Heliyon 10 (2024) e29301

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Analysis of trends and status of evaluation methods in thyroid scar

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A B S T R A C T

Background: The incidence of thyroid cancer has increased over the decades, and patients prefer short thin scars after thyroidectomy due to their cosmetic visibility. Several scar assessment methods have been used to determine the most cosmetically optimal surgical method, but a widely accepted measurement tool is still lacking. This study investigates the usage status in the thyroid scar scale according to time, region, and study method.

Methods: The authors searched for articles on thyroid scars published between January 2000 and September 2022 in the PubMed database. The study included clinical studies that mentioned thyroid scar and scar scale, excluding articles that did not evaluate neck scars. Statistical analysis was performed using IBM SPSS Statistics 29.

Results: A total of 35 studies were included. Among them, 17 used the Vancouver Scar Scale (VSS), 17 used the Patient and Observer Scar Assessment Scale (POSAS), four used the Manchester Scar Scale (MSS), and four used the Stony Brook Scar Evaluation Scale (SBSES). VSS and POSAS were the most commonly used scar evaluation methods. VSS tended to be used frequently in Asia, while POSAS was used frequently in Europe and in randomized controlled trials.

Conclusion: VSS and POSAS are popular thyroid scar assessment methods, with regional variations. Standardization is needed for meaningful comparisons. Patient's subjective evaluations should be considered, given the cosmetic importance of thyroid scars.

1. Introduction

The incidence of thyroid cancer has increased over the decades owing to both increasing surveillance and a true increase in the incidence of papillary thyroid cancer [1].

After thyroidectomy, patients prefer short thin scars. This is because a scar is formed in a cosmetically visible location after conventional thyroidectomy [2].

Several scar assessment methods have been used to determine the most cosmetically optimal surgical method. The most commonly used methods for thyroid scar evaluation are the Vancouver Scar Scale (VSS), Patient and Observer Scar Assessment Scale (POSAS), Manchester Scar Scale (MSS), and Stony Brook Scar Evaluation Scale (SBSES) [3].

The advantages and disadvantages of each scar evaluation method have been investigated in previous studies. However, a widely accepted measurement tool is still lacking for cosmetic outcomes [4].

Without standardization of the scar scale, it is difficult to compare cosmetic outcomes among studies.

In addition, previous reviews have rarely reported changes in evaluation methods with time or regional differences.

In the future, it is necessary to check the difference in the evaluation method according to the passage of time or region for the uniformity of outcome measures.

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https://doi.org/10.1016/j.heliyon.2024.e29301
Received 8 May 2023; Received in revised form 29 March 2024; Accepted 4 April 2024
Available online 16 April 2024

In this study, we investigated the changes in the thyroid scar scale according to time, region, and study method.

2. Methods

2.1. Search methods

We searched for articles on thyroid scars published between January 2000 and September 2022. The PubMed database was searched using the following search builder: (thyroid scar[All Fields]) AND (the name of scale[All Fields]). The search was conducted with four scales: VSS, POSAS, MSS, and SBSES. Visual analogue scale (VAS) is commonly used, but it is not included because it is not a standardized scale and the parameters vary from study to study. Also, scales which only reflect the patient's subjective evaluation were not included.

2.2. Inclusion and exclusion criteria of articles

Clinical studies that mentioned thyroid scar and scar scale were included in this study. Only articles that did not evaluate neck scars were excluded. (e.g., transoral endoscopic thyroidectomy vestibular approach).

2.3. Article review

Three authors (W. K. C., H. Y. S., and Y. J. P.) read the titles and abstracts of the reviewed articles. They evaluated the inclusion/exclusion criteria. In addition, they assessed the paper's evaluation method, publication year, region, study design, and the number of patients. In cases of disagreement, J. S. H. made the final decision.

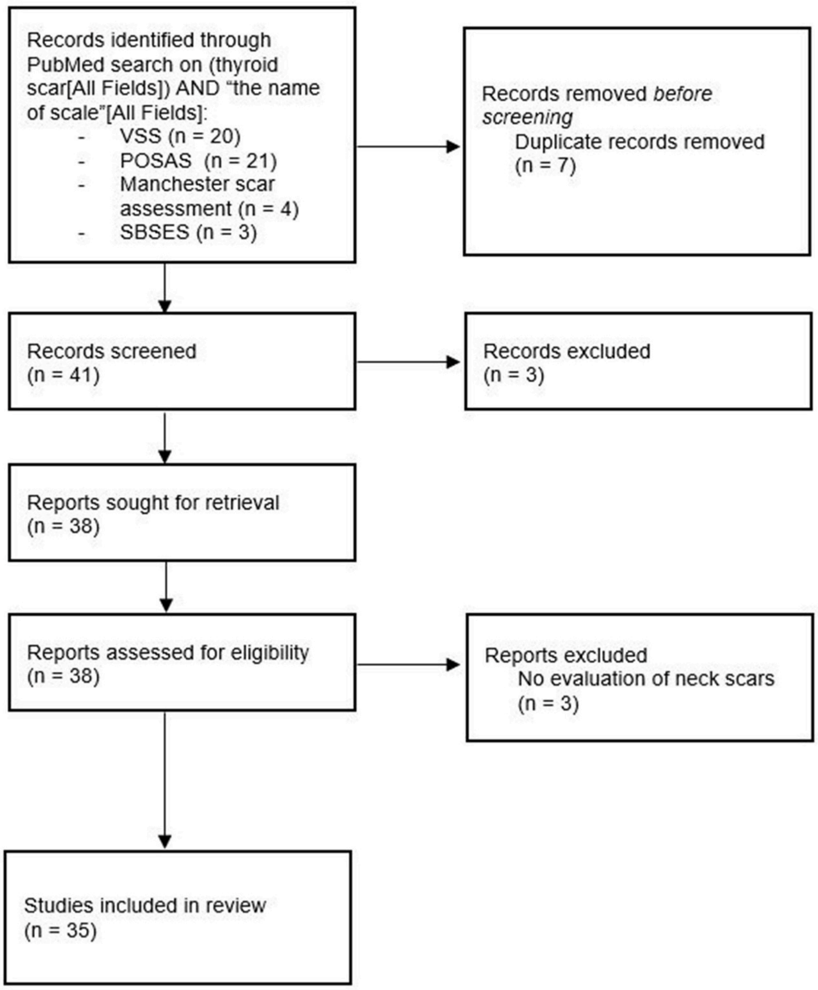

Fig. 1. Overview of included and excluded studies.

2.4. Statistical analysis

Chi-square test and Fisher's exact test were used to verify the difference in the ratio of thyroid scar scale used according to the year of publication, region, number of subjects, and study design. Multivariable logistic regression analysis was conducted to verify the effect of year of publication, study design, number of participants, and region on the possibility of the evaluation method. Statistical significance was set at $P < 0.05$. Statistical analyses were performed using IBM SPSS Statistics 29.

3. Results

3.1. Overview of included and excluded studies

A total of 48 articles were identified from the initial search. After excluding 7 duplicate records, 3 additional studies were excluded during title and abstract screening. An additional 3 articles were excluded because they did not evaluate neck scars during the full-text review. Ultimately, 35 studies were included (Fig. 1.).

3.2. General characteristics of included studies

Among the 35 studies [2,4–37], 15 (42.8 %) were published between 2008 and 2015. Most studies were conducted in Asia (n = 22; 62.9 %), followed by Europe (n = 10; 28.6 %) and North America (n = 3; 8.6 %). Fourteen (40 %) studies were observational studies. Among experimental studies (n = 21, 60 %), 19 were controlled studies. In 20 studies, the number of participants was less than 100. Table 1 for details.

3.3. Thyroid scar scale in included studies

In total, 17 (48.6 %) studies used VSS, 17 (48.6 %) used POSAS, four (11.4 %) used MSS, four (11.4 %) used SBSES. A total of six (17.1 %) studies assessed scar using two or more methods; one with VSS, POSAS, and SBSES; three with VSS and POSAS; and two with MSS and SBSES.

Table 1
Characteristics of included studies.

Author	Evaluation method	Year of publication	Region	Study design	Sample
Bae D [5]	Manchester, SBSES	2020	Asia	Controlled	40
Ku D [6]	Manchester, SBSES	2020	Asia	Controlled	40
Alicandri-Ciufelli M [7]	SBSES	2014	Europe	Controlled	89
Lee K [8]	VSS, POSAS, SBSES	2017	Asia	Controlled	66
Amin M [9]	manchester	2009	europe	controlled	72
Grover G [10]	manchester	2013	europe	observational	202
Chung J [4]	VSS, POSAS	2021	asia	observational	112
O'Connell D [11]	VSS, POSAS	2008	north america	observational	11
Ma X [12]	POSAS	2017	asia	observational	120
Chung J [13]	POSAS	2021	asia	controlled	126
Chaung K [2]	POSAS	2017	north america	observational	136
Alesina P [14]	POSAS	2021	europe	controlled	96
Pino A [15]	POSAS	2021	europe	controlled	100
Sahm M [16]	POSAS	2018	europe	controlled	219
Thamboo A [17]	POSAS	2016	north america	controlled	21
Marzouki H [18]	POSAS	2022	asia	observational	60
Lang B [19]	POSAS	2013	asia	controlled	141
Li T [20]	POSAS	2022	asia	controlled	172
Senne M [21]	POSAS	2018	europe	controlled	41
Consorti F [22]	POSAS	2013	europe	controlled	50
Cheon J [23]	POSAS	2022	asia	controlled	64
Scerrino G [24]	POSAS	2013	europe	controlled	224
Lee D [25]	VSS	2020	asia	uncontrolled	150
Kim J [26]	VSS	2018	asia	controlled	42
Jin Q [27]	VSS	2019	asia	observational	386
Choi Y [28]	VSS	2014	asia	observational	97
Ji Y [29]	VSS	2014	asia	observational	147
Jeon M [30]	VSS	2013	asia	observational	18
Kim D [31]	VSS	2015	asia	controlled	44
Song C [32]	VSS	2017	asia	observational	97
Jung J [33]	VSS	2011	asia	uncontrolled	23
Lee S [34]	VSS	2014	asia	observational	116
Lee J [35]	VSS	2013	asia	observational	16
Kim J [36]	VSS	2022	asia	observational	19
Lombardi C [37]	VSS, POSAS	2011	europe	controlled	140

3.4. Statistical analysis

Comparing the year of publication between 2008 and 2015 (n = 15) and 2016–2022 (n = 20), although not statistically significant, POSAS was used more frequently in 2016–2022 than in 2008–2015 (33.3 % vs. 65 %, P = 0.092, Table 2).

When examining the ratio of the thyroid scar evaluation method by region, the VSS was significantly different by region and was mainly used in Asia (P = 0.009, Table 2). POSAS also showed a significant difference in the usage rate (P = 0.039, Table 2).

The number of participants enrolled in each article was divided into <100 (n = 20) and ≥100 (n = 15) to verify the difference in the ratio of the evaluation methods used, but no statistically significant results were obtained.

When the study design was analyzed, the use rate of the VSS was significantly different depending on the study design, and it was mostly used in observational studies (P = 0.002, Table 3). In contrast, POSAS also had a significant difference, but was widely used in controlled studies (P = 0.047, Table 3).

Multivariable logistic regression was conducted to verify the effect of the year of publication, study design, participant number, and region on the rate of evaluation method use (Table 4). Region was shown to have a significant effect on VSS. The use of VSS was lower in Europe than in Asia (odds ratio [OR], 0.040; 95 % confidence interval [CI], 0.002–0.911). The year of publication and number of subjects appeared to have a significant effect on POSAS. Compared to 2016–2022, POSAS was used less frequently in 2008–2015 (OR, 0.044; 95 % CI, 0.002–0.854). In addition, the use of POSAS was lower when the number of participants was less than 100 compared to when the number of participants was more than 100 (OR, 0.047; 95 % CI, 0.003–0.755). Although not statistically significant, VSS was used more frequently in 2008–2015 than in 2016–2022, and was used more frequently in observational studies than in controlled studies. Similarly, although not statistically significant, POSAS was used less frequently in observational studies than in controlled studies.

4. Discussion

After thyroid surgery, scars form in cosmetically visible locations. Therefore, efforts to minimize scars have been made in various areas, such as the access method, instrument used, suture method, and postoperative scar management.

Access methods can be divided into conventional access, aesthetic principles access, and minimally invasive access [11,12]. Surgical methods other than conventional transcervical thyroidectomy include minimally invasive video-assisted thyroidectomy, gasless transaxillary endoscopic thyroidectomy, gasless unilateral axillo-breast approach, and postauricular robotic facelift thyroidectomy [14,16,24,25,29]. Intraoperative suture techniques, staples, adhesives, botox injections were also studied [6,7,9].Studies on the effects of fractional CO2 laser, triamcinolone intralesional injection, surgical subcision, and polynucleotide administration after surgery have also been published [23,26,33,35].

In general, the results showed that the new methods are helpful in improving scars compared to the conventional methods. However, a comparison between the new methods is lacking; therefore, additional research is required. Therefore, it is necessary to unify the evaluation methods for scars that are used in various ways.

Criteria used clinically for the evaluation of thyroid scars are the VSS, POSAS, MSS, and SBSES [3,4].

The VSS was developed in 1990 to evaluate burn scars [38]. It is a method of evaluating scar vascularity, pigmentation, pliability, and height, with a total score of 0–13. It has been mainly used for burn scar evaluation, but recently, it has been commonly used for postsurgical scar evaluation. Although it has the advantage of being relatively simple to evaluate, internal consistency has been shown in studies of linear scars or keloids that occurred after breast cancer surgery, but poor to moderate inter-rater reliability has been shown [39–41]. Moreover, VSS lacks symptoms or scarring evaluation in patients. To solve this problem, several studies have arbitrarily added and used patient-side evaluations; however, this has not been sufficiently verified.

POSAS is an evaluation method first created by Draaijers et al., in 2004, which divides observer and patient scar assessment into the observer scar assessment scale (OSAS) and patient scar assessment scale (PSAS) and sums them [42]. OSAS was used to evaluate thickness, relief, pliability, vascularity, and pigmentation in five ways, but the surface area was added in a modified version to evaluate six factors. The PSAS evaluates six factors: scar-related pain, itchiness, color, stiffness, thickness, and irregularity. Both OSAS and PSAS are evaluated with 10 points for each factor; 1 point is normal and 10 points are evaluated as the worst scar, and a total of 6–60 points are evaluated. This method was also developed to evaluate burn scars, but it is widely used for evaluating linear postsurgical scars, and its effectiveness has been sufficiently proven in several studies [39,43].Additionally, there is a study that proves the effectiveness of postsurgical scar evaluation after thyroid surgery. Both the OSAS and VSS seemed to have excellent internal consistency and inter-observer reliability, but OSAS was found to be superior [4,39].

MSS is a method for evaluating scars consisting of color, matte or shiny, contour, distortion, and texture. The peculiarity is that,

Table 2
Trends in evaluation methods of thyroid scars by year of publication and region.

	Year of publication			Region			
	2008–2015 (n = 15)	2016–2022 (n = 20)	P	North America (n = 3)	Europe (n = 10)	Asia (n = 22)	P
VSS	9 (60 %)	7 (35 %)	0.182	1 (33.3 %)	1 (10 %)	14 (63.6 %)	0.009
POSAS	5 (33.3 %)	13 (65 %)	0.092	3 (100 %)	7 (70 %)	8 (36.4 %)	0.039
MSS	2 (13.3 %)	2 (10 %)	1	0 (0 %)	2 (20 %)	2 (9.1 %)	0.706
SBSES	1 (6.7 %)	3 (15 %)	0.619	0 (0 %)	1 (10 %)	3 (13.6 %)	1

Table 3
Differences in evaluation methods of thyroid scars according to the design of study and number of participants.

	Number of subjects			Study design			
	<100 (n = 20)	≥100 (n = 15)	P	Observational study (n = 14)	Uncontrolled study (n = 2)	Controlled study (n = 19)	P
VSS	10 (50 %)	6 (40 %)	0.734	10 (71.4 %)	2 (100 %)	4 (21.1 %)	0.002
POSAS	8 (40 %)	10 (66.7 %)	0.176	5 (35.7 %)	0 (0 %)	13 (68.4 %)	0.047
MSS	3 (15 %)	1 (6.7 %)	0.619	1 (7.1 %)	0 (0 %)	3 (15.8 %)	0.703
SBSES	4 (20 %)	0 (0 %)	0.119	0 (0 %)	0 (0 %)	4 (21.1 %)	0.220

unlike other scar scales, when evaluating color, the score is evaluated not by the skin color of the lesion, but by the difference between the lesion and the surrounding skin color [44].

SBSES was created to evaluate scars after traumatic laceration. One point each is given to width, height, color, hatch marks or suture marks, and overall appearance, and the total score is 0–5 [44].

The scar descriptions evaluated by the scar scales commonly include dimension (height, width, thickness, area) color (vascularity, pigmentation), and pliability. When evaluating dimensions, VSS evaluates only height, POSAS evaluates only thickness, MSS does not evaluate, and SBSES evaluates width and height. When evaluating color, VSS and POSAS evaluate both vascularity and pigmentation of the lesion itself, but MSS evaluates the degree of mismatch between the lesion and normal skin, and SBSES evaluates pigmentation. Pliability is evaluated in both VSS and POSAS, and in MSS through distortion and texture, but not in SBSES. The degree of scoring for each scar description varies. VSS gives 2–5 points for each item, POSAS gives 1–10 points, MSS gives 1–4 points, and SBSES gives 0–1 points. Unlike other scar scales, only POSAS reflects the patient's subjective evaluation.

This study found that VSS and POSAS are the most commonly used scar evaluation methods. VSS tended to be used statistically frequently in Asia, POSAS was used frequently in Europe. And about the research methods, POSAS was used statistically frequently in randomized controlled trials (RCTs).

The high use of the POSAS in Europe and the high use of the VSS in Asia seem to be related to the fact that controlled studies account for the majority (90 %) in Europe, and the ratio of observational studies is higher in Asia than in Europe.

The reasons for the wide use of the POSAS in RCTs is that, first, when compared with the OSAS and VSS, reliability was found to be better in OSAS. This is probably because the OSAS evaluates each item with 10 points; therefore, it is more flexible than the VSS. In addition, it has the advantage of reflecting both patients' and observers' opinions, and since the OSAS and PSAS each use the same scoring system (total 6–60), it seems suitable for research to compare subjective appeal with objective observation.

The VSS, on the other hand, is considered to be the most used because it is easy to measure the scale and is an evaluation method developed before the POSAS. This may be preferred in studies that do not need to reflect on patient evaluation.

When creating a scar scale, the scar description can be made to include not only dimension, color, and pliability, but also more diverse. However, the more diverse it is, the less practical it is. In addition, if fewer points are assigned to each scar description, it is convenient to measure the scar scale, but it has the disadvantage of low flexibility. Therefore, scar scales that are frequently used in objective scar evaluation are validated through several studies. However, there is no agreement on which of the objective evaluation methods is the most effective and superior. Patients' subjective assessment is sometimes considered unimportant, but in a study of patients who underwent thyroidectomy for thyroid cancer, it was concluded that PSAS and quality of life score were related to thyroid scar color, stiffness, and thickness.[45] This suggests that since thyroid scars occur in cosmetically important locations, they can be thought of as affecting patient quality of life and psychological symptoms, and that PSAS is also related to the objective evaluation of scars. Among the evaluation methods widely used for thyroid scars, POSAS is the only one that reflects the patient's subjective evaluation. If a scar scale specialized for thyroid scar is used alone for research or developed, the subjective evaluation of the patient must be reflected.

The limitation of our study is that it does not indicate whether the patient's subjective satisfaction was investigated in the study using the VSS, MSS, and SBSES scales. Therefore, it was not possible to confirm the proportion of studies that evaluated patients' subjective satisfaction Another limitation is the small sample size. POSAS was used more frequently in 2016–2022 compared to before, but it was not statistically significant (P = 0.092), which is thought to be due to the small sample size. Small sample size is probably because the search was performed using only the PubMed database, without including other synonyms or Medical Subject Headings (MeSH). We also searched other databases currently accessible to us in an effort to address the issue of small sample size. However, most of the search results were included in the current author's searches. This suggests that the limitation is not necessarily in the number of databases but in the quantity of results yielded from our searches. However, this study is meaningful in that it confirmed the trend of scar evaluation methods after thyroid surgery over the past 22 years according to the year of publication, region, number of participants, and study design. This study can serve as a reference for selecting an appropriate evaluation method for scars after thyroid surgery.

COI/Disclosures: the author have no related conflicts of interest to declare.

Data availability statement

Data included in article.

Table 4
Multivariable logistic regression to adjust the year, region and study design, and number of participants.

		VSS		POSAS		MSS		SBSES	
		OR (95 % CI)	P	OR (95 % CI)	P	OR (95 % CI)	P	OR (95 % CI)	P
Year of publication	2008–2015 (n = 15)	Reference		Reference		Reference		Reference	
	2016–2022 (n = 20)	10.679 (0.841–135.575)	0.068	0.044 (0.002–0.854)	0.039	1.267 (0.125–12.854)	0.841	0.780 (0.036–17.114)	0.875
Study design	Observational study (n = 14)	Reference		Reference		Reference		Reference	
	Uncontrolled experimental study (n = 2)	7.458 (0.885–62.882)	0.065	0.078 (0.05–1.186)	0.066	0.668 (0.039–11.499)	0.781	0.000 (0.000)	0.998
	Controlled experimental study (n = 19)	4129494845.157 (0.000)	0.999	0.000 (0.000)	0.999	0.000 (0.000)	0.999	0.000 (0.000)	0.999
Number of study participants	<100 (n = 20)	Reference		Reference		Reference		Reference	
	≥100 (n = 15)	2.816 (0.350–22.683)	0.331	0.047 (0.003–0.755)	0.031	2.731 (0.232–32.220)	0.425	0.000 (0.000)	0.998
Region	North America (n = 3)	Reference		Reference		Reference		Reference	
	Europe (n = 10)	0.125 (0.003–5.916)	0.291	74494238254.8791 (0.000)	0.999	0.000(0.000)	0.999	0.000 (0.000)	0.999
	Asia (n = 22)	0.040 (0.002–0.911)	0.044	7.611 (0.400–144.767)	0.177	1.997 (0.143–27.850)	0.607	0.277 (0.014–5.474)	0.399

CRediT authorship contribution statement

Woo Kyoung Choi: Writing – original draft, Methodology, Data curation, Conceptualization. **Hui Young Shin:** Formal analysis, Data curation. **Yu Jeong Park:** Formal analysis, Data curation. **Seung Ho Lee:** Visualization, Supervision, Methodology, Formal analysis. **Ai-Young Lee:** Validation, Supervision. **Jong Soo Hong:** Writing – review & editing, Visualization, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This work was supported by the Dongguk University Research Fund of 2022.

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