REVIEW ARTICLE

The Surgical Treatment of Bilateral Benign Nodular Goiter

Balancing Invasiveness With Complications

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SUMMARY

Background: About 100 000 thyroid operations are performed in Germany each year. There is a current trend toward more radical surgery for bilateral euthyroid nodular goiter. In recent years, thyroid specialists and specialty guidelines have recommended total thyroidectomy, because it ensures that nodules will not recur and already provides an adequately radical excision in case an incidental carcinoma is found postoperatively on histological study of the specimen. An alternative method is unilateral hemithyroidectomy with contralateral subtotal resection (the Dunhill procedure).

Methods: Selective literature review.

Results: Three randomized controlled trials (RCTs) have compared the long-term outcomes of different surgical methods. In addition, retrospective studies have been published, but their findings must be interpreted with caution because of limitations of method. When all of the data are considered, it appears that radical procedures are often not justified. According to the RCTs, nodules arose during long-term follow-up in 4.7–14% of patients who had undergone subtotal resection; yet, in the two more recent and methodologically more valid RCTs, surgery for recurrent goiter was needed in only 0–0.5% of patients treated with a Dunhill procedure and given adequate hormone supplementation. Most incidental carcinomas are papillary microcarcinomas; this entity is usually adequately treated with hemithyroidectomy. The reported complication rates of total thyroidectomy for permanent hypoparathyroidism in particular range from 0.5% (in specialized centers) to 10% (in a cross-sectional study) and thus seem higher than the corresponding rate for a Dunhill procedure (1–2%).

Conclusion: Total thyroidectomy has significant risks and should only be performed if the indication has been critically assessed. Alternative methods such as the Dunhill procedure are often radical enough with a much lower rate of postoperative hypoparathyroidism; they remain an important option in thyroid surgery. Further RCTs with sufficient long-term follow-up are needed so that the different surgical methods can be reliably compared in detail.

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About 100 000 thyroid operations are performed in Germany each year. There were 90 000 in 2012, according to the Federal Statistical Office (1); the most common indication was bilateral multinodular goiter (2).

In earlier years, bilateral subtotal thyroidectomy (the Enderlen-Hotz procedure) was preferred to avoid complications. This operation left a relatively large amount of residual thyroid tissue dorsally (3). Recently, however, more radical resection has become much more common (4). From 2006 to 2008, the rate of total thyroidectomy for nodular goiter in Germany rose from 27% to 37%, while the rate of partial resection dropped from 53% to 40% (4).

Accordingly, in 2012, there were 44 000 total thyroidectomies and 42 000 subtotal resections (1). The decision to perform a total thyroidectomy was generally made not on the basis of the patient's age, but rather with a view toward radicality and lowering the rate of recurrent goiter (4). Accordingly, the Endocrine Surgery Working Group in its guidelines recommends total thyroidectomy for the treatment of multiple nodules in both thyroid lobes (5). Total thyroidectomy is said to obviate the need for a second operation (with a higher rate of complications) for recurrent goiter or for an incidentally discovered thyroid carcinoma. In contrast, the American and European guidelines do not recommend near total or total thyroidectomy for benign nodular goiter, citing a lack of supporting data (evidence level D) (6).

The Dunhill procedure—hemithyroidectomy combined with contralateral subtotal resection—offers a compromise with respect to radicality. A residual volume of 1–4 mL is recommended (*Figure 1*) (7).

Direct comparisons of the different types of resection with respect to recurrences and complication rates are available only from a few small-scale, prospective, randomized trials, mostly with brief follow-up. Thus, the currently available evidence that can serve as a basis for surgical indications is derived mainly from retrospective studies. In this article, we will discuss the advantages and disadvantages of different types of resection.

Recurrence rates after thyroid surgery

The surgical literature (reviewed in [8]) mainly cites data of two meta-analyses, one by Moalem (9) and

Surgical techniques for bilateral nodular goiter

PTG, parathyroid gland

FIGURE 1

one by Agarwal (10), which were based on overlapping sets of clinical studies (*Table 1*). The rate of recurrence after subtotal thyroid resection ranges from 0% to 50%, depending on the amount of thyroid tissue left behind (9, 10). In contrast, the single pertinent longitudinal study that was considered in these meta-analyses documented a recurrence rate of 0.3% after total thyroidectomy. Therefore, the authors of both meta-analyses recommended treating bilateral nodular goiter with total thyroidectomy.

Yet almost all of the publications that these meta-analyses considered were retrospective studies that often failed to provide important information about the surgical techniques used and the duration of post-operative follow-up. The five studies cited in both meta-analyses were assigned different evidence levels in each (III versus IV). Moreover, comparisons across studies are hampered by differing definitions of recurrent goiter, study designs, and practices with respect to thyroid hormone supplementation.

For example, an Italian group considered ultrasonographically detected nodular structures measuring 5 mm or more to count as recurrences (11). When such a broad definition is used, scarring in the operated area may end up being considered recurrent goiter. Other authors consider the ultrasonographically measured volume of the thyroid remnant or the need for reoperation. Such differences of method can themselves account for wide discrepancies in so-called recurrence rates.

Our literature search in PubMed with the search term “thyroid surgery AND complication” retrieved

2432 articles published in the last five years. A further restriction of the search with the term “clinical trial” narrowed the findings down to 144 articles. We read the abstracts and eliminated all but 20 clinical studies in which the different methods of surgical resection for benign goiter were compared. 18 of these were retrospective and mainly involved comparisons of multiple (in many cases, undefined) surgical methods that were practiced over different periods of time (*Table 2*). The data from these 18 studies were difficult to interpret for the reasons mentioned.

Only two prospective, randomized clinical trials have been performed in the last five years (*Table 3*) specifically to address the question of the frequency of recurrences after surgery for nodular goiter. A prior randomized trial on this question was published in 1998 (12).

From 2000 to 2004, Barczynski et al. (13) performed 200 cases of each of three types of surgery: total thyroidectomy, the Dunhill procedure, and bilateral subtotal resection. For each subtotally resected side of the thyroid gland, a nodule-free thyroid remnant 2 g in size was left in place. L-thyroxine was routinely given postoperatively, with a target TSH range of 0.3 to 2.5 mU/L. Five years after surgery, one or more small nodules (<1 cm) had arisen in 0.5% of the patients who had undergone total thyroidectomy, compared to 5% after Dunhill procedures and 12% after subtotal resection. Clinically relevant nodules necessitating reoperation arose only in one patient each after total thyroidectomy and a

TABLE 1

Overview of all studies with information about recurrence rates after subtotal thyroid resection that are cited in the meta-analyses of Agarwal (10) and Moalem (9)

Year	EL	Operation	Recurrence rate	Surgery for rec.	Follow-up	Author; comments
Agarwal						
1996	IV	STR bilat.	39%	16%	max. 192 mo.	73% of recurrences were without thyroxine
1998	I–II	DP	14%	13%	max. 173 mo.	surgical techniques unclear
1998	III–IV	all STR*	26%	13%	n.d.	
1999	IV	all STR	12%	n.d.	n.d.	RR hypothetical
2000	III–IV	STR	HT 13% STR bilat. 32% STR unilat. 60%	4%	93 mo. (mean)	no morbidity after surgery for recurrences
2000	IV	all STR	14%	n.d.	40 mo. (mean)	low case numbers, 30% hypocalcemia after TT
2001	IV	all STR	HT 18% STR 12%	n.d.	n.d.	low case numbers, 23% hypocalcemia after TT
2004	III–IV	only HT	34%	7%	80 mo. (mean)	only unilat. goiter (TT not an option)
2005	IV	STR bilat.	1%	n.d.	53 mo. (mean)	hypocalcemia after STR, 8% ; after TT, 30%
2005	III–IV	STR	DP 33% STR bilat. 50% HT 62% STR unilat. 70%	21%	max. 180 mo.	only patients under 30 years of age, low case numbers, 25% hypocalcemia after TT vs. 0% after STR, reop. in 41% only when desired by patient, no definition of "recurrence"
2007	IV	only HT	11 %	11%	max. 145 mo.	hypocalcemia after HT 0% , after TT 6% ; no morbidity from reop.
Moalem						
1990	III	n.d.	5%	0%	124 mo. (mean)	small subgroup without thyroxine (14 pts.): recurrence rate 43%
2002	III	n.d.	29%	n.d.	100 mo. (mean)	little information provided
1993	III	all STR	2.5%	2%	60–240 mo.	
1994	III	STR	HT 30% STR bilat. 11%	n.d.	89 mo. (mean)	low case numbers, 54% of recurrences were "subclinical"
1987	III	all STR	n.d.	n.d.	n.d.	meta-analysis states RR is 7.5% after STR; data not in original paper
2005	III	STR	DP 0% STR bilat. 33% HT 14% STR unilat. 100%	18%	98 mo. (mean)	small case numbers, only toxic goiter
1995	III	all STR	42%	n.d.	360 mo.	old study (1960), small case numbers
2007	III	TT	0.3%	0.3%	56 mo.	only total thyroidectomies, 9/10 recurrences not "genuine"
2007	III	all STR	STR bilat. 8%	n.d.	212 mo.	after radiation therapy, 31% without thyroxine
1999	III	HT	12%	6%	168 mo.	only hemithyroidectomy

bilat., bilateral; DP, Dunhill procedure; EL, evidence level; HT, hemithyroidectomy; max., maximum; mo., months; reop., reoperation; RR, recurrence rate; STR, subtotal resection; TT, total thyroidectomy; unilat., unilateral; pts, patients; *all types of subtotal resection taken together without further differentiation

Dunhill procedure, and in two patients after subtotal resection.

In the Charité Hospital in Berlin, a total of 200 patients with bilateral nodular goiter were operated on in the setting of a prospective randomized trial: 100 underwent a Dunhill procedure and 100 underwent bilateral subtotal resection (14). For each subtotally operated side, a nodule-free remnant no larger than 5 mL in size was left in place. All patients were given L-thyroxine postoperatively, with the TSH target in the mid-normal range. After a mean follow-up interval of 11 years, ultrasonography revealed nodules measuring less than 1 cm in size and without suspi-

cion of malignancy in 6% of the patients who had undergone a Dunhill procedure and in 8% of those who had undergone bilateral subtotal resection. Surgery for recurrent goiter was necessary for only one patient after bilateral subtotal resection and for no patient after a Dunhill procedure. The single patient who was operated on for a recurrence had stopped taking thyroxine eight years before. In accordance with these results, current data from a further 111 patients reveal that the recurrence rate after bilateral surgery (adapted to the intraoperative findings) is very low even if total thyroidectomy is not performed: clinically relevant recurrences occurred in

TABLE 2

Clinical studies from 2005 onward with information about complication rates and recurrence rates after resective thyroid surgery

Year	EL	Operation	RLNP, trans. / perm.	Hypoparath., trans. / perm.	Recurrence rate (follow-up)	Remarks
2008 (31)	IV	108 DP, 11 TT	total, 0% and 18 %	total, 2.8%	n.d.	no differentiation of trans./perm.
2008 (27)	III	45 STR, 209 DP, 1394 TT	n.d.	5-fold higher risk with TT	n.d.	no information on permanent complications
2009 (32)	III	73 function-preserving, 36 standard radical	n.d.	n.d.	18.6% vs. 2.5% (10 years)	standard radical = STR, DP, and TT
2009 (33)	III	1695 STR, 1211 TT	1.7% vs. 1.7% 0.6% vs. 0.9%	1.4% vs. 8.4% 0.4% vs. 0.8%	n.d.	2.2% vs. 0% completions of resection because of carcinoma, but in different temporal epochs
2009 (34)	IV	only TT (932)	1.3% / 0.2%	7.3% / 0.3%	0% (9 years)	no comparison group
2009 (35)	II–III	181 STR, 165 TT	1.7% vs. 1.9% 0% vs. 0%	5% vs. 7% 0% vs. 0%	7% vs. 0% (3 years)	“recurrence” defined as nodule of diameter 3 mm or more; no operations for recurrence
2009 (36)	III	260 HT, 248 TT	1.9% vs. 3.6% 0.3% vs. 0.4%	0% vs. 0% 0% vs. 0 %	1.9% vs. 0.4% (2.5 years)	no definition of “recurrence,” follow-up 0.1 to 16 years
2009 (37)	III	95 subtotal, 94 TT	1% vs. 3% 0% vs. 0%	3% vs. 11% 1% vs. 1%	n.d.	all subtotal resections considered together
2009 (38)	IV	88 TT	1.14% (?)	2.3% trans. 0% perm.	n.d.	no comparison group
2009 (39)	IV	323 TT	0.6% perm.	1.9% perm.	0% (n.d.)	no control group, no data on follow-up
2010 (e1)	III–IV	1051 HT, 2238 STR, 3834 TT	perm. HT 0.9% STR 1.2% TT 1.4%	perm. HT 1.4% STR 2.5% TT 3.5%	22% after STR (7 years)	no distinction between different subtotal techniques; no definition of “recurrence”
2010 (e2)	IV	all methods	2.8%	3.5%	n.d.	no distinction between surgical techniques or of transient vs. permanent complications; extensive surgery associated with higher complication rates
2010 (e3)	IV	117 STR, 777 NTR, 1149 TT	1.6% trans. 0.9% perm.	27.8% trans. 4.8% perm.	n.d.	extensive surgery associated with a higher rate of hypoparathyroidism
2011 (e4)	IV	228 STR, 227 DP, 348 TT	n.d.	n.d.	15% STR, 9% DP, 1% TT (n.d.)	no definition of “recurrence,” no data on follow-up, 15% complication rate for all operations taken together
2011 (e5)	IV	154 TT	6.4% trans. 2% perm.	11% trans. 0.6% perm.	n.d.	no control group, no data on recurrences
2011 (e6)	IV	50 TT	6% trans. 0% perm.	16% trans. 2% perm.	n.d.	no control group; carcinomas included
2011 (e7)	IV	340 operations	perm. 1.9% STR 7.2% TT	n.d.	n.d.	no distinction between different subtotal techniques; carcinomas included
2012 (e8)	IV	2294 STR, 1485 TT	comparisons across time only	comparisons across time only	comparisons across time only	no distinction between different subtotal techniques; carcinomas included; rates of complications and recurrences compared across temporal epochs, rather than types of operations

bilat., bilateral; DP, Dunhill procedure; EL, evidence level; HT, hemithyroidectomy; hypoparath., hypoparathyroidism; n.d., no data; NTR, near total thyroidectomy; perm., permanent; RLNP, recurrent laryngeal nerve palsy; STR, subtotal resection; trans., transient; TT, total thyroidectomy

only 0.9% of patients with 12 years of follow-up (15), a figure that is not appreciably higher than the one for total thyroidectomy.

The single prospective study that showed a substantially higher recurrence rate after Dunhill procedures was one involving 141 patients who were operated on from 1975 to 1985, randomized either to a total thyroidectomy or to a Dunhill procedure with a thyroid

remnant of 3–5 g (12). Postoperatively, a TSH value in the normal range was targeted, and any enlargement or nodular change of the thyroid thereafter was classified as a recurrence. In 15 years of follow-up, no patient (0/69) developed a recurrence after total thyroidectomy, compared to 10/72 (14%) in the Dunhill group. Nine of these patients underwent reoperation and the 10th declined a recommended reoperative procedure.

This study, however, included patients with either uni- or bilateral goiter. It thus remains unclear whether the 19 of 72 patients with unilateral involvement really underwent a Dunhill procedure as their initial surgical treatment, as opposed to a purely unilateral operation. Moreover, it was not stated whether the thyroid remnant left behind was free of any further nodules. It is, therefore, unclear whether the surgical techniques in this study—particularly, subtotal resection—were truly comparable with the ones performed today.

In summary, total thyroidectomy remains the most definitive method of preventing recurrent goiter, but recent studies show that the recurrences that arise after Dunhill procedures are generally of little clinical significance.

Incidental thyroid carcinoma

A further argument often made for total thyroidectomy is that it obviates the need for further surgery in case thyroid carcinoma is an incidental finding made postoperatively in the permanent histological sections, when no such tumor was found intraoperatively by frozen section (or when no frozen section was obtained). If the final histological findings do not become available till several days after the initial procedure, then the risk of a recurrent laryngeal nerve palsy and/or hypoparathyroidism due to reoperation will be much higher than the corresponding risk from the initial procedure if the time interval between initial surgery and reoperation exceeds 3 days (7% vs. 0%) (16).

In practice, however, second operations are rarely needed for this indication. Carcinomas are found incidentally in 5–15% of all operations for goiter (9, 17), but 60–80% of these are papillary microcarcinomas less than 1 cm in diameter (18, 19).

It is stated in the German guidelines that such tumors have an excellent prognosis and are, in general, adequately treated by hemithyroidectomy (20). It follows that the Dunhill procedure is superior to bilateral subtotal resection in this respect.

Incidental carcinomas were rare in the prospective randomized trials mentioned above. In two of them, no such carcinomas were discovered at all (12, 14). In the Barczynski trial, incidental carcinomas were found in 8% of patients. 1% of the patients in the Dunhill group (2/189) and 3% of those in the bilateral subtotal resection group (5/190) needed reoperation (13).

The increasing incidence of papillary microcarcinomas over the past few years presumably reflects a more thorough histologic examination of surgical thyroid specimens. Autopsy studies reveal that papillary thyroid carcinomas are found in 1.5% to 36% of unselected patients who died of causes other than thyroid disease, depending on the spacing of the histologic sections (21). It must, therefore, be presumed that many papillary microcarcinomas are clinically insignificant.

TABLE 3

Rates of recurrent nodular goiter and of second operations to remove clinically significant recurrent nodules after different operations for benign, euthyroid nodular goiter

Year of publication, follow-up interval	Thyroidectomy	Dunhill procedure	Bilateral subtotal resection
Pappalardo 1998 [12] (14.5 years)			
All recurrences	0%	14%	n.d.
Clinically significant recurrences	0%	13%*	n.d.
Barczynski 2010 [13] (5 years)			
All recurrences	0.5%	4.7%	11.6%
Clinically significant recurrences	0.5%	0.5%	1.0%
Raves 2012 [14] (11 years)			
All recurrences	n.d.	6%	8.0%
Clinically significant recurrences	n.d.	0%	1.5%

Results from the three prospective randomized studies that have been published to date (mean follow-up interval in parentheses; n.d., no data because this operation was not performed) (12–14).
*One patient for whom a reoperation was indicated declined to undergo the procedure

TABLE 4

The incidence of recurrent laryngeal nerve palsy and of hypoparathyroidism (transient and permanent) after different operations for benign, euthyroid nodular goiter

Study	Thyroidectomy	Dunhill procedure	Bilat. subtotal resection
Barczynski 2010 (600 pts.)	200 pts.	200 pts.	200 pts.
Rec. laryngeal n. palsy (ns)			
– transient	5.5%	4%	2%
– permanent	1%	0.8%	0.5%
Hypoparathyroidism			
– transient	11%	4%	2%
– permanent	0.5%	0%	0%
Thomusch 2003 (5195 pts.)	88 pts.	527 pts.	4580 pts.
Rec. laryngeal n. palsy (ns)			
– transient	4.5%	2%	1.7%
– permanent	2.3%	1.4%	0.8%
Hypoparathyroidism			
– transient	21.6%	8.7%	6.3%
– permanent	10.5%	2.1%	0.9%

Findings of the single prospective, randomized trial published to date by a specialized center (Barczynski [13]) and the single German cross-sectional study to date (Thomusch [23]) with data on complication rates of each of the three common types of resective surgery
bilat., bilateral; ns, not significant; rec. laryngeal n., recurrent laryngeal nerve

FIGURE 2

Calculation of the frequency of surgery for recurrences and of complications (permanent hypoparathyroidism and recurrent laryngeal nerve palsy) for different types of surgical procedure used to treat bilateral nodular goiter, based on the analyses of Thomusch and Barczynski, per 100 000 thyroid operations (13, 23). Reop., reoperation; subtot. bilat., subtotal bilateral; perm. RLP, recurrent laryngeal nerve palsy; perm. hypopara., hypoparathyroidism

Postoperative complications

Transient and permanent recurrent laryngeal nerve palsy

Far more prospective data are available about recurrent laryngeal nerve palsy, but the reported rates of this complication also vary quite widely. One reason for this is that recurrent laryngeal nerve palsy becomes less common as surgical experience increases: this was shown in a retrospective, multicenter study from Baltimore involving 5860 patients (22). Centers in which both total thyroidectomy and subtotal resection are performed only by experienced endocrine surgeons report rates of recurrent laryngeal nerve palsy that range from 0.5% to 1% for either type of procedure, without any significant difference between the two (11, 13) (Tables 2 and 4).

These excellent results in specialized centers do not, however, reflect the general situation in Germany. The single prospective multicenter trial dealing with this question, in which representative data were collected on a total of 5195 patients in 45 hospitals

providing different levels of care, revealed a higher rate of recurrent laryngeal nerve palsy after total thyroidectomy: 2.3%, compared to 1.4% after Dunhill procedures and 0.8% after bilateral subtotal resection (23). In view of the large number of thyroid resections now being performed in Germany, one cannot reasonably expect that all patients with benign nodular goiter will be operated on in specialized centers for endocrine surgery.

Transient and permanent hypoparathyroidism

The rate of transient and permanent hypoparathyroidism rises in parallel with the extent of resection to an even more marked degree than the rate of recurrent laryngeal nerve palsy. Moreover, the frequency of postoperative hypocalcemia does not consistently drop as surgical experience increases, as the above-mentioned retrospective analysis from Baltimore confirms (22). The risk of permanent hypoparathyroidism after any type of procedure is difficult to estimate from the available data, but a risk of about 9–10% should be expected after total thyroidectomy (23, 25), even though lower values of 0.5% have been reported in specialized centers (13). There is a consensus among all published evaluations of this question that the risk of permanent hypoparathyroidism is much lower (1–2%) after bilateral subtotal resection or a Dunhill procedure (10, 23).

This marked difference is explained by the anatomical location of the parathyroid glands, which are particularly vulnerable to injury with dorsal dissection and exposure of the inferior thyroid artery and its branches (Figure 1), because both parathyroid glands derive their blood supply from branches of this artery. If a small, subtotal thyroid remnant is left dorsally or at the upper pole, the upper parathyroid gland can generally be preserved safely and with an adequate blood supply. The lower parathyroid gland has a more variable position (26); its blood supply is more likely to be preserved if an intracapsular subtotal resection is performed.

The findings of a representative multicenter study from Scandinavia, published in 2008, are of concern: of 1648 patients with bilateral goiter, 1385 underwent total thyroidectomy. Six weeks after surgery, 18% were being treated for hypoparathyroidism with vitamin D or calcium (27).

The high rate of hypocalcemia due to hypoparathyroidism is not the only problem; inadequate treatment is another, as a recent analysis of 182 cases showed. 22% of patients with postoperative hypoparathyroidism had a serum calcium level that was too low, while 34% had one that was too high. 19% were not receiving any vitamin D supplementation at all (28).

In summary, when total thyroidectomy is performed too liberally, unnecessary postoperative morbidity results—above all, but not exclusively, in the hands of relatively inexperienced surgeons.

Duration of surgery and hospital stay

Economic pressure has made it important to shorten the duration of operations and hospital stays. In general, any type of procedure can be performed more rapidly with increasing surgical experience. All of the operations in Barczynski's study were performed by three experienced surgeons, and the mean duration of surgery for total thyroidectomy, the Dunhill procedure, and subtotal resection was very short—about 68 minutes for each (13). In contrast, total thyroidectomy took an average of 150 minutes in the German multicenter study, significantly longer than the other two procedures—118 minutes for the Dunhill procedure and 100 minutes for bilateral subtotal resection (23).

Hospital stays after thyroid resections have become shorter in recent years. Patients with an uncomplicated postoperative course can usually be discharged one or two days after surgery (29). The need for intravenous calcium administration can markedly prolong hospitalization.

Theoretical calculations

In selecting the appropriate thyroid operation, the surgeon must consider the risk group to which the patient belongs (*Figure 2*). Although only a few patients will be at high risk of needing a second operation for a recurrence, all patients are subject to the immediate risk of hypoparathyroidism or a recurrent laryngeal nerve palsy. The appropriate calculation for the approximately 100 000 patients undergoing surgery for benign goiter in Germany each year is as follows: if all of them underwent total thyroidectomy rather than a Dunhill procedure, only about 2000 would be spared a second operation, but 8000 more would suffer the consequences of permanent hypoparathyroidism. When surgery is planned, individual patient-specific factors (age, occupation) and hospital-specific factors (complication rates) must be taken into account (30).

Conclusion

Recent years have seen a trend toward increased radicality in the surgical treatment of benign goiter. Although radical procedures are often indicated, total thyroidectomy should only be performed if the indication has been critically assessed. In particular, the high rate of hypoparathyroidism after total thyroidectomy implies that there must still be a role for subtotal resection, in which the residual thyroid tissue should be small in size and free of nodules. The Dunhill procedure, in particular, is a good compromise: the current evidence shows that clinically significant recurrent goiter is rare, even over the long term, as long as thyroid hormone or iodide (100 µg qd) is given to prevent recurrences. The authors' view is that clinically insignificant small recurrences ought simply to be accepted in exchange for better functional status (recurrent laryngeal nerve function, normocalcemia), particularly in older patients.

KEY MESSAGES

- About 100 000 patients undergo thyroid surgery in Germany each year. Even patients with benign nodular goiter are more commonly treated with a total thyroidectomy so that recurrences can be avoided.
- According to recent studies, when subtotal thyroid resection leaves only a small, nodule-free thyroid remnant behind and adequate doses of iodide or thyroid hormone are given for recurrence prophylaxis, only 0–0.5% of patients will need a reoperation for recurrent goiter.
- The reported complication rates of total thyroidectomy for permanent hypoparathyroidism in particular range from 0.5% (in specialized centers) to 10% (in a German cross-sectional study) and are thus higher than the corresponding rate for a Dunhill procedure (1–2%).
- The Dunhill procedure is generally sufficiently radical even if a papillary microcarcinoma is incidentally discovered. It remains a valid option in thyroid surgery.
- In selecting the appropriate thyroid operation, the surgeon must consider individual patient-specific factors such as age, occupation, and comorbidities.

Conflict of interest statement

The authors state that they have no conflicts of interest.

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REVIEW ARTICLE

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Balancing Invasiveness With Complications

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