Journal of Plastic, Reconstructive & Aesthetic Surgery (2015) 68, 1127—1131

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Correlation between nipple elevation and breast resection weight: How to preoperatively plan breast reduction☆

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Received 21 September 2014; accepted 6 April 2015

KEYWORDS
Breast reduction;
NAC lift;
Preoperative planning;
Breast resection weight;
Insurance coverage;
Health-care system

Summary Breast hypertrophy is often associated with functional limitations. Beyond the aesthetic concerns, breast reduction can improve symptoms and self-esteem. In different countries, health-care system regulations have fixed the threshold for reimbursement in 500 g of predicted tissue resection for each breast. Different preoperative measurements have been proposed to predict breast-tissue weight to be removed, showing a variable correlation with post-operative evaluation. We describe a reliable, simple measurement to predict the quantity of breast reduction in grams, which can be applicable to any surgical technique.

A total of 128 patients undergoing bilateral breast reduction were evaluated. The correlation between the preoperative nipple—areola complex (NAC) lift distance and the weight of removed breast tissue was tested with linear regression and Pearson's test. Other anthropometric measurements were tested as a control. The ratio between resected grams and lift distance was explored to find a multiplication coefficient to be used at preoperative planning.

The mean resection weight was 686.65 g. The mean NAC-lift distance was 7.6 cm. Positive correlation between the NAC-lift distance and the weight of breast tissue removed was found (r: 0.87; $p < 0.001$). The mean weight of the removed breast tissue (g) per centimetre of NAC lift was 81 g/cm in the group between 6 and 12 cm and 70 g/cm in the group with >12 cm of lift distance.

The NAC-lift distance is a single, objective, repeatable measure that can provide a reliable prediction of breast-tissue grams to be removed; it helps in classifying breast-reduction indications.

☆ This paper was presented at the "Third Annual EURAPS Research Council Meeting" in LACCO AMENO, Isle of ISCHIA (Na), Italy, on 29 May 2014.

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http://dx.doi.org/10.1016/j.bjps.2015.04.007

Introduction

The cut-off measurement for the classification of breast reductions, distinguishing between those with aesthetic indications and those with functional indications, has been filed and accepted by institutions responsible for the regulation of the health-care system in many different countries. Insurance companies in the USA, UK National Health Service (NHS) Trusts, as well as the Italian Society of Plastic Reconstructive and Aesthetic Surgery guidelines in Italy have stated their criteria to restrict the coverage for breast-reduction surgery. One of these criteria requires that the amount of tissue to be removed must be at least 500 g from each breast.[1–3] Furthermore, breast reduction can be considered as a functional procedure if there are certified symptoms related to the static weight of the breasts, skin ulceration or severe intertrigo in obese patients, and in cases of symmetrization of the contralateral breast in post-mastectomy reconstruction. As a matter of fact, it may be helpful to codify a pre-surgical planning to guess the amount of tissue to be removed from each breast. Many preoperative measurements have been proposed in the literature as predictors of breast-tissue weight to be removed, but they have often shown a variable and unsatisfactory correlation with post-operative results. Some of the proposed measurements are poorly predictive, not easily repeatable or relative to some specific technique. We realized a retrospective study to establish a practical method to estimate the breast-tissue amount to be removed, and to correctly classify the requested breast reduction as aesthetic or reconstructive (functional), with objective criteria. We evaluated the correlation between the nipple—areola complex (NAC) uplift distance in centimetres and the weight of breast tissue removed in grams. Furthermore, we analyzed the ratio between grams and centimetres in the specimens of resected breast tissue to reliably predict the resection quantity in grams during preoperative planning.

Patients and methods

We analyzed samples from 128 bilateral breast reductions for a total of 256 breast-tissue weight measurements, of patients operated between January 2006 and December 2012. All patients underwent complete physical examination, and clinical history was recorded. Written informed consent was obtained before surgery. The mean patient age was 36 (ranging from 17 to 67 years). Each patient's weight, height and body mass index (BMI) was recorded. BMI was requested to be <30 in order to exclude obese patients. Moreover, patients with a previous history of obesity were also excluded by our series to avoid the potential bias of reduction mastopexy where a high NAC-uplift distance was associated to none or little tissue resection. An inverted T pattern or a vertical scar pattern of skin incisions was used. Different pedicles were used to ensure NAC adequate blood supply (superior, superomedial, superolateral and inferior) choosing the most suitable technique for each patient. All breast reductions were performed by the senior author. Free nipple graft procedures, invariably associated with larger resections and pure mastopexies, with none or minimal glandular excision were excluded. Breast asymmetry was accurately described, if present, and specific concerns regarding differential resections were addressed.[4] However, if the reduction weight on one side was planned to be <500 g, then the patient was not included in the study. The pattern of intended incision lines and the NAC complex pedicle were drawn in the upright position. Sternal notch-to-nipple (SNN) distance was measured, recorded and marked on the sub-clavicular skin. The position of the new nipple was marked with a digital manoeuvre at the projection point of the inframammary crease on the anterior breast skin with the patient in an upstanding position. This point was easily visualized and then marked by pushing the surgeon finger from inframammary crease in an upward direction on the vertical mid-breast line.[5] The NAC-lift distance was calculated as the difference between SNN and sternal notch-to-neo-nipple distance (Figure 1). The weight of the breast tissue removed at surgery was measured intraoperatively using a non-sterile standard digital weighing scale (KD7000 Digital Scale), to avoid sample dehydration. All data were collected after the approval of the local ethical committee, and procedures were conformed to the World Medical Association Declaration of Helsinki. Specimen weight measurements were then correlated to the centimetres of NAC lift, as measured at preoperative planning, with regression analysis. Pearson correlation test and regression analysis were used to investigate whether any correlation between grams of resected tissue and centimetres of NAC uplift was present. The correlation between the weight of removed breast tissue and the patient's SNN, weight, height and BMI was also investigated. The mean values of the removed breast-tissue weight per centimetre of NAC uplift were calculated (g/cm) in order to create a formula to be used to estimate the quantity of tissue to be removed during breast-reduction planning. We divided our patient's data into three subgroups according to the centimetres of NAC uplift: <6 cm, between 6 and 12 cm and >12 cm.

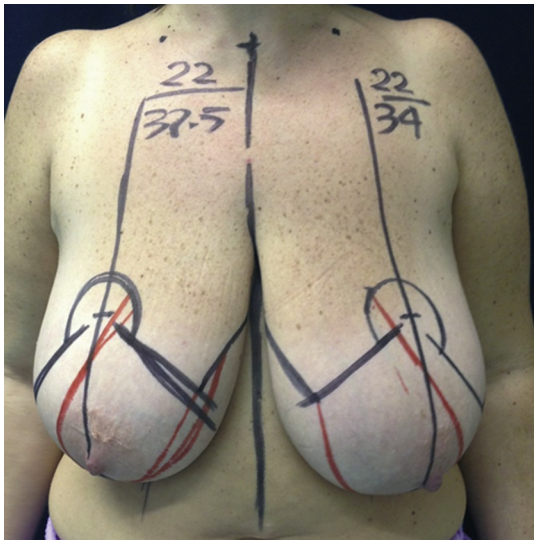
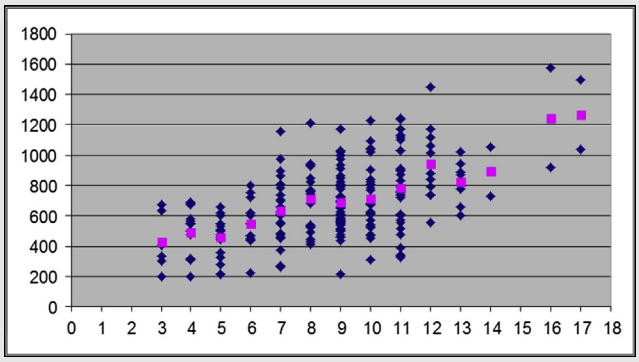


Figure 1 Preoperative markings of breast reduction with the calculation of the NAC uplift distance.

Table 1 Regression line generated by the correlation between NAC-uplift centimetres (on the *X*-axis) and breast tissue removed grams (on the *Y*-axis).



Results

The mean resected breast-tissue weight was 685.65 g (ranging from 300 to 1580 g). The average NAC lift distance was 7.6 cm ranging from 3 to 17 cm. Regression analysis showed a positive correlation between the increment of grams of removed breast tissue and the increment of centimetres of the NAC lift distance (Table 1). Analysis conducted with Pearson's test showed that the correlation was statistically significant with an *R* coefficient of 0.87 ($p < 0.001$). A lower correlation was found between the weight of resected breast tissue and the patient's SNN distance, BMI, weight and height (*R*: 0.81; 0.72; 0.63; and 0.68, respectively). Our observations were divided into three subgroups according to the data found. For the subgroup of patients with <6 cm of NAC uplift, we resected, on average, 448.7 and <500 g in 20 out of 31 cases. For the subgroup of patients with 6—12 cm of lift distance, we resected on average 717.4 g, and in 142 out of 174 cases (80%), >500 g of breast tissue was excised. For the subgroup of patients with >12 cm of NAC uplift, we resected on average 547.6 g, and in all of the cases the threshold value of 500 g of resection was exceeded (Table 2).

For patients with >6 cm of lift distance, using the breast-tissue samples obtained by resection, we calculated the ratio between weight and distance to find a mean value of grams of breast tissue removed per centimetre of NAC lift. The values of the NAC lift distances <6 cm were not included in this analysis because, according to the data found, they gave <500 g resection weight, on average. The mean value of breast tissue removed per centimetre of NAC lift was 81 g/cm for patients between 6 and 12 cm of NAC uplift and 70 g/cm for patients with >12 cm of NAC uplift.

Discussion

Breast reduction is a procedure that can be realized in public hospitals or reimbursed by insurance coverage if it fulfils specific restrictive criteria. In fact, excessive breast weight would contribute to physical impairment, and the removal of this redundant tissue would provide substantial pain relief, reduction in disability and improvement in

Table 2 Observed values.

Lift, cm	Sample's *n*°	Samples <500 g	Samples ≤500 g	Mean resected weight	Mean weight per cm
3	6	5	1	426 g	142 g
4	9	7	2	461.5 g	122 g
5	16	8	8	458.8 g	91 g
6	13	6	7	548 g	91 g
7	24	7	17	636 g	90 g
8	29	4	25	712 g	89 g
9	36	5	31	688 g	76 g
10	28	4	24	716 g	71.5 g
11	29	5	24	781 g	75 g
12	15	1	14	941 g	78 g
13	7	0	7	822 g	63 g
14	2	0	2	893 g	63 g
16	2	0	2	1246 g	77 g
17	2	0	2	1268 g	74 g

function. Preoperative measurements must help the surgeon to decide the appropriateness of breast-reduction surgery. Various methods have been described for preoperative estimation of breast volume ranging from the use of simple devices, such as water displacement[6] and the Grossman—Roudner device,[7] to complex approaches, such as mammograms, ultrasound, magnetic resonance imaging, three-dimensional computed tomography,[8,9] three-dimensional photography[10] or mathematical formulas including breast anthropometric measurements.[11] Furthermore, anthropometric measurements such as SNN distance,[12] nipple-to-inframammary-fold distance,[13,14] weight of breast-ptosis mass[15] and breast surface measurements along horizontal and vertical planes[16] have also been used to estimate resection amounts in breast-reduction surgery. This is the first study that evaluates the correlation of an indirect breast measurement with the resected breast weight. In fact, the NAC uplift distance is the difference between two breast measurements (SNN and sternal notch-to-neo nipple), and it is the only measurement that takes into account the surgical planned excision in numbers. The more NAC is lifted, the more tissue is likely to be excised to permit the breast to achieve an aesthetically pleasing shape and a functional rearrangement. Furthermore, by measuring how much the breast needs to be uplifted, we at the same time estimate how much it is dissimilar from normal ranges of NAC position (21—24 cm).[17,18] This observation can be useful in patients with different-sized body frame. The high coefficient of correlation of the NAC uplift distance with resected breast weight makes it possible to realize a new classification of breast reduction according to uplift categories. For patients with $<$6 cm of lift distance, breast reduction should be considered as an aesthetic procedure thus not authorized by NHS systems, because in 70% of the cases, the carried-out reduction is $<$500 g. For patients with $\geq$6 cm of uplift, breast reduction will be almost certainly a reconstructive or a functional procedure with $>$80% of the cases exceeding 500 g of resection. Breast-density measurements could provide further important data. However, Parmar et al. demonstrated no statistically significant differences in breast-density determination of bilateral breast-reduction specimens between different groups of women, such as premenopausal and postmenopausal.[19] Breast density could be thus assumed to be a uniform parameter between our patient's population. To estimate the grams of breast tissue to remove during surgical planning, a formula determined by the multiplication of the NAC lift distance with the respective mean weight of breast tissue per centimetre can be used. This formula intends to guide the surgeon in the resection, thereby furnishing an indicative value of the resection quantity expected for each breast. The use of different surgical techniques and different pedicles did not demonstrate to adversely affect the prevision; thus, this formula can be easily applied beyond the surgeon's preferences or the patient's indications. Progressive reduction of the mean weights of breast tissue per centimetre (Table 2) can be explained considering the prevalence of fatty tissue and cutaneous component of the ptosis in breasts with a higher SNN distance, compared to less ptotic breasts with a more dense glandular tissue.

Internal validation of the described predictive formula is actually ongoing at our department.

Financial disclosures

None of the authors has a financial interest in any of the products, devices or drugs mentioned in this manuscript.

Conflicts of interest

None.

Funding

None.

Ethical approval

N/A.

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