidectomy versus bilateral axillo- breast approach robotic thyroidectomy using a self- reporting application for iPad. *Annals of Surgical Treatment and Research, 90* (5), 239-245. doi:10.4174/astr.2016.90.5.239

Purpose/Sample	Design (Method/Instruments)	Results	Strengths/Limitations
Purpose: Study postop pain for robotic thyroid surgeries using bilateral axillo-breast approach (BABA) **Sample/Setting:** 27 BABA robotic thyroidectomy patients (RT) 27 open thyroidectomy patients (OT) Seoul National University Hospital **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level II **Quality:** B	Quasi- experimental **Method:** Self- report **Instrument:** Questionnaire on iPad using Visual Analog Scale ranging from 0 to 10 and Faces Pain Rating Scale Patients were asked about pain on postop days 1 to 3 and postop day 14	Long operating time & hospital stay in RT No differences in analgesic injections between groups No differences in postop pain scores for throat, anterior neck, posterior neck, or back between both groups RT pain scores for chest pain on postop days 1, 2, & 3 were considerable RT pain scores for chest pain on postop day 14 decreased **Conclusion:** RT has greater cosmetic satisfaction without increased pain	**Strengths:** All female patients No differences in terms of age, BMI, tumor size, multifocality, extrathyroidal extension, lymphovascular invasion, thyroiditis, & TNM stage **Limitations:** Selection bias Based on patient preference & capable of using iPad Non- randomized Small sample size
Author Recommendations: Larger study with longer follow- up is necessary for accurate comparison of RT and OT.			
Implications: RT has greater cosmetic satisfaction and comparable pain scores to OT.			

Source: Song, C.M, Ji, Y.B., Bang, H.S., Park, C.W., Kim, H., & Tae, K. (2014). Long- term sensory disturbance and discomfort after robotic thyroidectomy. *World Journal of Surgery, 38,* 1743-1748. doi:10.1007/s00268-014-2456-8			
Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**

Purpose: Compare sensory disturbance & discomfort after robotic thyroidectomy (RT) and open thyroidectomy (OT) **Sample/Setting:** 118 RT patients 176 OT patients Hanyang University, South Korea **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level II **Quality:** B	Quasi- experimental **Method:** Self- report **Instrument:** Visual Analog Scale 0-4, rating levels of discomfort & hypesthesia/paresthesia Measured on the day before surgery, postop days 1, 3, 7, and postop months 1, 3, 6, 12, 18	Operative time & drainage amount higher in RT Neck discomfort did not differ between OT & RT. Neck hypesthesia/ paresthesia was higher in RT on POD1 & POD7; no difference later. Chest discomfort higher in RT from POD1 to 12 mo; no difference at 18 mo. Chest hypesthesia/paresthesia score higher in RT from POD1 to 18 mo; recovered to preop levels. **Conclusion:** Anterior chest discomfort & sensory disturbance are greater in RT	**Strengths:** Same surgeon for RT surgeries Long- term follow up Larger sample size **Limitations:** Non- randomized Sensory changes not measured objectively
Author Recommendations: Minimizing dissection of anterior chest could decrease discomfort & sensory disturbance in RT group.			
Implications: Anterior chest discomfort & sensory disturbance are greater in RT and require time to recover to preoperative levels/comparable to OT group.			

Source: Yoo, J.Y., Chae, Y.J., Cho, H.B., Park, K.H., Kim, J.S., & Lee, S.Y. (2013). Comparison of the incidence of postoperative nausea and vomiting between women undergoing open or robotic- assisted thyroidectomy. *Surgical Endoscopy, 27,* 1321-1325. doi:10.1007/s00464-012-2607-7

Purpose/Sample	Design (Method/Instruments)	Results	Strengths/Limitations
Purpose: Compare the levels of postoperative nausea & vomiting (PONV) in women in open (OT) or robotic thyroidectomy (RT) **Sample/Setting:** 85 OT patients 85 RT patients No setting listed **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level I **Quality:** A	Experimental study, RCT **Method:** Self- report **Instrument:** 11- point verbal rating scale with 0 being no nausea to 10 being worst possible nausea Postoperative pain was measured by 11- point verbal analog scale with 0 being no pain to 10 being worst pain Measurements taken at 0-1h postop, 1-6h postop, & 6-24h postop	Anesthesia time & operating time were longer in RT Pain score during 6-24h postop period was decreased in RT compared to OT PONV was decreased in 6-24h postop period in RT compared to OT **Conclusion:** RT reduces incidence & severity of PONV compared to OT	**Strengths:** Prospective, double-blinded, randomized Standard anesthetic technique All patients were euthyroid women with ASA I or II Nurses or trainees were blinded History of smoking, motion sickness, & PONV were comparable between groups Extensiveness of thyroidectomy was comparable between groups **Limitations:** Short follow-up period
Author Recommendations: Surgical techniques with lower incidence of pain or discomfort in the neck, such as RT, may decrease PONV.			
Implications: PONV incidence and pain scores are decreased in RT.			

Source: He, Q., Zhu, J., Zhuang, D., Fan, Z., Zheng, L., Zhou, P., Hou, L., Yu, F., Li, Y., Xiao, L., Dong, X., & Ni, G. (2016). Comparative study between robotic total thyroidectomy with central lymph node dissection via bilateral axillo- breast approach and conventional open

<table>
<tr><td colspan="4">procedure for papillary thyroid microcarcinoma. Chinese Medical Journal, 129 (18), 2160-2166. doi:10.4103/0366-6999.189911</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instruments)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
Determine safety & effectiveness of robotic thyroid (RT) with open approach (OT) in papillary thyroid microcarcinoma

Sample/Setting:
50 RT patients
50 OT patients

Jinan Military General Hospital of People’s Liberation Army

Johns Hopkins Evidence Appraisal

Level of Evidence:
Level I

Quality:
A</td><td>Experimental study, RCT
Method:
Self- report

Instrument:
Visual analog scale for pain assessment</td><td>Operating time longer in RT

No difference in blood loss, hospital stay time, or drain volumes between groups

Pain scores higher in RT

Conclusion:
RT is safe and effective</td><td>Strengths:
Prospective, randomized

All patients had papillary thyroid microcarcinoma

Same surgeon performed all surgeries

No difference in postoperative care between two groups

Limitations:
Small sample size</td></tr>
<tr><td colspan="4">Author Recommendations:
Long-term follow up with a larger sample size, along with expanded indications are necessary.</td></tr>
<tr><td colspan="4">Implications:
Higher pain scores in RT group.</td></tr>
<tr><td colspan="4">Source: Kandil, E., Hammad, A.Y., Walvekar, R.R., Hu, T., Masoodi, H., Mohamed, S.E., Deniwar, A., & Stack, B.C. (2015). Robotic thyroidectomy versus nonrobotic approaches: A meta-analysis examining surgical outcomes. Surgical Innovation, 23 (3), 317-325.</td></tr>
</table>

<table>
<tr><td colspan="4">doi:10.1177/1553350615613451</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instruments)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
Determine safety and oncological effectiveness of robotic surgery (RT) versus open surgery (OT) for thyroid surgery

Sample/Setting:
1876 OT patients
1902 RT patients

Settings not listed

Johns Hopkins Evidence Appraisal

Level of Evidence:
Level III

Quality:
B</td><td>Systematic review with meta-analysis

Method:
Self- report

Instrument:
11- point visual analog scale where 0 being no pain and 10 being worst pain imaginable</td><td>Longer operating times with RT

RT patients reported less pain 24h postop

Conclusion:
RT surgery is safe and has similar complications and outcomes as OT; RT has longer operative times than OT</td><td>Strengths:
Large sample size

Limitations:
Some studies were non-randomized</td></tr>
<tr><td colspan="4">Author Recommendations:
Larger controlled trials are needed to evaluate cost- effectiveness, clinical outcomes, & patient satisfaction.</td></tr>
<tr><td colspan="4">Implications:
RT associated with decreased pain scores.</td></tr>
</table>

Source: Ha, K.T, Kim, D.W., Park, H.K., Shin, G.W., Heo, Y.J., Baek, J.W., Lee, Y.J., Choo, H.J., Kim, D.H., Jung, S.J., Park, J.S., Moon, S.H., Ahn, K.J., Baek, H.J., & Kang, T. (2018). Comparison of postoperative neck pain and discomfort, swallowing difficulty, and voice change after conventional, open, endoscopic, and robotic thyroidectomy: A single-center cohort study. *Frontiers in Endocrinology, 9* (416), 1-16. doi:10.3389/fendo.2018.00416

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: Compare postop neck pain, swallowing, & voice change between open thyroid (OT), endoscopic (ET), & robotic (RT) **Sample/Setting:** 169 OT patients 32 ET patients 53 RT patients Busan Pak Hospital **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level II **Quality:** B	Quasi-experimental **Method:** Self-report **Instrument:** Postoperative symptom survey with numerical rating scale	Postoperative pain higher in ET & RT group, but no significant differences in pain scale scores; reason for difference unclear Neck discomfort highest in RT group; lowest in OT **Conclusion:** Postoperative neck pain and discomfort were more common in ET & RT groups, rather than OT	**Strengths:** Same surgeon performed all surgeries **Limitations:** Female predominance in OT group, all females in ET & RT groups Unequal group sizes between OT, ET, & RT Inconsistent time intervals of postoperative survey Only one postoperative survey Survey conducted by 3 nurses

Author Recommendations:
Additional studies are needed with matched patients and procedures.

Implications:
Neck pain and discomfort are more common with RT than OT.

<table>
<tr><td colspan="4">Source: Kim, W.W., Jung, J.H., Lee, J., Kang, J.G., Baek, J., Lee, W.K., & Park, H.Y. (2016). Comparison of the quality of life for thyroid cancer survivors who had open versus robotic thyroidectomy. Journal of Laparoendoscopic & Advanced Surgical Techniques, 26 (8), 618-624. doi:10.1089/lap.2015.0546</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instruments)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
Compare quality of life between open thyroidectomy (OT) and robotic thyroidectomy (RT) patients

Sample/Setting:
112 RT
117 OT

Dept. of Surgery, Kyungpook National University Hospital

Johns Hopkins Evidence Appraisal

Level of Evidence:
Level I

Quality:
A</td><td>Experimental study, RCT
Method:
Self-report

Instrument:
Telephone counseling survey from 0-10 points</td><td>RT operation time longer

No difference in long-term postoperative pain between RT & OT groups

Conclusion:
RT and OT showed no difference in quality of life</td><td>Strengths:
Patients selected through block randomization before the study

Same number of patients assigned to surveyors blindly and randomly; surveyors did not know operation method

Long follow-up period

Limitations:
Quality of life terms are subjective versus objective

Expectation of surgical results could differ</td></tr>
<tr><td colspan="4">Author Recommendations:
RT and OT show no difference in quality of life during follow-up.</td></tr>
<tr><td colspan="4">Implications:
RT and OT have comparable quality of life results and no difference in long-term postoperative pain.</td></tr>
</table>

Source: Lang, B.H., Wong, C.K.H., Tsang, J.S., Wong, K.P., Wan, K.Y. (2014). A systematic review and meta-analysis comparing surgically-related compilations between robotic-assisted thyroidectomy and conventional open thyroidectomy. *Annals of Surgical Oncology, 21,* 850-861. doi:10.1245/s10434-013-3406-7			
Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: Compare complications between robotic thyroidectomy (RT) and open thyroidectomy (OT) patients **Sample/Setting:** 839 RT patients 1536 OT patients Settings not listed **Johns Hopkins Evidence Appraisal** **Level of Evidence:** Level III **Quality:** B	Systematic review with meta-analysis **Method:** Method not listed **Instrument:** Instrument tool not listed	Operating time & hospital stay longer with RT than OT Similar pain scores at 1 week, 1 month, & 3 months RT chest paresthesia worst, but normal at 3 months Blood loss comparable **Conclusion:** Comparable complications and morbidity	**Strengths:** Large sample size **Limitations:** All 11 studies were non-randomized Selection bias
Author Recommendations: RT and OT surgery should be discussed prior to decision making. Prospective studies are needed.			
Implications: Similar pain scores between RT and OT.			

<table>
<tr><td colspan="4">Source: Adam, M.A., Speicher, P., Pura, J., Dinan, M., Reed, S.D., Roman, S.A., & Sosa, J.A. (2014). Robotic thyroidectomy for cancer in the US: Patterns of use and short-term outcomes. Annals of Surgical Oncology, 21 (12), 3859-3864. doi:10.1245/s10434-014-3838-8</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instruments)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
Compare patterns & outcomes of robotic thyroidectomy (RT) to open thyroidectomy (OT)

Sample/Setting:
225 RT patients
57,729 OT patients

Settings not listed

Johns Hopkins Evidence Appraisal

Level of Evidence:
Level III

Quality:
B</td><td>Systematic review
Method:
Method not listed

Instrument:
Instrument tool not listed</td><td>RT has higher rates of chest paresthesia than OT

RT and OT have comparable hospital stay length

Conclusion:
Short-term outcomes of RT are comparable to OT</td><td>Strengths:
Data was extracted by trained & certified tumor registrars

Overall large sample size of patients

Limitations:
Selection bias

RT has small sample size

Database coding errors are possible</td></tr>
<tr><td colspan="4">Author Recommendations:
More studies are needed to compare specific complications and long-term outcomes.</td></tr>
<tr><td colspan="4">Implications:
RT and OT short-term outcomes are comparable.</td></tr>
</table>

<table>
<tr><td colspan="4">Source: Sun, G.H., Peress, L., & Pynnonen, M.A. (2014). Systematic review and meta-analysis of robotic vs conventional thyroidectomy approaches for thyroid disease. Otolaryngology- Head and Neck Surgery, 150 (4), 520-532. doi:10.1177/0194599814521779</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instruments)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:
Compare postoperative outcomes of robotic thyroidectomy (RT) and open thyroidectomy (OT)

Sample/Setting:
726 RT patients
1205 OT patients

No settings listed

Johns Hopkins Evidence Appraisal

Level of Evidence:
Level II

Quality:
B</td><td>Systematic review with meta-analysis
Method:
Self-report

Instrument:
5-point grading scale to grade neck & anterior chest pain at 24 hours postop

5-point grading scale to grade neck & anterior chest pain at 1 week, 1 month, & 3 months postop

5-point grading scale to grade neck & anterior chest pain at 1 day, 1 week, 1 month, & 3 months postop

4-point scale to grade paresthesia</td><td>Operating time longer with RT: hospital stay & postop complications similar; no significant difference in postop analgesic use

No significant difference in postop neck pain; higher anterior chest pain in RT; resolved 1-3 months later

Neck paresthesia higher in OT; anterior chest paresthesia higher in RT

Conclusion:
RT & OT have similar complications</td><td>Strengths:
Included randomized controlled trials

Same 2 authors extracted data

Large sample size

Limitations:
Some non-randomized trials included

Some selection bias may be present

Attrition bias present in one study

Short follow-up

Cohorts significantly different in age & BMI

Publication bias</td></tr>
<tr><td colspan="4">Author Recommendations:
Long-term studies with validated instruments are needed.</td></tr>
<tr><td colspan="4">Implications:
RT & OT have similar complications. No significant difference in postoperative neck pain; neck paresthesia higher in OT.</td></tr>
</table>