3D models "take the guesswork" out, for surgeons Richard Redett, Amir Dorafshar, and Anand Kumar.

An Effective Distraction

One of the most exciting technical advances in pediatric craniofacial surgery at Johns Hopkins today is distraction osteogenesis, which eliminates the need for bone grafting and replaces it with bone generation. By moving bones slowly over time, the technique avoids soft-tissue damage and promotes bone formation with no permanent hardware.

"The neonatal airway distraction program has really changed many lives," says Anand Kumar, the latest addition to Johns Hopkins' pediatric craniofacial team. To treat neonatal airway obstruction, in which an infant's jaw is so small that the tongue is pushed against the back of the throat, surgeons manipulate the jawbone and insert a device to gradually move it forward, bringing the tongue along with it. The device is initially adjusted, followed by a three-month healing period, and then removed to allow the patient to heal hardware-free.

Traditional treatments have included the use of breathing and feeding tubes, but distraction can eliminate these. It also decreases tissue damage, the need for secondary bone grafting procedures, potential tooth bud damage, and blood loss during surgery.

"It's the story of a team," says Kumar, who brings seven years' worth of lessons from battlefield injury reconstruction from his work in the Navy. "We work with our colleagues in neurosurgery, oral surgery, ENT, developmental psychology, social work, and speech language pathology to achieve the best possible outcome."

"The neonatal airway distraction program has really changed many lives."

COLLABORATION

A Blueprint for Craniofacial Surgery

As an expert in craniofacial surgery, Amir Dorafshar is leading the way in improving patient outcomes by turning to the use of computer-aided design and manufacturing (CAD/CAM), including 3-D printing and rapid prototyping.

"We are the pioneers in using this latest technology for craniofacial surgery," says Dorafshar.

Dorafshar and his Johns Hopkins colleagues start by requesting a CT scan and then sending it to a virtual surgical planning center for three-dimensional reconstruction. "Using 3-D printing, the center can create models to actual size. Then, with rapid prototyping, they create cutting and positioning guides, in three dimensions, which are shipped back to our team," says Dorafshar.

In the operating room, Dorafshar and his team refer to the 3-D model to guide their bone cuts throughout surgery and to avoid major blood vessels. "It takes the guesswork out," he says.

While CAD/CAM will never replace good basic surgical techniques and clinical judgment, says Dorafshar, the technology provides a valuable tool that benefits both patients and surgeons. Using it, surgeons can plan their surgeries prior to making a single cut, shortening the time a patient spends under anesthesia and reducing blood loss.

"We can move forward because we've performed the surgical planning already, and we know exactly where to place the bones in relation to the skull. The model is tailor-made to the exact millimeter," says Dorafshar.

For pediatric reconstructive surgeons at Johns Hopkins, CAD/CAM has become a particularly important tool in the surgical treatment of craniosynostosis, which occurs when the growth plates in a child's skull fuse before the skull is finished growing. The skull compensates by growing in whatever direction is possible, which can restrict the brain from developing normally. To avert that problem, surgeons perform open craniofacial repair, in which they cut and reconfigure the bones to restore the skull's symmetry.

"We are the pioneers in using this latest technology for craniofacial surgery."

"It's hard to plan bone cuts," says pediatric plastic surgeon Richard Redett, who has embraced the CAD/CAM technology. "This makes surgery shorter, and better for the child and for outcomes."

Redett says that the new technology is just one reason that the sky's the limit when it comes to improving the lives of children who need craniofacial repairs at Johns Hopkins.

"We have a core group of surgeons giving comprehensive and sophisticated care to kids with craniofacial differences," says Redett. "We can really do anything."

"Anything" often involves repositioning and/or adding bone. It also includes repairs to the relatively common condition of orofacial cleft (including cleft lip and palate), which occurs in one out of 500 to 550 births. The Johns Hopkins team also routinely performs repairs to underdeveloped parts of the face (most commonly the jaw or ear), and provides surgical solutions to upper airway obstruction and retraction of the tongue, in addition to craniosynostosis.