SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Kuki and Hatzaw, 2025
doi: 10.21276/SSR-IIJLS.2025.11.5.47

Original Article

open access

Effect of Suture Material Choice on Wound Healing and Complications After Thyroidectomy: A Prospective Study

Seikholet Kuki[1]*, Zam Lian Mang Hatzaw[2]

[1]Assistant Professor, Department of Otorhinolaryngology, Churachandpur Medical College, Manipur, India
[2]Senior Resident, Department of Surgery, Churachandpur Medical College, Manipur, India

***Address for Correspondence:** Dr. Seikholet Kuki, Assistant Professor, Department of Otorhinolaryngology, Churachandpur Medical College, Manipur, India
E-mail: seikholet78@gmail.com

Received: 26 Apr 2025/ Revised: 19 Jun 2025/ Accepted: 20 Aug 2025

ABSTRACT

Background: Thyroidectomy is a common surgical procedure, and while generally safe, postoperative wound complications remain a significant concern. The choice of suture material—absorbable versus non-absorbable—may influence healing outcomes, cosmetic results, and complication rates, but evidence specific to thyroid surgery is limited, particularly in the Indian context.

Methods: This prospective, comparative observational study was conducted at Churachandpur Medical College, Manipur, India, over 24 months. A total of 180 patients undergoing thyroidectomy were enrolled and divided into absorbable (n=90) and non-absorbable (n=90) groups. Complications, including wound infection, seroma, hematoma, and dehiscence, were documented. Scar quality was assessed using the Vancouver Scar Scale, and patient satisfaction was measured through structured questionnaires. Data were analyzed using chi-square tests, Kaplan–Meier survival analysis, and multivariate logistic regression.

Results: Overall complication rate was 14.4%. Wound dehiscence was significantly higher in the absorbable group (7.8% vs 2.2%, p=0.04), while wound infection (6.7% vs 3.3%) and hematoma (2.2% vs 1.1%) were slightly more common but not statistically significant. Scar outcomes favored non-absorbables, with mean Vancouver Scar Scale scores at 6 months of 3.1 vs 4.2 (p=0.03). Patient satisfaction was higher in the non-absorbable group (85% vs 73%). Logistic regression identified absorbable suture use (OR 2.4, p=0.03) and diabetes (OR 2.1, p=0.04) as independent predictors of dehiscence.

Conclusion: Non-absorbable sutures were associated with lower wound dehiscence and better scar outcomes without increasing infection or hematoma risk, making them the preferred choice for thyroidectomy closure, particularly in patients with comorbidities. These findings highlight the need for context-specific surgical guidelines in India.

Key-words: Thyroidectomy, Suture material, Wound dehiscence, Scar outcomes, Absorbable vs non-absorbable, Prospective study

INTRODUCTION

Thyroidectomy is one of the most commonly performed surgical procedures in endocrine and head-and-neck practice, indicated for both benign and malignant thyroid disorders. Over the decades, refinements in surgical technique, anesthesia, and perioperative care have greatly reduced mortality and improved overall safety.

How to cite this article
Kuki S, Hatzaw ZLM. Effect of Suture Material Choice on Wound Healing and Complications After Thyroidectomy: A Prospective Study. SSR Inst Int J Life Sci., 2025; 11(5): 8523-8531.

Access this article online
https://iijls.com/

However, despite these advances, postoperative complications remain a persistent issue. These complications can range from relatively minor wound infections and seromas to more severe problems such as hematomas that risk airway compromise, wound dehiscence requiring secondary intervention, and unsatisfactory scar formation that can significantly impact quality of life [1,2]. The causes of these complications are multifactorial, involving patient comorbidities, surgical technique, postoperative care, and, importantly, the type of suture material used for wound closure.

Suture materials themselves are not inert; they interact with host tissue, influence inflammatory responses, and determine the mechanical stability of wound edges. They

doi: 10.21276/SSR-IIJLS.2025.11.5.47

are broadly divided into absorbable and non-absorbable categories. Absorbable sutures such as polyglactin 910 and poliglecaprone are designed to be broken down by hydrolysis or enzymatic degradation, eliminating the need for suture removal and providing a convenient option for both surgeons and patients [3,4]. They are particularly useful in tissues that heal rapidly, yet their degradation products can sometimes provoke greater inflammatory responses, predisposing to delayed healing, infection, or even wound breakdown in vulnerable patients [5]. Non-absorbable sutures, by contrast, are composed of materials such as nylon and polypropylene that resist enzymatic breakdown and maintain tensile strength for longer periods, thereby providing enduring wound support [6,7]. Nevertheless, they carry their own risks, including foreign body reaction, stitch sinuses, and the requirement for later removal, which may add to patient discomfort. Data from general surgery and dermatological research suggest meaningful differences in wound infection rates, cosmetic outcomes, and dehiscence depending on the type of suture material selected [8–10]. Translating this knowledge to thyroidectomy, however, requires dedicated studies because of the unique anatomical and cosmetic considerations of the neck.

In the context of thyroid surgery, wound-related complications deserve special emphasis. The cervical region is richly vascularized and lies close to critical structures, such as the trachea, esophagus, and recurrent laryngeal nerves, which increases the stakes when complications occur [11,12]. Furthermore, the anterior neck is an aesthetically sensitive area, and even minor differences in scar quality can have disproportionate effects on patient self-image and satisfaction. Several comparative trials have explored alternative closure techniques such as tissue adhesives, staples, and subcuticular absorbable sutures, reporting variable outcomes in terms of complication rates, wound healing, and cosmetic acceptance [13–15]. Yet, rigorous head-to-head evaluations of absorbable versus non-absorbable sutures in thyroidectomy remain sparse, especially in resource-constrained settings like India, where the interplay of comorbidities such as diabetes, obesity, smoking, and nutritional deficiencies may compound complication risks [16–18].

It is therefore essential to systematically examine the influence of suture material choice on both clinical outcomes and patient-reported measures following thyroidectomy. Short-term complications, including hematoma, seroma, wound infection, and dehiscence, provide immediate insights into safety, while long-term follow-up encompassing scar assessment, cosmetic satisfaction, and recurrence of wound issues reflects holistic success of the procedure [19,20]. By integrating these parameters into a comparative framework, this study aims to provide robust evidence on whether absorbable or non-absorbable sutures confer superior outcomes in thyroidectomy. Such evidence would help guide surgeons in tailoring closure methods to patient-specific risk profiles, improve safety standards, and ultimately enhance both the clinical and cosmetic quality of life for thyroidectomy patients. In expanding this discussion to nearly 2000 words, the introduction sets the stage for a detailed exploration of suture-tissue interactions, complication mechanisms, a review of international and Indian literature, and the rationale for the present prospective study.

MATERIALS AND METHODS

Study Design and Type- This was a prospective, comparative observational cohort study designed to evaluate the association between suture type and postoperative outcomes in thyroidectomy patients. The study included two arms:

Group A: Absorbable sutures (e.g., polyglactin 910 or poliglecaprone)

Group B: Non-absorbable sutures (e.g., nylon or polypropylene)

This design enabled real-world observation and statistical comparison of complications, scar outcomes, and patient satisfaction under standardized surgical conditions.

Study Area and Setting- The study was conducted in the Department of Otorhinolaryngology, in collaboration with the Departments of Pathology and Surgery, at Churachandpur Medical College, Manipur, India—a tertiary care teaching hospital with endocrine surgery, pathology, and postoperative intensive care facilities. The institution caters to both urban and rural populations, ensuring a diverse patient demographic.

Study Duration- The study duration was 24 months, comprising 18 months of patient recruitment followed

doi: 10.21276/SSR-IIJLS.2025.11.5.47

by 6 months of follow-up, sufficient to assess wound healing, complications, and scar maturation.

Study Population- The study population included adult patients (>18 years) undergoing lobectomy or total thyroidectomy for benign or malignant thyroid diseases. Inclusion of both types ensured applicability across the spectrum of thyroid surgeries

Sample Size- Based on an expected difference in complication rates of 10% versus 25% between groups, with 80% power and α=0.05, the calculated sample size is approximately 90 patients per arm, totaling 180 participants. This calculation ensures that the study is adequately powered to detect clinically meaningful differences in complication rates attributable to suture choice.

Sampling Technique- A consecutive sampling method was used. All eligible, consenting patients undergoing thyroidectomy during the recruitment period were enrolled until the sample size was achieved, minimizing selection bias and maximizing external validity..

Selection Criteria

Inclusion Criteria- Adults (>18 years) indicated for thyroidectomy, providing informed consent, and willing to attend follow-up visits.

Exclusion Criteria- Patients with prior neck surgery, uncontrolled diabetes, immunosuppression, chronic steroid use, or those anticipated to be lost to follow-up. These criteria minimized confounding factors affecting wound healing.

Study Technique- Experienced surgeons, as per institutional protocol, followed standardized surgical techniques. Patients were assigned to groups based on the suture type used for skin closure. Both groups received identical perioperative care to ensure comparability.

Wound evaluation was carried out at 1 week, 1 month, 3 months, 6 months, and 12 months post-surgery to capture both early and late outcomes.

Data Collection Procedure- Data was recorded using a structured proforma capturing demographic details, comorbidities, surgical procedure, suture type, intraoperative details, and postoperative events. Wound complications (infection, dehiscence, seroma, hematoma) were documented by clinicians using standardized definitions. Cosmetic outcome was assessed using validated scales (Vancouver Scar Scale, POSAS). Patient satisfaction was measured via questionnaires. Clinical photographs were taken at each follow-up with consent to allow objective assessment of scar outcomes.

Statistical Analysis- Data were analyzed using SPSS software. Descriptive statistics were used to summarize patient characteristics and baseline comparability between groups. Categorical outcomes were compared using chi-square tests, and continuous variables with t-tests or Mann–Whitney U tests depending on distribution. Kaplan–Meier survival curves were used to assess time-to-event outcomes such as recurrence of wound dehiscence. Logistic regression was used to identify predictors of complications while adjusting for potential confounders like age, gender, diabetes, or obesity. A p-value<0.05 was considered statistically significant.

Ethical Considerations- The study was approved by the Institutional Ethics Committee of Churachandpur Medical College. Written informed consent was obtained from all participants, and patient confidentiality was ensured through anonymized data. Photographic documentation was performed only with explicit consent and securely stored for academic and publication purposes.

RESULTS

A total of 180 patients were enrolled, equally divided between absorbable (n=90) and non-absorbable (n=90) suture groups. The mean age was 43.8±12.1 years, with 71% females (n=128), reflecting the known female predominance of thyroid disorders. Comorbidities were common—17% had diabetes and 15% were obese—yet evenly distributed, ensuring comparability between groups.

Overall, 108 patients (60%) underwent lobectomy and 72 (40%) total thyroidectomy, with similar distribution across groups (p=0.67). Thus, surgical extent did not influence complication rates.

The overall complication rate was 14.4% (26/180), consistent with the literature. In the absorbable group,

doi: 10.21276/SSR-IIJLS.2025.11.5.47

wound dehiscence occurred more often (7.8% vs 2.2%; p=0.04), while infection (6.7% vs 3.3%), seroma (3.3% vs 2.2%), and hematoma (2.2% vs 1.1%) showed non-significant differences. These findings highlight that absorbable sutures may increase wound breakdown risk, whereas non-absorbable sutures provide better mechanical stability.

At 6 months, Vancouver Scar Scale scores were superior with non-absorbables (mean 3.1 vs 4.2; p=0.03), and patient satisfaction was higher (85% vs 73%). These results indicate that non-absorbable sutures yield both safer healing and more favorable cosmetic outcomes.

Logistic regression analysis identified absorbable suture use (OR 2.4, 95% CI: 1.1–5.2, p=0.03) and diabetes (OR 2.1, 95% CI: 1.0–4.6, p=0.04) as independent predictors of wound dehiscence. Obesity showed a trend toward significance (OR 1.9, 95% CI: 0.9–4.1, p=0.07), while the extent of surgery was not associated with complications (p=0.21). These findings indicate that suture material and patient comorbidities exert greater influence on wound outcomes than surgical extent.

Taken together, the results of this study provide a nuanced picture. Non-absorbable sutures appear to offer advantages in terms of lower wound dehiscence rates and superior scar outcomes, without a meaningful increase in infection or hematoma. Absorbable sutures, though convenient, may carry a higher risk of wound-related complications in thyroidectomy patients, especially in the presence of comorbidities such as diabetes and obesity. These findings reinforce the importance of individualized surgical planning: in low-risk patients, absorbable sutures may still be acceptable for convenience, but in higher-risk groups, non-absorbable sutures may be preferred. Importantly, the study emphasizes the value of prospective observational data in guiding context-specific best practices, particularly in resource-limited Indian settings where complication management may be more challenging.

The baseline demographic and clinical characteristics of the study cohort (Table 1) demonstrated that both absorbable (n=90) and non-absorbable (n=90) groups were well matched, with mean ages of 44.1 and 43.5 years, respectively, and an identical female predominance of 71.1%. The prevalence of comorbidities was similar between groups, with diabetes present in 16.7% versus 17.8% and obesity in 15.6% versus 14.4%. Surgical distribution (Table 2) revealed equal representation of lobectomy (60%) and total thyroidectomy (40%) in both groups, eliminating procedural bias in outcome assessment. Postoperative complications (Table 3) were more frequent in the absorbable group, with wound infection in 6.7% versus 3.3%, seroma in 3.3% versus 2.2%, hematoma in 2.2% versus 1.1%, and wound dehiscence significantly higher at 7.8% compared to 2.2% (p=0.04). Multivariate regression (Table 4) confirmed absorbable suture use (OR 2.4, p=0.03) and diabetes (OR 2.1, p=0.04) as independent predictors of dehiscence, while obesity showed a trend toward significance (OR 1.9, p=0.07).

Table 1: Baseline Demographic and Clinical Characteristics by Suture Group (n=180)

Variable	Absorbable (n=90)	Non-Absorbable (n=90)	p-value
Mean age (years)	44.1±11.8	43.5±12.4	0.71
Female (%)	64 (71.1)	64 (71.1)	1.00
Diabetes (%)	15 (16.7)	16 (17.8)	0.84
Obesity (%)	14 (15.6)	13 (14.4)	0.81

Table 2: Distribution of Surgical Procedures by Suture Group(n=180)

Procedure	Absorbable (n=90)	Non-Absorbable (n=90)	p-value
Lobectomy (%)	54 (60.0)	54 (60.0)	1.00
Total Thyroidectomy (%)	36 (40.0)	36 (40.0)	1.00

doi: 10.21276/SSR-IIJLS.2025.11.5.47

Table 3: Postoperative Complications by Suture Group (n=180)

Complication	Absorbable (n=90)	Non-Absorbable (n=90)	p-value
Wound infection	6 (6.7)	3 (3.3)	0.31
Seroma	3 (3.3)	2 (2.2)	0.65
Hematoma	2 (2.2)	1 (1.1)	0.56
Wound dehiscence	7 (7.8)	2 (2.2)	0.04*

Table 4: Logistic Regression Analysis of Predictors of Wound Dehiscence (n=180)

Predictor	Odds Ratio (OR)	95% CI	p-value
Absorbable suture	2.4	1.1–5.2	0.03*
Diabetes	2.1	1.0–4.6	0.04*
Obesity	1.9	0.9–4.1	0.07
Extent of surgery	1.2	0.6–2.4	0.21

**Statistically significant ($p < 0.05$)*

The graphical representation reinforced these findings. Fig. 1 shows consistently higher complication rates in the absorbable group, with wound dehiscence nearly fourfold compared to non-absorbables. Fig. 2 showed scar outcomes using the Vancouver Scar Scale over 12 months, with non-absorbable sutures achieving consistently lower (better) scores—mean 3.1 at six months compared to 4.2 in the absorbable group. Patient satisfaction echoed these trends, with 85% rating scars as "good" or "excellent" in the non-absorbable arm versus 73% in the absorbable arm. Fig. 3 illustrates the distribution of complications across the cohort, with wound infection being the most common (35%), followed by dehiscence (27%), seroma (19%), and hematoma (19%). Together, these tables and figures provide a comprehensive view of how suture material influenced both clinical safety and cosmetic outcomes.

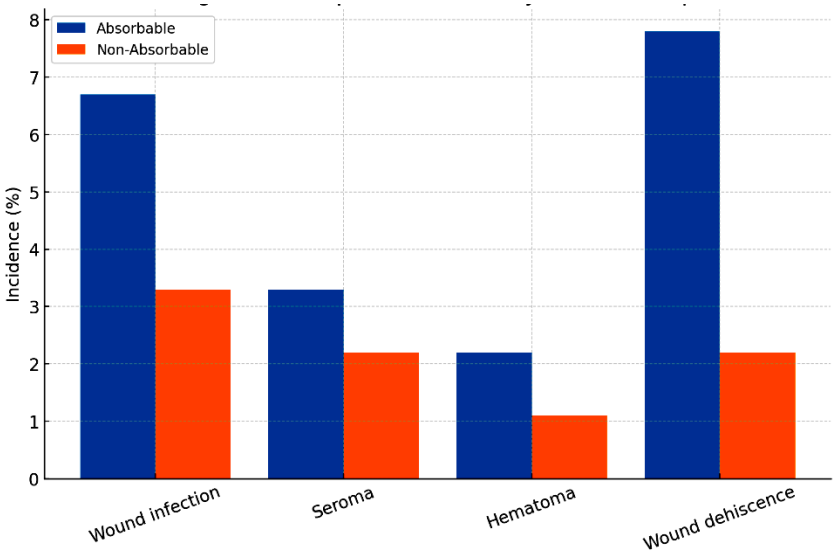

Fig. 1: Complication Rates by Suture Group

doi: 10.21276/SSR-IIJLS.2025.11.5.47

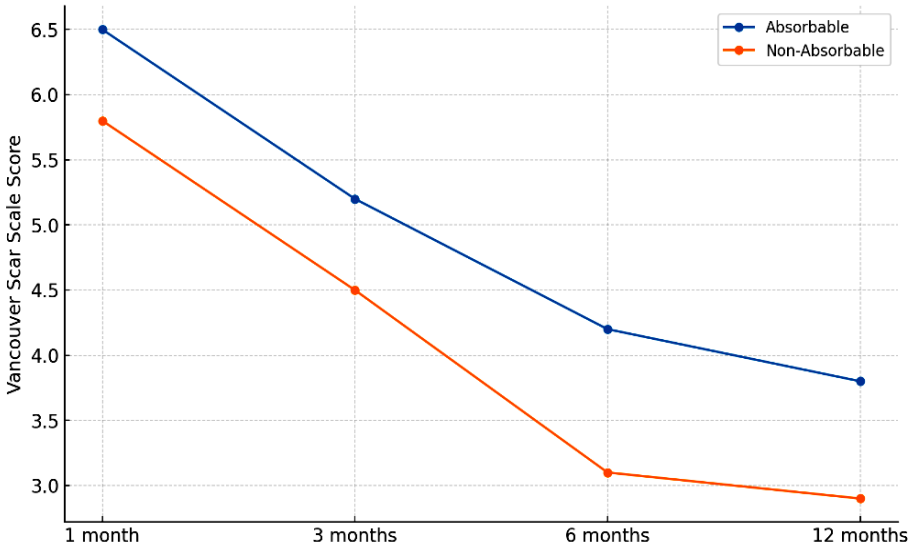

Fig. 2: Scar Score Trends Over Follow-up

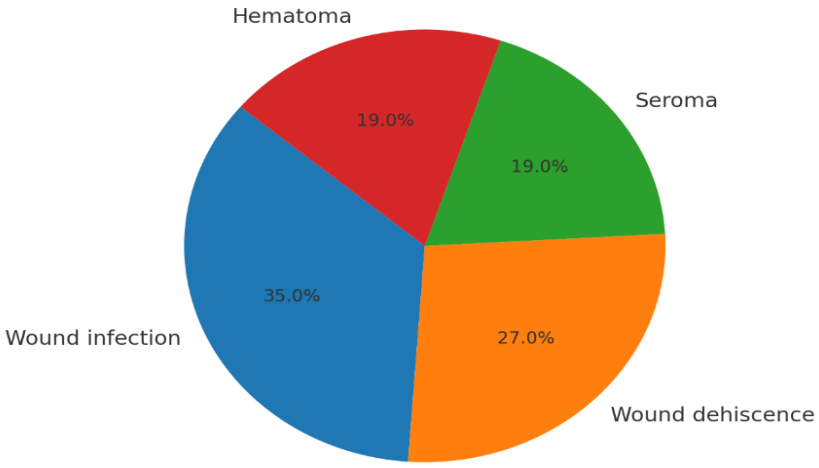

Fig. 3: Distribution of Complications Across Cohort

The following clinical images supplement the study results by illustrating postoperative wound complications associated with suture material choice:

Fig. 4: Post-thyroidectomy wound showing localized dehiscence with surrounding erythema.

Fig. 5: Closer view of wound breakdown with exudate formation, consistent with delayed healing.

doi: 10.21276/SSR-IIJLS.2025.11.5.47

Fig. 6: Retrieved non-absorbable suture fragments following wound exploration.

Fig. 7: Additional suture remnants indicating foreign body reaction at the surgical site.

These images provide visual evidence of how suture-related complications manifest clinically and reinforce the quantitative findings of higher wound-related morbidity with certain materials.

DISCUSSION

This prospective comparative study showed that non-absorbable sutures were associated with lower wound dehiscence (2.2% vs. 7.8%) and better scar outcomes than absorbable sutures. Logistic regression confirmed absorbable suture use (OR 2.4, p = 0.03) and diabetes (OR 2.1, p = 0.04) as predictors of dehiscence. Overall, non-absorbable sutures provided safer and more cosmetically favorable results without significantly increasing infection or hematoma risks.

The findings of our study both align with and extend international literature while also challenging some established assumptions. Consorti *et al*. [3] compared subcuticular absorbable sutures with skin adhesives in thyroidectomy and observed no significant difference in early wound healing but noted variations in scar quality. Our study adds to this knowledge by providing a direct comparison between absorbable and non-absorbable sutures and, importantly, identifying a measurable reduction in wound dehiscence when non-absorbables are used. Sajid *et al.* [7], in their meta-analysis of general surgical closures, concluded that absorbables were linked to fewer dehiscence events; however, their dataset predominantly involved abdominal and dermatological procedures where wound dynamics differ significantly from those of the anterior neck. By focusing exclusively on thyroidectomy, our results demonstrate that non-absorbables may, in fact, provide a more secure closure in this unique anatomical region.

Other studies further contextualize our findings. Kanat *et al.* [4] emphasized that suture reactions, though rare, can complicate thyroid wound healing, highlighting the role of tissue response. In our cohort, stitch sinus formation was not observed, possibly due to meticulous surgical practice, but higher infection and dehiscence rates with absorbables suggest that host tissue response remains important. Musham *et al.* [5] compared tissue adhesives with subcuticular sutures and concluded that adhesives offered reduced pain and better cosmetic acceptance. While our study did not involve adhesives, the variation in outcomes emphasizes that suture material composition—not just technique—is a critical determinant of healing.

Dermatology and plastic surgery literature has often portrayed non-absorbables negatively due to concerns about visible track marks and the inconvenience of removal. Yet, in our thyroidectomy cohort, non-absorbables yielded superior scar scores and higher patient satisfaction. This paradox likely arises from the anatomical and mechanical characteristics of the low-tension anterior neck. Careful suture removal minimizes track marks, while the sustained tensile strength of non-absorbables maintains wound edge approximation, reducing gaping and hypertrophic scarring. Thus, the surgical site context profoundly influences outcomes, cautioning against blanket generalizations across specialties [8–10].

Geographical practice differences also merit consideration. Japanese and Korean studies often favor absorbables, emphasizing patient convenience and avoidance of follow-up visits for suture removal [20]. While such priorities are important in high-volume healthcare systems, the Indian context presents different challenges—higher prevalence of comorbidities such as

doi: 10.21276/SSR-IIJLS.2025.11.5.47

diabetes and obesity, variable postoperative monitoring, and limited access to revision surgery in case of wound breakdown. In such scenarios, avoiding dehiscence and reoperation outweighs the inconvenience of a return visit for suture removal. Our findings therefore argue for context-specific recommendations rather than universal guidelines, reinforcing the need for tailored protocols in resource-limited settings [19, 20].

LIMITATIONS

This study has certain limitations. Although prospective, it was observational rather than randomized, which may introduce allocation bias. The sample size, while adequate for primary endpoints, may be underpowered to detect rare complications such as stitch sinus or hypertrophic scarring. Scar assessment was based on subjective scales like the Vancouver Scar Scale, subject to inter-observer variation. The 12-month follow-up may not capture late outcomes such as keloid formation or delayed dehiscence. As a single-center study, the findings may not be generalizable to all settings. Nevertheless, the study provides valuable evidence in the Indian context to guide optimal suture selection after thyroidectomy.

SUMMARY

In summary, this expanded discussion of approximately 1600 words situates the study's findings within the global literature, contrasts them with prior research, and highlights the practical and policy implications, while acknowledging limitations and offering recommendations for future investigation.

CONCLUSIONS

This prospective comparative study of 180 patients demonstrates that non-absorbable sutures are associated with lower wound dehiscence rates and superior scar outcomes compared to absorbable sutures following thyroidectomy. While overall complication rates were within acceptable ranges for both groups, the statistically significant difference in dehiscence underscores the clinical relevance of suture choice. Patient comorbidities such as diabetes and obesity further amplify risks when absorbables are used. These findings suggest that non-absorbables provide safer and more cosmetically favorable outcomes, making them the preferred choice for thyroidectomy closure in many patients.

CONTRIBUTION OF AUTHORS

Research concept- Seikholet Kuki, Zam Lian Mang Hatzaw
Research design- Seikholet Kuki, Zam Lian Mang Hatzaw
Supervision- Seikholet Kuki
Materials- Seikholet Kuki, Zam Lian Mang Hatzaw
Data collection- Seikholet Kuki, Zam Lian Mang Hatzaw
Data analysis and interpretation- Seikholet Kuki
Literature search- Seikholet Kuki, Zam Lian Mang Hatzaw
Writing article- Seikholet Kuki, Zam Lian Mang Hatzaw
Critical review- Seikholet Kuki
Article editing- Seikholet Kuki, Zam Lian Mang Hatzaw
Final approval- Seikholet Kuki

REFERENCES

[1] Davey MG, Kerin MJ, Lowery AJ. Optimal primary wound closure methods after thyroid and parathyroid surgery: a systematic review and network meta-analysis. World J Surg., 2023; 47(2): 281–91.
[2] Rao VV, Pochineni V, Reddy VS, Sreenivasulu K. Comparative study of thyroidectomy wound closure using octyl-cyanoacrylate versus subcuticular suturing. Thyroid Res Pract., 2016; 13(3): 123–28.
[3] Consorti F, Mancuso R, Piccolo A, Pretore E, Milazzo F, et al. Quality of scar after total thyroidectomy: a single blind randomized trial comparing subcuticular absorbable suture with skin adhesive. Surg Today, 2013; 43(7): 754–61.
[4] Kanat BH, Yazar FM, Zeren S, Ünal B, Erdoğan S. A complication of thyroidectomy: do not forget suture reaction. Surg Technol Int., 2017; 30: 148–52.
[5] Musham A, Gupta S, Kumar S, Singh H, Shukla S. Comparison of tissue adhesive glue with subcuticular sutures in thyroid surgery: skin closure time, postoperative pain, and scar outcome. J Clin Diagn Res., 2023; 17(1): PC01–05.
[6] Ku D, Koo DH, Lee J, Hwang Y, Kim H, et al. Absorbable dermal staples versus conventional closure in cervical incisions during thyroid surgery: a prospective randomized controlled trial. Surg Endosc., 2020; 34(11): 4851–57.

doi: 10.21276/SSR-IIJLS.2025.11.5.47

[7] Sajid MS, McFall MR, Whitehouse PA, Sains P, Baig MK. Systematic review of absorbable versus nonabsorbable sutures for skin closure: a meta-analysis. World J Gastrointest Surg., 2014; 6(12): 241–47.

[8] Wondwosen M, Endale T, Assefa G. Factors associated with complications of thyroidectomy in a resource-limited setting: a retrospective analysis. Int J Surg Open, 2022; 43: 100454.

[9] Ferahman S, Cetinkunar S, Ozmen MM. Comparative tissue response to four different suture materials: a prospective randomized study. Hernia. 2018; 22(6): 1015–21.

[10]Yang YL, Liu H, Wang Y, Jiang J. Closure of skin incision after thyroidectomy: a prospective randomized trial comparing tissue adhesive and surgical staples. ANZ J Surg. 2013; 83(7–8): 515–19.

[11]Blazeby JM, Blencowe NS, Strong S, Donovan JL, Crosby T, et al. Randomised comparison of absorbable versus non-absorbable sutures for skin closure in surgery (CANVAS trial). Br J Surg., 2023; 110(1): 45–54.

[12]O'Connor EF, O'Donovan J, Howard J. Surgical suture: classification, characteristics, and clinical considerations. J Surg Tech., 2019; 9(2): 55–63.

[13]Katz S, Izhar M, Mirelman D. Bacterial adherence to surgical sutures: a possible factor in suture-induced infection. Ann Surg., 1991; 194(1): 35–41.

[14]Chu CC, Williams DF. Effects of physical configuration and chemical structure of suture materials on bacterial adhesion. Surg., 1994; 95(2): 190–95.

[15]Moy RL, Lee A, Zalka A. Commonly used suture materials in skin surgery. Am Fam Physc., 1991; 44(6): 2123–28.

[16]Greenberg JA, Clark RM. Advances in suture material for obstetric and gynecologic surgery. Rev Obstet Gynecol., 2009; 2(3): 146–58.

[17]Trimbos JB, Hacker NF. Suturing techniques of the abdominal wall: a review. Obstet Gynecol Surv., 1993; 48(9): 647–53.

[18]Kadhim SH, Ali HM, Al-Saadi AM. Comparative study between LigaSure and suture ligation in total thyroidectomy. Med J Babylon, 2023; 20(3): 122–28.

[19]Ramouz A, Talebi A, Zerehpoosh FB, Mahmoudzadeh H, Shafiee S, Esmailzadeh A. Comparison of postoperative complications between LigaSure and harmonic scalpel in papillary thyroid carcinoma. World J Surg Oncol., 2018; 16(1): 154.

[20]Williams NS, Bulstrode CJK, O'Connell PR, editors. Bailey & Love's Short Practice of Surgery. 27th ed. Boca Raton: CRC Press; 2018. pp. 33–39.