The interrelation between science and surgery in the oral-maxillofacial (OMF) field

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According to the Science Council, "Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence."[1] The relatedness of science and surgery is a long-standing concept. The clinical practice of surgeons is grounded on scientific research.[2] Additionally, the attestation of surgeons, contributes to scientific understanding. This essay will discuss the interrelatedness of science and surgery, highlighting their dependent nature in the medical field. Firstly, the past and future advancement of surgery based on science in the Oral-maxillofacial (OMF) field will be discussed by looking at Sushruta and robot-assisted surgeries. Secondly, the OMF case-specific advancements of science based on surgery will be discussed by looking at Vesalius and pre-emptive third molar management.

Sushruta is accredited as the originator of plastic surgery. His use of scientific methodology led to detailed descriptions of over 300 surgical procedures.[3-4] It is estimated that he lived in India between 1000 to 800 BC, in the era of the Golden Age.[5] He specialised in Nasa, Oshtha and Karna Sandhan – which translates to rhino-, lobulo- and otoplasty respectively.[3] In certain cases of nasal defects, he would use skin from the forehead as a pedicled flap. This method, which is called the "Indian flap", is still in practice today. His scientific reasoning, classification and study of OMF defects, led to the development of reconstructive surgery.

The application of technological science in the field of medicine is demonstrated by increased robot-assisted surgeries. Robot-assisted OMF surgery has been associated

with decreased blood loss, fewer complications and shorter hospitalisations compared to standard open surgery.[6] Additionally, the combination of robotics with imaging technologies increases surgeon visibility, and precision, and allows for minimally invasive procedures. This presents better cosmetic results.[6-7] Examples of such surgeries include the excision of vallecular and lingual thyroglossal duct cysts, radical tonsillectomy, primary or recurrent neoplasm excision, parathyroid resection, post-ablative defect reconstruction, cleft lip and palate, maxillofacial fractures, etc.[6] More studies and technical modifications are required before robots become the standard treatment paradigm.[6,8] Nonetheless, the use of robots in OMF surgery is an application of science in surgery.

The two mentioned OMF examples highlight how science advances surgery, implying that surgery cannot exist without science. The next two examples will highlight how surgery advances science, by looking at the past and possible future practices in the OMF field.

Andreas Vesalius is considered the founder of modern anatomy.[9] His surgical dissection of human cadavers in the 16th century launched anatomy as a scientific discipline.[10] Vesalius was taught anatomical theory from Galen's texts, with limited practical application. After his studies, Vesalius had the opportunity to dissect executed criminals, and skeletons from the Parisian Cemetery of Innocents in France. His surgical findings presented information contradicting that of Galen. An example relevant to OMF surgery is Galen's belief that the mandible comprised of two bones; Vesalius rightfully claimed it to be one. Additionally, Galen did not use scientific nomenclature; the nomenclature of anatomy was developed by Vesalius and expressed in his book *De Fabrica*. Moreover, Vesalius pioneered the systematic teaching of anatomy by preparing anatomical plates, with detailed illustrations.[9-10] Vesalius's surgical dissection profoundly altered the study of the anatomical structures, which further led to advancements in physiological and pathological understanding.[11]

A possible future advancement of science based on surgery is pre-emptive third molar management. Impacted mandibular third molar teeth are in close proximity to the lingual, inferior alveolar, mylohyoid and buccal nerves.[12] It is estimated that the lingual nerve is damaged in 0.5% of mandibular third molar extractions, while the inferior alveolar nerve is damaged in 1.1% of cases.[13] Although complications are usually minor, the volume of surgeries leads to significant morbidity; it is estimated that 5 million people undergo third molar teeth extraction each year in the United States.[14] James R. Hupp, editor-in-chief of the *Journal of Oral and Maxillofacial Surgery*, has an acquaintance that performs molar extraction surgeries before root development is complete. In theory, this would

prevent possible innervation disorders if the teeth become impacted. Hupp predicts that the epidemiological research of this surgery can make it the standard for third molar management in the future.[7] Thus, this modern case justifies the advancement of scientific fields of study, from surgery.

The OMF-specific examples offer different arguments on the interrelatedness between science and surgery. Vesalius and pre-emptive third molar management highlight how surgery advances science. The implication thereof is that science, in the medical field, would not exist without surgery. In contrast, Sushruta and robotic surgery imply that surgery would not exist without science. Science is the pursuit of knowledge and understanding based on evidence.[1] The evidence here being surgical findings. Moreover, scientific deduction and experiments contribute to the knowledge and/or skillset required for successful surgery. Hence, science and surgery are dependent: one cannot exist without the other in the medical field, and success in one, leads to advancements in the other.

In conclusion, the evidence suggests that surgery is simultaneously an application of science, and an investigative procedure contributing to knowledge. Due to the dependency of the concepts, neither is exhaustive of the medical field. This perspective is essential in clinical practice, since surgery cannot be evaluated without an appreciation of science, and vice versa.

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