Section: General Surgery

Original Research Article

ROLE OF SELECTIVE PARATHYROID GLAND AUTO-TRANSPLANTATION DURING TOTAL-THYROIDECTOMY IN ELIMINATING POSTOPERATIVE HYPO-PARATHYROIDISM, IN A TERTIARY CARE CENTRE - A PROSPECTIVE STUDY

Kundhavi P[1], R. Kamatchi Shankar[1], Janakiraman R[2], S. Muthukumar[3], D. Geetha[4]

[1]Assistant Professor, Department of General Surgery, Government Rajaji Hospital, Madurai, India
[2]Associate Professor, Department of General Surgery, Government Rajaji Hospital, Madurai, India
[3]Assistant Professor, Department of Endocrine Surgery, Government Rajaji Hospital, Madurai, India
[4]Professor, Department of General Surgery, Government Rajaji Hospital, Madurai, India

Received : 12/09/2025
Received in revised form : 01/11/2025
Accepted : 18/11/2025

Keywords:
Calcium, Hypocalcaemia, Hypoparathyroidism, Parathyroid Hormone, and Thyroidectomy.

Corresponding Author:
Dr. Kundhavi P,
Email: pkundhavi80@gmail.com

DOI: 10.47009/jamp.2025.7.6.67

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (6); 343-347

ABSTRACT

Background: Postoperative hypocalcaemia, a frequent complication of total thyroidectomy caused by parathyroid injury or devascularization, may be prevented by selective autotransplantation of glands with doubtful viability. This study evaluated whether selective transplantation reduced postoperative hypocalcaemia and hypoparathyroidism. **Materials and Methods:** This prospective comparative study, conducted at Government Rajaji Hospital, Madurai Medical College, Madurai (August 2016–July 2022), included 58 patients (28 experimental, 30 control) undergoing total or near-total thyroidectomy for benign thyroid disease. In the experimental group, parathyroid glands with doubtful viability assessed using the Intraoperative Parathyroid Viability Score (IPVS) were resected, minced (1–3 mm), and auto-transplanted into the sternocleidomastoid muscle. Serum calcium and parathyroid hormone (PTH) levels were recorded pre-operatively, on postoperative day 2, and at 2 and 6 months. **Result:** The mean age was 44.89±9.63 years in the experimental group and 42.73±10.21 years in controls. The mean serum calcium (mg/dL) increased in the experimental group from 8.86±0.41 pre-operatively to 9.22±0.22 at 6 months (F=26.84, p=0.001), while in the control group it changed from 8.82±0.39 to 8.85±0.19 (F=1.44, p=0.69). Mean serum PTH (pg/mL) improved from 38.63±5.97 on postoperative day 2 to 49.50±2.83 at 6 months in the experimental group (F=37.77, p=0.001), and from 36.60±4.30 to 39.40±3.41 in controls (F=6.19, p=0.01). Hypocalcaemia symptoms were noted in 8(28.6%) vs. 9(30%) on day 2, 2(7.1%) vs. 8(26.7%) at 2 months, and 0 vs. 2(6.7%) at 6 months (p=0.05) in experimental vs. control groups. **Conclusion:** Selective parathyroid auto-transplantation guided by intraoperative viability scoring significantly improved postoperative calcium and PTH recovery and reduced transient and permanent hypocalcaemia after thyroidectomy.

INTRODUCTION

Postoperative hypocalcaemia is a well-recognised complication of total and near-total thyroidectomy. The removal of the thyroid gland may lead to injury or compromised blood flow to the adjacent parathyroid glands, causing reductions in parathyroid hormone (PTH) secretion and subsequent hypocalcaemia.[1] Reported rates of transient hypoparathyroidism vary from 19% to 38% and permanent hypoparathyroidism occurs in <5% after thyroidectomy even in experienced hands.[2]

The causes of post-thyroidectomy hypoparathyroidism include inadvertent removal of one or more parathyroid glands, devascularisation of the glands during surgical dissection and unrecognised damage to the glands' microarchitecture.[3]. The risk increases further when bilateral neck dissection or extensive thyroid surgery is performed.[4] Preservation of all four parathyroid glands with intact vascularity remains the gold

standard, but this is not always achievable, especially in complex thyroid disease or re-surgeries.[5]

Intraoperative decisions play a key role in the management of parathyroid gland viability. Surgeons assess colour of the gland, bleeding from the incised capsule and perfusion to decide whether a gland is viable.[6] More advanced techniques such as indocyanine green fluorescence angiography (ICG) and autofluorescence imaging, are being increasingly used to assess perfusion objectively, although cost and equipment availability limit their use in many settings.[7,8] These assessments are needed to guide in the preservation or auto-transplantation of an impaired gland.

When a parathyroid gland is judged to have compromised viability or is inadvertently removed, auto-transplantation of the gland into a muscle bed (commonly the sternocleidomastoid or Brachioradialis muscle) is an established surgical option.[9] A study showed very low rates (1.9 %) of permanent hypoparathyroidism when routine auto-transplantation was used in thyroid surgery.[10] In contrast, some recent evidence suggests that autotransplantation may not significantly reduce the risk of permanent hypoparathyroidism and may even be associated with higher rates of transient hypocalcaemia.[11]

Given the mixed evidence and the importance of selecting the right intraoperative strategy, there is a particular need to evaluate selective auto-transplantation in the setting of benign thyroid disease and routine total thyroidectomy. This study aims to assess whether selective auto-transplantation of parathyroid glands, when their viability is doubtful, during total thyroidectomy in a tertiary care centre, reduces the incidence of postoperative hypocalcaemia and permanent hypoparathyroidism at 6 months of follow-up.

MATERIALS AND METHODS

This prospective comparative study was conducted with 58 patients who underwent total or near-total thyroidectomy for benign thyroid disorders in the Department of General Surgery at the Government Rajaji Hospital and Madurai Medical College, from August 2016 to July 2022. Ethical approval for the study protocol was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants before inclusion.

Inclusion criteria

This study included patients aged between 25 and 65 years who underwent total or near-total thyroidectomy for benign thyroid disease, with no prior thyroid surgery.

Exclusion criteria

Patients with renal insufficiency or those on dialysis, and those with thyroid malignancy were excluded. Patients in whom all four parathyroid glands could not be identified during surgery were excluded. Individuals with pre-operative serum calcium levels < 8.0 mg/dl or >10.4 mg/dl, or serum albumin levels outside the range of 3.4–4.8 g/dl, were excluded.

Methods: Eligible patients were divided into two groups based on the intraoperative assessment of parathyroid gland viability. The experimental group consisted of 28 patients in whom selective Parathyroid auto-transplantation was performed when one or more parathyroid glands appeared devascularized, whereas the control group consisted of 30 patients in whom all parathyroid glands were preserved in-situ with intact vascularity.

All patients underwent total or near-total thyroidectomy under General Anaesthesia following standard aseptic precautions. Intraoperatively, meticulous dissection was performed to identify all four parathyroid glands and to preserve their vascular integrity. The viability of each identified parathyroid gland was assessed using an Intraoperative Parathyroid Viability Scoring (IPVS) system. Parathyroid glands with doubtful viability were carefully resected and immediately placed in ice-cold saline solution. The excised glands were then minced into 1–3 mm fragments, suspended in 1 ml of normal saline, and auto transplanted into a small pocket created within the belly of the ipsilateral sternocleidomastoid muscle. The muscle pocket was closed with fine absorbable sutures and the surgical incision was closed routinely at the end of the procedure.

Postoperatively, the patients were monitored for clinical symptoms of hypocalcaemia, and serial estimations of serum calcium and parathyroid hormone levels were performed to assess parathyroid function on second post-operative day, reviewed at the second and sixth post-operative months to identify any cases of persistent hypocalcaemia or the need for prolonged calcium supplementation. Patients were thus serially evaluated to compare outcomes in those who underwent selective parathyroid autotransplantation with those who did not.

Statistical analysis: All collected data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 23.0. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. An independent sample t-test was used to compare continuous variables between the groups, and a chi-square test was used to compare categorical variables. Repeated measures ANOVA and McNemar's test were applied to assess changes in biochemical parameters and paired categorical outcomes over time. Statistical significance was set at $p < 0.05$.

RESULTS

The mean age was 44.89 ± 9.63 years in the experimental group and 42.73 ± 10.21 years in the control group (Student Independent t test: $Z = 0.83$, $p = 0.41$). Among participants, 4 (14.3%) males and 24

ISSN (O): 2687-5365; ISSN (P): 2753-6556

(85.7%) females were in the experimental group, while 3 (10.0%) males and 27 (90.0%) females were in the control group (Chi square $\chi^2 = 0.25$, $p = 0.61$). The mean pre-operative serum albumin levels were 4.27 ± 0.34 g/dL and 3.99 ± 0.24 g/dL (Student Independent t test $t = 1.56$, $p = 0.12$), and serum calcium levels were 8.86 ± 0.41 mg/dL and 8.82 ± 0.39 mg/dL ($t = 0.38$, $p = 0.70$) in the experimental and control groups, respectively. The mean IPVS was 2.71 ± 0.76 in the experimental group and 3.03 ± 0.85 in the control group ($t = 1.50$, $p = 0.14$) [Table 1].

Table 1: Baseline characteristics of the study groups

Parameter		Experimental group (n = 28)	Control group (n = 30)	Tests
Age (years)	Mean ± SD	44.89 ± 9.63	42.73 ± 10.21	Z = 0.83, p = 0.41
Gender	Male	4 (14.3%)	3 (10.0%)	$\chi^2 = 0.25$, p = 0.61
	Female	24 (85.7%)	27 (90.0%)	
Pre-operative albumin (g/dL)	Mean ± SD	4.27 ± 0.34	3.99 ± 0.24	t = 1.56, p = 0.12
Serum calcium (mg/dL)	Pre-operative (Mean ± SD)	8.86 ± 0.41	8.82 ± 0.39	t = 0.38, p = 0.70
Index of parathyroid viability score (IPVS) (Min = 0, Max = 12)	Mean ± SD	2.71 ± 0.76	3.03 ± 0.85	T = 1.50, p = 0.14

The mean serum calcium (mg/dL) in the experimental vs. control groups was 8.86 ± 0.41 vs. 8.82 ± 0.39 pre-operatively ($t = 0.38$, $p = 0.70$), 8.93 ± 0.43 vs. 8.84 ± 0.40 on post-op day 2 ($t = 0.78$, $p = 0.43$), 9.05 ± 0.43 vs. 8.85 ± 0.40 at 2 months ($t = 1.77$, $p = 0.08$), and 9.22 ± 0.22 vs. 8.85 ± 0.19 at 6 months ($t = 6.88$, $p = 0.001$). Repeated measures ANOVA showed significance in the experimental group ($F = 26.84$, $p = 0.001$), but not in the control group ($F = 1.44$, $p = 0.69$).

The mean serum PTH (pg/mL) in the experimental vs. control groups was 38.63 ± 5.97 vs. 36.60 ± 4.30 on post-op day 2 ($t = 1.63$, $p = 0.10$), 43.82 ± 5.02 vs. 37.90 ± 3.21 at 2 months ($t = 3.08$, $p = 0.01$), and 49.50 ± 2.83 vs. 39.40 ± 3.41 at 6 months ($t = 3.31$, $p = 0.01$). Repeated-measures ANOVA showed significant variation over time in both groups ($F = 37.77$, $p = 0.001$ and $F = 6.19$, $p = 0.01$, respectively) [Table 2].

Table 2: Comparison of serum calcium and serum PTH levels between groups

Parameter	Subtype	Experimental group (n = 28)	Control group (n = 30)	Student's Independent t-test
Serum Calcium (mg/dL)	Pre-operative	8.86 ± 0.41	8.82 ± 0.39	t = 0.38, p = 0.70
	Post-op Day 2	8.93 ± 0.43	8.84 ± 0.40	t = 0.78, p = 0.43
	2nd Month post-op	9.05 ± 0.43	8.85 ± 0.40	t = 1.77, p = 0.08
	6th Month Post-op	9.22 ± 0.22	8.85 ± 0.19	t = 6.88, p = 0.001*
One-way ANOVA repeated measures		F=26.84 P=0.001*	F=1.44 P=0.69	-
Serum PTH (pg/mL)	Post-op Day 2	38.63 ± 5.97	36.60 ± 4.30	t = 1.63, p = 0.10
	2nd Month post-op	43.82 ± 5.02	37.90 ± 3.21	t = 3.08, p = 0.01*
	6th Month post-op	49.50 ± 2.83	39.40 ± 3.41	t = 3.31, p = 0.01*
One-way ANOVA (Repeated measures)		F = 37.77, p = 0.001*	F = 6.19, p = 0.01	-

On postoperative day 2, hypocalcaemia symptoms were present in 8 (28.6%) patients in the experimental group and 9 (30.0%) in the control group ($\chi^2 = 0.01$, $p = 0.90$). At the 2nd-month follow-up, symptoms were noted in two (7.1%) patients in the experimental group and eight (26.7%) patients in the control group ($\chi^2 = 3.86$, $p = 0.05$). By the 6th month, none of the patients in the experimental group and 2 (6.7%) in the control group reported symptoms ($\chi^2 = 1.93$, $p = 0.16$) [Table 3].

Table 3: Comparison of hypocalcaemia symptoms between groups

Parameter		Symptoms	Experimental group (n = 28)	Control group (n = 30)	Chi-square Test
Hypocalcaemia symptoms	Post-op Day 2	No	20 (71.4%)	21 (70%)	$\chi^2 = 0.01$, p = 0.90
		Yes	8 (28.6%)	9 (30%)	
	2nd Month Post-op	No	26 (92.9%)	22 (73.3%)	$\chi^2 = 3.86$, p = 0.05
		Yes	2 (7.1%)	8 (26.7%)	
	6th Month Post-op	No	28 (100%)	28 (93.3%)	$\chi^2 = 1.93$, p = 0.16
		Yes	0	2 (6.7%)	

In the experimental group, the proportion of patients without hypocalcaemia symptoms increased from 20 (71.4%) on postoperative day 2 to 26 (92.9%) in the 2nd month and 28 (100.0%) in the 6th month, showing significant improvement ($\chi^2 = 9.21$, $p = 0.001$). In the control group, the number of patients without symptoms increased from 21 (70.0%) on postoperative day 2 to 22 (73.3%) at the 2nd month and 28 (93.3%) at the 6th month, which also showed

ISSN (O): 2687-5365; ISSN (P): 2753-6556

a statistically significant improvement over time (χ^2 = 6.83, p = 0.01) [Table 4].

Table 4: Comparison of hypocalcaemia symptoms over time within groups

Parameter	Symptoms	Post-op Day 2	2nd Month	6th Month	McNemar's Test (Post-op Day 2 vs. 6th Month)
Hypocalcaemia symptoms in the experimental group	No	20 (71.4%)	26 (92.9%)	28 (100%)	χ^2 = 9.21, p = 0.001
	Yes	8 (28.6%)	2 (7.1%)	0	
Hypocalcaemia symptoms in the Control group	No	21 (70%)	22 (73.3%)	28 (93.3%)	χ^2 = 6.83, p = 0.01
	Yes	9 (30%)	8 (26.7%)	2 (6.7%)	

DISCUSSION

This study evaluated the effect of selective parathyroid autotransplantation during total thyroidectomy on postoperative calcium balance. The results showed that transplanting parathyroid glands with doubtful viability significantly improved serum calcium and PTH levels and reduced the frequency and duration of hypocalcaemic symptoms in the recipients. Thus, selective autotransplantation supports better parathyroid recovery and minimises transient hypocalcaemia after thyroidectomy.

In our study, both groups were comparable at baseline, with no significant differences in age, gender distribution, serum albumin, serum calcium, or IPVS values. In a prospective study, Barczyński et al. evaluated 340 patients who underwent total thyroidectomy, equally divided into two groups. Both groups were comparable in terms of age, gender ratio, and thyroid pathology, showing no significant differences (p > 0.05).[12] Similarly, Sun et al. studied 1,153 patients, including 501 who underwent parathyroid autotransplantation and 652 who did not. The groups showed no significant variations in demographic or tumour-related characteristics (p > 0.05).[13] These findings confirm that all study groups were well matched at baseline, ensuring a reliable comparison of postoperative outcomes.

In our study, serum calcium levels improved significantly over time in the experimental group, while they remained stable in the control group. This indicates that the intervention promoted better calcium recovery after surgery than the standard treatment. Barczyński et al. found that postoperative serum calcium levels were initially low but gradually normalised, rising from 2.01 ± 0.09 mmol/L at 24 hours to 2.36 ± 0.06 mmol/L at 6 months in Group B compared to 2.21 ± 0.06 mmol/L in Group A (p < 0.001).12 Similarly, Zedenius et al. observed a transient postoperative calcium decline, with mean decreases of 0.22 mmol/L and 0.35 mmol/L in the non-replacement and calcium replacement groups, respectively, which normalised by 2 months.[14]

Almquist et al. noted a drop in serum calcium in 97.6% of patients on day 1, where 52.9% had levels <2.10 mmol/L; however, most recovered over time, and permanent hypoparathyroidism occurred in only 1.2%.[15] Furthermore, Palazzo et al. reported temporary hypocalcaemia in 12.5% of patients after total thyroidectomy, with incidence increasing as more parathyroid glands were autotransplanted (p = 0.001), though permanent hypocalcaemia remained rare (0.84%).[16] The consistent pattern across studies suggests that transient calcium decline is a normal postoperative response, and proper intervention facilitates full recovery.

In our study, serum PTH levels increased over time in both groups, with a more increase in the experimental group, indicating enhanced parathyroid functional recovery following the intervention. Similarly, Barczyński et al. reported that the mean intraoperative PTH value before skin closure was significantly higher in Group B (26 ± 8.6 ng/L) than in Group A (18.2 ± 6.8 ng/L, p < 0.001). Similarly, postoperative PTH recovery was greater in Group B throughout follow-up, with 33.4 ± 5.6 ng/L at 6 months versus 27.3 ± 6.7 ng/L in Group A (p = 0.005).12 Likewise, Almquist et al. found that intact PTH (iPTH) measurements were highly predictive of postoperative hypoparathyroidism. An iPTH < 15 pg/mL on day 1 had very high sensitivity for predicting hypoparathyroidism, and most patients with transient hypoparathyroidism had normalised iPTH by 4 weeks.[15] Progressive PTH improvement demonstrates effective restoration of parathyroid function following selective gland preservation or transplantation.

In our study, hypocalcaemia symptoms resolved more quickly and completely in the experimental group, indicating a faster recovery with the intervention. In a comparative study, Barczyński et al. reported transient hypocalcaemia in 22.4% of patients without autotransplantation and 11.2% with it (p = 0.006), with no cases of permanent hypocalcaemia, indicating fewer symptoms among those who underwent parathyroid autotransplantation.[12] Similarly, Sun et al. found a higher rate of transient hypoparathyroidism in the autotransplantation group (67.1% vs. 49.8%) but a significantly lower rate of permanent hypoparathyroidism (1.2% vs. 4.4%, p = 0.001), suggesting effective long-term prevention.[13] In line with these results, Palazzo et al. observed that although temporary hypocalcaemia increased with the number of glands autotransplanted, permanent hypocalcaemia remained uncommon (0.84%), showing that most patients achieved full calcium recovery over time.[16] These results highlight the clinical advantage of selective autotransplantation in reducing permanent hypocalcaemia and improving postoperative recovery.

In our study, both groups showed improvement in symptom-free status over time, with the experimental group achieving faster and more complete recovery,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

indicating better postoperative calcium restoration. Sun et al. found that transient hypoparathyroidism increased with the number of autotransplanted glands (49.8%, 59.5%, 86.0%, and 85.7% for 0–3 glands; $p < 0.001$), while permanent hypoparathyroidism significantly decreased (4.4%, 1.4%, 0.7%, 0.0%; $p = 0.016$), indicating better long-term parathyroid recovery.[13] Likewise, Zedenius et al. reported complete resolution of postoperative hypocalcaemia symptoms within 2 months, with all 14 affected patients recovering fully and no permanent hypocalcaemia.[14] Almquist et al. noted that most cases of transient hypoparathyroidism resolved within weeks, with normalisation of iPTH by 4 weeks and Se Ca at later follow-ups, and permanent hypoparathyroidism was rare (1.2%), showing a steady recovery pattern.[15] The consistent recovery trends across studies suggest that autotransplantation supports sustained restoration of calcium balance and parathyroid function.

Limitations: This study was conducted at a single tertiary care centre with a relatively small sample size, which may limit the generalisability of the findings.

CONCLUSION

Selective parathyroid auto-transplantation during total thyroidectomy, guided by intraoperative viability assessment, significantly improved postoperative calcium and parathyroid hormone recovery compared with in situ preservation alone. The experimental group showed earlier resolution of hypocalcaemia symptoms and better biochemical outcomes at six months. These findings support selective autotransplantation as an effective strategy for minimising transient and long-term postoperative hypocalcaemia. Future studies with larger multicentre samples and longer follow-up periods are warranted to validate these results and to assess long-term graft functionality.

REFERENCES

1. Akgun IE, Unlu MT, Aygun N, Kostek M, Tufan AE, Yanar C, et al. The reality of hypoparathyroidism after thyroidectomy: Which risk factors are effective? Single-center study. SiSli Etfal Hastan Tip Bul / Med Bull Sisli Hosp 2022;56:262–9. https://doi.org/10.14744/SEMB.2022.24356.
2. Loncar I, Noltes ME, Dickhoff C, Engelsman AF, Schepers A, Vriens MR, et al. Persistent post-thyroidectomy hypoparathyroidism in the Netherlands. JAMA Otolaryngol Head Neck Surg 2021;147:959–65. https://doi.org/10.1001/jamaoto.2021.2475.
3. Privitera F, Centonze D, La Vignera S, Condorelli RA, Distefano C, Gioco R, et al. Risk factors for hypoparathyroidism after thyroid surgery: A single-center study. J Clin Med 2023;12:1956. https://doi.org/10.3390/jcm12051956.
4. Wang X, Wang S-L, Cao Y, Li C-Q, He W, Guo Z-M. Postoperative hypoparathyroidism after thyroid operation and exploration of permanent hypoparathyroidism evaluation. Front Endocrinol (Lausanne) 2023;14:1182062. https://doi.org/10.3389/fendo.2023.1182062.
5. Rao SS, Rao H, Moinuddin Z, Rozario AP, Augustine T. Preservation of parathyroid glands during thyroid and neck surgery. Front Endocrinol (Lausanne) 2023;14:1173950. https://doi.org/10.3389/fendo.2023.1173950.
6. Sobutay E, Cakit H, Terzioglu T. Assessing parathyroid gland viability and predicting postoperative hypoparathyroidism in thyroid surgery: The utility of indocyanine green angiography. SiSli Etfal Hastan Tip Bul / Med Bull Sisli Hosp 2023;57:466–72. https://doi.org/10.14744/SEMB.2023.06691.
7. Santa Ritta Barreira CE, Miranda AP, Peixoto TF, Pinheiro RN. Indocyanine green angiography to evaluate immediate hypoparathyroidism after thyroid cancer surgery. Endocrine 2025;88:847–51. https://doi.org/10.1007/s12020-025-04210-1.
8. Richard M, Rizo P. Feasibility of parathyroid gland autofluorescence imaging after indocyanine green fluorescence angiography. Front Endocrinol (Lausanne) 2023;14:1248449. https://doi.org/10.3389/fendo.2023.1248449.
9. Hicks G, George R, Sywak M. Short and long-term impact of parathyroid autotransplantation on parathyroid function after total thyroidectomy. Gland Surg 2017;6:S75–85. https://doi.org/10.21037/gs.2017.09.15.
10. Almquist M, Hallgrimsson P, Nordenström E, Bergenfelz A. Prediction of permanent hypoparathyroidism after total thyroidectomy. World J Surg 2014;38:2613–20. https://doi.org/10.1007/s00268-014-2622-z.
11. Kasmirski JA, Allahwasaya A, Wu C, Song Z, Akhund R, Balachandra S, et al. Does parathyroid autotransplantation prevent hypoparathyroidism after thyroid surgery? Ann Surg 2025. https://doi.org/10.1097/SLA.0000000000006631.
12. Barczyński M, Cichoń S, Konturek A, Cichoń W. Applicability of intraoperative parathyroid hormone assay during total thyroidectomy as a guide for the surgeon to selective parathyroid tissue autotransplantation. World J Surg 2008;32:822–8. https://doi.org/10.1007/s00268-007-9405-8.
13. Sun H, Gao L, Xiao G, Xie L, Zhuang Y, Wang J. Selective parathyroid autotransplantation prevent permanent hypoparathyroidism after total thyroidectomy with central neck dissection. Front Surg 2025;12:1565581. https://doi.org/10.3389/fsurg.2025.1565581.
14. Zedenius J, Wadstrom C, Delbridge L. Routine autotransplantation of at least one parathyroid gland during total thyroidectomy may reduce permanent hypoparathyroidism to zero. Aust N Z J Surg 1999;69:794–7. https://doi.org/10.1046/j.1440-1622.1999.01697.x.
15. Asari R, Passler C, Kaczirek K, Scheuba C, Niederle B. Hypoparathyroidism after total thyroidectomy: a prospective study: A prospective study. Arch Surg 2008;143:132–7; discussion 138. https://doi.org/10.1001/archsurg.2007.55.
16. Palazzo FF, Sywak MS, Sidhu SB, Barraclough BH, Delbridge LW. Parathyroid autotransplantation during total thyroidectomy--does the number of glands transplanted affect outcome? World J Surg 2005;29:629–31. https://doi.org/10.1007/s00268-005-7729-9.

ISSN (O): 2687-5365; ISSN (P): 2753-6556