# Large language models for post-operative guidance in refractive surgery

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## Introduction

Refractive surgery is a field in ophthalmology which aims to provide clear vision for patients, to reduce spectacle and contact lens dependence, and to increase patient quality of life. Although refractive surgery is a common and well known ocular surgical procedure, the post-procedure complications and risks are less known to the general lay public. Generative pre-trained transformer (GPT)-4, is an advanced computing model developed by OpenAI (1,2) that uses a large multimodal model capable of processing both text and image inputs to generate and transform text outputs (1). The system is built upon the transformer architecture, a deep learning model that has demonstrated significant efficacy in various natural language processing tasks (1).

GPT-4 utilizes a preliminary pre-training phase in which the technology acquires knowledge from extensive quantities of textual data, thereby facilitating its ability to comprehend and incorporate statistical patterns and linguistic structure (1). The process of pre-training facilitates the development of robust comprehension of language semantics, grammar, and context in GPT-4. This, in turn, empowers the model to produce responses that are both coherent and contextually appropriate.

ChatGPT has already been shown to be highly promising for ophthalmology during human space flight associated neuro-ocular syndrome (SANS) (2), for ophthalmic operative surgical notes (3), and for triaging ophthalmic symptoms (4).

The potential impact of artificial intelligence (AI) technologies (e.g., GPT-4, ChatGPT) on refractive surgery is intriguing and expanding. These technologies have the capacity to revolutionize various aspects of this medical field, including patient care, surgical planning, and communication between healthcare providers and patients (5).

## The advantages of ChatGPT in the field of refractive surgery

The Improvement of Patient Education ChatGPT possesses the potential to assume a pivotal function in the field of patient education pertaining to refractive surgery procedures. This includes the ability to effectively address patient concerns and offer custom data responses to meet their unique requirements. Through the use of its conversational capabilities, ChatGPT has the capacity to replicate human-like exchanges, thereby enabling patients to acquire precise and comprehensible information pertaining

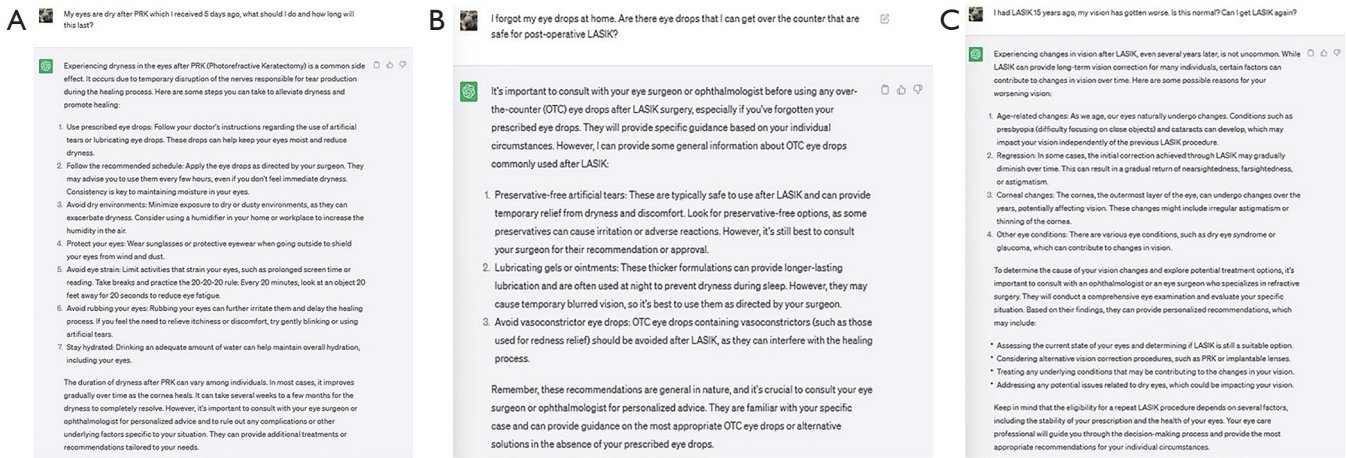


**Figure 1** Three panels with different questions related to refractive surgery given to ChatGPT. (A) We asked ChatGPT using the following prompts: "My eyes are dry after PRK which I received 5 days ago, what should I do and how long will this last?". (B) We asked ChatGPT using the following prompt: "I forgot my eye drops at home. Are there eye drops that I can get over the counter that are safe for post-operative LASIK?". (C) "I had LASIK 15 years ago, my vision has gotten worse. Is this normal? Can I get LASIK again?". PRK, photorefractive keratectomy; LASIK, laser-assisted in situ keratomileusis.

to surgical alternatives, pre-operative and post-operative procedures, potential hazards, and expected outcomes (5).

The integration of ChatGPT into the clinical workflow of refractive surgery has the potential to enhance efficiency by reducing routine phone and electronic communications and streamlining various administrative tasks (e.g., routine scheduling appointments and post-operative follow-ups). ChatGPT is capable of managing routine inquiries, delivering automated responses, and facilitating the prioritization of patient inquiries (5). As a result, it may alleviate the workload of healthcare professionals, enabling them to dedicate their time to more demanding clinical responsibilities which require human attention.

In addition, ChatGPT technology has the capability to function as a decision support tool for refractive surgeons by providing pertinent information, proposing potential treatment strategies, and facilitating surgical preparation. Through the analysis of patient data and the consideration of individual factors, ChatGPT has the capability to generate valuable insights that can aid surgeons in making better and well-informed decisions and potentially improve surgical outcomes. We explored the capabilities of ChatGPT using 3 simple prompts that are frequently asked patient questions to evaluate the accuracy and reliability of its responses in *Figure 1*.

## Challenges

While ChatGPT holds substantial promise in the field of medicine, it is essential to recognize and address potential challenges that may impede its seamless integration. One critical concern is the susceptibility to generating inaccurate or illogical outputs, posing a risk in medical decision-making scenarios (6). This limitation calls for continuous refinement to enhance the model's logical reasoning abilities and minimize the likelihood of providing misleading information.

Another significant challenge stems from the potential biases embedded in the training data, which could inadvertently perpetuate existing disparities in healthcare (6). The need for diverse and representative datasets becomes paramount to mitigate bias and ensure that ChatGPT delivers equitable and unbiased responses across various patient demographics.

Furthermore, the model's reliance on existing information, while efficient, introduces a challenge in confirming the accuracy of the provided data (6). This emphasizes the importance of implementing mechanisms to validate and cross-verify information, preventing the spread of misinformation in medical contexts (6).

The utilization of ChatGPT in various domains,

including healthcare, gives rise to ethical considerations encompassing privacy, data security, informed consent, and accountability (6). When integrating AI into healthcare, it is imperative to adopt a meticulous approach to protect patient information, secure informed consent, and establish accountability frameworks to promptly address any potential discrepancies or errors (6).

In the context of AI-assisted refractive surgery, the importance of rigorous human oversight by context experts and trained ophthalmologists cannot be overstated (6). This oversight not only ensures the accuracy and precision of AI-generated information but also addresses concerns regarding reliability, reproducibility, and the overall quality of patient care (6).

It is crucial to note that language models, such as ChatGPT, are presently neither permitted nor recommended as a substitute for medical professionals in providing guidance to patients (6). The use of such tools requires a validation process to uphold their reliability and effectiveness in clinical settings (6). A tool must undergo thorough validation before being considered for use in a manner that aligns with established medical standards and practices (6).

## Conclusions

In conclusion, the integration of ChatGPT holds tremendous potential in revolutionizing refractive surgery by improving patient education, streamlining clinical workflows, and serving as a valuable decision support tool for surgeons (7). However, challenges such as the risk of generating inaccurate outputs, biases in training data, and ethical considerations highlight the need for continuous refinement, diverse datasets, rigorous human oversight, and adherence to established medical standards (8).

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The content of this manuscript is the authors' original work and has not been written with the aid of a technical tool such as a language model. Identifying details modified to protect the identity of the patient.

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