Editor: John van Aalst, MD, Cincinnati, OH

President: William Hoffman, MD, San Francisco, CA

Editorial Board Members
Craig Birgfeld, MD, Seattle, WA
Sean Boutros MD, Houston, TX
Elliott Chen, MD, Columbia, SC
Roberto Flores, MD, New York, NY
Chad Gordan, MD, Baltimore, MD
Reza Jarrahy MD, Los Angeles, CA
James Liau, MD, Lexington, KY
Jeffrey Marcus MD, Durham, NC
John Mesa, MD, Livingston, NJ
Douglas Monasebian, MD, New York, NY
Adam Oppenheimer, MD, Melbourne, FL
Parit Patel, MD, Maywood, IL
Rajiv Parikh, MD, St. Louis, MO
Michael Pharaon, MD, Chapel Hill, NC
Jesse Taylor, MD, Philadelphia, PA
Peter Taub, MD, New York, NY
Sunil Tholpady, MD, Indianapolis, IN
Ali Totonchi, MD, Cleveland, OH
Jeyhan Wood, MD, Winston-Salem, NC
Kristen Yee, MD, Los Angeles, CA

Section Editors
Announcements
Martha Matthews, MD, Camden, NJ
Coding Update
Gregory Pearson, MD, Columbus, OH
Ethics and Professionalism
Christian VerCler, MD, Ann Arbor, Michigan
Historian’s Corner
Mark Urata, MD, Los Angeles, CA
International News
Arun Gosain, MD, Chicago, IL
Ray Harshbarger, MD, Austin, TX
Letters to the Editors
Stephen Chidyllo, MD, West Long Branch, NJ

New Member Highlights
Oluwaseun Adetayo, MD, Albany, NY

Panel Discussions / Webinars
Joseph Williams, MD, Atlanta, GA

Scientific Articles
Devra Becker, MD, Beechwood, OH
John van Aalst, MD, Cincinnati, OH

Surgical Pearls
Stacey Francis, MD, Ontario, CA

Editor: John van Aalst, MD, Cincinnati, OH

CONTENTS

Editor’s Update ........................................ 3
President’s Message ...................................... 4
Prime Time Surgical Pearls .............................. 5
Examining the Safety & Efficacy of Supplemental Regional Anesthesia After Iliac Crest Harvesting During Cleft Aveolar Bone Grafting .............. 6
From Fellowship to a Real Job ......................... 9
ASMS/PSF Cleft Palate Registry ....................... 10
CPT Coding Update ..................................... 10
PolySomnographic Titration of Mandibular Lengthening by Distraction in Tongue-Based Airway Obstruction ......................... 11
Is NAM a Scam? ........................................... 17
History of ASMS ......................................... 21
ASMS New Member. .............................. 22
ASMS Webinar: VSP in Your Practice .......... 23
Dear Readers,

Welcome to the Spring Edition of the Journal of the ASMS. In many ways, this is our best issue yet.

This issue of the Green Journal includes three original articles. The first is by Russell Reid, examining the novel idea of performing polysomnography during mandibular distraction in order to inform an exact endpoint for distraction. Anand Kumar and colleagues present data on the combined use of minimal access iliac bone graft harvest with regional anesthesia, suggesting that this combination results in improved pain control. Amanda Gosman presents a written version of the ASMS Pre-Conference Symposium panel on NAM use in cleft lip and nasal deformities. Her paper is provocatively entitled “Is NAM a SCAM?” You may be surprised by her concluding statements.

Bill Hoffman, our current President, provides an overview of recent progress made by the organization and future directions for the ASMS. A history of the past ten years of the ASMS has been accepted for publication in PRS. This paper is highlighted by Arun Gosain, and continues a tradition of describing the history of the ASMS for publication every decade. Dr. Gosain and Ray Harshbarger describe a new Cleft Palate Registry. In addition, you’ll find introductions to new member Dr. Christine Lee from UCLA and to mid-career member Dr. Stacey Francis, who announces the transition of her column from a focus on “seasoned members” to members in their prime. Dr. Greg Pearson’s CPT corner explains coding strategies when excising and reconstructing basal cell cancers of the nose.

Joe Williams’ rendition of the ASMS Webinar given by Anand Kumar is filled with a wealth of information about virtual surgical planning for orthognathic and facial skeletal surgery. In Joe Williams’ own words, “this is one of the best webinars I have ever heard.” Congratulations Dr. Kumar.

The ASMS Journal continues to grow. We need your articles. There are several potential paradigms for new articles. One of them is Anand Kumar’s article. These authors presented their work at the ACPA in 2015 and are now publishing in the Green Journal. Another paradigm is Dr. Gosman’s strategy: a review of a panel discussion. Lastly, Dr. Reid’s article describes a novel use of an old idea. Publication in the Green Journal was a natural next step for each of these authors.

Please consider publishing presentations and panel discussions from National Meetings, or a new idea you may be championing in your clinical practice. The Green Journal is your journal.

Enjoy this issue. Jva
It was a great honor to be inducted as the new ASMS president in Los Angeles. After 11 years on the ASMS Board I can say that the organization is strong and still growing.

Education remains a core mission of the society. We are continuing the Basic Course under the leadership of Gaby Doumit and already have had an excellent course in Miami at the end of January, with 55 attendees (Check out the photos on our Facebook site!). Following the Philadelphia course in July, we will be taking the Basic Course across the Atlantic again this year when we go to Romania in late August. This course is supported by Rotaplast. Ray Harshbarger in Austin has obtained another Rotaplast grant for us to do the Basic Course in El Salvador, probably in early 2018.

We have embarked on a plan to hold at least one advanced course each year. Last August we had a tremendously successful Pediatric Surgery Symposium at Pittsburgh Children’s Hospital hosted by Joe Losee. Over 100 people attended including several international attendees. The presentations were excellent and there was significant time devoted to panel discussions with Q and A. This year we are planning an Advanced Techniques Course from April 7-9 at St Louis University. This course is being coordinated by Alex Lin, and will feature cadaver dissections for both cosmetic and reconstructive facial procedures, including everything from facelift to nasal endoscopy to dental implants. Space is limited, so sign up soon if you have not yet!

The Visiting Professor Program remains strong under the direction of Greg Pearson. Our Visiting Professors this year – Bruce Bauer, Greg Evans, Michael Grant, and David Staffenberg – are on track to visit over 20 program to discuss a wide variety of topics. We are thankful for the members who donate this kind of time to teach and promote the ASMS.

Webinars continue to be another means of fulfilling our educational goals. The first webinar of 2017 was held on March 8; Peter Taub and I addressed cleft palate and alveolar cleft management. We are planning 2 to 3 each year. Watch for email blasts to determine time and subject.

John van Aalst has transformed the Green Journal into much more than a Newsletter. The last issue highlighted motivations of Board members to pursue their careers in Maxillofacial and Craniofacial Surgery, ethical concerns for our specialty, and CPT advice; a review of the last webinar on frontal sinus fractures, and a paper on rhinophyma. We are continuing to work to obtain Pubmed citation status. If you have original material for publication, please contact John.

Advocacy is an area we are trying to develop a greater presence. Several years ago, I worked with Deb Johnson, our new ASPS president, when she was president of the CSPS, to get a bill passed that provides orthodontic care for children with clefts under medical rather than dental insurance. The national push for the CARES Bill (coverage for reconstructive surgery defined as not cosmetic) is generally felt to be an uphill struggle in the current political climate. With bills like this, we are looking into how we can help accomplish similar goals at the state legislature level. If you have any inquiries about legislative ideas, send them to me or to Devra Becker, our VP for Socioeconomic Affairs.

Amanda Gosman is working on how we can cooperate with the PSF and ACAPS to provide a centralized calendar for international mission trips. This will only work if we have widespread “buy in.” I encourage everyone to respond to an electronic survey we will be sending next month.

The ASMS continues to have excellent representation in sister organizations. Donald MacKay, next year’s president, is Chair of the American Board of Plastic Surgery, and Arun Gosain, immediate past president is the president-elect of the Plastic Surgery Foundation. Beyond the world of plastic surgery, Kent Lin now represents us in the AMA and Arun Gosain is our representative to the Board of Governors of the American College of Surgeons.

Orlando is the site of the national meeting this year. It is more family oriented than usual, so think about bringing the kids if you can. The opening ceremonies are being planned at Epcot Center and should be outstanding. Our usual Preconference Symposium will be incorporated into the main program this year, on Saturday rather than Thursday, and will be included in the general meeting registration. This means that we will now have over 2 full days of programming. Peter Taub and Tom Samson are planning the symposium as a series of cadaver demonstrations by surgical masters.

Orlando is the site of the national meeting this year...... Our usual Preconference Symposium will be incorporated into the main program this year, on Saturday rather than Thursday, and will be included in the general meeting registration. This means that we will now have over 2 full days of programming. Peter Taub and Tom Samson are planning the symposium as a series of cadaver demonstrations by surgical masters.

Lastly, Fan Liang, our resident representative on the Board, has helped set up a Facebook page for the society as we finally begin our foray into social media. The address is https://www.facebook.com/groups/ASMSPlasticSurgery/. Join and post – we can start our online community this week!

It is an honor and privilege to be President of ASMS, working with so many remarkable and committed surgeons. I hope that we can continue to serve our members with outstanding representation and educational programs.
Introducing “Prime Time Surgical Pearls”

Stacey Francis, MD

“To know that we know what we know, and that we do not know what we do not know, that is true knowledge.” Henry David Thoreau

It has been my honor to serve as the Journal Section Editor for Seasoned Members for the last two years. Highlighted members have shared fascinating stories about the history of our field and their personal and professional memories and pearls. As the ASMS has grown, the next generation of surgeons needs to fill the very large shoes of the leaders before us. Our challenge is to share the experiences from our own practices.

With this in mind, we will transition to highlighting Surgeons in Their Prime. By surgical prime, we are describing surgeons who have been in practice for more than 5 years. We have practiced long enough to make and learn from mistakes; we may have developed new techniques and practice styles; yet, we are not so far away from our training that we don’t still appreciate the many different ways surgeons approach problems in our field.

So, I invite you to share. Share the good, the bad, the ugly, and anything in between. Share what has worked well for you. What hasn’t worked. And what you consider your “Prime Time Top Ten Surgical Pearls.” Some of what you suggest may be standard of practice for others. Some will disagree with what you say. The goal is to share thoughts that encourage others to think about their own practices. You will likely tell them something new. Some of your pearls may be technique-driven; others may be related to practice styles; how to manage patients pre- and post-operatively.

So, as the fearless leader of this idea, I will share my Prime Time Top Ten Surgical Pearls.

Prime Time Top Ten Surgical Pearls

10. Don’t be afraid to give your cell phone to patients and family members. They actually rarely use it; if they do, it is generally for something you would want to know about. This practice helps resolve concerns quicker and families are very grateful.

9. Infraorbital blocks in all primary cleft lip surgeries and cleft lip revisions. Children with good blocks rarely need narcotics, which minimizes post-operative respiratory depression.

8. Overboard and repetitive pre-operative education. No longer is the day where whatever we say goes as surgeons. Parents are educated. They have searched the internet and want to be as informed as possible. The more you give them, and less they find on the internet themselves, the better.

7. Pre-bending and plating of the fronto-orbital bar on the back table during CVR surgery. This improves efficiency and shortens anesthesia time in all fronto-orbital advancements. I do this manipulation on the back table while my neurosurgery colleague performs osteotomies and barrel staves I have marked.

6. Don’t be afraid to be humble and honest with patients. If I am not sure what I would do with a difficult case, I tell them that I want to take some pictures and do some research and share the case with mentors and colleagues around the country. All patients and families have been grateful for my honesty.

5. Soft tissue resuspension. Whether the temporalis in cranioplasty or malar resuspension in facial fractures, this final step must be performed to recreate pre-morbid aesthetics.

4. Use of posterior distraction on all patients with multi-suture syndromic craniosynostosis. I don’t think we can get enough intracranial volume in this subset of patients without distraction.

3. Inter-domal sutures for primary cleft nasal repair in both unilateral and bilateral clefts. I was trained to use McComb nasal sutures, but started using inter-domal sutures a few years ago and have been much happier with outcomes for nasal tip and columellar lengthening.

2. Use of small resorbable plates as backing for thin bone on the posterior cranial surface. Without this supportive backing, the bone stock is insufficient to secure a distractor or a plate.

1. Under promise and over deliver.

I look forward to calling on friends and colleagues over the next year to share their own pearls of wisdom from their careers. If you are interested in being featured, please feel free to contact me! My email is staceyhindy@gmail.com.
Examining the Safety & Efficacy of Supplemental Regional Anesthesia After Iliac Crest Harvest During Cleft Alveolar Bone Grafting

Robert Lesko BS; Srinivas M. Susarla, DMD, MD, MPH; Denver Lough MD, PhD; Anand R. Kumar, MD
Department of Plastic and Reconstructive Surgery, Case Western Reserve University School of Medicine

Conflicts of Interest: None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript.
This work was presented, in part, at the 72nd Annual Meeting of the American Cleft Palate-Craniofacial Association, April, 2015, Palm Springs, CA.

ABSTRACT

Background
The optimal prevention and treatment of pain associated with iliac crest bone graft donor sites for the treatment of cleft alveolar defects has not been well characterized. The aim of this study is to assess the efficacy of minimal access bone graft techniques with or without regional anesthesia in iliac crest bone harvest compared to outcomes of traditional open harvest techniques.

Methods
A retrospective review of 46 patients undergoing iliac crest bone harvest using traditional open iliac crest bone graft (ICBG) alone (Group 1, n=20), minimal access ICBG (Group 2, n=20), or minimal access ICBG with paravertebral anesthetic block (Group 3, n=5) was performed. Post-operative pain scores, narcotic consumption, and hospital stay were analyzed.

Results
The average time to first narcotic was 247 min in Group 1, 193 min in Group 2, and 1,162 min in Group 3 (p<.0002). Total narcotic use was 0.117mg/kg in Group 1, 0.131mg/kg in Group 2, and 0.072mg/kg in Group 3. The average pain score (VAS) was 2.96 in Group 1, 1.83 in Group 2, and 1.08 in Group 3 (p<.01). The average length of stay was 1.45 for Group 1, 1.36 for Group 2, and 1.0 for Group 3. Bone graft extrusion occurred in 6 patients (27.3%) in Group 1 and none in Group 2 or 3. There were no wound infections, bleeding requiring reoperation, or mortalities in any of the groups.

Conclusions
The addition of regional anesthesia to minimal access alveolar bone graft harvest significantly reduced time to first narcotic use. Although not significant, a strong trend toward lower pain score (VAS) and total narcotic use was found with regional anesthesia. Regional anesthesia did not significantly reduce the length of hospital stay compared to either group. Minimal access techniques with supplemental regional anesthesia significantly lowered the pain score and time to first narcotic, and trended to decreased length of hospitalization and total narcotic use compared to traditional open techniques.

Introduction
The iliac crest is a common source for autogenous bone grafting in maxillofacial surgery and is preferred by many surgeons due to accessibility and the quantity of bone available. Numerous papers have explored the safety, efficacy and tolerability of iliac crest bone harvest procedures, but few have considered techniques that improve pain management. Following the development of open iliac crest grafting techniques by Wolfe and Kawamoto, several comparative studies have compared open iliac crest grafting techniques with more minimally invasive techniques, and found a correlation between pain associated with iliac crest bone harvest and the amount of sub periosteal dissection. Multiple studies have found that minimal access iliac crest autogenous bone grafting significantly reduces the postoperative recovery time and quantity of narcotics administered.

While some studies have looked at minimal access iliac crest autogenous bone grafting in comparison to open iliac crest grafting techniques, few studies have focused on regional anesthesia effects on time to first narcotic administration, pain score (VAS), total narcotic use, and length of hospital stay. One study comparing the use of local anesthesia to saline solution placebo following iliac bone harvest found that continuous anesthetic infusion of iliac crest wounds significantly reduced postoperative pain and improved mobility.

The purpose of this paper is to answer the following clinical question: Among patients who undergo iliac crest harvest during alveolar bone grafting, how do the outcomes of minimal access bone graft techniques with or without regional anesthesia compare to traditional open harvest techniques? Our hypothesis is that patient outcomes will be better for patients who undergo minimal access iliac crest bone grafting with or without regional anesthesia compared to those who undergo traditional open access iliac crest bone grafting. The aim of this paper is to compare the safety and efficacy of supplemental regional anesthesia with minimal access iliac crest harvest techniques to both minimal access iliac crest harvest techniques alone and to open iliac crest grafting technique.

Materials and Methods

Study Design and Sample
This is a retrospective study of patients who underwent iliac crest bone harvest at a single institution between 2004 and 2012. Subjects eligible for study inclusion must have undergone either unilateral or bilateral alveolar bone grafting, had parental consent for enrollment in the study, and were monitored in the PACU for up to 72 hours following the procedure. Subjects were excluded from study enrollment if their parents refused study enrollment. The predictor variable in this study was whether the patient underwent iliac crest bone harvest using traditional open iliac crest bone graft (ICBG) alone, minimal access (continued on next page)
Regional Anesthesia After Iliac Crest Harvest (continued from previous page)

ICBG, or minimal access ICBG with paravertebral anesthetic block. The primary outcome variable was the average time to first narcotic administration. Secondary outcome variables were postoperative pain scores, total narcotic consumption, and length of hospital stay.

This study was not randomized or blinded. Two surgeons and their teams collected data over a period of up to 72 hours in 4-hour intervals for the first 24 hours and 12-hour intervals for the remaining measurements. Data was input and stored in a Microsoft Excel spreadsheet and average values for each group were calculated. Descriptive statistics were computed for each study variable. Mann-Whitney U tests were performed for the length of hospital stay and visual analog pain score (VAS). Unpaired t-tests were performed on total opioids given and average time until first narcotic. Both surgeons’ groups were compared in a two-tailed t-test to each other and to the treatment groups.

Results

During the study period, iliac crest bone harvest for alveolar bone grafting was performed on 46 patients. Twenty iliac crest bones were harvested using traditional open iliac crest bone graft (ICBG) alone and were classified as group 1; twenty iliac crest bones were harvested using minimal access ICBG and were classified as group 2; five iliac crest bones were harvested using minimal access ICBG along with paravertebral anesthetic nerve block and were classified as group 3. The sample’s mean age was 10.0±2.8 years. The sample’s mean weight was 38.3±20.8 kilograms. Eighteen clefts (42%) were bilateral and 25 clefts (58%) were unilateral deformities. The mean time to first narcotic was 351±538 minutes. The mean total narcotic use was 0.16±0.20 mg/kg. The mean pain score (VAS) was 2.27±2.00. The mean length of stay was 1.42±1.30 days. There were no wound infections, bleeding requiring reoperation, or mortalities in any groups.

When comparing group 1 with group 2, there were few statistical differences. Patients in group 1 had a higher mean pain score (VAS) than patients in group 2 (2.96±1.41 vs. 1.88±1.22; P=.02). Groups 1 and 2 were otherwise statistically equivalent. When comparing groups 1 and 3, group 3 resulted in a statistically longer time to first narcotic (1162±213 vs. 252±346; P=.00042) and a lower mean pain score (VAS) (1.11±0.72 vs. 2.96±1.41; P<.01). Similarly, when comparing groups 2 and 3, group 3 resulted in a statistically longer time to first narcotic (1162±213 vs. 193±217; P<.00025). Bone graft extrusion occurred in 6 patients (27.3%) in Group 1 and none in Group 2 or 3. Descriptive and comparative statistics are presented in Table 1.

Discussion

Optimizing pain management in iliac crest bone harvest for alveolar bone grafting is of significant importance and results in better patient outcomes following surgery. The hypothesis of this study is that minimal access iliac crest bone grafting with and without paravertebral anesthetic nerve block improves patient outcomes. The study assesses the efficacy of minimal access bone graft techniques with or without regional anesthesia in iliac crest bone harvest and compares outcomes to traditional open harvest techniques by comparing post operative pain scores, narcotic consumption, and hospital stay length.

The results of this study confirm the hypothesis that minimal access iliac crest bone grafting with and without paravertebral anesthetic

(continued on next page)
Regional Anesthesia After Iliac Crest Harvest (continued from previous page)

nerve block improves patient outcomes. The average time to first narcotic use for Group 3 (minimal access ICBG with paravertebral anesthetic nerve block) was 1162 ± 213 minutes; this finding was significantly longer when compared to both Groups 1 and 2 (P = .00004 and P = .0002). Based on these results, the use of paravertebral nerve block following iliac crest bone harvest appears to be beneficial because it increases the time to first narcotic use following surgery. Postoperative pain scores indicated that both Groups 2 and 3 (minimal access ICBG without paravertebral nerve block and minimal access ICBG with paravertebral nerve block) have significantly lower pain scores (VAS) than Group 1 in which patients underwent traditional open access ICBG. Group 1 had an average pain score of 2.96 ± 1.41 compared to Group 2, with an average pain score of 1.88 ± 1.22 (P = .020). Similarly, Group 1 had an average pain score of 2.96 ± 1.41 versus Group 3, which had an average pain score of 1.11 ± 0.72 (P = .008). There was no statistical difference between the pain scores (VAS) of Groups 2 and 3; however, there was a strong trend suggesting that regional anesthesia lowers the pain score (VAS) further. Although not statistically significant, minimal access ICBG with supplemental regional anesthesia appeared to decrease length of hospitalization and total narcotic use compared to traditional open techniques.

Several recent studies have examined the effects of regional anesthesia improvement of patient outcomes. Singh et al. used local anesthetic infusion at the iliac crest bone site; although this study did not examine alveolar cleft bone grafting, it is still useful to look at the difference in pain scores between the group given local anesthesia and the control group. The local anesthesia group had a statistically significant decrease in postoperative pain scores (VAS) (1.4 versus 4.8) four years following surgery. In addition, Gadsen et al. examined the use of regional anesthesia for trauma patients and found that regional anesthesia offered excellent site-specific pain relief with no major side effects and reduced patient requirement of opioids. Gadsen et al. also found that early use of regional anesthetics reduced the length of hospital stay. Numerous studies have compared the outcomes of traditional open access iliac crest bone grafting with minimal access iliac crest bone grafting. Burstein et al. compared traditional open access iliac crest bone grafting to two different methods of minimal access iliac crest bone grafting (trephine and bone grinder); this study found that both minimal access techniques were superior to traditional iliac crest bone grafting. Incision length was decreased by 60% in both minimal access groups (mean, 2 cm; range 1.0 cm to 3.0 cm) compared to the control group (open ICBG; mean, 5 cm; range, 4 to 7.5 cm). These authors also found that the minimal access iliac crest bone grafting groups required fewer analgesics than the control group. These studies suggest that combining minimal access iliac crest bone harvesting techniques with the use of regional anesthesia should have a positive impact on patient outcomes.

Our study is limited because it is retrospective, with a relatively small sample population. Given that the procedures were performed at a single institution by two surgeons, there is a possibility of the introduction of bias because of the limited variability in technique. However, despite these limitations, we found no significant differences in age, weight, and cleft type between groups, confirming that these variables do not have statistically significant impact on outcomes.

Conclusions

The addition of regional anesthesia to minimal access alveolar bone graft harvest significantly reduces time to first narcotic use. Although not significant, a strong trend was also found with regional anesthesia to lower the pain score (VAS) and total narcotic use. Regional anesthesia did not significantly reduce the length of hospital stay compared to either group. Minimal access techniques with supplemental regional anesthesia significantly lowered the pain score and time to first narcotic use, and trended toward decreased length of hospitalization and total narcotic use compared to traditional open techniques.

Acknowledgments

The authors would like to acknowledge the assistance of Dr. Joseph Losee with clinical care of patients in this study and Dr. Karen Boretsky MD, Dr. Christopher Madsen with data collection.

References


Table 2. SUMMARY OF BIVARIATE ASSOCIATION BETWEEN PROCEDURE TYPE AND TIME TO FIRST NARCOTIC USE

<table>
<thead>
<tr>
<th>Procedure type</th>
<th>Time to First Narcotic (min)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Access ICBG</td>
<td>247 ± 346</td>
<td></td>
</tr>
<tr>
<td>Minimal access ICBG</td>
<td>193 ± 217</td>
<td></td>
</tr>
<tr>
<td>Minimal access ICBG with paravertebral anesthetic nerve block</td>
<td>1162 ± 213</td>
<td>&lt;.0002</td>
</tr>
</tbody>
</table>

(continued on next page)
Regional Anesthesia After Iliac Crest Harvest (continued from previous page)


Pathway from Fellowship to Real Job

Nataliya Biskup, MD

Knowing my passion for Craniofacial Surgery very early on during my residency and the very real shortage of jobs in this sub-specialty within a surgical specialty, I knew that I needed to be proactive in my job search. Because of this, I started reaching out and researching opportunities in my fourth year of residency, well before I matched into fellowship. To make things even more challenging, I had geographic preferences. Having two small children, my husband and I desperately wanted to be close to either one of our families.

In one of my desired locations, I kept in touch and reached out early to a contact, who actually happened to be my mentor from medical school. However, this particular opportunity was not temporally aligned with the completion of my Craniofacial Fellowship.

In my other desired location, I had no contacts whatsoever. So, I acquired email addresses over the ASPS and ACPA website and sent emails to various Plastic Surgeons in the area to get a pulse on Craniofacial and Pediatric Plastic Surgery in this medium-sized community of 500,000 people. I was pleased to receive an interested reply from an older surgeon, who was performing all of the pediatric cases in the community and, who also happened to be on the verge of retirement. He invited me to interview with his practice. Even more fortuitous was the opening of a new children’s hospital, which is associated with a high volume birthing center that delivers 7,000 babies per year.

Though it took several emails and phone calls without an answer, I was finally able to get through to the COO of the children’s hospital, who happened to be interested in expanding Pediatric Services at the hospital. I emphasized that my Craniofacial Fellowship gave me not only a strong bony, craniofacial experience, but also sharpened my understanding of cleft surgery and expanded my experience in congenital hand, brachial plexus, and pediatric microsurgery. I firmly believed that being able to offer a greater spectrum of skills made me much more attractive to this potential future employer.

After a period of discussion and negotiation, I was offered a recruitment contract from the children’s hospital and an employment contract from the private practice. Now, I am about to begin the next stage, continuing and growing a Craniofacial and Pediatric Plastic Surgery practice, which is another article in and of itself.

In the end, I can’t say that I created this opportunity for myself. Much of my finding a craniofacial job was fortuitous and random, as most opportunities are. However, reaching out, making contacts, letting potential employers know the spectrum of surgical services that I offered was a critical component. Starting this search very early was even more critical, especially in Craniofacial and Pediatric Plastic surgery.

In summary, the sooner you start to look, the more likely you are to find a job or perhaps even a job that matches your desires for location. Even if this does not result in a job at that exact moment, you may gather valuable information and make critical contacts that prove beneficial in securing a job in the future.

Dr. Biskup is currently the Craniofacial Fellow at Cincinnati Children’s Hospital.
Development of the ASMS/PSF Shared Registry: Cleft Palate

Arun K. Gosain

The ASMS is partnering with the PSF to develop a template for a cleft palate registry, focusing on the long-term outcomes of cleft palate repair. Until now, there have been few reliable databases in which to collect these data on a national level. The National Safety and Quality Improvement Project (NSQUIP) has developed a highly-cited registry system, but is limited to 30-day outcomes.

This limits the utility of NSQIP data in evaluating the outcomes of cleft palate repair. We believe that a database specific to the outcome of cleft palate repair over 3 to 5 years can be developed; this initiative will provide more objective data on outcomes in primary cleft palate repair. In order to accomplish this goal, we have selected a subcommittee, consisting of Ray Harshbarger, John van Aalst, and Arun Gosain, to accomplish this goal. The registry will focus on questions related to:

1. Diagnostic factors;
2. Pre-treatment status;
3. Treatment outcomes;
4. Post-treatment outcomes and complications (short and long-term).

This initiative will provide prospective data on the incidence of post-palatoplasty fistula, and speech outcomes measured at or beyond age 3 years-of-age. The data collection will be developed within a platform based on the TOPS Registry that is in current use through PSF. We plan to initiate the registry system in 5 to 6 core centers for the first year, in order to test the template before broader dissemination.

The initiative to jointly develop a registry focused on a specialty-specific procedure is a new frontier for both the ASMS and the PSF. Furthermore, the Maintenance of Certification (MOC) Committee of the American Board of Plastic Surgery (ABPS) may be able to adapt this registry to replace the current cleft palate module used for MOC. The registry data would be more comprehensive, and will focus on key outcome parameters, both short- and long-term, that the ABPS is currently unable to capture. Our goal is that our members will enter data from every case rather than from 10 select cases at the end of a 3-year cycle, as is currently recorded in the current MOC module. In addition, data collection will be ongoing, vastly improving data validity.

This database may be able to provide the most useful multi-institutional dataset available to track cleft palate outcomes. Such an initiative could truly help us to improve cleft palate care over the next decade. In addition, development of a pilot procedure-specific registry will provide an example for sister societies to develop similar registries. These advances will greatly enhance development of evidence-based treatment protocols specific to index procedures.

CPT Coding Update: Basal Cell Cancer of the Nasal Tip

Gregory Pearson, MD

A patient with a basal cell cancer of the tip of the nose inspired this CPT coding corner.

Cancerous lesions of the nose are coded based upon size. One should mark out appropriate surgical margins and include these in the reported size of the lesion. The lesion code is 1164X. The “X” is determined by the size of the resection with 0 being 1-5 mm, 1 being 6-10 mm; 2 being 11-20 cm, and 3 being 21-30 cm. After the lesion is resected, codes for closure must be considered. If the lesion is closed primarily in a layered manner, codes 1252X should be used (again with X being cm of closure; 1 being <2.5 cm, 2 being 2.6 to 5.0 cm, and 3 being 5.1 to 7.5 cm).

Ascending the reconstructive ladder, occasionally a full thickness skin graft is used for reconstruction (use codes 15260—20 sq. cm or less—or 15261—each additional 20 sq. cm). The donor site closure (for example, behind the ear) is included with the 152XX codes. If one elects to perform a bi-lobed flap or an adjacent tissue transfer, then code 14060 (defect 10 sq. cm of less) can be used. When using an adjacent tissue transfer code, one CANNOT code for the excision of the lesion. Excision of the lesion is bundled into the ATR code. Remember that code 14060 refers to a randomly based flap and not an axially based flap.

If a surgeon performs a forehead flap, the CPT code 15731 should be employed. This code is a relatively new code (given that code 15732 was previously used to include all head and neck flaps). Debulking of the flap with initial inset is included in the description of this code. Primary repair of the donor site is also included with this code. If the donor site is closed with a skin graft, ATR, or even “extensive mobilization (per the CPT coding book), then additional codes can be used.

Occasionally, cartilaginous support is required for framework support. If the surgeon uses ear cartilage or rib cartilage, codes 21230 (ear) or 21235 (rib) can be reported. Remember that closure of the donor site for cartilage harvests is included in the primary descriptor. When repairing a full thickness rim loss with a composite graft, the code 15760 best describes the work performed. Closure of the donor site and inset of the graft are similarly bundled with this code.

Finally, if axial flaps such a nasolabial flap are utilized for closure, the surgeon should use the 15576 code for this type of repair. The codes 15576, 15760 and 15731 are not bundled with the excision code so the initial 1146x should be coded as well.
Polysomnographic Titration of Mandibular Lengthening by Distraction in Tongue-Based Airway Obstruction

Julie M. Mhlaba, MD; Garrick D. Talmage, MD; Fuad M. Baroody, MD; Hari P.R. Bandla, MD; Russell R. Reid, MD, PhD

Department of Surgery, Section of Plastic Surgery (R.R.R.), University of Chicago Medical Center, Chicago, Illinois; From the University of Chicago Pritzker School of Medicine (J.M.M., G.D.T.); From the Department of Surgery, Section of Otolaryngology – Head and Neck Surgery (F.M.B.), University of Chicago Medical Center, Chicago, Illinois; From the Department of Pediatrics (F.M.B., R.R.R.), University of Chicago Medical Center, Chicago, Illinois; From the Department of Pediatrics, Section of Sleep Medicine (H.P.R.B.), Medical College of Wisconsin.

The research in this article was performed entirely at the University of Chicago Medical Center.

Disclosure statement: The authors have no financial support, conflicts of interest, or off-label use of pharmaceuticals to disclose.

Abstract

Review of current evidence regarding the use of polysomnography (PSG) for the evaluation of Pierre Robin Sequence (PRS) in infants has shown great variability. We developed a protocol that includes the use of standard overnight 16-channel PSG performed at the bedside during the early consolidation phase of mandibular distraction osteogenesis (MDO), with management decisions informed by the results. We describe our experience and outcomes with this protocol.

Pre-operative overnight PSG was performed on patients with PRS undergoing MDO at our institution and scored according to the AASM Scoring Manual Version 2.2. Patients who demonstrated persistent obstructive sleep apnea (OSA) underwent further distraction.

Pre-operative and initial post-distraction PSG was obtained and available for analysis in 17 patients during the study period. Apnea-Hypopnea Index (AHI) improved from 48 ± 38 to 6 ± 5 (p < 0.001) for the cohort. There was evidence for persistent, severe OSA in four out of 17 (24%) patients and persistent, moderate OSA in one out of 17 patients (6%). Four of the five patients with persistent OSA underwent additional distraction and demonstrated improvement in OSA. Although patients’ airway volumes by 3D-CT increased from 1.0 ± 0.5 cm³ to 2.3 ± 1.7 cm³ (p = 0.057), there was no correlation between improvement in AHI and increase in airway volume.

PSG can be performed at the bedside at the end of the distraction phase of MDO to assess the need for further distraction. Because it is a physiological assessment, PSG is the best available modality to evaluate for residual airway obstruction in patients undergoing MDO.

Key Words

Polysomnography, Tongue-Based Airway Obstruction, Mandibular Distraction Osteogenesis

Introduction

Pierre Robin Sequence (PRS) is the triad of micrognathia, glossoptosis and resultant upper airway obstruction (UAO). Generally, the evaluation of UAO in patients with PRS includes four key components: 1) Clinical exam, 2) Evaluation of the anatomic airway using flexible nasolaryngoscopy or bronchoscopy, 3) Imaging and 4) Cardiorespiratory sleep studies. The first three components help clarify the anatomy of the airway and describe the level and severity of the obstruction. Importantly only the fourth component, cardiorespiratory sleep studies can provide a physiologic and quantitative assessment of the obstruction.1,3,4

Therapeutic options for the management of PRS include both non-operative methods (e.g. observation, nasopharyngeal airway, prone positioning) and operative methods (e.g. tongue-lip adhesion, tracheostomy, mandibular distraction osteogenesis) when less invasive methods are insufficient.1 First described in 1992, mandibular distraction osteogenesis (MDO) has been shown to be a safe and effective alternative to tracheostomy in patients requiring surgical intervention.5,6 The goal of MDO is to lengthen the mandible and subsequently increase the volume of the airway, leading to a resolution of airway obstruction.

Mandibular distraction has four stages: 1) Distractor placement, during which the device is applied to the osteotomized mandible, 2) Latency phase, before distraction is begun, 3) Distraction or activation phase, during which the device is turned such that the distance between the mandibular bone fragments increases and 4) Consolidation, during which new bone grows between the osteotomized segments of the mandible. In the majority of mandibular distraction cases for airway obstruction, planning involves achieving an arbitrary skeletal relationship (Class III malocclusion) or “overcorrection” of the mandibular hypoplasia. More recently, virtual surgical planning (VSP) has been used pre-operatively to more precisely estimate length, as well as predict airway volume achieved by proposed lengthening.7

(continued on next page)
Historically, various cardiopulmonary sleep studies were used in the assessment of UAO in PRS infants. These included oximetry studies, daytime nap studies, limited polysomnographic studies (without EEG) and standard overnight 16-channel polysomnographic studies. PSG has been reported as a tool to measure the physiologic effects of airway obstruction pre- and post-operatively in PRS patients undergoing MDO.\(^5,6,10\) Importantly while the use of post-operative PSG is mentioned in these studies, there is often no specific timing noted for the repeat study.\(^5,6,10,11\) In other studies, the timing is mentioned, but the authors make no mention of using the results to influence management of distraction length.\(^10,11\) Review of current evidence using polysomnography for the evaluation of PRS infants has shown great variability in methods of performing the studies and scoring of events.\(^14\)

At our institution, a protocol has been instituted that includes the use of standard overnight 16-channel PSG at the bedside with standardized scoring system using American Academy of Sleep Medicine criteria. We perform these studies in the early consolidation phase of MDO, with management decisions informed by the results. Used in this manner, PSG serves as a physiologic measure of symptom improvement and aids in the decision-making process regarding the total length of distraction. We report our early experience employing this protocol in the management of PRS patients undergoing MDO.

**Materials and Methods**

This study was approved by the University of Chicago Institutional Review Board (IRB14-0092). A retrospective review was performed on all patients who underwent MDO by a single surgeon (RRR) from 2009-2015. Patients without pre- and post-operative PSG were excluded from the study.

Diagnosis of UAO and estimate of the severity of obstructive sleep (OSA) pre-operatively were facilitated by performing overnight PSG. All studies were performed at the bedside in the NICU (Neonatal Intensive Care Unit) at The University of Chicago-Comer Children’s Hospital, using portable digital PSG diagnostic systems (Polysmith-Nihon Kohden America Inc, CA, USA). The PSGs were scored as per the 2012 American Academy of Sleep Medicine (AASM) guidelines for the scoring of sleep and associated events.\(^15\)

The obstructive apnea-hypopnea index (AHI) was defined as the number of obstructive apneas and hypopneas per hour of total sleep time (TST). The children with AHI 1-5 were classified as having mild OSA and children with AHI of >5-10 and >10 were classified as moderate and severe OSA, respectively. Several quantitative measures of oxygenation were also derived from the oximetry recordings, including Oxygen Desaturation Index (ODI, hourly average number of desaturations), SpO2 nadir, mean SpO2, and percentage of time with SpO2 less than 90%.

Surgical procedures were performed using either a linear internal mandibular distractor device (eight patients, 47%), a curvilinear distractor device (eight patients, 47%) or a multi-vector external distractor device (one patient, 6%) (Synthes, Paoli, PA). In the eight patients who underwent curvilinear distraction, virtual surgical planning (VSP) was utilized preoperatively using the 3D-reformatted CT data obtained to optimize device placement and to establish a distraction endpoint based on predicted skeletal advancement of the mandible and airway volume after the virtual surgery.\(^7\) Intraoperatively, at least three millimeters of distractor length was added to the pre-determined length of the curvilinear distractors to allow for additional distraction if necessary. The extra length of the distractor arm was limited by the patient’s mandibular dimensions and the space afforded by the soft tissue envelope. Standard protocol for all patients included a latency period of 24 hours followed by distractor activation at roughly 2mm/day (1mm BID) for three days followed by 1mm/day (0.5mm BID) until virtual distraction endpoint was reached.\(^11\)

Following initial distraction, PSG was repeated to quantify the degree of improvement of the severity of OSA. Of note, these studies were also performed at the bedside post-extubation after discontinuation of any sedative medications. If the AHI d”5, distraction was discontinued and the consolidation period was initiated. If AHI >5 distraction was continued based on the severity of obstruction (0.5mm BID or 1mm/day) until the maximum device lengthening capacity was reached. When possible, PSG was repeated following additional distraction. Three-dimensional CT was then performed post-operatively to assess for bony regenerate consolidation prior to device removal and airflow volume.

Statistical and graphical analyses were completed using SPSS 23.0 (IBM Corp., Armonk, NY). Paired t-tests were used to compare measurements obtained before and after distraction. Student’s t-test and Pearson’s chi-square test compared characteristics of patients that received or did not receive additional distraction. Finally, Pearson’s correlation was used to determine if changes in airway volumes correlated to changes in PSG values.
Polysomnographic Titration (continued from previous page)

Results

Initial phase of distraction improves polysomnographic measures of sleep apnea

Both pre-operative and initial post-distraction PSG were obtained and available for analysis in 17 patients during the study period, with demographics of the cohort shown in Table 1. There was an overall improvement in markers of OSA in the cohort, including statistically significant improvements in AHI, OAHI, Mean SpO$_2$, Oxygen Desaturation Index, and nadir SpO$_2$ (Table 2). There was a trend towards an increase in sleep efficiency (p=0.09) and percentage of sleep time spent in N3 (p=0.06), and a trend towards a decrease in percentage of time spent below 90% oxygen saturation (p = 0.09). There was evidence for persistent, severe OSA in four out of 17 (24%) patients and persistent, moderate OSA in one out of 17 patients (6%). Four of the five patients with persistent OSA underwent additional distraction (individual patient histories shown in Table 3). The final patient (number 12 in Table 3), who underwent distraction with an external device, had a complicated course, including post-operative aspiration requiring reintubation and right-sided external distractor dislodgement. Post-operative CT revealed resolution of retrognathism, and the residual OSA was presumed caused by severe glossoptosis and hypotonia, secondary to the patient’s syndromic diagnosis (Rubenstein-Taybi). The patient eventually underwent tracheostomy for airway protection and treatment of persistent OSA.

Table 1. Baseline cohort demographics and clinical characteristic

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>17</td>
</tr>
<tr>
<td>Age (years ± SD)</td>
<td>2 ± 5</td>
</tr>
<tr>
<td>Males (%)</td>
<td>9 (53)</td>
</tr>
<tr>
<td>Race (%)</td>
<td></td>
</tr>
<tr>
<td>Caucasian/non-Hispanic</td>
<td>10 (53)</td>
</tr>
<tr>
<td>Caucasian/Hispanic</td>
<td>2 (18)</td>
</tr>
<tr>
<td>African-American</td>
<td>4 (24)</td>
</tr>
<tr>
<td>Asian</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Syndrome (%)</td>
<td></td>
</tr>
<tr>
<td>Isolated PRS</td>
<td>14 (82)</td>
</tr>
<tr>
<td>PRS + other anomalies</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Treacher Collins syndrome</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Rubenstein-Taybi syndrome</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Cleft palate (%)</td>
<td>14 (82)</td>
</tr>
<tr>
<td>Pre-distraction AHI ± SD</td>
<td>48 ± 38</td>
</tr>
<tr>
<td>Post-activation phase AHI ± SD</td>
<td>6 ± 5</td>
</tr>
<tr>
<td>Initial distraction length (mm ± SD)</td>
<td>14 ± 3</td>
</tr>
<tr>
<td>Total distraction length (mm ± SD)</td>
<td>15 ± 3</td>
</tr>
</tbody>
</table>

Table 2. Comparison between pre-operative PSG and initial post-operative PSG

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-distraction (mean ± SD)</th>
<th>Initial post-operative PSG (mean ± SD)</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall AHI</td>
<td>48 ± 38</td>
<td>4 ± 5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Range</td>
<td>8 ± 15</td>
<td>0 ± 15</td>
<td></td>
</tr>
<tr>
<td>Obstructive AHI</td>
<td>40 ± 15</td>
<td>2 ± 5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Central AHI</td>
<td>13 ± 2.5</td>
<td>0.1 ± 0.9</td>
<td>0.3</td>
</tr>
<tr>
<td>Mean SpO2 (%)</td>
<td>94 ± 2</td>
<td>90 ± 2</td>
<td>0.009</td>
</tr>
<tr>
<td>Oxygen Desaturation Index</td>
<td>43 ± 10</td>
<td>14 ± 13</td>
<td>0.001</td>
</tr>
<tr>
<td>Percentage of time &lt;90% SpO2 (%)</td>
<td>11 ± 19</td>
<td>2 ± 5</td>
<td>0.09</td>
</tr>
<tr>
<td>SpO2 Nadir (%)</td>
<td>71 ± 9</td>
<td>81 ± 10</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*P-values are from paired t-tests, with p<0.05 indicating statistical significance.
AHI: Apnea-Hypopnea Index; SpO2: Saturation of oxygen

Table 3. Distraction Protocol Results

<table>
<thead>
<tr>
<th>Pt</th>
<th>Pre-op AHI</th>
<th>Initial Distraction Length (mm)</th>
<th>Post-op AHI</th>
<th>Additional Distraction (Y/N)</th>
<th>Additional Distraction Length (mm)</th>
<th>Repeat AHI</th>
<th>Total Distraction Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.3</td>
<td>21</td>
<td>1.2</td>
<td>N</td>
<td>N</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>15.3</td>
<td>13</td>
<td>0</td>
<td>N</td>
<td>N</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>40.4</td>
<td>17</td>
<td>4</td>
<td>N</td>
<td>N</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>36.7</td>
<td>10.5</td>
<td>4.9</td>
<td>N</td>
<td>N</td>
<td>10.5</td>
<td>10.5</td>
</tr>
<tr>
<td>5</td>
<td>26.9</td>
<td>14</td>
<td>4.98</td>
<td>N</td>
<td>N</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>11.5</td>
<td>12</td>
<td>2.8</td>
<td>N</td>
<td>N</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>154</td>
<td>14</td>
<td>2</td>
<td>N</td>
<td>N</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>35.7</td>
<td>17</td>
<td>4.97</td>
<td>N</td>
<td>N</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>9</td>
<td>63.7</td>
<td>15.75</td>
<td>10.6</td>
<td>Y</td>
<td>2.2</td>
<td>22.75</td>
<td>22.75</td>
</tr>
<tr>
<td>10</td>
<td>37.2</td>
<td>11</td>
<td>15.2</td>
<td>Y</td>
<td>3 N/A</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>11</td>
<td>119</td>
<td>R-12.75</td>
<td>5.6</td>
<td>Y</td>
<td>R-3</td>
<td>N/A</td>
<td>R-15.75</td>
</tr>
<tr>
<td>12</td>
<td>41.6</td>
<td>13</td>
<td>13.2</td>
<td>N</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>13</td>
<td>29.3</td>
<td>14</td>
<td>15.1</td>
<td>Y</td>
<td>5 8.7</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>14</td>
<td>49</td>
<td>12.5</td>
<td>1.5</td>
<td>N</td>
<td>N</td>
<td>12.5</td>
<td>12.5</td>
</tr>
<tr>
<td>15</td>
<td>35.8</td>
<td>12</td>
<td>3.1</td>
<td>N</td>
<td>N</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>16</td>
<td>36.5</td>
<td>13</td>
<td>2.7</td>
<td>N</td>
<td>N</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>17</td>
<td>75.8</td>
<td>13.5</td>
<td>3.4</td>
<td>N</td>
<td>N</td>
<td>13.5</td>
<td>13.5</td>
</tr>
</tbody>
</table>

*Pt: patients
AHI: Apnea-Hypopnea Index

PSG can be performed at the bedside at the end of the distraction phase of MDO to assess the need for further distraction. Because it is a physiological assessment, PSG is the best available modality to evaluate for residual airway obstruction in patients undergoing MDO.
Polysomnographic Titration (continued from previous page)

Characteristics and outcomes of patients receiving additional distraction

The four remaining patients with residual OSA identified by PSG after initial distraction underwent an average of 4.38 mm (R=2-7mm) of additional distraction in an attempt to further decrease their airway obstruction. There were no significant differences in demographic or clinical characteristics between patients who did not require additional distraction and those who did, including length of initial distraction (Table 4). However, there was a trend towards patients requiring additional distraction when a curvilinear distractor was used. In two of the four patients undergoing additional distraction, repeat PSG was obtained after completion of the extended phase of distraction. In these two patients, there was a further decrease in AHI from 13 ± 3 to 5 ± 5 and in OAHI from 11 ± 1.5 to 1.4 ± 0.6. The remaining two patients were evaluated following distraction by team members from Sleep Medicine and Otolaryngology and were determined not to require additional PSG, as both patients had been successfully weaned off oxygen and were no longer experiencing obstructive events. Both patients have continued to do well post-operatively and subsequently have remained on room air.

3D estimations of airway volumes, pre- and post-distraction (continued from previous page)

Table 4. Comparison of patients with and without additional distraction

| Characteristic                              | Patients who did not receive additional distraction | Patients who received additional distraction | p-value*
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>13</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Age (years ± SD)</td>
<td>1.9 ± 5</td>
<td>2 ± 4</td>
<td>0.9</td>
</tr>
<tr>
<td>Males (%)</td>
<td>7 (54)</td>
<td>2 (50)</td>
<td>0.9</td>
</tr>
<tr>
<td>Race (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian/non-Hispanic</td>
<td>6 (46)</td>
<td>4 (100)</td>
<td>0.3**</td>
</tr>
<tr>
<td>Caucasian/Hispanic</td>
<td>2 (15)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>African-American</td>
<td>4 (31)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>1 (8)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Syndrome (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolated PRS</td>
<td>10 (77)</td>
<td>4 (100)</td>
<td>0.8**</td>
</tr>
<tr>
<td>PRS + other anomalies</td>
<td>1 (8)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Treacher Collins syndrome</td>
<td>1 (8)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Rabenstein-Taybi syndrome</td>
<td>1 (8)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cleft palate (%)</td>
<td>11 (85)</td>
<td>3 (75)</td>
<td>0.7</td>
</tr>
<tr>
<td>Pre-distraction AHI ± SD</td>
<td>44 ± 35</td>
<td>62 ± 40</td>
<td>0.4</td>
</tr>
<tr>
<td>Post-activation phase AHI ± SD</td>
<td>4 ± 3</td>
<td>12 ± 5</td>
<td>0.002</td>
</tr>
<tr>
<td>Pre-distraction mean SpO2 (% ± SD)</td>
<td>94.2 ± 1.5</td>
<td>93 ± 5</td>
<td>0.5***</td>
</tr>
<tr>
<td>Pre-distraction ODI ± SD</td>
<td>39 ± 32</td>
<td>56 ± 21</td>
<td>0.3</td>
</tr>
<tr>
<td>Pre-distraction percentage of time &lt;90%</td>
<td>7 ± 7</td>
<td>25 ± 38</td>
<td>0.4***</td>
</tr>
<tr>
<td>SpO2 (%)</td>
<td>71 ± 10</td>
<td>69 ± 6</td>
<td>0.8</td>
</tr>
<tr>
<td>Initial distraction length (mm ± SD)</td>
<td>14 ± 3</td>
<td>13 ± 2</td>
<td>0.6</td>
</tr>
<tr>
<td>Total distraction length (mm ± SD)</td>
<td>14 ± 3</td>
<td>18 ± 4</td>
<td>0.06</td>
</tr>
<tr>
<td>Pre-operative airway volume (cm³ ± SD)</td>
<td>2.6 ± 3.2</td>
<td>1.8 ± 1.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Distractor Type (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal, Linear</td>
<td>8 (61)</td>
<td>0</td>
<td>0.053**</td>
</tr>
<tr>
<td>Internal, Curvilinear</td>
<td>4 (31)</td>
<td>4 (100)</td>
<td></td>
</tr>
<tr>
<td>External</td>
<td>1 (8)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

* p-values are from paired t-tests (except as noted) comparing the group who received additional distraction to the group who did not, with p<0.05 indicating statistical significance
** p-values determined by Chi-Square
*** Levene’s test for equality of variances rejected the null hypothesis that there was no difference in the variances between the groups; therefore, equal variances were not assumed in calculating the p-value
*PRS: Pierre Robin sequence; *AHI: Apnea-Hypopnea Index; *SD: standard deviation; *ODI: Oxygen Desaturation Index
Eight patients had both pre- and post-distraction 3D reconstruction CT maxillofacial images available with the post-distraction scan taken within 3 months of the original imaging. The average pre-operative airway volume in this set of patients was $1.0 \pm 0.5 \text{ cm}^3$, compared to a volume of $2.3 \pm 1.7 \text{ cm}^3$ after the completion of distraction. This change trended toward statistical significance (paired T-test, $p = 0.057$). Pre-operative airway volume did not predict need for additional distraction, nor was there a correlation between change in airway volume and change in AHI by Pearson’s correlation.

**Discussion**

Polysomnography is a unique method of evaluation because it provides a quantitative assessment of airway obstruction. Developed in the mid-twentieth century, PSG is a safe and reliable method for measuring sleep pathology. Importantly, the degree of airway obstruction in patients undergoing MDO does not always correlate to the severity of clinical symptoms. In one study of 13 infants with PRS undergoing PSG, OSA was identified in 85% of patients. Of the patients with OSA, only 55% exhibited snoring. For this reason, the evaluation and management of patients with PRS cannot hinge on clinical suspicion, and PSG is an important, objective tool for assessing presence and severity of obstruction.

At our institution, we are able to perform comprehensive, 16-channel PSG studies in our PRS population at bedside during MDO using standardized techniques and score the events in accordance with the AASM guidelines. These attributes make PSG especially useful as a tool to measure physiologic improvements in OSA during treatment.

The distraction protocol used during MDO is typically based on institutional policy, surgeon preference, and availability of PSG equipment. A standardized method to determine when to cease distraction and begin consolidation has not been established. In most studies, distraction is continued to the full length of the distraction device or until the patient is in a slight class III position. While several studies have included the use of both pre- and post-operative PSG in their management of patients undergoing MDO, the timing of testing is rarely clarified. Mitsukaka et al. describe clear improvements in AHI post-operatively, but the only mention of timing of repeat PSG is six months to one year post-operatively. Denny et al. are more explicit regarding the timing of repeat PSG, with several patients undergoing PSG from one week to one month following distractor placement. However, while all seven patients studied had normal post-operative PSG, there is no mention of using the study results to influence distraction phase.

We propose the use of PSG immediately after distraction has ended to stratify patients who may or may not need additional distraction. A significant subset of patients (24%) in our cohort would have had residual, severe OSA if distraction had not been extended (Table 3). The patients who required additional distraction had a notably higher pre-operative AHI, ODI, and percentage of time below 90% $\text{SpO}_2$. Although the difference in these markers did not reach statistical significance, it is possible that a larger sample size would reveal that the initial severity of OSA predicts the need for additional distraction. Both of the patients in our study who did complete a third and final PSG after additional distraction showed a continued decrease in AHI. The remaining two patients who underwent additional distraction underwent close clinical follow-up and were noted to have normal saturation on room air.

If there is length available to extend distraction, distraction can be resumed in an attempt to further reduce the amount of obstructive events. We have identified a cutoff AHI of >5 as an indication for further distraction. It is not clearly established what constitutes pathologically significant OSA in infants. Given the potential for accelerated bone growth in the distracted segments of the mandible reported in the PRS infants following distraction, combined with natural growth of the jaw during the first year of life, we anticipate that mild OSA will resolve during infancy.

A key to our protocol development is the use of VSP, which gives us a target endpoint to distraction based on skeletal relationships and airway volume. Such a strategy aids in the synchronization of postoperative PSG testing. Our practice has shifted to reflect this, as patients undergoing MDO later in the series underwent distraction with a curvilinear distractor and VSP for surgical planning. The decision to change to a curvilinear device and add VSP to our protocol was based on the goal of adding precision to the postoperative skeletal position (maximizing occlusal and anatomical relationships between the maxilla and mandible) and device placement. However, with a curvilinear system, the demands for precision are even greater than those with a linear system. Furthermore, it is more difficult to calculate the virtual lengthening of the mandible as each turn of the curvilinear device does not exactly correspond to a direct A-P advancement. Therefore, in the curvilinear distraction patients, the distractor device was modified intra-operatively to reflect the proposed distraction length with at least 3mm of additional length added to the proposed length to account for any possible error in VSP.

Interestingly, all of the patients who required additional distraction length had VSP performed prior to their operation. We have previously reported our experience using VSP to predict increase in airway volume post-operatively. While pre- and post-operative airway volumes are useful in estimating the static volume change afforded by MDO, they do not provide a physiologic measurement of the frequency and severity of obstruction. Some factors that affect airway obstruction in patients with PRS are not measured by static CT imaging – in particular, patients with PRS may have hypotonia associated with other anomalies or syndromes. PSG better identifies which patients have unresolved obstruction and has greater utility for making further management decisions. Our next steps include further characterization of the utility of VSP and its relation to PSG.

This analysis does have several limitations. A major limitation in our series is the fact that our patient population is heterogeneous in terms of type of device used for distraction. Our plan going forward is (continued on next page)
Polysomnographic Titration (continued from previous page)

to reduce heterogeneity by prospectively analyzing patients undergoing curvilinear distraction only. Furthermore, due to unique patient characteristics and logistical issues, strict adherence to protocol is challenging. Often, insurance issues, patient compliance and complications can serve as barriers to acquiring repeat PSG. PSG is also operator and patient-condition dependent, and not all institutions have PSG currently available at the bedside.

Nonetheless, we believe that institutions should consider employing PSG in the early consolidation phase in order to assess need for further distraction. We strongly encourage the use of 16-channel PSG scored according to the AASM standard criteria in order to achieve this goal. Additionally, we recommend the continued use of VSP to establish an initial distraction endpoint and to better classify the relationship between post-operative changes in airway volume as measured by 3D-CT and improvements in airway obstruction as measured by PSG. We recommend that this protocol can be considered for adoption by institutions with necessary resources to ensure physiologic improvement before distraction is completed.

When available, patients undergoing MDO should receive bedside overnight polysomnographic studies at the end of the planned distraction phase to evaluate for further airway obstruction and guide further management.

Acknowledgements

We would like to thank the technologists at the University of Chicago Sleep Disorders Center, including Chief Sleep Technologist Shane Szutensch, for their expertise and help with this project.

References

Nasoalveolar Molding (NAM) is a presurgical modality involving a removable alveolar molding plate used to gradually correct the nasal and alveolar deformities in infants born with cleft lip and palate. NAM includes a passive molding appliance that expands the ala and increases the columellar length as well as align the alveolar arches prior to surgical repair. With this modality, come both advantages and disadvantages, as well as an often-controversial debate amongst advocates and opponents. Proponents suggest NAM can improve feeding, align cleft segments, facilitate lip repair and gingivoperiosteoplasty, and improve nasal form. However, others are quick to point out the paucity of strong evidence to support the practice, as well as the existence of disadvantages including, but not limited to, a significant learning curve implementing the modality in treatment centers, adjacent tissue injury, burden of care, and poor compliance.

In a recent survey of the American Cleft Palate-Craniofacial Association and the Canadian Society of Plastic Surgeons, the vast majority of surgeons responded that they did not use NAM in either patients with complete or incomplete clefts; only 39 percent used NAM in some of their patients with complete clefts. According to Sisco et al., 43 cleft centers, or 37% of the 117 surveyed, reported the use of NAM, demonstrating its use in only 21% of the 207 ACPA Membership teams. Could this be related to the level of evidence surrounding the modality?

The majority of evidence in support of NAM is Level III and IV. There is strong Level II evidence evaluating the positive effects of passive infant orthopedics without the nasal molding attachments in the well-designed prospective Dutchcleft studies. These studies include a prospective, multicenter, randomized controlled trial with the use of infant orthopedics (IO+) using passive alveolar molding plates from 2 weeks-of-age until surgical closure of the soft palate at 52 weeks of age versus the control group (IO-) that did not undergo presurgical orthopedics. The Dutchcleft outcomes demonstrated no difference between the groups among the following variables: occlusion, maxillary arch, maxillary arch facial appearance, facial growth, patient satisfaction, and short-term cost. With such conclusive evidence against infant orthopedics, the crux of the NAM debate has focused on its effect on the nose.

Level II evidence in support of NAM has been published by Bennun et al. These authors looked at the nonsurgical correction of nasal deformity in unilateral complete cleft lip patients over a 6-year period. The first group in the study had a nasal component in addition to the occlusal prostheses, which only stabilized the maxillary segments, and no surgical procedure to correct the nasal deformity. In the second group, a nasal acrylic component was not added and different techniques for primary nasal reconstruction were performed. The study groups were compared to control subjects by measuring different nasal anthropometric measurements over a 6-year period of follow-up. The authors demonstrated that nasal nostril symmetry was better and more sustained in those patients with the nasal prosthesis component. Chang et al. compared two NAM techniques in unilateral complete cleft lip patients by performing a Level II randomized, prospective, single blind trial to compare nasal outcomes. Overall the two techniques produced similar nasal outcomes; however, alveolar ulceration was more frequent in the Grayson group versus the Figueroa group.

The need for a greater level of evidence has been recommended by the authors of recent articles reviewing the NAM literature. Van der Heijden and colleagues of the Netherlands performed a systematic review of the literature and concluded that studies were inconsistent with regards to changes in nasal symmetry. They also determined that although NAM appeared beneficial, the evidence was not substantial and they recommended future research to develop a consensus regarding the effect of the technique. Abbott and Meara also performed a systematic review of the NAM literature to evaluate whether the technique improved nasal symmetry and form, and whether it demonstrated advantages over alternative protocols. Of the 98 articles reviewed, 21 reported objective outcome measures of nasal anatomy. Six of these articles were given evidence level ratings. All of these articles focused on patients with unilateral cleft lip and palate. None provide level I evidence; three were level III and two were level IV evidence. Overall, the authors deduced that though NAM demonstrated promise, it clearly deserved further study due to a lack of high-level evidence.

Expert opinion, or Level V evidence, is often heralded as support for NAM. Dr. Joe Losee, presented the argument that pre-surgical NAM makes surgical repair on these patients “easier.” Related arguments for NAM include improved alignment of the maxillary segments to facilitate lip and nasal repair. In addition, the assumption is made that approximation of the alveolar segments and cleft lip decreases tension with improved post-operative outcome. However, Winters and Hurwitz,
Is NAM a Scam? (continued from previous page)

from Pittsburgh, have discussed that this assumption has not been definitively established.\(^{18}\) Some surgeons, including these authors, argue that excellent aesthetic results can be achieved in cases of severe cleft lip and palate repair without presurgical molding. Still, others point to the more recently published study by Broder et al., a nonrandomized, prospective, multicenter study looking at appraisals of primary cleft lip treatment with and without NAM. In conclusion, the authors demonstrated that based on clinician ratings infants who underwent NAM were found to have comparable results to those patients who underwent lip repair alone.\(^{19}\)

Even with varying levels of evidence regarding NAM, other factors such as monetary costs must also be identified and closely examined. With NAM comes costs to both the practitioner and institution, as well as the patient and caretaker. Based upon our own experience, it has become clear that there is a steep learning curve and tremendous cost to practitioners that comes with developing a NAM program. Training alone—as demonstrated by our own dental colleagues new to the technique—can cost over $5,000.00. Additional studies have demonstrated that cost and compliance can be a significant issue. Shay et al. performed a retrospective analysis of cleft lip and palate patients over a five-year period. They identified 35 patients who had undergone NAM. The mean cost of NAM was approximately $3,550.00. Patients undergoing NAM made an average of 11 office visits prior to their cleft repair and demonstrated a significantly higher level of non-compliance with clinic visits. These patients had a greater number of made, cancelled, no-show, and missed visits demonstrating a non-compliance of 35 percent of total scheduled visits, suggesting a higher burden of care for the patient’s caretakers.\(^{20}\) The financial burden to the patient’s family undergoing NAM treatment cannot be overlooked.

We analyzed data from our own patient population at Rady Children’s Hospital, San Diego to evaluate the financial burden to caretakers involved in NAM utilization. In reviewing 39 patients who had completed NAM over a period of three years from 2013 to 2016 we were able to extrapolate travel costs and lost wages. Average round trip was 83.8 minutes and 78.9 miles of travel with an additional one-hour time duration associated with the visit. An average total travel cost per visit of $49.77 was calculated based upon 2015 AAA median sedan cost per mile traveled ($0.58) and additional parking costs of $4.00 per two hours. This preliminary data has also shown that lost wages for one adult per visit is $62.45 based upon an hourly wage of $26.06 per hour in our region with the financial burden per clinic visit totaling $112.22. Overall, our patients with unilateral cleft lip average 10 visits and bilateral cleft lip patients averaged 14 visits for a total financial burden of $1,122.10 and $1,571.08, respectively. In addition, reimbursement for medical costs for our patients often only ranges from $1,800.00 to $2,200.00 depending on pay source (e.g. Dental versus Private Insurance).

Recently, Patel et al. performed a 9-year retrospective cohort study of medical costs examining the need for early secondary nasal revision in patients with clefts treated with and without NAM. They found that the risk of secondary nasal revision was higher in the group treated without NAM. This resulted in an overall cost savings between $491 and $4,893 for those patients treated with NAM due to the lower need for revision surgery.\(^{21}\) However, their argument supporting NAM is weakened by a lack of objective criteria to determine need for early secondary nasal revision.

Financial concerns are not the only contentious issue surrounding NAM. There are complications associated with the practice. In 2009, Levy-Bercowski et al. retrospectively examined complications in 27 patients treated with NAM therapy and noted both soft and hard tissue complications including the following: mucosal irritation, intraoral bleeding, tissue fungal infections, tissue irritation, mega-nostril, impingement of nasal epithelium, nasal bleeding, and asymmetric T-shaped arch. Tissue irritation (the only complication with an incidence greater than 10%) occurred in 74% of patients. These authors also found protocol compliance as a significant issue. They estimated an incidence of 30% for broken appointments and removal of the appliance by the patient’s tongue occurring 26% of the time.\(^{22}\) In more recent studies performed by Chang et al., skin rash was noted in 87% of patients undergoing modified Figueroa NAM and 73% undergoing modified Grayson NAM.\(^{15}\)

Confounding variables that may affect outcomes must also be closely examined when discussing NAM. For example, what is the impact of the primary rhinoplasty? Garfinkle et al. performed a longitudinal, retrospective analysis of 77 bilateral cleft lip and palate patients who underwent NAM and Cutting bilateral cleft lip and nasal reconstruction. All patients underwent NAM and primary rhinoplasty and were compared to a control group of individuals with normal nasal morphology. Although the authors demonstrated that patients who underwent NAM and primary nasal reconstruction presented with normal nasal morphology through 12.5 years, the study lacked a group of patients who did not undergo presurgical treatment with NAM.\(^{23}\)

What is the impact of surgical overcorrection? Chang et al. performed a retrospective study over 11 years comparing long-term outcomes of nasal reconstruction. Four techniques were studied, including primary rhinoplasty alone, NAM alone, NAM plus primary rhinoplasty, and NAM plus primary rhinoplasty plus overcorrection with each group undergoing panel assessment using a visual analogue scale performed at five years-of-age. Overall, NAM plus primary rhinoplasty with overcorrection (Group IV) demonstrated the best panel assessment; a necessary overcorrection of 20 percent was required to maintain nos-
Is NAM a Scam? (continued from previous page)

tril height,24 The same group examined patients with bilateral cleft nasal repair using the same four techniques, and a comparison to patients without cleft lip. They found that those undergoing NAM plus primary rhinoplasty plus overcorrection (Group IV) had the best overall results and demonstrated a nasal appearance that was more similar to those patients without cleft lip.25 In order to maintain overcorrection, it should be noted that group IV patients in both studies were treated with silicone sheets and nasal conformers for at least 6 months postoperatively.

What is the impact of such post-operative molding as well as the duration of the molding? As mentioned previously, the Chang Gung group used postoperative nasal stents on postoperative day six for at least six months in all groups.24,25 In addition, Group IV patients used postoperative conformers with additional silicone sheets that were added during three subsequent monthly visits. Other studies have also implemented nasal stents or conformers. Liou et al. looked at progressive changes of nasal symmetry with growth after NAM over a three-year period. The results of their study demonstrated that nasal symmetry was improved after NAM. However, nasal symmetry significantly relapsed postoperatively during the first year and then remained stable thereafter in the second and third years. Based on these findings they recommended maintaining nasal conformers postoperatively to improve results.26 Should we consider having our patients maintain the use of nasal conformers indefinitely? These additional confounders may be distorting the magnitude of benefits with NAM.

In summary, NAM has both its advocates and its opponents, but in many cases, there is a paucity of high quality evidence to support or detract from the practice. Additionally, confounding variables, such as primary rhinoplasty and the long-term use of post-operative nasal conformers, may further cloud the issue. Proponents of NAM argue that its advantages such as facilitation of lip repair and gingivoperiosteoplasty, and long-term improvement of nasal form still need closer investigation. Potential disadvantages must not be overlooked either: the steep learning curve associated with the technique, adjacent tissue injury, the burden of care including cost to families and healthcare systems, as well as the poor compliance rate and poor access to centers providing NAM.

In closing, we do not feel that NAM is a scam. We have been pleased with the short-term results of our center’s NAM program. However, following a careful review of the literature, there is still a clear need for higher level of evidence to support the long-term benefits of NAM and to justify the costs.

In summary, NAM has both its advocates and its opponents, but in many cases, there is a paucity of high quality evidence to support or detract from the practice.

References

(continued on next page)
Is NAM a Scam? (continued from previous page)

Updated History of the ASMS

Arun K. Gosain, MD


The latest article outlines how the ASMS has continued to advance representation of the specialty of Maxillofacial Surgery. These advances include new innovations in the education of ASMS members, including the ASMS Basic Course, the Preconference Symposium, the Annual Meeting; two Basic Maxillofacial Courses per year; the Advanced Maxillofacial Course, Boot Camp for Craniofacial Fellows; Cleft Course, quarterly webinars, sponsored fellowships, a Visiting Professorship, and the recently initiated ASMS Journal.

In conjunction with its advocacy efforts, these advances continue to position the ASMS as the premier national organization representing Maxillofacial and Pediatric Plastic Surgery in the United States. Continued documentation of the evolution of the ASMS every decade should serve as a model for our sister societies in Plastic Surgery, to do the same.

Progress that is not documented is easily lost. We hope that this effort to chronicle our major advances every decade will be continued by future leadership, and will be adapted by all other major societies in Plastic Surgery.

JOIN THE DISCUSSION

Add your voice to the Maxillofacial Discussion Group on PSEN

PSEN is a great forum for education and interchange of ideas in maxillofacial surgery.

- Log into the PSEN Portal: http://www.psenetwork.org. Username and password are the same as that used for login to the ASPS website (www.plasticsurgery.org)
- From the homepage, click on the following links: Community – Forum – Maxillofacial Discussion Group
- Click on “Follow this forum” if you would like notification when new topics are posted within the forum
J ASMS Highlights a New Member: Justine C. Lee, MD, PhD

Oluwaseun Adetayo, MD

1. What prompted your decision to pursue Craniofacial Surgery?
   It is just so fun! I love the kids and their families and I love working through all of the anomalies which are like puzzles.

2. What gets you out of bed for work each day?
   I love what I do. Work is not work, but life.

3. What are your current or past positions?
   I currently hold the Bernard G. Sarnat Endowed Chair for Craniofacial Biology and Assistant Professor of Surgery in the UCLA Division of Plastic and Reconstructive Surgery.

4. What are your clinical and/or research interests?
   **Clinical Interests:**
   - Congenital ear anomalies
   - Microtia
   - Craniofacial microsomia and Goldenhar Syndrome
   - Cleft lip and palate
   - Cleft rhinoplasty
   - Craniosynostosis
   - Apert, Crouzon, Pfeiffer, Saethre-Chotzen and other syndromic craniosynostoses
   - Rare craniofacial clefts
   - Treacher Collins Syndrome

   **Research Interests:**
   - Bone regeneration
   - Biomimetic materials
   - Clinical outcomes for craniofacial surgery
   - Technological advances in craniofacial surgery

5. Tell us a little about yourself and your family (spouse/partner, children, parents, siblings, pets, etc.)
   I’m a first generation (mostly) Chinese American. My other half is Belgian. My father is a retired civil engineer and my mother works for the County of Los Angeles in their probation department but is ready to retire...finally! I grew up in a lower middle class/working class suburb of LA which was predominantly Latino and Asian. I have one little brother who is not really little any more since I have a niece also! My newest family member is a black, white and tan Pomeranian puppy named Tiberius, as in Captain James Tiberius Kirk.

6. What is your favorite pastime/hobby?
   There are a few favorites: 1. Learning new things (anything, especially techy things), 2. Yoga, 3. Netflix.

7. Tell us something interesting about yourself that others might not know.
   I’m ridiculously private but a few people know this already so I’ll just tell – I have a black belt in Tae Kwon Do. Don’t ask me to spar with you though. It’s been awhile!

8. What is the best part of your day?
   I love morning coffee with the CNN app, followed by the BBC app.

9. If there is anything you could change, what would it be?
   For me, the pie in the sky would be to eradicate all extrinsic causes of mortality.

10. What is the greatest accomplishment you are most proud of so far?
    I am extraordinarily proud to have been named the Bernard G. Sarnat Endowed Chair in Craniofacial Biology.

11. What are your personal, professional, and career aspirations?
    Professionally, my major aspiration is to move our field. Despite all of the outstanding advances that have changed craniofacial surgery in the past 50 years, we have much more work to be done. The next frontier is not better than before but normal in all aspects including psychosocial, intellectual, visual, and functional.

12. As a selected New Member Highlight, how would you like to see ASMS cater to younger and newer members?
    Active involvement of all young members on committees and in leadership positions. Everybody can have some kind of role contributing to the Society.
Introduction

I will be starting with Advances in Craniofacial Surgical Planning: Incorporating Virtual Surgical Planning into Your Practice. I have no commercial financial interests. We have been fortunate to be funded by the Military and Veterans Health Institute at Johns Hopkins and have a couple of patents filed. Everything I am showing you tonight has been reviewed by the IRB at Johns Hopkins as it pertains to research. I would like to go over the indications for virtual surgical planning and splint fabrication and its use. I wanted to look at this in the context of history. We will talk about the history of dentofacial splint development, technological considerations as they relate to anatomy, and then go over particular cases and the evolving role of surgical planning. I will review cases involving patients with Class II malocclusion with or without an occlusal cant abnormality, the Class III patient, orbital malposition (orbital box osteotomy) and finally we will examine exorbitism, telorbitism and the facial bipartition procedure in order to see how VSP can be used to facilitate treatment planning.

When reviewing topics such as VSP, it is always important to maintain a critical eye as to what you think is truly adding value to your practice and what is merely gimmickry. I would hope that you will be convinced by this presentation that the fabrication of splints using VSP, particularly for orthognathic Class II and Class III malocclusions, is immensely helpful. I think there is room to debate the efficacy and cost effectiveness for “craniofacial cases;” I think more time and greater experience will help us decide the answers to these questions.

There are really two central problems we face as maxillofacial surgeons. First is dentoalveolar segment control - any segmental osteotomy that has tooth-bearing segments—and the control of those tooth-bearing segments. Second, is facial-skeletal malposition and subsequent segment control. The key word here in both situations is control.

Historical Perspective

The history lesson begins with the desire to manipulate and control bone fragments either because of iatrogenic issues, facial trauma or specific facial osteotomies. The first description of a tool for controlling facial bone movement was from Jon Rhea Barton. He described the figure-of-eight facial dressing for facial fractures. This was obviously the rudimentary beginnings of a tool for skeletal control. The next major development in facial skeletal surgery was during the American Civil War. Thomas Brian Gunning was a Union dentist and was credited for the development of the interdental splint. His Confederate counterpart, Dr. James Baxter Bean, also was very instrumental in the development of interdental splints and used vulcanite, a rare copper telluride mineral. History judges the winner—not the loser—and we all talk about the Gunning splint, and not the Bean splint.

Hugo Obwegeser—a lightning rod in his field, comparable to Dr. Tessier in Craniofacial Surgery—really gave us the tools for Orthognathic Surgery. He introduced these techniques at Walter Reed Army Hospital and really brought the revolution of facioskeletal surgery to Americans in 1966. The use of an intermediate splint followed by a final splint really facilitated the ability to move two jaws in space separated by individual osteotomies, segmental control followed by plating, and then a sequential osteotomy.

I also have to give credit to Pravin Patel who has been pushing virtual surgical planning and really developed a lot of translational engineering technologies, particularly with CAD-CAM, computer-assisted design and computer-assisted manufacturing, bridging 3D photography as well as 3D printing. All of these technologies were designed to facilitate improved control of the facioskeletal osteotomies given to us either by Tessier or Obwegeser and then modified by others.
WEBINAR: Advances in Craniofacial Surgical Planning  (continued from previous page)

Dental Splints

Let’s look at the functional value of dental splints. Clearly, they prevent rotation or tilting of the dentoalveolar segments and assist in fracture reduction. Splints prevent malocclusion by the establishment of centric occlusion, therefore providing long-term stability after facial osteotomy movement and positioning. The goal is to re-establish pre-traumatic dental relationships, establish new pre-determined occlusion or prevent iatrogenic segmentation during fracture, for instance during monobloc down fracture prior to facial bipartition. We have always used dental splints in some form or fashion, as illustrated on this slide. The more modern VSP or virtual surgical planning splints are marked on the right of the slide and include a splint within-a-splint technology.

What are the steps in dental splint creation? Most people appreciate that this is labor-intensive, and includes taking of impressions, pouring of the impressions and fabricating the dental models; mounting of these models, followed by dental occlusal registry, and later cutting of the models, moving them in the right position, and eventually fabricating acrylic splints to act as guides for facial-skeletal segment motion.

Most people are familiar with this labor-intensive process, some sort of segmentation and movement using a galetti. These require use of complex polymers, ordering a logistics chain and the ability to have a dental lab, which may or not be easy to get access to in a Plastic Surgery Department when compared to a Dental Department. Here is a typical case that we used to do pre-virtual surgical planning and the results after double jaw surgery. The results were not bad by any means, but were clearly a labor-intensive process.

What are the steps we use now with VSP? One can either take a stone model and digitize it, or proceed straight to a digital model. At Johns Hopkins, we use a 3M Intraoral Scanner. I either take an impression and then digitally scan it or go straight to the patient and digitally scan her bite. A SQL file is created with a permanent record of the patient’s pre-intervention teeth. I don’t have to physically store the casts anymore, and this allows me a useful tool for research, a useful tool for the medical and dental record and most importantly a reproducible tool that I don’t have to store. I believe this is definitely the future of digital occlusion, at least for cataloging. The digital images are superimposed onto a CT, using some form of commercially available CAD-CAM software (usually through our various plating companies). It’s no surprise and not new knowledge that virtual surgical planning, in essence, requires no training. It requires no physical space and no equipment other than the occlusal bite registration and scanning of the bite. The supplies are provided by the manufacturer and, in fact, there is minimal time required for fabrication of the splint.

I have eight simple and easy steps for a two-jaw case. One starts with a plan, whether it is digital or analog, including how many millimeters the surgeon is going to move the maxilla and in what dimension. So really, the first maneuver is to either move the maxilla or man-
WEBINAR: Advances in Craniofacial Surgical Planning

(continued from previous page)

Financial Considerations
Is VSP cost effective?
Jim Zins’ article from several years ago, illustrates the actual cost of the surgeon in time and the remuneration. Listed are the actual times for preoperative preparation for doing double-jaw surgery. This includes three hours for a maxilla, two hours for a mandible, and about five hours of preparatory time for a double jaw. Look at the more common procedures done in Plastic Surgery such as the TRAM, breast reduction or lesion excision; they are clearly much shorter. And the reimbursement is quite skewed. Steve Baker’s original paper looked at average times, including a digital facebow, which is no longer necessary for virtual surgical planning. Now, one needs only a CT scan with 1mm cuts, and a digitized occlusal bite either from a direct occlusal scan or a stone model. Dr. Baker averaged 26 minutes and 14 seconds for total prep time. With the re-calculation, it turns out that the TRAM is much more complex in terms of its preoperative planning. And the actual reimbursement of doing Orthognathic Surgery is very similar to what I would argue any Plastic Surgery graduate can do, i.e. TRAM surgery. I think at the very least, virtual surgical planning does help save time, and makes reimbursements at least comparable to time spent doing breast surgery.

Case Examples
Class II Malocclusion: Case Study 1

This slide represents our typical armamentarium of facial osteotomies. Dr. Gaby Doumit will look more at the cranial or craniosynostosis group, so I’ve chosen to do more frontofacial and occlusal surgery. Our first case example is a patient with Juvenile Rheumatoid Arthritis who has had completion of her anti-inflammatory treatment. Her bone scan shows no active disease in the condylar heads. The patient has a profound vertical maxillary excess, occlusal cant abnormality, Class II malocclusion with a significantly positive overjet, and microgenia with very poor cervicovisacl definition; her cervicovisacl angle is close to 170 degrees. Doing the same sequence of movements, we’re going to first move the maxilla forward, impact the maxilla, rotate the maxillary occlusal plane counterclockwise, correct the yaw, correct the midlines, and set the maxilla in position with the mandible in centric relation. The program determines the final position of the mandible. A genioplasty is added based on clinical assessment. Virtual surgical planning is by no means a crutch for good surgical judgment. Completing the process digitally makes it much faster. B point is moving 19 millimeters, and the Pogonion is moving 32 millimeters—by no means a small movement. Doing this in stone is incredibly challenging, particularly with the intermediate splint and the large amount of material required. In addition, the program provides interference analysis, obviously not available with stone modeling. It also provides positioning of the inferior alveolar nerve, a nice adjunct to the planning. I would argue that her post-operative results are easily reproducible with virtual surgical planning. This slide demonstrates a pre- and post-lateral view simply to highlight the translation and motion of the virtual surgical plan to reality.
Class II Malocclusion: Case Study 2

The next case study is one that I would argue would have been incredibly labor-intensive for anyone in the pre-virtual surgical world. This is a patient who has severe developmental delay with a typical Class II division 1 occlusal pattern, with both an occlusal cant abnormality, midline discrepancy, and a large overjet discrepancy. I describe this type of case as a “gnathic surgery,” a surgery without braces first, because she can’t tolerate braces. I think all of us would have different types of plans, but I thought this would be a good procedure for a LeFort I osteotomy and impaction, anterior apical osteotomy, premolar extraction, immediate setback BSSO and genioplasty. So, this case is going to require a splint within a splint, because of the extraction of the premolars. First, do the anterior osteotomy, including the LeFort I into a final bite before making the intermediate splint. Have the intermediate splint dock within the final splint, and then do the osteotomy of the maxilla, dock and plate followed by the removal of the intermediate splint and then the mandible. This is easily five to six hours of work in the dental lab. The VSP simplifies this process immensely. This slide demonstrates the preoperative evaluation. Again, the plan is the plan, whether done digitally or analog, with or without VSP. The first premolars on each side and number fours will be removed. We plan to set back the anterior apical segment as well as level the occlusal plane and impact the LeFort segment. These slides demonstrate the virtual execution. The LeFort I segment is cut. Arch bars are then segmented; the anterior apical osteotomy is cut. It is critical to remove the premolar before doing the down-fracture—this is just much simpler, just a technical note. The first premolars are removed; the teeth are set back and put into the final splint with wires. The splint within a splint is docked, and then plated. Once the maxilla is plated, the intermediate splint is removed. The final mandibular osteotomy is made while in the final occlusion and plated. I happen to like intraoral drains for the mandible just to decrease postoperative edema. There is not a lot of data to support this, but is mostly training bias. I think this is a reasonable result for pure “gnathic” surgery without orthodontic preparation, providing excellent control of the incisor plane inclination without orthodontics.
Class II Malocclusion: Case Study 3

The third case study is another Class II example with an occlusal cant—a typical hemifacial microsomia patient. This patient was spared a severe ear anomaly. However, the case would be very challenging to set up with a classic facebow transfer, because porion is different on both sides, which requires the surgeon to guess where to put the porion on one side. The digital model and virtual surgical planning allows one to simply choose a point above the osteotomy and then drop a perpen-

dicular, for instance in this case, from the glabella. Here’s the virtual surgical plan which demonstrates a significant occlusal cant. The intermediate position is seen in this slide and the final position with the asymmetric genioplasty in this slide. The final analysis of the chin advancement is completed, in essence a propeller genioplasty, kind of standard type of thing for patients with hemifacial microsomia. The immediate result after surgery is seen in this slide. The result is fairly reasonable, and most importantly, incredibly reproducible, particularly since the facebow transfer errors are eliminated.

Class III Malocclusion: Case Study 1

Let’s go to the Class III patient. Yet again, a plan has been created: to increase incisor show, advance the mandible, adjust the occlusal plane, and perform a genioplasty. This slide represents the sequence of events, digitally executed, and the patient after LeFort I, BSSO, with genioplasty. One of the critical points about this case is that despite the alar cinch stitch, there is still an increase in alar width. In order to control this, a rhinoplasty is needed. So, here’s exactly what she looks like after rhinoplasty and debanding.

Class III Malocclusion: Case Study 2

Another example of a Class III patient is presented here; she has a pharyngeal flap with moderate VPI, virtual surgical plan, after the LeFort I, BSSO genioplasty, and a pretty typical type of result. Again, note the alar base widened despite alar cinch stitch; the lack of correction, which is different than in non-cleft orthognathic nasal changes. We wrote a paper in JCS looking at this issue. In the final slide, here is the patient after rhinoplasty.

Virtual surgical planning is by no means a crutch for good surgical judgment. Completing the process digitally makes it much faster.
WEBINAR: Advances in Craniofacial Surgical Planning  
(continued from previous page)

Distraction: Case Study

What about distraction? I have done a fair number of virtual surgical planning sessions using distraction and I think the benefit in these cases is marginal at best. This is what happens typically after the advancement: the patient may have an open bite deformity. When the internal distraction device is removed, the surgeon will redo the osteotomy, dock into perfect occlusion and then plate. So, I’m not entirely certain that VSP really gives us what we need after LeFort surgery followed by rhinoplasty. This is a technology in evolution.

Here is another example of a LeFort distraction patient with a reasonable result. But I’m not sure that VSP gave me that much technically.

Large Advancement vs. Distraction vs. VPI Risks

Large Advancement vs. Distraction vs. VPI Risks

Large Advancement vs. Distraction vs. VPI Risks

Large Advancement vs. Distraction vs. VPI Risks

(continued on next page)
WEBINAR: Advances in Craniofacial Surgical Planning (continued from previous page)

Facial Segmentation: Case Study 1

The next case study is an interesting example of trying to make VSP better. This is a Neurofibromatosis case, which can be particularly challenging, especially in the ocular area. Here’s the typical patient after debulking of the neurofibroma. He was left with enophthalmos, cyclotropia, and esotropia. What makes this patient particularly challenging is the mild exorbitism on the normal non-disease side. The challenge is to determine how much of the orbit is going to be raised, compressed, and how to address the orbital floor. Virtual surgical planning can really help in this type of challenging situation. Orbital volume is expanded and the supraorbital bar is too high. The orbital rim is also in the wrong position. The plan is to complete an orbital osteotomy and raise the medial canthus. One can tell by looking at this picture that the patient’s medial canthus would benefit being moved up. An orbital box osteotomy is competed first, and the entire orbital box up lifted up. The NM and ZM buttresses are plated. One then segments the FOA, removing the intervening bone segment, compressing the orbit and repairing the cranial defect. I used custom orbital implants to improve both the external shape of the orbit and, more importantly, the internal shape. This is where I think it is challenging to put split bones grafts in the orbit and achieve normal volume. This is the actual plan. Virtual surgical mirroring can determine exactly how much the upper aspect of the FOA needs to come down and how much the orbit needs to be moved up. Cutting guides can be helpful, but I find these have marginal benefit. A patient-specific implant is produced from the normal side to create the exact same orbital volume for the diseased side. The orbital box and compression is going to control the external orbit and the internally placed implant will control the internal orbit. Here’s what this looks like with the box osteotomy virtually executed with a custom implant. Here’s what this looks like in reality. So, the osteotomy is marked here; this is the distance we’re going to move. The osteotomy is elevated; we have completed plating in the mouth. The FOA segment is then now cut free. The custom implant is placed before putting reconstruction. And here is the final result. In terms of matching orbital volume, I would say this is a reasonable correction.

When reviewing topics such as VSP, it is always important to maintain a critical eye as to what you think is truly adding value to your practice and what is merely gimmicky. I would hope that you will be convinced by this presentation that the fabrication of splints using VPS, particularly for orthognathic Class II and Class III malocclusions, is immensely helpful.

(continued on next page)
WEBINAR: Advances in Craniofacial Surgical Planning  (continued from previous page)

Facial Segmentation:  Case Study 2

The last case study is a facial segmentation case. Here’s an example of the facial bipartition. Having a custom-made splint for this during downfracture can be very helpful. However, I don’t find VSP particularly helpful for a bipartition procedure. The exception may be utilizing VSP for predicting and designing the V-shaped wedge extension which may save some time by having this pre-drawn as a cutting guide as opposed to using calipers. Obviously, the palatal splint is much faster to make virtually than by hand in the lab. This patient had a previous failed LeFort III, cantilever bone graft that’s been moved to the patient’s left side, and a Class III malocclusion, cyclotropia, and esotropia. So, here’s the virtual surgical plan preoperatively, with the bipartition, and with the advancement, utilizing an internal distraction system. This slide shows the segment after advancement. The same patient is seen intra-operatively with pericranial flap elevated, internal distractors utilizing the presurgical guide for the central bipartition. The patient is seen post-operatively with correction of the occlusal cant. He is now ready for ptosis repair and strabismus correction.
WEBINAR: Advances in Craniofacial Surgical Planning (continued from previous page)

Conclusion

In conclusion, the dental lab of the future may not be necessary to perform high quality orthognathic or facioskeletal surgery. Whether we like it or not, absence of a good lab has always been a very crippling aspect in most Plastic Surgical programs. At present, I would say that stone models are only required if the dental lab product is needed for VSP; otherwise, we can use a total digital scan. I think overall quality of preparation for these cases can be maintained without a dental lab. It will be interesting to determine if the decreasing numbers of orthognathic surgery and orbital surgery will stabilize or be reversed with VSP. I certainly hope these cases will be maintained in the future of our specialty. We have a large team at Hopkins and this is a team sport, as everyone knows. I’d just like to thank each one of them. Thank you.

Conclusions

Virtual Surgical Planning/Splint fabrication

- Dental Lab may not be necessary to perform quality orthognathic or other facial skeletal surgery
- Stone models are only required if the dental lab product need for VSP currently
- Overall quality may be maintained without a dental lab
- Future research will determine if national trends in orthognathic/orbital surgery have stabilized or reversed

Questions

1. Could you define the term ‘yaw’?
Dr. Kumar: Yes. There are three planes of motion typically, similar to an airplane. These are roll, pitch, and yaw. Roll is the side to side motion of the maxilla which is typically used to correct an occlusal cant. Pitch is typically the up and down of the incisors; that’s what you’re going to use to control your occlusal plane abnormality. Yaw is the side to side motion of the jaw, almost rotary in space, that controls the midline. Each one of those three motions: roll, pitch, and yaw, just like an airplane, are going to give ultimate control of the maxilla or mandible.

2. Could you provide your preference for which jaw to fix first when performing two-jaw surgery, so as to minimize the chance for occlusal mismatch once the patient awakes and the fixation is removed?
Dr. Kumar: This is a great question. In the pre-VSP age, if I had a patient with a huge occlusal plane abnormality, particularly an abnormality of roll, a patient with occlusal cant, the intermediate splint was typically quite horrendous. The amount of orthodontic resin used to build up the one side, where we have created an iatrogenic open bite is immense. Actually fabricating the splint, made this case very difficult. This was a classic indication for doing a mandible-first procedure; or if you were going to segment the maxilla into three pieces and create a splint within a splint, and you just didn’t have the fortitude to take the beating of doing a splint within a splint in the dental lab, you would have done the mandible-first and then gone to a final one-piece maxillary splint. With virtual surgical planning, I personally like to go with the maxilla-first for one reason: I like to set incisor show, pitch, angle and control the forward advancement of the midface prior to the mandible osteotomy. I think anyone that does a fair amount of orthognathic surgery is not going to have issues controlling centric relation, so I go with the maxilla first. Using VSP, I don’t have to worry about these issues of building up the acrylic for the intermediate splint—which was horrendous—and I can do a splint within a splint. So, I don’t mind doing a multipiece LeFort going straight to the final splint, wiring that in place, and then using a splint within a splint technology to then do the mandible surgery. Using VSP, it doesn’t matter as much as it once did due to those two very legitimate technical points that really affected surgeons in the dental lab. Doing a splint within a splint honestly can take hours if you actually take pride in what you do, with polishing and making sure everything is perfect. It’s very challenging.

3. What is the average cost per case in the role of insurance coverage?
Dr. Kumar: This is a really interesting question.... I’m a capitalist, there’s no question. I can tell you at Hopkins—this is very interesting—we’ve actually seen no change in the cost of doing virtual surgical planning because what’s happened is that for each company we now have a single unified price for combined VSP plus hardware for each orthognathic case. So, it’s not a la carte, it’s now bundled and so each company, Stryker, Synthes, and KLS—our three biggest companies—in essence are in a bidding war now to drop the cost. So, the average cost for us to do this entire procedure hardware-wise is $3,500, which includes VSP plus typically four maxillary plates and two mandible plates. The hardware cost is about $3,500. Just to put this into perspective, the average cost of one pedicle screw for spine surgery is $2,000. I hope this helps answer the question.

4. With complex osteotomy planning, impaction, downfracture, correction of yaw.roll/pitch, do you need special cutting guides or splints with attachments? In other words, how do you make sure that your VSP plan actually translates?
Dr. Kumar: That’s a great question. In reality, yaw, roll and pitch are going to be corrected by the splint. The splint is going to dock the bone segment movements. The thickness of the splint on one side or the other is what’s really correcting the yaw, the pitch and the roll, and the incisor inclination. If you do your VSP and are planning on a counter-clockwise rotation, you’re going to have a greater amount of acrylic in the front of your splint compared to the back of your splint. If you’re going to do a clockwise rotation you may have a greater amount of acrylic in the posterior aspect of your splint than in the front to in-
WEBINAR: Advances in Craniofacial Surgical Planning (continued from previous page)

crease the amount of incisor show. Once you place the patient into centric occlusion with whatever wires or elastics, your next move—as you seat the patient into centric relation with the condyles—is simply rotating the whole complex back up to determine the incisor show. I like that part of the operation because VSP in essence now controls the midlines, including yaw and roll. The one item with which the surgeon still has some flexibility, is how much incisor show is desired. Each patient is a little different, and the amount of scar tissue, particularly with a cleft case, may not be easy to predict. That’s where the splint is going to correct all of the dental issues that we discussed. Now, we’re going to set incisor show based on the impaction or down motion of the complex of the jaw on the condyles. VSP gives the surgeon the best of both worlds: it allows control in real time of incisor show, which I think is very important, and also corrects those other issues which the surgeon doesn’t want to only rely on her judgement, such as pitch, yaw and roll.

5. What about time saving with pre-bent plates?
Dr. Kumar: There’s no question that pre-bent plates can be quite helpful. If a surgeon is fast and does a lot of jaw surgery, pre-bending a plate can be done in under 15 seconds. I don’t think the timing issue is as critical as the size of the plate: when you want a 1.5 mm thickness plate—or less—and you use 2.0 and 2.3 mm in the maxilla, you don’t have a lot of room to make up for any errors postoperatively. Semi-rigid fixation of the maxilla with a 1.5 mm plate allows the surgeon to use a 6-ounce elastic after surgery to guide the bite. Let’s say calculations are slightly off, and there is asymmetric swelling on one side or the other after jaw surgery. For example, the patient happens to sleep on the right side. The surgeon can adjust elastic treatment, using a cross-elastic, a Class III elastic, or a Class II. I personally like Class II elastics in Class II patients and Class III elastics in Class III patients, to reinforce the motion of the skeleton that has been accomplished during surgery. More importantly it allows us to adjust micromotion of the patient’s bite. If 2.0, 2.3 and 2.5 plates are used in the maxilla with rigid fixation, then there is zero room for correction using elastics. So, I would argue that semi-rigid fixation is a better thing.

6. Who usually pays for VSP? Does insurance cover it or is it even billed to the insurance company?
Dr. Kumar: I can tell you at least two things. Everybody’s medical economic system is a little different. At Hopkins, the hardware is billed to medical insurance. So, the hospital is very interested in making sure that there is a bundled package for that particular operation. Our hospital has a training program and has contracted with the manufacturer that the cost for maxillofacial double jaw procedure is $3,500 and for double jaw plus genioplasty is $4,500. Because I burn through multiple plates with my trainees learning how to bend plates, I’m not penalized for those extra plates.

It all depends on where you are, if you’re with or without residents. When I was in the military, we knew that if we were in a training command, we had to accept error, and were not going to get efficiency. Efficiency comes with competency and executing something multiple times. I think this is an area where it’s imperative that if you’re in a training area that you try to get bundled package software, or bundle package hardware for the cases that you’re doing. This allows flexibility for training. Otherwise, you’re in a situation where you can’t allow people to train; you have to be tolerant of error. If there’s one thing I’ve learned over the last ten years in trying to be a better teacher, it’s how to tolerate error when it comes to training residents.

7. With the intraoral scanner, do you still need to send the company a dental cast showing the final occlusion?
Dr. Kumar: That’s a great question. The answer is that you still need to send the cast with final occlusion to the company. If you use Dolphin—which I use in my clinic as an orthodontic record keeping software—3D systems is using Dolphin, or a proprietary version of Dolphin, you’ll need to send in the cast with final occlusion because the company doesn’t have haptic feedback with the models, to figure out exactly where the perfect bite is. Currently I still obtain stone models even though I scan them for my own records, so I don’t have to keep them later, but you do still need stone models at this time.

8. Do you need to outsource the VSP modeling and printing, or can a surgeon do it by him or herself?
Dr. Kumar: This is a medico-legal question, not a technological question. If you have Dolphin, you have the digital modeling software sitting on your computer; if you have a 3D printer, you can simply print the model. So, the question is, do you have a certified process to print a model, put it into a patient and recognize that it’s going to be reproducible, certifiable and safe? These are the real issues. This is the difference between putting something together at your own institution or interfacing with a system. I would argue that the answer is not technically can you do it in your dentofacial lab, the answer is if you’re going to do something using VSP and 3D printing. Do you have quality control measures where you know that what’s on your computer is being printed properly? I would argue I don’t know. I’m not in that business. If you’re looking at economy of scale, I would say it is better to go to a place like Kinkos and have it printed by someone who is really doing this work all of the time. This way you don’t have to manufacture or maintain your own equipment. It’s great to 3D print your own stuff. I’m not sure it’s economical.

9. Using VSP do you see any difference in post-op relapse? What is your relapse rate and percent in cleft and CF orthognathic?
Dr. Kumar: This is just like lap chole. The operation hasn’t changed, it is just how we do to the operation that has changed. The human factor that came before VSP has not changed. I don’t know anyone that’s reported that they have had a decrease in relapse rate in the cleft orthognathic patient using VSP versus non-VSP. I don’t have that data particularly; however, I would surmise that there is no difference because VSP has not changed the basic problem of biology. One of the first papers I wrote with Jim Bradley and Henry Kawamoto, years ago, looked at a comparison of LeFort I distraction versus LeFort I step advancement. There’s a direct relationship with distance; the greater the advancement, there is a higher rate of VPI and a higher rate of relapse. I would argue that there is absolutely no difference in this finding when comparing VSP and analog fabrication. I would love to do this study. Feel free to email me offline at arkumar@me.com. I would love to collaborate on a project like this.