



Mini Review

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# The History of Craniofacial Plastic Surgery and Modern-Day Pediatric Craniofacial Reconstruction

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## Abstract

The discipline of reconstructive craniofacial plastic surgery was formally developed in 1967 at The Fourth International Congress of Plastic and Reconstructive Surgery in Rome, Italy. It was here that the French plastic surgeon Paul Tessier, MD, FACS presented to his colleagues the concept of pediatric craniofacial surgery as a major surgical discipline. This meeting laid the foundation for this surgical specialty and led to the founding of the International Society of Craniomaxillo facial Surgery in 1983. The discipline has continued to grow rapidly ever since with more and more innovative operations being described routinely. Interestingly, despite these more recent official meetings and founding societies, craniofacial reconstruction has been practiced for centuries.

**Keywords:** Pediatric; Craniofacial Surgery; Reconstruction; History

## Mini Review

There is much evidence that as early as 10,000 B.C. ancient humans practiced trephination (or the drilling of holes) of the cranial vault. At a burial site dated to 6500 B.C. in France, 40 out of 120 prehistoric skulls were found to have holes from trephination procedures [1]. This procedure has been performed throughout much of recorded time and continues today as a method by which to reduce intracranial pressure. While surgical procedures of the cranial skeleton were occasionally performed in ancient times, more frequently reconstructive craniofacial procedures of the soft tissues such as the nose or ears were performed.

Sushruta, an Indian medical practitioner, described operations for reconstructing the nose and the earlobes in the year 600 B.C.[2]. In India during Sushruta's time, it was common practice for criminals and war captives to have their noses amputated because the nose was considered as a symbol of reputation and respect. Thus, a group of potters known as the Koomas developed nasal reconstruction to help remedy this problem [3]. His method involved using flaps from the cheek and forehead that are still staples of reconstruction of nasal deformities to this day.

During the Roman Empire, surgeon Paulus Aegineta (625 to 690 A.D.) described techniques for correcting nasal deformities and fractures of the mandible. His procedures were groundbreaking at the time and have proven to be instrumental in the history of plastic surgery [4].

The Renaissance (14th to 17th centuries) was a time relatively devoid of advancements in craniofacial plastic surgery. However,

during this time there was one standout physician who many consider the father of modern plastic surgery: Gaspare Tagliacozzi (1545-1599) of Bologna. He also specialized in reconstruction of the nose and detailed his approaches in his 1597 publication entitled, "De Curtorum Chirurgia per Insitionem". For soft-tissue nasal reconstruction, he described the elevation of a pedicled bicipital arm flap, attachment of the flap to the nasal deformity, 14 days of immobilization of the arm attached to the face, and subsequent division and inset of the flap from the arm [5]. It was, of course, Tagliacozzi who in 1597 penned the most infamous phrase in plastic surgery: "We restore, repair, and make whole those parts...which nature has given but which fortune has taken away, not so much that they may delight the eye but that they may buoy up the spirit and help the mind of the afflicted."

Joseph Carpue, in October of 1814, described a method for nasal reconstruction using a forehead rotation advancement flap as Sushruta and the Koomas had been performing for centuries in India. Around that same time, in 1845, Dieffenbach described the usefulness of secondary rhinoplasty procedures to correct and refine the shape of the nose after the first procedure [6]. Following Dieffenbach, von Langenbeck made major contributions to the modern approaches for correcting congenital cleft lip/palate and jaw deformities. Advancements in correcting pediatric craniofacial abnormalities was more recently advanced by plastic surgeons such as Joseph McCarthy, Court Cutting, Ralph Millard and Paul Tessier. The majority of reconstructive craniofacial surgery prior to 1914 was focused on the soft tissues of the face. However, trench

warfare during World War I changed everything and redefined the world of plastic surgery.

Craniofacial injuries during the First World War were remarkable in both number and extent of damage. Prior to World War I, there were very few practicing plastic surgeons in general, and almost none who were capable of handling the appalling damage suffered by war veterans. Furthermore, many of the veterans were presenting with gunshot wounds to the face and cranial skeleton and few surgeons specialized in the craniofacial skeleton other than surgeons whose interests were in pediatric cleft lip and palate [7]. Because of this, both the United States and France set up specialized medical centers on military bases to manage patients who had been facially mutilated. It took just a few years before plastic surgeons were learning how to appropriately manage these injuries; in 1921, Blair published his important paper: "Reconstructive surgery of the face" [8]. Many leaps and bounds were made during World War I in the arena of maxillofacial surgery. Harold Gillies was an important plastic surgeon who pioneered many techniques for treating individuals with disfiguring facial injuries. With the onset of World War II, plastic surgeons again found themselves re-inventing the specialty.

World War II presented craniofacial plastic surgeons with a myriad of new craniofacial challenges due to advances in weaponry. Complex fractures and displacement of the craniofacial skeleton were common and it was here that modern skeletal craniofacial plastic surgery was introduced. In 1949, Kazanjian and Converse published one of their most important works: "Surgical Treatment of Facial Injuries"[9]. This was the first comprehensive paper discussing the surgical management and intricacies of traumatic craniofacial injuries.

In terms of modern pediatric craniofacial surgery, in addition to soft-tissue reconstruction, plastic surgeons address all aspects of the bony skeleton including entering the cranial vault in craniosynostosis cases: an anatomic region previously only violated by neurosurgeons. Since 1967, the scope of practice of the craniofacial reconstructive surgeon has increased dramatically and the complexity of the procedures performed has increased similarly. Today, craniofacial surgery is performed neonatally, in infancy and in pediatric patients as well.

Modern plastic surgeons trained in craniofacial reconstruction perform many reconstructive operations on young patients including mandibular distraction and reconstruction, Le Fort distractions, maxilla mandibular advancement, ear reconstruction for microtia, rhinoplasty and others. Additionally, craniofacial surgeons help correct defects in trauma patients, pediatric patients diagnosed with craniosynostosis, cleft lip and/or palate, micrognathia, mandibular retrognathism, hemifacial microsomia, mandibular prognathism, Treacher Collins Syndrome, Crouzon Syndrome and others. While these lists are nowhere near exhaustive, they are presented to demonstrate the dynamic field that is pediatric craniofacial plastic surgery and the incredible advancements in surgical technique that have evolved throughout

history.

Currently, high-resolution prenatal ultrasound technology is making the diagnosis of pediatric craniofacial abnormalities not only more efficacious, but also diagnoses are being made earlier during pregnancy. This is important for many reasons. First of all, early diagnosis can help with family planning, genetic counseling and education of parents by obstetricians and pediatricians at an earlier time. This may be psychosocially helpful for parents and allow them to prepare and potentially reduce distress at the time of birth. Perhaps more importantly, antenatal diagnosis of conditions such as Pierre-Robin Sequence can be better prepared for ahead of time. Severe glossoptosis and/or retrognathism can cause lethal respiratory compromise at time of birth, and the high-risk pediatric and airway teams can be notified ahead of time.

Another exciting aspect of earlier, prenatal diagnoses of pediatric craniofacial abnormalities is the possibility for intrauterine surgery. In recent years, the use of intrauterine surgery for craniofacial malformations has been successfully utilized many times. The conditions that have been addressed most commonly in utero are cleft lip/palate operations and occasionally simple Tessier facial clefts. The intricacy of these operations leads to scar-less repairs of the cleft palate and lip, for example. This is important because repair of cleft palates often lead to palatal scarring which frequently results in mid face growth restriction as the pediatric patient develops. This leads to the necessity for maxillary advancement in the future. In utero repair without scarring can reduce the need for multiple future surgeries including for mid face growth restriction, secondary alveolar clefts and perhaps oral nasal fistula formation.

Pediatric craniofacial abnormalities can be very distressing for both the parents and the child as he/she grows. Pediatricians and neonatologists alike can make a great impact for children and their families for the life of the children and this impact can be profound. Fortunately, as an adjunct, plastic surgeons trained in pediatric craniofacial surgery can make remarkable, life-changing, interventions for these children and families.

It is important to mention briefly that certain craniofacial malformations such as Treacher-Collins Syndrome with multiple skeletal and soft-tissue disfigurements may be treated with microsurgery and even facial transplantation in the future. It is important to note that facial all o grafts in children have not been described in the literature and obviously finding families willing to donate a brain-dead pediatric donor face is wrought with its own ethical concerns. However, it is a possibility that likely will take place one day and may revolutionize the future of the management of children with complicated craniofacial abnormalities. With the remarkable rate that technology is advancing, the future certainly will again refine and redefine craniofacial pediatric surgery and plastic surgeons will undoubtedly lead the way in traversing that path in multi-disciplinary cooperation with pediatricians and neonatologists.

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