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Artificial Intelligence in Plastic Surgery: Insights from Plastic Surgeons, Education Integration, ChatGPT's Survey Predictions, and the Path Forward

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Background: Artificial intelligence (AI) is emerging as a transformative technology with potential applications in various plastic surgery procedures and plastic surgery education. This article examines the views of plastic surgeons and residents on the role of AI in the field of plastic surgery.

Methods: A 34-question survey on AI's role in plastic surgery was distributed to 564 plastic surgeons worldwide, and we received responses from 153 (26.77%) with the majority from Latin America. The survey explored various aspects such as current AI experience, attitudes toward AI, data sources, ethical considerations, and future prospects of AI in plastic surgery and education. Predictions from AI using ChatGPT for each question were compared with the actual survey responses.

Results: The study found that most participants had little or no prior AI experience. Although some believed AI could enhance accuracy and visualization, opinions on its impact on surgical time, patient recovery, and satisfaction were mixed. Concerns included patient privacy, data security, costs, and informed consent. Valuable AI training data sources were identified, and there was agreement on the importance of standards and transparency. Respondents expected AI's increasing role in reconstructive and aesthetic surgery, suggesting its integration into residency programs, addressing administrative challenges, and patient complications. Confidence in the enduring importance of human professionals was expressed, with interest in further AI research.

Conclusion: The survey's findings underscore the need to harness AI's potential while preserving human professionals' roles through informed consent, standardization, and AI education in plastic surgery. *(Plast Reconstr Surg Glob Open 2024; 12:e5515; doi: 10.1097/GOX.0000000000005515; Published online 10 January 2024.)*

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INTRODUCTION

The field of plastic surgery has evolved significantly over the years, undergoing a profound transformation with the advent of advanced artificial intelligence (AI). AI represents a powerful set of technologies that leverage sophisticated algorithms and machine learning to analyze vast datasets and make data-driven decisions, ultimately enhancing patient care and surgical practices.[1,2] These applications extend not only to plastic surgery but also to various surgical fields and the broader field of medicine.

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AI has found its place in plastic surgery including applications in burns, hand surgery, wound analysis, breast surgery, head and neck surgery, flap monitoring, and aesthetics.[3–5] For instance, in burn treatment, AI-powered tools assist in accurately assessing burn severity and recommending optimal treatment options.[6] In hand surgery, AI aids surgeons in precise planning and execution of intricate procedures.[7] Furthermore, AI algorithms enable comprehensive wound analysis, monitoring the progress of healing with remarkable accuracy.[8] In the domain of aesthetics, AI-driven simulations allow patients and surgeons to visualize and plan procedures, enhancing the consultation process and ensuring realistic expectations.[9–11] In 1950, the visionary Alan Turing posed the fundamental question: "Can machines think?"[12] Today, we stand on the precipice of a different inquiry within the field of plastic surgery: can machines operate? It is a question that compels us to examine the extent to which AI has penetrated the field of plastic surgery and the awareness among plastic surgeons regarding the impending revolution it promises to bring.

This article represents an initial attempt to delve into the perspectives of plastic surgeons and plastic surgery residents, shedding light on their awareness of and engagement with AI's pivotal role in healthcare. Additionally, we assess ChatGPT's (version Generative Pre-Trained Transformer 3.5) potential to predict responses in comparison to actual survey responses for each question.

METHODS

A group of plastic surgery trainees and plastic surgery trainers created a 34-question survey focused on AI's role in plastic surgery. The survey was then sent via the South American Plastic Surgery Organization. The survey was distributed to 564 plastic surgeons worldwide, and we received responses from 153 of them, accounting for approximately 26.77% of the total. Notably, the majority of responses came from Latin America (Table 1). The survey covered a broad range of topics related to AI in plastic surgery, including the current level of experience with AI, attitudes toward AI in plastic surgery, data sources for training AI algorithms, and ethical considerations related to the use of AI in plastic surgery. It also asked about the future of plastic surgery and education in AI. (**See appendix, Supplemental Digital Content 1**, which displays the pie chart results of each survey question, **http://links.lww.com/PRSGO/D2**.) We asked ChatGPT to provide predictions for each question in the survey that was sent, and subsequently compared those results with the actual responses (Table 2).

Table 1. Geographic Distribution of Respondent Plastic Surgeons

Country of Practice	No. Responders
➢Colombia	54
➢Mexico	23
➢Brazil	15
➢Argentina	7
➢Venezuela	4
➢Peru	5
➢Dominican Republic	5
➢Chile	4
➢Others	16

Takeaways

Question: What are plastic surgeons' perceptions on the role of artificial intelligence (AI) in plastic surgery?

Findings: A survey of 153 plastic surgeons revealed limited AI experience among respondents. Although recognizing the value of AI in surgical planning and anatomical visualization, concerns were raised regarding overreliance on technology and patient privacy. The results highlight the need for informed consent, establishment of guidelines, and incorporation of AI education in plastic surgery training.

Meaning: Plastic surgeons' awareness and attitude toward AI in plastic surgery are still very limited. Integrating AI into education and practice requires addressing challenges while maintaining human professionals' significance.

RESULTS

Of 564 plastic surgeons, 153 (26.77%) completed the survey. They had an average age of 44 (range: 24–67), with 43 (28.5%) being female. The respondents included 37 trainees (24.5%), 59 consultants (39.1%), and 55 professors (36.4%). The survey received responses from 20 countries, with a notable representation from Colombia, Mexico, and Brazil.

Approximately 82.1% (124 individuals) reported little to no experience with AI in plastic surgery, whereas 17.3% (27 individuals) claimed moderate to extensive experience. Regarding AI usage, 82% (n = 123) had never used AI for PowerPoint presentations, 87.3% (n = 131) for scientific articles, and 75.3% (n = 113) for studying plastic surgery topics. Additionally, 88.6% (n = 132) had never used AI support during patient injections, and 78% (n = 117) had never used AI for surgical procedures such as rhinoplasty or breast augmentation. Concerning the potential benefits of AI, 66.2% (n = 100) believed it could enhance surgical planning accuracy and precision, 4.6% disagreed, and 29.1% were unsure.

Ninety percent recognized AI's value for visualizing anatomical structures in plastic surgery, with 35.6% (n = 53) believing AI could reduce surgical time and aid recovery, whereas 51% (n = 76) thought outcomes depended on procedure complexity and surgeon skill.

Regarding patient satisfaction, 36.7% (n = 55) saw AI as an enhancer, and 60% (n = 90) said it depended on patient expectations, surgeon expertise, and AI quality. Concerns about technology versus clinical judgment were divided: 35% (n = 51) cautioned against overreliance, 28.7% (n = 43) believed AI augments clinical judgment, and 36.7% (n = 55) said impact depends on AI technology and its implementation.

Table 2. Qualitative Predictive Analysis of our Survey by ChatGPT and a Comparison with Plastic Surgeon Responses

ChatGPT Prediction	Result of Survey	ChatGPT Accuracy (Correct or Incorrect)
General information:		
• More male plastic surgeons are expected to respond.	71.5% of male respondents	Correct
• Various age groups and levels of practice are likely to be represented.	25–75 y	Correct
Experience with AI:		
• Most respondents are expected to have no or limited experience with AI in plastic surgery.	82.7%	Correct
• Few have likely used AI technology in patient injections.	88.6%	Correct
Attitudes toward AI in plastic surgery:		
• Respondents are likely to agree that AI can improve accuracy, visualization, and patient satisfaction.	66.2%	Correct
• Concerns may arise regarding overreliance on technology and patient privacy.	65.3%	Correct
Data sources for training AI algorithms:		
• Electronic health records and imaging data are likely to be viewed as useful for training AI algorithms.	94.7%	Correct
• Biometric data may generate mixed responses due to ethical considerations.	96%	Incorrect
Ethical considerations:		
• Ensuring informed consent and establishing standards for responsible AI use are likely to be viewed as important.	91.9%	Correct
The future of plastic surgery and education in AI:		
• Respondents may believe that AI will increasingly impact plastic surgery and potentially revolutionize the field.	84%	Correct
• Reconstructive and aesthetic surgery are likely to be seen as areas with the greatest AI impact.	68%	Correct
• Preparing plastic surgeons and residents may involve incorporating AI education, encouraging continuing education, and ensuring access to high-quality AI technology.	Varies	Correct
Specific preferences and interest:		
• Administrative overload reduction, patient complication reduction, and surgical time/patient recovery are potential areas where respondents hope AI can bring change.	Varied	Correct
• Interest in participating in further research on AI in plastic surgery may vary.	90.6%	Correct
Survey creation:		
• Some respondents may speculate that the survey was created using AI technology.	59.7%	Correct

Drawbacks included patient privacy and data security (66.3%, n = 98), increased costs (54.4%, n = 81), and the importance of informed patient consent (91.9%, n = 137). Establishing responsible AI standards had 87.2% (n = 130) agreement, and 6.1% (n = 91) stressed transparency in AI algorithm development and training.

Clinical notes, pathology reports, electronic health records, patient demographics, medical history, and surgical data were identified as valuable data sources by a significant majority of respondents. Specifically, 95% (n = 142) expressed agreement for each of these sources. Additionally, 90.6% (n = 135) found imaging data from previous procedures and their outcomes to be valuable, whereas 96% (n = 146) believed that biometric data collected from patients before and after surgery held great potential for training AI algorithms in plastic surgery. Regarding the areas where AI is likely to have the greatest impact in plastic surgery, opinions varied: 37.6% (n = 56) believed it would be in reconstructive surgery, 31.5% (n = 46) in aesthetic surgery, and 21.5% (n = 32) in craniofacial surgery. Some respondents believed AI could impact all these fields.

To prepare plastic surgeons and residents for AI in plastic surgery, respondents recommended the following: 43.6% (n = 65) favored encouraging ongoing AI education and training, 40.3% (n = 60) suggested integrating AI education into plastic surgery residency programs, and 14.1% (n = 21) wanted improved access to high-quality AI technology.

Regarding desired changes from AI in their practice, opinions were as follows: 42.3% (n = 63) wanted reduced administrative workload, 37.6% (n = 56) hoped for fewer patient complications, and 20.1% (n = 30) wished for shorter surgical times and faster patient recovery. Only 64 respondents mentioned using AI tools, with most indicating they had not found them particularly useful.

When asked about AI's impact on plastic surgery in the next 5–10 years, 66% (n = 99) believed it would become more important, 18% (n = 27) thought it would revolutionize the field, and the rest expected a minor role. The majority (87.8%, n = 130) did not think AI would replace humans in plastic surgery and 90.6% (n = 135) expressed interest in further AI research in plastic surgery. Opinions on the need for a regulatory body for AI in plastic surgery varied: 62.8% (n = 93) believed it is necessary, 8.1% (n = 12) were uncertain, and 29.1% (n = 43) were unsure. Finally, 59.7% (n = 89) believed the survey was created by AI technology.

DISCUSSION

Plastic Surgeons' Experience of AI

In plastic surgery, the application of AI has demonstrated considerable potential in improving surgical outcomes, augmenting patient safety, and optimizing healthcare delivery.[11–13] The results of this survey provide a unique and valuable insight into the perspectives of plastic surgeons regarding the adoption of AI. The findings reveal that a significant proportion of plastic surgeons has limited experience with AI, with only 17.3% reporting

moderate or extensive experience with AI in plastic surgery, and the majority of plastic surgeons have not utilized AI in various tasks, such as preparing PowerPoint presentations (82%), scientific articles (87.3%), or studying plastic surgery topics (75.3%). This may indicate a lack of awareness or access to AI tools and resources within the plastic surgery community. It is crucial to bridge this gap and promote the use of AI technologies in these areas, as they have the potential to enhance efficiency and productivity in research and education.

Plastic Surgeons' Attitude toward AI

The respondents' perspectives on the potential benefits of AI in plastic surgery are mixed (see section 2 of **Supplemental Digital Content 1, http://links.lww.com/PRSGO/D2**). Although a significant majority (82.1%) agreed that AI can enhance accuracy and precision in surgical planning, a small percentage of 4.6% held a contrary view. Additionally, the recognition of AI's value in providing improved visualization of anatomical structures was acknowledged by a significant majority (90%). This demonstrates the potential of AI to augment surgical procedures. Recent studies on AI-powered tools such as facial analysis, preoperative planning, surgical navigation, and postoperative monitoring have facilitated more precise and personalized surgical interventions, thus enhancing the efficacy of these procedures.[14,15] AI algorithms can analyze large datasets of facial images, three-dimensional models, and medical records to identify patient-specific factors that affect surgical outcomes.[16,17] One of the most significant benefits of AI in plastic surgery is its ability to improve surgical accuracy and precision,[18] and that it can assist surgeons in identifying and locating critical structures, reducing the risk of damage to surrounding tissues and improving surgical outcomes, for example, in facial reconstruction and breast reconstruction.[19]

Regarding specific areas of impact, respondents expressed their opinions on the potential influence of AI in different subspecialties of plastic surgery. The majority believed that reconstructive surgery (37.6%) would be the field where AI is likely to have the greatest impact, followed by aesthetic surgery (31.5%) and craniofacial surgery (21.5%).

Concerns about AI and Ethical Considerations

One of the concerns raised by plastic surgeons is the potential overreliance on AI technology and its impact on clinical judgment (see section 4 of **Supplemental Digital Content 1, http://links.lww.com/PRSGO/D2**). Thirty-five percent cautioned against overreliance on AI, as they believed it could compromise clinical judgment. Another segment (36.7%) acknowledged that the impact would depend on the specific AI technology used and its proper implementation. The differing perspectives on this matter emphasize the importance of finding balance between harnessing the potential of AI as a valuable aid in enhancing clinical judgment and safeguarding the importance of human expertise, particularly in the field of plastic surgery, where an appreciation for creativity and harmony holds important significance. The successful integration of AI should be based on a collaborative approach, where AI is seen as a supportive tool rather than a replacement for human professionals.

Data security and patient privacy emerged as significant concerns among the respondents. A majority (66.3%) expressed concerns about patient privacy and data security when using AI in plastic surgery. Opinions regarding the need for a regulatory body to address AI in plastic surgery varied, with 62.8% believing that such a body is necessary. This reflects the ongoing discussions and debates surrounding the development of appropriate regulations and guidelines to ensure the responsible use of AI in our everyday lives. As of 2023, the European Union has implemented the AI Act, a comprehensive law governing the use of AI. Likewise, in numerous states across the United States, there is an ongoing discussion about the need for AI regulation.[20–22] This highlights the need for robust measures to safeguard sensitive patient information when implementing AI technologies.

Establishing standards for the responsible use of AI in plastic surgery was strongly supported, with 87.2% agreeing on the necessity of such standards. This indicates the need for guidelines and regulations to ensure the ethical and safe integration of AI technologies. Moreover, the importance of increasing transparency around the development and training of AI algorithms was acknowledged by 61.1% of respondents (see section 4 of **Supplemental Digital Content 1, http://links.lww.com/PRSGO/D2**). An illustrative example of this is the potential for AI to inadvertently perpetuate biases related to ethnicity and gender. In isolation, AI applications have the capacity to reinforce racial divisions and potentially erode diversity, as exemplified in the field of cosmetic surgery.[23] In Table 3, we present potential solutions aimed at addressing issues related to patient privacy, data security, and algorithmic biases.

Education in Plastic Surgery and AI

Several studies have also suggested that AI can be used to improve the quality and efficiency of plastic

Table 3. Strategies for Enhancing Patient Privacy, Data Security, and Mitigating Algorithmic Biases

Ethical Consideration	Potential Solutions
Patient privacy concerns	➢Data encryption and access control: implement robust encryption and access controls to protect patient data. ➢HIPAA compliance: ensure AI systems adhere to HIPAA regulations for patient data confidentiality.
Data security	➢Data quality assurance: regularly audit and validate data to reduce biases and errors in AI algorithms. ➢Anomaly detection: implement systems to identify unusual data patterns that may indicate security breaches or inaccuracies.
Algorithmic biases	➢Diverse data sources: use diverse and representative data for training to mitigate biases. ➢Continuous monitoring: monitor AI algorithms for biases and disparities, and correct them as they are identified. ➢Explainability and transparency: develop transparent AI systems that provide explanations for decisions.

HIPAA, Health Insurance Portability and Accountability Act.

surgery training programs. For example, when the AI text-to-picture system was used, it generated clinical photographs to improve medical and plastic surgery education.[24] AI-powered simulators provided trainees with a safe and controlled environment to practice surgical techniques, reducing the risk of errors and complications during actual surgery.[25] This can also enhance the overall quality of training programs from medical school to the end of the residency program, ensuring that plastic surgeons are adequately trained and competent in the latest surgical techniques.[10,26–29] Another area of medicine where AI plays an important role in education is radiology with the use of augmented radiology and case examples.[30,31] Our survey shows that to effectively prepare plastic surgeons and residents for the integration of AI (see section 3 of **Supplemental Digital Content 1, http://links.lww.com/PRSGO/D2**), respondents emphasized the importance of continuing education and training (43.6%), incorporating AI education into residency programs (40.3%), and ensuring access to high-quality AI technology (14.1%). These recommendations underscore the need for structured initiatives to equip plastic surgeons with the necessary skills and knowledge to effectively leverage AI tools in their practice. We introduce in Figure 1 a structured proposal of how to integrate AI in plastic surgery training and education.

Data Sources

Clinical notes and pathology reports from previous cases were identified as a valuable data source by a significant majority of 95% of the respondents (see section 3 of **Supplemental Digital Content 1, http://links.lww.com/PRSGO/D2**). Likewise, electronic health records capturing patient demographics, medical history, and surgical data were recognized as another valuable data source, also with 95% of respondents expressing agreement. When it comes to imaging data of previous procedures and their outcomes, 90.6% of respondents believed it to be the most useful data source for training AI algorithms in plastic surgery. Furthermore, the potential usefulness of biometric data collected from patients before and after surgery was widely acknowledged, with 96% of respondents in agreement. These findings highlight the significance of high-quality data sources in training AI models for enhanced decision-making and patient outcomes. This emphasizes the importance of accurate and comprehensive data collection.

Future of AI in Plastic Surgery

Looking forward, plastic surgeons hold varying expectations regarding the future impact of AI with a majority (66%) of respondents believing that AI will become an increasingly important tool; 18% thought it would revolutionize the field. These optimistic views suggest that plastic surgeons recognize the potential of AI to reshape the landscape of plastic surgery, enhancing patient care and outcomes. Finally, the majority of respondents (87.8%) expressed confidence in the continued role of human professionals and did not believe that AI will one day replace humans in the field of plastic surgery. Furthermore, a significant majority (90.6%) indicated their interest in participating in further research on the use of AI in plastic surgery (section 5 of **Supplemental Digital Content 1, http://links.lww.com/PRSGO/D2**), demonstrating the willingness of plastic surgeons to contribute to the advancement of AI in the field.

ChatGPT Survey Prediction

ChatGPT, developed by OpenAI, is a versatile language model for generating human-like text based on input. It handles various natural language tasks, including answering questions, explaining, creating content, and engaging in conversations.[32] In plastic surgery, ChatGPT has found applications in systematic reviews, virtual consultations, preoperative planning, and patient education.[33–36] Our study demonstrated ChatGPT's ability to provide a broad qualitative prediction with approximately 91% accuracy in survey questions, showcasing its potential to analyze extensive datasets and offer insightful predictions. However, challenges exist, and ChatGPT lacks medical specialization, which can lead to inaccuracies and ethical concerns. It may struggle with nuanced moral decisions and individual patient preferences. Biases from its training data can affect recommendations and perpetuate healthcare disparities. To use ChatGPT effectively in plastic surgery, validation, ongoing monitoring, and expert medical judgment are crucial.[37–39]

Study Limitations

The geographical concentration of respondents in our survey being primarily from South America introduces a limitation to the generalizability of our study's findings. Plastic surgery practices, and the integration of AI technologies, can be influenced by regional disparities in healthcare infrastructure, economic factors, and educational resources.

In light of this limitation, it is crucial to emphasize that our results should be interpreted within the context of the geographical bias present in our sample. Our study is the first of its kind; hence, we cannot directly compare our respondent group to the global population of plastic surgeons and trainees. Our findings can still provide valuable insights into the specific challenges and opportunities related to AI adoption within the plastic surgery community. Future research endeavors should aim to replicate this study on a larger scale, encompassing a more diverse set of regions and healthcare systems to obtain a more comprehensive understanding of AI adoption trends in the field.

CONCLUSIONS

This study reveals the evolving landscape of AI in plastic surgery, highlighting limited current experience and diverse perspectives among plastic surgeons and residents. Bridging the knowledge gap and ensuring access to AI tools is essential to maximize its potential benefits. The varying opinions on AI's impact on plastic surgery underscore the need for ongoing discussions and collaborations. Ethical concerns, especially regarding patient

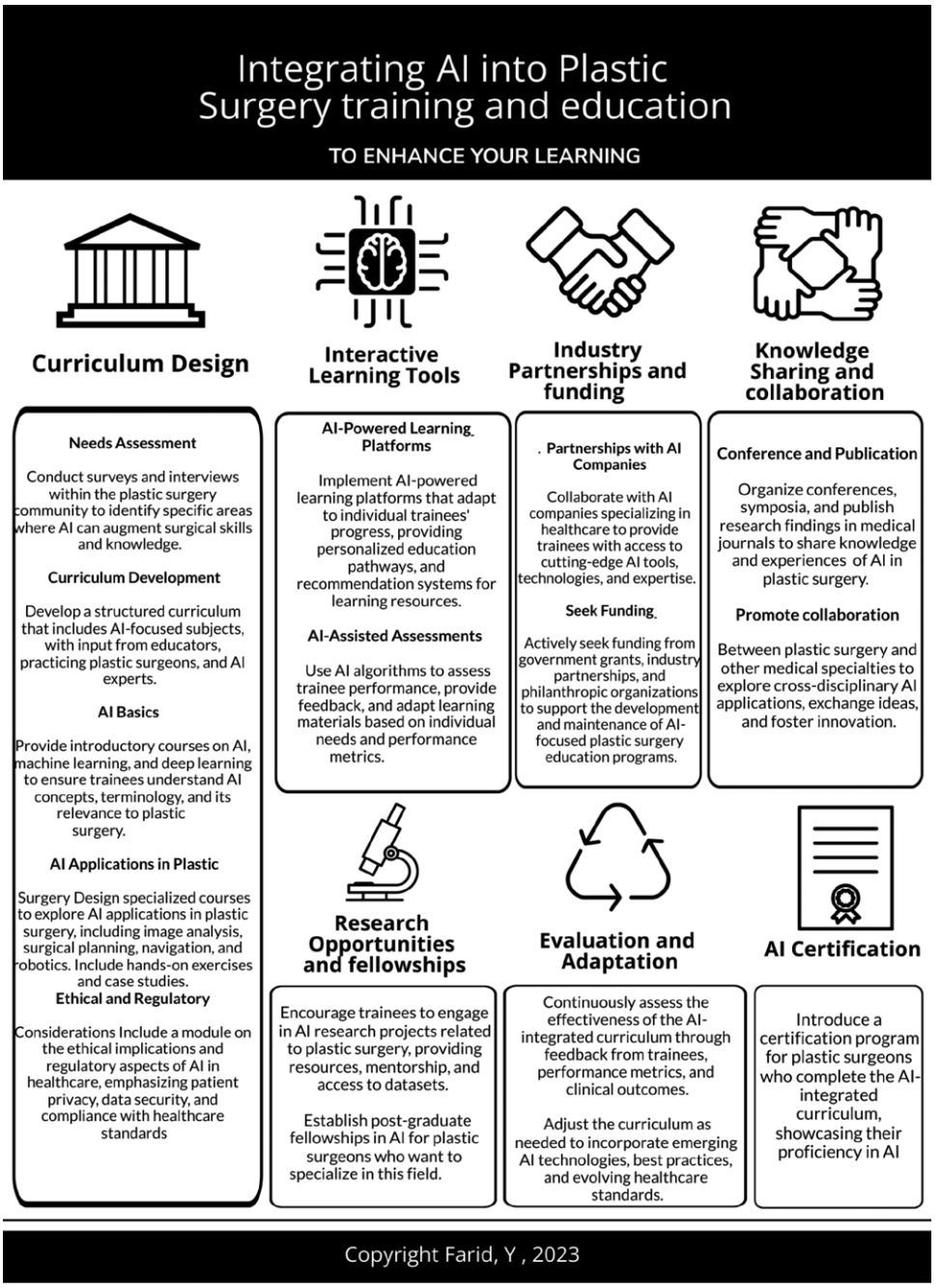

Fig. 1. Structured proposal of how to integrate AI in plastic surgery training and education.

privacy and data security, call for regulatory frameworks. The study identifies valuable data sources for training AI algorithms and emphasizes the importance of comprehensive data collection. Plastic surgeons expect AI to have the greatest impact in reconstructive surgery, aesthetic surgery, and craniofacial surgery. They also recognize the need for AI education and training programs to prepare future generations of plastic surgeons for the integration of AI technologies. Although optimistic about AI's future, plastic surgeons value human expertise and acknowledge the potential of AI models like ChatGPT for survey research. Balancing AI with human skills, guided by ethics and education, will enable AI to enhance plastic surgery while preserving the human touch.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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