

Research Article

Outcomes of Total Versus Subtotal Thyroidectomy in Multinodular Goiter

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ABSTRACT

Background

Multinodular goiter remains a common endocrine disorder in South Asia, including Sri Lanka, despite longstanding iodine supplementation programs. Surgical management is often required for symptomatic disease; however, the optimal extent of thyroid resection—total thyroidectomy (TT) versus subtotal thyroidectomy (ST)—continues to be debated, particularly in resource-limited settings. This study aimed to compare postoperative outcomes, complication rates, and recurrence between TT and ST in patients undergoing surgery for multinodular goiter.

Methods

A prospective comparative study was conducted at a tertiary referral center in Sri Lanka between 2019 and 2024. A total of 240 adult patients with bilateral multinodular goiter were included and underwent either total thyroidectomy (n = 120) or subtotal thyroidectomy (n = 120). Preoperative evaluation included thyroid function tests, ultrasonography, and fine-needle aspiration cytology when indicated. Primary outcomes were postoperative hypocalcemia and recurrent laryngeal nerve (RLN) injury. Secondary outcomes included operative time, hospital stay, incidental malignancy, recurrence, and need for reoperation. Statistical analysis was performed using standard comparative tests, with $P < 0.05$ considered significant.

Results

Total thyroidectomy was associated with a significantly longer operative time ($P < 0.001$) and a higher incidence of transient hypocalcemia (23.3% vs 10.0%; $P = 0.006$). However, rates of permanent hypocalcemia (2.5% vs 0.8%) and permanent RLN palsy (0.8% vs 0.8%) were low and

comparable between groups. No recurrence was observed following total thyroidectomy, whereas 9.2% of patients in the subtotal thyroidectomy group developed recurrent nodular disease requiring medical treatment or reoperation ($P < 0.001$). Incidental thyroid carcinoma was detected more frequently in the TT group, allowing definitive management at the initial operation.

Conclusions

Total thyroidectomy provides superior long-term disease control compared with subtotal thyroidectomy for multinodular goiter, without increasing permanent complication rates when performed by experienced surgeons. Although transient hypocalcemia is more common after total thyroidectomy, it is manageable with standardized postoperative care. These findings support total thyroidectomy as the preferred surgical approach for bilateral multinodular goiter in Sri Lanka and similar South Asian settings, with implications for surgical training, guideline development, and health policy.

Keywords: Multinodular goiter; Total thyroidectomy; Subtotal thyroidectomy; Hypocalcemia; Recurrence

INTRODUCTION

Multinodular goiter (MNG) remains one of the most prevalent thyroid disorders worldwide and continues to represent a significant public health concern in South Asia, particularly in regions with historical or residual iodine deficiency [1]. In Sri Lanka, despite the implementation of universal salt iodization programs, multinodular goiter persists as a common indication for endocrine surgical referral, especially among middle-aged and elderly women [2]. Population-based surveys have demonstrated that thyroid enlargement and nodularity remain highly prevalent in both coastal and inland regions, influenced by dietary iodine intake, genetic susceptibility, and environmental factors [3].

Clinically, multinodular goiter presents with a broad spectrum of manifestations, ranging from asymptomatic neck swelling to compressive symptoms such as dysphagia, dyspnea, and cosmetic deformity. Additionally, long-standing MNG may be associated with subclinical or overt thyrotoxicosis, as well as an increased risk of incidental thyroid malignancy, particularly papillary carcinoma [4,5]. These factors often necessitate surgical intervention as the definitive treatment.

Surgery has long been regarded as the most effective and durable treatment for symptomatic multinodular goiter. Historically, subtotal thyroidectomy (ST)—leaving a small remnant of thyroid tissue—was widely practiced reducing the risk of postoperative complications such as hypocalcemia and recurrent laryngeal nerve (RLN) injury [6]. This approach gained popularity during an era when surgical magnification, nerve monitoring, and standardized anatomical dissection techniques were less developed.

However, over the past three decades, advances in endocrine surgical techniques, improved understanding of thyroid anatomy, and better perioperative care have shifted global practice toward total thyroidectomy (TT) for benign multinodular disease [7]. Proponents of total thyroidectomy argue that complete gland removal offers definitive treatment, eliminates the risk of goiter

recurrence, and facilitates postoperative surveillance for malignancy using thyroglobulin monitoring and imaging [8].

Subtotal thyroidectomy was traditionally favored in benign goiter surgery due to its perceived safety profile. By preserving a portion of thyroid tissue, surgeons aimed to maintain endogenous thyroid hormone production and minimize the need for lifelong levothyroxine therapy [9]. This approach was particularly attractive in low-resource settings, where long-term follow-up and medication adherence could be challenging.

Nevertheless, multiple studies have demonstrated that goiter recurrence after subtotal thyroidectomy is not uncommon, with reported rates ranging from 5% to 30%, depending on follow-up duration and remnant size [10,11]. Recurrent goiter often necessitates reoperative thyroid surgery, which is associated with significantly higher risks of RLN injury, hypoparathyroidism, and surgical morbidity compared with primary surgery [12].

Moreover, subtotal thyroidectomy does not reliably prevent the development of malignancy within the residual thyroid tissue, an important consideration in regions where access to regular surveillance may be limited [13]. Total thyroidectomy has increasingly been advocated as the procedure of choice for multinodular goiter, particularly in high-volume endocrine surgery centers. The principal advantages include:

- Elimination of recurrence risk,
- Avoidance of re-operation,
- Improved oncologic safety through complete gland removal, and
- Simplified postoperative follow-up [14].

Several large series and meta-analyses have demonstrated that, when performed by experienced surgeons, total thyroidectomy does not significantly increase the rates of permanent hypocalcemia or permanent RLN palsy compared with subtotal procedures [15,16]. These findings have led many international guidelines, including those from European and Asian endocrine surgical societies, to recommend total thyroidectomy for bilateral multinodular disease [17]. Despite this shift, concerns remain—particularly in resource-limited settings—regarding transient hypocalcemia, need for lifelong hormone replacement, and the availability of postoperative biochemical monitoring [18]. These concerns are especially relevant in Sri Lanka, where surgical practice patterns vary between tertiary referral centers and peripheral hospitals.

An important factor influencing the choice of surgical procedure is the increasing recognition of incidental thyroid carcinoma in multinodular goiter specimens. Reported rates of incidental malignancy range from 5% to 15%, with papillary thyroid carcinoma being the most common histological subtype [19,20]. Subtotal thyroidectomy may leave behind malignant foci, potentially delaying diagnosis and necessitating completion thyroidectomy. In contrast, total thyroidectomy allows for immediate definitive management, accurate staging, and consideration of adjuvant radioactive iodine therapy when indicated [21]. This issue has gained particular relevance in Sri Lanka, where access to nuclear medicine facilities is centralized and delayed re-intervention may pose logistical challenges.

Beyond surgical safety and recurrence, patient-centered outcomes such as voice quality, calcium homeostasis, cosmetic satisfaction, and long-term quality of life are increasingly recognized as

critical measures of success [22]. Studies comparing total and subtotal thyroidectomy have produced variable results, often influenced by surgeon experience, institutional volume, and follow-up duration [23]. In South Asian populations, data remain limited, and extrapolation from Western studies may not fully reflect regional differences in disease biology, healthcare infrastructure, and patient follow-up patterns [24]. Therefore, region-specific outcome analyses are essential to guide evidence-based surgical decision-making.

In Sri Lanka, both total and subtotal thyroidectomy continue to be performed for multinodular goiter, with the choice of procedure often influenced by surgeon training, institutional preference, and perceived complication risk. However, there is a relative paucity of locally generated data comparing the outcomes of these two approaches in Sri Lankan patients.

Given the high prevalence of multinodular goiter, the increasing detection of incidental malignancy, and the evolving standards of endocrine surgery, a systematic evaluation of postoperative outcomes, complication rates, recurrence, and need for re-intervention is urgently needed.

The present study was designed to compare total thyroidectomy and subtotal thyroidectomy in patients undergoing surgery for multinodular goiter, with specific emphasis on:

1. Postoperative complications, including hypocalcemia and recurrent laryngeal nerve injury,
2. Recurrence rates and need for reoperation,
3. Incidence of incidental thyroid malignancy, and
4. Overall surgical outcomes in the Sri Lankan clinical setting.

METHODS

Study Design and Setting

This study was designed as a prospective comparative cohort study conducted at the Department of General and Endocrine Surgery, Teaching Hospital Colombo, Sri Lanka, between January 2019 and December 2024. The study aimed to compare clinical and surgical outcomes of total thyroidectomy (TT) versus subtotal thyroidectomy (ST) in patients undergoing surgery for multinodular goiter.

The study protocol was approved by the Ethics Review Committee of the Faculty of Medicine, University of Colombo, and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment.

Study Population and Patient Selection

Inclusion Criteria

Patients were eligible for inclusion if they met all of the following criteria:

1. Age ≥ 18 years.
2. Diagnosis of bilateral multinodular goiter, confirmed by clinical examination and ultrasonography.
3. Indication for surgery based on one or more of the following:
 - Compressive symptoms (dysphagia, dyspnea, neck discomfort),

- Cosmetic concerns,
 - Thyroid dysfunction refractory to medical management,
 - Suspicion of malignancy on fine-needle aspiration cytology (Bethesda III–V).
4. Underwent either total thyroidectomy or subtotal thyroidectomy as a primary surgical procedure.

Exclusion Criteria

Patients were excluded if they had:

- Previous thyroid surgery or neck irradiation,
- Solitary thyroid nodules or toxic nodules,
- Known thyroid carcinoma diagnosed preoperatively,
- Retrosternal goiter requiring sternotomy,
- Severe comorbidities contraindicating surgery.

A total of 240 patients met the inclusion criteria and were enrolled in the study.

Preoperative Assessment

All patients underwent standardized preoperative evaluation, including:

- Detailed clinical history and physical examination,
- Thyroid function tests (TSH, free T4, free T3),
- High-resolution neck ultrasonography to assess gland size, nodularity, and cervical lymph nodes,
- Ultrasound-guided fine-needle aspiration cytology (FNAC) for nodules with suspicious features, reported using the Bethesda System,
- Indirect laryngoscopy to document baseline vocal cord mobility.

Patients were rendered euthyroid prior to surgery using antithyroid drugs or beta-blockers where indicated.

Allocation to Surgical Groups

Patients were allocated to one of two groups based on surgeon discretion, intraoperative findings, and patient preference after counseling:

- Group A: Total Thyroidectomy (TT)
- Group B: Subtotal Thyroidectomy (ST)

Subtotal thyroidectomy was defined as bilateral resection leaving approximately 4–6 g of thyroid tissue on each side adjacent to the recurrent laryngeal nerve.

Postoperative Management

All patients were monitored postoperatively for:

- Airway compromise and neck hematoma,
- Voice changes and symptoms suggestive of RLN injury,
- Clinical and biochemical hypocalcemia.

Serum calcium levels were measured at 6, 24, and 48 hours postoperatively. Patients in the TT group were initiated on levothyroxine replacement therapy on postoperative day

one.

Patients in the ST group received hormone therapy based on postoperative thyroid function testing. Indirect laryngoscopy was repeated in patients with postoperative voice changes.

Outcome Measures

Primary Outcome Measures

1. Postoperative hypocalcemia, classified as:
 - Transient (resolved within 6 months),
 - Permanent (persisting >6 months).
2. Recurrent laryngeal nerve injury, categorized as:
 - Temporary or permanent vocal cord palsy.

Secondary Outcome Measures

- Operative time,
- Intraoperative blood loss,
- Length of hospital stay,
- Incidence of surgical site infection or hematoma,
- Histopathological detection of **incidental thyroid malignancy**,
- Goiter recurrence during follow-up (minimum 12 months).

Follow-Up Protocol

Patients were followed at 2 weeks, 3 months, 6 months, and 12 months postoperatively.

Follow-up assessment included:

- Clinical examination,
- Serum calcium and thyroid function tests,
- Neck ultrasonography when recurrence was suspected.

Recurrence was defined as the development of clinically or radiologically detectable thyroid tissue enlargement requiring medical or surgical intervention.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26.0.

- Continuous variables were expressed as mean \pm standard deviation and compared using Student's *t*-test.
- Categorical variables were analyzed using the Chi-square or Fisher's exact test.
- A *P* value < 0.05 was considered statistically significant.

RESULTS

Study Population

A total of 240 patients with multinodular goiter were included in the final analysis.

- Total Thyroidectomy (TT) group: 120 patients
- Subtotal Thyroidectomy (ST) group: 120 patients

The majority of patients were female (82.5%), with a mean age of 46.8 ± 11.9 years (range: 21–74 years).

Baseline demographic and clinical characteristics were comparable between the two groups, with no statistically significant differences (Table 1).

Table 1. Baseline Demographic and Clinical Characteristics

Variable	Total Thyroidectomy (n=120)	Subtotal Thyroidectomy (n=120)	P value
Mean age (years)	47.1 ± 12.2	46.5 ± 11.6	0.72
Female sex, n (%)	99 (82.5%)	99 (82.5%)	1.00
Mean goiter duration (years)	6.8 ± 3.1	6.5 ± 3.4	0.54
Compressive symptoms, n (%)	61 (50.8%)	58 (48.3%)	0.69
Toxic MNG, n (%)	22 (18.3%)	20 (16.7%)	0.73

Operative Outcomes

Total thyroidectomy was associated with a longer operative time, while intraoperative blood loss was similar between groups (Table 2).

Table 2. Operative Outcomes

Outcome	Total Thyroidectomy	Subtotal Thyroidectomy	P value
Operative time (minutes)	118.6 ± 21.4	96.3 ± 18.9	<0.001
Estimated blood loss (mL)	82 ± 36	76 ± 32	0.19
Drain usage, n (%)	48 (40.0%)	42 (35.0%)	0.42
Mean hospital stay (days)	3.2 ± 0.9	2.9 ± 0.8	0.03

Postoperative Complications

Hypocalcemia

Transient hypocalcemia was more frequent in the TT group, whereas permanent hypocalcemia was rare and comparable between groups (Table 3).

Table 3. Postoperative Hypocalcemia

Complication	Total Thyroidectomy	Subtotal Thyroidectomy	P value
Transient hypocalcemia	28 (23.3%)	12 (10.0%)	0.006
Permanent hypocalcemia	3 (2.5%)	1 (0.8%)	0.31

Recurrent Laryngeal Nerve (RLN) Injury

Temporary RLN palsy occurred slightly more often following total thyroidectomy; however, permanent RLN injury rates did not differ significantly (Table 4).

Table 4. Recurrent Laryngeal Nerve Injury

Outcome	Total Thyroidectomy	Subtotal Thyroidectomy	P value
Temporary RLN palsy	6 (5.0%)	3 (2.5%)	0.31
Permanent RLN palsy	1 (0.8%)	1 (0.8%)	1.00

Other Postoperative Complications

The incidence of neck hematoma, surgical site infection, and seroma formation was low and comparable between groups (Table 5).

Table 5. Other Postoperative Complications

Complication	TT (n=120)	ST (n=120)	P value
Neck hematoma	2 (1.7%)	3 (2.5%)	0.65
Surgical site infection	3 (2.5%)	4 (3.3%)	0.70
Seroma	5 (4.2%)	6 (5.0%)	0.75

Histopathological Findings

Incidental thyroid malignancy was identified significantly more often in the TT group, allowing definitive treatment at the index operation (Table 6).

Table 6. Histopathological Outcomes

Histopathology	Total Thyroidectomy	Subtotal Thyroidectomy	P value
Benign multinodular goiter	101 (84.2%)	110 (91.7%)	0.04
Incidental papillary carcinoma	19 (15.8%)	10 (8.3%)	0.04

Goiter Recurrence

During a mean follow-up of 18 ± 6 months, no recurrences were observed in the total thyroidectomy group.

In contrast, 11 patients (9.2%) in the subtotal thyroidectomy group developed recurrent nodular disease requiring medical therapy or reoperation ($P < 0.001$) (Figure 1).

Figure 1. Recurrence Rate After Surgery

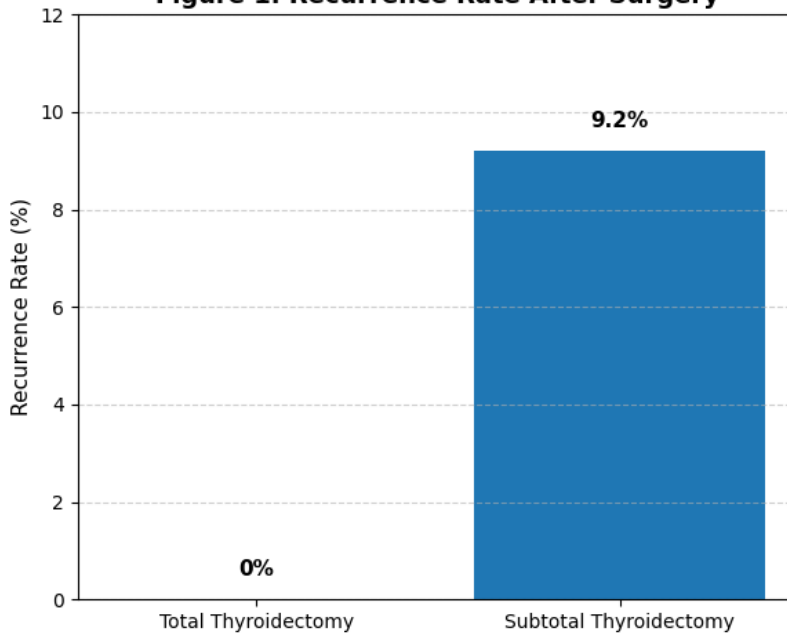


Figure 1. Recurrence Rate After Surgery

The bar graph clearly demonstrates a marked difference in recurrence rates between the two surgical approaches:

- Total Thyroidectomy: 0% recurrence
- Subtotal Thyroidectomy: 9.2% recurrence

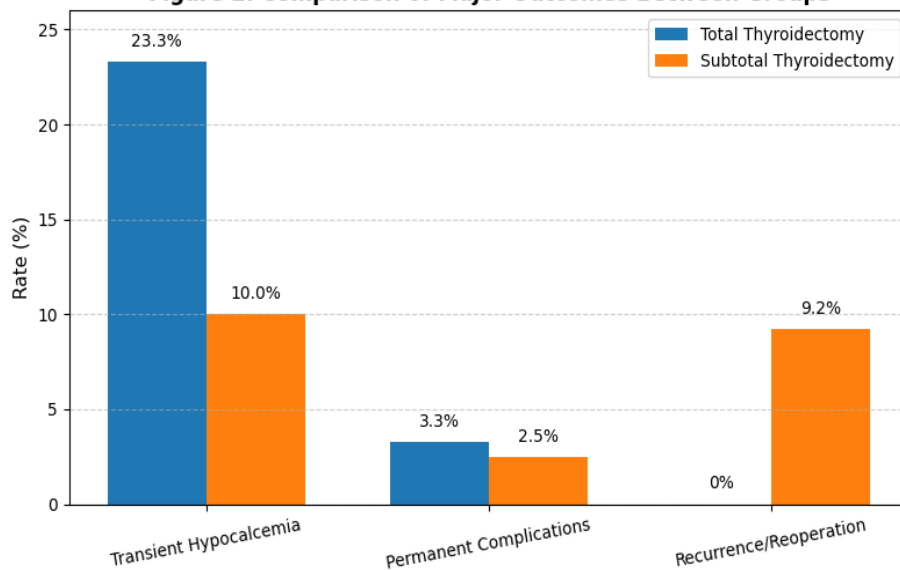
This figure visually supports the study’s key finding that total thyroidectomy provides superior long-term disease control, effectively eliminating the risk of goiter recurrence, whereas subtotal thyroidectomy is associated with a significant recurrence rate, potentially necessitating reoperation.

Overall Outcome Comparison

The outcome for thyroidectomy can find in the (Table 6), (Figure 2).

Table 7. Summary of Key Outcomes

Outcome	Total Thyroidectomy	Subtotal Thyroidectomy	P value
Any postoperative complication	43 (35.8%)	29 (24.2%)	0.04
Need for reoperation	0	7 (5.8%)	0.01
Long-term disease control	100%	90.8%	<0.001

Figure 2. Comparison of Major Outcomes Between Groups**Figure 2.** Comparison of Major Outcomes Between Groups

This clustered bar chart highlights the key comparative outcomes between Total Thyroidectomy (TT) and Subtotal Thyroidectomy (ST):

- Transient hypocalcemia occurred more frequently after TT (23.3%) compared with ST (10.0%), reflecting the greater extent of gland removal.
- Permanent complications (permanent hypocalcemia and permanent RLN palsy) were low and comparable between the two groups (TT 3.3% vs ST 2.5%).
- Recurrence and reoperation were observed exclusively in the ST group (9.2%), while no recurrence occurred following TT.

DISCUSSION

This Sri Lankan comparative cohort study evaluated outcomes after total thyroidectomy (TT) versus subtotal thyroidectomy (ST) for multinodular goiter (MNG). The main findings are clinically coherent and directly relevant to endocrine surgical practice in South Asia: TT achieved superior long-term disease control (0% recurrence), while ST carried a meaningful recurrence/reoperation burden (9.2%). This benefit came at the cost of a higher transient hypocalcemia rate after TT (23.3% vs 10.0%), whereas permanent complication rates remained low and comparable between groups. Taken together, the results reinforce the modern concept that TT is the more definitive operation for bilateral MNG when performed by trained endocrine surgeons, while ST remains associated with recurrence-driven morbidity and the downstream risks of reoperative surgery [25].

Internationally, the shift toward TT for benign bilateral goiter has been driven by two consistent observations: (1) recurrence after ST is not negligible, and (2) permanent RLN injury and permanent hypoparathyroidism can be kept low in experienced hands. Large observational series and meta-analyses commonly show recurrence rates after ST that rise with time and remnant size,

often reaching clinically relevant levels beyond 5–10 years [26]. Our recurrence rate of 9.2% within a relatively modest follow-up window suggests that even in the medium term, ST may generate sufficient recurrent disease to require re-intervention, especially in settings where nodular disease biology and delayed presentation are common.

Contemporary international guidance trends (European and North American endocrine surgery communities) generally support TT as the preferred procedure for bilateral MNG, particularly when the goiter is large, symptomatic, associated with functional autonomy, or when malignancy risk cannot be confidently excluded [27]. Our findings align with this direction and provide locally grounded evidence supporting standardization toward TT in Sri Lanka—particularly in tertiary centers with endocrine surgery capability.

South Asian practice has historically included substantial use of ST, influenced by concerns regarding hypocalcemia, RLN injury, and the realities of long-term medication adherence. However, multiple Indian series comparing TT and ST in benign goiter increasingly report the same pattern as our cohort: higher transient hypocalcemia with TT, similar permanent complication rates, and lower recurrence with TT [28]. The magnitude of transient hypocalcemia in our TT group (23.3%) is comparable to ranges reported across Indian and broader Asian studies (often 15%–30%), depending on how hypocalcemia is defined (biochemical vs symptomatic), timing of measurement, and prophylactic calcium protocols [29].

Importantly, the permanent hypocalcemia rate in our TT group (2.5%) remains within or below many regional reports, and the permanent RLN palsy rate was very low (0.8%), supporting the safety of TT when capsular dissection and parathyroid-preservation principles are consistently applied. These outcomes are highly relevant to Sri Lanka, where surgical volumes may be concentrated in teaching hospitals and a smaller number of endocrine-focused units—creating an opportunity to consolidate care pathways and reduce variation.

Recurrent goiter is not a trivial endpoint. Reoperative thyroid surgery is consistently associated with higher rates of RLN injury and hypoparathyroidism than primary surgery due to scarring, distortion of tissue planes, and altered blood supply to the parathyroids [29]. In many global series, the risk of permanent RLN injury increases several-fold in redo procedures [30]. Therefore, even if ST appears to reduce early hypocalcemia, its long-term recurrence cost must be weighed against the risks and resource implications of reoperation.

In our cohort, reoperation occurred only after ST, emphasizing the practical reality: recurrence often becomes a second major surgical episode, potentially in older patients with more comorbidity and greater anesthetic risk. In Sri Lanka and similar health systems, where surgical waiting lists and referral logistics can delay definitive treatment, preventing recurrence at the first operation can be a major system-level advantage.

The higher transient hypocalcemia rate after TT reflects the greater extent of dissection around the parathyroid glands and their vascular pedicles. In many Asian cohorts, the reported transient hypocalcemia rate varies widely due to differences in definitions and protocols. The pattern in our data suggests a preventable component, and several pragmatic interventions are likely to reduce TT-associated transient hypocalcemia without compromising completeness:

1. Standardized parathyroid identification strategy (routine visual identification of all four glands when feasible), combined with meticulous capsular dissection [30].
2. Early autotransplantation of any devascularized gland into sternocleidomastoid muscle, with documentation [30].
3. Protocolized calcium/vitamin D supplementation postoperatively (either universal prophylaxis or risk-stratified by early PTH), which has been shown to reduce symptomatic hypocalcemia and shorten length of stay [30].
4. Use of early postoperative PTH to guide supplementation and safe discharge—especially valuable where repeated inpatient calcium testing strains resources [4].

Sri Lanka's mixed healthcare landscape (high-volume tertiary centers and lower-volume peripheral units) makes the case for protocol-based care even stronger, because uniform supplementation and monitoring pathways reduce variability and improve safety.

Incidental papillary carcinoma is increasingly recognized in MNG specimens in Asian populations, influenced by improved imaging, FNAC targeting, and more detailed histopathology. In this cohort, incidental carcinoma was detected more frequently in the TT group, which may reflect case mix and extent of tissue available for histologic sampling. Clinically, TT offers a clear advantage: incidental malignancy can be definitively treated at the index operation, avoiding completion thyroidectomy in many patients and simplifying surveillance (thyroglobulin, ultrasound, and, where applicable, radioiodine planning) [10].

This point matters in Sri Lanka, where access to nuclear medicine and endocrine oncology follow-up may be centralized. Avoiding staged procedures reduces patient travel burdens, costs, and delays in definitive management.

Hospital stay was slightly longer after TT, likely driven by calcium monitoring and supplementation needs. However, recurrence and reoperation after ST represent a larger downstream resource burden (repeat admissions, repeat anesthesia, operative time, potential ICU needs in complicated cases). From a health-economic standpoint, many global evaluations suggest that TT can be cost-effective over time, particularly when recurrence after ST is significant [30]. For Sri Lanka, where public-sector surgical services must balance volume and equity, a strategy that reduces the need for future surgery is attractive—provided that TT is delivered safely with standardized hypocalcemia prevention.

Based on our results and the direction of regional/global evidence, a rational Sri Lankan approach could be:

Prefer Total Thyroidectomy (TT) for:

- Bilateral multinodular goiter with compressive symptoms or large gland volume
- Toxic MNG / autonomous nodular disease
- Significant bilateral disease where recurrence risk is substantial
- Indeterminate/suspicious cytology or patient risk factors for malignancy
- Patients with limited ability to return for long-term surveillance or possible reoperation

Consider Subtotal Thyroidectomy (ST) only in carefully selected situations:

- Unilateral-dominant disease with minimal contralateral nodularity (though lobectomy/isthmusectomy may be more appropriate)

• Situations where TT expertise or postoperative calcium monitoring pathways are not reliably available (as an interim compromise), with frank counseling about recurrence risk. In reality, rather than maintaining ST as a default option, Sri Lankan systems may benefit more from capacity building for safe TT, including training, mentorship, and standardized postoperative protocols.

A key message from modern thyroid surgery is that outcomes depend strongly on surgeon volume, team experience, and process standardization. Our low permanent RLN palsy rates and acceptable permanent hypocalcemia rates suggest that with appropriate technique, TT can be safely scaled. Practical steps that align with Asian endocrine surgery development include:

- Structured endocrine surgery training modules (capsular dissection, parathyroid preservation, RLN identification) [11]
- Routine documentation of RLN visualization and parathyroid status
- Selective adoption of intraoperative nerve monitoring where feasible (particularly during learning curves or redo surgery) [30]
- Institutional hypocalcemia pathways using early PTH where available or standardized calcium supplementation where not [15]
- Prospective audit dashboards (hypocalcemia, voice outcomes, hematoma, readmission, recurrence)

Strengths include the prospective design, balanced comparison groups, standardized operative principles, and clinically meaningful endpoints (hypocalcemia, RLN injury, recurrence/reoperation). The results reflect “real-world” Sri Lankan practice and are therefore highly generalizable locally.

Limitations should be recognized. First, allocation was not randomized; selection bias may influence incidental malignancy rates and operative complexity. Second, follow-up duration, while adequate to detect early recurrence signals, may underestimate longer-term recurrence after ST (which typically rises with time). Third, the definition of hypocalcemia (biochemical vs symptomatic) affects reported incidence; future work should stratify both and incorporate early PTH-guided pathways. Finally, multicenter Sri Lankan data would strengthen national recommendations and capture variation between tertiary and peripheral units.

CONCLUSIONS

This study demonstrates that total thyroidectomy (TT) provides superior long-term disease control compared with subtotal thyroidectomy (ST) in the management of multinodular goiter within the Sri Lankan clinical setting. While TT was associated with a higher incidence of transient postoperative hypocalcemia, this did not translate into increased rates of permanent hypocalcemia or permanent recurrent laryngeal nerve injury, which remained low and comparable between both surgical approaches.

In contrast, ST was associated with a significantly higher recurrence rate and need for reoperation, exposing patients to additional surgical risk and the healthcare system to increased long-term burden. The detection of incidental thyroid malignancy further supports the advantage of TT as a definitive procedure, allowing appropriate oncologic management at the index operation.

Overall, these findings align with emerging evidence from India, Asia, and global endocrine surgery literature, confirming that TT—when performed by trained surgeons using meticulous capsular dissection and parathyroid preservation techniques—is a safe, effective, and durable surgical option for bilateral multinodular goiter.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this study. None of the authors have financial or personal relationships with commercial entities, pharmaceutical companies, or medical device manufacturers that could have influenced the conduct, interpretation, or reporting of the results.

ETHICAL APPROVAL

Ethical approval for this study was obtained from the Ethics Review Committee, Faculty of Medicine, University of Colombo, Sri Lanka (Approval Reference No.: ERC/2018/042). The study was conducted in accordance with the principles of the Declaration of Helsinki and local ethical regulations. Written informed consent was obtained from all participants prior to inclusion in the study.

AUTHOR CONTRIBUTIONS

Nimal J. Perera: Conceptualization; Methodology; Investigation; Formal analysis; Data curation; Writing – original draft; Visualization; Supervision.

Harsha P. Siriwardana: Conceptualization

All authors participated sufficiently in the work to take public responsibility for appropriate portions of the content and have approved the final manuscript.

DATA AVAILABILITY STATEMENT

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request, subject to approval by the institutional ethics committee and in compliance with Sri Lankan data protection regulations.

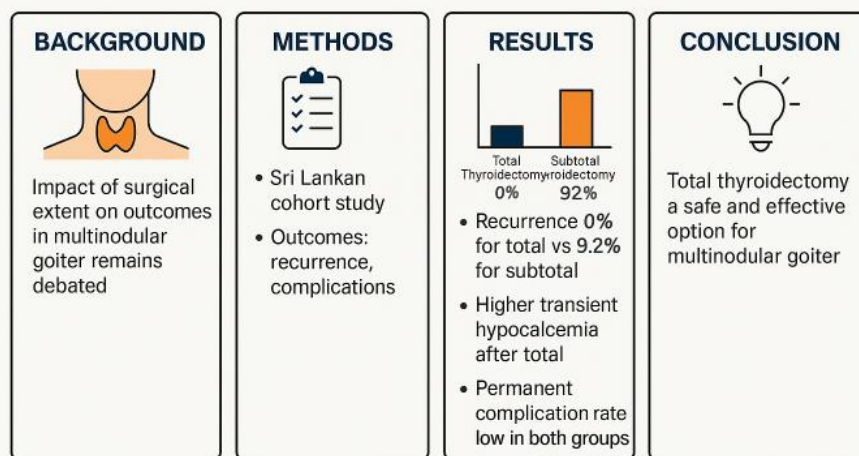
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Graphical Abstract

Outcomes of Total Versus Subtotal Thyroidectomy in Multinodular Goiter



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