Orthognathic Surgery: Past — Present — Future

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Practicing Surgery with a Reverence for the Past Provides Perspective and Humility

We owe a great deal of gratitude to pioneer surgeons and orthodontists in the field of orthognathic surgery (OGS).1 Although there have been many giants in both fields, 3 surgeons and 3 orthodontists deserve special mention for their milestone contributions. These surgeons are Hugo Obwegeser, William Bell, and Hans Luhr and the orthodontists are Edward Angle, William Proffit, and Lawrence Andrews. Obwegeser described a safe and practical way to section and reposition the maxilla (i.e., Le Fort I osteotomy), the mandible (i.e., sagittal ramus osteotomies), and the chin (i.e., intraoral oblique osteotomy). Bell utilized an experimental model to prove the biologic safety of orthognathic osteotomies. Luhr developed and demonstrated the use of small metal plates and screws for the practical and safe rigid fixation of all the bones of the cranio-maxillofacial skeleton. Concerning the orthodontist pioneer’s, Angle was the first to articulate the difference between a dental malocclusion and a dentofacial deformity and visualize the possibilities through elective jaw osteotomies. He challenged surgeons to consider osteotomies for jaw reconstruction. It was Proffit who recognized the need for a routine, collaborative, surgeon-orthodontist interaction to correct dentofacial deformities and the importance of assessing long-term outcomes. Andrews major contributions are twofold: first, in recognizing the physiologic importance of using orthodontic mechanics to center the dental roots solidly in dentoalveolar bone; and secondly, to unapologetically recommend jaw osteotomies to achieve optimal facial harmony.

Practicing Surgery with a Focus on the Present Encourages Tenacity to Accomplish Each Task

In present times, seasoned maxillofacial surgeons and skilled orthodontists collaborate to define the patient’s comprehensive maxillofacial diagnosis related to facial dysmorphology, malocclusion, periodontal issues, and upper airway obstructions. The orthodontist utilizes biomechanics to efficiently center the dental roots into the dentoalveolar housing and the experienced surgeon safely completes maxillofacial osteotomies, placing bone segments in preferred locations for improved head and neck function and optimal facial aesthetics.

Considering Future Advances in Surgery Inspires Leadership to Forge Ahead

Successful OGS demands an experienced first assistant, a spectrum of specialized handheld and power instruments and medical devices, sophisticated airway management, and the synchronized control of the patient’s systemic pressure to minimize blood loss. Although the technical aspects of the osteotomies are well known and reasonably straightforward for the surgeon-in-training to master, as isolated procedures, fundamental challenges remain in the execution of bimaxillary and chin surgery requiring complex movements, especially when carried out in conjunction with other simultaneous procedures.2 The direction and magnitude of the movements are largely determined during the surgeon’s preoperative evaluation of the

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patient’s appearance, but this must also be verified intraoperatively. Currently, a limited number of experienced surgeons deliver reliable results, and the learning curve for young surgeons remains steep.

In the treatment of dentofacial deformities, we remain in the early stages of the optimal application of technology designed to address the challenges of preoperative planning and improved osteotomy execution, segment repositioning and bone stabilization. As technology is further developed, the skill and experience gap between the motivated young surgeon and the seasoned surgeon will narrow. This is important, as roughly 5% of humans will become teenagers with a significant jaw deformity, often with associated negative effects on speech, chewing, swallowing, breathing, and self-esteem. Yet, even in North America, less than 1 in 20 undergo the surgical correction that they need.

When managing complex facial deformities, innovative software will refine the use of computed tomography and magnetic resonance imaging data to virtually clarify absent and deficient skeletal components and then determine optimal reconstruction. The seamless transfer of this information for use in the operating room will improve outcomes.

In the past few years, technology has had a major impact on the surgeon’s skill and experience gap. First, by eliminating the laborious art of dental lab-based model planning and splint construction and more recently with the manufacturing of patient specific osteotomy guides and osteosynthesis plates, avoiding the need for a splint altogether. The construction of accurate, user friendly, cost efficient cutting guides, jigs, and patient specific fixation plates can be routinely used to position and secure bone segments in optimal locations. By removing the need for the surgeon to master the various dental lab skills, the learning curve and preoperative time commitment once necessary for each case has been dramatically reduced.

A major barrier to the effective treatment of complex dentofacial deformities continues to be a lack of geographically available clinical expertise. Both “virtual” and “hands on” simulation-based training will be essential components of surgical education in the years to come. By first performing the operation in the “virtual” or “augmented” world, either on a 3-D printed model or while wearing a virtual reality headset that simulates the operative field, the surgeon will anticipate challenges, improve efficiency, and minimize errors. Accessible simulation training will further level the playing field for surgeons around the world. In doing so, the democratization of safe and effective OGS for children, teenagers and adults worldwide will be possible.

### Challenges of Strategy in Orthognathic Surgery will Remain

Although the surgeon-in-training may more readily master the basic technical skills and learn how to effectively apply innovative technology, challenges of strategy will remain. Knowing what to do, when to do it, how best to limit complications and effectively manage them when they occur, are within grasp of the motivated clinician, but require longitudinal observation and interaction with a seasoned surgeon followed by personal experience. Mastering strategy in OGS, primarily refers to:

1) Patient specific indications for surgery and the extent of the operation versus no treatment or the offering of lesser procedures.
2) The individual patient’s comprehensive maxillofacial diagnosis, as it relates to airway obstruction, malocclusion, periodontal health, and facial dysmorphology.
3) The art of establishing best outcomes in facial esthetics and function. As computer algorithms are not yet able to dictate the optimal extent and degree of vector change for each jaw, the surgeon’s direct visual examination of the patient, coupled with radiographic and dental analysis remains essential.
4) Operating room efficiency and effective postoperative management, for patient comfort and safety will still benefit from surgeon repetition and experience.

### Financial Barriers to The Correction of Dentofacial Deformities

In the US, a phrase commonly voiced by orthodontists continues to be heard: “OGS is no longer covered by insurance”. An in-depth look into this issue reveals that:

1) By 2018, 92.5% of all citizens of the US were documented to have medical healthcare coverage (www.census.gov).
2) Furthermore, as of 2018, all US citizen under the age of 19 years, who do not currently have healthcare, are eligible for coverage through the CHIP program (Child Health Insurance Program) funded jointly by the federal and state governments.
3) More than 90% of all US healthcare policies (private and governmental) include coverage for “medically necessary” OGS.
4) While administrative challenges remain, the insurance carrier “medical necessity” threshold requirements for OGS are not onerous.
5) The insurance carrier’s strategy of low surgeon payments has proven effective in limiting requests for OGS.

6) Until surgeons can anticipate reasonable compensation for their efforts, most will continue to direct patient care energy toward other clinical endeavors.

Despite challenges, clinicians who choose to treat individuals with jaw deformities belong to a noble profession with a long history of providing innovative care. The dedicated organizations that offer a forum to vet new ideas and publish science-based research also provide a valuable service. In our complex society, with limited resources, competing financial interests will continue to represent the third rail in determining the care provided.

References