EDITORIAL

https://doi.org/10.5125/jkaoms.2018.44.5.205
pISSN 2234-7550 · eISSN 2234-5930

The Fourth Industrial Revolution and oral and maxillofacial surgery

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The Fourth Industrial Revolution was described in the book of Klaus Schwab, founder and executive chairman of the World Economic Forum. The First Industrial Revolution used water and steam power to mechanize production, while the Second Industrial Revolution used electric power to create mass production. The Third Industrial Revolution used electronics and information technology to automate production. Now, the Fourth Industrial Revolution is building on the Third, a digital revolution that has been occurring since the middle of the last century. It is characterized by a fusion of technologies that has blurred the lines between the physical, digital, and biological spheres[1]. The Fourth Industrial Revolution is considered to be more advanced and widespread than the previous industrial revolutions. Intelligent information technologies of the current industrial revolution include artificial intelligence, the Internet, cloud computing, big data, and mobile convergence on existing industries and services. In particular, this revolution combines all the products and services of the real world with new technologies in various fields such as three-dimensional (3D) printing, robotics, biotechnology, and nanotechnology[2].

We have already experienced changes and advancements, specifically in dental implants, esthetic surgery, and oncology. Modern 3D imaging and implant treatment planning systems are available today for precise dental implant planning and placement. The transfer of implant position information to industrially manufactured templates for guided implant surgery has been possible for many years[3]. Cone-beam computed tomography (CBCT) has been associated with computer-aided design and computer-aided manufacturing (CAD/CAM) providing surgical planning in both virtual and 3D environments, providing the practitioner with a realistic view of the patient's bony anatomy and permitting virtual execution of the surgery in an ideal and precise prosthetically driven manner. This approach has been introduced and allowed for the transfer of virtual planning to the clinical procedure, allowing for less invasive surgeries, adequate implant placement, reduction of postoperative discomfort, and fabrication of prosthetic structures before surgical procedures[4].

In addition, 3D computer-assisted technology has recently been used in orthognathic surgery to improve surgical planning and outcomes. Conventional two-dimensional (2D) treatment plan for orthognathic surgery has limitations such as landmark identification and overlapping of anatomic structures, especially for patients with facial asymmetry. However, 3D computed tomography allows for reconstruction of a 3D craniofacial skeletal model for accurate presentation of complex 3D shapes and surgical plans on 3D skeletal models extracted from computed tomography (CT) images to simulate surgical procedures on a virtual environment, as well as to predict the final outcome[5]. Intraoperative guidance such as surgical splints, positioning guides, and preoperative navigation plans are digitally designed and prepared by simulating surgery on a 3D CT image model. 3D printed surgical occlusal splints for orthognathic surgery require less effort than a manually fabricated splint using conventional face bows and dental casting models on an articulator[6].

Big data and machine learning, a subfield of artificial intelligence (AI), can help to clinically resolve issues in oral and maxillofacial surgery, including aesthetic surgery and cancer treatment[7]. Soft tissue prediction in aesthetic surgery has been very difficult for a long time. 3D soft tissue analysis systems with AI techniques may easily result in precise predictions for clinicians and patients. 3D virtual surgery with AI may reduce the time and efforts of oral and maxillofacial surgeons

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to analyze 3D images. Precision medicine in oncology is an approach to disease prevention and treatment that takes into account genetic variability and environmental and lifestyle influences that are unique to each patient. It also facilitates stratification of patient populations that vary in susceptibility to disease and response to therapy. Shared databases (big data) and implementation of new technology systems designed to advance the integration of this information will enable health care providers to more accurately predict and customize prevention and treatment strategies for patients[8].

Robotic surgery is often heralded as the new revolution, and it is one of the most discussed subjects in surgery today[9]. Robot-assisted maxillofacial surgery has been growing steadily in popularity. Taking inspiration from its use in other surgical fields, robotics offers benefits including a 3D magnified view, precise movements, bimanual operation with articulated arms, and suppression of tremor, enhancing the surgeon's physical capabilities. Therefore, procedures with robotic assistance can be performed with less blood loss, fewer complications, shorter hospital stays, and better cosmetic results than standard open surgical techniques[10]. If AI technology is fused into the robotic surgery system, even unskilled surgeons can perform any maxillofacial surgery.

On the other hand, in March 2018, an experimental Uber vehicle, operating in autonomous mode, struck and killed a pedestrian in Tempe, Arizona, USA—the first fatal accident of its kind. The automated driving system is a complex combination of various components that can be defined as systems where perception, decision making, and operation of the automobile are performed by electronics and machinery instead of a human driver. This leads to a central legal question surrounding the use of fully autonomous cars: who should be made responsible if such an incident occurs? In the case of robotic surgery with an AI system, who should be held responsible for surgical accidents? The manufacturer, AI system, or surgeon?

Klaus Schwab[1] stated that "Debates about fundamental issues such as the impact on our inner lives of the loss of control over our data will only intensify in the years ahead. Similarly, the revolutions occurring in biotechnology and AI, which are redefining what it means to be human by pushing back the current thresholds of life span, health, cognition, and capabilities, will compel us to redefine our moral and ethical boundaries. In the end, it all comes down to people and values. We need to shape a future that works for all of us by putting people first and empowering them."

Although the Fourth Industrial Revolution could be ended in a mere slogan, challenges and advancements have been frequent in the history of humankind. As always, if we cannot adapt to environmental changes, we will fall behind the competition. Guiding and preparing the future revolution must become a role of oral and maxillofacial surgeons without eliminating humanity and morality.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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