



# Evaluation of the Artificial Intelligence Chatbot on Breast Reconstruction and Its Efficacy in Surgical Research: A Case Study



Yi Xie<sup>1</sup> · Ishith Seth<sup>1,2</sup> · Warren M. Rozen<sup>1,2</sup> · David J. Hunter-Smith<sup>1,2</sup>

Received: 6 March 2023 / Accepted: 27 May 2023 / Published online: 14 June 2023  
© Crown 2023

## Abstract

**Background** ChatGPT is an open-source artificial intelligence (AI) chatbot that uses deep learning to produce human-like text dialog. Its potential applications in the scientific community are vast; however, its efficacy on performing comprehensive literature searches, data analysis and report writing in aesthetic plastic surgery topics remains unknown. This study aims to evaluate both the accuracy and comprehensiveness of ChatGPT's responses to assess its suitability for use in aesthetic plastic surgery research.

**Methods** Six questions were prompted to ChatGPT on post-mastectomy breast reconstruction. First two questions focused on the current evidence and options for breast reconstruction post-mastectomy, and remaining four questions focused specifically on autologous breast reconstruction. Using the Likert framework, the responses provided by ChatGPT were qualitatively assessed for accuracy and information content by two specialist plastic surgeons with extensive experience in the field.

**Results** ChatGPT provided relevant, accurate information; however, it lacked depth. It could provide no more than a superficial overview in response to more esoteric questions and generated incorrect references. It created non-existent references, cited wrong journal and date, which poses a significant challenge in maintaining academic integrity and caution of its use in academia.

**Conclusion** While ChatGPT demonstrated proficiency in summarizing existing knowledge, it created fictitious references which poses a significant concern of its use in academia and healthcare. Caution should be exercised in interpreting its responses in the aesthetic plastic surgical field and should only be used for such with sufficient oversight.

**Level of Evidence IV** This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors [www.springer.com/00266](http://www.springer.com/00266).

**Keywords** ChatGPT · Artificial intelligence · Chatbot · Breast reconstruction

## Introduction

Since its introduction in November 2022, ChatGPT, an artificial intelligence (AI)-based language model, has drawn considerable attention and controversy for its ability to generate scholarly content [1, 2]. Developed initially for text generation and then refined for human interaction, ChatGPT has been leveraged by researchers to analyze data, write research literature and identify potential areas for future technology [3–5]. This has sparked concerns within the scientific community with some apprehension about the possible erosion of originality and autonomy, while others remain optimistic about the potential accelerated innovation and diverse perspectives [6].

This study aims to evaluate ChatGPT's potential to assist in breast reconstruction research. Breast cancer is one of the most prevalent cancers in the world and poses significant challenges to healthcare and patient well-being.

✉ Ishith Seth  
ishithseth1@gmail.com

<sup>1</sup> Department of Plastic Surgery, Peninsula Health, Melbourne, Victoria 3199, Australia

<sup>2</sup> Faculty of Medicine, Monash University, Melbourne, Victoria 3004, Australia

Approximately 40% of women diagnosed with breast cancer opt for mastectomy as a treatment with an estimated 60% of these patients choosing breast reconstruction postoperatively [7]. The authors with expertise in this field targeted specific questions to ChatGPT to assess its ability to provide current and precise medical information on breast reconstruction options, as well as its capacity to identify prospective research ideas.

## Methods

Six questions were posed to ChatGPT to evaluate its level of knowledge in the field of breast reconstruction post-mastectomy, the first two questions focused on the current evidence and options for breast reconstruction post-mastectomy, while the remaining four questions focused specifically on autologous breast reconstruction.

An assessment framework utilizing a Likert scale (Table 1) was implemented to perform a qualitative analysis of the outputs generated by ChatGPT. Two specialist plastic surgeons (WMR and DJHS) evaluated ChatGPT responses, focusing on its accuracy, reliability, comprehensiveness and ability to generate accurate references. The Likert scale was structured from 1 (strongly disagree) to 5 (strongly agree) for each individual category. There were no specific exclusion criteria. ChatGPT's response was limited to its first response, and the option of "regenerate response" was not utilized. Due to the study's structure as an observational case study on public artificial chatbot, no institutional ethics approval was required.

## Results

Initially, we requested ChatGPT to "In 200 words, describe the current evidence on breast reconstruction post-mastectomy with relevant references" (Figure 1). We then posed a follow-up question "In 200 words, describe the current evidence and options for breast reconstruction post-mastectomy, describe the quality of the evidence and provide 5 references." (Figure 2).

In response, ChatGPT provided an accurate definition of breast reconstruction and discussed its potential benefits and complications [8]. However, its paragraph on the psychological advantages of breast reconstruction was incorrectly cited as a systematic review and meta-analysis comparing reconstruction to no reconstruction. In actuality,

the source was a retrospective review assessing the psychological impact of immediate versus delayed breast reconstruction on patients [9]. Furthermore, ChatGPT's subsequent claims that breast reconstruction does not appear to compromise oncologic outcomes or increase the risk of cancer recurrence were inadequately supported by the cited sources, as they did not address this specific question in detail.

Regarding the second question, ChatGPT accurately identified the two primary breast reconstruction options—autologous and implant-based methods—and provided a surface-level overview of both. However, it failed to mention the combination of both as an option. Additionally, its citations and reference list were erroneous. None of the 5 references provided by ChatGPT could be confirmed in the literature. While the authors' names were genuine, the article titles and journal references did not produce any outcomes in these databases (PubMed, Cochrane and Ovid).

Due to word count constraints, ChatGPT's response to the third and fourth questions was focused on autologous breast reconstruction. ChatGPT was asked to "In 200 words, describe the current evidence and options for autologous breast reconstruction post-mastectomy, describe the quality of the evidence, and provide 5 references" (Figure 3). The follow-up question expanded on this, querying "Which autologous reconstruction is superior in breast reconstruction post-mastectomy with relevant references?" (Figure 4).

ChatGPT accurately presented the more common options for autologous breast reconstruction and highlighted potential advantages such as lower complication rates and higher patient satisfaction compared to implant-based reconstruction [10]. It listed three of the most commonly described flaps used in breast reconstruction, with a perfunctory description of each. ChatGPT also emphasized the importance of tailoring reconstructive options to each patient's unique circumstances and correctly noted that no single flap can be considered superior to others. However, again it demonstrated erroneous referencing, the two citations it used were not found in the literature.

Finally, the authors wanted to assess ChatGPT's ability to identify gaps in the existing literature and provide insights into potential areas of research. ChatGPT was asked, "In 200 words, where is the lack of evidence in the management of breast reconstruction post-mastectomy, provide relevant references" (Figure 5). This was followed up with "In 200 words, provide future recommendations

**Table 1** Evaluation of large language model platforms' responses

Criteria	ChatGPT
The large language model provides accurate answers to questions.	<input type="checkbox"/> 1—Strongly disagree <input type="checkbox"/> 2—Disagree <input type="checkbox"/> 3—Neither agree or disagree <input checked="" type="checkbox"/> 4—Agree <input type="checkbox"/> 5—Strongly agree
The large language model is proficient at understanding complex questions and providing appropriate answers.	<input type="checkbox"/> 1—Strongly disagree <input type="checkbox"/> 2—Disagree <input checked="" type="checkbox"/> 3—Neither agree or disagree <input type="checkbox"/> 4—Agree <input type="checkbox"/> 5—Strongly agree
The large language model provides comprehensive information when answering questions.	<input type="checkbox"/> 1—Strongly disagree <input type="checkbox"/> 2—Disagree <input type="checkbox"/> 3—Neither agree or disagree <input checked="" type="checkbox"/> 4—Agree <input type="checkbox"/> 5—Strongly agree
The large language model can provide in-depth information for a wide range of topics.	<input type="checkbox"/> 1—Strongly Disagree <input type="checkbox"/> 2— Disagree <input checked="" type="checkbox"/> 3—Neither agree or disagree <input type="checkbox"/> 4—Agree <input type="checkbox"/> 5—Strongly agree
The large language model is a valuable source of general knowledge.	<input type="checkbox"/> 1—Strongly disagree <input type="checkbox"/> 2—Disagree <input type="checkbox"/> 3—Neither agree or disagree <input checked="" type="checkbox"/> 4—Agree <input type="checkbox"/> 5—Strongly agree
The large language model rarely makes errors when referencing sources.	<input checked="" type="checkbox"/> 1—Strongly disagree <input type="checkbox"/> 2— Disagree <input type="checkbox"/> 3—Neither agree or disagree <input type="checkbox"/> 4—Agree <input type="checkbox"/> 5—Strongly agree
The large language model is consistent in providing accurate citations.	<input checked="" type="checkbox"/> 1—Strongly disagree <input type="checkbox"/> 2—Disagree <input type="checkbox"/> 3—Neither agree or disagree <input type="checkbox"/> 4—Agree <input type="checkbox"/> 5—Strongly agree

for breast reconstruction post-mastectomy, and innovation that is needed for further advancements in this field” (Figure 6).

ChatGPT highlighted the need for more research on the long-term outcomes of breast reconstruction using patient-reported outcomes, an area that lacks many prospective,

randomized trials [11]. It also identified more recent advancements in reconstructive techniques such as fat grafting and the use of scaffolds, [12] and the need to assess their long-term efficacy and safety profiles. ChatGPT also recognized the paucity of evidence around the impact that the type and timing of post-mastectomy



Breast reconstruction is a surgical procedure that aims to restore the appearance of the breast following mastectomy, a common treatment for breast cancer. The decision to undergo breast reconstruction is often a personal choice made by the patient in consultation with their healthcare provider.

There are several types of breast reconstruction procedures, including implant-based reconstruction and autologous tissue reconstruction, which uses the patient's own tissue to create a new breast.

Current evidence suggests that breast reconstruction following mastectomy can have significant psychological and physical benefits for patients, including improved body image, self-esteem, and quality of life. A systematic review and meta-analysis of 28 studies found that breast reconstruction was associated with a significant improvement in body image, psychosocial well-being, and sexual well-being compared to no reconstruction (Al-Ghazal et al., 2000).

Additionally, recent studies have shown that breast reconstruction does not appear to compromise oncologic outcomes or increase the risk of cancer recurrence (Ramsay et al., 2017; Kronowitz et al., 2016).

However, breast reconstruction is a complex surgical procedure that carries potential risks and complications, including infection, implant failure, and poor cosmetic outcomes. Patients should discuss these risks with their healthcare provider and carefully consider the potential benefits and drawbacks before undergoing reconstruction.

In summary, breast reconstruction can have significant benefits for patients following mastectomy, including improved body image and quality of life. However, patients should carefully consider the potential risks and complications before deciding to undergo reconstruction.

#### References:

Al-Ghazal SK, Sully L, Fallowfield L, Blamey RW. The psychological impact of immediate rather than delayed breast reconstruction. *Eur J Surg Oncol*. 2000 Oct;26(7):17-9.

Ramsay DT, Kent C, Song DH, Matsen CB, Morris DJ, Mathes DW. Breast reconstruction and adjuvant therapy: a systematic review of surgical outcomes. *J Surg Res*. 2017 Sep;217:236-245.

Kronowitz SJ, Hunt KK, Kuerer HM, et al. Delayed-Immediate Breast Reconstruction. *Plast Reconstr Surg*. 2016 Dec;138(6):1110-1123.

**Fig. 1** In 200 words, describe the current evidence on breast reconstruction post-mastectomy with relevant references



Breast reconstruction post mastectomy is an important option for women with breast cancer, and there are several types of breast reconstruction procedures available. The two main types are implant-based and autologous reconstruction. The decision to undergo breast reconstruction is made by the patient in consultation with their healthcare provider.

Implant-based breast reconstruction uses silicone or saline implants to create a new breast, while autologous breast reconstruction uses the patient's own tissue, such as from the abdomen, back, or thighs, to create a new breast. Both types of reconstruction have advantages and disadvantages, and the choice should be made based on individual patient factors and goals.

Current evidence suggests that both implant-based and autologous breast reconstruction are safe and effective options for patients. Several studies have found that breast reconstruction can improve quality of life, self-esteem, and body image in breast cancer survivors (Eltahir et al., 2013; Jagsi et al., 2014).

The quality of the evidence is generally good, with several randomized controlled trials and systematic reviews supporting the safety and efficacy of breast reconstruction. However, more research is needed to further explore the long-term outcomes and potential risks of these procedures.

In summary, breast reconstruction post mastectomy is an important option for women with breast cancer. Both implant-based and autologous breast reconstruction are safe and effective options, and the choice should be made based on individual patient factors and goals.

#### References:

1. Zhong T, Hu J, Bagher S, et al. A comparison of autologous and implant-based breast reconstruction: systematic review and meta-analysis. *Plast Reconstr Surg.* 2020 May;145(5):1324-1334.
2. Coombs DM, Ding J, Starostik P, et al. A systematic review of autologous breast reconstruction and postoperative radiotherapy: addressing the challenges of conflicting evidence. *Plast Reconstr Surg.* 2021 May;147(5):726e-733e.
3. Lardi AM, Kempton SJ, Stuart-Smith J, et al. A systematic review of autologous breast reconstruction in obese women. *Plast Reconstr Surg.* 2021 Mar 1;147(3):602-613.
4. Kobraei EM, Cauley R, Gadd M, et al. A systematic review of risk factors for complications of implant-based breast reconstruction with prereconstruction and postreconstruction radiotherapy. *Plast Reconstr Surg.* 2021 Jan 1;147(1):57e-66e.
5. Safran T, Kesmodel S, Yoon AP, et al. Breast reconstruction after nipple-sparing mastectomy: a systematic review of the literature. *Plast Reconstr Surg.* 2015 Nov;136(5):892-900.

**Fig. 2** In 200 words, describe the current evidence and options for breast reconstruction post-mastectomy, describe the quality of the evidence and provide 5 references



Autologous breast reconstruction is a surgical procedure that uses a patient's own tissue to create a new breast following mastectomy for breast cancer. This type of reconstruction can be performed using tissue from the abdomen, back, or thighs, and is typically more complex than implant-based reconstruction.

Current evidence suggests that autologous breast reconstruction is a safe and effective option for patients undergoing mastectomy. A systematic review and meta-analysis of 41 studies found that autologous breast reconstruction had lower complication rates and higher patient satisfaction compared to implant-based reconstruction (Zhong et al., 2020).

There are several options for autologous breast reconstruction, including the deep inferior epigastric perforator (DIEP) flap, the transverse rectus abdominis myocutaneous (TRAM) flap, and the latissimus dorsi (LD) flap. Each option has its own benefits and drawbacks, and patients should discuss these with their healthcare provider to determine the best approach for their individual needs.

The quality of the evidence for autologous breast reconstruction is generally good, with several randomized controlled trials and systematic reviews supporting its safety and efficacy. However, more research is needed to further explore the long-term outcomes and potential risks of this procedure.

#### References:

1. Zhong T, Hu J, Bagher S, et al. A comparison of autologous and implant-based breast reconstruction: systematic review and meta-analysis. *Plast Reconstr Surg*. 2020 May;145(5):1324-1334.
2. Coombs DM, Ding J, Starostik P, et al. A systematic review of autologous breast reconstruction and postoperative radiotherapy: addressing the challenges of conflicting evidence. *Plast Reconstr Surg*. 2021 May;147(5):726e-733e.
3. Lardi AM, Kempton SJ, Stuart-Smith J, et al. A systematic review of autologous breast reconstruction in obese women. *Plast Reconstr Surg*. 2021 Mar 1;147(3):602-613.
4. Kobraei EM, Cauley R, Gadd M, et al. A systematic review of risk factors for complications of implant-based breast reconstruction with preconstruction and postreconstruction radiotherapy. *Plast Reconstr Surg*. 2021 Jan 1;147(1):57e-66e.
5. Safran T, Kesmodel S, Yoon AP, et al. Breast reconstruction after nipple-sparing mastectomy: a systematic review of the literature. *Plast Reconstr Surg*. 2015 Nov;136(5):892-900.

**Fig. 3** In 200 words, describe the current evidence and options for autologous breast reconstruction post-mastectomy, describe the quality of the evidence and provide 5 references



There is currently no consensus on which autologous breast reconstruction technique is superior as it largely depends on the individual patient's anatomy, preference, and surgical goals. Each technique has its own benefits and drawbacks, and the decision should be made in consultation with the patient and their healthcare provider.

The most commonly used autologous breast reconstruction techniques include the deep inferior epigastric perforator (DIEP) flap, the transverse rectus abdominis myocutaneous (TRAM) flap, and the latissimus dorsi (LD) flap. The DIEP flap and TRAM flap are both based on the blood supply from the abdominal region, while the LD flap is based on the blood supply from the back.

A systematic review and meta-analysis of 41 studies comparing autologous breast reconstruction techniques found that the DIEP flap had the lowest risk of donor site complications, while the TRAM flap had the highest rate of flap loss (Zhong et al., 2020). However, the study also noted that the differences between the techniques were not statistically significant.

Another systematic review and meta-analysis of 18 studies found that there were no significant differences in complication rates or patient-reported outcomes between the DIEP and TRAM flaps (Ho et al., 2017).

In summary, there is no clear consensus on which autologous breast reconstruction technique is superior, and the choice should be made in consultation with the patient and their healthcare provider based on individual factors and goals.

**Fig. 4** Which autologous reconstruction is superior in breast reconstruction post-mastectomy with relevant references?

reconstructions have on locoregional recurrence rates. Finally, ChatGPT alluded to the psychosocial aspect of breast reconstruction and the existence of different models of healthcare which impact the efficacy of resource utilization and health burden on society.

## Discussion

This case study demonstrates that ChatGPT can provide sufficiently accurate information to the layperson and identify potential areas of future research in the field of

breast reconstruction post-mastectomy. However, ChatGPT's issue of generating non-existent references poses a significant challenge to academic integrity. This practice is vital not only for crediting original ideas but also allowing readers to verify the reliability of the information by tracking back to its original source. Therefore, for potential integration of this AI tool in academia and healthcare, this technology needs to be trained on specialized datasets and its outputs need to be rigorously scrutinized by experts on its field.

While ChatGPT has received significant public and media attention, there are an increasing number of



Despite the advances in breast reconstruction post mastectomy, there are still some areas where the evidence is lacking or inconclusive. One area where more research is needed is in the long-term outcomes of breast reconstruction, including patient-reported outcomes such as quality of life and functional outcomes. There is also a need for more research on the safety and efficacy of newer techniques such as fat grafting and acellular dermal matrix-assisted reconstruction.

Additionally, there is a lack of evidence regarding the optimal timing of breast reconstruction relative to mastectomy. While immediate breast reconstruction is often performed at the time of mastectomy, there is a need for more research to determine the optimal timing for delayed breast reconstruction.

There is also a need for more research on the impact of breast reconstruction on cancer surveillance and detection, particularly in patients who undergo implant-based reconstruction.

Finally, there is a lack of evidence regarding the impact of breast reconstruction on healthcare costs and resource utilization, particularly in the context of different models of care.

In summary, there are several areas where the evidence is lacking or inconclusive in the management of breast reconstruction post mastectomy. Further research is needed to address these gaps and improve the care of patients undergoing breast reconstruction.

**Fig. 5** In 200 words, where is the lack of evidence in the management of breast reconstruction post-mastectomy, provide relevant references

alternative AI systems that may be used for research purposes. Language models such as BERT (Bidirectional Encoder Representations from Transformers) [13] and ELMO (Embeddings from Language Models) [14] use deep learning techniques to understand the context of words in a sentence and generate word embeddings. They have been used for various natural processing language (NLP) tasks such as named entity recognition and question answering. IBM Watson Discovery is a cognitive search and content analysis platform that uses NLP and machine learning algorithms to analyze large datasets and provide insights [15]. A research model based on IBM Watson has demonstrated the ability to search large information databases and produce comparable analytical results for clinical genome sequencing to a multidisciplinary team at a specialized cancer hospital [16]. The AI-powered research assistant Iris.ai similarly uses NLP and machine learning algorithms to analyze research papers and identify key

concepts and ideas, thereby saving time by summarizing the relevant papers for the researcher [17].

These examples highlight the growing interest in the use of AI to support research, especially with the exponential growth of scientific literature. Nevertheless, the findings of this study caution against relying solely on AI tools such as ChatGPT for medical information. The accuracy and comprehensiveness of information provided by such tools should be critically evaluated and validated by healthcare professionals. Additionally, efforts should be made to improve the capabilities of these tools to critically analyze and accurately reference the literature they draw from.

## Conclusion

While ChatGPT demonstrated proficiency in summarizing existing knowledge, it was superficial and avoided medical jargon. The problem of generating non-existent references





Breast reconstruction following mastectomy is an important component of the treatment of breast cancer, and there are several areas where future research and innovation can help to improve patient outcomes.

One area of future research is to further explore the long-term outcomes of breast reconstruction, including the impact on quality of life and functional outcomes. Additionally, there is a need for more research on the safety and efficacy of newer techniques, such as fat grafting and acellular dermal matrix-assisted reconstruction.

Another area of innovation is the development of new technologies and techniques to improve the precision and safety of breast reconstruction. For example, the use of 3D printing and virtual reality technology can help to optimize surgical planning and improve outcomes. There is also a need for the development of new materials and implant designs that are more biocompatible and have better long-term outcomes.

Lastly, it is important to improve access to breast reconstruction for all patients, including those in underserved communities and those with limited resources. This may involve the development of new models of care, such as telemedicine, and the implementation of policies to improve insurance coverage and reduce financial barriers.

In summary, future research and innovation in breast reconstruction should focus on improving long-term outcomes, developing new technologies and techniques, and improving access to care for all patients.

**Fig. 6** In 200 words, provide future recommendations for breast reconstruction post-mastectomy and innovation that is needed for further advancements in this field

is a critical concern for academic integrity. To enhance ChatGPT's applicability in academic and medical fields, improvements should be made through specialized dataset training and meticulous examination of outputs by experts. Despite advancements in AI, ChatGPT use in academia and healthcare should be exercised with caution.

**Acknowledgements** None

**Funding** Open Access funding enabled and organized by CAUL and its Member Institutions. No authors have received any funding or support.

**Declarations**

**Conflict of interest** The authors declare that they have no conflicts of interest to disclose.

**Human and Animal Rights** This article does not contain any studies with human participants or animals performed by any of the authors.

**Informed Consent** For this type of study informed consent is not required.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

1. Else H (2023) Abstracts written by ChatGPT fool scientists. *Nature* 613:423
2. Xie Y, Seth I, Hunter-Smith DJ, Ross R, Lee M (2023) Aesthetic surgery advice and counseling from artificial intelligence: a rhinoplasty consultation with ChatGPT. *Aesth Plastic Surg.* <https://doi.org/10.1007/s00266-023-03338-7>

3. Huang J, Yeung AM, Kerr D, Klonoff DC (2023) Using ChatGPT to predict the future of diabetes technology. *J Diabetes Sci Technol* 17(3):853–854
4. Macdonald C, Adeloye D, Sheikh A, Rudan I (2023) Can ChatGPT draft a research article? An example of population-level vaccine effectiveness analysis. *J Glob Health* 13:01003
5. King MR, chatGPT (2023) A Conversation on artificial intelligence, chatbots, and plagiarism in higher education. *Cell Mol Bioeng.* 16(1):1–2
6. van Dis EA, Bollen J, Zuidema W, van Rooij R, Bockting CL (2023) ChatGPT: five priorities for research. *Nature* 614:224–226
7. Panchal H, Matros E (2017) Current trends in post-mastectomy breast reconstruction. *Plast Reconstr Surg* 140:7S
8. Seth I, Seth N, Bulloch G, Rozen WM, Hunter-Smith DJ (2021) Systematic review of Breast-Q: a tool to evaluate post-mastectomy breast reconstruction. *Breast Cancer Targets Ther* 13:711–724
9. Al-Ghazal S, Sully L, Fallowfield L, Blamey R (2000) The psychological impact of immediate rather than delayed breast reconstruction. *Eur J Surg Oncol* 26:17–19
10. Broyles JM, Balk EM, Adam GP, Cao W, Bhuma MR, Mehta S et al (2022) Implant-based versus autologous reconstruction after mastectomy for breast cancer: a systematic review and meta-analysis. *Plast Reconstr Surg Glob Open* 10:e4180
11. Cordova LZ, Hunter-Smith DJ, Rozen WM (2019) Patient reported outcome measures (PROMs) following mastectomy with breast reconstruction or without reconstruction: a systematic review. *Gland Surg* 8:441
12. Frey JD, Salibian AA, Karp NS, Choi M (2019) Implant-based breast reconstruction: hot topics, controversies, and new directions. *Plast Reconstr Surg* 143:404e–e416
13. Devlin J, Chang M-W, Lee K, Toutanova KB (2018) BERT: Pre-training of deep bidirectional transformers for language understanding. arXiv preprint [arXiv:1810.04805](https://arxiv.org/abs/1810.04805)
14. Peters M, Neumann M, Iyyer M, Gardner M, Clark C, Lee K, et al (2018) Deep contextualized word representations. [arXiv:1802.05365](https://arxiv.org/abs/1802.05365)
15. Van Hartskamp M, Consoli S, Verhaegh W, Petkovic M, Van de Stolpe A (2019) Artificial intelligence in clinical health care applications. *Interact J Med Res* 8:e12100
16. Itahashi K, Kondo S, Kubo T, Fujiwara Y, Kato M, Ichikawa H et al (2018) Evaluating clinical genome sequence analysis by Watson for genomics. *Front Med* 5:305
17. Extance A (2018) How AI technology can tame the scientific literature. *Nature* 561:273–275

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.