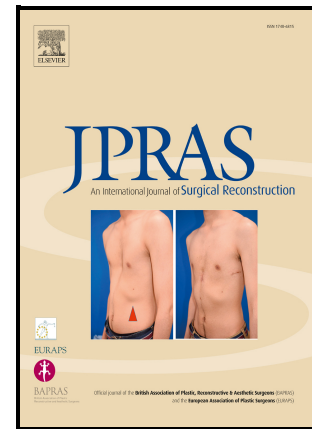


Optimal Strategies for Addressing Developmental Breast Asymmetry and the Significance of Symmetrical Treatment: A Systematic Review

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Title: Optimal Strategies for Addressing Developmental Breast Asymmetry and the Significance of Symmetrical Treatment: A Systematic Review

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SUMMARY

Background: Approximately one quarter of women are affected by asymmetry as a result of abnormal breast development, which can lead to significant emotional distress. Despite this, there is currently no widely accepted approach for managing this prevalent condition. This systematic review aims to review the available literature on the management of developmental breast asymmetry.

Methods: A comprehensive search in MEDLINE, EMBASE and CENTRAL databases was conducted for primary clinical studies reporting on the management of developmental breast asymmetry from 1962 to November 2022. The primary outcome measures were long term aesthetic outcome and patient reported outcomes.

Results: 11 case series and 2 cohort studies were included, comprising a total of 1237 patients with a mean age of 26.5 years (range 14-65). Twelve studies (92%) addressed asymmetry through surgical means, using various augmentation and reduction procedures, while one study (8%) utilised external prosthesis. Meta-analysis of the data was not deemed to be possible due to heterogeneity of data, a narrative synthesis of the literature was provided.

Conclusions: There is no consensus on how to manage developmental breast asymmetry. Furthermore, there is a lack of consistency in the classification of patients with developmental breast asymmetry and in the reporting of outcomes, highlighting the need for a consensus. Further research outlining long term aesthetic and patient reported outcomes is needed to understand which procedures provide optimal outcomes. Additionally, external breast prosthesis is a promising non-surgical alternative and further studies into its efficacy are needed.

Key words: breast asymmetry; breast symmetrisation; external breast prosthesis

INTRODUCTION

Breast asymmetry refers to a variation in volume or shape between the breasts and is observed in approximately 25% of women (1, 2). While a minor difference in breast volume is considered normal, significant asymmetry is regarded as a deformity. There are different classifications for breast asymmetry based on the presenting form of asymmetry, for example classifying based on descriptive terms (3, 4, 5, 6), or volume discrepancy (7, 8, 9). Such descriptive terms include unilateral hypoplasia/hypertrophy (depending on reference breast), bilateral asymmetric hypoplasia, unilateral hypertrophy with contralateral hypoplasia, and bilateral asymmetric hypertrophy (3).

Breast asymmetry can be further categorised based on the underlying causes, which include developmental breast asymmetry, congenital breast asymmetry, and acquired breast asymmetry. Developmental breast asymmetry refers to a difference in size or shape between the breasts resulting from abnormal development during adolescence. This type of asymmetry typically emerges as the breasts grow and develop, leading to noticeable variations in their appearance. Congenital breast asymmetry, on the other hand, is present from birth and is often associated with certain conditions such as tuberous breasts or Poland's syndrome. Tuberous breasts are characterized by an unusual shape and restricted growth (2), while Poland's syndrome involves underdevelopment or absence of the chest muscles on one side, often accompanied by breast asymmetry (1). Acquired breast asymmetry can occur as a consequence of various factors. Tumours, whether benign or malignant, can lead to changes in breast size or shape due to their growth and impact on surrounding tissues. Trauma to the breasts, such as injuries or accidents, can also result in asymmetry. Additionally, certain medical treatments, such as breast surgery or radiotherapy, may cause acquired breast asymmetry as a side effect.

Breast asymmetry can have a significant effect on psychological well-being and quality of life, with breast asymmetry patients scoring 5-10% worse than controls on psychological surveys (10). Problems with poor body image and social anxiety are common, as patients are not confident in their body silhouette. There is also an impact on daily living, with patients complaining of the inability to find well-fitting clothes, bras, and bathing suits (11, 12). It is these psychological, social, and daily living issues that motivate patients to seek treatment (4, 10, 13, 14, 15).

Understanding the different causes of breast asymmetry is essential for determining appropriate management strategies tailored to each specific case. Reconstructive surgeons have a variety of options at their disposal for addressing breast asymmetry, such as implant augmentation, lipotransfer, mammoplasty, and mastopexy. However, patients with congenital

or acquired asymmetry may require additional interventions to address specific abnormalities. For example, individuals with tuberous breasts may require procedures to address abnormalities in breast connective tissue, while those with Poland's syndrome may require interventions to correct chest wall deformities. These additional needs can complicate the comparability of outcomes among patients with different types of breast asymmetry.

To ensure a more focused approach and facilitate meaningful comparisons, our study aims to concentrate exclusively on the management of developmental breast asymmetry. By narrowing our focus to this specific subtype, we can better assess the effectiveness of various surgical techniques and their impact on aesthetic outcomes and patient-reported results over time. There is currently no definitive agreement on the treatment of developmental breast asymmetry. Several studies have demonstrated positive results of various methods for achieving symmetry. The purpose of this review is to provide a comprehensive overview of the existing literature regarding the treatment of developmental breast asymmetry.

METHODS

SEARCH STRATEGIES

A comprehensive, systematic literature search of published articles was conducted according to the Preferred Reporting Items for Systematic Reviews (PRISMA) guidelines (16). The search collected articles published until November 2022.

The literature search was performed using MEDLINE, EMBASE, SCOPUS and CENTRAL databases. The keywords used in the search were selected from key papers; two search strings were created and combined using the Boolean term 'AND'. Additionally, a MeSH term search was also conducted. Forwards and backwards citation searching, as well as grey literature was checked to identify further articles

String 1: "Breast" AND "Asymmetry" OR "Deformity" OR "Hypertrophy" OR "Hypoplasia" OR "Developmental" OR "Abnormality"

String 2: "Management" OR "Surgery" OR "Treatment" OR "non-surgical" OR "Correction" OR "Repair" OR "Reconstruction" OR "Augmentation"

INCLUSION CRITERIA

1. Original research publications including randomised controlled trials, cohort studies, case-control studies and case series which reported on the management of developmental breast asymmetry.
2. Human subjects
3. Minimum follow up ≥ 3 months.

EXCLUSION CRITERIA

1. Studies reporting on management of congenital breast asymmetry (Tuberous breasts & Poland's syndrome).

2. Studies reporting on management of acquired breast asymmetry (secondary to malignancy, trauma or iatrogenic causes).
3. Review articles
4. Conference abstracts without full text
5. Case reports
6. Non-English studies
7. In-vitro & animal or cadaveric studies

OUTCOME MEASURES

The primary outcome measures were the aesthetic and patient reported outcomes of different management techniques. Secondary outcome measures included revision rates and complications.

STUDY SELECTION AND DATA EXTRACTION

Study selection was conducted in a two-stage process. Titles and abstracts were initially screened by two reviewers (DS and RF) for potential eligibility, after excluding duplicate records. Next, studies identified as relevant underwent full-text review by both reviewers. Any discrepancies between the reviewers were resolved by discussion or referral to a third reviewer (DK). The data from all full-text articles accepted for the final analysis were independently retrieved by DS and RF using a standardized data extraction form. Any discrepancies between the reviewers were resolved by discussion or referral to DK. All data was then reviewed by DK. The search results, including abstracts, full-text articles and records of reviewers' decisions, including reasons for exclusion, were recorded in Endnote X8 (Clarivate Analytics, USA).

The extracted data includes data on study characteristics, patient demography, cause of asymmetry, management, follow up, subjective aesthetic result, objective aesthetic result, patient reported outcomes, number of procedures needed, residual asymmetry, revision rates and complications. Data were extracted from the studies as presented or were calculated.

ASSESSMENT OF BIAS

Article review included analysis of study design to ascertain risk of bias. Risk of bias assessment was performed using the ROBINS-I tool for non-randomised (Table 3) (17).

RESULTS

LITERATURE SEARCH RESULTS

We found 937 articles in the MEDLINE database search, 1018 in the EMBASE database search and 67 in the CENTRAL database search. 107 additional records were identified through other sources. References from these searches were combined, and after removing duplicates, 1632 articles were available for title and abstract reviewing. Out of these, 1585

did not meet the inclusion criteria. Following full text review of the remaining 47 articles, 36 were excluded as the inclusion criteria were not met. A secondary search of the reference list revealed an additional 2 articles.

A total of 13 articles were included in the final review and formed the basis of this systematic review. Details of the included studies are outlined in Table 1. There were 11 case series and 2 cohort studies. No randomised controlled trials were identified.

PAPER DEMOGRAPHICS, TYPES OF ASYMMETRY AND MANAGEMENT OPTIONS

In these 13 studies, a total of 1237 patients were evaluated with a mean age of 26.5 years (range 14-65).

Of the 13 papers included in the review, 9 studies described the nature of developmental breast asymmetry. The most common method of describing asymmetry was using descriptive terms (ie. unilateral hypoplasia, bilateral asymmetric hypoplasia, unilateral hyperplasia, bilateral asymmetric hyperplasia, unilateral hypoplasia with contralateral hyperplasia). Four studies used this method (3, 4, 5, 6). The second most common method was measuring the volume difference between the breasts, which was used in 3 out of 9 articles (7, 8, 9). One article categorized types of asymmetry based on patients' perceptions of the degree of their breast asymmetry (18). Several different management options were used in these studies, including both surgical and non-surgical options. The different techniques and their frequencies are outlined in Table 2. The average follow-up period was 25.2 months (range 1.5-192 months).

PRIMARY OUTCOME MEASURES (aesthetic outcome & patient reported outcomes)

Of the 13 articles reviewed, 7 commented on aesthetic outcomes. Three of these articles used objective methods to assess aesthetic outcomes (5, 9, 19), while three used subjective methods (3, 12, 20). One article used both objective and subjective methods (6).

There were several techniques used to objectively assess breast aesthetics. One article described using multiple linear measurements related to breast aesthetics to assign a score on each breast of excellent, good, fair, or poor based on predetermined ranges (5). According to their criteria, authors reported 40% of patients having excellent results, 25% good, 20% fair and 15% poor. Another article used the "Symmetry Index," which assigns a percentage score of symmetry based on 7 anthropometric measurements associated with breast aesthetics (19). These authors reported an average Symmetry Index of 93% postoperatively. A third article calculated the differences in several linear measurements between the breasts, with smaller differences indicating a better aesthetic result (6). This paper showed that at long term follow-up, patients who underwent more symmetric procedures (same/similar procedures on both breasts) had smaller differences in distances between linear measurements, compared to patients who were operated on with more asymmetric procedures (different procedures on both breasts). Hence, patients who underwent more symmetric procedures maintained a better aesthetic outcome over time compared to patients who underwent more asymmetric procedures. A fourth article compared the difference in sternal notch-nipple (SN-N) distance between both breasts preoperatively and postoperatively (9). In this study, the average difference in the SN-N distance preoperatively was 2.44cm, while the average difference in

SN-N distance postoperatively was 1.1cm, and every patient in this study experienced an improvement in their SN-N distance postoperatively.

Articles that subjectively assessed breast aesthetics mainly did so using descriptive terms, such as 'excellent postoperative symmetry'. Three studies used this method (3, 12, 20). One study scored the breasts out of 20 based on general appearance (0 to 8), symmetry of size (0 to 4), symmetry of shape (0 to 4) and symmetry of areolas (0 to 4) (6).

Eight studies assessed patient-reported outcomes. Four of these studies simply reported the proportion of satisfied patients (4, 5, 6, 21). Among studies that reported patient satisfaction in this way, the mean satisfaction rate was 82.86%, and the range of satisfaction rates was from 69% - 93%. Three studies investigated patient reported outcomes in more detail, evaluating psychosocial wellbeing, satisfaction with breast size, shape and symmetry (8, 11, 18). These studies showed that at follow up, patients who underwent more asymmetric procedures reported lower levels of psychosocial well-being, satisfaction with breast size, shape and symmetry. However, patients who underwent more symmetric procedures reported higher satisfaction with these variables at follow up. One study used the 'BreastQ Survey' (augmentation modules) (19).

SECONDARY OUTCOME MEASURES (revision rates and complications)

Seven studies reported on revision rates (4, 5, 7, 8, 9, 18, 20, 21). The average revision rate was 13.57% (range 3 - 28%). Common indications for revision were recurrence of asymmetry, ptosis, implant displacement and capsular contracture. One article reported that recurrence of asymmetry primarily occurred among patients who were operated on while still adolescent (5). Another article found that patients who underwent asymmetric surgical procedures were more likely to experience recurrence of asymmetry compared to patients who underwent more symmetric procedures (18).

Ten studies discussed complications (3, 4, 5, 6, 7, 9, 12, 18, 20, 21). The average rate of complications was 10.98% (range 0 - 37%). Common complications included recurrence of asymmetry, capsular contracture, hypertrophic scarring and fat necrosis. Contrary to revision rates, studies have shown that complication rates do not correlate with whether a patient has undergone more symmetric versus more asymmetric surgical procedures (3, 18).

DISCUSSION

The aim of this review was to synthesize the available evidence for the management of developmental breast asymmetry. We identified 13 primary studies on the management of developmental breast asymmetry, highlighting a paucity of research in this area. Due to the significant heterogeneity in the classification of developmental breast asymmetry and reporting of outcomes, a meta-analysis of the data was not possible. The narrative synthesis alone was useful to elucidate the differences between different management options and what they have to offer.

The classification of developmental breast asymmetry varied between studies. The most commonly used systems were categorising patients using descriptive terms (3, 4, 5, 6), or

volume difference between breasts (7, 8, 9). The diversity of classification systems poses a significant challenge as it hinders the ability to determine whether patients from different studies, utilising diverse classification systems, have comparable deformities. This makes it challenging to compare the outcomes of studies that use different classification systems. Additionally, utilising the measure of volume discrepancy as a means of classifying patients with developmental breast asymmetry may not be the most precise method of classification. This is because, patients with similar volume discrepancy between breasts can have entirely distinct breast dimensions. This makes it difficult to conduct studies and make recommendations on how to manage a specific volume discrepancy. In contrast, classifying patients using descriptive terms can be more effective. For example, two patients classified as having bilateral asymmetric hypoplasia are more likely to have similar deformities compared to two patients classified as having a breast volume discrepancy of any given amount.

Our review revealed that the two primary areas of focus when assessing the outcomes of symmetrisation surgery are aesthetic outcomes and patient reported outcomes. However, there is a lack of consensus on how to evaluate these outcomes. In the literature, authors have utilised a combination of both subjective (3, 6, 11, 20) and objective (5, 6, 9, 19) methods to measure aesthetic outcomes. The use of subjective methods such as describing aesthetic outcomes as 'excellent', or 'satisfactory' or scoring the breasts on a point-scale based on an individual surgeon's opinion in these studies is not able to provide an unbiased and accurate understanding of postoperative results. However, objective methods can provide a more precise representation of postoperative symmetry and enable greater comparability of outcomes between studies. With regards to patient reported outcomes, most authors have only reported the proportion of satisfied patients, which is not comprehensive approach. Other aspects such as psychosocial well-being, activities of daily living and physical well-being need to be evaluated as well. The Breast-Q survey is a validated, highly reliable patient reported outcome measure that is able to assess all of these aspects and collate the results into a numeric form, allowing for comparability between studies (22). Despite this, only 1 study utilised the Breast-Q to assess patient reported outcomes at follow-up (19). In the evaluation of postoperative outcomes, it is necessary to consider the potential impact of chest wall asymmetries. Although our review did not specifically analyse this aspect, it is worth noting that chest wall deformities can significantly influence the perception of breast symmetry. As a result, the comparability of outcomes between patients with and without chest wall asymmetry may be affected.

One crucial factor in predicting long-term preservation of aesthetic outcomes is the degree of similarity in treatment of both breasts. Breasts that are treated more symmetrically (with similar procedures on both sides) are more likely to maintain a desirable aesthetic outcome over time compared to breasts treated asymmetrically (different procedures on both sides). This is because breasts treated more symmetrically are more likely to undergo similar changes and react to aging, pregnancy or changes in weight similarly to each other over time (6). Therefore, asymmetrically treated breasts may experience dissimilar changes and thus, a desirable aesthetic outcome may not be sustained (6, 8, 18). This principle of treating both breasts in a similar manner is essential, yet despite evidence, asymmetric techniques such as unilateral reduction with bilateral augmentation are frequently performed. Vita et al (18) have demonstrated that patients who undergo more asymmetric procedures are also more likely to have reduced satisfaction with breast size, breast symmetry, psychosocial well-being, sexual well-being, and more likely to have residual asymmetry and thus, more likely to require revision surgery. Kuzbari et al (6) have also shown that at a mean follow up of 88 months, patients who underwent more symmetric procedures maintained better aesthetic results (as

per linear measurements) compared to patients who underwent more asymmetric procedures.

When making the decision to undergo symmetrising surgery, several factors come into play, including the current size of the patient's breasts, the patient's desired breast size, and the degree of asymmetry. These considerations are crucial in determining the appropriate surgical technique. In cases where patients have small to medium-sized breasts and a significant degree of asymmetry, and they desire larger breasts, a commonly performed technique in the past involved unilateral implant augmentation of the smaller breast. This approach aimed to address the volume difference and achieve a more balanced appearance by augmenting the smaller breast with an implant. This technique has shown satisfactory postoperative results at short-term follow-up (5) but is now less commonly performed due to the growing awareness of the necessity for symmetric procedures. In cases where patients have small to medium-sized breasts and a less significant degree of asymmetry but desire larger breasts, a commonly used approach has been bilateral asymmetric implant augmentation, which is characterised by the placement of different sized or shaped implants in each breast to achieve a more balanced and symmetrical appearance (3, 5, 7, 8, 22). The specific volumes of both implants can be adjusted based on the patient's desires for their breast size. However, it has been speculated that this technique is not able to maintain good long-term results, as the difference in size and weight between the implants can cause dissimilar effects on the surrounding tissue over time (7). These issues with bilateral asymmetric implant augmentation can potentially be overcome with bilateral symmetric implant augmentation combined with bilateral asymmetric fat grafting. This technique has been proven to yield good postoperative outcomes (23) and has the added benefit of providing the ability to fine-tune the symmetrisation according to the patient's wishes for breast size and shape. Additionally, fat grafting alone is becoming an increasingly popular modality for the treatment of breast deformities. Studies have revealed that patient satisfaction, breast symmetry and long-term follow-up using fat grafting alone produces comparable (19), if not superior (21), outcomes in comparison to implant augmentation alone, for the treatment of developmental breast asymmetry. However, large volume fat transfers are associated with fat necrosis, calcification, cysts, donor site irregularities and donor site pain (21, 23). Therefore, in cases requiring significant volume alteration, fat transfer alone may not be appropriate. More recently, unilateral reduction with bilateral symmetric implant augmentation has been described (7, 9) as a technique to overcome the issues associated with bilateral asymmetric implant augmentation. However, both studies investigating this method have a small sample size, short follow-up period, and lack well-defined outcome variables. Additionally, this technique goes against the increasingly appreciated principle of treating both breasts as similarly as possible. Hence, more studies with a longer follow-up period and well-defined outcome variables to justify the value of this technique.

Breast reduction can be achieved through resection or liposuction. In comparison to reduction by resection, reduction by liposuction is associated with higher patient, faster return to work and daily activities and shortest possible scars, (24, 25, 26). However, this technique has had difficulty gaining widespread acceptance, possibly because fewer patients are deemed to be suitable candidates compared to reduction with resection. This is because, reduction by liposuction, for the most part, does not offer improvements in breast shape, the aesthetic result largely relies on skin retraction. Therefore, issues with tone of the skin, for example caused by previous pregnancies or long-term steroid use are relative contraindications for reduction by liposuction (27). For patients with large breasts and a greater degree of asymmetry who desire smaller breasts, techniques described in the literature include

unilateral reduction, with or without contralateral implant augmentation. These techniques do not appear to maintain good aesthetic outcomes over time (6, 18), which can be attributed to the significant differences in the treatment of both breasts. For patients with large breasts and a lesser degree of asymmetry who desire smaller breasts, bilateral asymmetric reduction has been described in the literature and shown to have good postoperative results and patient satisfaction at 1.5 year follow up (3, 5)

Many patients presenting with developmental breast asymmetry will be adolescents. However, symmetrisation surgery is typically deferred until patients have reached Tanner Stage 5 breast development and stable adult weight. This is because operating on adolescent breasts is associated with disruption of breast development, asymmetric growth, and the possibility of suboptimal aesthetic outcomes due to weight changes in late adolescence (11, 18, 28). Furthermore, developmental asymmetry can resolve spontaneously by early adulthood (2), therefore any surgical intervention during adolescence may not only prove ineffective but could potentially cause more harm than good. Hence, by postponing surgery until after adolescence, potential risks can be avoided, however, the psychological and emotional concerns of the patient must be addressed. Therefore, a non-surgical approach, often in the form of external prostheses is typically employed as a temporary solution during this period. (8, 11, 29, 30). Pike et al (10) have demonstrated that external prosthesis can be an effective interim management option for adolescents. The majority of patients in their trial who used the custom-fit prosthesis reported improvements in their body image, self-esteem, social participation, and ability to find clothing that fit properly. Patients described their prosthesis as a valuable “between step” and “gateway” to surgery. Furthermore, the beneficial effects of an external prosthesis can be further supported by studies investigating their use following mastectomy and lumpectomy. The use of external prostheses among these patients has been shown to improve self-esteem, body image, feminine identity, quality of life and reduce emotional distress (31, 32, 33).

Other uses of external prosthesis in the management of developmental breast asymmetry are as an alternative to reconstructive surgery in low-income countries, where access and affordability of reconstructive surgery is an issue (34, 35). Studies utilising external prosthesis as an alternative to reconstructive surgery in low-income settings following mastectomy show its ability to improve self-esteem, feminine identity, body posture and gait (34, 36, 37). Reflecting on this potential use is important, as in low-income settings, it has been shown that patients are often not informed about the availability of such prostheses or are hesitant to ask about their availability due to cultural barriers (35). Consequently, many patients turn to home-made alternatives (i.e. from cloth and cotton) (38), which don't offer an ideal contour match and leave patients feeling that their problems were unaddressed.

According to Pike et al study, the fitting and provision of external prostheses for adolescents with developmental asymmetry was carried out through a specialised prosthetics unit located within a cancer centre (11). This unit was staffed by individuals who received specialised training, resulting in a highly positive patient experience and a sense of legitimacy for the patients' concerns. However, for many patients who only have access to commercially available prostheses, the reality is often different. They often feel unsupported and have a negative experience because they feel that their fitter or vendor lacks experience and specialised knowledge about their condition. (32, 35). This emphasises the importance of medicalising the provision of external breast prostheses for patients with developmental asymmetry, which would allow for a higher standard of care by ensuring individuals providing the service are adequately trained. Provision of prostheses through specialised

prosthetics units may also provide the option for custom-designed prostheses, which patients universally prefer over conventional prostheses due to superior comfort and increased sensation of the prosthesis feeling like a natural part of their body (32, 39).

LIMITATIONS

There are several limitations to consider in the findings outlined by our review. Firstly, our conclusions are limited by the scarcity of primary studies on this topic and the lack of level 1 evidence. Our findings primarily based on retrospective observation studies such as case series and cohort studies, which are susceptible to bias. Additionally, variation in the classification and reporting of outcomes following symmetrising procedures, deeming meta-analysis of the data was not possible. A consensus in this area is needed to facilitate better comparison of outcomes in future studies assessing results of breast symmetrisation procedures.

CONCLUSION

Currently, there is no established agreement on how to manage developmental breast asymmetry. Our literature review has revealed a lack of consistency in the classification of patients with developmental breast asymmetry and in the reporting of outcomes following surgery to correct asymmetry. We recommend the Breast-Q survey as the measure of choice for assessing patient reported outcomes at follow-up, as it is a validated and reliable tool. Several augmentation and reduction procedures can be performed to achieve satisfactory short term aesthetic outcomes. However, some studies have shown that treating both breasts with similar techniques is an important principle for the sustenance of aesthetically pleasing outcomes. Further research comparing long term aesthetic and patient reported outcomes among patients treated with symmetric versus asymmetric surgical techniques is needed to support this fact. Additionally, external prosthesis has great potential to serve as a non-surgical option for adolescent patients awaiting surgical intervention, and further studies are needed to investigate its effectiveness.

CONFLICT OF INTEREST STATEMENT

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ETHICAL APPROVAL

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Figure 1. PRISMA Flowchart

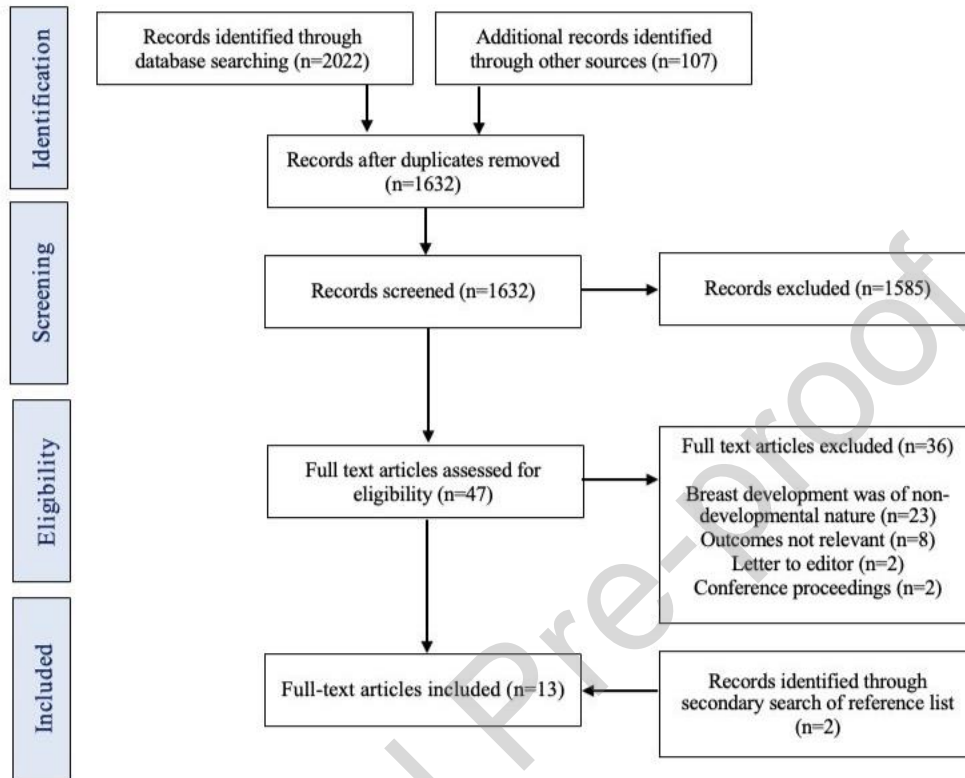


Table 1. Included Papers

Study	Country	Journal	Study design	Number of patients	Classification of Asymmetry	Management	Aesthetic Outcomes	Patient Reported Outcomes	Revision Rate
Stark et al. 1991 ¹²	Germany	European Journal of Plastic Surgery	Case series	72	Descriptive terms	Based on type of asymmetry	Excellent 40%, good 25%, fair 20%, poor 15%	Very good 65%, good 20%, fair 12%, poor 3%	-
De Vita et al. 2019 ¹⁸	Italy	Aesthetic Plastic Surgery	Case series	343	Based on patient's perception of degree of asymmetry	Based on patient's perception of degree of asymmetry and patient desires re. breast size	-	Patients with greater degree of preop asymmetry reported lower postop	Overall 5%. Revision rates higher among patients with greater

								satisfactio n	preop asymmetr y
Patlazh an et al. 2020 ¹⁶	Ukraine	Aesthetic Plastic Surgery	Case series	402	Based on volume difference	Vol asymmetry <40ml: bilateral asymmetric implant Vol asymmetry >40ml: reduction of larger breast + augmentati on of smaller breast	-	Patients with greater degree of preop asymmetry reported lower postop satisfactio n	28%
Araco et al. 2006 ¹⁴	UK	Aesthetic Plastic Surgery	Case series	177	Descriptive terms	Based on type of asymmetry	Most patients able to achieve good aesthetic results	-	-
Brebant et al. 2022 ¹⁹	Germa ny	Aesthetic Plastic Surgery	Retrospecti ve cohort study	32	-	Implant group: 16 Lipotransfer group: 16	Implant group: 93% Lipotransfer group: 93%	Implant group: breastq: 71% Lipotransfe r group breastq: 76%	-
Summa et al. 2021 ²¹	UK	Gland Surgery	Prospective cohort study	65	-	Implant group: 35 Lipotransfer group: 30	-	Implant group: 69% satisfied Lipotransfe r group: 80% satisfied	Implant group: 26% Lipotransf er group: 0%
De Fazio et al. 2020 ²⁰	Italy	Plastic and Reconstructi ve Surgery	Case series	34	-	Augmentati on with fat graft combined with mastopexy	Good aesthetic outcomes maintained as graft take	-	6%

							considered >70% in all		
Somogyi et al. 2015 ¹⁵	Australia	Aesthetic Surgery Journal	Case series	5	Based on volume difference	Disc of parenchymal tissue resected from larger breast + bilateral symmetric implant augmentation	-	-	20%
Peterson et al. 2021 ¹⁷	Canada	Aesthetic Plastic Surgery	Retrospective case series	35	Based on volume difference	Liposuction of larger breast + bilateral symmetric implant augmentation	Sternal notch-nipple distance improved in all patients postoperatively		3%
Oakes et al. 2009 ⁶	USA	Journal of Pediatric Adolescent Gynaecology	Case series	14	Descriptive terms	2-stage expander followed by implant	-	90%	-
Piza-Katzer et al. 2005 ⁵	Austria	Aesthetic Plastic Surgery	Case series	11	-	Unilateral reduction +/- contralateral implant augmentation	Subjectively deemed excellent results	Unanimously high patient satisfaction	-
Kuzbari et al. 1993 ¹³	Austria	Journal of Plastic and Reconstructive Surgery and Hand Surgery	Case series	30	Descriptive terms	Based on type of asymmetry	Patients treated with similar procedures on both breasts achieved greater aesthetic outcomes	Very satisfied 40%, satisfied 53%, disappointed 7%	-
Pike et al. 2017 ⁴	USA	Journal of Adolescent Health	Case series	17	-	Custom fit breast prosthesis	-	82% improved body	CT

image,
71%
improved
self
esteem,
71%
improved
social
participati
on

Table 2. Management Techniques Utilised

Management	Number of studies applying this technique
Bilateral asymmetric implant augmentation	5
Bilateral asymmetric reduction	4
Unilateral implant augmentation	4
Unilateral reduction	4
Unilateral reduction + contralateral implant augmentation	3
Unilateral reduction + bilateral symmetric implant augmentation	2
Unilateral fat transfer	2
Bilateral asymmetric fat transfer	2
Bilateral asymmetric reduction + bilateral symmetric implant augmentation	1
Bilateral asymmetric reduction + bilateral asymmetric implant augmentation	1
2-stage expander / implant	1
Custom fit external prosthesis	1

Table 3. Risk of Bias

Study	Primary outcome of paper	Pre-intervention	At intervention	Post-intervention	Overall risk of bias judgment				
		Bias due to confounding	Bias in selection of participants into the study	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of the reported result	Bias in selection of the reported result	

	asymmetry with lipograft vs implant augmentation								
Summa et al. 2021 ²¹	To compare the long- term outcomes of implant- based and fat grafting procedures for reconstructi on of breast asymmetry	Low risk	Low risk	Low risk	Low risk	Low risk	Moderate Risk	Moderate risk	Low risk
De Fazio et al. 2020 ²⁰	To evaluate the effectiveness of mastopexy combined with fat grafting and the stability of results over time	Moderate risk	Moderate risk	Low risk	Low risk	Low risk	Serious Risk	Serious risk	Moderate risk
Somogyi et al. 2015 ¹⁵	To propose our novel single-stage technique to treat breast asymmetry	Moderate risk	Moderate risk	Low risk	Low risk	Low risk	Serious Risk	Serious risk	Moderate risk
Peterso n et al. 2021 ¹⁷	To present our approach for correction of developmental breast asymmetry using ultrasonic assisted	Low Risk	Low risk	Low risk	Moderate risk	Low risk	Serious Risk	Low risk	Moderate risk

Oakes et al. 2009 ⁶	liposuction with augmentation To retrospectively examine a cohort of young women with severe asymmetric breast development who underwent early implantation of an expandable breast implant	Moderate risk	Moderate risk	Low risk	Low risk	Moderate risk	Serious Risk	Moderate risk	Moderate risk
Pizarro et al. 2005 ⁵	To describe our technique of reduction mammaplasty to treat breast asymmetry	Low Risk	Moderate risk	Low risk	Low risk	Serious risk	Serious Risk	Serious risk	Serious risk
Kuzbari et al. 1993 ¹³	To evaluate different surgical techniques for the management of developmental breast asymmetry to help decide at what age corrective operations are best	Low risk	Low risk	Moderate risk	Low risk	Low risk	Low Risk	Low risk	Low risk

Pike et al. 2017 ⁴	To evaluate the effect external breast prosthesis services on patients with developmental breast asymmetry	Low Risk	Low risk	Low risk	Low risk	Moderate risk	Low Risk	Low risk	Low risk
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Journal Pre-proof