

Artificial Intelligence in Plastic Surgery

Vijay Kumar

Department of Plastic & Reconstructive Surgery, King George's Medical University, Lucknow, UP, India

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Artificial intelligence (AI) is the branch of computer science that performs various complicated tasks, for which human intelligence is required. The term “Artificial Intelligence” was first given by an American scientist John McCarthy.¹

AI in the medical field has recently gained popularity, and its use in other fields is widely accepted. AI technology is being used in the banking, education, e-commerce, and manufacturing sectors, agriculture, production, engineering sectors, etc. Various computer softwares also use AI in web search, sound recognition systems, etc. In the medical field, AI is widely used in the management of large amounts of data, which would otherwise take extensive effort. AI can extract data including image files, analyse the data, make a diagnosis, draw a prognosis, drug implementation discovery, etc. scope of AI in medicine is very vast, and practically many complicated tasks can be completed by fairly using AI.²⁻⁴

In previous times, before the era of smart devices and Biosensors, medical technology was largely machine-based. With the help of modern AI-enabled programs, those devices are converted into “Intelligent medical devices” based on digital tools, navigation systems, virtual reality, etc.

The huge available data makes the vast scope of AI in the medical field. As a routine practice we record our data related to patients, diagnosis, treatment, outcome, etc., with the help of already available large amounts of data, the application of AI becomes more feasible. AI is being used in various clinical specialties such as cardiology for ECG monitoring and estimation of cardiovascular risk, endocrinology like blood sugar monitoring and diagnosis and prevention of hypoglycemic episodes, pulmonary medicine like performing pulmonary function tests and detection of abnormalities, neurology like seizure detection devices, nephrology like glomerular filtration rate (GFR) calculator and diagnosis of abnormal GFR, gastroenterology like radiological diagnosis of various bowel conditions, oncology in making histopathological diagnosis and cancer markers etc.⁵⁻⁹

Uses of AI in Plastic Surgery

Plastic surgery is a branch largely dependent on decision-making, accuracy, practice and perfection. With the help of AI we can provide vast educational materials for patients, residents, and clinicians.

Radiological diagnosis- Radiologic image reading and making a clinical diagnosis of fractures, abnormal bony proportions, bone tumors, bony fusion, congenital anomalies etc.

***Correspondence:** Vijay Kumar, kuhwidush@hotmail.com

Department of Plastic & Reconstructive Surgery, King George's Medical University, Lucknow, UP, India

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Facial plastic surgery- Plastic surgery on the face is largely dependent on age-based facial proportions, line of wrinkles, underlying facial skeleton, and follow-up images in case of repeat surgery. By using software specific to face (FaceX), one can see the post-operative outcomes after various cosmetic surgeries. Elliot *et al.* studied the outcomes of Rhytidectomy procedure by using FaceX technology, they found it highly useful in estimating the outcome.¹⁰

Cosmetic surgery procedures- Other procedures where this technique can be used is SMAS-pllication, eyebrow lift, eyelid surgeries, platysmaplasty, rhinoplasty, etc. Other uses of AI in facial surgery are facial fractures, understanding geometry, and surgical planning. Craniofacial anomalies pose a great challenge to plastic surgeons due to multiple bony and multiple anatomical component involvements. With the help of AI and 3D printing techniques and using age-based stored images, surgical planning can be done, not only surgical planning, but also mock surgery can be performed to reduce operative time and to perform smooth surgery. Many rhinoplasty patients visit to plastic surgeons with high and sometimes unrealistic expectations. Based on their pre-operative images, age-specific images, and 3D models the amount of correction and expected outcomes can be shown to the patient.¹¹

Free flap monitoring- Free flap monitoring is an essential component after surgery, and careful and accurate monitoring can salvage many compromised flaps. With the use of AI arterio-venous insufficiency can be accurately diagnosed.

Data recording-Record monitoring and data extraction is another use of AI which is extremely helpful in extracting useful data from large and miscellaneous data. Which is helpful for publications, strategy making, protocol making, and implementation.

Surgical Simulation and Robots - Simulation surgery is an important aspect of surgical specialties, especially plastic surgery. It helps in better understanding the surgery, better and précised surgery as it increases the confidence of the surgeon, and improves the estimation of outcome of surgery. AI-mediated simulators can be used to plan surgeries and watch

the outcomes, hence surgical error is minimized, especially while dealing with rare surgeries. AI-enabled robotic surgery is another scope, which is highly accurate, précised, and with improved dexterity.

Precautions while using AI in Practice

The first and most important thing is that AI should assist and not replace the clinical decision and clinician.

Frequent feedback should be taken for its adequacy, and errors of AI should be kept in mind. Patient information and consent should be obtained, in case AI is used for clinical purposes. Patient-doctor interaction should not be compromised while using AI integrated program.

Although the use of AI is vast in plastic surgery, but clinician's expertise, decision-making, experience, communication, patient's faith, and comfort are crucial and should not be overlooked while using AI.

Limitations of Artificial Intelligence

Require human input, hence subjected to the risk of bias, Limitation of resources, computers, software, Socio-economic cultural barriers etc.

Ethical Conduct

Patient privacy must be ensured and data should be protected. Informed consent should be taken to use AI in their diagnosis, planning, management etc.

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