

Prospective, case–control study of surgical efficiency of ultrasonic shear ('harmonic scalpel') thyroidectomy compared with conventional thyroidectomy

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Abstract

Objectives and hypothesis: To evaluate the efficacy of ultrasonic shear ('harmonic scalpel') thyroidectomy, compared with conventional thyroidectomy.

Study design: Prospective, case–control comparison.

Methods: Twenty-three consecutive patients were recruited over an eight-month period. Patients were divided into two groups according to their thyroidectomy technique, i.e. ultrasonic shear technique (harmonic scalpel) vs conventional technique (scalpel and bipolar diathermy). Surgical time, thyroidectomy type and thyroid specimen weight were recorded by theatre nursing staff. The ratio of surgical time to specimen weight, in minutes per gram, was used to measure surgical efficiency. The unpaired Student's *t*-test was used for statistical analysis.

Results: The mean surgical time per specimen unit weight was 2.56 min/g for harmonic scalpel thyroidectomy and 5.99 min/g for conventional thyroidectomy. This difference was statistically significant ($p = 0.037$). The difference was most evident for procedures involving smaller thyroid glands.

Conclusions: Our study suggests that thyroidectomy using a harmonic scalpel is more time-efficient than conventional thyroidectomy, especially when operating on smaller thyroid glands.

Key words: Thyroidectomy; Thyroid; Surgery; Efficiency

Introduction

Ultrasonic shear technology has long been used for various surgical procedures, such as laparoscopic cholecystectomy,¹ fundoplication,² laparoscopic hysterectomy³ and liver resection.⁴ More recently, it has also been used in thyroid surgery.⁵

The technology works on the principle of ultrasonic, high frequency vibration at about 55 kHz. This cuts and coagulates via protein denaturation. Proponents of ultrasonic shear surgery claim that, because it works at a lower temperature than diathermy, it causes less lateral thermal damage and tissue charring. As it cuts and coagulates at the same time, this reduces the need for ligatures and instrument change. Hence, there is an argument that ultrasonic surgery is more time-efficient.

A few studies have demonstrated that use of the harmonic scalpel reduces operative time for thyroid surgery by between 20 and 40 minutes, compared with conventional thyroidectomy.^{5–7} However, these studies only used operative time as a measure of surgical efficiency. Pathological thyroid glands vary greatly in size, from a small nodule to a large, multinodular goitre. Therefore, the operative

advantage of the harmonic scalpel in thyroid surgery, taking into consideration the thyroid gland size, remains a subject worthy of further investigation.

Aim

The aim of this study was to evaluate the surgical efficiency of ultrasonic shear technique compared with conventional thyroidectomy, by measuring the ratio of surgical time to specimen weight (as minutes/gram).

Materials and methods

Between 9 May 2005 and 5 January 2006, a total of 23 consecutive patients were admitted for thyroid surgery under the care of the otolaryngology/head and neck surgeons. Due to funding issues, harmonic scalpels were not available for nearly half of these cases. Therefore, 13 patients underwent conventional thyroid surgery (using scalpel and diathermy) while the remaining 10 patients underwent thyroid surgery using an ultrasonic shear technique. We therefore took this unique opportunity to carry out a

TABLE I

DISTRIBUTION OF SURGICAL PROCEDURES IN THE 2 SURGICAL TECHNIQUE GROUPS

Procedure	Ultrasonic shear* (n (%))	Traditional† (n (%))
Hemithyroidectomy	6 (60)	10 (77)
Total thyroidectomy	4 (40)	3 (23)
Total	10	13

*Median age 53 years; 3 men, 7 women. †Median age 55 years; 4 men, 9 women.

prospective, case-control study of surgical times for both techniques.

Table I summarises the surgical procedures undertaken in the two study groups. Of the 10 patients receiving ultrasonic shear surgery, six (60 per cent) underwent hemithyroidectomy and four (40 per cent) underwent total thyroidectomy. Of the 13 patients receiving conventional surgery, 10 (77 per cent) underwent hemithyroidectomy and three (23 per cent) underwent total thyroidectomy. Patients' median ages were 53 years for the ultrasonic shear group and 55 years for the traditional thyroidectomy group. The male to female ratio was 3:7 for the ultrasonic shear group and 4:9 for the conventional group.

All operations were carried out by the same principal surgeon. This reduced inter-operator confounding factors. An accurate record of start and finish times was kept by theatre staff. Starting time was defined as the time the surgical scalpel first touched the skin for the initial incision. Finishing time was defined as the time of completion of the last stitch to the surgical wound. The weight of each thyroid specimen was measured and recorded before it was sent to the pathology department.

Outcome measures

Tables II and III summarise the surgical times and specimen weights for both the ultrasonic shear group and the traditional thyroidectomy group, respectively. As the specimens varied greatly in size, we used the ratio of surgical time to specimen weight (minutes/gram) in order to measure surgical efficiency. The surgical efficiency for each case is shown in the last column of Tables II and III.

TABLE II

SURGICAL TIME AND SPECIMEN WEIGHT, ULTRASONIC SHEAR GROUP

Case no	Time (min)	Weight (g)	Time/weight (min/g)
1	161	40	4.03
2	104	50	2.08
3	146	220	0.66
4	109	15	7.27
5	175	255	0.69
6	200	90	2.22
7	220	95	2.32
8	85	35	2.43
9	59	25	2.36
10	145	95	1.53
Average	140	92	2.56

No = number; min = minutes

TABLE III

SURGICAL TIME AND SPECIMEN WEIGHT, CONVENTIONAL THYROIDECTOMY GROUP

Case no	Time (min)	Weight (g)	Time/weight (min/g)
1	140	25	5.60
2	117	22	5.32
3	125	30	4.17
4	140	10	14.00
5	180	25	7.20
6	380	40	9.50
7	172	20	8.60
8	158	125	1.26
9	143	10	14.30
10	222	265	0.84
11	173	45	3.84
12	195	75	2.60
13	154	225	0.68
Average	177	71	5.99

No = number; min = minutes

Statistical analysis and results

As the data for surgical efficiency were continuous, unpaired and small, unpaired Student's *t*-testing was used for statistical analysis. The average surgical efficiency for the ultrasonic shear group and the traditional group was 2.56 and 5.99 min/g, respectively. This difference in surgical efficiency was found to be statistically significant (*p* = 0.037).

Discussion

Figure 1 demonstrates the distribution of surgical efficiency (defined as operative time per specimen unit weight) for the two groups. From this comparison, it is quite obvious that harmonic scalpel thyroidectomy was more time-efficient than traditional thyroidectomy. This finding is in keeping with previous studies, which have demonstrated that thyroid surgery using a harmonic scalpel is 20–40 minutes faster than that using conventional techniques.^{5–7}

However, when we re-plotted the distribution of surgical efficiency according to the weight of the specimens, a very interesting trend emerged. It

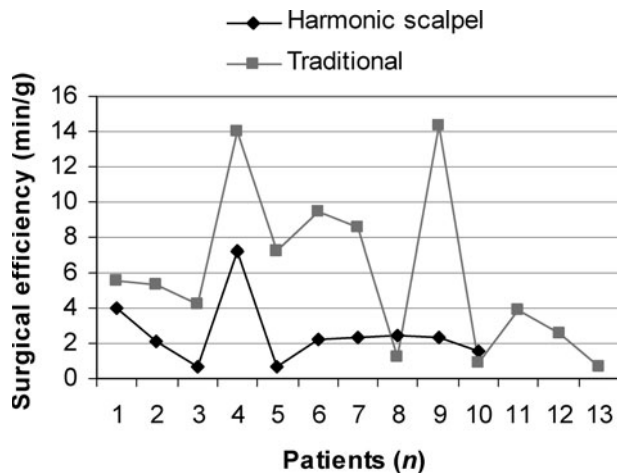


FIG. 1

Comparison of surgical efficiency in the two patient groups.

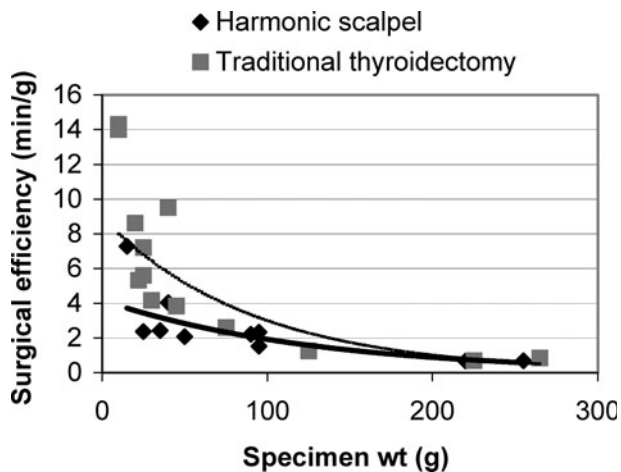


FIG. 2

Comparison of surgical efficiency according to thyroid specimen weight (wt). The harmonic scalpel had greater surgical efficiency for smaller thyroid specimens.

appeared that the harmonic scalpel was more efficient than traditional thyroidectomy when operating on smaller thyroid glands, and that this superiority faded as the size of the thyroid lesion increased (Figure 2).

- **Proponents of ultrasonic shear surgery claim that it causes less lateral thermal damage and tissue charring, as it works at a lower temperature than diathermy**
- **This study sought to evaluate whether thyroid surgery using the ultrasonic shear technique ('harmonic scalpel') was more efficient than conventional thyroidectomy**
- **The results suggest that harmonic scalpel thyroidectomy is more time-efficient than conventional thyroidectomy, especially when operating upon smaller thyroid glands**

This raises an interesting question. Why is the harmonic scalpel more time-efficient when operating on smaller thyroid glands? As the harmonic scalpel cuts and coagulates at the same time, this saves time when raising the sub-platysmal flap and dissecting the pre-tracheal fascia and the strap muscles. This may explain why the harmonic scalpel is superior in straightforward operations involving smaller thyroid

glands. However, in operations involving larger thyroid lesions with very tight operating space, it may be that reduced room for manoeuvre (necessary to identify and protect the recurrent laryngeal nerve and the parathyroid glands) results in a dilution of the harmonic scalpel's advantage. Further study to audit the various stages of the thyroid operation is required in order to investigate this theory.

Conclusion

Our study demonstrated that the harmonic scalpel is more time-efficient than traditional thyroidectomy for smaller thyroid specimens. However, its superiority fades when operating on larger thyroid lesions. The reason for this requires further study, in order to investigate harmonic scalpel use during the various stages of thyroid surgery.

References

- 1 Tebala GD. Three-port laparoscopic cholecystectomy by harmonic dissection without cystic duct and artery clipping. *Am J Surg* 2006;**191**:718–20
- 2 Underwood RA, Dunnegan DL, Soper NJ. Prospective, randomized trial of bipolar electrosurgery vs ultrasonic coagulation for division of short gastric vessels during laparoscopic Nissen fundoplication. *Surg Endosc* 1999;**13**:763–8
- 3 Nezhad F, Mahdavi A, Nagarsheth NP. Total laparoscopic radical hysterectomy and pelvic lymphadenectomy using harmonic shears. *J Minim Invasive Gynecol* 2006;**13**:20–5
- 4 Wrightson WR, Edwards MJ, McMasters KM. The role of the ultrasonically activated shears and vascular cutting stapler in hepatic resection. *Am Surg* 2000;**66**:1037–40
- 5 Siperstein AE, Berber E, Morkoyun E. The use of the harmonic scalpel vs conventional knot tying for vessel ligation in thyroid surgery. *Arch Surg* 2002;**137**:137–42
- 6 Cordon C, Fajardo R, Ramirez J, Herrera MF. A randomized, prospective, parallel group study comparing the harmonic scalpel to electrocautery in thyroidectomy. *Surgery* 2005;**137**:337–41
- 7 Shemen L. Thyroidectomy using the harmonic scalpel: analysis of 105 consecutive cases. *Otolaryngol Head Neck Surg* 2002;**127**:284–8

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Dr S K Kang takes responsibility for the integrity of the content of the paper.
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