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ORIGINAL PAPER

Current trends in breast reduction: an international analysis

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Abstract

Background Breastand reductions mastopexies continue to rank among the most frequently performed plastic surgical procedures worldwide. While there exists a consensus on several aspects of the procedure, a plethora of controversies remain. This study aims to compare the most relevant peri- and intra-operative factors on an international level to standardize this common procedure according to evidence-based guidelines.

Methods A questionnaire was sent to over five thousand surgeons in 77 countries. The survey was divided into three categories according to the volume of removed breast tissue (50–500 g, 500–1000 g, and > 1000 g) and inquired about standard practices, secondary procedures, use of new technologies, current controversies, and surgeon demographics. The results were evaluated and correlated with evidence-based literature.

Results A total of 1431 surveys were gathered, corresponding to a response rate of 29%. It was found that specific surgical approaches and standard practices prevail on an international basis. Still, there exist controversies that seem to be linked to geographic locations. For instance, irrespective of resection weight, in the majority of countries, a superior or superomedial pedicle is used most frequently, while in North America and South East Asia, the inferior-based pedicle is preferred.

Conclusions We identified common traits in several aspects of breast reduction surgery. However, in this study, it became apparent that international practice patterns remain incoherent. Seen from a global perspective, plastic surgeons would thus still benefit from high-quality studies to further establish evidence-based, standardized, and universally applicable practice guidelines.
Level of Evidence: Not gradable

Keywords Breast hyperplasia · Breast reduction · Resection weight · Pedicle choice · Scar choice · Use of drains

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Introduction

Breast reductions and mastopexies continue to rank among the most frequently performed plastic surgical procedures worldwide, with a total of 534,294 breast reductions and 710,014 breast lift cases reported in 2018 [1]. Because accurate diagnosis and patient selection are crucial to achieving reproducible results, several attempts were made to develop specific treatment approaches. Most algorithms match estimated resection weights and degree of ptosis to the most appropriate type of breast reduction technique [2–5]. However, despite these efforts and the high relevance of the procedure, no internationally accepted standards exist regarding several aspects.

Preoperatively, the surgeon has to decide on the surgical technique, including various skin incision patterns and

pedicle types. Postoperative care and management of possible complications can also be handled in various ways.

In 2002, Rohrich et al. conducted a US-based study evaluating trends in breast reduction techniques with a particular focus on satisfaction rates and complications. The authors pointed out that the then newer short incision techniques were used by only 15.5% of the respondents. However, wise-pattern reduction techniques remained the standard in the USA and were supported by higher satisfaction rates, greater versatility, and fewer complications [6].

Currently, it appears that there remains a considerable variation regarding multiple aspects of breast reduction surgery. While several most common surgical approaches may exist, it remains unclear to what extent new techniques and technologies become integrated into daily practice. This study aims to compare the most relevant intra- and perioperative factors related to breast reduction surgery on an international level to further standardize this common procedure according to evidence-based guidelines.

Methods

An online survey was designed and sent to over five thousand active plastic surgeons in 77 countries using a professional e-mail marketing service (Mailchimp, Atlanta, GA, USA). Using contacts provided by national and international specialty societies, surgeons were invited to complete a linked questionnaire. In addition, societies without open access were contacted to obtain their members' e-mail addresses (Table 1). The International Society of Aesthetic Plastic Surgery (ISAPS) and the Argentinian (SACPER) and

Table 1 Countries of collected data according to geographic region and international plastic surgery societies contacted

Region	Countries	Contacted societies
International		International Society of Plastic Surgery
North America	USA, Canada	American Society of Plastic Surgeons
Latin America and the Caribbean	Argentina, Brazil, Mexico, Chile, Venezuela, Mexico, and Peru	Brazilian Society of Plastic Surgery ("Sociedade Brasileira de Cirurgia Plastica"), Colombian Society of Aesthetic and Reconstructive Plastic Surgery ("Sociedad Colombiana de Cirugia Plastica Estetica y Reconstructiva")
Western Europe	Austria, Belgium, Luxembourg, France, Germany, Italy, Norway, Portugal, Spain, Sweden, Lithuania, Switzerland, the Netherlands, Ireland, and the UK	Austrian Society of Aesthetic and Reconstructive Plastic Surgery ("Österreichische Gesellschaft für Plastische, Ästhetische und Rekonstruktive Chirurgie"), French Society of Aesthetic and Reconstructive Plastic Surgery ("La Société française de Chirurgie Plastique Reconstructrice et Esthétique"), German Association of Plastic Surgeons ("Vereinigung der Deutschen Ästhetisch-Plastischen Chirurgen"), Italian Society of Plastic Reconstructive and Aesthetic Surgery ("Società Italiana di Chirurgia Plastica Ricostruttiva ed Estetica"), Spanish Society of Plastic Reconstructive and Aesthetic Surgery ("Sociedad Española de Cirugia Plastica Reparadora y Estètica"), Swiss Society of Plastic Reconstructive and Aesthetic Surgery ("Schweizerische Gesellschaft für Plastische, Rekonstruktive und Ästhetische Chirurgie"), British Association of Plastic Reconstructive and Aesthetic Surgeons
Eastern Europe	Czech Republic, Serbia	Contacted individually
Oceania	Australia	Contacted individually
Eastern Asia	China, Japan, Philippines, and Republic of Korea	Japanese Society of Plastic and Reconstructive Surgery, Korean Society for Aesthetic Plastic Surgery
Southern Asia	India	Indian Association of Aesthetic Plastic Surgeons
South-Eastern Asia	Thailand, Myanmar, Laos, Singapore, Indonesia, and Malaysia	Society of Aesthetic Plastic Surgeons of Thailand
Western Asia	Israel, Jordan, Lebanon, Turkey, and United Arab Emirates	Oriental Society of Aesthetic Plastic Surgery, Turkish Society of Plastic-Reconstructive and Aesthetic Surgeons
North Africa	Algeria	Contacted individually
Eastern Africa	Egypt	Contacted individually
Southern Africa	Republic of South Africa	Contacted individually

the German Societies of Plastic, Reconstructive, and Aesthetic Surgery (DGPRAEC, VDAEPC) forwarded the survey directly to their members.

The survey was designed corresponding to the original version published by Rohrich et al. in 2002 to generate comparable data. The following areas of interest were addressed: demographics, common practices, and technical considerations. The survey was divided into three categories according to the volume of removed breast tissue: 50–500 g, 500–1000 g, and > 1000 g. Skin-only mastopexy techniques were also evaluated but analyzed separately as they represent a distinct surgical entity.

The survey was launched on February 1, 2018, and reminders were sent out 4 and 8 weeks later, respectively. Data collection was closed on June 30, 2018. Results were tabulated using Microsoft Excel (Microsoft Corp., Redmond, WA, USA), and statistical analysis was performed using an SPSS Advanced Statistical software package (version 13; SPSS Inc., Chicago, IL). All individual responses and questions with commentary options were gathered anonymously and assessed individually. The gathered data sets were then compared regarding common practice patterns and regional differences.

Results

A total of 1431 surveys were fully completed and returned, corresponding to a response rate of 29%. To enhance statistical power, single countries were grouped by major geographic regions into North America ($n = 221$), Latin America ($n = 430$), Europe ($n = 502$), Africa ($n = 39$), the Middle East ($n = 97$), Central Asia ($n = 74$), South East Asia ($n = 32$), and Oceania ($n = 36$) [7].

The majority of respondents indicated that they were working solely in private practice (overall 43%; North America 59%, Latin America 44%, Europe 31%, Africa 64%, Middle East 49%, Central Asia 45%, South East Asia 44%, and Oceania 50%). Small plastic surgery groups of two to five surgeons constituted the second largest group (25%). Only in Oceania did 38% specify to be working solely in shared facilities. Surgeon experience was distributed evenly among the six intervals of practice time surveyed, although over one-third of respondents reported a work experience of more than 20 years.

Forty-nine percent of respondents across all geographic regions perform mainly aesthetic (75%) rather than reconstructive surgeries (25%). The second most common were surgeons working in aesthetic-only practices.

The majority (64%) of the participating surgeons reported to perform less than 50 breast reductions per year (North America 53%, Latin America 68%, Europe 66%, Africa 80%, Middle East 56%, Central Asia 73%, South East Asia 84%, and Oceania 44%). About a third of respondents indicated to perform between 51 and 150 reduction mammaplasties annually. Only very few surgeons reported working in high-volume centers of over 250 breast reductions per year.

Irrespective of the tissue resection weight and practice location, the inverted T incision was the most common approach for breast reductions (resection weight 50–500 g, 51%; 500–1000 g, 79%; more than 1000 g, 79%). The limited inverted T incision was reported second most frequently (resection weight 50–500 g, 34%; 500–1000 g, 13%; more than 1000 g, 11%). This ranking held for most regions. The only difference was observed in the group of resection weights of 50 to 500 g. In the Middle East (40%) and Central Asia (43%), the limited inverted T incision is preferred over the classic inverted T approach (Fig. 1a, b, c).

For all three weight groups, the majority of respondents reported to primarily utilize a superomedial or superior-based pedicle (resection weight 50 to 500 g, 74%; 500–1000 g, 63%; > 1000 g, 55%) and second most commonly the inferior pedicle (resection weight 50 to 500 g, 19%; 500–1000 g, 28%; > 1000 g, 32%). This distribution was observed in all geographic regions, except in North America and South East Asia, where it was vice versa, and the inferior pedicle is used the most (resection weight 50 to 500 g, 50 and 47%; 500–1000 g, 60 and 39%; > 1000 g, 58 and 50%, respectively) (Fig. 2a, b, c).

The majority of surgeons always use drains (resection weight 50 to 500 g, 43%; 500–1000 g, 53%; > 1000 g, 57%), except in North America, where most respondents (50%) never use them for resection weights from 50 to 500 g. For larger resection weights of 500 to 1000 g, it is evenly distributed, with 44% of surgeons always and 44% never using drains (Fig. 3a, b, c).

Complications seem to occur similarly frequently among all groups, with less than 5% overall complication rates. However, depending on the resection weight, this number shifts to higher rates of up to 34% (resection weight 50–500 g, 22%; 500–1000 g, 34%; > 1000 g, 34%). The most common type of complication is suture spitting (40%). The second most common, reported by 21% of respondents, are wound complications or T-point breakdown.

Most surgeons currently do not use three-dimensional imaging in their practice (83%). However, in North America, Africa, Central Asia, and Oceania, 9 to 11% always use it.

Over 50% of all surgeons always infiltrate vasoactive solution preoperatively, except in Europe and Africa, where 42 and 46% of surgeons always use it, and 44% never do.

Regarding the application of postoperative dressings, the answers were distributed reasonably even among all groups, and the majority of respondents reported using Steri-Strips® or similar products (63%). The second and third most

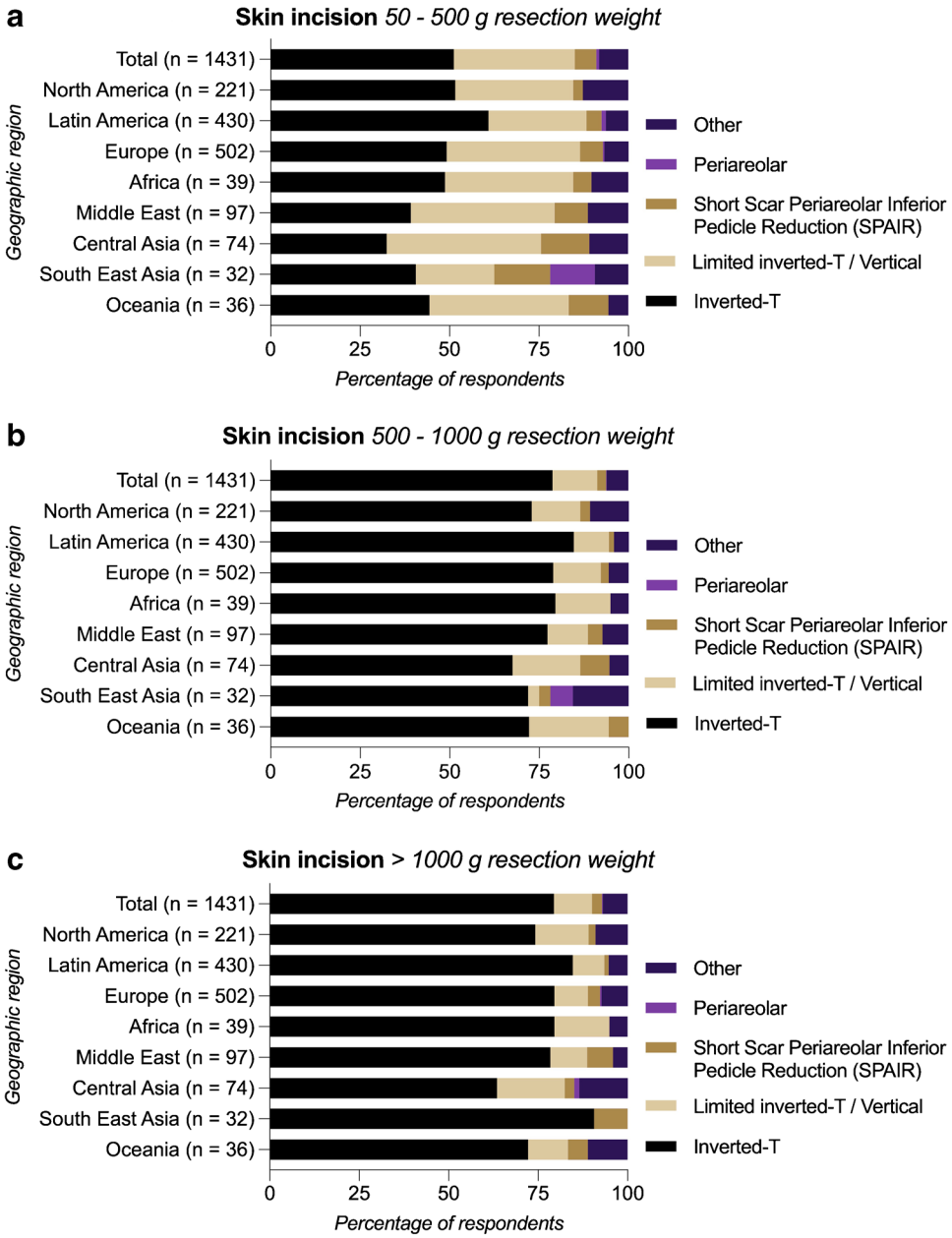

Fig. 1 **a** Responses regarding type of skin incision in breast reductions with a resection weight 50–500 g. **b** Responses regarding type of skin incision in breast reductions with a resection weight 500–1000 g. **c** Responses regarding type of skin incision in breast reductions with a resection weight > 1000 g

common is the use of adhesives like Dermabond® (12%) and the use of antibiotic ointments like Bacitracin® (9%). Only in North America are Steri-Strips® less often (26%) and Dermabond® more often used (24%).

Overall, 73% of surgeons always send resected tissue to histopathological analysis. In North America, 83% and, in Oceania, 100% send it, whereas the lowest rates were reported in Central and South East Asia (57 and 53%).

Regarding the return to unrestricted activities, 29% of respondents reported a period of 2 to 3 weeks, 27% 4 weeks, and 20% 6 weeks.

The majority of respondents (47%) reported performing secondary breast reductions in less than 5% of their cases. The distribution was comparable in all regions, except in Latin America (20%) and in Africa, where respondents reported performing this procedure between 10 and 20%.

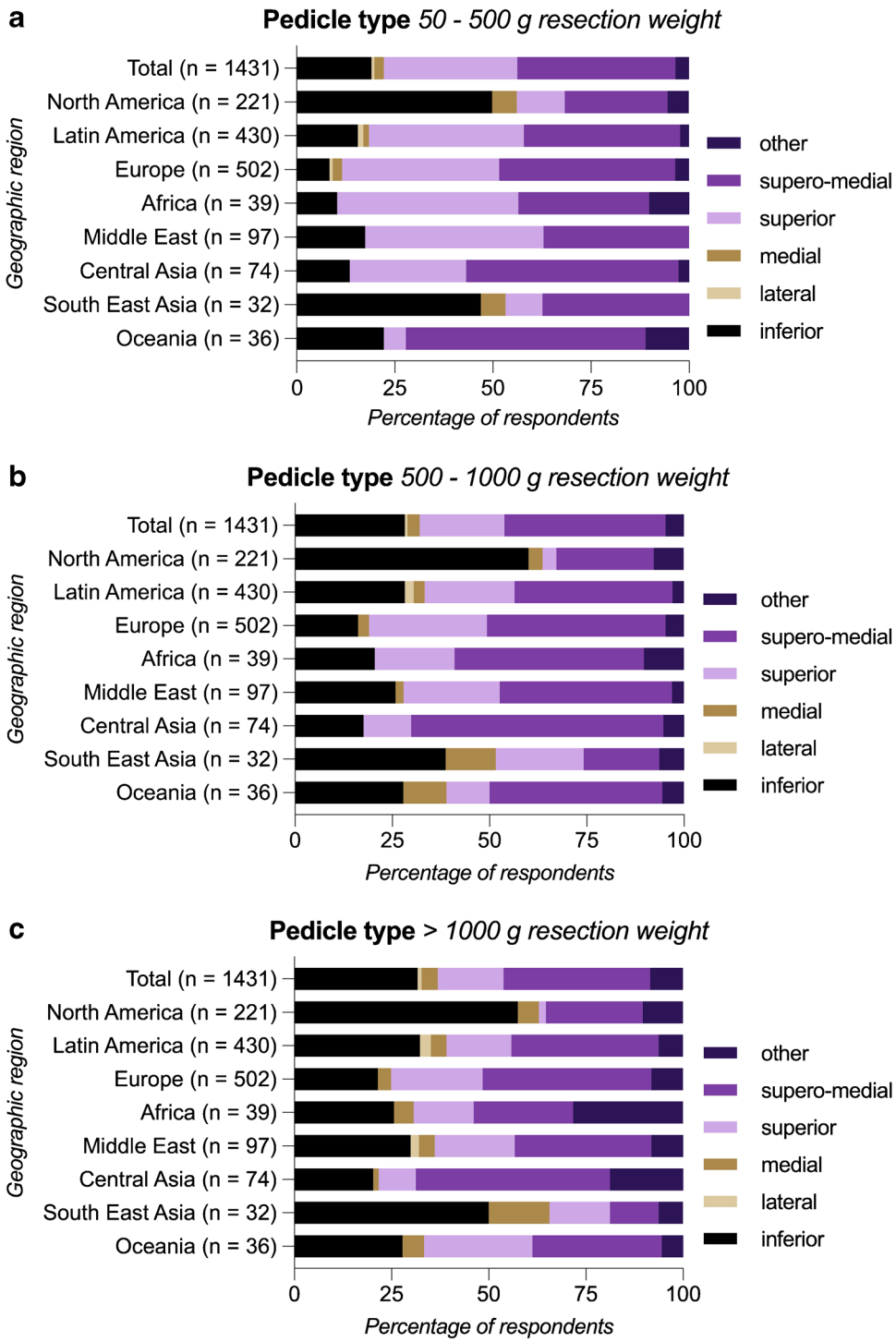

Fig. 2 **a** Responses regarding pedicle type in breast reductions with a resection weight 50–500 g. **b** Responses regarding pedicle type in breast reductions with a resection weight 5,001,000 g. **c** Responses regarding pedicle type in breast reductions with a resection weight > 1000 g

Discussion

In this study, we observed significant international discordance regarding several aspects of breast reductions, although breast reductions are frequently performed procedures around the globe. This may be due to various reasons, encompassing the surgeons' preferences based on their training, including university education and residency programs, local traditions and cultural differences, their experience, and general hesitance to embrace new technologies or potential lack of knowledge regarding established standards. The assumption that practice patterns are influenced by geographic location was one of the working hypotheses, given that trends arguably emerge in the USA. Therefore, one of the aims was to identify current practice preferences in the USA, which

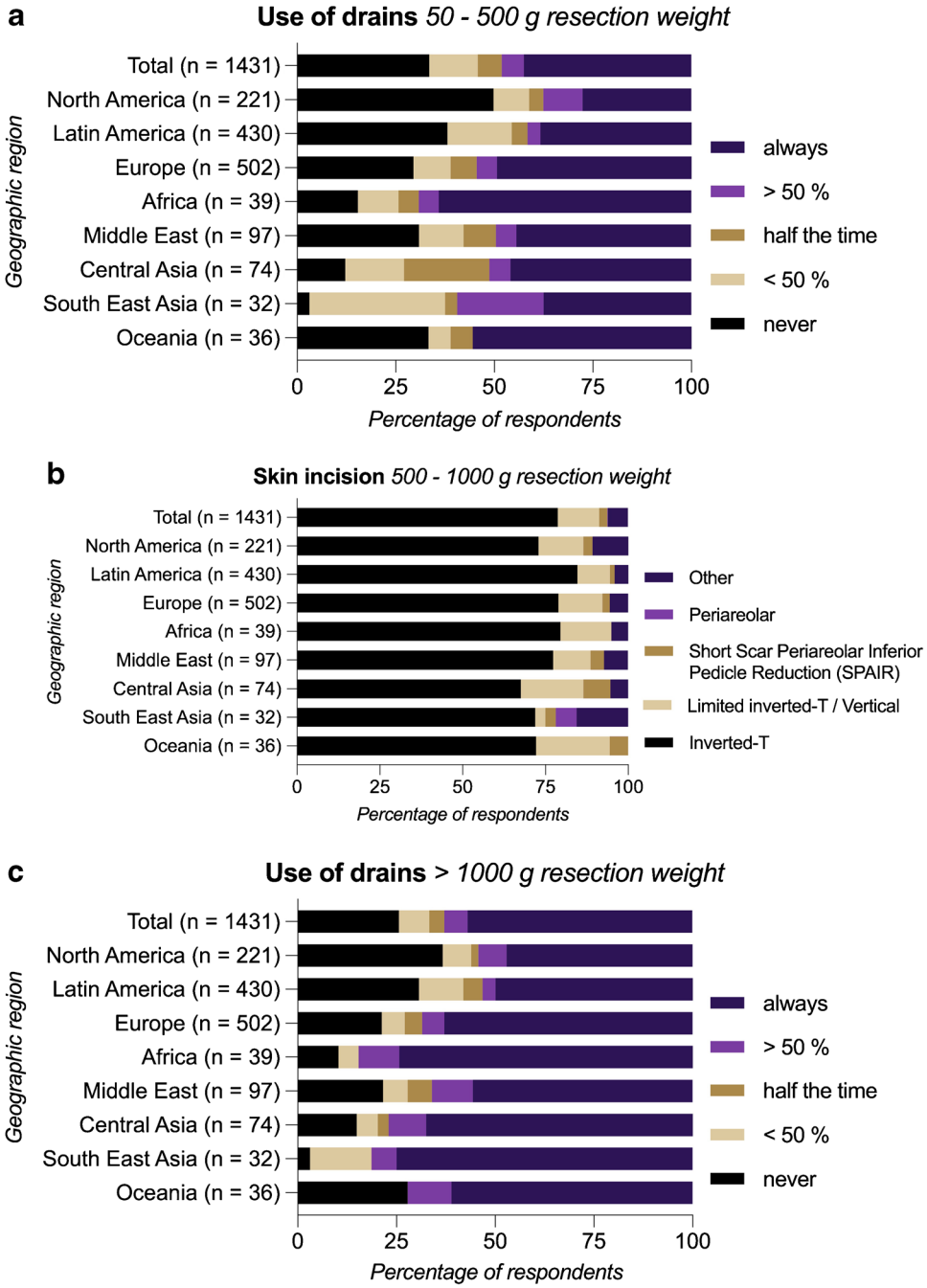

Fig. 3 **a** Responses regarding the use of drains in breast reductions with a resection weight 50–500 g. **b** Responses regarding the use of drains in breast reductions with a resection weight 500–1000 g. **c** Responses regarding the use of drains in breast reductions with a resection weight > 1000 g

could potentially become the global gold standard, once established elsewhere.

Internationally, a consensus seems to exist regarding the type of skin incision. The inverted T approach was reported by 51 to 79% of all respondents, with increasing use directly correlated to the increasing amount of resected breast tissue. However, several geographical differences were observed regarding the associated choice of pedicle type. Irrespective of resection weight, a superior or superomedial pedicle made the first rank in most geographic regions, except in North America and South East Asia, where an inferior-based pedicle vascularization seems to be preferred. The high frequency of the inferior pedicle in North America aligns with a study by Greco and Noone. They reviewed a series of 2010 reduction mammaplasties per the Reduction Mammaplasty Practice Assessment module, which the American Board of Plastic Surgery developed for the practicing surgeon to report activities to meet the obligations of the Maintenance of Certification program. The authors reported the use of the inferior pedicle in 59% of cases [8]. The Wise pattern with an inferior pedicle technique has been the mainstay

treatment in the USA for many years [6, 9, 10] and seems to remain the first choice even in secondary cases.

Notwithstanding multiple extensive studies [11–14] that have shown that postoperative use of drains has led to no difference in hematoma rates and wound healing complications, drain usage, which is still very common internationally (depending on the resection weight, 43 to 57% of surgeons always use drains), provides more significant patient discomfort, more economical costs, and longer hospital stays. Only in North America, half of the surgeons (50%) never use drains for resection weights from 50 to 500 g. Greco and Noone also reported a slight decrease from 56 to 53% of drain use in breast reductions between 2012 and 2014 [8]. Given the evidence from those studies should lead to a further reduction of drain use, but it seems that most surgeons hesitate to do so.

The use of a vasoactive solution injected along the incision lines has been found to reduce the amount of blood loss and the need for blood transfusions [15]. Overall, the majority of surgeons seem to be aware of these facts, and 54% reported always infiltrating vasoactive solution preoperatively, and only 32% rarely do. In Europe and Africa, it is more evenly distributed: 42 and 46% of surgeons always use it, and 44% never do. Surgeons often report the fear of delayed bleeding when the vasoactive agent dissipates, but the review by Kerrigan and Slezak of their series of 6271 patients refutes this concern [9].

Regarding the type of postoperative dressing, the majority of respondents of all regions reported the use of Steri-Strips® (63%). However, only in North America is the use of 2-octyl-cyanoacrylate skin adhesive (Dermabond®) more common. This may be due to the difference in the availability of the product. Otherwise, one could probably advocate its use given the encouraging results from multiple recent studies [16, 17].

Overall, the majority of surgeons (73%) reported sending their resected breast tissue to histopathological analysis, while Asian respondents did so the least. Even though the incidence of breast cancer is lower in Asia, its incidence is growing [18], and the histopathological analysis of resected breast tissue should be performed as incidental pathologic findings can be present in up to 10% in other cohorts of patients [19, 20]. Of note, the risk of finding abnormalities is significantly higher in patients over age 40 [21]. We find this essential information because, in turn, about one-third of plastic surgeons do not send their breast reduction specimens for analysis while they probably should. According to the current literature, histopathologic examination of the removed specimen after breast reduction mammaplasties is highly recommended in all patients independently of their predicted risk factors [22].

With respect to newer technologies, only a small percentage of surgeons (4%) reported using of three-dimensional imaging, except for Oceania, where about twice as many respondents (11%) use it. This trend is in accordance with a similar study investigating international breast augmentation analyses, which revealed that Oceanian surgeons were the number one users of three-dimensional imaging technology [23]. While some users describe the technique as a valuable educational or marketing tool, and while the achievable accuracy has been proven by several studies [24, 25] worldwide, the majority of surgeons currently seem to use it only for breast augmentations, if at all.

Albeit the fact that several striking findings could be elucidated from the presented study, the analysis comes with limitations. One lies with the study design, it being an electronically disseminated questionnaire. While response rates are generally considered the most widely compared statistic for judging the quality of surveys, they are also one of the most controversial [26]. This becomes even more relevant, considering that they have been declining, both in the USA and in most of the industrialized world, for at least several decades [27]. Several authors have consequently questioned their validity as a research method [28].

Nonetheless, according to the current literature, surveys remain a valuable tool to assess current trends and practice preferences in plastic surgery. In this setting, response rates seem to settle between 10 and 20%. Therefore, this study's achieved response rate of 29% appears reasonably representative [29–32]. Also, this rate probably needs to be adjusted given the high bounce rates of the recipients' e-mail servers of up to 30% when using a professional e-mail service. Considering the mean bounce rate, an achieved response rate of approximately 40% appears more accurate.

A further limitation of the study lies is that the survey was very detailed and somewhat lengthy to take, which might have imposed some bias as, in the end, potentially only surgeons with a particular interest in the matter completed the questionnaire. Also, the reported incidence of complications needs to be viewed critically. Although the questionnaire design was strictly anonymous, there is a chance of underreporting, which is another limitation of the study.

As with most plastic surgical procedures, surgeons will undoubtedly need to customize their technique concerning the individual patient, and therefore the presented standard practices have to be seen in the context of this limitation. However, assuming that patients are equally often different in all geographic regions, thus equally often require deviations from the standard approach, most preferred treatments still maintain their validity.

Many different approaches towards breast reduction surgery exist, as illustrated also influenced by geographic and cultural factors. Nonetheless, while decision-making is multi-factorial, it is apparently not always made according to the evidence base, as the latter should be universally accepted.

Conclusions

We were able to identify consensus regarding several aspects of breast reduction surgery. However, international practice patterns remain very incoherent. Specific techniques can be advocated, independent of practice location based on already existing, internationally applicable high-quality studies, which have promulgated evidence-based and standardized practice guidelines. Apparently, a more efficient dispersion of this knowledge would benefit the international plastic surgery community and their patients.

Declarations

Ethical approval This was a survey-based study; the local ethics committe confirmed that ethical approval was not required.

Consent to participate Participants gave by default their consents as they complied with the survey.

Informed consent This was a global observational study among plastic surgeons. Information on individual patients was not obtained.

Conflict of interest Broer PN, Forte AJ, Topka C, Richter DF, Colombo M, Aung T, Prantl L, Ninkovic M, Rohrich R, and Heidekrueger PI declare no competing interests.

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