



Liposuction Assisted Gynecomastia Surgery With Minimal Periareolar Incision: a Systematic Review

Theddeus Octavianus Hari Prasetyono^{1,2,3}  · Angelica Gracia Budhipramono² · Illona Andromeda²



Received: 26 June 2021 / Accepted: 1 August 2021 / Published online: 11 August 2021
© Springer Science+Business Media, LLC, part of Springer Nature and International Society of Aesthetic Plastic Surgery 2021

Abstract

Background This study aims to analyse the quality of studies and revisit the liposuction assisted gynecomastia surgery performed through minimal incision.

Methods A systematic review, based on the literature in the PubMed, Scopus, Science Direct, and Cochrane, to the treatment of Simon's grade I and II gynecomastia was conducted using keywords “gynecomastia” AND “liposuction.” Study appraisal was performed using MINORS to assess the methodological quality of the paper.

Results There were 18 out of 415 studies eligible to review. A total of 244 out of 1628 patients with the average age of 23.13 years. Liposuction facilitated the easy handling to remove the breast tissue via small incisional design; showed consistent improved quality of life in terms of satisfaction after surgery. However, the measuring method of satisfaction rate varied, resulting in difficulties to interpret the results. Complication rates were

inconsistent throughout the studies, ranging from 0.06 to 26.67%. Reoperation rate of liposuction-assisted surgery is between 0.6 and 25%. There are only two studies of a total 25 patients that are considered as good in quality. The two studies, which discuss laser-assisted liposuction technique, show minor complication of seroma in two patients. While one study shows high patient's satisfaction rate; both studies indicate high surgeon's satisfaction rate.

Conclusion Small incisional design for breast parenchymal removal in gynecomastia assisted by liposuction showed a good technical approach for consistent improvement in quality of life. However, only 2 studies reported good quality methods of non-randomized case series urging for a better quality of studies in the future.

Level of Evidence III This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Angelica Gracia Budhipramono and Illona Andromeda are Research Assistant to the First Author.

✉ Theddeus Octavianus Hari Prasetyono
theddeus.h@ui.ac.id

¹ Division of Plastic Surgery, Department of Surgery, Cipto Mangunkusumo Hospital/ Faculty of Medicine, Universitas Indonesia, Medical Staff Wing, A building, 4th Floor, Jl. Diponegoro No. 71, Jakarta 10430, Indonesia

² ICTEC (Indonesian Clinical Training and Education Center), Cipto Mangunkusumo Hospital/ Faculty of Medicine, Universitas Indonesia, Jl. Diponegoro No. 71, Jakarta 10430, Indonesia

³ Medical Technology Cluster, Faculty of Medicine Universitas Indonesia, Universitas Indonesia, Education Tower, 2nd Floor, Jl. Salemba Raya No. 6, Jakarta 10430, Indonesia

Introduction

Gynecomastia is a common problem in male, characterized by enlargement of the breast, and can present bilaterally, and rarely unilateral [1–3]. The enlargement of breast tissue is caused by an increase in amount of ductal tissue, fat, and/or both [2, 4]. Diagnosis can be determined by patient's history and physical examination. There are three phases in life where gynecomastia can occur. The first is right after birth, due to stimulation of estradiol and progesterone, but usually regresses after several weeks. The second phase occurs on pubertal stage, usually detected at peak age of 14. Pubertal gynecomastia usually regresses spontaneously in 3 years within onset. It is caused by an

Table 1. Characteristics of the studies

No	Study	Type of study	Year	No. of patients		Average age (years)
				Grade I	Grade II	
1	Choi et al. [13]	Retrospective Study	2017	24	47	17.5
2	Sim et al. [14]	Retrospective Study	2019	72	90	NA*
3	Abdelrahman et al. [15]	Retrospective Study	2018	11	7	31
4	Lee et al. [16]	Retrospective Study	2018	430	695	NA*
5	Tarallo et al. [17]	Prospective Study	2019	5	10	23.5
6	Jarrar et al. [8]	Prospective Study	2011	4	0	25.76
7	Taheri et al. [18]	Retrospective Study	2016	0	14	NA*
8	Khalil et al. [19]	Case Series	2016	10	42	26.9
9	Kim et al. [20]	Retrospective Study	2016	22	22	NA*
10	Camarena et al. [21]	Prospective Study	2016	5	0	NA*
11	Trelles et al. [22]	Prospective Study	2011	0	3	NA*
12	Tripathy et al. [23]	Randomized Control Trial	2020	0	20	23.6
13	Lee et al. [24]	Retrospective Study	2017	8	7	21.5
14	Cigna et al. [12]	Retrospective Study	2010	37		NA
15	Ergun et al. [25]	Retrospective Study	2017	0	22	24.6
16	Hoşnüter [7]	Prospective Study	2013	3	20	NA
17	Gökkaya et al. [26]	Retrospective Study	2020	8	26	NA
18	Xu et al. [27]	Cross-sectional Study	2019	16	11	24.2

*Not all patients were included; thus, the average of the study was not applicable for calculation

imbalance in androgen to estrogen ratio. Elderly stage is the third phase in which gynecomastia can occur. It is hypothesized to be caused by increased amount of fat that will produce excessive estrogen and a decrease in testosterone [5, 6].

Gynecomastia causes social anxiety and sometimes pain or tenderness [5]. When gynecomastia does not resolve spontaneously, it can be treated with either medical therapy or in adjunct with surgery [7]. Surgery is only indicated as last resort for patients with persistent gynecomastia and suspected malignancy. Generally, the aim is to reduce the volume of the breast with minimal scar possible [5, 6].

Many techniques are available and can be used according to the grade of gynecomastia. Minimally invasive surgery such as endoscopic approach, or liposuction assisted minimal incision surgery are the choices as it has been associated with less complications, less recovery time, and better aesthetic outcome [6, 8]. Complications of gynecomastia surgery can be divided into early and late complications. Some examples of early complications include hematoma, seroma, infection, and bleeding. Late complications include residual breast tissue, hypertrophic scar/keloid, numbness, asymmetry, nipple necrosis, and contour irregularity [5]. This study aims to analyse the quality of the studies on liposuction-assisted minimal incisional surgery and revisit the techniques by

summarizing the satisfaction and complication rate for the treatment of gynecomastia.

Methods

Search Strategies and Screening Procedure

A review using the PRISMA guideline [10] was conducted to studies in online databases of PubMed, ScienceDirect, Cochrane Library, and Scopus using keywords: “gynecomastia” AND “liposuction.” All searches were limited to time range of January 2011–November 2020, published in English. Access to all of the database was conducted on 28th of October 2020. Inclusion criteria includes studies on: (1) male patients with gynecomastia that underwent minimal incision liposuction assisted surgery with or without pharmacological intervention; (2) specified Simon’s grade of gynecomastia grade I and II; (3) with minimum follow up of 6 months; and (4) there is either complication, satisfaction rate or both in the result. *Minimal periareolar incision* is defined as periareolar incision that is made across $\frac{1}{2}$ to $< \frac{3}{4}$ periareolar line. Exclusion criteria were studies on transgender, surgery with skin excision, and patient treated with endoscopic surgery. Letter to Editor, Discussion, Comments, and Expert Opinion were excluded

Table 2. MINORS quality assessment of the studies

No	Study	Aim	Inclusion of consecutive patients	Prospective collection of data	Endpoints appropriate to the aim of the study	Unbiased assessment of the study endpoint	Follow up period appropriate to the aim of study	Loss to follow up <5%	Prospective calculation of the study size	Adequate control group	Contemporary groups	Baseline equivalence of groups	Adequate statistical analysis	Total score
1	Choi et al. [13]	2	2	2	2	0	1	2	1					12
2	Sim et al. [14]	2	2	2	2	0	2	1	2	2	2	2	2	21
3	Abdelrahman et al. [15]	2	2	2	2	2	2	1	2					15
4	Lee et al. [16]	2	2	2	2	0	2	2	2					14
5	Tarallo et al. [17]	2	2	2	2	0	2	2	0					12
6	Jarrar et al. [8]	2	2	2	2	1	2	2	0					13
7	Taheri et al. [18]	2	2	2	2	1	2	2	2					15
8	Khalil et al. [19]	2	2	2	2	0	1	2	0					11
9	Kim et al. [20]	2	2	2	2	2	2	2	2	2	2	1	2	23
10	Camarena et al. [21]	2	2	2	2	0	2	2	0					12
11	Trelles et al. [22]	1	2	2	2	2	2	2	2					15
12	Tripathy et al. [23]	2	2	2	2	0	2	2	2	2	2	2	2	22
13	Lee et al. [24]	2	2	2	2	0	2	2	0					12
14	Cigna et al. [12]	2	2	2	2	0	2	2	0					12
15	Ergun et al. [25]	2	2	2	2	2	2	2	2					16
16	Hoşnuter [7]	2	2	2	2	0	2	1	0					11
17	Gökkaya et al. [26]	1	2	2	1	2	2	2	0					12
18	Xu et al. [27]	2	2	2	2	0	2	2	2					14

MINORS Methodological Index for Non-Randomized Studies

Table 3. Gross descriptive categories to interpret mean satisfaction score

Gross descriptive categories	5-point Likert Scale	10-point scoring system (VAS)	4-point categorization
Highly satisfied	3.68–5.00	7.01–10.00	3.01–4.00
Satisfied	2.34–3.67	4.01–7.00	2.01–3.00
Unsatisfied	1.00–2.33	1.00–4.00	1.00–2.00

VAS Visual Analogue Scale

in the screening process. The data were then screened by two authors (AGB and IA) independently.

Data Extraction and Quality Assessment

Data were extracted by two authors independently (AGB and IA) and then combined into a single Microsoft Excel spreadsheet. Discrepancies were justified by further discussion by all authors to get conclusion agreement. Corresponding authors of each journal were contacted via email when additional data are needed. A timeframe of 1 month was given to get response from each author.

Average age particularly was obtained from multiplying the average age of each study times number of subjects per study; all studies added, then divided by total number of subjects. Due to the inconsistency between mean as median vice versa, the obtained age data that comes as mean and median in all included studies are treated as average.

The patient satisfaction score was obtained from generalizing different scores such as Visual Analogue Score (VAS), Likert score, and general satisfaction score; into gross standardized groups defined by the authors. Knowing VAS and general satisfaction score are defined as interval data, while Likert score is defined as ordinal data; the authors acknowledged that this method is not ideal. Nevertheless, some studies and reports do use this method and treat Likert scale as interval data [9].

Quality assessment of the studies was performed using Methodological Index for Non-Randomized Studies (MINORS) [11] by two authors independently, then combined. The MINORS assessment shows ideal if the score is 16 for non-comparative studies and 24 for comparative studies [11].

Results

Records identified through PubMed, ScienceDirect, Cochrane Library, and Scopus showed 98, 67, 2, and 248 relevant studies, respectively. Ninety-five studies were duplicates, and 227 studies were excluded after abstract and title screening. Full text of 9 studies were not available. Eighty-four articles were assessed for inclusion and

exclusion criteria. Finally, there were 18 studies eligible for review.

The patients' average age is 23.13 years, calculating from 244 available patients. The remaining 1384 patients were not included in the calculation due to incomplete data. The total patients treated by liposuction-assisted surgery that have gynecomastia grade I are 618, and 1036 for grade II, excluding 37 patients from the study by Cigna et al. [12] due to the incomplete detail of data. (Table 1)

Table 2 shows the detail of quality assessment using MINORS. The mean score of the non-comparative studies concerning satisfaction rate of improved quality of life after treated by liposuction with or without small incision surgery is 13.69. Two non-comparative studies are deemed ideal. Mean of comparative study included in this study is 22 ± 1.73 .

We categorized the satisfaction rate of the quality of life into three broad range as a gross descriptive index, converting the results of each study into 'Highly satisfied', 'Satisfied', and 'Unsatisfied'. We converted the 5-point Likert scale, the 10-point scoring system, and the 4-point categorization used by each study to each category as described in Table 3. There is no universally accepted cut-off point for these scores; thus, the cut-off is determined arbitrarily, modified from studies that used similar method [28]. The interval of each score was determined by the formula for tertile; the highest possible average minus the lowest possible average, then divided by three. VAS is an interval data; thus, cut-off can be done with the method described in Table 3.

As already mentioned in the methods, the limitations are to be considered when interpreting the data. A study by Voutilainen et al. shows that the usage of VAS results in lower satisfaction rate compared to Likert scale [29]. As a result, the findings are fair for VAS studies. All studies included reported a high satisfaction rate, having only two studies reporting 'satisfied' patients: using power-assisted/ultrasound [14] and suction-assisted liposuction [17] methods; the former was caused by residual breast tissue, and latter not explained. The overall reoperation percentage ranges from 0.6 to 25%. Table 4 shows the detail of each study's complication rate, satisfaction score, and the reoperation rate.

Table 4. Extracted data from reviewed studies

No	Study	Technique	No. of patients		Follow up duration	Complications		Rate (%)	Quality of Life		Reoperation/Revision
			Grade I	Grade II		Early	Late		Tool used	Results	
1	Choi et al. [13]	Periareolar incision SCM and power-assisted liposuction	24	47	18.6 ± 8.93 months	Seroma	Scar, inverted nipple, hypoesthesia, contour irregularity	19.70	5-point Likert scale	Highly satisfied (4.85)	None
2	Sim et al. [14]	MELT [®]	55	72	12 months	Hematoma*	Scar, residual breast tissue*	17.9*	10-point scoring system	Highly satisfied (8)*	28 reoperations (17.85%)*
		Power-assisted/Ultrasound liposuction	17	18		Hematoma*	Residual breast tissue*	25.3*		Satisfied (7)*	13 reoperations (25%)*
3	Abdelrahman et al. [15]	Suction-assisted liposuction and liposculpturing	11	7	6 months	Infection	Residual breast tissue	16.67	5-point Likert scale	Highly satisfied (4.7)	2 reoperations (11.11%)
4	Lee et al. [16]	Periareolar incision SCM and power-assisted liposuction (asymmetric)	26	25	32.3 ± 9.29 months	Bleeding	Scar	5.88	5-point Likert scale	Highly satisfied (4.78 ± 0.5)	None
		Periareolar incision SCM and power-assisted liposuction (symmetric)	404	607	30.9 ± 7.95 months*	Bleeding, seroma*	None	0.06*		Highly satisfied (4.71 ± 0.52)*	7 reoperations (0.6%)*
5	Tarallo et al. [17]	Suction-assisted liposuction and liposculpturing	5	10	12 months	None	None	0.00	5-point Likert scale	Satisfied (3.5 ± 0.6)	None
6	Jarrar et al. [18]	Vacuum-Assisted Liposuction	4	0	56 weeks	Seroma, infection	None	0.00	10-point scoring system	Highly satisfied (9)	None
7	Taheri et al. [18]	SCM + Liposuction	0	14	6 months	None	Scar, hypoesthesia, residual breast tissue, asymmetry*	Unable to extract data**	10-point scoring system	Highly satisfied (8.1)*	Not reported
8	Khalil et al. [19]	Liposuction + pull-through technique	10	42	6 months	None	Residual breast tissue	1.92	–	“High patient satisfaction”	1 revision (1.82%)
9	Kim et al. [20]	Power-assisted Liposuction	7	4	23.8 ± 10.8 months*	NR	Residual breast tissue*	Unable to extract data***	10-point scoring system	Highly satisfied (7.39)***	1 revision (9.09%)
		SCM + Power-assisted Liposuction	15	18	33.1 ± 16.7 months*	NR	Scar, residual breast tissue, contour irregularity*	Unable to extract data***		Highly Satisfied (7.57)***	None

Table 4. continued

No	Study	Technique	No. of patients		Follow up duration	Complications		Quality of Life		Reoperation/Revision
			Grade I	Grade II		Early	Late	Tool used	Results	
10	Camarena et al. [21]	Liposuction	5	0	6 months	None	None	Excellent, Good, Regular, Bad	Highly satisfied (Excellent result)	None
11	Trelles et al. [22]	Laser-assisted liposuction	0	3	6 months	None	None	Very good, Good, Fair, Poor	Highly satisfied (Very good)	None
12	Tripathy et al. [23]	SCM + Power-assisted Liposuction	0	10	6 months	Hematoma	Not reported	5-point Likert scale	Highly satisfied (4.4)	Not reported
13	Lee et al. [24]	Power-assisted Liposuction + pull-through technique	0	10		None	Not reported		Highly satisfied (4.5)	Not reported
14	Cigna et al. [12]	Power-assisted liposuction	8	7	11.2 months	Bleeding	Asymmetry	–	“Every patient was satisfied”	None
15	Ergun et al. [25]	Power-assisted liposuction + SCM	37		12 months	Hematoma	None	–	“Expressed Satisfaction”	None
16	Hosnuter [7]	Laser-assisted liposuction	0	22	6 months	Seroma*	None	–	Not reported	None
17	Gökkaya et al. [26]	SCM + Liposuction	3	20	12.13 months	Dehiscence	None	Excellent, Good, Poor	Highly satisfied (Excellent 17, Good 4)	None
18	Xu et al. [27]	Suction-Assisted Liposuction	8	26	6 months	Seroma*	Inadequate result*	Excellent, Good, Inadequate	Highly satisfied (Excellent 28, Good 7, Inadequate 3) *	1 revision (2.94%)
		SCM + Liposuction	16	11	9.1 ± 1.8 months	Hematoma	NR	BODY-Q Scale	Highly satisfied (82/100)	None

*May include grade III data; ** unknown whether one patient have multiple complications; *** data available includes patients with pseudogynecomastia; ^a Microdebrider Excision and Liposuction Technique; technique used power-assisted liposuction

Table 5. Liposuction techniques with its complications

Liposuction technique	Number of studies	Number of patients	Complication										% complication per technique			
			Bleeding	Hematoma	Seroma	Dehiscence	Infection	Inverted nipple	Hypoesthesia	Residual	Scar	Asymmetry		Contour irregularity		
Laser-assisted liposuction	2	25	0	0	2	0	0	0	0	0	0	0	0	0	0	8
Power-assisted liposuction	7	1411	31	15	11	0	0	0	2	4	30	30	3	2	2	9.07
Suction-assisted liposuction	3	67	0	0	2	0	0	1	0	0	2	0	0	0	0	7.46
Vacuum-assisted liposuction	6	125	0	2	0	1	0	0	0	2	3	1	1	0	0	7.2
Total Complication			31	10	15	1	1	1	2	1	17	28	4	2		

The studies reveal 4 different techniques of liposuction. If no technique was specified, we consider it as vacuum-assisted liposuction. The complication and the rate of each technique are described in Table 5. The most common complications were bleeding and scar which occurred to 31 patients each, and revisions were done to 35 patients out of 1628 patients analyzed in this paper. Power-assisted liposuction has the highest complication rate as high as 9.07%. [12–14, 16, 20, 23, 24] With the use of tumescent technique, excessive intraoperative-bleeding was reduced throughout the years. The reduced amount of bleeding referred was accounted as the amount of blood in the lipoaspirate, while also comparing preoperative and post-operative hemoglobin. [30, 31] The estimated blood loss on tumescent technique liposuction is 1% of volume aspirated, while 20-45% of blood in the lipoaspirate were estimated in liposuction without any fluid infiltration [32] (Fig. 1).

Discussion

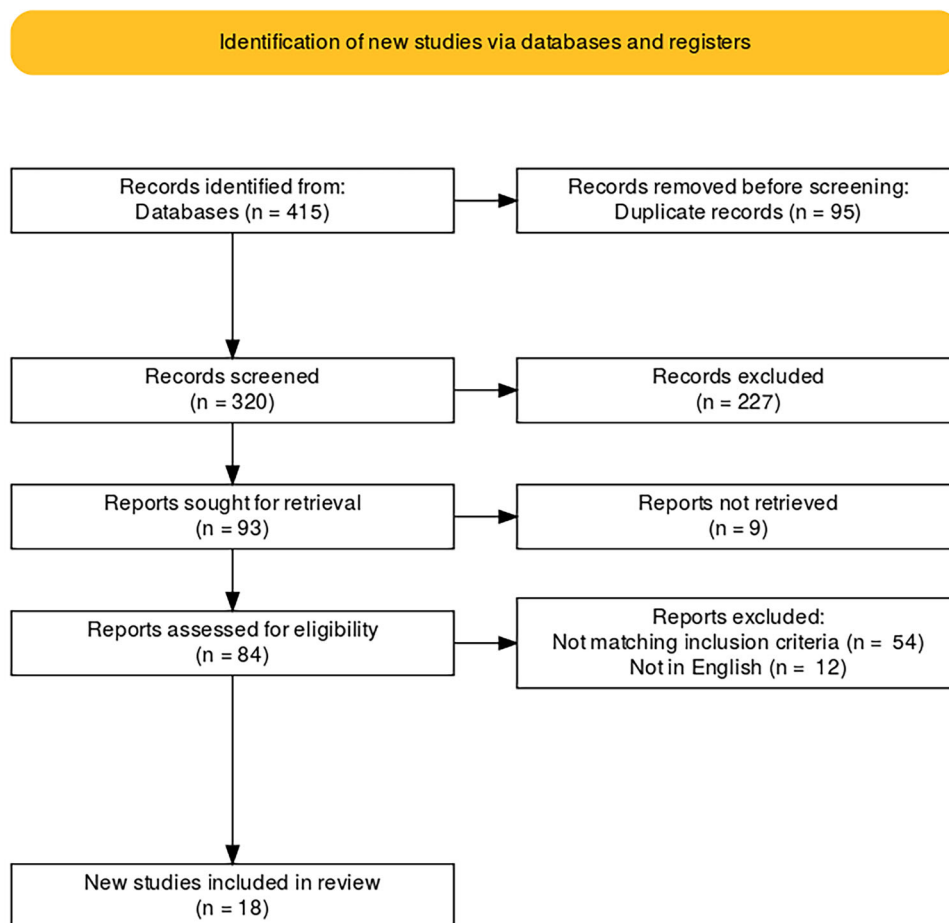
Biased assessment of the study endpoint is the most common cause of MINOR low score. However, when assessed further, the cause of getting 0 for the point is because the point was inapplicable for the study. All the studies’ endpoint were the patient’s own judgement; thus, bias is unavoidable. Since there is a high risk of bias, the determination of which surgical technique is better cannot be obtained. The lack of statistical result is also one of the most common contributors of low score. A study by Fagerlund et al. [1] shows similar result. The low score of methodological review of each study does not allow us to draw any conclusion, as any conclusion will be biased.

The lower satisfaction rate on power-assisted liposuction may be due to high percentage of residual breast disc (19.2%) and resulting in high rate of reoperation. Under-resection is a common complication in liposuction only cases [33]. Cause of reoperation found in this study is mostly due to residual breast tissues. Other causes are hematoma and scar. This wide range of reoperation percentage can be caused by: (1) the discrepancy of number of subjects; (2) the surgeon’s experience; and (3) the surgical technique that is used, such as liposuction only technique, compared to combined technique.

The high rate of bleeding and scar complication shown in this review was mostly contributed by Lee et al. [16]. But the conclusion of bleeding as the highest complication rate could not be drawn, because the total patient in that study were 1011, which means only less than 1% have bleeding and/or scar as its complication.

Our study has several limitations. First, there were limitations on detail of each patient while extracting the

Fig. 1 Identification of new studies via database and registers



data, such as no explanation about complications or satisfaction level. This results in small number of subjects that can be analyzed. Secondly, the lack of subjects concerning laser-assisted and suction-assisted liposuction studies also contributes to higher risk of bias. Thirdly, we found that the studies available for gynecomastia has low quality of methodological technique. This results in the inability to draw firm conclusions without high risk of bias.

Conclusions

Small incisional design for breast parenchymal removal in gynecomastia assisted by liposuction showed a good technical approach for consistent improvement in quality of life. The studies included in this review mostly does not comply as an ideal non-comparative study, mostly due to high risk of bias. This review can be used as a reference for further studies to have a better methodological quality, less bias, and have a standardized method of measurement in regards to satisfaction rate for gynecomastia patients.

Author Contributions TOHP contributed to this article in developing the conception and design of the study, conducting the acquisition and performing the analysis and interpretation of the data, reviewing the manuscript draft and generating the final approval of the manuscript to be submitted. AGB contributed to this article by conducting the literature search and appraisals, performing the analysis, data interpretation, and writing the manuscript draft. IA contributed to this article by conducting the literature appraisals, data interpretation, and critically reviewing the discussion of the manuscript draft.

Funding The authors did not receive any specific grant from funding agencies from public, commercial, or not-for-profit sectors.

Declarations

Conflict of interest The authors report no conflict of interest.

Human or animal participants This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study, informed consent is not required.

References

- Fagerlund A, Lewin R, Rufolo G, Elander A, Santanelli Di Pompeo F, Selvaggi G (2015) Gynecomastia: a systematic review. *J Plast Surg Hand Surg* 49:311–318
- Zugang K, Hassan A (2016) Combined approach for gynecomastia. *GMS Interdiscip Plast Reconstr Surg* 5:1–12
- Jose RM, Thomas S (2011) Gynaecomastia correction—the role of power-assisted liposuction. *Eur J Plast Surg* 34:187–191
- Mohan A, Abbas Khan MA, Srinivasan K, Roberts J (2014) Gynaecomastia correction: a review of our experience. *Indian J Plast Surg* 47:56–60
- Polat S, Cuhaci N, Evranos B, Ersoy R, Cakir B (2014) Gynecomastia: clinical evaluation and management. *Indian J Endocrinol Metab* 18:150–159
- Swerdlhoff RS, Ng CM (2000) Gynecomastia: etiology, diagnosis, and treatment. *Endotext*. PMID: 25905330 Available from: <https://www.ncbi.nlm.nih.gov/books/NBK279105/>
- Hoşnuter M (2014) An ameliorated approach for sharp resection in gynecomastia surgery. *Indian J Surg* 76:419–424
- Jarrar G, Peel A, Fahmy R, Deol H, Salih V, Mostafa A (2011) Single incision endoscopic surgery for gynecomastia. *J Plast Reconstr Aesthetic Surg*. <https://doi.org/10.1016/j.bjps.2011.04.016>, May 13, 2011
- Polit DF, Beck CT (2004) Analyzing quantitative data: descriptive statistics. In: Polit DF, Beck CT (eds) *Nursing research: principles and methods*, 7th edn. Lippincott-Raven, Philadelphia, pp 451–476
- Page M J, McKenzie J E, Bossuyt P M, Boutron I, Hoffmann T C, Mulrow C D et al (2021) The PRISMA 2020 statement: an updated guideline for reporting systematic reviews *BMJ*. <https://doi.org/10.1136/bmj.n71>, March 29, 2021
- Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J (2003) Methodological index for non-randomized studies (MINSORS): development and validation of a new instrument. *ANZ J Surg* 73:712–716
- Cigna E, Tarallo M, Fino P, De Santo L, Scuderi N (2011) Surgical correction of gynecomastia in thin patients. *Aesthetic Plast Surg* 35:439–445
- Choi BS, Lee SR, Byun GY, Hwang SB, Koo BH (2017) The characteristics and short-term surgical outcomes of adolescent gynecomastia. *Aesthetic Plast Surg* 41:1011–1021
- Sim N, Tan G, Tan B-K, Goh T (2020) Review of the microdebrider excision and liposuction technique (MELT) for the treatment of gynecomastia. *J Plast Reconstr Aesthetic Surg* 73:303–312
- Abdelrahman I, Steinvall I, Mossaad B, Sjöberg F, Elmasry M (2018) Evaluation of glandular liposculpture as a single treatment for grades I and II gynecomastia. *Aesthetic Plast Surg* 42:1222–1230
- Lee SR, Lee SG, Byun GY, Kim MJ, Koo BH (2018) Clinical characteristics of asymmetric bilateral gynecomastia: suggestion of desirable surgical method based on a single-institution experience. *Aesthetic Plast Surg* 42:708–715
- Tarallo M, Di Taranto G, Fallico N, Ribuffo D (2019) The round-the-clock technique for correction of gynecomastia. *Arch Plast Surg* 46:221–227
- Taheri AR, Farahvash MR, Fathi HR, Ghanbarzadeh K, Faridniya B (2016) The satisfaction rate among patients and surgeons after periareolar surgical approach to gynecomastia along with liposuction. *World J Plast Surg* 5:287–292
- Khalil AA, Ibrahim A, Afifi AM (2017) No-drain single incision liposuction pull-through technique for gynecomastia. *Aesthetic Plast Surg* 41:298–303
- Kim DH, Byun IH, Lee WJ, Rah DK, Kim JY, Lee DW (2016) Surgical management of gynecomastia: subcutaneous mastectomy and liposuction. *Aesthetic Plast Surg* 40:877–884
- Cardenas-Camarena L, Dorado C, Guerrero MT, Nava R (2017) Surgical masculinization of the breast: clinical classification and surgical procedures. *Aesthetic Plast Surg* 41:507–516
- Trelles MA, Mordon SR, Bonanad E, Moreno Moraga J, Heckmann A, Unglaub F et al (2013) Laser-assisted lipolysis in the treatment of gynecomastia: a prospective study in 28 patients. *Lasers Med Sci* 28:375–382
- Tripathy S, Likhyan A, Sharma R, Sharma RK (2020) Prospective analysis and comparison of periareolar excision (delivery) technique and pull-through technique for the treatment of gynecomastia. *Aesthetic Plast Surg*. <https://doi.org/10.1007/s00266-020-01618-0>, January 27, 2020
- Lee JH, Kim IK, Kim TG, Kim YH (2012) Surgical correction of gynecomastia with minimal scarring. *Aesthetic Plast Surg* 36:1302–1306
- Sönmez Ergün S, Kayan RB, Güleş ME, Kuzu İM (2017) Effects of laser-assisted lipolysis on nipple-areola complex. *J Cosmet Laser Ther* 19:215–218
- Gökkaya A, Görgü M, Acuner B (2020) Gynecomastia treatment with liposuction: clinical experience. *Duzce Med J* 22:17–22
- Xu B, Mu D, Yang Y, Liu T (2020) Endoscopic axillary approach improves patient satisfaction of gynecomastia subcutaneous mastectomy: a cross-sectional study using the BODY-Q chest module. *Aesthetic Plast Surg* 44:2011–2020
- Boonstra AM, Schiphorst Preuper HR, Balk GA, Stewart RE (2014) Cut-off points for mild, moderate, and severe pain on the visual analogue scale for pain in patients with chronic musculoskeletal pain. *Pain* 155:2545–2550
- Voutilainen A, Pitkäaho T, Kvist T, Vehviläinen-Julkunen K (2016) How to ask about patient satisfaction? The visual analogue scale is less vulnerable to confounding factors and ceiling effect than a symmetric Likert scale. *J Adv Nurs* 72:946–957
- Bellini E, Grieco MP, Raposio E (2017) A journey through liposuction and liposculpture: review. *Ann Med Surg* 24:53–60
- Samdal F, Amland PF, Bugge JF (1994) Blood loss during liposuction using the tumescent technique. *Aesthetic Plast Surg* 18:157–160
- Stephan PJ, Dauwe P, Kenkel J (2018) Liposuction: A comprehensive review of techniques and safety. In: Rubin JP, Neligan PC (eds) *Plastic surgery, vol 2. Aesthetic surgery*. Elsevier, Seattle, pp 545–567
- Ghnam WM (2014) Gynaecomastia Surgery: Should it be individualised? *J Cutan Aesthet Surg* 7:116–117

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.