ORIGINAL ARTICLE

Incision Length for Standard Thyroidectomy and Parathyroidectomy

When Is It Minimally Invasive?

Laurent Brunaud, MD; Rasa Zarnegar, MD; Nobuyuki Wada, MD; Philip Ituarte, PhD; Orlo H. Clark, MD; Quan-Yang Duh, MD

Hypothesis: Current techniques for open conventional thyroidectomy or parathyroidectomy have evolved to enable a shorter incision (main proposition), and the length of the incision is influenced by objective factors.

Design: Case series.

Setting: University referral center.

Patients and Intervention: Retrospective study of the most recent 200 primary consecutive routine thyroid and parathyroid operations (excluding neck dissections).

Main Outcome Measures: The length of incision was routinely measured with a ruler before the incision. Univariate and multivariate analysis was performed to distinguish variables affecting length of incision.

Results: Mean length of the incision was 5.5 cm for total thyroidectomy, 4.6 cm for lobectomy, and 3.5 cm for parathyroidectomy ($P<.001$). It was 4.1 cm for bilateral parathyroid exploration, but was reduced to 3.2 and 2.8 cm for unilateral ($P<.001$) and focal ($P<.001$) explorations, respectively. By multiple regression analysis, thyroid specimen volume and patient body mass index were independent predictors of incision length in thyroidectomy. Extent of exploration and resident training level were independent predictors of incision length in parathyroidectomy.

Conclusions: Current techniques for open conventional thyroidectomy or parathyroidectomy have evolved to enable a shorter incision. Thyroid volume, patient body mass index, extent of the planned parathyroid exploration, and the resident clinical training stage are important variables for incision length in open operation and should be taken into account when minimally invasive thyroidectomy and parathyroidectomy are evaluated.

Arch Surg. 2003;138:1140-1143

From the Departments of Surgery, University of California, San Francisco (Drs Brunaud, Zarnegar, Wada, Ituarte, Clark, and Duh), and Mount Zion Medical Center, San Francisco (Drs Brunaud, Zarnegar, Wada, Ituarte, and Clark); and Surgical Service, Veterans Affairs Medical Center, San Francisco (Dr Duh). Dr Brunaud is now with the Department of General and Endocrine Surgery, University of Nancy, Brabois, France.

THERE ARE many definitions of "minimally invasive" thyroidectomy and parathyroidectomy in the literature.[1,2] No matter how they are defined, the main advantage is a shorter cervical incision. Many surgeons who perform "minimally invasive" surgery make a misleading comparison to the traditional Kocher incision of 8 to 10 cm, which is rarely necessary. The aim of this study was to determine our current standard neck incision length for open conventional thyroidectomy and parathyroidectomy and to determine what variables may influence this length of incision.

METHODS

PATIENTS AND PROCEDURES

Data from 200 consecutive patients undergoing either thyroid or parathyroid operations were reviewed. We excluded all reoperations and patients undergoing neck dissection. All procedures were performed by 1 of 2 of us (Q.-Y.D. and O.H.C.). All procedures were performed with the patient under general anesthesia. There was at least 1 surgical resident and a scrub nurse assisting the surgeon. A transverse lower midcervical skin incision was made for all patients, at the level of the isthmus, usually 1 cm below the cricoid cartilage. This incision was preferably placed in one of the skin creases of the neck. The superior margin of dissection extended usually to just above the notch of the thyroid cartilage. The inferior flap was created similarly and the dissection extended inferiorly to the level of the sternal notch. Retractors were used to provide and maintain exposure.

EXAMINED VARIABLES

The data were collected by reviewing the prospectively kept endocrine surgery database and patients' medical charts. These variables included the following: (1) body mass index (BMI), (2) patient's age, (3) duration of operation, and (4) resident clinical training stage. Variables related to thyroid surgery included, more specifically, (1) type of operation (unilateral lobectomy or total thyroidectomy), (2)

Table 1. Length of Incision in 200 Patients Who Underwent Total Thyroidectomy, Lobectomy, or Parathyroidectomy

Procedure	No. of Patients	Length, cm		*P* Value
		Mean ± SEM	Range	
Total thyroidectomy	73	5.5 ± 0.1	3.0 to 9.0	<.001
Multinodular goiter	39	5.9 ± 0.2	4.0 to 9.0	. . .
Graves disease	8	5.5 ± 0.5	3.0 to 8.0	. . .
Cancer	25	5.0 ± 0.2	4.0 to 7.0	. . .
Benign nodule	1	5.0	5.0	. . .
Lobectomy	60	4.6 ± 0.1	3.0 to 8.0	<.001*
Multinodular goiter	10	5.7 ± 0.3	4.0 to 7.0	. . .
Cancer†	13	4.6 ± 0.3	4.0 to 7.0	. . .
Benign nodule	37	4.4 ± 0.1	3.0 to 8.0	. . .
Parathyroidectomy	67	3.5 ± 0.1	2.5 to 6.0	<.001‡
Bilateral exploration	28	4.1 ± 0.2	2.5 to 6.0	. . .
Unilateral exploration	25	3.2 ± 0.1	2.5 to 5.0	<.001§
Focal exploration	14	2.8 ± 0.1	2.5 to 4.0	<.001§
Total	**200**	4.6 ± 0.1	2.5 to 9.0	. . .

*Compared with total thyroidectomy.
†These patients had initial operation for thyroid nodules that were found later to be cancers.
‡Compared with total thyroidectomy or lobectomy.
§Compared with bilateral parathyroid exploration.

indications for operation, (3) thyroid specimen volume and weight, (4) substernal extension, and (5) number of recurrent laryngeal nerves or parathyroid glands identified. Variables related to parathyroid surgery included, more specifically, (1) type of operation (bilateral, unilateral, or focal parathyroid exploration), (2) extent of cervical exploration (number of parathyroid glands located and number of parathyroid glands resected), (3) indications for surgery (primary or secondary hyperparathyroidism), (4) size of resected parathyroid gland(s), and (5) whether or not thymectomy was performed. The intended incision line was routinely drawn and measured with a ruler, so that skin incision lengths were increased incrementally by 0.5 cm. A few of the incisions (6 patients) were extended when the surgeon believed that the initial incision was too short to provide an adequate exposure to perform the procedure. For these we used the final length after extension for analysis.

STATISTICS

All values are expressed as mean±SEM except in the box plot showing resident level. Statistical analysis was performed with the unpaired, 2-tailed *t* test. A nonparametric test (Mann-Whitney test) was performed when distribution was nonnormal. Correlations were evaluated by means of a correlation matrix and backward multiple regression analysis. Statistical significance was accepted when $P<.05$. The data were analyzed and compared by means of StatView 5.0 software (Abacus Concepts, Berkeley, Calif).

RESULTS

ALL PATIENTS

Seventy-three patients (36%) underwent total thyroidectomy and 60 patients (30%) unilateral lobectomy. Sixty-seven patients (34%) underwent parathyroidectomy. Mean age was 49.9±1.2 years. There were 159 women (80%) and 41 men. Mean length of the incision was 5.5±0.1 cm for total thyroidectomy, 4.6±0.1 cm for unilateral thyroid lobectomy, and 3.5±0.1 cm for parathyroidectomy (**Table 1**) ($P<.001$).

EXAMINED VARIABLES FOR THYROIDECTOMY

The mean incision length was longer in patients with substernal thyroid extension and in patients with obstructive signs ($P<.001$) (**Table 2**). The shortest incision length was observed for benign nodules: 4.4±0.1 cm. In comparison, thyroidectomy for cancer, Graves disease, and multinodular goiter was associated with a longer incision ($P<.01$) (Table 2). The matrix correlation analysis showed a significant positive correlation for thyroidectomy between length of incision and thyroid volume or weight (**Table 3**).

The length of the incision was significantly shorter when an R4 or R5 resident assisted the surgeon for total thyroidectomy ($P<.03$) (**Figure 1**). The matrix correlation analysis showed a significant negative correlation between length of incision and resident clinical training stage (Table 3). A positive correlation was found between length of incision and patient BMI, age, and duration of operation ($P<.001$).

EXAMINED VARIABLES FOR PARATHYROIDECTOMY

The mean length of incision was 4.1±0.2 cm for bilateral exploration. This length was reduced to 3.2±0.1 cm and 2.8±0.1 cm for a unilateral ($P<.001$) or a focal parathyroid ($P<.001$) exploration (Table 1). Although these incisions were significantly shorter than those for bilateral exploration, no statistically significant difference was noted between unilateral and focal parathyroid explorations. The matrix correlation showed a positive correlation between length of incision and extent of cervical exploration, and duration of operation (Table 3).

We also found that incisions were longer when a unilateral (4.1±0.5 cm vs 3.4±0.1 cm; $P<.05$) or bilateral (5.0±0.5 cm vs 3.4±0.1 cm; $P<.001$) thymic resection was added to the parathyroid exploration, and in patients with secondary hyperparathyroidism (5.4±0.2 cm vs

Table 2. Factors Associated With Length of Incision for Thyroidectomy

Criteria	No. of Patients	Length, cm		*P* Value
		Mean ± SEM	Range	
Related to thyroid volume				
No substernal thyroid	116	4.9 ± 0.1	3.0 to 8.0	<.001
Substernal thyroid	17	6.4 ± 0.3	4.0 to 9.0	
No obstructive sign	114	4.9 ± 0.1	3.0 to 8.0	<.001
Obstructive signs	19	6.5 ± 0.3	4.0 to 9.0	
Pathologic findings				
Benign nodule	38	4.4 ± 0.1	3.0 to 8.0	. . .
Cancer	38	4.9 ± 0.1	4.0 to 7.0	<.01*
Graves disease	8	5.5 ± 0.5	3.0 to 8.0	<.01*
Multinodular goiter	49	5.8 ± 0.2	4.0 to 9.0	<.001*

*Compared with benign nodule.

Table 3. Correlation Matrix for Length of Incision and Evaluated Criteria*

	Coefficient	No. of Patients	95% CI
Thyroid			
Operation duration	0.58	132	0.45 to 0.68
Specimen volume	0.54	126	0.41 to 0.66
Specimen weight	0.56	101	0.41 to 0.68
BMI	0.42	101	0.25 to 0.57
Age	0.31	132	0.14 to 0.45
Resident level	–0.34	118	–0.49 to –0.17
Parathyroid			
No. of parathyroids identified	0.51	68	0.31 to 0.66
No. of parathyroids resected	0.42	67	0.20 to 0.60
Operation duration	0.39	68	0.17 to 0.57
Resident level	–0.42	60	–0.61 to –0.19

Abbreviations: BMI, body mass index; CI, confidence interval.
*A significant positive correlation for thyroidectomy was evident for all variables ($P<.001$).

3.4±0.1 cm; $P<.001$). The incision was significantly shorter when an R4 or R5 resident helped the surgeon during surgery ($P=.009$) (Figure 1). Similar to thyroidectomy, a negative correlation was found between length of incision and resident clinical training stage (Table 3).

MULTIPLE REGRESSION ANALYSIS

In multiple regression analysis, thyroid specimen volume ($P<.001$) (**Figure 2**) and BMI ($P=.02$) remained independent predictors of incision length for thyroid surgery. For parathyroid surgery, extent of cervical exploration (number of parathyroids seen) ($P<.001$) and resident level of clinical training ($P<.001$) remained independent predictors.

COMMENT

Minimally invasive surgery is defined as the ability of the surgeon to perform traditional surgical procedures in novel ways to minimize the trauma of surgical exposure.[3] High-technology imaging systems and new surgical tools are generally used to achieve this goal. Since one of the goals for surgeons and patients is to minimize "surgical invasiveness," when the operation can be done safely, the length of incision is consequently one of the key variables in defining minimally invasive surgery.[1,3] In endocrine surgery, minimally invasive surgical techniques have been widely applied in thyroid and parathyroid surgery since 1996.[1]

We found that the cervical incision length routinely used at the University of California, San Francisco, for standard total thyroidectomy and unilateral lobectomy was 5.5 and 4.6 cm, respectively. The incision length was 4.1 cm for bilateral parathyroid exploration but was reduced to 3.2 and 2.8 cm when unilateral and focal parathyroid approaches, respectively, were performed. Thus, we confirmed that current techniques for open conventional thyroidectomy or parathyroidectomy have evolved to use a shorter incision. This evolution in shortening the incision is not specific to our institution and has been widely observed.[4] Indeed, Yim and Carty[5] recently showed by questionnaire that the mean incision length used by 27 internationally respected practicing endocrine surgeons was 5 cm for thyroid surgery (lobectomy and total thyroidectomy). They also prospectively showed that mean incision length in their group was 5.9 and 5.1 cm for open conventional total thyroidectomy and unilateral lobectomy, respectively.[5] This trend has also been observed for open conventional parathyroidectomy, with an average length of incision less than 5 cm.[6,7]

We think that it is essential to recognize that current techniques for open conventional thyroidectomy and parathyroidectomy can routinely be performed through incisions of 3.5 to 5.5 cm. Consequently, this reduced average length of incision for open conventional thyroidectomy and parathyroidectomy currently should be taken into account when advantages and disadvantages of new minimally invasive approaches are evaluated. Historical description should no longer be used for comparison when minimally invasive thyroidectomy and parathyroidectomy are studied.[8-10] For example, minimally invasive procedures should not be compared with "a wide transverse skin incision in the exposed anterior neck region"[11] or "a 6 to 8 cm, or bigger, transverse wound on the lower neck."[12]

Furthermore, we showed that the length of incision is determined by other factors. We confirmed that thyroid volume is a main independent predictor of incision length for thyroidectomy, as previously observed with

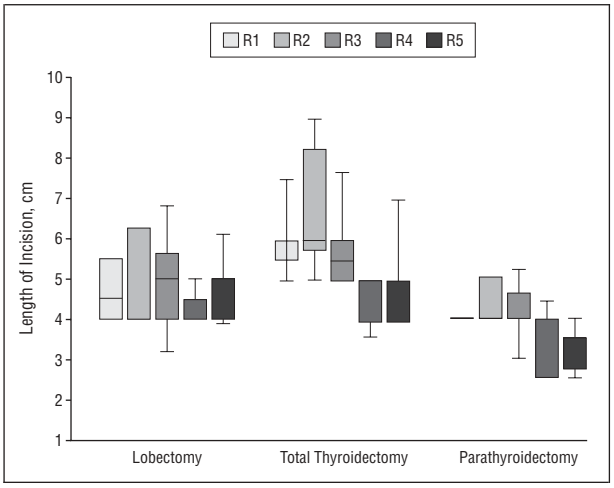

Figure 1. Box plots of length of incision according to resident clinical training level (R1 through R5) and type of surgery. The incision was shorter when a senior resident (R4 or R5) assisted the surgeon for total thyroidectomy ($P<.03$) and parathyroidectomy ($P=.009$) (Mann-Whitney test). Boxes indicate the 25th and 75th percentiles; horizontal lines in boxes, mean; and limit lines, SD.

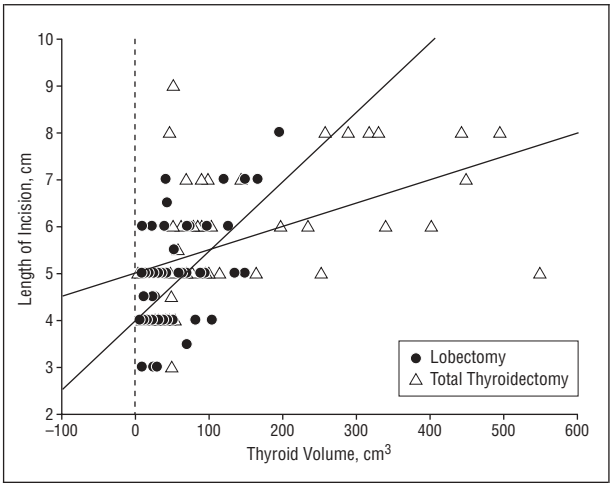

Figure 2. Bivariate graph showing the correlation between length of incision for thyroidectomy (lobectomy and total thyroidectomy) and thyroid specimen volume. The diagonals are lines for linear regression analysis.

minimally invasive surgery.[13,14] We also confirm that patient BMI influences incision length. This last criterion is rarely reported in studies describing minimally invasive thyroidectomy and is not considered by most authors.[13] For parathyroidectomy, predictors of incision length are the extent of the planned exploration and the clinical training level of the resident helping the staff surgeon during the procedure. In the literature, the number of parathyroid glands seen was rarely used to discriminate among the various minimally invasive parathyroid procedures.[1,11,15] Although the skill and level of assisting surgeons (residents) may influence the conduct of the operation, how they affect the surgical procedure has rarely been studied.[9] In our opinion, this implies that thyroid volume (gland volume and/or nodule volume), patient BMI, extent of the planned parathyroid exploration, and the resident clinical training stage should be taken into account when minimally invasive thyroidectomy and parathyroidectomy are evaluated.

Our study raises the question of what is a minimally invasive neck surgery and what is not. Many criteria are used to define and discriminate among minimally invasive techniques (pain, duration of operation, general or local anesthesia, cost, cosmetic results, and cure of the disease).[1,2,6,13] The length of incision is only one of the criteria, and it varies among these procedures. The incision length for these procedures sometimes comes very close to the length observed with open and conventional thyroidectomy and parathyroidectomy.[5] The term *minimally invasive*, when used in the context of thyroid and parathyroid operations, currently is not specific enough and overlaps with conventional open operation. We propose that this term be used only to describe thyroid and parathyroid procedures that are routinely associated with an incision shorter than 3.0 cm for thyroidectomy and 2.5 cm for parathyroidectomy. These threshold values correspond to the minimum lengths observed in this study.

Accepted for publication February 22, 2003.

This study was supported in part by Mt Zion Health Systems, San Francisco; Friends of Endocrine Surgery, San Francisco; and the Jerrold Heller Family Foundation, Encinitas, Calif.

This article was presented in part at the 22nd Annual Meeting of the British Association of Endocrine Surgeons; May 10; Pisa, Italy.

Corresponding author: Quan-Yang Duh, MD, Surgical Service, Veterans Affairs Medical Center SF, 4150 Clement St, San Francisco, CA 94121.

REFERENCES

1. Miccoli P, Berti P. Minimally invasive parathyroid surgery. *Best Pract Res Clin Endocrinol Metab*. 2001;15:139-147.
2. Shimizu S. Minimally invasive thyroid surgery. *Best Pract Res Clin Endocrinol Metab*. 2001;15:123-137.
3. Hunter JG. Minimally invasive surgery: the next frontier. *World J Surg*. 1999; 23:422-424.
4. Ng J. Minithyroidectomy: a critical appraisal [letter]. *J Am Coll Surg*. 2002;194: 99-100.
5. Yim JH, Carty SE. Re-defining the modern standard for open thyroidectomy. In: Program and abstracts of the 73rd Annual Meeting of the American Thyroid Association; September 13-16, 2001; Washington, DC.
6. Lorenz K, Miccoli P, Monchik JM, Duren M, Dralle H. Minimally invasive video-assisted parathyroidectomy: multiinstitutional study. *World J Surg*. 2001;25: 704-707.
7. Prager G, Czerny C, Kurtaran A, et al. Minimally invasive open parathyroidectomy in an endemic goiter area. *Arch Surg*. 2001;136:810-816.
8. Bellantone R, Lombardi CP, Bossola M, et al. Video-assisted vs conventional thyroid lobectomy. *Arch Surg*. 2002;137:301-305.
9. Miccoli P, Berti P, Raffaeli M, Materazzi G, Baldaci S, Rossi G. Comparison between minimally invasive video-assisted thyroidectomy and conventional thyroidectomy: a prospective randomized study. *Surgery*. 2001;130:1039-1043.
10. Henry JF, Raffaeli M, Iacobone M, Volot F. Video-assisted parathyroidectomy via the lateral approach vs conventional surgery in the treatment of sporadic primary hyperparathyroidism. *Surg Endosc*. 2001;15:1116-1119.
11. Okido M, Shimizu S, Kuroki S, Yokohata K, Uchiyama A, Tanaka M. Video-assisted parathyroidectomy for primary hyperparathyroidism. *Surg Endosc*. 2001; 15:1120-1123.
12. Yeh TS, Jan YY, Hsu B, Chen KW, Chen MF. Video-assisted endoscopic thyroidectomy. *Am J Surg*. 2000;180:82-85.
13. Ferzli GS, Sayad P, Abdo Z, Cacchione RN. Minimally invasive, nonendoscopic thyroid surgery. *J Am Coll Surg*. 2001;192:665-668.
14. Gagner M, Inabnet WB. Endoscopic thyroidectomy for solitary thyroid nodules. *Thyroid*. 2001;11:161-163.
15. Henry JF, Iacobone M, Mirallie E, Deveze A. Indications and results of video-assisted parathyroidectomy by a lateral approach in patients with primary hyperparathyroidism. *Surgery*. 2001;130:999-1004.