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Clavicle height asymmetry: A common problem for planning reduction mammoplasties – A correlational study

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Summary The distance between the mid-clavicle and nipple (MCN) is crucial in planning reduction mammoplasties. MCN has been shown to be superior in achieving nipple-areola complex symmetry. However, there is great variability in clavicle anatomy. Detecting clavicle asymmetries is crucial for achieving optimal postoperative breast symmetry. This study assessed clavicle asymmetries in patients undergoing reduction mammoplasties and used correlation analyses to understand the outcome measures, including variations in resection weight and clavicle angles.

We included 100 patients who underwent reduction mammoplasties with wise-pattern skin resections. Clavicle height asymmetries were identified through preoperative anthropometric measurements. Clavicle angles were assessed from pre- and postoperative images to differentiate between fixed and dynamic asymmetries. Statistical analyses used frequency distributions, generalized linear models, and logistic regression.

Clavicle height differences were identified in 78% of the patients using preoperative anthropometric measurements. Pre- and postoperative images revealed fixed clavicle angle differences in 45% of the cases and dynamic differences in 16%. Dynamic clavicle height asymmetries were significantly associated with differences in resection weight between the breasts ($p = 0.012$), smaller differences

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in clavicle angles (p = 0.006), and patients aged 40 to 64 years (p = 0.038). Fixed asymmetries correlated with larger differences in clavicle angles (p = 0.023).

Clavicle height asymmetry is common in reduction mammoplasty patients. Differentiating dynamics from fixed asymmetries preoperatively is important, as this study demonstrates significant correlations with resection weight, clavicle angles, and age. These findings suggest that compensatory clavicular asymmetries play a significant role in cases of pre-existing breast asymmetry, affecting surgical planning.

Background

Precise preoperative markings and conventional anthropometric measurements between anatomical landmarks[1-4] are essential in planning breast reduction surgeries to achieve postoperative symmetry. Essential metrics include the mid-clavicle to nipple (MCN)[1,2,4-6] and suprasternal notch to nipple (SSN) distances. Prior research indicates that MCN provides greater accuracy than SSN, particularly with variations in breast width.[7,8] Advanced tools such as laser-level projection and 3D scanning have also been used to enhance postoperative symmetry.[7,9]

However, variations in clavicle anatomy, including height differences,[6] pose challenges in the preoperative planning of breast reduction surgery. Even if MCN measurements are equal bilaterally, any clavicle asymmetries can be a challenge to achieving nipple-areola complex (NAC) symmetry. Such asymmetries can also affect the perceived alignment of the breasts to the patient, potentially leading to their dissatisfaction if not properly addressed during surgical planning.

Distinguishing between dynamic (or compensatory) and anatomically fixed clavicle asymmetries is essential for planning. Dynamic clavicle topographic asymmetries involve temporary changes in the clavicle alignment due to movement, posture, or muscle activity and may also be attributed to differences in breast width. In contrast, fixed asymmetries often result from preconditions such as adolescent idiopathic scoliosis (AIS) and previous spine surgeries.[10,11] These distinctions are important because they can influence the proposed surgical approach. For example, dynamic asymmetries may be managed with preoperative physical therapy or posture correction, while fixed asymmetries may require more complex surgical strategies to achieve optimal results.

Recognizing clavicular height and angle differences enhances measurement accuracy, supporting better outcomes in breast reduction surgeries. This study assessed clavicle asymmetry frequency and examined the associations with resection weight, clavicle angles, and age as the primary outcomes.

Methods

This study received approval from the Spital Thurgau HPC Research Committee (AZ, November 30, 2023). No additional ethics board (EKOS Ostschweiz) approval was required as data analysis used anonymized, retrospective photographic data without further patient involvement or impact on treatment. The study adhered to the ethical standards outlined in the Declaration of Helsinki.

We reviewed the medical records of 100 patients aged ≥17 years who underwent reduction mammoplasties with superomedial, superior, or central pedicles and wise-pattern skin resections. All surgeries were conducted by senior plastic surgeons at the Thurgau Hospital Group in Switzerland, with data collected from July 2023. The study included patients with complete pre- and postoperative data and excluded those with incomplete records or prior breast surgeries.

Baseline characteristics, including demographics, treatment details, and clavicle anthropometry measurements, were summarized using frequency distribution tables. To explore the associations between these characteristics and predefined outcome measures, we used generalized linear models for count data and logistic regression for categorical data. The data were analyzed using the Jamovi software (v2.3, Sydney, Australia).

Baseline demographic data

Collected patient-related data included age, obesity (defined as a body mass index (BMI) ≥ 30 kg/m^2), medical history of regular nicotine consumption, diabetes mellitus, arterial hypertension, peripheral artery disease, and other pre-existing conditions such as AIS and previous spine surgeries.

Treatment-specific characteristics of patients undergoing reduction mammoplasty

In terms of treatment-specific characteristics, we included all 100 patients who underwent primary reduction mammoplasty with either a superomedial, superior, or central pedicle combined with a wise-pattern resection. We assessed the resected tissue weight per breast and calculated the total weight differences, categorizing them into smaller (0-50 g) and larger (51-300 g) variances based on prior literature.[12,13]

Postoperative complications were classified per the Clavien-Dindo classification[14] into three grades: grade I for minor wound healing issues requiring no additional intervention or complications, referring to wound healing disorders necessitating prolonged wound dressing, local wound debridement during regular postop follow-up visits; grade II, IIIa, and

IIIb complications, encompassing any complications requiring surgical intervention, such as surgical hematoma evacuation or secondary wound closure, excluding scar corrections. We also reviewed the interventions performed during follow-up as a further treatment-specific characteristic.

Clavicle anthropometry measurement data

The primary goal of this study was to identify clavicle asymmetries using anthropometric measurement data, together with laser level projection.[7,8] We assessed the preoperative discrepancies between each side, focusing on the differences between the MCN distance and a 5 cm line below the suprasternal notch (5HLN). Measurements were double-checked for accuracy by trained personnel, with averages recorded to reduce human error.

We also aimed to distinguish fixed from dynamic clavicle changes by analyzing pre- and postoperative clavicle angles differences, based on the pre- and postoperative photographic data, through Synedra View® software (Synedra Information Technologies GmbH, Innsbruck, Austria). Calibration was standardized. Differences in clavicle height were computed in a blinded manner by establishing the sagittal axis and placing the horizontal axis at a 90° angle at the level of the sternoclavicular joint. Subsequently, a third line connecting the intersection of the sagittal and horizontal axes was drawn through the highest convexity point of the clavicle (Figures 1 and 2). Sehrawat et al.[15] described a lateral angle of the clavicula representing the curvature of its lateral one-third. This angle was formed by connecting straight lines from the highest lateral convexity of the clavicle to the acromion and from the deepest medial convexity of the clavicle.[16,17] Finally, the angle between the horizontal axis and connecting line through the highest point of the clavicle was determined. Clavicle angle differences were categorized as smaller (0-9°) or larger (10-16°), with a 2° cutoff for significant asymmetry. The angles were manually

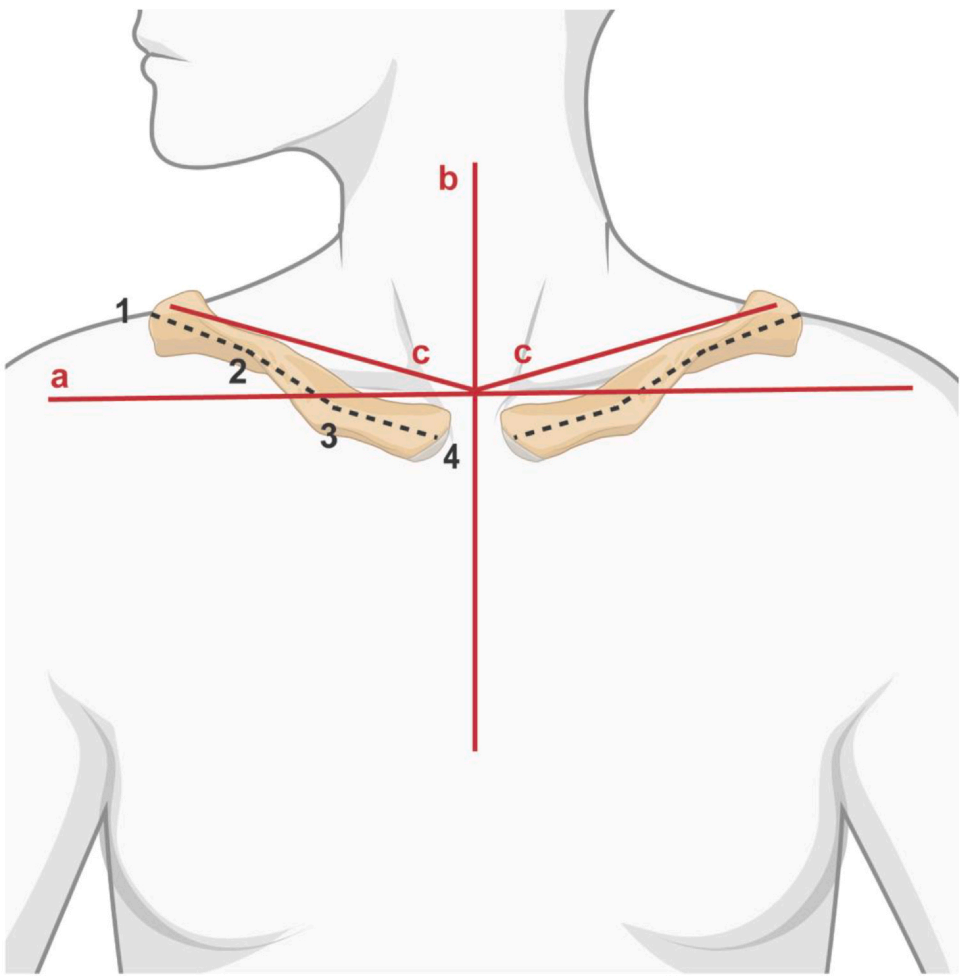

Figure 1 Measurement of clavicle angles differences based on photographic patient data. Symmetrical mirrored patient-based breast model. Computed sagittal axis (a) and placing the horizontal axis at a 90° angle at the level of the jugulum or sternoclavicular joint (b). Subsequently, a third line (c) connecting the intersection of the sagittal and horizontal axes is drawn through the highest convexity point of the clavicle "123," the curvature of the lateral one-third. The highest and deepest points on the two curves of the clavicle where the convexities are the maximum, and marked as points "2" and "3" and joined by a straight line. The points "2" and "3" are joined with midpoints "1" and "4" at the corresponding ends to form lines "1–2" and "3-4," thus forming two angles; a lateral angle "123," which represents the curvature of the lateral one-third, and a medial angle "234," which gives the curvature to the medial two-thirds. Angle measurements were made using a baseline finger goniometer. We considered a cutoff value of 2° for clavicle angle differences. Data = counts and °.

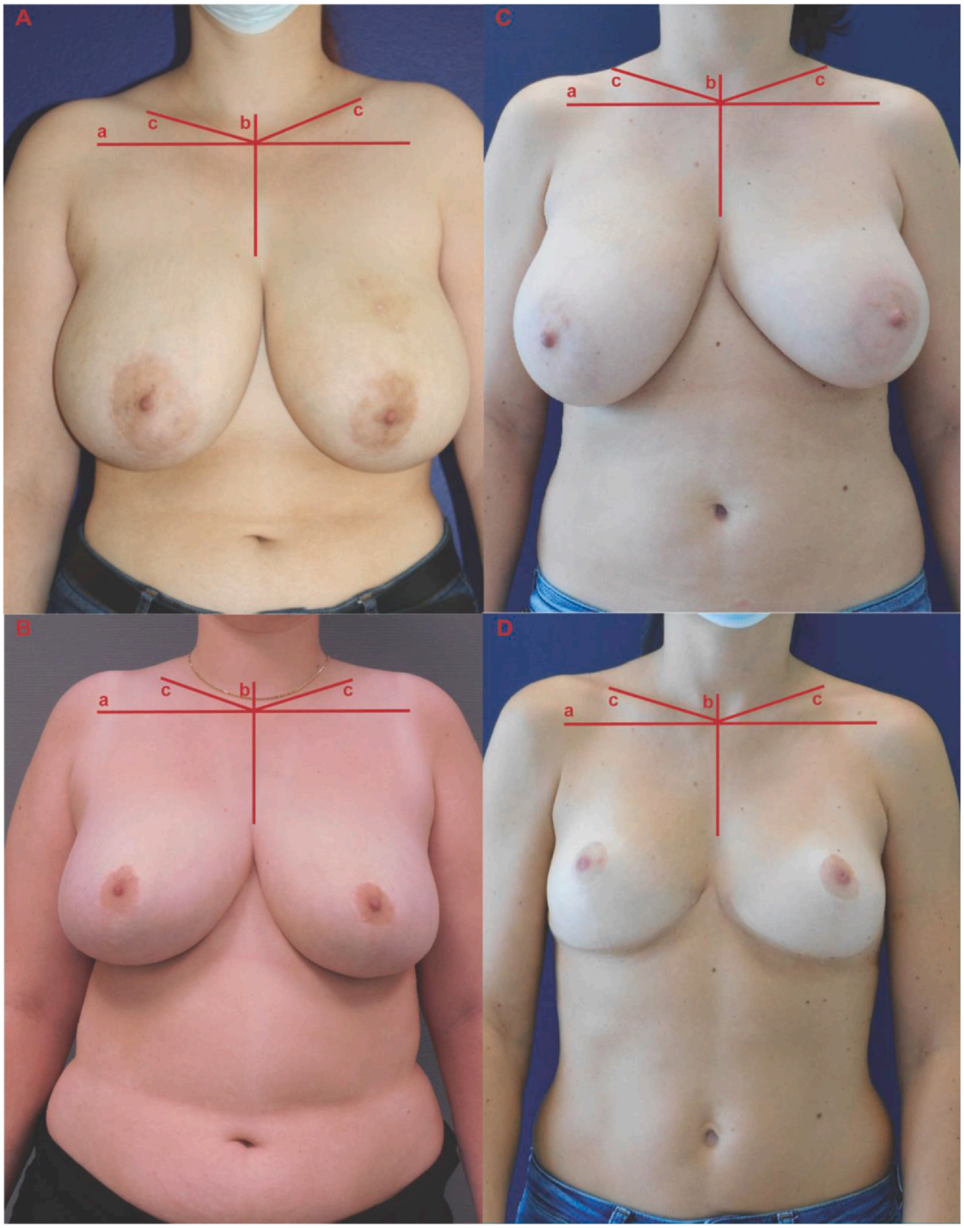

Figure 2 Clavicle angle differences based on pre- and postoperative image data. Symmetrical mirrored patient-based breast model. Computed sagittal axis (a) and placing the horizontal axis at a 90° angle at the level of the jugulum or sternoclavicular joint (b). Subsequently, a third line connecting the intersection of the sagittal and horizontal axes was drawn through the highest convexity point of the clavicle (c). Angle measurements are made using a baseline finger goniometer. We considered a cutoff value of 2° for clavicle angle differences. Data = counts and **°. A and B: Compensatory or dynamic clavicle asymmetries.** The preoperative image (A) shows a clavicle angle difference of 10° (right 15° and left 20°). Postoperatively (B), the angles are equalized (10° for right and left), suggesting dynamic asymmetry. C and D: Fixed clavicle asymmetries. The preoperative image (C) shows a clavicle angle difference of 2° (right 20° and left 18°). Postoperatively (D), the difference remains at 2° (right 20° and left 18°).

measured using a goniometer, providing insights into whether these asymmetries were structural or compensatory and helping refine surgical planning strategies.

Statistical analyses

Frequency distribution tables provided descriptive statistics for the data. The primary goal was to assess the correlations/associations between patient characteristics and predefined outcomes, including resection-weight differences between the breasts (0-50 g), resection-weight variance, and age range (40–64 years). Given the skewed distribution, these count data were analyzed using a generalized linear model (GLM) with a negative binomial distribution and log link, addressing significant overdispersion. Incident rate ratios (IRR) were calculated for relevant patient characteristics (age, BMI $\geq$ 30 kg/m^2, and other risk factors, such as AIS and spine surgeries), therapy-associated characteristics (reduction mammoplasty with superomedial pedicle and grade I complications), and clavicle anthropometry measurement data (fixed or dynamic clavicle asymmetry and clavicle asymmetry based on anthropometric measurements preoperatively) or resection-weight difference between each breast.

Additional outcomes included clavicle angle differences, categorized as smaller (0-9°) or larger (10–16°) and analyzed via logistic regression for binary data. Estimates represented log odds of "survival = yes" versus "no." The differences in clavicular angle were also estimated for relevant patient characteristics (age, BMI $\geq$ 30 kg/m^2, and other risk factors, such as AIS and spine surgeries), therapy-associated characteristics (reduction mammoplasty with superomedial pedicle and grade I complications), and clavicle anthropometry measurement data (fixed or dynamic clavicle asymmetry and clavicle asymmetry based on anthropometric measurements preoperatively).

Statistical analysis was carried out using the Jamovi (v2.3, Sydney, Australia) software. Count variables were reported as mean ± standard deviation (SD), age as median ± interquartile range (IQR), and categorical data as counts and percentages. Significance was set at $p < 0.05$.

Results

Baseline characteristics and demographic data

A total of 100 female patients undergoing reduction mammoplasty were included, with a median age of 38.5 years (IQR, 17–80 years). The most noted comorbidities upon admission were medical history of obesity (18%), nicotine abuse (3%), diabetes mellitus, arterial hypertension (5%), peripheral artery disease, and others (10%), including medical records of AIS and previous spine surgeries. Detailed baseline characteristics and comorbidities recorded upon admission can be found in Table 1.

Treatment-specific characteristics of patients undergoing reduction mammoplasty

A cohort of 100 patients who underwent primary reduction mammoplasty along with wise-pattern resection. The median number of superomedial pedicles was 89 (SD: 89.9), 4 for superior pedicles (SD: 4.1), and 6 for central pedicles (SD: 6.1). On the right side, the median resection weight was 420 g (SD: 313), and on the left side, it was 420 g (SD: 323). Additionally, the median resection-weight difference between the breasts was 80 g (SD: 94.6). When examining the resection-weight difference within specific ranges, the median was 15 g (SD: 17.6) for differences between 0 to 50 g and 120 g (SD: 64.4) for differences between 51 to 300 g (Table 2).[18]

Table 1 Baseline demographic data.

Baseline demographic data (n = 100)	
Patient characteristics	N [counts] (Percentage [%]), or median (IQR)
Age, years	38.5 (17 and 80)
BMI $\geq$ 3 kg/m^2	18 (18)
Nicotine consumption	3 (3)
Diabetes mellitus	0 (0)
Arterial hypertension	5 (5)
Peripheral artery disease	0 (0)
Others (e.g., AIS, spine surgeries)	5 (5)

Continuous variables ± IQR, binary variables respectively, frequency tables.
AIS = adolescent idiopathic scoliosis, BMI = body mass index, IQR = interquartile range, N = total number of patients.

Table 2 Therapy characteristics.

Therapy specific characteristics (n = 100)	
Patient characteristics	N [counts] (Percentage [%]), or median (SD)
Primary reduction mammoplasty, wise-pattern	
Superomedial pedicle	90 (90)
Superior pedicle	4 (4)
Central pedicle	6 (6)
Resection weight (g)	
Right	420 (313)
Left	420 (323)
Resection-weight difference btw. each breast	
(g)	80 (94.6)
range 0 to 50 (g)	15 (17.6)
range 51 to 300 (g)	120 (64.4)
Complications (Clavien-Dindo classification)	
Grade I	16 (16)
Grade II	0 (0)
Grade IIIa	0 (0)
Grade IIIb	1 (1)
Interventions during the follow-up period	2 (2)

Continuous variables ± SD, binary variables respectively, frequency tables. Missing data for resection weight right: 5 and left: 5, and interventions during the follow-up period: 1.
N = total number of patients, SD = standard deviation.

Upon further assessment of complications, 16% of the patients experienced grade I complications, characterized by minor wound healing issues that necessitated no additional intervention or wound healing disorders requiring extended wound dressing, local wound debridement during routine postoperative follow-up visits. Additionally, one patient (1%) faced grade IIIb complications, necessitating surgical intervention (Table 2).

Clavicle anthropometry measurement data

As outlined in the methods section, clavicle asymmetries were identified using a predefined anthropometric measurement data sheet, together with laser-level projection. This involved determining the preoperative differences between each side in terms of the difference between MCN and the 5HLN. With this type of measurement method, we identified 78.4% of the patients with clavicle asymmetries (Table 3).

Table 3 Clavicle anthropometry characteristics.

Clavicle anthropometry pre- and postoperative photographic measurement data (n = 100)	
Clavicle anthropometry characteristics	N [counts] (Percentage [%])
Clavicle asymmetry-preoperative measurement data	58 (78.4)
Clavicle asymmetry (cut-off angle of 2°)	
Fixed	45 (45)
Dynamic	16 (16)

Binary variables, respectively, frequency tables. Missing data for clavicle anthropometry preoperative measurement data: 26. N = total number of patients.

Furthermore, we could distinguish between fixed and dynamic clavicle changes by analyzing clavicle angle differences based on pre- and postoperative photographic data (Figure 2). Our analysis revealed that 45% of the patients had fixed asymmetries, and 16% showed dynamic asymmetries (Table 3).

Resection-weight variances between the breasts (range 0 to 50 g) were positively associated with dynamic clavicle asymmetries

We first investigated the potential correlations between the differences in breast resection weights (range, 0–50 g) and various predictive factors. These factors were age, fixed and dynamic clavicle asymmetry (measured from images), preoperative clavicle asymmetry data based on anthropometric measurements, BMI $\geq$ 30 kg/m^2, risk factors such as AIS and previous spine surgeries, reductions with superomedial pedicles, and grade I complications (Table 4).

The initial focus was on possible correlations with the incidence of clavicle asymmetries. The results demonstrated a significant positive correlation between 0-50 g resection-weight differences and dynamic clavicle asymmetries (p = 0.012, IRR: 4.500). Similarly, we observed a significant correlation with preoperative clavicle asymmetry data based on anthropometric measurements (p = 0.002, IRR: 0.289). This strongly suggests that patients undergoing reduction mammoplasty within this range of resection-weight differences may experience a correction of preoperatively identified dynamic clavicular asymmetries.

Furthermore, we identified significant interactions between preoperative clavicle asymmetries based on anthropometric measurements and dynamic clavicle asymmetry based on angle measurements from images (p = 0.041, IRR: 5.025). This underscores the importance of identifying patients with clavicle asymmetries, especially dynamic ones, to decide the amount of breast tissue to be resected during reduction mammoplasty.

Moreover, a significant correlation was found between resection-weight differences in the same range and BMI $\geq$ 30 kg/m^2 (p = 0.007, IRR: 4.151), as well as grade I complications (p = 0.011, IRR: 6.770). These results suggest that patients with a history of obesity and those experiencing minor wound healing issues requiring no further intervention are likely to have resection-weight differences in this range after reduction mammoplasty.

Resection-weight variances between the breasts were positively associated with clavicle asymmetries

We also explored the potential connections between variations in breast resection weights and other predictive factors. These factors included age, fixed and dynamic clavicle asymmetries measured from the images, preoperative clavicle asymmetry data based on anthropometric measurements, BMI $\geq$ 30 kg/m^2, risk factors such as AIS and prior spine surgeries, reduction mammoplasties using superomedial pedicles, and grade I complications (Suppl. Table 1). Moreover, the emphasis was to investigate the possible correlations between such resection-weight variations and the occurrence of clavicle asymmetries.

Table 4 Associative regression results: Resection-weight differences between the breasts ranging from 0 to 50 g [counts].

Outcome: resection-weight difference between each breast ranging from 0 to 50 g [counts], generalized linear model with negative binomial distribution

Names	IRR (95%CI)	p-value
Age	1.010 (0.989 to 1.031)	0.374
Fixed clavicle asymmetry	1.132 (0.519 to 2.389)	0.752
Dynamic clavicle asymmetry	4.500 (1.267 to 14.479)	**0.012**
Clavicle asymmetry-anthropometric measurements preoperatively	0.289 (0.110 to 0.733)	**0.002**
BMI* $\geq$ 3 kg/m^2	4.151 (1.212 to 13.471)	**0.007**
Other risk factors (AIS, spine surgeries)	0.699 (0.201 to 3.219)	0.588
Superomedial pedicle	1.451 (0.535 to 4.739)	0.492
Complications, grade I	6.770 (1.374 to 27.541)	**0.011**
Clavicle asymmetry-anthropometric measurements preoperatively * Dynamic clavicle asymmetry	5.025 (0.731 to 37.195)	**0.041**

Significant associations were found for this range of breast resection-weight differences and dynamic clavicle asymmetries (p = 0.012), preoperative anthropometric measurements of clavicle asymmetries (p = 0.002), BMI $\geq$ 30 kg/m^2 (p = 0.007), and grade I complications (p = 0.041). These results were based on a GLM regression model with a negative binomial distribution and log link due to a skewed distribution. Significant interactions between clavicle asymmetry-anthropometric measurements preoperatively and dynamic clavicle asymmetries (p = 0.041).
BMI = body mass index, CI = confidence interval, IRR = incidence rate ratio.
All significant values are highlighted in bold.

We found significant correlations between resection-weight differences and age (p = 0.011, IRR: 1.017) and also between fixed clavicle asymmetry measured using photographic angles and age (p = 0.020, IRR: 0.729). This highlights the important role of clavicular asymmetries in existing breast symmetry, which is influenced by age, and may impact decisions regarding the amount of tissue to be removed.

Positive associations between dynamic clavicle asymmetries and smaller differences in clavicular angles, and between fixed clavicle asymmetries and larger clavicular angles

As an additional aim, we examined any correlations between dynamic and fixed clavicular asymmetries and preoperative variances in clavicular angles, categorized either as smaller (range, 0–9°) or larger (range, 10–16°). We found a significant association between dynamic clavicle asymmetries and smaller variances in clavicle angles (range, 2–9°) (p = 0.006, IRR: 0.106), indicating that patients identified with clavicular asymmetries featuring a dynamic component are likely to have smaller clavicle angle variances (Table 5). Conversely, individuals with larger clavicle angle differences were more likely to have fixed clavicle asymmetries (p = 0.023, IRR: 7.393) and were also more likely to have a pre-existing obesity diagnosis (p = 0.045, IRR: 5.801) (Table 6).

Age variance was positively associated with dynamic clavicle asymmetries

We also investigated the potential correlations between age (range, 40–64 years) and various predictive factors. These factors were fixed and dynamic clavicle asymmetry measured using images, BMI ≥ 30 kg/m^2, risk factors such as AIS and previous spine surgeries, reduction mammoplasties using superomedial pedicles, grade I complications, and resection-weight differences between the breasts (Table 7).

We found a significant positive association between the 40–64 years age variance and dynamic clavicle asymmetries (p = 0.038, IRR: 161876.02). This strongly suggests that patients in this age range undergoing reduction mammoplasty are more likely to have variances in clavicle anatomy with dynamic/compensatory asymmetries.

Discussion

This study provides valuable insights for planning reduction mammoplasties by emphasizing the prevalence of clavicle anatomical variations and their strong correlation with resection weight and patient age, potentially influencing postoperative breast symmetry.[19]

Accurate preoperative planning relies heavily on anthropometric measurements, with MCN being a key reference point in breast reduction surgeries.[8] As the clavicle is the primary anatomical reference for MCN,[1,2,4-6] variations in clavicle height or angle can impact postoperative breast symmetry. Awareness of these anatomical differences is essential for achieving optimal outcomes.

One of the primary objectives of this study was to identify clavicle asymmetries preoperatively using a predefined 5 cm horizontal line together with laser technology, independent of MCN measurement. Hereby, we propose this method as a practical and accessible tool that can be integrated into clinical practice to improve surgical outcomes.

Using this method, we identified 78% of the patients with variations in clavicle anatomy. These were further classified into fixed (45%) and dynamic or compensatory (16%) asymmetries, which strongly correlated with the differences in resection weights, clavicle angles, and age.

Previous studies have also linked resection weight with anthropometric measurements.[18] Tenna et al.[12] found a difference of > 200 g between the right and left breasts in 20% of their patients, and another study reported that 65% of women had a volume difference of > 50 cc.[13] Based on these findings, we categorized weight differences between the breasts, finding a positive correlation between dynamic clavicle asymmetry and resection-weight variances of 0–50 g. This suggests that patients with dynamic clavicle

Table 5 Associative regression results: clavicle asymmetries using preoperative measurements of clavicle angles ranging from 2 to 9°, with different risk factors.

Outcome: Clavicle asymmetries, using preoperative measurements of clavicle angles ranging from 2 to 9° [counts], logistic regression model

Names	Odds ratio (95%-CI)	p-value
Age	1.561 (0.996 to 1.053)	0.094
Dynamic clavicle asymmetry	0.106 (0.021 to 0.527)	**0.006**
Resected tissue differences btw. breasts	1.004 (0.999 to 1.010)	0.115
BMI $\geq$ 3 kg/m^2	2.023 (0.582 to 7.022)	0.267
Other risk factors (AIS, spine surgeries)	0.853 (0.107 to 6.788)	0.881
Superomedial pedicle	0.269 (0.045 to 1.616)	0.151
Complications, grade I	0.775 (0.195 to 3.085)	0.718

Positive correlations were found between preoperative clavicle-angle measurement differences ranging from 2 to 9° and dynamic clavicle asymmetries (p = 0.006). Logistic regression model for binary data. Estimates represent the log odds of "clavicle asymmetries, by preoperative measurements of clavicle angles ranging from 2 to 9° = yes" vs. "clavicle asymmetries, by preoperative measurements of clavicle angles ranging from 2 to 9° = no."
AIS = adolescent idiopathic scoliosis, BMI = body mass index, CI = confidence interval.
All significant values are highlighted in bold.

Table 6 Associative regression results: clavicle asymmetries using preoperative measurements of clavicle angles ranging from 10 to 16°, with different risk factors.

Outcome: Clavicle asymmetries, by preoperative measurements of clavicle angles ranging from 10 to 16° [counts], logistic regression model

Names	Odds ratio (95%-CI)	p-value
Age	1.044 (0.991 to 1.100)	0.106
Fixed clavicle asymmetry	7.393 (1.310 to 41.73)	**0.023**
Resected tissue differences btw. breasts	1.000 (0.992 to 1.010)	0.981
BMI* ≥ 3 kg/m^2	5.801 (1.039 to 32.400)	**0.045**
Other risk factors (AIS, spine surgeries)	0.439 (0.020 to 9.730)	0.602
Superomedial pedicle	7.31e+6 (0 to Inf)	0.994
Complications, grade I	0.439 (0.040 to 4.870)	0.502

Positive correlations were found between preoperative clavicle-angle measurement differences ranging from 10 to 16°, clavicle asymmetries ($p = 0.023$), and BMI ≥ 30 kg/m^2 ($p = 0.045$). Logistic regression model for binary data. Estimates represent the log odds of "clavicle asymmetries, by preoperative measurements of clavicle angles ranging from 10 to 16° = yes" vs. "clavicle asymmetries, by preoperative measurements of clavicle angles ranging from 10 to 16° = no."
AIS = adolescent idiopathic scoliosis, BMI = body mass index, CI = confidence interval.
All significant values are highlighted in bold.

Table 7 Associative regression results: 40 to 64 years of age variance [counts], with different risk factors.

Outcome: 40-64 year of age variance [counts], generalized linear model with negative binomial distribution

Names	IRR (95%-CI)	p-value
Age	1.110 (0.925 to 1.330)	0.267
Fixed clavicle asymmetry	2814.32 (0.0923 to 8.58e^7)	0.141
Dynamic clavicle asymmetry	161876.02 (3.147 to 8.33e^9)	**0.038**
Resection-weight difference btw. breasts	1.010 (0.9736 to 1.040)	0.760
BMI ≥ 3 kg/m^2	39.050 (0.0670 to 22760.73)	0.268
Other risk factors (AIS, spine surgeries)	1.780 (1.22e^{-5} to 261569.510)	0.925
Superomedial pedicle	2.93e^{-6} (1.65e^{-14} to 518.910)	0.781
Complications, grade I	2148.190 (0.707 to 6.53e^6)	0.070

A significant association was found between this age variance and dynamic clavicle asymmetries ($p = 0.038$). These results were based on a GLM regression model with negative binomial distribution and a log link due to a skewed distribution.
AIS = adolescent idiopathic scoliosis, BMI = body mass index, CI = confidence interval, IRR = incidence rate ratio.
All significant values are highlighted in bold.

asymmetries might benefit from this insight for improved outcomes, whereas fixed asymmetries may necessitate more planning.

We also observed a relationship between the resected tissue weight and age. Patients aged 40–64 years were more likely to exhibit compensatory asymmetries, whereas younger and older patients predominantly had fixed clavicle differences. This highlights the importance of tailoring surgical approaches based on age and type of asymmetry.[20]

Our analysis revealed that dynamic clavicle asymmetries were associated with smaller preoperative clavicle angle differences, whereas fixed asymmetries correlated with larger angle discrepancies. These findings suggest that patients with minor clavicle variations are more likely to exhibit compensatory anatomical adjustments, whereas larger angle differences typically indicate fixed asymmetries. Recognizing these distinctions allows for more personalized surgical planning, ultimately improving aesthetic and functional outcomes.

The limitations of this study should be acknowledged. First, preoperative breast asymmetry was assessed using a predefined anthropometric data sheet,[7,8] focusing solely on MCN differences and horizontal line measurements below the jugulum.[8] Clavicle angle differences were not considered, which may have led to overlooked asymmetries in some patients.

Additionally, the use of a manual goniometer introduces potential observer and interobserver bias. Future research should explore more advanced technologies or radiographic tools based on standardized anatomical reference values to enhance measurement accuracy and reproducibility.

Human error in anthropometric and imaging measurements may have also impacted precision. Furthermore, the retrospective design limited control over confounding variables, potentially affecting the strength of observed correlations.

Finally, as the study was conducted in a single hospital, the findings may not be generalizable to broader populations or clinical settings.

Even though the human body is not perfectly symmetrical, and millimeter differences are tolerable, plastic surgeons strive for the best aesthetic and symmetrical results.[6,21-23] The use of anthropometric measurements and image analyses[24,25] allows for thorough and objective examinations of clavicle asymmetries in mammoplasty patients. By distinguishing between dynamic and fixed clavicle asymmetries, the present study provides insight into these variations that could impact surgical outcomes related to postoperative breast symmetry. Future studies should consider a prospective design and include additional measurements to further validate these findings and explore new strategies for managing clavicle asymmetries in breast reduction surgery.

Conclusion

Clavicle height asymmetry is a prevalent and clinically significant factor in patients undergoing reduction mammoplasty. Differentiating between dynamic and fixed asymmetries is essential for optimal surgical planning and achieving postoperative breast symmetry. Relying solely on anthropometric measurements such as MCN for surgical planning, we might end up with asymmetrical breasts in cases of variations in clavicle anatomy.

Our findings suggest that incorporating a horizontal laser line, rather than the MCN distance, combined with laser technology, should be adopted as a standard preoperative assessment tool. This approach is particularly beneficial in cases of pronounced asymmetry and in older patients, where it can enhance surgical precision and improve postoperative breast and nipple-areolar complex symmetry.[7]

This study underscores the importance of integrating compensatory clavicle asymmetries into preoperative planning. These asymmetries are significantly associated with resected breast tissue volume, clavicle angle differences, and patient age. By considering these factors, surgeons can tailor their approach to each patient's unique anatomical characteristics.

Finally, personalized surgical strategies and thorough preoperative counseling based on these findings can significantly improve surgical outcomes and enhance patient satisfaction, ensuring aesthetic and functional success in breast reduction surgery.

Ethical approval

Not required.

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Conflict of interest

None declared.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.bjps.2024.12.003.

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