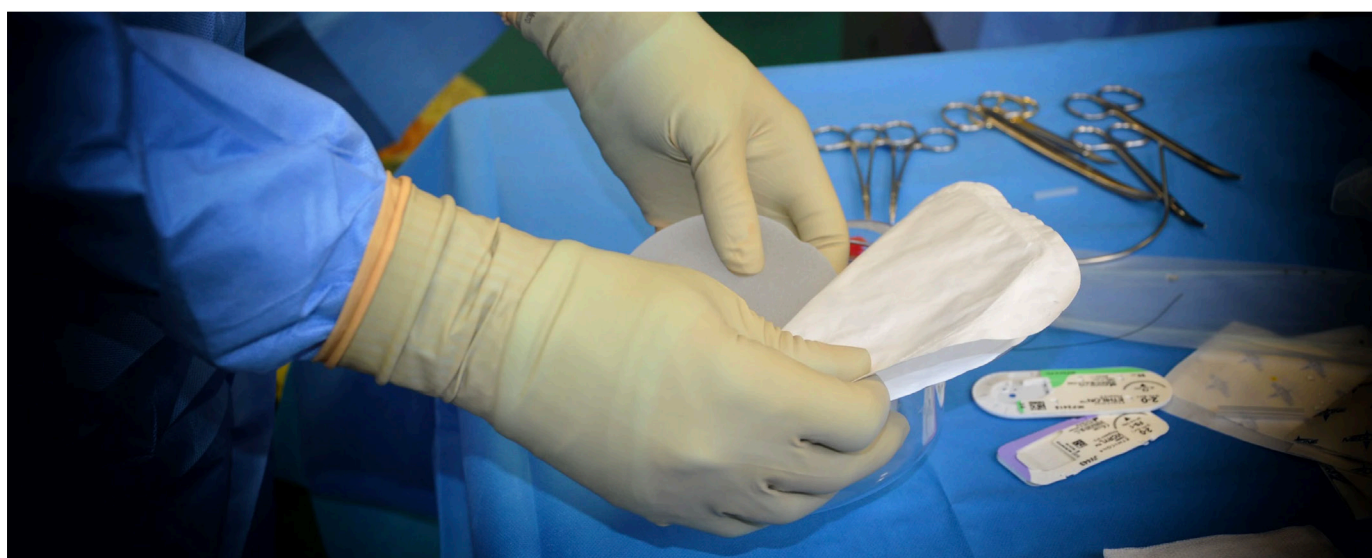


Silicone breast implants versus deep inferior epigastric perforator flap: a comparative analysis of two approaches to breast reconstruction following mastectomy

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Abstract

Approximately 150 new cases of breast cancer are diagnosed daily in the UK and 81% of breast cancer patients undergo surgery as part of the management of their primary tumour. Consequently, breast reconstruction surgery is becoming increasingly prevalent and is a branch of plastic surgery that is constantly developing. Silicone breast implants and the deep inferior epigastric perforator (DIEP) flap are two forms of breast reconstruction used by the NHS to help recreate the physical appearance of breast tissue. Silicone breast implants provide patients with a more immediate result and related positive mental health outcomes, but are associated with complications and increased health risks in the longer term. These health risks include capsular contracture and breast-implant-associated anaplastic large cell lymphoma (BIA-ALCL), which often require subsequent surgical management. Conversely, the DIEP flap is associated with longer hospital stays and increased post-operative pain in the short-term, but better long-term prospects in terms of reduced incidence of complications and adverse health reactions. As the DIEP flap is an autologous breast reconstruction surgery, using the patients' own tissue, there are no risks of rejection or cancer as seen with silicone breast implants. Whilst DIEP flap reconstruction is initially more expensive than silicone implant reconstruction, the shorter hospital length of stay and reduced incidence of complications requiring surgical revisions diminishes the cost difference. Further research is recommended to analyse the total long-term costs of both approaches to better understand which offers the best outcome for patients and the best value for the NHS.

Abbreviations

ALCL - Anaplastic large cell lymphoma
 BIA-ALCL - Breast-implant-associated anaplastic large cell lymphoma
 CT - Computerised tomography
 DIEP - Deep inferior epigastric perforator
 FDA - Food and Drug Administration
 MDR - Medical device report
 PFD - Pirfenidone
 WHO - World Health Organization

Introduction

Following a mastectomy, many women are left feeling unsatisfied with the image of their breasts and breast reconstruction serves as a way for them to restore the physical appearance of their breasts.¹ However, there are different approaches to breast reconstruction, and each varies in procedure and outcome. Breast implants, invented by Cronin in 1961,² account for 80% of implant procedures and are a popular choice for breast reconstruction.³ The implant material referred to in this review is silicone as this is the most common form of breast implant in the UK.⁴ An alternative to breast implants is the deep inferior epigastric perforator (DIEP) flap, which removes the skin of the abdominal area, along with the deep inferior epigastric artery and vein, while leaving the rectus abdominis muscle and fascia intact, to reconstruct the breast (**Figure 1**).⁵ This literature review compares silicone breast implants with DIEP flap surgery in the reconstruction

of the breast to evaluate which is more advantageous for patients seeking breast reconstruction following mastectomy.

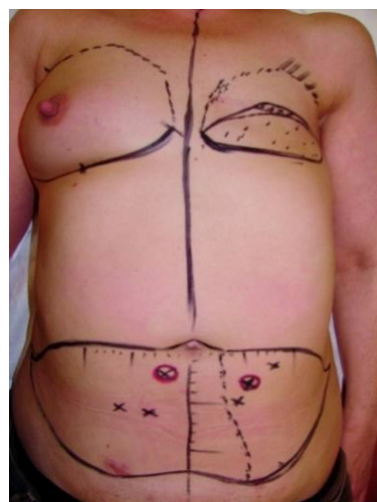


Figure 1. An image illustrating the DIEP flap for breast augmentation of both left and right breast. Perforator arteries of the deep inferior epigastric are indicated by the crosses. Image from Hamdi and Rebecca (2006),⁵ copyright holder: www.thieme.com (reprinted by permission).

Methodology

For this report, an initial search of 'breast reconstruction' AND 'silicone breast implants' OR 'DIEP flap' was carried out in medical databases. Inclusion criteria were research articles that reviewed the short- or long-term outcomes of breast augmentation with large population cohorts or specific clinical cases (see **Figure 2**)

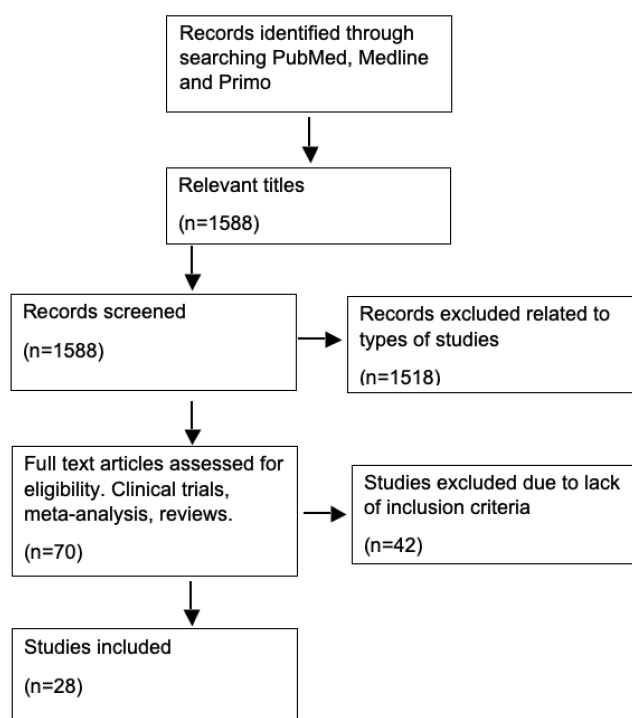


Figure 2. Flow chart of the search process.

Psychological wellbeing of patients

A study released in 2017 explored the short-term psychological impacts of silicone breast implants and DIEP flap surgery for breast reconstruction and found that both treatments had an impact on a patient's mental health.⁶ It stated that patients who received implants showed decreased anxiety following surgery, most likely due to the immediate results that breast implants deliver, whereas DIEP flap surgery was associated with an increase in depressive symptoms following surgery.⁶ It could be inferred that this is due to the higher levels of pain experienced by patients receiving autologous reconstruction and the scarring on the abdomen. The study explored the short-term psychological impacts of breast reconstruction with pre- and postoperative psychological questionnaires. The use of

questionnaires increases reproducibility and reliability of these data as they allow a variety of responses from patients. They are, however, limited by response bias, where respondents may not answer questions truthfully. Limitations of using questionnaires can be overcome by ensuring anonymity (and ensuring participants are aware of this) and asking participants to complete the questionnaire within a short time-period post-operatively.⁶

In contrast, studies into the ongoing psychological well-being of patients have found that, in the long-term, patients are more satisfied with the outcomes of the DIEP flap than silicone breast implants.^{5,7-9}

This is supported by a study that reviewed patient satisfaction a year after either DIEP flap surgery or silicone implants for breast reconstruction following mastectomy. It was found that patients who had autologous reconstruction were more satisfied with their breasts a year after the surgery, having greater psychological and sexual well-being, as compared with women with breast implants.⁸ It could, therefore, be argued that the long-term benefits of the DIEP flap outweigh the pain and poor mental health issues found in the short term. DIEP flaps are a newer form of breast reconstruction compared with breast implants,⁵ so there are fewer studies that investigate the long-term psychological impacts of DIEP flap surgery. Further research into the psychological impacts of DIEP flap surgery is needed to accurately assess the ongoing psychological effects and influences of the two approaches.

Cost-effectiveness

Currently, in the NHS, silicone breast implants cost around £3,500-£7,000 per patient,¹⁰ marginally less than the £10,000 cost of the DIEP flap.¹¹ However, evidence suggests that, in the long term, DIEP flap reconstruction is more cost-effective.^{9,12} Patients receiving breast implants have high rates of complications and surgical revisions compared with autologous reconstruction. The US Food and Drug Administration (FDA) stated that, after three years, 73% of women with breast implants experience a common complication, such as capsular contracture or a rupture requiring additional surgery.

Along with complications, breast implants are not a permanent form of reconstruction and need to be replaced approximately every ten years.^{10,13} Due to the additional surgical revisions associated with breast implants,¹³ along with the higher rates of long-term patient satisfaction following DIEP flap surgery, it has been argued that DIEP flap surgery is more cost-effective.¹²

Breast-implant-associated anaplastic large cell lymphoma

Evidence indicates that there is an associated risk between silicone breast implants and a form of cancer called breast-implant-associated anaplastic large cell lymphoma (BIA-ALCL).^{10,14} BIA-ALCL was officially recognised as a subclass of anaplastic large cell lymphoma (ALCL) by the World Health Organization (WHO) in 2016.¹⁴ BIA-ALCL is thought to occur when the body adversely reacts to the silicone in the breast implants,¹⁵ leading to damage of the T cells in the immune system and surrounding breast tissue.^{14,15} BIA-ALCL is symptomatic with swelling and pain in the breasts due to an implant-associated seroma that occurs more than one year after surgery.¹⁴ This condition is commonly detected through the presentation of the above symptoms, combined with raised CD30, a tumour marker antigen.¹⁶ If a patient is diagnosed with BIA-ALCL, the implant and surrounding breast tissue is removed.¹⁶

Case reports describe BIA-ALCL as a delayed seroma that develops typically in patients with a median age of 55 years and an interval

of implantation of 7 to 10 years (**Figure 3**).¹⁷ One case describes the development of a palpable mass over four weeks in the left breast of a 68-year-old woman, on a background of mastectomy and breast reconstruction with textured implants 7 years previously. Ultrasound revealed a 300ml seroma, which required bilateral surgical resection of the implants.¹⁷ This case is a typical presentation of a BIA-ALCL and highlights that textured implants are a risk factor for developing BIA-ALCL.

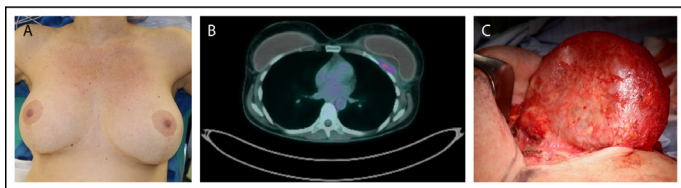


Figure 3. BIA-ALCL following breast reconstruction using silicone breast implants. (a) An image taken 7 years after cosmetic breast augmentation with bilateral textured breast implants. (b) Perioperative computerised tomography (CT) scan showing posterior capsule wall mass invading the chest wall (shown in pink). (c) Image showing a total capsulectomy with excision of skin involvement to ensure that any residual disease is removed and to reduce risk of disease progression. Republished with permission of Elsevier Science & Technology Journals, from Mehta-Shah et al;¹⁷ permission conveyed through Copyright Clearance Center, Inc.

The rates of BIA-ALCL are shown to be increasing internationally. A report by De Jong et al (2008) stated the rate was 0.1-0.3 per 10,000 patients in the Netherlands,¹⁶ and the US FDA in 2017 reported an incidence of 0.6-1.2 per 100,000 in the USA.¹⁸ As of 30th September 2018, the US FDA received 457 individual medical device reports (MDRs) of BIA-ALCL.¹⁴ This data recognises a significant increase in the incidence of BIA-ALCL, which correlates to the increased number of silicone breast implant reconstructions performed. While MDRs provide a valuable source of information, it should be recognised that they do not give details about the patient's past medical history and are completed by doctors. Thus, this allows the generation of bias and false priors, whereby the doctors are more focussed on the detection of a specific condition.

Incident rates of BIA-ALCL may be difficult to calculate as the condition is rare and there is a lack of reporting and possible duplicate reporting; however, several countries, including France and the US, are taking BIA-ALCL very seriously. The French National Cancer Institute is considering a general ban on breast implants, and in 2015 the French Ministry of Health ordered all breast implants to come with a cancer warning.¹⁴ However, it could be argued that, in doing this, the French Ministry is removing patient autonomy.

Capsular contracture with breast implants

A significant proportion of patients who have silicone breast implants need to have further surgery due to complications, such as capsular contracture. Capsular contracture is defined as a pathological process involving the contraction of the encapsulated scar tissue associated with the implant.¹⁹ The condition can cause patients to have chest pain, as well as firmness and distortion of the breast.¹⁹ Capsular contracture occurs due to a fibrotic reaction between the surrounding breast tissue and the silicone contained within the implant, although it should be noted that the exact mechanism is unclear.²⁰

Capsular contracture is stated by the FDA to occur in 12.7% of primary reconstructions, with global rates of up to 45%.^{21,22} A 10-year study into women receiving silicone breast implants in the US found that 24.6% of patients who received implant reconstruction developed capsular contraction.²³ Patients are commonly treated by the removal of the breast implant and affected scar tissue.¹⁴ Not only does this incur further pain and discomfort for the patient, but it also increases NHS costs and lengthens time spent in hospital.

Further research has been carried out exploring the medical management of capsular contracture with pirfenidone (PFD).¹⁷ As an anti-inflammatory and antifibrotic agent, PFD acts to reduce inflammation, contracture and capsule thickness when used for eight weeks. The Baker classification is a system commonly used to grade capsular contracture.¹⁷ A 2016 literature review demonstrated that, in cases of capsular contracture with Baker Grade III, anti-inflammatory medications can be used and in three months patients are re-classified as Baker Grade I.²⁴ As surgical management is typically reserved for cases of capsular contracture with Baker Grade III or VI, PFD could be an intervention that reduces the necessity for surgical management in some severe cases of capsular contracture.¹⁷

Length of stay of patients in hospital

For patients receiving silicone breast implants, the surgery time is 60-90 minutes, with many patients being able to go home the same day.⁴ As well as this, breast implantation is a relatively simple procedure and can be carried out by a number of surgeons.⁵ In comparison, the DIEP flap is a form of microsurgery and, thus, can only be carried out by surgeons with training in microsurgery.²⁵ DIEP flap surgery can take 6-8 hours, and patients are required to stay in the hospital for 5-8 days.⁵ The specialist skills required for DIEP flap surgery means it is less available to patients compared with breast implants.

While the DIEP flap surgery and associated hospital length of stay are longer, the breast reconstruction is permanent and does not need to be repeated, provided there are no complications. In contrast, breast implants last around ten years before they are required to be replaced,¹³ and there may be complications before this that lead to the removal of the implant pre-term.¹³

A report summarises this, stating that the mean number of surgical revisions for breast implants is 1.5 days compared with 0.8 days for DIEP flap.¹¹ Considering this, it could be surmised that, whilst the length of stay in the hospital is longer with the DIEP flap surgery in the short term, the overall length of hospital stay is not significantly different between the two procedures. However, it is important to recognise that complications can arise from DIEP flap reconstruction that lead to an extended length of hospital stay. A study reviewed 737 breast cancer patients who had autologous breast reconstruction, either immediately following mastectomy or after a period of time.²⁶ It showed that with immediate reconstruction, there is a greater risk of developing haematomas and seromas, whereas with delayed reconstruction, there is a greater association with wound problems.²⁶ Furthermore, bilateral DIEP flap breast reconstruction is a more risky procedure than unilateral reconstruction, with twice as many postoperative complications, primarily due to venous congestion, requiring reoperation.²⁷

Conclusion

Reconstruction of the breasts is a major part of many women's pathway to recovery following mastectomy. Silicone breast implants offer women immediate satisfaction with their breasts in a quicker surgical procedure, at a smaller cost to the NHS.¹⁰⁻¹² However, complications can arise from breast implants, including BIA-ALCL and capsular contracture. Both conditions are treated by the removal of the implant and the surrounding tissue, leading to further physical pain and mental distress to the patient.^{14,20}

In comparison, DIEP flap surgery is a much longer surgery and a more

expensive form of breast reconstruction.^{5,11} Patients are required to remain in the hospital for 5-8 days and many experience depressive symptoms in the short term.⁵ This considered, the DIEP flap has been shown to provide greater overall patient satisfaction in the long term.⁷ It is a procedure with fewer associated complications and a history of requiring fewer surgical revisions.⁷ Arguably, these factors outweigh the short-term disadvantages (see **Table 1**).

Table 1. Comparison of DIEP flap surgery with silicone breast implants for patients seeking breast reconstruction following mastectomy.

	DIEP flap	Breast implants
Impact on patients' mental health	Can be detrimental to mental health in the short term. ⁷ Have high levels of satisfaction in the long term. ⁸	Good mental health outcomes in short term. ⁷ Have slightly lower levels of satisfaction in the long term. ⁸
Risk of developing cancer	DIEP flap surgery does not involve the use of silicone thus avoids risk of BIA-ALCL.	Small risk of developing BIA-ALCL from silicone breast implants. ^{14,18}
Lifespan of reconstruction	DIEP flap breast reconstruction is a life-long solution. ^{4,13}	Silicone breast implants need to be replaced every ten years. ^{4,13} Increased incidence of surgical revisions required in breast implants. ²⁷
Hospital length of stay	Length of stay in hospital is longer for patients receiving the DIEP flap than for those receiving breast implants. ¹⁰	Breast implants have higher rates of surgical revision, making the length of stay less significant. ¹³
Cost to the NHS	It is suggested that DIEP flap surgery is more cost effective in the long term. This is evident when the case of additional surgeries and medical interventions are taken into account. ^{12,16}	Initial surgery using breast implants is cheaper. ¹²

Additional case studies exploring the long-term outcomes of DIEP flap reconstruction are needed to support the replacement of breast implants by DIEP flap surgery in the NHS. There should be a focus on complications, expense, and patient-perceived outcomes. To help reduce the limitations of cohort bias and increase the reliability of data, where possible, studies should be carried out on large cohorts. However, based on the research conducted for this review, it is suggested that DIEP flap surgery is a more beneficial form of breast reconstruction, compared with silicone breast implants. DIEP flap reconstruction is also more cost-effective for the NHS in the long term, indicating a possible way for the NHS to deliver more satisfactory patient care at a lower cost.

Contribution statement: The above literature review is the sole work of the author; the author contributed to the design and content and gave final approval of the above review to be included in Inspire.

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References

- Koçan S, Gürsoy A. Body Image of Women with Breast Cancer After Mastectomy: A Qualitative Research. *J Breast Health*. 2016;12(4):145–50.
- Glicenstein J. History of augmentation mammoplasty. *Ann Chir Plast Esthet*. 2005;50(5):337–49.
- Ooi AS, Song DH. Reducing infection risk in implant-based breast-reconstruction surgery: challenges and solutions. *Breast Cancer Dove Med Press*. 2016;8:161–72.
- Fardo D, Sequeira Campos M, et al (2021). Breast Augmentation. Available from: www.ncbi.nlm.nih.gov/books/NBK482206/. Accessed: 18 April 2021
- Hamdi M, Rebecca A. The Deep Inferior Epigastric Artery Perforator Flap (DIEAP) in Breast Reconstruction. *Semin Plast Surg*. 2006;20(2):95–102.
- Gopie JP, Timman R, Hilhorst MT, et al. The short-term psychological impact of complications after breast reconstruction. *Psychooncology*. 2013;22(2):290–298.
- Sgarzani R, Negosanti L, Morselli PG, et al. Patient Satisfaction and Quality of Life in DIEAP Flap versus Implant Breast Reconstruction. *Surg Res Pract*. 2015;2015:405163.
- Pusic AL, Matros E, Fine N, et al. Patient-Reported Outcomes 1 Year After Immediate Breast Reconstruction: Results of the Mastectomy Reconstruction Outcomes Consortium Study. *J Clin Oncol Off J Am Soc Clin Oncol*. 2017;35(22):2499–506.
- Lagares-Borrego A, Gacto-Sanchez P, Infante-Cossio P, et al. A comparison of long-term cost and clinical outcomes between the two-stage sequence expander/prosthesis and autologous deep inferior epigastric flap methods for breast reconstruction in a public hospital. *J Plast Reconstr Aesthetic Surg*. 2016;69(2):196–205.
- NHS (2017) Cosmetic surgery - Breast enlargement (implants). Available from: www.nhs.uk/conditions/cosmetic-procedures/breast-enlargement/. Accessed: 11 April 2019
- Atherton DD, Hills AJ, Moradi P, Muirhead N, Wood SH. The economic viability of breast reconstruction in the UK: comparison of a single surgeon's experience of implant; LD; TRAM and DIEP based reconstructions in 274 patients. *J Plast Reconstr Aesthetic Surg*. 2011;64(6):710–5.
- Matros E, Albornoz CR, Razdan SN, et al. Cost-effectiveness analysis of implants versus autologous perforator flaps using the BREST-Q. *Plast Reconstr Surg*. 2015;135(4):937–46.
- Goodman CM, Cohen V, Thornby J, et al. The life span of silicone gel breast implants and a comparison of mammography, ultrasonography, and magnetic resonance imaging in detecting implant rupture: a meta-analysis. *Ann Plast Surg*. 1998;41(6):577–85; discussion 585–586.
- US Food & Drug Administration (2019) Questions and Answers about Breast Implant-Associated Anaplastic Large Cell Lymphoma (BIA-ALCL). Available from: www.fda.gov/medical-devices/breast-implants/questions-and-answers-about-breast-implant-associated-anaplastic-large-cell-lymphoma-bia-alcl. Accessed: 31 March 2019.
- Bizjak M, Selmi C, Praprotnik S, et al. Silicone implants and lymphoma: The role of inflammation. *J Autoimmun*. 2015;65:64–73.
- Breastcancer.org (2019) DIEP Flap Reconstruction: What to Expect. Available from: www.breastcancer.org/treatment/surgery/reconstruction/types/autologous/diep/what-to-expect. Accessed: 31 March 2019
- Mehta-Shah N, Clemens MW, Horwitz SM. How I treat breast implant-associated anaplastic large cell lymphoma. *Blood*. 2018;132(18):1889–98.
- Ezekwudo DE, Ifabiyi T, Gbadamosi B, et al. Breast Implant-Associated Anaplastic Large Cell Lymphoma: A Case Report and Review of the Literature. *Case Rep Oncol Med*. 2017;2017:e6478467.
- Gammer TJ, Khoury H, Gottlieb W, et al. Silicone gel implants in breast augmentation and reconstruction. *Ann Plast Surg*. 2007;59(5):581–90.
- Veira VJ, D'Acampora A, Neves FS, et al. Capsular Contracture In Silicone Breast Implants: Insights From Rat Models. *An Acad Bras Cienc*. 2016;88(3):1459–70.
- Coroneos CJ, Selber JC, Offodile AC, et al. US FDA Breast Implant Postapproval Studies: Long-term Outcomes in 99,993 Patients. *Ann Surg*. 2019;269(1):30–6.
- El-Sheikh Y, Tutino R, Knight C, et al. Incidence of capsular contracture in silicone versus saline cosmetic augmentation mammoplasty: A meta-analysis. *Can J Plast Surg J Can Chir Plast*. 2008;16(4):211–5.

23. Spear SL, Murphy DK. Natrelle round silicone breast implants: Core Study results at 10 years. *Plast Reconstr Surg.* 2014;133(6):1354–61.
24. Malahias M, Jordan DJ, Hughes LC, et al. A literature review and summary of capsular contracture: An ongoing challenge to breast surgeons and their patients. *International Journal of Surgery Open.* 2016;1;3:1–7.
25. Lhuire M, Hivelin M, Dramé M, et al. Determining the best recipient vessel site for autologous microsurgical breast reconstruction with DIEP flaps: An anatomical study. *J Plast Reconstr Aesthetic Surg JPRAS.* 2017;70(6):781–91.
26. Wade RG, Razzano S, Sassoon EM, et al. Complications in DIEP Flap Breast Reconstruction After Mastectomy for Breast Cancer: A Prospective Cohort Study Comparing Unilateral Versus Bilateral Reconstructions. *Ann Surg Oncol.* 2017;24(6):1465–74.
27. Beugels J, Bod L, van Kuijk SMJ, Qiu SS, et al. Complications following immediate compared to delayed deep inferior epigastric artery perforator flap breast reconstructions. *Breast Cancer Res Treat.* 2018;169(2):349–57.