What is the biggest threat to the future of plastic and reconstructive surgery training worldwide?

Pessimism about the future of plastic surgery is not an uncommon feeling. Many point to the loss of work to more regionally specific specialities. Others suspect that the range of conditions managed by plastic surgeons will be narrowed as non surgical management advances. An especially contemporary concern is the recent strident advances in artificial intelligence (AI) technology.

Plastic surgery's underlying vulnerability to losing work to regional specialities is in its generalism. Plastic surgery is defined first and foremost by techniques and principles rather than regional anatomy, meaning plastic surgeons operate throughout the body, although this largely excludes body cavities.[1] Techniques first pioneered by plastic surgeons, most notably flap reconstruction, have since been integrated into breast surgery, otolaryngology, maxillofacial surgery and reconstructive urology. In fact most facial plastic surgeons are ENT surgeons by training.[2] In terms of breast surgery, plastic surgeons in the UK tend to only be involved in free flap breast reconstruction. However, with breast surgery likely to become its own speciality in the coming years, this work may well be lost to future generations of plastic surgeons.[3]

The reasons for this are simple, surgeons devoted to a specific anatomical region tend to receive referrals for patients with surgical pathologies in that region in their dedicated units.[2] Since those surgeons are now trained in plastic surgery techniques there is less reason for them to involve plastic surgeons. Some foresee this trend continuing and future plastic surgeons being confined to a much narrower remit, likely focussed on skin cancer, burns and hand surgery.

This essay is primarily focussed on operations which are typically covered by state funded institutions in the developed world, as opposed to aesthetic surgery. Aesthetic surgery's association with plastics is so firmly established in the public consciousness that the terms are typically interchangeable to lay persons. This will likely largely protect the private workload of plastic surgeons.

Maintaining and expanding the current diverse workload of plastic surgeons will require two components: effective leadership and advocacy by professional associations of plastic surgeons worldwide, and further innovation by plastic surgeons. Steadfast action by professional associations could help to codify the role of the plastic surgeon. Innovation could pursue the surgical frontiers of lymph node surgery,[2] intrauterine surgery,[4] reconstructive transplantation[5] including facial transplantation and practical application of biomimicry.[6]

In terms of the advances of non surgical treatments, there is reason for cautious optimism in plastic surgery. The fundamental reason that surgery is susceptible to usurpation by medications and non surgical procedures are the considerable risks, waiting times and costs associated with surgery. This has most dramatically impacted cardiothoracic surgery, which has been impacted by the advent of new medications and endovascular procedures over recent decades and an attendant loss of trainees.[7] The considerably more superficial nature of most indications for plastic surgery makes minimally invasive techniques less advantageous. For example in carpal tunnel release, endoscopy has failed to broadly supplant open release.[8] The indications for plastic surgery are also typically less susceptible to drug treatment, with trauma and neoplasm making up a significant proportion of the workload. The management of rheumatoid arthritis is one major exception to this.[9] Drug treatment of early Dupuytren's contracture is also in its early stages.[10] Nevertheless, few conditions managed by plastic surgeons are amenable to existing or foreseeable non surgical management.

Over the last few years, artificial intelligence has dramatically outstripped expectations. A striking example is the victory of Google’s AlphaGo programme over the most accomplished living player of the highly complex east asian board game Go.[11] It was widely believed by Go practitioners that AI couldn’t beat expert human players or certainly wouldn’t for decades to come.[11] The game was thought to be too complex, requiring too much creativity and initiative for a programme to compete with professionals. This was proven false in a series of games in 2016. The AI notably made unconventional and highly effective moves humans would very likely have not made. Even more strikingly, the subsequent AlphaGo Zero program was superior to its predecessor and used no data from human games, its playstyle was entirely self devised.[12] Then there are the more recent advances in GPT software, GPT-4 is said to show “sparks of general intelligence.”[13] An AI guided robot has also been able to complete simulated surgery, anastomosing a bowel, autonomously. The robot used a combination of hard programming and deep learning and even outperformed human surgeons by several metrics.[14]

Doubt about the progress of AI has not proven prophetic over the last few years. There are however some reasons to believe medicine is safer than some other professions. Games like chess and Go are favourable environments for machine learning. The inputs the computer receives are unambiguous, there is a clear rule set, clear victory conditions and vast numbers of repetitions of the scenario can be undertaken by the machine in simulation. Radiology is the speciality most often thought to be vulnerable to AI given the large volume of existing images for AI to learn from.[15] However many specialities including ophthalmology have seen successful proprietary deep learning programs be employed.[16] These are largely in a diagnostic capacity but given the above mentioned bowel anastomosis robot, procedures may be impacted sooner than expected. This is an isolated technical task however and doesn’t equate to totality of the role of a surgeon.

The creativity of plastic surgery may delay task automation given the wide range of reconstructive options available in various situations. It seems unlikely that currently practising surgeons will be significantly impacted by task automation, future generations of surgeons however will likely have significantly different careers to their predecessors. The expenses and time associated with training new surgeons alongside rapid advancements in the efficacy of the technology make several aspects of surgical training vulnerable to automation. An autonomous surgical robot, in conjunction with diagnostic algorithms and AI image interpretation would simply require maintenance and could conceivably improve its own practices. Were this to happen, far fewer trained surgeons would likely be needed and even their training would take a different form.

This would however require a seismic shift in the provision of healthcare both logistically and philosophically. It would not only be a gargantuan technical task but would require widespread public acceptance. Whether such acceptance would be forthcoming is difficult to anticipate, however there is evidence that it would be. One study found that interacting with a triage robot[17] was considered acceptable to most patients and another found that automated cochlear implant insertion was also acceptable.[18] This may not hold true for major surgery, but this acceptance of robots may well increase as they become more prevalent in wider society, with one study linking higher acceptance of robot assisted surgery with having worked with robots.[19] Entirely autonomous surgery still has enormous obstacles to overcome though. More likely, robots with limited autonomy would be integrated into existing practice, analogous to the impact of sewing machines on textile production. Limited healthcare budgets would also likely be an obstacle, it certainly has been for the integration of the latest information technologies.[20]

Of course only time will tell what the greatest threat to plastic surgery training is. The rise of AI may dramatically change the world of plastic surgery but if it improves outcomes, then it is an improvement even if it significantly curtails training. This also predominantly focuses on the developed world, already decades old medical technologies are not available to most of the world's population.[21] For the majority of the world's population, the greatest threat to plastic surgery training is clearly lack of existing resources. This limits the provision of plastic surgery generally and by extension training of new plastic surgeons. In the developed world training is likely most threatened by advancing AI powered automation. There is always recourse to oppose the loss of work to other specialities and many experts in the field are not especially concerned by it.[2] Automation may seem a distant possibility however it is an existential threat to current practice. It could drastically reduce the number of trainees and shift the focus almost entirely to research, communication and intraoperative decision making rather than technical skills.

It does however seem unlikely that a specialty as historically dynamic and innovative as plastics will fail to adapt to changes in healthcare. It is worth noting that automation could already have eliminated many existing jobs but they have failed to do so. Proponents of such technology are reminiscent of Keynes's prediction that the work week would fall to just 15 hours.[22] The nature of work has doubtless changed dramatically, only a tiny proportion of the population are now involved in farming for instance. However a dramatic reduction in the amount we work would require a fundamental shift in our economic paradigm. No matter how sophisticated a machine became, it may not entirely supplant the surgeon's ability to communicate with and counsel patients through some of the most difficult times of their lives, meaning there should be a role for future generations of plastic surgeons for many years to come.

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