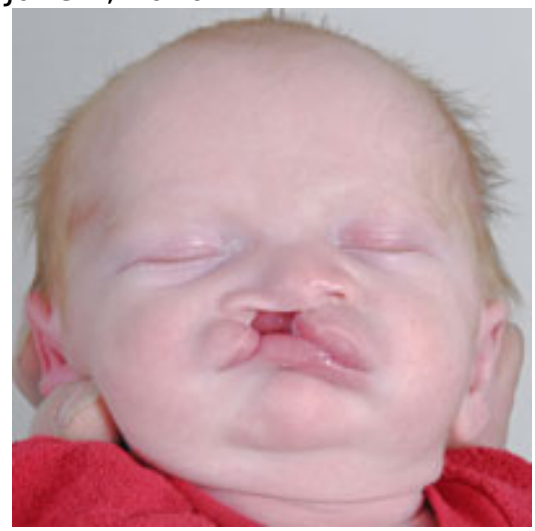
New Treatment Helps Babies Smile

Bob Cramblitt

Using 3D scanning technology, engineers have developed a new treatment for severe cleft lip and palate that reduces the cleft width before surgery without inhibiting upper-jaw growth.

June 7, 2010



One of the first babies to receive the new cleft lip and palate treatment, during his initial visit to Shriners Hospital.

Geomagic software has been used for everything from helping to ensure safety of the NASA space shuttle to making personally fitted devices that remove the stigma of hearing aids. But perhaps the most life-affirming application of Geomagic software has come out of an engineer-physician team working at Shriners Hospital for Children in Springfield, Massachusetts.

The engineer, Beth Roscoe, and the physician, Dr. Philip Stoddard, are using Geomagic software to bring smiles to children’s faces, and by extension, the faces of their families. With the help of 3D scanning technologies, Roscoe and Stoddard have developed a new treatment for severe cleft lip and palate that reduces the cleft width before surgery without inhibiting upper-jaw growth.

Like many breakthroughs, this one came through a combination of vision, innovation, great technology and a fair amount of luck. The good fortune came from a chance encounter in a hospital cafeteria, and the friends Stoddard has made through his hobby flying glider planes.

Prosthetics researcher Beth Roscoe and surgeon Dr. Philip Stoddard of Shriners Hospital for Children examine dental impressions of one of the first patients to receive the new treatment.

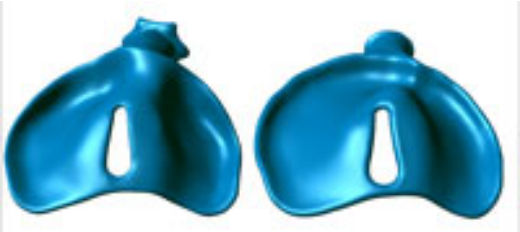
Searching for a better way

The search for a new treatment began a few years ago after Stoddard returned from a workshop on Naso-Alveolar Molding (NAM) – one of the two major pre-surgical treatment methods for babies born with severe cleft lip and palate. NAM is labor-intensive and requires a dental lab and on-site orthodontic staff. Results can vary depending on the skill of the orthodontist administering the treatment.

The other treatment method, DentoMaxillary Appliance (DMA), also has drawbacks. It is invasive, requiring surgical pinning of an appliance to the roof of the mouth under anesthesia, and daily screw tightening by caretakers. Some physicians think it might also impede jaw growth.

Stoddard thought there must be a better way. He believed that computers might be the key to better pre-surgical treatment for wide cleft lip and palate, but he didn't know about the technology to make it happen. That's when a first bit of serendipity took place.

Stoddard was having lunch in the Shriners Hospital cafeteria when he had a chance meeting with Roscoe, who at the time was a resident in prosthetics. During the course of their conversation, Stoddard learned that Roscoe was previously a software engineer who developed CAD systems.



The first and last appliances in a series modeled by Beth Roscoe using Geomagic software.

A new methodology takes shape

A light bulb went on in Stoddard's head. Could Roscoe develop a proposal for using CAD/CAM for pre-surgical treatment of cleft lip and palate?

Roscoe was up for the challenge, and from the beginning her approach was very similar to the final methodology.

The document she wrote proposed scanning a plaster model of a patient's cleft palate to obtain 3D shape data, modeling a corrected cleft, interpolating between the model of the patient at the beginning and the end of the treatment to reduce cleft width while accommodating growth, and then producing the series of treatment appliances with a rapid manufacturing system.

The concept of a series of different devices to accommodate growth and the closing of the cleft gap was an inspired idea.

"The serial appliance approach was a way to circumvent the need to modify a single appliance every week," says Roscoe. "Each appliance in the series would represent the manual modification used in the other methods. I knew it wasn't an A-to-B linear path of treatment. The appliances needed to morph to accommodate changes in size, shape and even configuration."

The right tool at the right time

With the procedure outlined, the main question was the software that would be used for 3D modeling. Roscoe thought she might have to use the scan data as a reference and create the CAD model from scratch.

She gave the proposal to Stoddard, who planned to run it by Peter Fuss – an electrical engineer, fellow glider enthusiast and friend – during an upcoming ski vacation. Stoddard didn't know at the time that Fuss was on the Geomagic board of directors.

When Stoddard showed him the proposal, Fuss thought that Geomagic would be the ideal software for the process. When he returned from vacation, Fuss made arrangements for Roscoe to obtain Geomagic Studio software, and she began learning how to use it.

"I didn't have any formal training," says Roscoe. "I muscled through and got a good command of the software on my own, with the help of some online tutorials from Geomagic."

Roscoe's initiation with Geomagic confirmed what Fuss had suspected.

“Geomagic was the perfect solution to our very specific need – to be able to create and easily manipulate detailed 3D models from point clouds,” says Roscoe. “It enables us to produce highly accurate appliances that provide a custom-fit for each baby, and a means of specifying each patient’s unique 3D prescription.”

Dr. Philip Stoddard holds the patient near the end of his pre-surgical treatment.

Putting it all together

The final piece of the puzzle – how to manufacture the series of individualized appliances – involves Bob Morehardt, another of Stoddard’s technology-minded glider friends.

Although Stoddard didn’t know it when they first met, Morehardt is owner of RMB Tool (formerly Mor-Tech), the first rapid prototyping service bureau in the Northeast United States to use selective laser sintering (SLS) systems. When Roscoe found out about Morehardt, she thought he might be able to provide the manufacturing part of the solution.

Roscoe and Stoddard met with Morehardt and came away confident that they could use RMB Tool’s SLS systems from 3D Systems to create the dozen or more appliances needed to serially mold a patient’s gums into a more normal position, while allowing the palate to grow naturally.

After outlining the treatment methodology and determining the technology tools, it was time to put the new regimen to the test. This required permission from the Institutional Review Board (IRB), the medical equivalent of the Federal Aviation Administration (FAA).

One of the first babies to be treated, a few months after surgery.

The proof is in the smile

The IRB approved the Roscoe/Stoddard plan and treatment for the first baby began shortly thereafter. The procedure is fairly simple, comprising three basic steps:

- Establish the initial palate shape by scanning a mold of the child's lip and palate. Initially a CMM system was used for this; now Roscoe uses a ShapeGrabber 3D laser scanner for data capture.
- Within Geomagic, define the desired final palate shape (allowing for growth), create the intermediate steps, and convert each palate shape into a digital model of the appliance at the different intermediate steps.
- Manufacture the series of appliances needed for treatment using Morehardt's SLS systems.

Treatment typically begins within the first month of the baby's life and lasts 10 to 15 weeks, after which lip repair surgery is performed by the plastic surgeon. Two patients have completed the process. Treatment was well-tolerated in both cases and the physical transformations are stunning.

Besides the dramatic differences in physical appearance, other benefits of the new procedure include:

- No anesthesia risk when inserting the appliance.
- Less invasive – the appliance is not pinned into the roof of the mouth.
- Computer-controlled process for more consistent results.
- Accuracy in correcting the growing palate and gum shape prior to lip repair.
- Process is repeatable and cost-efficient.

"The treatment couldn't have gone any better," says Rose Kellogg, grandmother of

the second baby treated. “We wanted something less invasive and this was perfect. He is sensitive but he got through it nicely. He was treated as an individual and our whole family was given special treatment by everybody at Shriners Hospital.”

The new pre-surgical treatment offers a couple of important precedents from a physician’s perspective.

“We now can digitally mold and narrow a wide cleft dental arch, and accurately accommodate projected normal growth,” says Stoddard. “This is a wonderful combination.”

Roscoe and Stoddard hope to make the new methodology available to other cleft clinics in the future. There’s also great potential for using the process in other areas of orthopedic and reconstructive medicine.

“Physicians that have been introduced to the capabilities of Geomagic have a new perspective in problem-solving,” says Roscoe. “I believe we are just scratching the surface of how this technology can be used to help patients in a wide variety of ways.”

Bob Cramblitt (www.cramco.com [1]*) writes about design and engineering technologies that improve processes and transform human lives.*

Source URL (retrieved on *09/20/2014 - 5:40am*):
http://www.surgicalproductsmag.com/articles/2010/06/new-treatment-helps-babies-smile?cmpid=related_content

Links:
[1] http://www.cramco.com