Minimally invasive video-assisted thyroidectomy: a critical analysis of long-term cosmetic results using a validated tool

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ABSTRACT

INTRODUCTION Since its first publication in 1997, minimally invasive video-assisted thyroidectomy (MIVAT) has developed into the predominant minimally invasive surgery of the thyroid. A major advantage over conventional thyroid surgery is the superior cosmetic result. However, there are still few data comparing the long-term cosmetic results of the two methods. This paper compares the long-term cosmetic results of the two methods, based on follow-up assessments.

METHODS Between 2004 and 2011, 143 preselected patients underwent a MIVAT in our department. Additionally, 134 patients underwent a conventional thyroidectomy in our hospital in 2011. A total of 117 patients from the MIVAT group and 102 patients from the conventional thyroidectomy group received follow-up assessments after 23.1 and 23.6 months, respectively, using the patient and observer scar assessment scale.

RESULTS The measurable cervical scar length averaged 1.9 cm in the MIVAT group and 3.9 cm in the conventional group ($P < 0.001$). Some 11.1% of the patients in the MIVAT group and 7.1% of the patients in the conventional group had developed keloid ($P = 0.391$). The patient scar assessment score was 10.4 for the MIVAT group compared with 9.9 for the conventional thyroidectomy group ($P = 0.691$) and the observer score assessment score was 8.6 for MIVAT compared with 9.9 for conventional thyroidectomy ($P = 0.011$).

CONCLUSION In the patient assessment instrument, conventional thyroidectomy had a small advantage over MIVAT in the cosmetic long-term results. This difference between the two groups was, however, not significant. Our result contradicts short-term cosmetic results of published randomized studies with improvement for MIVAT. The Observer Score demonstrates a significant advantage of the MIVAT.

KEYWORDS

Minimally invasive video-assisted thyroidectomy – Conventional thyroidectomy – Scar – Long-term cosmetic results

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Introduction

Minimally invasive video-assisted thyroidectomy (MIVAT) is the dominant minimally invasive thyroid surgery. Twenty years have passed since the beginnings of video-assisted thyroid and parathyroid procedures.^{1–4} Since then, MIVAT has gained international prominence under the leadership of Professor Miccoli, with more than 2400 published surgeries.⁵ A main goal of this surgical technique is to improve the cosmetic results by minimising the size of the cervical incision. The surgical scar is one of the most important aspects that endocrine surgeons consider when performing thyroid surgery because the neck is always an

exposed area. This was also the motivation for the development of the cervical scarless thyroid surgery. Procedures such as the axillo-bilateral-breast approach, bilateral axillo-breast approach or totally transoral video-assisted thyroidectomy are characterised by incisions outside the cervical area.^{6–8} Robot-assisted transaxillary thyroidectomy also uses an extracervical entry point.⁹ Extracervical procedures such as the axillo-bilateral-breast approach and the bilateral axillo-breast approach have been met with scrutiny because they are not considered to be minimally invasive, since they include extensive internal dissection of the chest and neck. Currently, 90,000 thyroid surgeries are performed annually in Germany. Since its implementation

20 years ago, MIVAT has become the most common minimally invasive procedure, yet it is not performed in every hospital offering thyroid surgery in Germany. The proportion of MIVAT performed in German centres of thyroid surgery is estimated at 5–10%, while cervical scarless thyroid surgery plays a minor role in clinical practice.

The goal of this study is the evaluation and comparison of cosmetic long-term results after MIVAT compared with conventional thyroidectomy. There is insufficient information from follow-up assessments with long-term data that attempt an objective evaluation of the cosmetic results. Most published data describe the results less than six months postoperatively.^{10,11} The scar analysis needs a long follow-up period because the healing and remodelling process is lengthy.¹² Our study analysed the quality of clinical results and the differences between the current status of research compared with routine clinical care.

Methods

In order to include a comparable number of patients, we used different time frames in cohort studies. This was necessary since MIVAT is a rarely used method.

Between January 2004 and December 2011, 143 patients underwent MIVAT at our hospital. Patients were pre-screened for compatibility. The maximal permissible nodule size was 35 mm in length and the maximum permissible thyroid volume was 25 cm³, determined by sonography. Exclusion criteria for this procedure were larger goitre, relapse surgery, patients with Graves' disease or patients with known carcinoma. For patients, the small cervical scar was a decisive factor in favour of MIVAT. The conventional thyroidectomy group consisted of 134 conventionally operated patients in our hospital in 2011. This group comprised patients covering the entire range of thyroid surgeries in our hospital including nodular goitre, Graves' disease, relapse surgery and thyroid carcinomas.

The operations were performed by two specialist thyroid surgeons. We conducted multiple follow-up assessments to evaluate the cosmetic long-term results following MIVAT and conventional thyroidectomy. Owing to the long time span over which MIVAT was performed, follow-up assessments for the MIVAT group were conducted at three different points. The assessments were conducted in June 2009, April 2010 and June 2013. The patients in the conventional thyroidectomy group also received follow-up assessments in June 2013. Follow-up assessments with usable long-term cosmetic results after MIVAT and conventional thyroidectomy were possible for 117 patients in the MIVAT group and 102 patients in the conventional thyroidectomy group. Eight patients in the MIVAT group had a thyroid carcinoma with indication for a lymphadenectomy and subsequently received conventional follow-up surgery. Three MIVAT surgeries were converted to conventional thyroidectomy intra-operatively. These 11 patients were not included in the long-term cosmetic results for MIVAT. One patient in the MIVAT group died of natural causes before a follow-up assessment was possible. All data originated from the follow-up assessments performed in our hospital.

We performed a scar assessment with a measurement of length and width of the cervical scar. The patient and observer scar assessment scale (POSAS) was used as a second objective assessment tool for the follow-up assessments in 2009, 2010 and 2013. This scar assessment scale is a complete scar evaluation tool and was developed by plastic surgeons (Fig 1).¹³ POSAS consists of two numerical scales. One component is the observer scar assessment scale (OSAS) and the second part is a patient-directed subjective score, the patient scar assessment scale (PSAS). The OSAS score included five domains. All domains were graded on a ten-point scale. One point indicates normal skin and ten points the worst scar result. The best summary score has five points and the worst possible scar result has 50 points. The assessment using OSAS scores was performed by the same thyroid surgeons in our hospital. The mode of operation of the observer comprised a critical scar assessment independent of the method of surgery. The PSAS has six domains with the same ten-point scale. The best summary score of six points indicates the best scar result and 60 points the worst result. Every patient evaluated the result of operation by using a mirror according to the six domains.

The analysis was performed using a database (Microsoft Office Access). Data processing was performed using the statistical analysis software SPSS version 24.0. A *P*-value of less than 0.05 was considered statistically significant. We also used propensity score match pairs analysis according to the criteria age and sex.

Results

The study enrolled 143 patients who had MIVAT and 134 patients who had conventional thyroidectomy. Demographic and perioperative data are reported in Table 1. There were 132 (92.3 %) women and 11 (7.6%) men with an average age of 49.2 years (range 19–80 years) in the MIVAT group. The conventional thyroidectomy group consisted of 96 (71.6%) women and 38 (28.4%) men with an average age of 58.6 years (range 22–83 years). The age difference between the MIVAT group and the conventional thyroidectomy group is significant (*P* < 0.001).

We included 219 patients in our follow-up assessment (117 MIVAT vs 102 conventional thyroidectomy; Table 2). The mean duration (MIVAT group vs conventional thyroidectomy group) of postoperative follow-up was 25.1 months compared with 23.6 months postoperatively (*P* = 0.096). In the MIVAT group one patient died of natural causes and three patients had a conversion to open thyroid surgery. Six patients had thyroid cancer with an indication for lymphadenectomy. We performed a second surgery using the conventional technique.

The scar results from MIVAT and conventional thyroidectomy and summary scores for the POSAS are depicted in Table 2. In the MIVAT group the mean postoperative scar length after a standard incision length of 2.0 cm was 1.9 cm with a range of 1.0–5.2 cm. The postoperative scar width was 1.7 mm with a range of 0.5–15 mm. The scar width of 15 mm was that of a woman with keloid and

Figure 1 Patient and observer scar assessment scale.

wideness scar extension. In the conventional thyroidectomy group the mean postoperative scar length was 3.9 cm with a range of 2.0–7.8 cm. The difference in scar length in the two groups was significant ($P < 0.001$). The results of the validated scores of scar evaluation are also shown in Table 2. The matched pair analysis resulted in 42 matched pairs. PSAS score in the MIVAT group was 10.0 compared with 10.6 in the conventional thyroidectomy group ($P = 0.360$) and OSAS score was 8.3 compared with 10.2 ($P = 0.049$).

Discussion

Our prospective cohort study analysed the cosmetic long-term results of MIVAT compared with conventional thyroidectomy in a follow-up assessment of the patients. The main criterion of the analysis was the evaluation of the scar after thyroid surgery. A decisive reason for the implementation of the minimally invasive thyroid surgery was improvement of the cosmetic result. Another published benefit of MIVAT was the reduction of the postsurgical

pain.¹⁰ The prevailing clinical perspective is that a smaller cervical incision correlates with a better cosmetic result. Despite this, there have repeatedly been studies that do not confirm this hypothesis. Studies describing the benefits of MIVAT evaluated the scar from the perspective of early postoperative assessments performed one month or between three and six months after surgery.^{10,11} However, scars should not be analysed less than six months after surgery because of the long duration of the healing and remodelling process.¹² There are significant discrepancies between long-term studies and early postoperative results in particular.

In 2008, O’Connell et al.¹⁴ found no significant difference in cosmetic results between minimal access and conventional surgery (scar length, mean 34 mm vs 75 mm). He used the POSAS as his assessment tool. To allow for comparable results, we used the same tool for our study. Unfortunately, there are very few published studies evaluating scars that use validated instruments.¹⁵ In our first analysis of scar assessment after MIVAT as a non-comparative case series we saw that the data from our MIVAT

Table 1 Patient data, type of surgery and complications.

	MIVAT	Conventional thyroidectomy	P-value
Patients (n)	143	134	
Mean age, years (95% CI)	49.2 (47.1–51.4)	58.6 (56.2–61.0)	< 0.001
Range (years)	19–80	22–83	
Sex:			
Male, n (%)	11 (22.4)	38 (77.6)	< 0.001
Female, n (%)	132 (57.9)	96(42.1)	< 0.001
Type of surgery (intention-to-treat):			
Total thyroidectomy	19 (13.3%)	61 (45.5%)	<0.001
Total thyroidectomy and lymphadenectomy	6 (4.2%)	18 (13.4%)	0.006
Dunhill procedure	27 (18.9%)	26 (19.4%)	0.912
Partial thyroid resection or hemithyroidectomy right	49 (34.3%)	15 (11.2%)	<0.001
Partial thyroid resection or hemithyroidectomy left		42 (29.4%)	14 (10.4%)
Revision for postoperative haemorrhage	3 (2.1%)	1 (0.7%)	0.346

CI, confidence interval; MIVAT, minimally invasive video-assisted thyroidectomy.

Table 2 Follow-up examination.

	MIVAT	Conventional thyroidectomy	P-value
Patients (n)	117	102	
Mean postoperative follow up, months (95% CI)	23.1(20.3–26.0)	23.6(22.7–24.5)	0.096
Range (months)	1–64	5–43	
Mean scar length, mm (95% CI)	19.7 (18.9–20.4)	39.7 (37.5–41.9)	
Range (mm)	10–32	20–78	
Mean scar width, mm (95% CI)	1.7 (1.4–2.1)	1.4 (1.2–1.6)	0.587
Range	0.5–15	0.5–5	
Keloids, n (%)	13 (11.1%)	7 (7.1%)	0.391
Female, n (%)	12 (92.3%)	7 (100%)	
Mean age, years (95% CI)	39.5 (33.4–45.6)	49.6 (31.3–67.9)	
Range (years)	19–49	28–75	
Male, n (%)	1 (7.7)	0	
POSAS score:			
OSAS, mean score (95% CI)	8.6 (8.0–9.4)	9.9 (9.0–10.9)	0.011
Range	5–25	5–34	
PSAS, mean score (95% CI)	10.4 (9.3–11.5)	9.9 (8.7–11.1)	0.691
Range	6–37	6–43	

CI, confidence interval; MIVAT, minimally invasive video-assisted thyroidectomy. OSAS, observer scar assessment scale; POSAS, patient and observer scar assessment scale; PSAS, patient scar assessment scale.

group were no better than the conventional thyroidectomy group in the Canadian study in patient score (9.7 vs 7.4 points). In the observer evaluation, however, our first

results showed an advantage of MIVAT compared with conventional thyroidectomy (8.1 vs 9.9 points).¹⁶ One disadvantage of the Canadian study was the very small group of

patients: only 11 patients in each comparison group. This motivated us to perform the comparison study in our hospital.

An study of 691 patients by Linos *et al*¹⁷ yielded the same results with no advantage for the minimally invasive procedure. With a mean age of the scar of 4.6 years after thyroid and parathyroid surgery, patient satisfaction was no higher for the minimal approach compared with conventional surgery. In this analysis, the patient scar assessment questionnaire was used. A disadvantage of this study was the method of data acquisition used, a telephone survey. In our studies, we repeatedly saw the necessity for direct contact with the patient for an objective observation.

A systematic review of the present literature by Dordea *et al*¹⁵ of the cosmetic short- and long-term results of thyroid surgery also showed no advantages for the minimally invasive procedure. Here, again, it was possible to show a lack of data regarding long-term results and the fact that only a few studies used a validated score for the analysis.¹⁵ The data situation therefore remains difficult, with a lack of comparability of the different results and low evidence in the studies regarding long-term results.

The factors that influence the cosmetic result have been repeatedly discussed in the literature.^{18,19} Is it the size of the cervical incision, the suture technique used for closure of the skin (cutaneous/intracutaneous)? Does the closure of the skin take place using non-absorbable or absorbable sutures or a skin stapler? What influence do energy-based devices have, with the added danger of a thermal injury to the wound edges?

There is a significant discrepancy in the literature regarding the length of the cervical incision for different techniques of thyroid surgery. Invariably, the incision length for MIVAT is stated as 1–3 cm.^{20,21} Data pertaining to incision length in minimally invasive, non-endoscopic surgeries and the smallest incisions by conventional surgeons are also given as 3 cm.^{22,23} In our experience, at an incision with a size of 2 cm it is necessary to work with an endoscope and specialised MIVAT instruments. For incision lengths above 2 cm, surgeons often mix the procedures of MIVAT and conventional thyroid surgery. In our analysis we used a standard incision of 2 cm for MIVAT.

To enable a comparison between the MIVAT group and the conventional thyroidectomy group regarding the evaluation of the scars, we used a standardised procedure for closure of the wound. In both groups intracutaneous absorbable suture stitching was used. We did not use cutaneous stitches with non-absorbable sutures or a skin stapler. We cannot make any statement regarding those techniques. Thermal injury of the skin edges inflicted by energy-based devices is a known problem. For MIVAT, where we used such a device for vessel sealing, we taped the lower edge of the wound with a separate surgical drape to avoid thermal alteration. This is a result of our experience from the first MIVAT operations with this problem and it is efficient.

The results of the follow-up assessment of the cosmetic long-term results with a follow-up of 23.1 and 23.6 months, respectively, in the MIVAT and conventional thyroidectomy group showed a slight advantage for the conventional thyroidectomy group in the validated patient score, with 10.4 compared with 9.9 (MIVAT vs conventional thyroidectomy). This difference is not significant ($P = 0.691$). Our study does not therefore yield an advantage for MIVAT compared with the conventional procedure in patient evaluation. This confirms the work of different studies and systematic reviews, that a smaller incision does not reflect in a better cosmetic long-term result.^{14,15,17} In matched pair analysis resulting in 42 matching pairs this difference does not exist. The OSAS of the general basic analysis was 8.6 compared with 9.9 (MIVAT vs conventional thyroidectomy), which yields a significant ($P = 0.011$) advantage for the minimally invasive procedure. The results were very good in both PSAS and OSAS.

One problem with the evaluation of scars, which should not be neglected, is the development of keloids after thyroid surgeries. This can be a serious problem for the cosmetic result and is only be detected in long-term studies. Again, there are too few data available. Böhm *et al*²⁵ describe a rate of keloids of 4.1% in patients after conventional thyroid surgery. Because those results mostly stem from one survey and because only 22.5% of patients had been re-examined it is not certain whether the rate of keloids would not have been higher in a complete re-examination of the patients. A primary risk factor for keloids is intensively pigmented skin, as it occurs with Hispanic, Asian and African individuals.²⁴ Younger individuals, under 30 years of age, are also disproportionately affected.²⁴ This age group includes many patients who receive thyroid surgery and especially those represented in the MIVAT group. Our analysis shows no significant difference (MIVAT vs conventional thyroidectomy; $P = 0.391$) in development of keloids between the groups.

Despite this, 11.1% of patients in the MIVAT group and 7.1% in the conventional thyroidectomy group were affected. In the MIVAT group with keloids, 92.3% were women. In the conventional thyroidectomy group with keloids, only women were affected. The mean age of the women was 39.5 years in the MIVAT group compared with 49.6 years in the conventional thyroidectomy group. As a consequence of these results, our patient history includes a detailed survey of known keloid tendencies. Predisposing factors were also examined. In cases where there is an increased risk, we recommend the postsurgical application of a silicone gel ointment. To avoid a cervical keloid, the only option is the application of a extracervical treatment. Because of the low case numbers, however, none of these treatments is significant in the clinical routine of thyroid surgery. In a comparing analysis of 30 patients with MIVAT and 32 patients with robot-assisted transaxillary thyroidectomy, Materazzi *et al*⁹ showed that the use of patient scar assessment questionnaire did not yield a higher patient

satisfaction in robot-assisted transaxillary thyroidectomy compared with MIVAT.

Conclusion

Our study compared the cosmetic long-term results of minimally invasive video-assisted thyroidectomy and conventional thyroidectomy using data gathered using a validated assessment instrument. The data were objectively obtained based on follow-up assessment. In both instruments used in the evaluation of the cosmetic long-term results, MIVAT and conventional thyroidectomy had very good outcomes. In the patient instrument (PSAS), conventional thyroidectomy had a small but not significant advantage over MIVAT in cosmetic long-term results. However, the smaller incision length of the MIVAT does not produce a better cosmetic long-term result as viewed by patients themselves. This forces a reassessment of the surgical conception that has repeatedly postulated that a smaller scar automatically corresponds with an improved cosmetic result. The observer instrument (OSAS) established a significant advantage of the MIVAT over conventional thyroidectomy. The measurable difference is clinically insignificant and has no effect in clinical routine. This fact can be used in preoperative consultation with the patient. Thyroid surgery is one of the few operative specialist fields where the advantage of the minimal invasive surgery cannot be proven in cosmetic long-term results.

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