



# ChatGPT in Plastic and Reconstructive Surgery

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## Abstract

**Background** Chat Generative Pre-Trained Transformer (ChatGPT) is a versatile large language model-based generative artificial intelligence. It is proficient in a variety of tasks from drafting emails to coding to composing music to passing medical licensing exams. While the potential role of ChatGPT in plastic surgery is promising, evidence-based research is needed to guide its implementation in practice.

**Methods** This review aims to summarize the literature surrounding ChatGPT's use in plastic surgery.

**Results** A literature search revealed several applications for ChatGPT in the field of plastic surgery, including the ability to create academic literature and to aid the production of research. However, the ethical implications of using such chatbots in scientific writing requires careful consideration. ChatGPT can also generate high-quality patient discharge summaries and operation notes within seconds, freeing up busy junior doctors to complete other tasks. However, currently clinical information must still be manually inputted, and clinicians must consider data privacy implications. Its use in aiding patient communication and education and training is also widely documented in the literature. However, questions have been raised over the accuracy of answers generated given that current versions of ChatGPT cannot access the most up-to-date sources.

**Conclusions** While one must be aware of its shortcomings, ChatGPT is a useful tool for plastic surgeons to improve productivity for a range of tasks from manuscript preparation to healthcare communication generation to drafting teaching sessions to studying and learning. As access improves and technology becomes more refined, surely more uses for ChatGPT in plastic surgery will become apparent.

## Keywords

- ▶ ChatGPT
- ▶ artificial intelligence
- ▶ large language models
- ▶ Chatbot

## Introduction

Artificial intelligence (AI), though poorly defined, can be thought of as the “imitation by computers of the intelligence

inherent to humans.”<sup>1</sup> Over the last 6 years, the development of large language models (LLMs) has revolutionized the landscape for AI. LLMs are a type of generative AI that uses deep learning techniques and large data sets to understand,

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summarize, and generate human-like content. Since Google created its neural network algorithm in 2017, LLMs have been at the forefront of AI development. Significant examples of such technologies include Google's chatbots LaMDA and BARD, Stability AI's, and Open AI's image generators Stable Diffusion and Dall-E.<sup>2</sup>

On November 30, 2022, Chat Generative Pre-Trained Transformer (ChatGPT), an LLM chatbot, developed by Open AI, was released to the public. ChatGPT is able to respond to questions posed by users. It has the ability to admit to shortcomings and learn from prior mistakes.<sup>3</sup> ChatGPT is proficient in a variety of skills ranging from drafting emails to coding to composing music to passing medical licensing exams. While the predecessor (GPT-3) was unimodal, meaning that it could only recognize and generate text content, the latest edition (GPT-4) is multimodal. This means the chatbot can now accept and produce text and image inputs and outputs making it significantly more versatile.<sup>4</sup>

With its ability to perform repetitive and seemingly daunting tasks with speed and on a scale that has previously been unachievable, ChatGPT will inevitably become an established tool within society. The chatbot gained 1 million users within 5 days after its launch, and within the first 2 months it had over 100 million users. In comparison, it took Facebook 10 months to reach 1 million users and Netflix 41 months.<sup>5</sup> Since conception, the use of ChatGPT within medical and surgical practice has been widely documented with over 250 publications on PubMed as of April 2023.

Plastic and reconstructive surgery is a constantly evolving, innovative surgical specialty, priding itself on implementing cutting-edge technology. The use of AI in plastic and reconstructive surgery has been widely documented in recent years.<sup>6,7</sup> Studies suggest AI can perform breast mammography more accurately and efficiently than humans, mitigating human error.<sup>8</sup> AI has also been shown to accurately differentiate between benign and malignant dermatological skin pathology with equivalent or greater success than qualified dermatologists.<sup>9</sup> AI-based robots such as robot assisted microsurgery and transoral robotic surgery are becoming more common in plastic surgery.<sup>10</sup>

With increasing public access to novel modes of AI, it is crucial to consider the use of ChatGPT with a view to guiding practice. Chatbots such as ChatGPT will have alternative uses in surgical specialties when compared to other forms of AI such as robots that may also improve the quality of patient care. The potential role for ChatGPT to produce literature and research; aid patient communication; assist medical professionals with simple clinical tasks such as letter writing and discharge summaries; as well as supporting trainees with their education and training within this specialty should be explored.

While some view LLMs such as ChatGPT as valuable tools that can revolutionize medical and surgical practice, others are more skeptical about its use and have raised concern. Due to the novelty of the platform, it is important that evidence-based research is used to guide the implementation of this resource into practice. This article is the first literature

review assessing the use of ChatGPT within plastic and reconstructive surgery. We aim to summarize the current literature and direct future research for the use of ChatGPT in plastic surgery.

## ChatGPT for Research

Over the last 40 years, evidence-based medicine (EBM) has been at the forefront of advancements made in plastic surgery. EBM is a logical approach to patient management which ensures learning from peers and their experiences.<sup>11</sup> While the importance of adapting practice based on previous experience to enhance patient care is crucial, it is equally important to ensure published research is reliable and unbiased. ChatGPT is likely to revolutionize the way research is conducted but with the opportunities it creates, it also comes some concerns.<sup>12</sup>

A 2023 systematic review examining ChatGPT's utility in healthcare education, research, and practice suggested chatbots can be effective tools for conducting comprehensive literature reviews. Furthermore, the authors also found ChatGPT can be used to generate computer code for use in research, which could save significant amounts of time for research steps that require greater effort from human intelligence. It also found ChatGPT to be useful in critiquing pre-existing literature as well as generating better written research, communicating results, and discussions in a more coherent way than current literature.<sup>13</sup>

However, the review also found several limitations with the chatbot including the frequent use of superficial, inaccurate, or incorrect content and its inability to produce accurate or sufficient references when creating literature. They have been shown to facilitate plagiarism and academic misconduct.<sup>14,15</sup>

Additionally, ChatGPT creates its content based on data limited to before 2021, and so any literature review conducted by the chatbot will not include research conducted after these years, meaning that its content may not be up to date and could therefore be inaccurate.<sup>4</sup> Furthermore, ChatGPT does not have access to closed-access/subscription-based papers on databases such as PubMed.

The implications of using ChatGPT to write literature have been frowned upon by articles published in journals such as *Nature*, *Science*, and the *Lancet*.<sup>16-18</sup> These papers suggest that including the chatbot in the list of authors would be scientific misconduct and that failing to include the chatbot when it was used in the production of literature would be fraudulent. This ethical discussion requires careful consideration as its implications have vast implications.

ChatGPT has a role to play in the production of academic literature in the field of plastic surgery.<sup>19</sup> Its ability to run searches through large datasets in minimal amounts of time and its eloquent writing style makes it desirable in the production of scientific writing. However, its current limitations mean that the content it produces requires checking and correcting (where necessary) in order to ensure plagiarism and misinformation is not being produced. Any content produced using ChatGPT should also be

edited such that research produced after 2021 is manually incorporated.

### ChatGPT for Healthcare Communication

A further potential area for ChatGPT is in generation of healthcare communication such as patient discharge summaries.<sup>20</sup> Discharge summaries are a written handover to other healthcare professionals, such as general practitioners, explaining why patients were admitted, what happened during their inpatient stay, and important information to pick up the care of the patient after discharge. Effective discharge summaries facilitate the safe transition of patient care from secondary care back to primary care.<sup>21</sup> They can also be used to provide specific patient information, such as postoperative instructions. National Health Service (NHS) trusts also typically calculate earnings per patient based on the information recorded in these documents. The literature shows that poor quality summaries lead to an increased risk of adverse events and rehospitalization.<sup>22</sup> This highlights the importance of well-written discharge summaries. However, the literature reveals that general practitioners are often dissatisfied by the quality of documents being produced, reporting they frequently lack content that would be important for patient care, such as changes to regular medications.<sup>23</sup> At the same time, trainee doctors feel that these clerical tasks are time consuming and take them away from clinical care and training opportunities. With an increasingly busy NHS, discharge summaries are often a lower priority for pressurized staff who may also have had insufficient training to write such vital documents.<sup>21</sup> Delays to discharge summary completion can result in delayed patient discharge, further burdening an already struggling health service.

ChatGPT and other generative AI applications may offer the solution by generating high-quality discharge summaries within seconds while freeing up junior doctors to complete other tasks. In its current form, ChatGPT allows doctors to enter brief clinical information, concepts to elaborate on and guidance to explain to patients, generating a complete discharge summary in seconds.<sup>20</sup>

ChatGPT can also be used to write operation notes. Operation notes are an essential part of surgical documentation, serving as legal and medical records of surgical procedures. They must be clear, concise, and comprehensive records to ensure that all relevant information is captured. Traditionally, they are written by surgeons themselves or by a designated scribe. However, this can be a time-consuming process and the quality of the notes may vary depending on the surgeon's writing skills and experience. Moreover, surgeons may have different styles of writing, which can lead to inconsistencies in documentation. ChatGPT can save surgeons time, improve documentation efficiency, and lead to improved patient care. However, there is currently a paucity of published studies on this particular use case. Singh et al conducted a study investigating the use of ChatGPT for writing both operation notes and discharge

summaries within ophthalmology and found encouraging results.<sup>24</sup> The authors discussed that the quality of the inputs given to ChatGPT determined the quality of subsequent discharge summary. Additionally, when prompted, the chatbot could add information such as follow-up instructions, consultation time, and location in a matter of seconds.

A limitation of using generative AI such as ChatGPT for healthcare communication is that currently salient clinical information must still be manually inputted. Future AI models may automatically scrape patient data from electronic health records without the need for manual data inputting. However, this increases concern for patient privacy and data governance. Use of AI in healthcare has already led to mistrust from patients.<sup>25</sup> Clinicians must be clear to patients about which parties have access to their personal health information and how it is being used. Furthermore, the consequences of failure of such technologies must be considered carefully. As already demonstrated, inaccurate discharge summaries lead to increased risk of rehospitalization and adverse events. Thus, ChatGPT must be seen as a tool to aid writing clinical documents, but a clinician should review before signing to avoid such errors. Finally, a 2022 paper found that completely machine generated discharge summaries may not be feasible. The authors reported that 43% of information in the 24,000 analyzed discharge summaries originate from past clinical records, 39% from external sources other than inpatient records, 18% from referral documents and importantly, 11% was not derived from any documents but from clinician's memory or reasoning. The authors, therefore, concluded that AI's can only be a tool used as part of the discharge summary writing process.<sup>26</sup>

### ChatGPT for Patient Communication

Patient communication in the field of plastic surgery is critical for ensuring informed consent, addressing patient concerns, and managing patient expectations. Chatbots powered by natural language processing and machine learning algorithms, such as ChatGPT, have emerged as a potential tool to support patient communication.

ChatGPT has several potential applications in patient communication in plastic surgery. Chatbots can provide patients with relevant information about their surgery, such as the risks and benefits of the procedure, preoperative preparation, and postoperative care. ChatGPT uses patient friendly language and can easily adjust output based on user requests, such as "Explain a pinnaplasty to a 5-year-old" thereby aiding informed consent. Second, ChatGPT can be used to answer frequently asked questions about surgery, such as the expected recovery time, type of anesthesia used, and length of the hospital stay. It can be used to address patient concerns and manage expectations, such as fear of pain and complications, and the realistic outcomes of the surgery. ChatGPT can provide personalized recommendations based on the patient's medical history and preferences.

A 2020 systematic review of 31 studies found generally positive or mixed results with regard to usability, effectiveness, and satisfaction of AI-based conversational agents such as chatbots for patient communication.<sup>27</sup> AI technologies have advanced significantly since this publication suggesting current results may be even more favorable. Moreover, research has shown that chatbots can be useful for promoting health behavioral changes such as smoking cessation and weight loss.<sup>28</sup> This application demonstrates the connection generative AI's can develop with patients and their potential to be powerful aids for preoperative patient optimization. ChatGPT and other AI models can provide support to patients' postoperative recovery. A recently published prospective study of 26 patients undergoing hip arthroscopy were invited to use a chatbot based on similar technology to ChatGPT for 6 weeks following surgery. Eighty percent found the chatbot was good or excellent at responding to their queries.<sup>29</sup>

A further usage of ChatGPT is in generation of clinic letters. Reconstructive surgeons based in Swansea, Wales, UK used ChatGPT to write clinic letters to 38 hypothetical skin cancer patients.<sup>30</sup> This pilot study showed that ChatGPT can successfully produce letters with high overall correctness and high humanness scores. They were also written at an appropriate level for patients to understand. This can save plastic surgeons valuable time in outpatient clinics and increase productivity as well as reducing the burden on secretaries.

Using ChatGPT and other chatbots for patient communication in plastic surgery can have several benefits. ChatGPT can reduce the workload of healthcare professionals, as it can handle routine queries and provide basic information to patients. ChatGPT can also improve patient satisfaction and engagement by providing quick and easy access to information and addressing their concerns 24/7. Chatbots can improve patient understanding and informed consent by providing clear and accurate information about the surgery. They can act as an "intelligent patient companion."<sup>31</sup> Finally, ChatGPT may improve the efficiency of the healthcare system by reducing the need for face-to-face consultations and improving patient flow.

However, there are also some limitations to consider. ChatGPT is unable to provide emotional support or empathy, which is clearly a critical part of being a healthcare professional. ChatGPT may also not be able to handle complex queries or understand the context of the patient's question, leading to inaccurate or incomplete responses. In the paper following patients after hip arthroscopy, 3 out of the 10 queries that posed potential health concerns were inappropriately responded to by the chatbot.<sup>29</sup> This highlights the potential dangers of such applications, though no patients suffered any adverse effects as a result in that particular study.

## ChatGPT for Training and Education

ChatGPT has several potential applications for training and education in plastic surgery. First, ChatGPT can act as a

virtual training assistant, providing plastic surgery trainees with relevant information such as operation techniques, anatomy, and patient management.<sup>5</sup> Certainly, studies have found that ChatGPT has the ability to access relevant information, effectively analyze the data, and understand complex clinical information to successfully pass medical examinations including the USMLE and Korean General Surgery board exams.<sup>32,33</sup> Second, ChatGPT can be used to simulate patient interactions, allowing trainees to practice communication skills and gain experience in handling patient inquiries. Third, ChatGPT can be used to generate case studies and scenarios, allowing plastic surgery trainees to develop problem-solving skills and clinical decision-making abilities. ChatGPT can provide personalized feedback and recommendations based on the trainee's performance.<sup>34</sup> Finally, ChatGPT can be a useful tool for surgical educators to create courses and session content as well as assessment questions.<sup>5,35</sup> This can save surgical educators valuable time while still being able to deliver effective lessons.

Using ChatGPT in plastic surgery training and education can have further benefits. First, ChatGPT can provide a consistent and standardized approach to training, ensuring that all trainees receive the same level of education and support. Second, ChatGPT can reduce the workload of plastic surgery educators, as it can handle routine queries and provide basic information to trainees. Third, ChatGPT can improve the efficiency of the education system by providing remote access to education materials and reducing the need for face-to-face consultations. Fourth, ChatGPT can provide personalized feedback and recommendations, allowing trainees to identify their strengths and weaknesses and improve their performance.

There are also some limitations of using ChatGPT in surgical training and education. ChatGPT may not be able to simulate the complexity of real-life patient interactions, leading to incomplete training. Furthermore, as previously mentioned current iterations of ChatGPT can only access data published up to 2021 and only open-access articles on databases such as PubMed, it is clearly a significant concern. A further drawback is that ChatGPT may encourage academic dishonesty through plagiarism and cheating. A rising concern is that with increasing use of AI, students will lose their ability to form original ideas and present arguments.<sup>5</sup>

## Discussion

ChatGPT is the figurehead of a wave of generative AI products entering the consumer market. AI-based technologies are advancing far quicker than society can keep up with. This will bring about widespread changes across all areas of society, including in the field of plastic surgery.

In this article, we have highlighted areas of use for ChatGPT for plastic surgeons, most notably for research, including writing literature and systematic reviews, generating healthcare communication documents such as clinic letters, discharge summaries and operation notes,

supporting patients through their operative journey and aiding trainees with education. Despite the wide range of use cases, ChatGPT is still very much in its infancy, only being released to the public less than 6 months ago. In a recent survey of 844 attendees at a health-technology conference at Northwestern University in Chicago, United States, just 40% of respondents had used ChatGPT.<sup>36</sup> As access improves and the technology becomes more refined, surely more uses for ChatGPT in plastic surgery will become apparent.

As with all newly introduced technologies, there are some important limitations to consider. In its current form, ChatGPT can only access information published up to 2021. It also cannot access closed-access/subscription-based papers on databases such as PubMed. This raises questions over the accuracy of answers generated. One must consider the consequences of failure of such technology in healthcare and also who holds ultimate responsibility. There are also concerns over privacy and data governance with personal information being given to data-hungry technology giants. Further holistic concerns include the inability for AI to provide emotional support and the human touch and an increasing dependence on AI may lead to a reduced ability of users to form their own original ideas.

In conclusion, ChatGPT is a useful tool for plastic surgeons to improve productivity for a range of tasks from manuscript preparation to healthcare communication generation to drafting of teaching sessions to studying and learning. However, its limitations must be considered and thus, it must be used judiciously.

#### Conflict of Interest

None declared.

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