

## **P11: Autologous Breast Reconstruction Using the Superficial Inferior Epigastric Artery Flap Revisited**

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**INTRODUCTION:** In 1989, the first superficial inferior epigastric artery (SIEA) flap for breast reconstruction was performed at Charity Hospital (New Orleans). Initially, the SIEA flap was greeted with tempered enthusiasm because the pedicle diameter and length were small. A more technically challenging microsurgical scenario was encountered compared to free TRAM/DIEP flaps. The advantages of the flap included 1) preservation of the abdominal muscle/fascia integrity similar to an abdominoplasty and 2) perfusion of ample skin and fat for breast reconstruction. These favorable characteristics of the SIEA flap made it an attractive donor flap; therefore, further evaluation and technical refinement was initiated.

**MATERIALS & METHODS:** A 7 year retrospective chart review was performed to evaluate SIEA flap breast reconstruction patients performed at a single institution. Patient demographics, timing of breast reconstruction, etiology of breast defect, and postoperative complications were determined.

**RESULTS:** From 1997-2004, 210 SIEA flaps were performed on 174 patients for breast reconstruction. The patients ranged from 15 to 70 years of age (mean 46 years). The internal mammary vessels were always used as recipient vessels. The arterial and venous diameter at the take off from the common femoral ranged from 1.5-2.5 and 2.0-4.0 mm, respectively. OR time averages 4 hours. The take back rate was similar to a DIEP flap (5.6%). The flap volume is limited to the hemi-abdomen but can be extended laterally. All 210 SIEA flaps survived. 43% underwent immediate reconstruction after skin-sparing mastectomy. In this study, 18 patients had bilateral reconstructions. Of these, 76% had one SIEA and one DIEP flap; 24% had bilateral SIEA flaps. Four flaps (2%) were for augmentation of the contralateral breast for symmetry. One case was breast reconstruction for Poland's Syndrome. Seromas were seen at the donor site in 4% of patients. Fat necrosis was apparent in 13%. 4% of all SIEA flap cases had donor-site wound healing problems, but eventually healed without significant sequelae. In our series, hernias or bulges were not observed after SIEA flap harvest while a low incidence (0.6%) was observed after DIEP flap harvest.

**CONCLUSIONS:** We report the largest experience to date on the SIEA flap for breast reconstruction. This adipocutaneous flap can be an excellent choice for breast reconstruction patients with favorable vascular anatomy. Good aesthetic results without functional donor site morbidity can be achieved.

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## **P12: Bilateral Breast Reconstruction with Latissimus Dorsi Musculocutaneous Flaps — A Primary Strategy in Sixty Consecutive Patients**

*Stephen F. Davidson, MD; Alan Muskett, MD*

With increasing frequency, patients are requesting bilateral mastectomies with reconstruction. In most series, latissimus dorsi myocutaneous flap reconstruction of the breast has traditionally been viewed as a secondary option. TRAM flaps and tissue expander/implants are the primary techniques chosen, with the latissimus flap reserved for patients deemed unsuitable for or who have failed the primary options. Bilateral TRAM flaps are lengthy operations subject to failure, fat necrosis, and significant donor site complications. Bilateral expanders/implants frequently provide unnatural, less than acceptable cosmetic results and can be unstable over time. From 1997-2004 sixty patients underwent bilateral breast reconstruction with 120 latissimus dorsi myocutaneous flaps as a primary reconstruction method by a single surgeon. Fifty five patients had a diagnosis of malignancy and elected bilateral mastectomy based on tumor histology or strong risk factors. Five had either a strong family history or severe fibrous breast disease, but no malignancy. Mean number of breast biopsies was 2.8. Mean age was 45.7 years. Mastectomies and initial latissimus dissection was performed in the supine position, with the patient then repositioned in a sitting position to allow for simultaneous bilateral latissimus harvest. Inset of the latissimus flap and placement of the

subpectoral tissue expanders was performed in the supine position. Mean operative time was 3.6 hours with a hospital stay of 2.3 days. Two patients were transfused, and one was readmitted late with an infected tissue expander. All patients underwent a secondary procedure which included removal of the expander and placement of a permanent implant, nipple reconstruction, and any revisions needed. This was performed in 8-12 weeks in the absence of chemotherapy, or delayed until treatment was complete. No patients were delayed in their chemotherapy or radiation treatment due to healing problems. The procedure was completed with nipple tattooing in the office. Virtually all patients had donor site seromas requiring repeated aspiration. Four patients had minor wound sloughs treated conservatively. There was no flap loss. Patient satisfaction surveys were returned by 76% of patients. 92% were pleased with their outcome, 4% unsure, 4% unhappy. On a 10 point scale (10 being excellent) patients rated their aesthetic outcome as a 10 in 59%, 9 in 23%, 7-8 in 14%, 6 or less in 14%. Patients reported returning to 50% activity at 3.6 weeks and 100% at 9 weeks. Postoperative pain was rated as mild (71%), moderate (25%), or severe (4%). All patients have completed reconstruction with two patients having minor revisions. Followup ranges from 6 months to 7 years.

**CONCLUSIONS:** The latissimus dorsi myocutaneous flap is an efficient and reliable method of breast reconstruction with excellent aesthetic results (see photographs), particularly in the demanding arena of bilateral breast reconstruction.




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### **P13: Comparison Study of Smooth Pulsed Light and Long-pulsed Dye Laser in The Treatment of Facial Skin Rejuvenation**

*Taro Kono, MD; Ali Riza Erçöçen, MD; Hiroyuki Sakurai, MD; Masaki Takeuchi, MD; Motohiro Nozaki*

Recently non-ablative skin resurfacing is available in facial skin rejuvenation. The objective of our study is to compare the effectiveness of Smooth Pulsed Light (SPL) and Long-pulsed dye laser (LPDL) in the treatment of facial skin rejuvenation.

**METHOD:** 10 Asian patients with Fitzpatrick skin types III-IV were enrolled in this study. Half side of the face was treated by SPL and the other side was treated by LPDL. A LPDL with a wavelength of 595nm, spot size of 7mm was used. Lentigines were treated by LPDL by compression method with fluence between 9 to 12J/cm<sup>2</sup> and pulse duration of 1.5 milliseconds (no skin cooling). Wrinkle was treated with fluence between 10 to 12J/cm<sup>2</sup> and pulse duration of 10 to 20 milliseconds (with skin cooling). A Smooth pulsed light with type B handpiece was used. Lentigines and wrinkle were treated with fluence between 27 to 40J/cm<sup>2</sup> and pulse duration of 20 millisecond. All patients were assessed before and after treatment by the use of clinical photographs for assessment by independent observers (score 0 to 10).

**RESULTS:** The mean scores of improvement of lentigines are 6.2 in SPL sites and 8.1 in LPDL sites. The mean scores of improvement of wrinkle are 4.9 in SPL sites and 6.7 in LPDL sites. There was no scarring or hypo, hyperpigmentation.

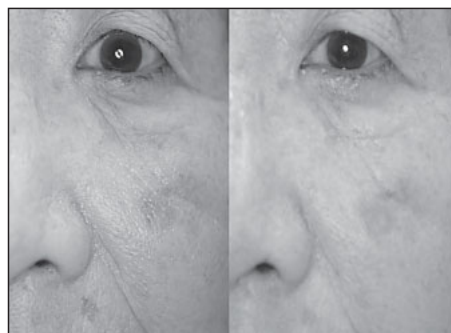
**CONCLUSION:** Both SPL and LPDL are effective for facial skin rejuvenation in Asians, but LPDL treatment is significantly better than SPL treatment ( $p < 0.01$ ).

**Table 1.** Long-pulsed Dye laser operating parameters.

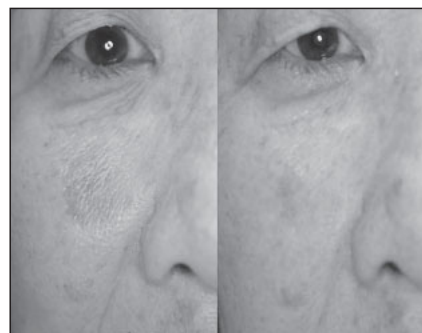
	Fluence	Pulse Width	Skin Cooling	Others
lentiginoses	9-11	1.5	off	Compression
Wrinkle	10-12	10-20	40/20	Stacking



**Figure 1.** Flat glass is attached at the tip of the hand piece.



**Figure 2.** 77 year old (lt: pre-treatment, rt: after smooth-pulsed light treatment).



**Figure 3.** Same patient (lt: pre-treatment, rt: after long-pulse dye laser treatment).

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## P14: Components Separation Combined with Abdominal Wall Plication for Repair of Large Abdominal Hernias Following Gastric Bypass

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**PURPOSE:** Abdominal wall hernias frequently occur following open bariatric surgical procedures. The defects are often quite large and not amenable to simple primary closure. Standard methods of repair with synthetic mesh may be suboptimal with a recurrence rate as high as 50%. Patients often seek repair of these hernias in conjunction with abdominal body contouring procedures following a period of substantial weight loss. The purpose of this report is to determine whether the technique of components separation followed by abdominal wall plication is effective in treating large hernias in the postbariatric population.

**METHODS:** In 66 consecutive patients undergoing abdominal surgery following open bariatric surgery, abdominal wall hernias of some size were found in 50 patients. In 65 of these patients, panniculectomy was performed simultaneously. In one patient with a previous panniculectomy, only ventral hernia repair was performed. The majority of these hernias could be closed primarily in conjunction with abdominal wall plication (38/50 or 76%). In 12 patients (24% of hernias), the defects were too large (median 10.8cm) or located too close to the xiphoid to permit primary closure without undue tension. Using a components separation technique, without the use of a permanent mesh, primary fascial closure was attempted in 12 patients. The technique was modified to include abdominal wall plication above and below the repaired hernia defect and the use of an absorbable mesh onlay.

**RESULTS:** In all 12 patients with hernias too large to primary repair, components separation and abdominal wall plication was successful in permitting fascial closure under minimal tension. While these patients had a high (50%)

rate of minor or major superficial wound complications, all wounds subsequently closed without additional operative procedures. Despite the high risk nature of this group, ventral hernia recurred in only 1/12 patients (8.3%) after a median followup period of 16 months. The single recurrence occurred in one of two patients with the largest diameter (15cm) hernias in the series.

**CONCLUSION:** Components separation with abdominal wall plication is the preferred technique for the repair of large hernias not amenable to primary repair in patients after open gastric bypass. Since this technique avoids placement of permanent mesh, it is particularly advantageous in the post-bariatric patients at high risk for wound dehiscence and infection.

## **P15: Correction of Lipodystrophy in HIV-positive Patients: Surgeon Beware**

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**BACKGROUND:** Lipodystrophy syndrome, including metabolic and body-fat abnormalities, is common among adults infected with HIV who are receiving highly active antiretroviral therapy (HAART). These abnormalities may manifest as facial lipoatrophy or central adiposity, including a dorsocervical fat pad (or “buffalo hump”) and truncal fat. Along with fat redistribution, these drugs are associated with insulin resistance, hyperlipidemia, and cardiovascular complications. Therefore, elective plastic surgery in these patients necessitates a comprehensive pre-operative assessment and vigilant post-operative management.

**OBJECTIVES:** To provide practical strategies for safely facilitating elective cosmetic surgery in HIV-positive patients who are receiving HAART.

**STUDY DESIGN/METHODS:** Case report and review of the literature.

**RESULTS:** A 49-year old, HIV-positive female receiving HAART underwent ultrasonic liposuction of a buffalo hump, micro-fat injections for facial lipoatrophy, and abdominoplasty. Postoperatively, the patient developed flash pulmonary edema secondary to a hypertensive crisis. The patient was successfully resuscitated in an ICU setting, with aggressive diuresis and anti-hypertensive management. Postoperative outcome measurements were otherwise similar to those reported in lipodystrophy patients.

**CONCLUSIONS:** With the advent and widespread use of HAART, HIV-positive patients are living longer, and in increasing numbers seeking elective, cosmetic surgery. Operative intervention in these patients can prove dangerous, if not deadly, as HAART increases the risk of systemic arterial hypertension, pulmonary hypertension, pericardial effusion, and coagulopathy. Ultimately, the atherogenic effects of HAART promote acceleration of coronary heart and cerebrovascular disease and enhance the risk of myocardial infarction and stroke. Pre-operatively, plastic surgeons caring for HIV-infected adults should assess important disease indicators such as cardiovascular risk factors, viral load, and CD4 T-lymphocyte counts. After evaluation, risk reduction should be targeted. Post-operatively, means such as continuous cardiovascular monitoring and strict management of hypertension may be employed to minimize morbidity. We present an algorithm for plastic surgeons to safely treat lipodystrophy in HIV-infected patients.

## **P16: Cost-Benefit Analysis for Pathologic Examination of Reduction Mammoplasty Specimens**

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Reduction mammoplasty is performed over 100,000 times a year in the United States, making it one of the most common procedures performed by plastic surgeons.<sup>1</sup> The procedure has a number of indications, including relieving back pain, improving the cosmetic appearance of the breast, and providing symmetry after excision of a contralateral malignancy. However, it is not indicated for resection of malignant or premalignant lesions of the breast. Despite this, the excised breast tissue is routinely sent for pathologic examination.

Over 200,000 new cases of breast cancer are diagnosed each year in the United States. It is the most common cancer and the second leading cause of cancer deaths in women. The lifetime incidence of breast cancer is 13.2%, or approximately 1 in 8 women.<sup>2</sup>

In 1996, Titley et. al. reported a case series of 157 women undergoing reduction mammoplasties in which pathologic examination of all specimens failed to identify any malignant or premalignant changes.<sup>3</sup> This raises into question the value and cost benefit of routinely submitting breast reduction specimens to pathology.

Our study seeks to determine the incidence of premalignant changes in the pathology of women undergoing reduction mammoplasty at our institution, as well as to determine the cost-effectiveness of routine pathologic examination of specimens from reduction mammoplasty. Specifically, this study examines whether it would be more cost-effective to only submit the specimens from women age 40 or above, as that is the age at which routine screening mammography is recommended.

**METHODS:** A retrospective chart review was performed on 300 women who underwent bilateral reduction mammoplasty at a tertiary care center between 1991 and 1999. The inferior pedicle technique was used in all cases, and a total of four surgeons performed the operations. Any patient with a previous history of breast cancer was excluded.

The specimens were sent to pathology in formalin, and were then examined grossly at 1 cm multiple intervals. If no gross abnormalities were seen, three representative sections from each breast were prepared for histologic examination. If a gross abnormality was noted, then further sampling from that specific area was performed.

The women with abnormal breast pathology were then stratified into low, moderate, or high risk groups. The low-risk lesions included apocrine changes, duct ectasia, moderate or florid hyperplasia, sclerosing adenosis, and papilloma. The moderate-risk lesions included atypical lobular hyperplasia and atypical ductal hyperplasia. The high-risk lesions included lobular carcinoma in situ (LCIS) and ductal carcinoma in situ (DCIS).

**RESULTS:** In this study, 36 of the 300 patients (12%) had abnormal pathology reports which indicated either a premalignant lesion, or a lesion which puts the patient at increased risk of developing breast cancer. The average age of patients in this study was 33.8 years old (range 14 to 73). The average age of patients with benign pathology was 32.6 years old (range 14 to 67), and the average age of patients with abnormal pathology was 42.5 years old (range 15 to 73).

Seventy-two percent (26/36) of the abnormal pathology reports showed low-risk lesions. Three percent of all patients in the study (10/300) had lesions which were moderate or high risk, and would put them at significantly higher risk than the general population for developing breast cancer (Table 1).<sup>3,4</sup> The average age of these patients was 45 years old (range 15 to 73), and 2 of 10 were less than 40 years old. These 2 patients had LCIS and atypical ductal hyperplasia.

The cost of pathologic examination of one breast specimen at our facility is \$190.86 (\$381.72 for a bilateral reduction mammoplasty), resulting in a total cost of \$229,032 for all 300 patients. The cost to identify a patient with a moderate to high risk lesion was \$22,903. If pathologic examination was restricted to women 40 years or older (86 patients), the total cost would have been reduced to \$32,828, with a total savings of \$196,204.

**CONCLUSIONS:** In today's health care field, there are many areas which are constantly under scrutiny for their high costs. There is an opportunity for cost savings by limiting the routine pathologic examination of reduction mammoplasty specimens to women over the age of 40. However, at our institution, this would have failed to identify 20% of moderate to high risk pathology. Despite the savings, this is not an acceptable risk.

Specimens from reduction mammoplasty should continue to be routinely sent to pathology for examination. This is especially important in women over the age of 40. Furthermore, women who have pathology reports that indicate abnormalities should receive closer follow-up. This includes education regarding self breast exam, breast ultrasound, and mammography. At our institution, a report of a moderate to high risk lesion will generate a referral of the patient to the Comprehensive Breast Center for further evaluation. We also continue to perform pre-operative mammography on women over 40, as well as on younger women with a family history of breast cancer.

This is an area in which there is potential for multicenter trials to determine a consensus regarding the post-

operative handling of reduction mammoplasty specimens and how this can affect patient outcomes.

**Table 1.** Incidence and Risk of Abnormal Pathology after Reduction Mammoplasty (n = 300 patients).

Pathologic Finding	Patients	Increased Risk
Low Risk	26	Low (< 2 times)
Atypical Ductal Hyperplasia	5	Moderate (4-5 times)
Atypical Lobular Hyperplasia	3	Moderate (4-5 times)
Lobular Carcinoma in Situ	2	High (5-12 times)
Ductal Carcinoma in Situ	0	High (5-12 times)

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## **P17: Delayed Reconstruction of Alveolar Clefts Without Corticocancellous Grafts: 65 Cases Treated with Recombinant Human Bone Morphogenetic Protein-2 and Absorbable Collagen Sponge**

*Michael H. Carstens, MD; Martin Chin, DDS; Theodore Ng, DDS; William K. Tom, DDS*

Corticocancellous bone grafting from the iliac crest is widely used for repair of primary palate clefts. In most protocols this procedure is delayed until mid childhood. Donor site morbidity is considerable, requiring hospitalization in most cases. Consolidation of the site depends upon the survival of the graft. Osteoconduction (replacement of the transferred bone by autogenous bone) also takes place. For these reasons the ultimate "fill" of the cleft site can be quite irregular, sometimes as low as 20%.

The mesenchymal source for craniofacial bone, the skull base excluded, is the neural crest. These cells all have membrane-receptors for bone morphogenetic protein (BMP). They are found in the cambium layer of the periosteum and are responsible for the membranous ossification process by which the maxilla develops. Stimulation of periosteal mesenchymal stem cells (MSCs) by recombinant human bone morphogenetic protein-2 (rhBMP-2) results in membranous bone formation in a variety of animal and human models. This process is known as osteoinduction.

The mesenchymal source for all bones below the skull is mesoderm, not neural crest. Because dissection of an alveolar cleft involves exposure of its original mucoperiosteal lining, BMP-2 mediated osteoinduction of local neural crest MSCs is more logical than transfer of a non-neural crest mesenchymal graft. Dosing of rhBMP-2 is species-specific. Humans respond best to 1.5 mg/cc. This is delivered in a uniform concentration by saturation of an absorbable collagen sponge (ACS) of fixed size, by a predetermined amount of reconstituted rhBMP-2. This technique of bone synthesis is called in situ osteogenesis (ISO).

We report the use of rhBMP-2/ACS implantation in human cleft sites. Graft take was evaluated by a combination of dental radiographs and 3-dimensional CT scans. Grafting was successful in 64/65 sites. One site required re-entry and healed well subsequently. Bone formation within the clefts was remarkably uniform. Successful osteoinduction took place regardless of cleft size. All surgeries were done on an outpatient basis. Alveolar cleft

reconstruction using ISO is highly effective, fast, and carries minimal morbidity when compared to conventional grafting techniques.

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## **P18: Dermabond Skin Closures for Bilateral Reduction Mammoplasties: A Review of 255 Consecutive Cases**

**Gregory R. Scott, MD; Cynthia L. Carson, PA-C; Gregory L. Borah, MD**

**PURPOSE:** DERMABOND (Octyl-2-cyanoacrylate, *Ethicon*) has been available as a skin closure alternative or adjunct since 1997.<sup>1</sup> Skin closures with DERMABOND have been shown in other areas to be equivalent to closures with sutures regarding healing potential, wound strength, and cosmesis.<sup>2,3</sup> DERMABOND has been reported as an adjunct to skin closure for bilateral reduction mammoplasty<sup>4</sup>, however no large series have been presented to date. The purpose of this study is to review a large series of 255 consecutive bilateral reduction mammoplasty patients (510) breasts to evaluate the safety and efficacy of DERMABOND for these procedures.

**METHODS:** A retrospective review was undertaken of 255 consecutive patients undergoing primary bilateral reduction mammoplasty for the relief of symptomatic macromastia by a single surgeon from 1999-2005. Since 1999 all breast reduction incisions have been closed with interrupted, buried, intradermal sutures of 3-0 Monocryl followed by application of DERMABOND to seal the skin edges. An inferior pedicle, "inverted T" technique using a Wise pattern was used for all patients. The patients' medical records were reviewed to obtain information including age, bra cup size (pre-op and post-op), resection weights (grams/breast), and operative times. Postoperative results including nipple sensation, relief of symptoms, and satisfaction with results were noted. Complications including delayed wound healing, hypertrophic scar revisions, cellulites, and wound dehiscence (minor and major) were noted. Patients were instructed to resume showering or bathing and apply antibiotic ointment to their incisions to remove the DERMABOND remnants at about the seventh postoperative day.

**RESULTS:** The average age of patients in the review was 41 years with a range of 15-73 years. The most common preoperative bra cup size was "DD" (52%) and the most common postoperative bra cups size was "C" ((60%) (Table 1). The average resection per breast was 605 grams with a range of 174-1684 grams. The average operative time (incision to closure) was 93 minutes with a range of 50-130 minutes. All surgeries were performed as outpatient procedures. The overall complication rate was 15% (Table 2). Delayed wound healing, usually in the area of the "inverted T", occurred in 15 patients (6%). These wounds healed uneventfully with local care. Hypertrophic scar revisions were performed in 13 patients (5%). Cellulitis resolving with p.o. antibiotic therapy occurred in 7 patients (3%). Minor wound dehiscence requiring non-suture reclosure (steri-strips) occurred in 3 patients (1.1%). Major wound dehiscence requiring a sutured reclosure occurred in 2 patients (0.8%). Two patients required liposuction for postoperative asymmetry, one patient required surgical of medial "synmastia", and one patient developed unilateral skin flap necrosis which healed secondarily. Patients reported "good to normal" nipple sensation in 86% of cases. Unilateral diminished nipple sensation was reported in 14% of patients. No patients reported complete loss of nipple sensation. The majority of patients (98%). Reported relief of their preoperative symptoms and satisfaction with their results. In the authors' previous review of bilateral reduction mammoplasties with sutured closures, the rate of minor wound complications was 20% and unilateral diminished nipple sensation occurred in 13% of patients.<sup>5</sup> The previous operative time averaged 116 minutes.

**CONCLUSIONS:** The use of DERMABOND for skin closures in bilateral reduction mammoplasty is safe and effective. Complication rates involving wound healing are comparable to sutured skin closures. The ease and speed of application contributes to shortened operative times (23 minutes or 20% less time). Patient postoperative discomfort is minimized since only simple gauze dressings are needed, no surgical tapes are used, and showering or bathing can be resumed within the first week following surgery.

**Table 1.** Preoperative and Postoperative Bra Cup Sizes.

Preoperative		Postoperative	
DD	(52%)	C	(60%).
DDD	(20%)	B	(21%).
D	(18%)	D	(19%)
E and greater	(10%)		

**Table 2.** Complications.

Delayed wound healing	15 (6%)
Hypertrophic scar revisions	13 (5%)
Cellulitis	7 (3%)
Minor wound dehiscence	3 (1.1%)
Major wound dehiscence	2 (0.8%).
Overall	30 (15%)

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## P19: Dermal Wound Closure Method Alters Scar Structure

*Peter Whittaker, PhD; Richard Ehrlichman, MD; Lillian Rich, MD*

**BACKGROUND:** Collagen plays a vital structural role in wound healing, with fiber content, thickness, and orientation all influencing scar integrity. Our hypothesis was that the method of wound closure could alter these structural parameters. We tested this concept using 4 different closure techniques.

**METHODS:** A 29 mm full-thickness incision was made on the back of 64 adult female Sprague-Dawley rats, randomized to wound closure with sutures (S), a coaptive film device (Clozex, CX: which exerts tension perpendicular to the long axis of the incision via adhesive pads and filaments), CX + deep absorbable sutures (CX+S), or tissue adhesive (TA; high-viscosity Dermabond). Histologic sections (5  $\mu$ m) stained with picrosirius red were viewed with circularly polarized light at 1 and 4 weeks (n = 8 for each group at each time) after the incision was made (the sutures and closure devices were removed at 2 weeks). We assessed scar width, collagen content (CC), and fiber thickness (with this microscopy technique, collagen fiber color changes from green to yellow to orange as the fibers mature and thickness increases). In addition, exploiting the optical properties of collagen, we measured the two-dimensional orientation of 50 fibers in each scar and also in the intact dermis, distant from the incision, in 4 samples and calculated the angular deviation (AD) of each distribution obtained (the smaller the AD, the more aligned the collagen fibers).

**RESULTS:** At 1 week (Table), TA-treated scars were wider ( $\ast P < 0.05$ , by ANOVA), contained less collagen ( $P < 0.05$ ) and a greater proportion of immature, thin green fibers ( $P < 0.05$ ). At 4 weeks, scar width decreased (170–225 microns) and all groups displayed increased collagen content (94–95%) and fiber thickness: few green fibers remained (1%) and  $> 60\%$  of the fibers were mature (orange) ( $P = \text{NS}$  between groups for all comparisons). In general, collagen fibers were aligned perpendicular to the long axis of the incisions; however, fiber orientation did differ between closure methods. Specifically, increased fiber alignment was seen with CX at 1 week (smaller AD;  $P < 0.05$ ). At 4 weeks, fibers were less aligned and the average AD had increased (24.5 degrees); however, the organization was still not the same as in the normal dermis, which had a near random alignment (AD = 35.0 degrees).

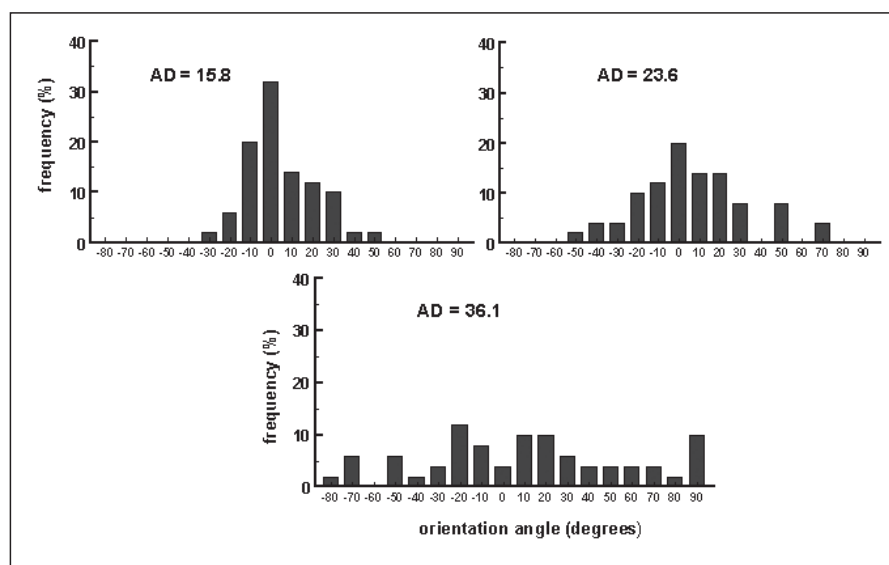
**CONCLUSIONS:** The method of dermal wound closure altered the structure of the scar formed in the early, but not in the late, phase of healing. Poor early closure with tissue adhesive appeared to delay healing; the wider scars



contained less collagen and also a greater proportion of immature, thin, green fibers. In contrast, the film device provided more uniform wound closure (i.e., a smaller width and smaller standard deviations) and increased fiber alignment. Nevertheless, at 4 weeks, there was no difference between groups for any of the measured parameters. Thus, the potential early advantage provided by collagen fiber alignment across the incision with the film device did not adversely affect late healing.

**Table 1.** Wound Healing Parameters 1 Week After Injury.

	S	CX	CX + S	TA
width (µm)	470 ± 300	310 ± 70	310 ± 70	1050 ± 250*
CC (%)	66 ± 4	69 ± 4	65 ± 5	53 ± 5*
green (%)	14 ± 2	12 ± 3	14 ± 3	23 ± 3*
AD (°)	24 ± 1	17 ± 2*	19 ± 2	21 ± 2



**Figure 1.** Representative two-dimensional orientation frequency distributions of collagen fibers in the 1-week wounds (*top panels*) and in normal skin (*lower panel*). The orientation angle (in 10° intervals) is shown on the x-axis, while the percent frequency of fibers at each orientation is given on the y-axis. The mean orientation angle of each distribution corresponds to zero on the x-axis. The spread of the distribution is denoted by the angular deviation (AD) — the smaller the AD, the more aligned the fibers. The smallest ADs were found in wounds closed with the film device (*e.g., upper left*). In contrast, fibers were more disorganized in wound closed with sutures (*upper right*). In normal skin, the collagen fibers had a near random organization — the distribution was evenly spread over the entire range of possible orientations.

## P20: Detection of Perfusion Disturbances in Digit Replantation Using Near-Infrared Spectroscopy

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**PURPOSE:** The postoperative monitoring of digit replants continues to be a challenge. Current objective methods of digit monitoring have not been widely adopted due to complexity or lack of sensitivity. Tissue oxygen tension measures the pressure gradient between capillary oxygen delivery and tissue consumption thus providing an index of oxygen cellular availability. A clinical study was undertaken to evaluate non-invasive monitoring of tissue oxygenation using near-infrared spectroscopy in post-operative digit revascularization and replantation.

**METHODS:** Seventeen patients were enrolled and twenty-four digits monitored in one institute. There were 15 males and 2 females with an average age of 45 years old (range 13–79). Digits were monitored by clinical exam, fluorescein, and the ViOptix ODISsey™ tissue oxygenation probe (Figure 1) at 1–2 hour intervals for 24–48 hours.

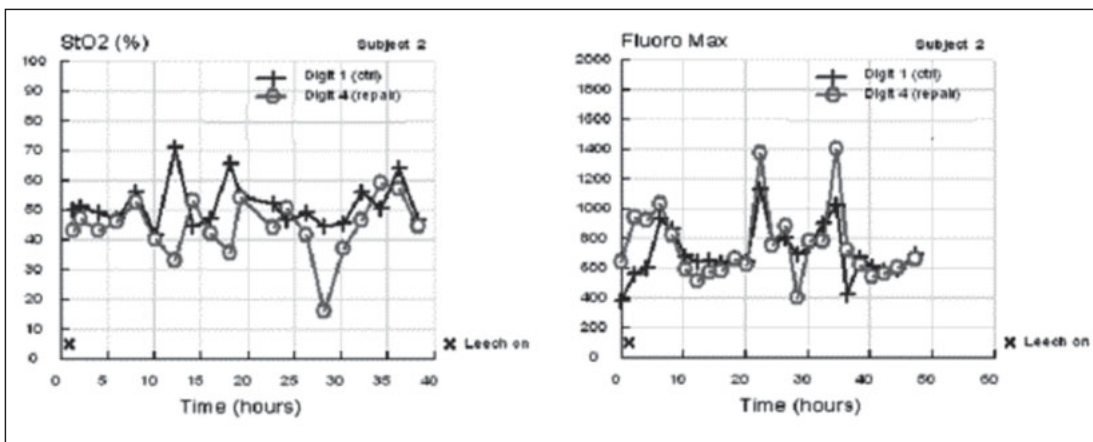
**RESULTS:** Twenty-three digits survived and one digit failed. In the survival digits, the fluorescein and tissue oxygenation (StO<sub>2</sub>) readings were similar to the control digit readings. There were no significant differences between fluorescein and StO<sub>2</sub>, or between StO<sub>2</sub> readings for control and survival digits (Figure 2). The digit that failed was a combination right hand crush injury and third digit amputation. In this digit, both fluorescein and StO<sub>2</sub> readings were lower in the failed compared to control digit immediately post-op and for the remainder of the hospital course (Figure 3). The mean StO<sub>2</sub> values for this digit were significantly reduced, ranging 30–50% lower

than those obtained for the control digit ( $p < 0.0002$ ). There were no complications associated with fluorescein or tissue oxygenation measurements. This data combined with another 31 patients and 40 digits monitored at our institute show a significant difference between survival (61) and failure (3) digits ( $p < 0.0001$ ) (Figure 4).

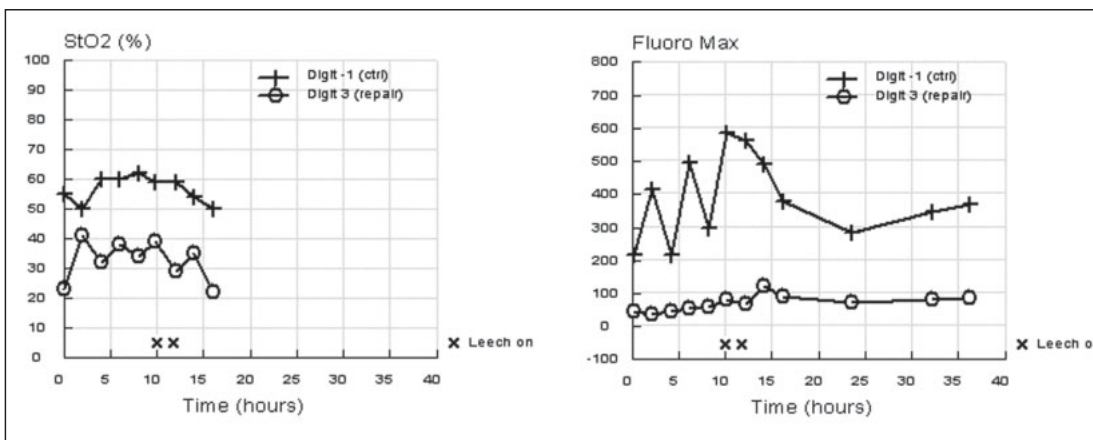
**CONCLUSION:** Near-infrared spectroscopy measurement of tissue oxygenation correlates with fluorescein monitoring, digit perfusion, and clinical outcome. This non-invasive monitoring is easy, reliable, safe, and potentially useful in post-operative monitoring of digit replantation.



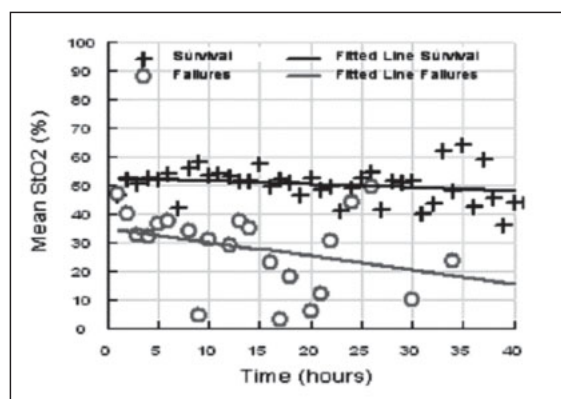
**Figure 1.** The ViOptix tissue oximeter data is displayed on a windows based console with a touch-screen, user friendly interface (left). The probe (right) emits two wavelengths of light and measures reflected light.



**Figure 2.** Tissue oxygenation (left) and fluorescein (right) readings from a survival digit. Survival digit data closely tracks control digit data with both measurements.



**Figure 3.** Tissue oxygenation (left) and fluorescein (right) readings from the failed digit repair. Note the lower readings of the failed digit using both monitoring techniques.



**Figure 4.** Tissue oxygen saturation of survival (61) and failure (3) digits. There is a significant difference in tissue oxygen measurements between survival and failure digits ( $p < 0.0001$ ).

## P21: Development of a Predictive Nomogram for Complications Following Tissue Expander/Implant Reconstruction

Colleen M. McCarthy, MD; Babak J. Mehrara, MD; Joseph J. Disa, MD; Peter G. Cordeiro, MD; Andrea L. Pusic, MD, MPH

**INTRODUCTION:** Complications stemming from breast reconstruction can cause significant patient morbidity, the most important of which may be the delay of subsequent adjuvant antineoplastic therapies. The compound effect of individual risk factors on the development of complications following tissue expander/implant reconstruction has not, however, been well delineated. The purpose of this study was to develop a statistical model that combines preoperative, clinical risk factors in order to predict the likelihood of complications following tissue expander/implant breast reconstruction.

**METHODS:** From April 2002 to December 2003, 515 tissue expander/implant breast reconstructions were performed at Memorial Sloan-Kettering Cancer Center. A prospectively-maintained, clinical database was reviewed. Nomogram predictor variables including: patient age (years), smoking status (current smoker, ex-smoker or non-smoker), body mass index ( $\text{kg}/\text{m}^2$ ), history of diabetes and/or hypertension (yes or no), history of adjuvant chemotherapy, neoadjuvant and/or adjuvant radiotherapy (yes or no), and timing of reconstruction (immediate or delayed) were recorded. Overall complications as well as specific complications including: reconstructive failure, skin flap necrosis, infection, seroma and hematoma, were evaluated. Reconstructive failure was defined as the premature removal of a prosthesis (temporary expander or permanent implant). Multiple predictive factors were analyzed using logistic regression modeling. Statistical significance was set at the  $p < 0.05$  level.

**RESULTS:** The overall rate of complications following 515 tissue expander/implant breast reconstructions was 17.1%. Seventy-five percent of patients were non-smokers and 25.6% were smokers, of which 59.1% were ex-smokers (stopped smoking  $> 4$  weeks prior to surgery). Complications were 3 times more likely in smokers (OR 3.1, 95%CI: 1.9-5.0), 2 times more likely in obese patients (OR 2.1, 95%CI: 1.1-3.9), and 2 times more likely in patients with hypertension (OR 2.3, 95%CI: 1.2-4.8). Reconstructive failure was 7 times more common in smokers (OR 7.1, 95%CI: 2.0-25.3); and, mastectomy skin flap necrosis was 3 times more common in smokers than nonsmokers (OR 3.1, 95%CI: 1.7-5.9). A nomogram that combines pre-operative, clinical risk factors was developed.

**CONCLUSIONS:** Smoking, obesity and hypertension are independent risk factors for postoperative complications following tissue expander/implant breast reconstruction. A nomogram is developed that can be used to predict the probability of complications following tissue expander/implant breast reconstruction based on preoperative clinical predictors. This nomogram can provide important information to the surgeon and patient when evaluating overall risks and individualizing reconstructive options.

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## P22: Development of a Three-Dimensional Craniofacial Trauma Surgery Simulator

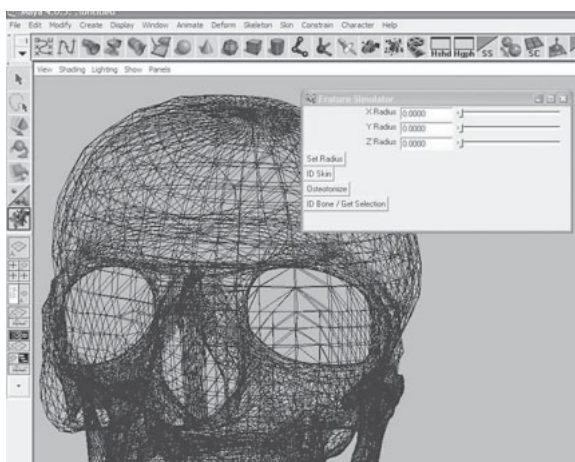
Darren M. Smith, MD; Jeffrey Weinzweig, MD

**INTRODUCTION:** Craniofacial surgery is inherently complex in three dimensions. However, only a limited number of 3D surgical planning systems are available, and are not widely used.<sup>1</sup> Only a handful of these address the prediction of soft-tissue results of skeletal manipulation.<sup>2,3</sup> We offer a new method for 3D post-traumatic craniofacial surgical planning that has the potential to simulate, in real-time, the soft tissue changes associated with manipulation of the craniofacial skeleton. Our system is unique in its emphasis on user-friendliness and cost containment to foster widespread use in clinical practice.

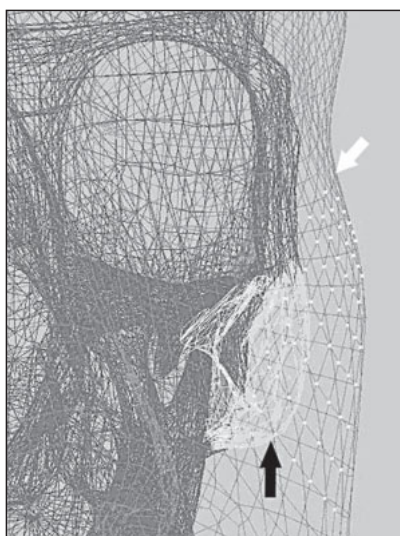
**METHODS:** This system was programmed in MEL (Maya Embedded Language) and uses empirical data for soft tissue results of craniofacial bone movement to predict the soft tissue consequences of skeletal changes. The first phase of the project involved designing and writing the program itself in MEL; we are currently programming an optimized version in C++. As this system is designed as a plug-in for Maya (3D animation and modeling software), it is flexible and can be adapted to base its soft tissue predictions on different databases of soft tissue biomechanics as improved databases are developed (Figure 1). The second phase of the project will involve correlation of pre- and post-op CT and laser scans of craniofacial trauma patients to build a superior database of soft tissue biomechanics.

**RESULTS:** We have successfully completed the first phase of the project, the design of a Maya plug-in that allows the user to move bone fragments and observe predictions of soft tissue results in 3D based on a user-defined database (Figures 2 and 3). The plug-in is compatible with the importation of processed skeletal and skin data from patient CT scans. We are now positioned to begin the next phase of the project, in which we will develop an improved database of craniofacial biomechanics.

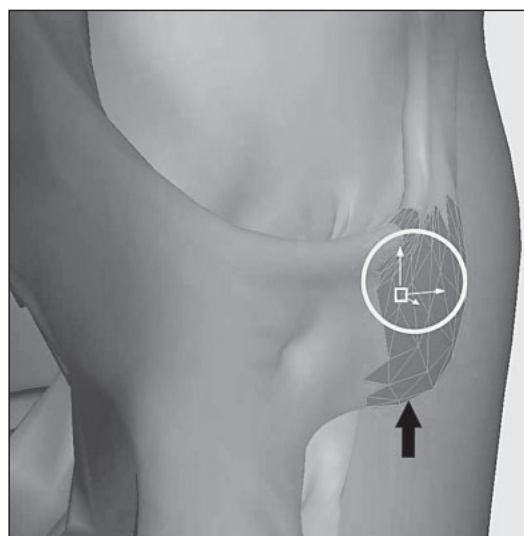
**CONCLUSION:** We have designed the framework of a 3D virtual reality craniofacial planning system that will allow the user to simulate bone fragment manipulation with real-time prediction of the resultant soft tissue effects. This system allows the simulations to be viewed from any angle and interactively manipulated. Moreover, we have taken care to design our system to be practical for widespread use. This program is a useful educational tool in its present form and is intended, after the next stage of the project, to play a role in post-traumatic surgical planning.



**Figure 1.** The de-bugging version of the simulator window is shown in the Maya environment, with demo skull data in the background. For testing purposes, we are using the simplified geometry shown in these sample figures. The system is, however, compatible with importing real patient CT scan data. This de-bugging version allows the user to manually input the distances in XYZ space from the osteotomized segment defining the region in which skin will be effected by bone moves. In the final version, this information will be part of a pre-defined biomechanical model. The “Osteotomize” button allows the user to create bone fragments to test the simulator.



**Figure 2.** The simulation plug-in has identified the vertices (white points on mesh) on the skin mesh (white arrow) that will be the focus of soft tissue deformation secondary to movement of the fractured bone fragment (black arrow) here a portion of the body of the zygoma.



**Figure 3.** A similar perspective to that shown in Figure 2. Here, shading is activated so surfaces are visible (the bone fragment is indicated by a black arrow). Within the white circle three arrows are visible; these comprise the manipulator that the user drags to move the bone fragment in 3D space with real-time responsive changes in the overlying skin, as bounded by the vertices illustrated in Figure 2.

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## P23: Distraction Osteogenesis in Craniosynostosis

**Takeshi Miyawaki, MD, PhD; Akihiko Shinoda, MD; Kunitoshi Ninomiya, MD, PhD; Kunihiro Kurihara, MD, PhD; Yuichiro Nonaka, MD; Shizuo Oi, MD, PhD**

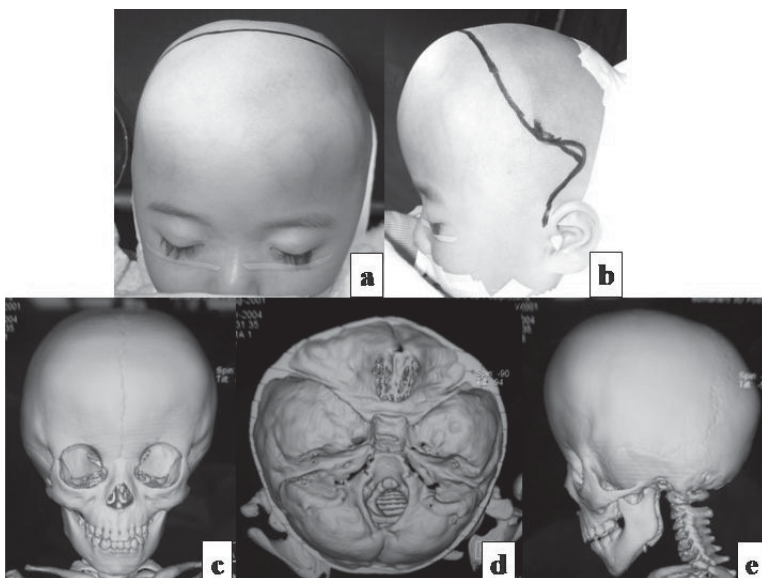
**INTRODUCTION:** Distraction osteogenesis is becoming the treatment of choice for the patients with craniosynostosis in Japan<sup>1-4</sup>. We have treated 14 cases of craniosynostosis with this technique since 2000.

**MATERIALS & METHOD:** Fourteen cases of craniosynostosis treated with the technique of distraction osteogenesis were evaluated in terms of age at surgery, latency and consolidation periods, rate and frequency of distraction, device stability, complications and pre and postoperative changes in the cranial volume, which was calculated using ZedView® software from their CT data. Fourteen cases consisted of 6 brachycephaly (Fig 1-3), 6 Apert syndrome, one scaphocephaly and one plagiocephaly. The mean follow-up period was 3.2 years. They were planned for surgical intervention for intracranial decompression, reshaping of the skull and four out of fourteen underwent LeFort IV distraction for improving airway problems and severe exophthalmos.

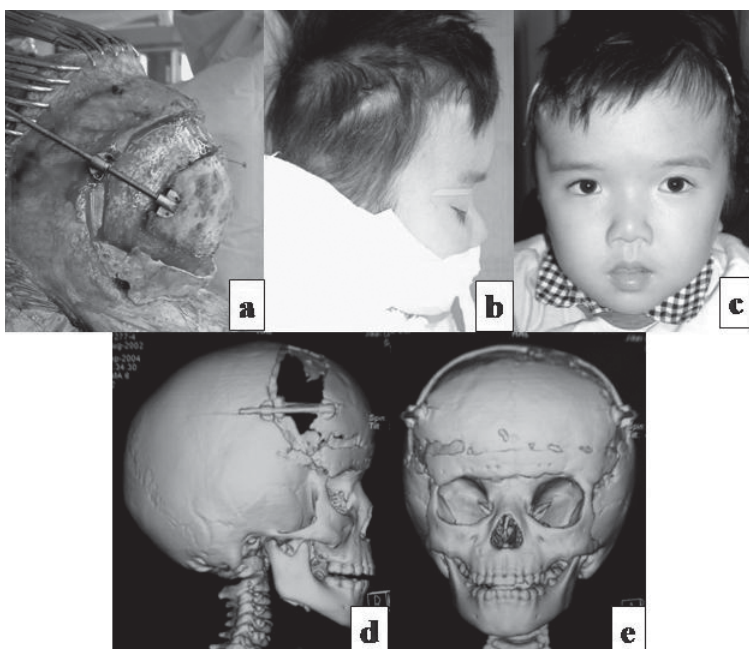
**RESULTS:** Cranial bone distraction (group 1) was performed in ten of fourteen cases and craniofacial distraction (LeFort IV type distraction, group 2) was undergone in the rest of the four. The age at surgery ranged from 1 year and 5 months to 12 years (mean 4 years 6 months). Latency period before starting distraction was 4.7 days (mean) and rate and frequency of distraction were 1 mm/ day, once a day in both groups. The age at surgery ranged from one year and 5 months to 6 years (mean 2.7 years) in group 1, and from one year and four months to 12 years (mean 6.3 years) in group 2. The length of distraction ranged from 13.5 to 30.0 mm (mean 20mm) in group 1 and from 12 to 28 mm (mean 24mm) in group 2. Devices were removed as soon as an ideal length was obtained and

bony bridges confirmed with the CT images between the distracted gaps were formed. No infection was observed throughout the course of treatment. Both groups achieved exact length of distraction as planned, however, one case of group 2 showed iatrogenic deformity at maxillo-zygomatic junction as a result of the distraction forces applied to the zygoma pushing it forward and thus leaving the middle part of the face posterior. Even though, upper airway was expanded and sleep apnea was significantly improved after surgery. Displacement of the device was found in a case of brachycephaly, who underwent reattachment of the device to the skull. Device bent was found in 2 cases as the devices fixed to the skull with screws were not strong enough to conduct distraction force to the bone. Cranial volume increase was measured to be 35.4 ml to 110.0 ml.

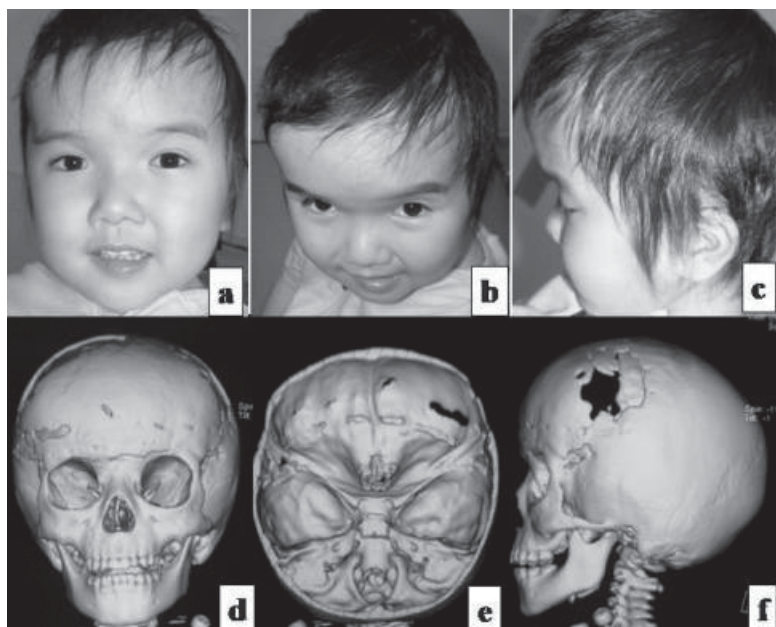
**CONCLUSION:** Although it required a longer treatment period and second operation for the removal of devices, distraction was apparently safer and more effective than conventional cranioplasty as it only required craniotomy and occasionally with craniectomy. It allows not only for surgeons but parents to determine the final shape of the cranium or craniofacial appearance. If distraction is performed under 2 years of age, cranial bone is flexible enough not only to be advanced by distractor but bent creating a smooth curvature of the cranium.<sup>4,5</sup> Up to date, all cases showed no retrusion of the distracted segment.



**Figure 1.** A case of brachycephaly, who underwent cranial bone distraction at the age of 1 year and 7 months. **a, b:** preoperative view of the head. **c, d, e:** 3D-CT revealed typical brachycephaly.



**Figure 2.** **a,** Intraoperative findings. Distractors in place. **b, c, d, e,** completion of 2 weeks of distraction and 6 weeks of consolidation.



**Figure 3. a-f**, One year after device removal. Anterior cranial base is expanded, obtaining a smooth contour of the skull.

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## P24: Dynamic Infrared Imaging in Reconstructive Surgery

**Xavier Tenorio, MD; Ajay Mahajan, MD; Denys Montandon, MD; Brigitte Pittet, MD**

In reconstructive surgery, there is an increased use of perforator and septo-cutaneous free flaps due to the decreased morbidity of the donor site and their better tailoring capacity. The preoperative location of the dominant perforators is an important task to ensure flap perfusion.<sup>1</sup> For this purpose we analyzed flap perfusion by dynamic infrared imaging (DIRI®), a new non-invasive, non-toxic medical imaging technique carried out by a medical device called BioScanIR®. DIRI allows precise mapping of the superficial temperature and temperature modulation of any tissue.<sup>2</sup> This technology was applied as a pre-operative examination to locate superficial perforators in 17 free flaps.

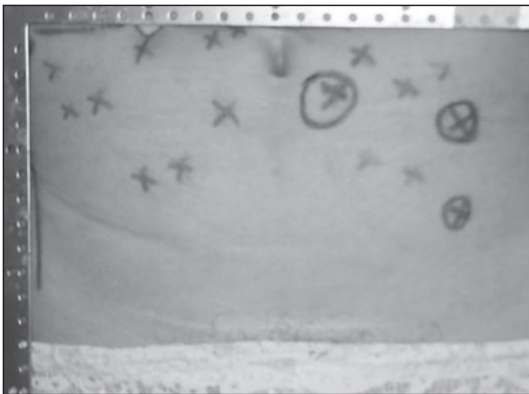
The BioScanIR® is an infrared-based functional imaging system that detects infrared emissions of superficial tissues.<sup>3</sup> The superficial temperature of the skin, measured by its infrared emission, is proportional to the local blood flow, local metabolic process and heat radiation from deeper tissues.<sup>4,5</sup> By this method, the exact location of the vessels irrigating the skin may be defined making the analysis of the superficial perfusion a simple procedure.

**METHOD:** 8 DIEP flaps for breast reconstruction, 6 fibular free flaps for mandibular reconstruction, 2 latissimus dorsi flaps and 1 serratus free flap for facial reconstruction were analyzed between May 2004 and March 2005. The day prior to surgery, perforators or septo-cutaneous vessels were located in the donor site by two techniques: flow

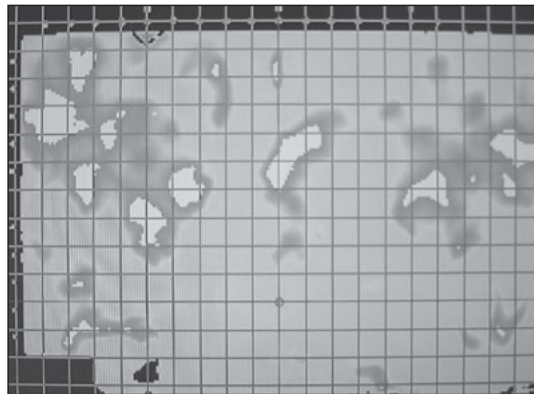
Doppler (Fig. 1) and DIRI (Fig. 2). An “L” shaped ruler, visible in infrared and visible light, was applied over the area of interest to allow precise location of the findings on the infrared image and relate the locations to the patient body. The choice of the skin paddle depended on the location of the perforator with the larger thermographic diameter (dominant perforator) found by DIRI.

**RESULTS:** Perforators and their area of perfusion were found by the DIRI analysis as ‘hot spots’ in comparison with the surrounding temperature. Analysis was refined by selecting only locations within images corresponding to cardiac systole using the Fast Fourier Transform algorithm (FFT). (Fig. 3). The flow Doppler technique identified the location of the perforators but not the area of perfusion (Fig 4). The duration of flow Doppler method is approximately 30 minutes. The duration a DIRI examination takes 20 seconds.

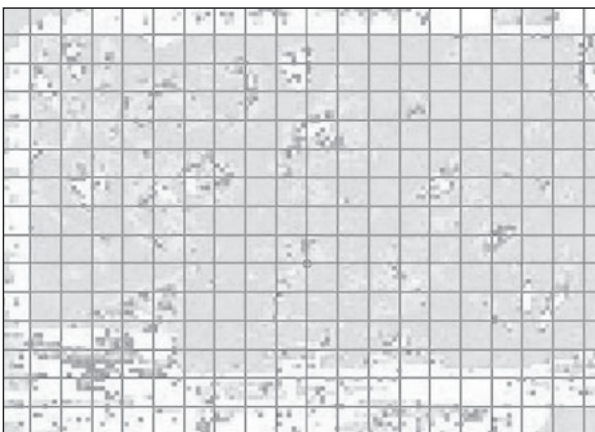
**CONCLUSIONS:** DIRI® is a fast and precise non-invasive technique that allows creation of color maps of the superficial temperature of any tissue allowing to precisely locate the superficial perforators, septo-cutaneous vessels and their individual area of perfusion. The FFT algorithm permits to select only locations during cardiac systole eliminating any possible artifacts. Flow Doppler can identify the perforator position in a deeper level but cannot determine its area of perfusion. The combination of both techniques allows better identification and selection of the main perforator along with the skin paddle, increasing the chances of success and reducing the surgical time.



**Figure 1.** Patient A. Localisation of abdominal perforators by the flow Doppler technique prior to breast reconstruction by DIEP free flap. Vessels found by Flow Doppler were marked with a surgical pen.

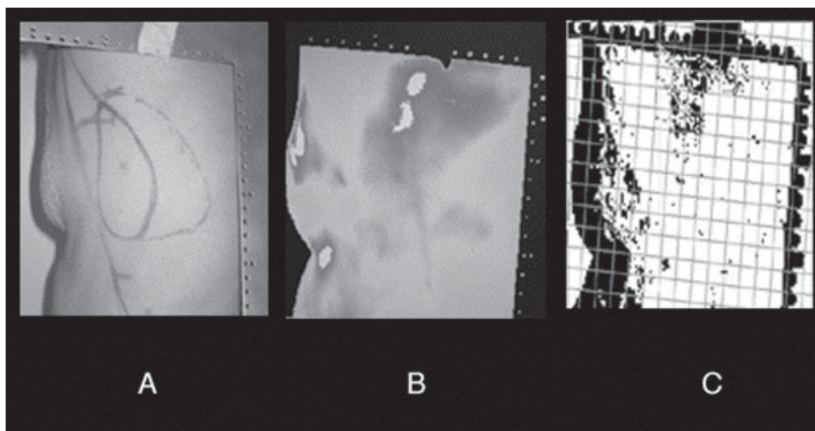


**Figure 2.** Patient A. Map of the superficial perforators by DIRI analysis. An “L” shaped ruler was applied to the skin to facilitate location for further analysis. The software allows a grid to be superimposed for precise location and the area of perfusion of the perforator vessels.



**Figure 3.** Patient A. Frequency analysis using FFT algorithm. Analysis was refined by selecting only locations within images corresponding to cardiac systole.





**Figure 4.** Localisation of perforators in a latissimus dorsi flap. A: flap design and perforators location by Flow Doppler. B: Perforators location by thermal signature, C: precise localization of the most potent perforators by DIRI frequency analysis.

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## P25: Effect of Amifostine on UVB Radiation Induced Skin Tumors in Xeroderma Pigmentosum Mice

Faeza R. Kazmier, MD; Matthew J. Concannon, MD; C. Lin Puckett, MD

Skin cancer is the most common human malignancy in the U.S. There is a positive correlation between skin malignancies and exposure to ultraviolet radiation. This occurs at a higher frequency in Xeroderma pigmentosum (XP) patients, in whom there is a 1000 fold increase in the development of skin cancers.

The purpose of the study is to evaluate the effect of Ethiol (amifostine) (known for its ionizing-radiation protective effects) on the development of skin cancer in the presence of ultraviolet-B (UVB) radiation. Based on previous studies, when exposed to UVB, all Xeroderma pigmentosum mice develop skin cancer. The hypothesis of this study is that amifostine has a preventative effect on the development of skin cancer in the Xeroderma pigmentosum mouse exposed to high levels of UVB radiation.

**METHODS:** Twenty-five Xeroderma pigmentosum mice were studied over 9 months. Five mice received no radiation or medication and served as the unexposed control. The remaining twenty mice were irradiated with UVB every other day. They were separated into 4 equal groups: the placebo control group received saline intraperitoneal (IP) injection; the low-dose group received 50 mg/kg of amifostine IP; the medium-dose group received 100 mg/kg of amifostine IP; and the high-dose group received 200 mg/kg amifostine IP. The mice were inspected daily and suspicious lesions were biopsied and examined by histology.

**RESULTS:** In the unexposed control group, all mice survived with no tumors. In the placebo control group, initial squamous cell carcinoma (SCC) was seen at 3.5 months and all had tumor by 4.5 months. In the low-dose treatment group, initial tumor was at 4 months and all mice developed SCC by 7.5 months. In the medium-dose treatment group, initial tumor was at 4 months and all mice developed SCC by 6.5 months. In the high-dose treatment, initial

tumor was at 7.5 months and all mice had SCC by 9 months. Two mice (from the placebo control group and the high-dose treatment groups, respectively) died, at 2 and 5 months, from splenic and hepatic injections.

Using the Holm-Sidak method of one way analysis of variance, it was determined that the time to tumor development was significant greater in the treated groups. In addition, the results of our study suggest that there may be a dose dependent protective effect of amifostine with the most statistically significant benefit in tumor latency for the highest treatment group. The resultant p value was <0.001. In addition to the squamous cell carcinomas that developed, an ocular keratitis was noted without evidence of tumor in all mice except the nonradiated placebo control and the highest treatment group mice.

**CONCLUSION:** In this study, high dose amifostine appears to result in a statistically significant delay in the development of skin cancer and prevents ocular keratitis in Xeroderma pigmentosum mice exposed to high levels of UVB radiation.

## **P26: Effectiveness of Cryo-Preserved Human Bone Marrow Stromal Cells at Forming Bone *in Vivo***

*Mahesh H. Mankani, MD; Sergei Kuznetsov, PhD; Pamela Gehron Robey, PhD*

**PURPOSE:** Cultured bone marrow stromal cells (BMSCs) contain osteoprogenitor cells which provide the cellular basis for bone-directed tissue generation. The majority of BMSC studies involve the transplantation of cells which have undergone recent harvest and culture expansion. Any anticipated clinical trial may require that some cells undergo a period of cryo-preservation, in order to match cell availability with clinical need. In this study, we compared bone formation among freshly-expanded cells with those cells which have been cryo-preserved.

In brief, human bone marrow isolates underwent a low number of culture passages and were then divided into 2 groups, one of which was immediately transplanted into mice, and the other of which was cryo-preserved for an extended period of time, thawed, re-expanded, and then transplanted into a second set of mice. Bone from the 2 groups of transplantations was compared.

**METHODS:** Multi-colony derived strains of BMSCs were obtained from patient bone marrow as previously described. (Kuznetsov, et al; JBMR; 1997) The cells were isolated in tissue culture and expanded via sequential passaging. Aliquots of cells from passage 2 and 3 (for Hum-40 cells) and from passage 1 (for Hum-65 cells) were cryo-preserved in a freezing solution consisting of aMEM, 50% fetal bovine serum of a pre-selected lot, 100 U/mL penicillin, and 5% DMSO (Sigma: St. Louis, Missouri). Cells which had never been frozen, from passages 2 through 4, were combined with hydroxyapatite/tricalcium phosphate (HA/TCP) particles and transplanted into three month old immunodeficient Bg-Nu-Xid female mice using our standard technique. (Mankani, *et al*; Biotechnol Bioeng; 2001)

Cryo-preserved cells were recovered after freezing periods of 15 weeks (Hum-40) and 13 to 37 weeks (Hum-65), reconstituted in our standard culture media, passaged 1 to 3 times more, combined with HA/TCP particles, and then transplanted into a second set of three month old immunodeficient Bg-Nu-Xid female mice.

All transplants were recovered from periods of 8 weeks to 67 weeks. Transplants arising from freshly utilized BMSCs were harvested at an average of 48 weeks, while transplants from the cryo-preserved progeny of these cells were harvested at an average of 23 weeks. HE-stained sections of the transplants were then examined histologically; the extent of bone within each transplant was scored on a semiquantitative, logarithmic scale by 3 independent, blinded observers:

**Semiquantitative Scale for the Estimation of Bone Formation.**

Score	Extent of bone present within the transplant
0	No bone evident
1	Minimal bone evident (1 trabecula)
2	Weak bone formation, occupying only a small portion of the section
3	Moderate bone formation, occupying a significant portion but less than one half of the section
4	Abundant bone formation, occupying greater than one half of the section

**RESULTS:** The freshly-prepared and cryo-preserved BMSCs were uniformly successful at forming extensive bone (Figure 1), and the mean bone scores of each group (4.00 vs. 3.92, respectively) were statistically equivalent.

**CONCLUSION:** The clinical use of cultured osteoprogenitor cells may require an interval of cryo-preservation prior to transplantation. In this study, freshly-expanded BMSCs and cryo-preserved BMSCs originating from the freshly-expanded BMSCs formed bone which was equivalent, suggesting that cryo-preservation did not impair bone formation.

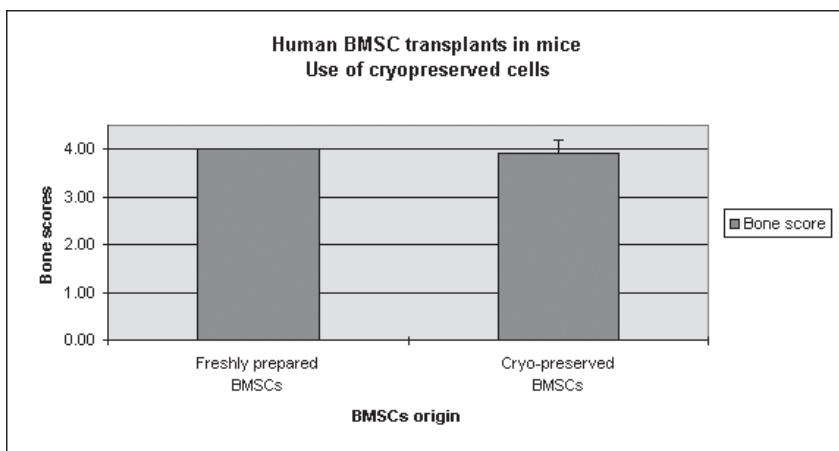


Figure 1.

**P27: Evaluation of the Acute and Chronic Systemic and Metabolic Effects From the Use of High Intensity Focused Ultrasound for Adipose Tissue Removal and Non-Invasive Body Sculpting**

*Enrique Garcia Murray, MD; Oscar E. Adan Rivas, MD; Kathryn A. Stecco, MD, MA; Charles S. Desilets, PhD; Larry Kunz, DVM*

**PURPOSE:** High intensity focused ultrasound (HIFU) provides a non-invasive method for adipose tissue removal. A transducer is used to focus a beam of energy into the specified treatment area without damage to any intervening tissues outside of the focal zone. The damaged and disrupted adipocytes along with released triglyceride content are subsequently resorbed through normal physiological pathways via inflammatory cells. The purpose of this study was to evaluate the acute and chronic systemic and metabolic effects from the use of HIFU for adipose tissue removal.

**MATERIALS & METHODS:** Twenty four patients received transcutaneous HIFU therapy (Liposonix Prototype System, Liposonix, Inc., Bothell, WA.) to their lower abdominal adipose tissue followed by subsequent abdominoplasty performed at different time points after HIFU therapy. The human clinical study was performed between July 15, 2003 and February 2, 2004 at Hospital Santa Monica in Mexico City after Ethics Committee and Ministry of Health Approval was obtained. Treated adipose tissue volumes ranged from 25 cc - 225 cc. HIFU treated tissue residence times ranged from peri-acute (hours) in 4 patients, 4-7 days in 7 patients, 4 weeks in 1

patient, 56–59 days in 6 patients and 84–86 days in 6 patients. Each abdominoplasty flap was examined for gross and histologic HIFU induced tissue changes. Each patient had blood drawn at the following time intervals: baseline, 24 hours, 48 hours, 72 hours, 1 week and 1–3 months depending on the treated tissue residence time. Blood was analyzed for changes in lipid panels, free fatty acids, and end organ function.

**RESULTS:** There were no clinically significant changes from baseline in any of the 24 patient lipid panels including free fatty acids, total cholesterol, very low density lipoprotein (VLDL), high density lipoprotein (HDL), low density lipoprotein (LDL), and triglyceride levels. In addition, none of the 24 patients had clinically significant changes from baseline in their comprehensive metabolic panel, amylase, lipase and complete blood count with differential values when examined at the varying time intervals post HIFU therapy.

**CONCLUSIONS:** The use of HIFU for non-invasive adipose tissue removal does not induce any clinically significant acute or chronic changes in lipid metabolism, free fatty acids, glucose metabolism, kidney and liver function and provides a safe method for body sculpting.

## **P28: Exposed Posterior Spinal Instrumentation: Extra-anatomic Approaches to the Complex Wound**

*David E. Morris, MD; Joanna L. Partridge, MD; Harry M. Richter, MD; Yogesh N. Gandhi, MD; Sai S. Ramasastry, MD*

Exposed instrumentation following spinal surgery is associated with significant morbidity. Local muscle flaps may not be available for coverage due to previous surgery, trauma, or radiation, or may not be suitable for defects associated with a large dead space. Here, distant flaps may provide vascularized coverage and deliver antibiotics to the wound. Previously described approaches include the omental pedicle flap and latissimus dorsi free flap with vein elongation.<sup>1-4</sup> We describe our use of the omental pedicle flap and latissimus dorsi free flap without vein graft to close such defects.

**METHODS:** Four patients (ages 21–31 years) with complex back wounds, significant dead space, and exposed instrumentation underwent successful reconstruction. Defect location was thoracolumbar (one) and lumbosacral (three).

The latissimus dorsi muscle had been transected and not available in the patient with the thoracolumbar defect. Here, an omental pedicle flap based on the left gastroepiploic pedicle was tunneled through the quadratus lumborum muscle to close the defect (Figure 1).

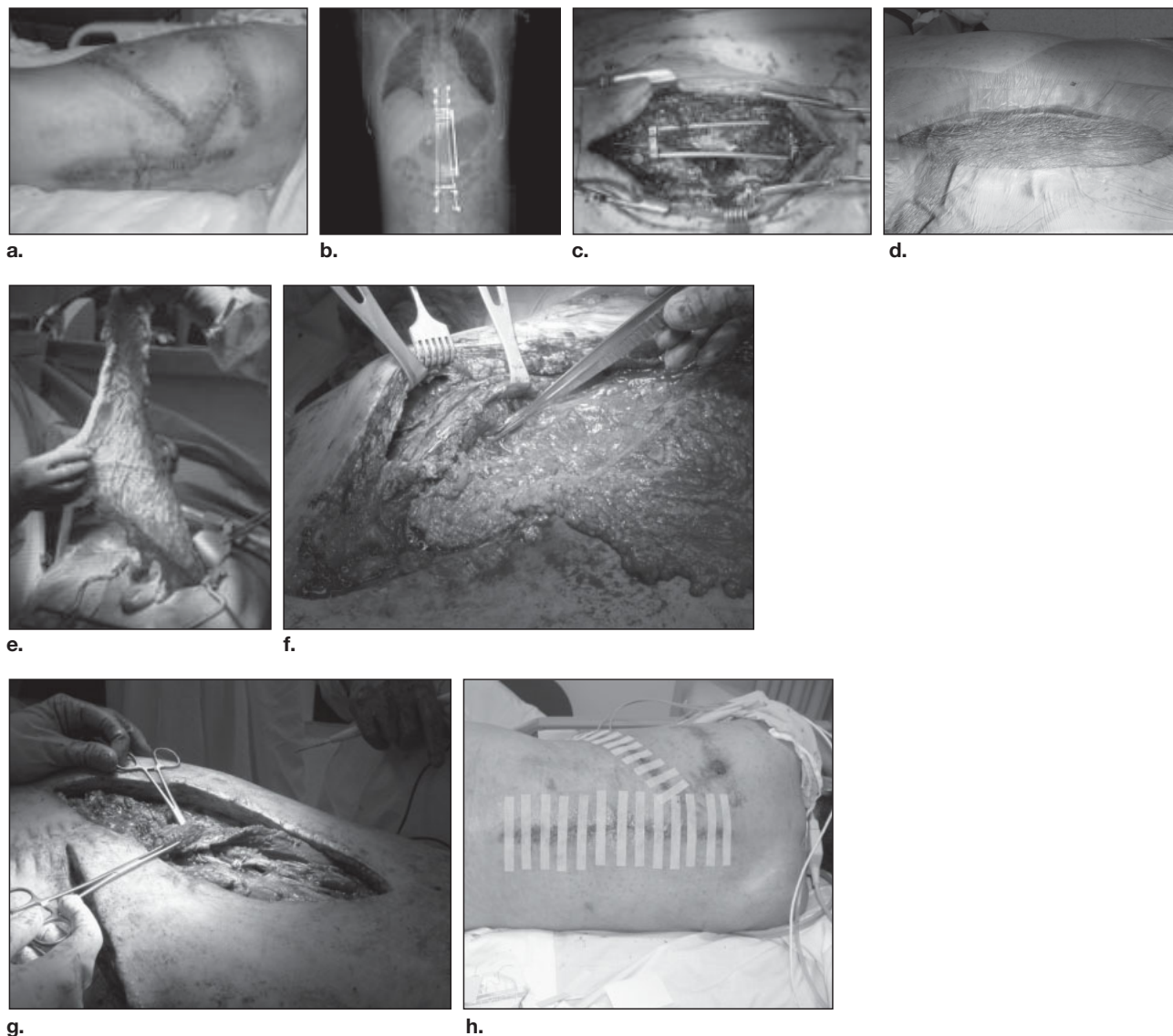
In the other three patients, the lumbosacral defects were beyond reach for a latissimus dorsi pedicle flap, and the gluteal muscles had been previously transected. In these three cases, the latissimus dorsi muscle free flap with anastomosis to the fourth lumbar perforator was used to close each defect. No vein grafts were used.

For two cases (Figures 1 and 2), our approach to reconstructive staging, use of the Vacuum-Assisted Closure (VAC) device as a bridge to flap coverage, and techniques in flap harvest are illustrated.

**RESULTS:** All wounds healed without complication; three patients are ambulatory and one remains wheelchair bound.

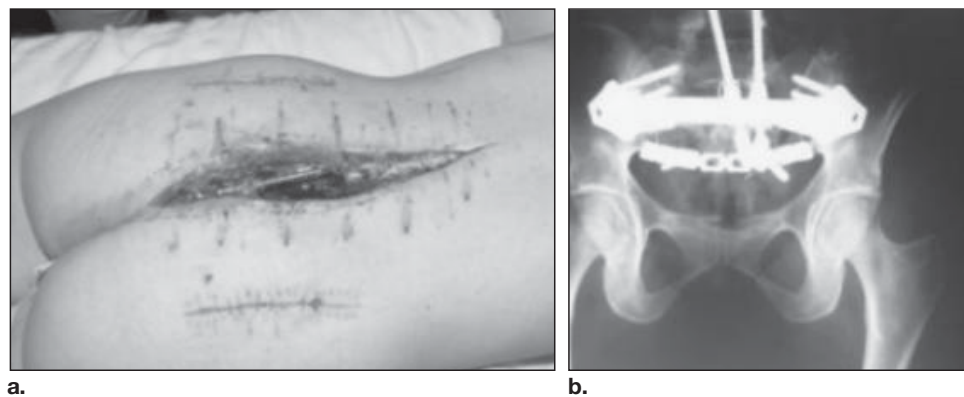
**CONCLUSION:** The omental pedicle flap and latissimus dorsi free flap are excellent options for the closure of difficult back wounds with exposed spinal instrumentation when local flaps are unavailable. The fourth lumbar perforator provides an excellent recipient vessel for microanastomosis.

Figure 1.

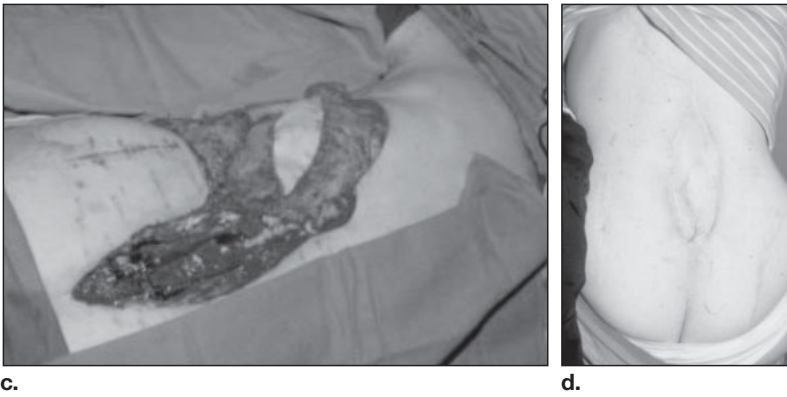


**Figure 1 (a-h).** Omental flap. **(a)** 29-yo male with infected thoracolumbar wound and exposed posterior spinal instrumentation. Previous T10-L1 corpectomy and stabilization and thoracotomy for aortic injury. **(b)** X-ray showing instrumentation. **(c)** Debridement of open thoracolumbar wound. **(d)** Application of VAC device for temporary wound closure. **(e)** Omental flap based on the left gastroepiploic artery is harvested through midline abdominal incision. **(f)** Flap is tunneled through a quadratus lumborum muscular window, then under the paraspinous muscles. It is inset to cover the exposed instrumentation and fill the paraaortic dead space. **(g)** Bilateral paraspinous muscles are brought over the omental flap for extra bulk. **(h)** Final wound closure at 2 weeks.

Figure 2.



**a.** **b.**



**Figure 2 (a-d).** Latissimus dorsi musculocutaneous free flap. **(a)** 21-year-old female with lumbosacral dissociation, pelvic fractures, and paraplegia. She underwent spinal distraction and stabilization of the spinal and pelvic fractures. Exposed instrumentation followed wound dehiscence. Superior gluteal vessels were sacrificed during open reduction and internal fixation of pelvic fractures. **(b)** X-ray showing extensive instrumentation. **(c)** Latissimus dorsi musculocutaneous (mc) flap was outlined and 4th lumbar perforator artery dopplered. Latissimus dorsi mc flap was mobilized. Thoracodorsal pedicle was anastomosed to the 4th lumbar vessels and flap was inset to cover the exposed instrumentation. Muscle was skin grafted. **(d)** Healed wounds 6 months postoperatively. At this time, the skin graft was excised and adjacent skin flaps were advanced to close the wound for extra bulk and for improved cosmesis (not shown). The patient's wound is healed and she is fully ambulatory.

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## P29: External Cranial Distraction With MCDO System

*Yasushi Sugawara, MD; Syunji Sarukawa, MD; Shinichi Hirabayashi, MD*

**INTRODUCTION:** The distraction osteogenesis has been widely accepted to the facial skeletal deformities, however, its application to craniosynostosis is still controversial.

Internal cranial distraction procedure has been performed in our unit for the treatment of selected 21 cases of craniosynostosis since 1996. That led us to the conclusion that two disadvantages diminished the benefit of cranial distraction. One is the limitation of deformed skull reshaping with unidirectional distraction device, and the other is the need for a second operative procedure to remove the implanted distraction devices.

In order to solve these problems we have designed new distraction system, which is multidirectional cranial distraction osteogenesis (MCDO) system.

**MATERIAL AND METHODS:** Since 2002, we have performed this new method for 11 cases of syndromic and non-syndromic craniosynostosis.

Basic maneuver is the same as previously reported distraction procedure, however, calvarium is osteotomised in 9 to 15 small rectangular pieces of bone. The bone flaps are not dissected from the dura, so that vascularity of each bone flap is left intact. The tiny pins are fixed on the temporal bone and the bone flaps. After closing the wound as the pins are penetrating the scalp, the helmet-like frame is then fixed on the pins in temporal bone. The wires tied with each pin on bone flap are passed through holes in the frame as the bone flaps would be pulled in adequate direction.

Finally the wires are fixed to the distractors attached on the flame.

Distraction is initiated 5 days postoperatively, and continued until the desired skull shape is achieved by controlling the amount of distraction of each bone flaps. The flame and all pins are removed after 3 weeks consolidation period under sedation.

**CASE REPORT:** A 4-year-old girl with Pfeiffer syndrome underwent cranial distraction with MCDO system. The bone flap was pulled with wire by activating the distractor (Fig. 1). Preoperative (Fig. 2), before removal of devices (Fig. 3), and 20 months postoperative 3DCT (Fig. 4). MCDO system is easy to manage at home (fig. 5).

**RESULTS:** There were no neurologic findings during distraction. No meningitis, liquoric fistula, or extradural hematoma developed. Loosening of pins and pin-track infections occurred in 7 and 6 of 11 cases.

The mean total blood transfusion (intra- and postoperative) was 29ml/kg, which is in contrast to the transfusion requirements for the more extensive operations (58.9ml/kg).

The longest follow up was 21 months. There was no detectable relapse in any of 11 cases.

**DISCUSSION:** The advantages of distraction osteogenesis in the field of craniofacial surgery are widely accepted. Refinement of distraction devices is extending its application to various kinds of craniofacial malformations.

MCDO system is a type of external distraction device including the following advantages: 1) multidirectional skull contouring is possible with distraction osteogenesis; 2) a second surgery is much less invasive than internal distraction device; 3) leaning curve of surgery is acute; 4) it is applicable to secondary cranial expansion with multiple skull defects. MCDO system allows us to contour various kinds of skull deformities with ease under the concept of cranial distraction.

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### **P30: Facial Cutaneous Anthrax, Prompt Recognition Required for Accurate Disease Surveillance**

*Ian F. Wilson, MD, MPH; Edmond F. Ritter, MD*

Accurate diagnosis of cutaneous anthrax, appropriate management and prompt disease surveillance depends on clinicians been familiar with the characteristic appearance of typical skin lesions. This has become more imperative with the emerging threat of bioterrorism worldwide. Plastic surgeons may well be initially consulted if a patient develops a cutaneous anthrax lesion in a non-endemic environment. Anthrax is primarily a zoonotic disease (e.g. cattle, goats and sheep).<sup>1</sup> However cutaneous anthrax is seen in patients who are exposed to contaminated meat or animal products in endemic countries such as Haiti. If affected patients receive prompt antibiotic therapy, their mortality rate is significantly reduced (25% to <1%).<sup>2</sup> Inhalational and gastrointestinal anthrax resulting from respiratory exposure or ingestion of anthrax spores respectively are less common (10% of naturally-acquired anthrax) and have a worse prognosis even with appropriate therapy.

The evolution of a characteristic facial lesion of cutaneous anthrax is outlined in a seventeen-year-old girl (Figs 1, 2 & 3) who was treated at Hôpital Albert Schweitzer in Deschappelle, Haiti. She lives in a remote region of the Artibonite valley where anthrax is endemic. She was apparently exposed during the slaughtering process of a presumably infected cow. Her mother had a similar facial lesion (Fig. 4), which highlights the importance of seeking out other individuals similarly exposed.

The facial lesions of cutaneous anthrax occur predominantly in the cheek region, presumably through the contamination of abraded skin during the process of patients wiping their faces. The notable soft tissue swelling (Fig. 1) resulting from an edema toxin (pX01) is characteristic for facial cutaneous anthrax, especially when associated with the typical evolution of this skin lesion. The initial papule evolves to a vesicular stage often with associated satellite vesicles (Fig. 2). Typically these vesicles form an ulcer over a period of 7-10 days with a depressed central black eschar (Fig. 3). *Bacillus anthracis*, a gram positive, non-motile, spore forming "box-car" like bacillus can be identified by gram stain and culture from fluid obtained from these vesicular lesions.<sup>3</sup> The appearance of these two patients' facial lesions is characteristic for cutaneous anthrax. Recognition of this pathogenic lesion allows clinicians to make the correct "spot diagnosis". Management of naturally acquired facial cutaneous anthrax

should include intravenous antibiotics therapy (penicillin G, 2MIU q4hrly or chloramphenicol, 1g q8 hrly) and supportive measures. The CDC recommends using fluoroquinolone therapy in a non-endemic environment (ciprofloxacin 500mg Q12 hrly) because of concerns for bioengineered resistant strains of *B. anthracis*.<sup>4</sup> Early tracheotomy may reduce the mortality in patients with progressive edema leading to airway obstruction. After the acute infection has resolved, the black eschar may be debrided and may subsequently require skin grafting. The mortality of anthrax may be reduced through prompt recognition of these cutaneous lesions and appropriate therapy. In non-endemic areas, cutaneous anthrax should now be considered in the differential diagnose of any suspicious lesions as they may represent the first sign of an impending terrorist attack. Astute clinicians should be suspicious, test for *B. anthracis* and report their findings to the appropriate public health service.<sup>5</sup>



Figure 1.



Figure 2.



Figure 3.



Figure 4.

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