The Surgical Treatment of Migraine Headaches

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Disclosures

- Royalties – Quality Medical Publishing/CRC Press
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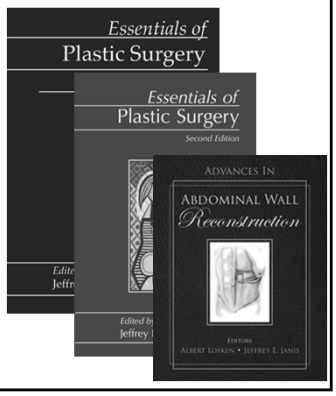
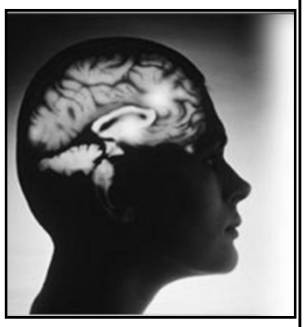


Migraine Headaches

- 35 million people in the U.S. alone
- Affect 18% of women
- Affect 6% of men
- Cumulative lifetime incidence:
  - 43% women
  - 18% men
- 1 in 4 households have at least one person who suffers from migraine headaches



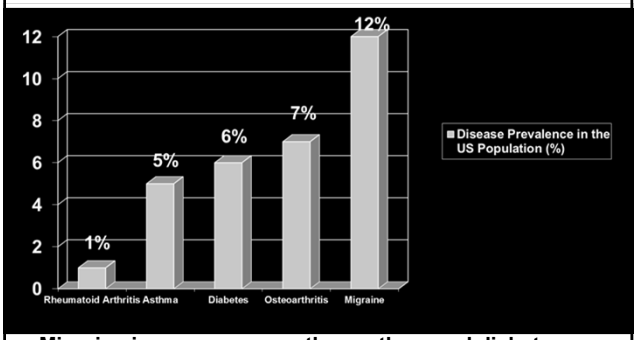
Lipton RB, Stewart WF, Diamond S, Diamond ML, Reed M. Prevalence and burden of migraine in the United States: Data from the American migraine study II. Headache. 2001; 41: 646-657.
Stewart WF, Wood C, Reed ML, Roy J, RB Lipton; AMPP Advisory Group. Cumulative lifetime migraine incidence in women and men. *Cephalagia* 2008;28:1170-8.

Impact of Migraines

- Single most disabling neurologic disorder
- 5th leading cause of visits to the emergency room
  - 4 million emergency room visits annually
- 6 million prescriptions for anti-migraine drugs

Leonardi M, Raggi A. Burden of migraine: International perspectives. *NeurolSci* 2013;34:S117-8.
Smitherman TA, Burch R, Sheikh H, Loder E. The prevalence, impact, and treatment of migraine and severe headaches in the United States: A review of statistics from national surveillance studies. *Headache* 2013;53:427-36.

Migraine Headaches

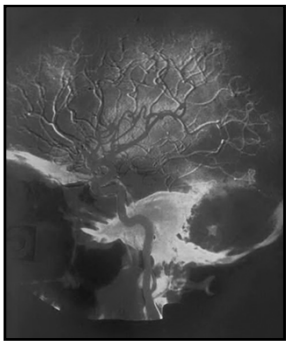


Migraine is more common than asthma and diabetes combined

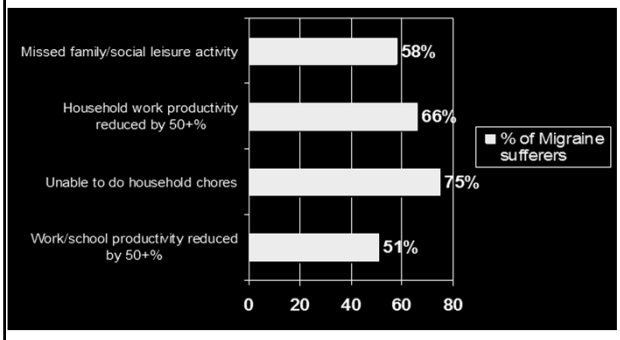
Data from the Centers of Disease Control and Prevention. U.S. Census Bureau, and the Arthritis Foundation

Migraine Headaches

- **1/3 of the patients are not helped by standard therapies**
- **Even the most efficacious medications only reduce their severity and frequency, rather than eliminate them**



Migraines Affect Patients' Abilities to Perform ADL's



Lipton RB, Stewart WF, Diamond S, Diamond ML, Reed M. Prevalence and burden of migraine in the United States: Data from the American migraine study II. Headache. 2001; 41: 646-657.

Economic Consequences

- **112 million collective workdays lost**
- **$14-$17 billion in productivity lost**

Author: TaxRebate.org.uk

Hu XH, Markson LE, Lipton RB, Stewart WF, Berger ML. Burden of migraine in the United States. Arch Internal Med. 1999; 159: 813-818.
Goldberg LD. The cost of migraine and its treatment. *Am J Manag Care* 2005;11:S62-7.

Traditional Treatments

- Abortive
  - Goal: To prevent a migraine attack or to stop it once it starts
- Preventative
  - Goal: To lessen the frequency and severity of the migraine attacks.

Traditional Treatments

- Abortive Examples
  - Sumatriptan (Imitrex)
  - Zolmitriptan (Zomig)
  - Eletriptan (Relpax)
  - Naratriptan (Amerge, Naramig)
  - Rizatriptan (Maxalt)
  - Frovatriptan (Frova)
  - Almotriptan (Axert)

Traditional Treatments

- Preventative Examples
  - Beta-blockers (propanolol [Inderal])
  - Calcium channel blockers (verapamil [Covera])
  - Antidepressants - Amitriptyline (Elavil), nortriptyline (Pamelor)
  - Antiseizure medications – Gabapentin (Neurontin), valproic acid (Depakote), topiramate (Topamax)
  - Some antihistimines and anti-allergy drugs, including diphenhydrapmine (Benadryl) and cyproheptadine (Periactin)

Traditional Treatment Disadvantages

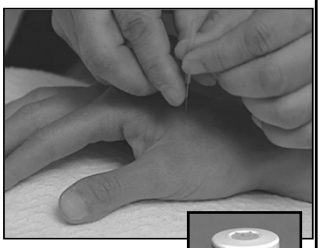
- Must be taken on a regular basis
- Can be expensive, even with co-pays
- Time to take effect

Traditional Treatment Disadvantages

- Can have side effects
  - Drowsiness
  - Weight gain
  - Hair loss
  - Difficulty concentrating/memory issues
- Contraindications:
  - Some contraindicated with pregnancy, history of coronary artery disease, stroke, etc.

Alternative Treatments

- Acupuncture
- Menthol patches
- Electrical Stimulation
- Magnesium
- Massage therapy
- Chiropractor
- Biofeedback
- Botulinum toxin
- Nerve Blocks
- Surgery



History of Botox and Surgery for Migraines

- 1st 2 patients in 2000
  - Dr. Bahman Guyuron – Case Western Reserve University
  - Unexpected outcome after cosmetic browlifts – improvement of migraine headaches

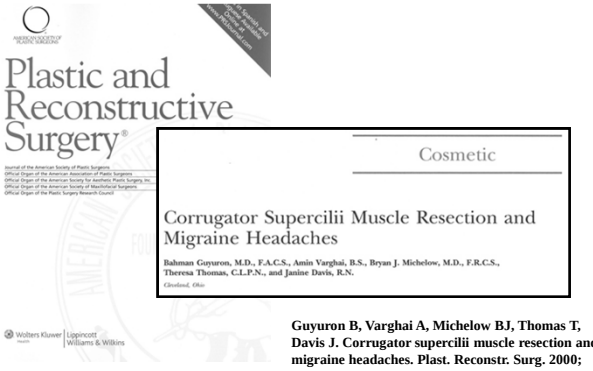
Evolution of Thought

- *"Carpal tunnel syndrome of the head"*
  - Nerve compression, irritation, entrapment by surrounding tissues
  - Thought to be supraorbital and supratrochlear nerve entrapment by the corrugator supercilli muscle

Etiology of Migraine Headaches

- Traditional
  - Centrally-mediated neurovascular phenomenon
- New Concept
  - Peripherally-mediated "trigger points"
    - –Branches of the trigeminal nerve and their muscular investments

First Publication



Guyuron B, Varghai A, Michelow BJ, Thomas T, Davis J. Corrugator supercilii muscle resection and migraine headaches. Plast. Reconstr. Surg. 2000; 106: 429-434

First Publication

- Retrospective Questionnaire
  - Sent to 314 patients who had undergone resection of corrugator for cosmetic reasons
  - Found 79.5% of those patients who had pre-op migraines had elimination or improvement

Evolution of Technique

- Can't perform corrugator resection on everyone with a migraine headache
- Introduction of botulinum toxin as a test

Translational Anatomical Investigation

- Migraine patients tend to have pain in typical locations:
  - Periorbital area
    - –Supraorbital and supratrochlear nerves (SON/STN)
  - Temples
    - –Zygomaticotemporal branch of the trigeminal nerve (ZTN)
  - Back of neck
    - –Greater, lesser, and third occipital nerves (GON, LON, TON)

Major Peripheral Trigger Points

- Supraorbital
- Supratrochlear

} Muscle, Fascia, Bone, Vessel

- Zygomaticotemporal – Muscle, Fascia
- Greater Occipital Nerve – Muscle, Fascia, Vessel
- Nasoseptal (SPG) - Cartilage

Minor Peripheral Trigger Points

- Auriculotemporal
- Lesser Occipital Nerve
- Third Occipital Nerve

Putting It All Together

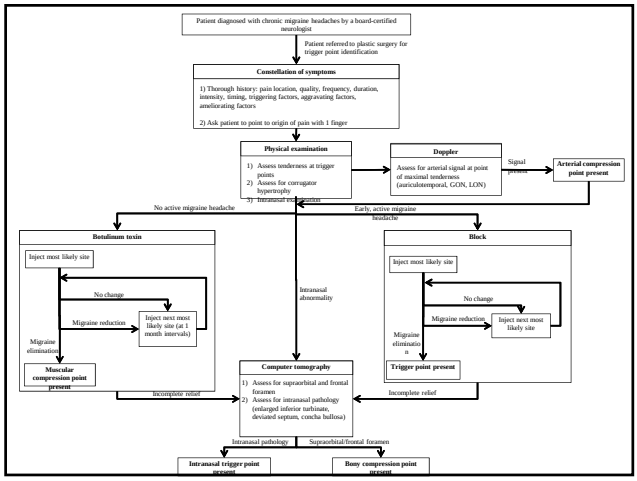
- Patient Selection
  - Officially diagnosed with migraine headaches by a neurologist
  - Failure or intolerance of traditional medications
  - Disability

Choosing Injection Sites

- Guided primarily by where the headaches usually begin:
  - Periorbital region
  - Temple
  - Back of neck
    - –GON/LON/TON
  - Retroorbital

Choosing Injection Sites

- Augmented by use of:
  - Nerve blocks
  - CT scan
  - Doppler

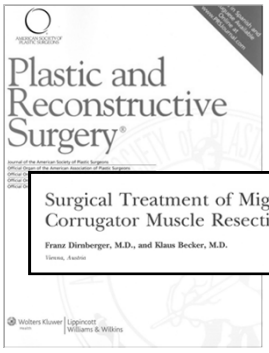


Surgery

- Endoscopic or transpalpebral glabellar muscle resection
- Zygomaticotemporal nerve avulsion
- Greater occipital nerve release with fat flap transposition
- Septoplasty with ITR/outfracture

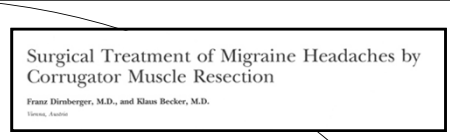
Evidence and Outcomes

Further Publications



- PRS Sept 2004
- Austrian experience

Dirnberger F, Becker K. Surgical treatment of migraine headaches by corrugator muscle resection. Plast. Reconstr. Surg. 2004; 114: 652-657



- Prospective study on 60 patients who underwent migraine surgery
  - 28.3% complete elimination
  - 40% significant improvement
  - 31.7% minimal to no change

The Early Landmark Publication

- PRS Jan 2005
- Prospective study on migraine surgery

Guyuron B, Kriegler JS, Davis J, Amini SB. Comprehensive surgical treatment of migraine headaches. Plast. Reconstr. Surg. 2005; 115: 1-9


Comprehensive Surgical Treatment of Migraine Headaches

Bahman Guyuron, M.D., Jennifer S. Kriegler, M.D., Janine Davis, R.N., and Saeid B. Amini, Ph.D., M.B.A., J.D.

Cleveland, Ohio

- 89 patients underwent surgery
- 25 patients were controls (no surgery)
- 92% who underwent surgery had benefit
  - 35% complete elimination
  - 57% significant improvement
- Only 15.8% of controls had benefit
  - 0% elimination

Guyuron B, Kriegler JS, Davis J, Amini SB. Comprehensive surgical treatment of migraine headaches. Plast. Reconstr. Surg. 2005; 115: 1-9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Cleveland, Ohio

- Mean follow-up 396 days
- Mean annualized cost for migraine care:
  - Treatment group: $925
  - Control group: $5,530
  - Baseline: $7,612
- Mean # of days lost/month from work:
  - Treatment group: 1.2
  - Control group: 4.4
  - Baseline: 4.41

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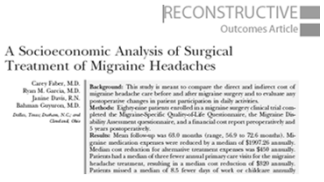
Proven Socioeconomic Benefit


RECONSTRUCTIVE
Outcomes Article

A Socioeconomic Analysis of Surgical Treatment of Migraine Headaches

- Median total cost reduction of $3,949/year
  - ↓ med costs
  - ↓ primary care visits
  - ↓ # of work days missed with regained productivity time

Faber, C., et al., A socioeconomic analysis of surgical treatment of migraine headaches. Plast Reconstr Surg, 2012. 129(4): p. 871-7

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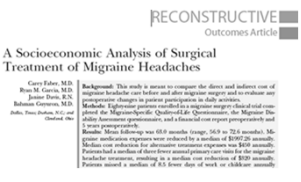
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- Average surgical cost: $8,378
- Expense of medical management exceeded up-front cost of surgery shortly after 2 years post-operatively

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Corroborative Evidence


RECONSTRUCTIVE

Confirmation of Surgical Decompression to Relieve Migraine Headaches

- PRS July 2008
- Poggi et al demonstrated reproducibility
- Retrospective review of 18 surgical patients

Poggi JT, Grizzell BE, Helmer, SD. Confirmation of surgical decompression to relieve migraine headaches. Plast. Reconstr. Surg. 2008; 122: 115-122

Corroborative Evidence


RECONSTRUCTIVE

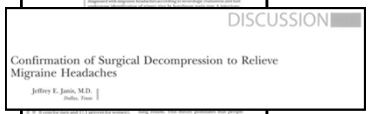
Confirmation of Surgical Decompression to Relieve Migraine Headaches

- 17% elimination
- 50% significant improvement
- 33% minimal to no change
- Mean follow up: 16 months

Corroborative Evidence


RECONSTRUCTIVE

Confirmation of Surgical Decompression to Relieve Migraine Headaches


DISCUSSION

Confirmation of Surgical Decompression to Relieve Migraine Headaches

Jeffrey E. Janis, M.D.

- The nasoseptal trigger point was not addressed in this cohort, which may have led to artificially low success rate
- Still an invaluable addition to the literature

Janis, J.E.. *Discussion: Confirmation of Surgical Decompression to Relieve Migraine Headaches.* by Poggi, J.Y. et. al. Plast Reconstr Surg. 122(1):123-124, 2008.

Corroborative Evidence

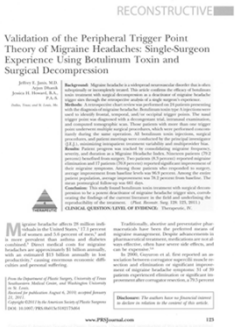

RECONSTRUCTIVE

Validation of the Peripheral Trigger Point Theory of Migraine Headaches: Single-Surgeon Experience Using Botulinum Toxin and Surgical Decompression

- Single surgeon study
- 2005-2009
- 96 patients
- 24 operations
- 63 trigger sites decompressed

Janis J.E., Dhanik A, Howard J.H. Validation of the Peripheral Trigger Point Theory of Migraine Headaches: Single-Surgeon Experience Using Botulinum Toxin and Surgical Decompression. Plast Reconstr Surg. 128(1):123-131, 2011.

Corroborative Evidence

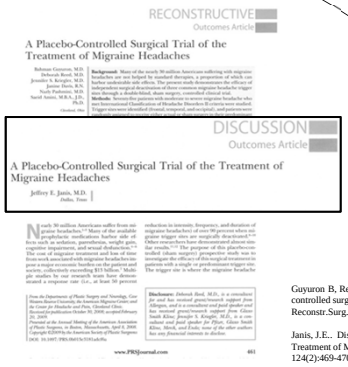

RECONSTRUCTIVE

Validation of the Peripheral Trigger Point Theory of Migraine Headaches: Single-Surgeon Experience Using Botulinum Toxin and Surgical Decompression

- **100%** response rate to Botox
  - Average of 87.5% improvement in MHI over baseline
- **80%** response rate to surgery
  - Average of 96.6% improvement in MHI over baseline

Janis J.E., Dhanik A, Howard J.H. Validation of the Peripheral Trigger Point Theory of Migraine Headaches: Single-Surgeon Experience Using Botulinum Toxin and Surgical Decompression. Plast Reconstr Surg. 128(1):123-131, 2011.

The Definitive Publication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Outcomes Article

A Placebo-Controlled Surgical Trial of the Treatment of Migraine Headaches

DISCUSSION
Outcomes Article

A Placebo-Controlled Surgical Trial of the Treatment of Migraine Headaches

- PRS August 2009
- IRB-approved prospective sham surgery study
- 75 patients
  - 26 sham surgery/49 actual

Guyuron B, Reed D, Kriegler JS, Davis J, Pashmini N, Amini S. A placebo controlled surgical trial for the treatment of migraine headaches. Plast. Reconstr.Surg. 2009; 124: 461-468

Janis, J.E.. Discussion: A Placebo Controlled Surgical Trial for the Treatment of Migraine Headaches. by Guyuron, B. Plast Reconstr Surg. 124(2):469-470, 2009.

The Definitive Publication


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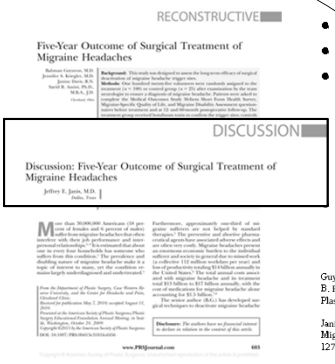
A Placebo-Controlled Surgical Trial of the Treatment of Migraine Headaches

- 57.1% **complete elimination** in actual surgery vs. 3.8% in sham surgery ($p<0.001$)
- 83.7% **significant improvement** in actual surgery vs. 57.7% in sham surgery ($p<0.05$)

Longevity Addressed


RECONSTRUCTIVE

Five-Year Outcome of Surgical Treatment of Migraine Headaches

DISCUSSION

Discussion: Five-Year Outcome of Surgical Treatment of Migraine Headaches

- PRS Feb 2011
- **5 year follow-up**
- 61/69 (88%) - positive response to the surgery after 5 years
  - 20 (29%) - complete elimination
  - 41 (59%) - significant decrease
  - 8 (11%) - no significant change

All measured variables at 60 months improved significantly **($p<0.0001$)**

Guyuron, Bahman; Kriegler, Jennifer S.; Davis, Janine; Amini, Saeid B. Five-Year Outcome of Surgical Treatment of Migraine Headaches. Plastic & Reconstructive Surgery. 127(2):603-608, 2011.

Janis, J.E.. Discussion: Five-Year Outcome of Surgical Treatment of Migraine Headaches. by Guyuron, B. Plast Reconstr Surg. 127(2):609-610, 2011.

Factors for Success and Failure


RECONSTRUCTIVE

Factors Contributing to Migraine Headache Surgery Failure and Success

- Success:
  - Older age of migraine onset
  - No lightheadedness or sensitivity to bright light/loud noises
  - Surgery on SON/STN/ZT
  - Deactivating all four operative sites at same time

Larson, Kelsey; Lee, Michelle; Davis, Janine; Guyuron, Bahman
Factors Contributing to Migraine Headache Surgery Failure and Success
Plastic & Reconstructive Surgery. 128(5):1069-1075, November 2011.

Factors for Success and Failure


RECONSTRUCTIVE

Factors Contributing to Migraine Headache Surgery Failure and Success

- Failure:
  - Increased intraoperative bleeding
  - Surgery on fewer trigger sites (1-2 vs. 3-4)

Larson, Kelsey; Lee, Michelle; Davis, Janine; Guyuron, Bahman
Factors Contributing to Migraine Headache Surgery Failure and Success
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Anatomical Conclusions

- Complete CSM resection (and portion of procerus and depressor)
- Branch patterns and asymmetries can lead to failures (SON/STN/ZT/GON)
- Release of foramen or notch, as indicated
- Complete release of GON
- Compression can take different forms (muscle, fascia, bone, vascular, etc.)

Current Body of Evidence

- **3 case series**
- **8 retrospective cohort studies**
- **3 prospective cohort studies**
- **2 randomized controlled trials**

Janis, J.E., Barker, J.C., Javadi, C., Ducic, I., Hagan, R., Guyuron, B. A Review of Current Evidence in the Surgical Treatment of Migraine Headaches. Accepted for publication, Plast Recon Surg

Summary of 17 Clinical Studies

- Average success rate: 90%
  - Either elimination or >50% improvement
- Reproduced by multiple surgeons
- Reproduced at multiple institutions

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Summary of 17 Clinical Studies

- F/U > 1 year in all but 1 retrospective study
- Adverse events reported in 10/17 studies

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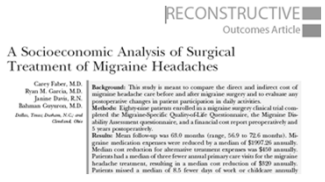
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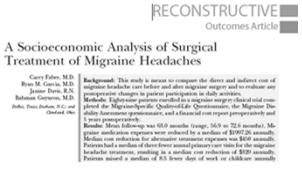
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Longevity Addressed


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Systematic Review


Annals of Plastic Surgery
PERIPHERAL NERVE SURGERY AND RESEARCH
A Systematic Review of Peripheral Nerve Interventional Treatments for Chronic Headaches

- Examined prevalence, efficacy and complication rates
  - Peripheral nerve decompression – 86%
  - Radiofrequency therapy – 55%
  - Peripheral nerve stimulation – 68%
- Decompression with highest success and lowest complication rate

Ducic, I., J.M. Felder, 3rd, and S.A. Fantus, A Systematic Review of Peripheral Nerve Interventional Treatments for Chronic Headaches. Ann Plast Surg, 2013.

Conclusions

- Botox, blocks, and constellation of symptoms can be used to diagnose peripheral trigger points
- Surgical decompression is effective in the treatment of migraine headaches

Developments in Plastic Surgery

Rajiv Chandawarkar, MD
Director of Plastic Surgery, University Hospital East
Associate Professor of Plastic Surgery
Adjunct Associate Professor of Orthopedics
Department of Plastic Surgery
The Ohio State University Wexner Medical Center

Mission

"We restore and make whole those parts which nature or ill fortune have taken away,

not so much to delight the eye, but to buoy up the spirit of the afflicted."

Gaspare Tagliacozzi, 1597

The Clinical Need

Common diagnoses that threaten limbs include:

- Diabetic foot ulcers
- Vascular disease
- Surgery especially high risk patients with joint replacements
- Chronic osteomyelitis with open wounds,
- Non-healing ulcers (vascular or neuropathic) and
- Tumors both acute and chronic trauma

The Clinical Need: Fast Facts

One in four diabetic individuals develops peripheral vascular disease that, when severe, may require amputation

More than 60 percent of non-traumatic lower-limb amputations occur in people with diabetes.

Incidence of initial amputation due to diabetes would be 179 per 100,000 person-years (compared to amputation in peripheral arterial disease in non-diabetic individuals is 10 per 100,000 person-years).

What is the CWC Limb Preservation Program?

- **Multidisciplinary Team**
  - **Said Atway- Podiatry**
  - **Rajiv Chandawarkar – Plastic Surgery**
  - **Michael Go -Vascular Surgery**
  - **Jeff Janis – Plastic Surgery**
  - **Gayle Gordillo – Plastic Surgery**
  - **Richard Schlanger – General Surgery**
- **Objective – prevent amputations**
- **Patient-Centered Care**
  - **Combined Vascular and Podiatry evaluation**
  - **PT, orthotist, labs, dietician – available on site**
  - **Wound care expertise**
  - **Complex Plastic Surgical reconstruction for limb preservation**

Significance

- **A COMBINED TEAM APPROACH is the best treatment strategy.**
- **Vascular restoration: accurate evaluation and minimally invasive repair (interventional techniques)**
- **Orthopedic debridement and salvage**
- **Plastic Reconstructive Surgery:The soft tissue surrounding the bone injury is the vascular envelope - nurturing bone back to health**
- **Wound Care**
- **Hyperbaric O2**

Principles

- **Step 1: identify nature of the defect: Characterize Vascular, Orthopedic and Soft Tissue needs**
- **Step 2: Outline a treatment plan that simultaneously treats blood supply, bone and soft tissue synergistically.**
- **ASK THE CRITICAL QUESTIONS**

Principles

CRITICAL QUESTIONS

- **Is the limb salvageable**
- **If so, what is the algorithm of reconstruction**

Amputation Versus Salvage

- **In complex extremity injuries, the treating physician must always first determine whether limb salvage is feasible.**
- **Are neurovascular structures are injured, are they repairable?**
- **Is normal sensation obtainable?**

Amputation Versus Salvage

- **Does a compartment syndrome exist? Unless a compartment syndrome is recognized and treated, muscle ischemia and muscle death will occur, converting potentially viable soft tissue to infarcted muscle and scar**
- **Is the FINAL outcome functional?**
- **Will the patient tolerate rehabilitation?**

Amputation Versus Salvage

"A fantastic operation not worth doing, is not worth doing well."

- Ashok Shaha MD, MSKCC

Plastic & Reconstructive Service Timing of Soft Tissue Reconstruction

- Early soft tissue reconstruction reduces the nosocomial contamination and secondary necrosis of exposed tissues.
- Late soft tissue reconstruction is associated with a significantly higher infection and flap complication rate – but allows for wound and patient stability.

Timing of Soft Tissue Reconstruction

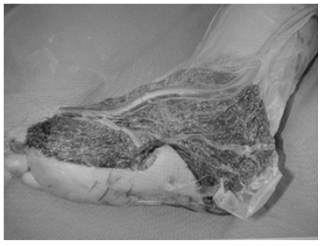
INITIAL Debridement is a must. If soft tissue reconstruction needs delayed, employ well established temporizing measures.

Timing of Soft Tissue Reconstruction

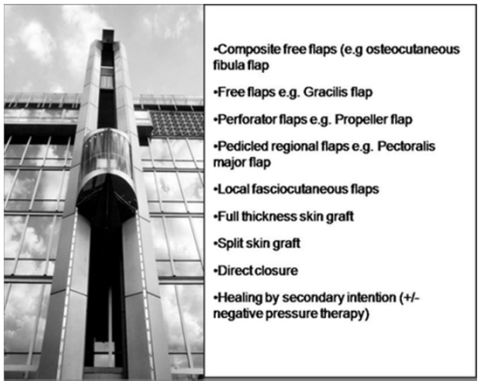
- Vacuum-assisted closure (VAC)
  - Seals the wound
  - Exposes a wound to sub-atmospheric pressure.
  - It is extremely effective in treating a wide spectrum of wounds including traumatic wounds as well as dehisced incisions with or without exposed hardware
- Hyperbaric oxygen (HBO)
  - Promotes formation of granulation tissue and stimulate angiogenesis in wounds that are compromised, usually by impaired arterial inflow or venous outflow

Timing of Soft Tissue Reconstruction

– Vacuum-assisted closure (VAC)



WOUND CLOSURE



WOUND CLOSURE

- **This is a continuum of procedures ranging from the simplest to the most complex (free flap transplantation.**
- **As a general principle the procedure with the greatest chance of success and lowest risk is chosen, often being one of the simpler techniques.**
- **The more complex procedures are required in larger wounds with exposed bone, fixation devices or poorly vascularized tissues.**

WOUND CLOSURE

- **Muscle Flaps**
- **Fasciocutaneous Flaps**

EACH HAS ADVANTAGES

WOUND CLOSURE

- **Muscle Flaps**
  - **Compromises donor function**
  - **Bulky, many times non-pliable**
  - **Usually microvascular surgery**
  - **Typically needs skin cover/graft**
  - **Complex, time consuming and resource-rich**

WOUND CLOSURE

- **Muscle Flaps**
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WOUND CLOSURE

- **Fasciocutaneous Flaps**
  - Easier to perform
  - Skin is composite to the flap
  - Less expensive
  - Donor function is preserved
  - Needs local vascular supply

TEAM APPROACH TO EXTREMITY RECONSTRUCTION

- Reconstruction is a coordinated effort among orthopaedic surgeons, vascular surgeons, traumatologists, infectious disease and plastic surgeons.
- Subsequent involvement of rehabilitation specialists and prostheticians

TEAM APPROACH TO EXTREMITY RECONSTRUCTION

- It is not uncommon in practice for an orthopaedic traumatologist to stabilize a fracture, a vascular surgeon to perform an arterial interposition graft, and a microsurgeon to do a free tissue transfer.

TEAM APPROACH TO EXTREMITY RECONSTRUCTION

- Communication and careful preoperative planning are important to ensure successful reconstruction.
- The ability of the reconstructive plastic surgeon to deliver the correct tissue at the correct time with the correct composite nature enhances limb salvage.

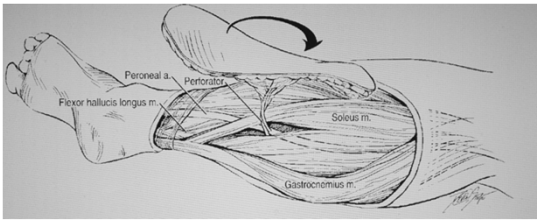
Novel Fasciocutaneous Flaps for the Reconstruction of Complicated Lower Extremity Wounds

- Fasciocutaneous perforator flaps can be used as an elegant alternative to other local or free flaps to treat the loss of tissues of the leg, once risk, benefits and expected results are understood.
- Novel fasciocutaneous flaps nourished by perforator vessels have been developed and are increasingly used as a valuable local alternative to the local flaps, with their high complication rates, and to the microsurgical flaps, with their more difficult and specialized technique.
- They provide local tissue, replacing like with like, but they harvest it from a distant, undamaged, region of the leg, which means healthy and well-vascularized tissue.

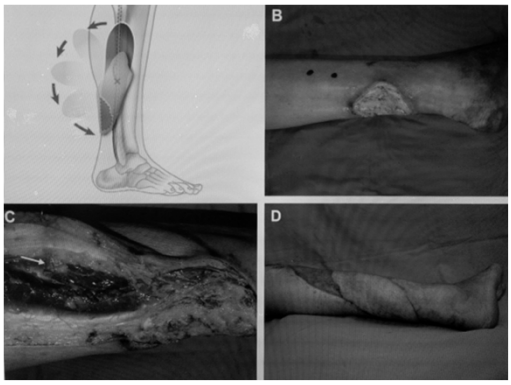
Novel Fasciocutaneous Flaps for the Reconstruction of Complicated Lower Extremity Wounds

- They do not need microsurgical facilities and skills, which may not be available everywhere. However, it is vital that the vessels are handled with great care and meticulous attention to detail in their preparation for the rotation.
- The known anatomic exiting sites of the perforator from the fascial plane will guide the planning of the flap, aided by the Doppler ultrasound and an exploratory incision. the surgical technique of perforator flaps harvesting and flap design, complications and solutions.

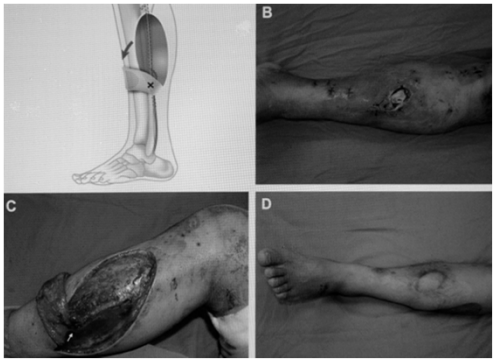
Sural Flaps



Sural Flaps

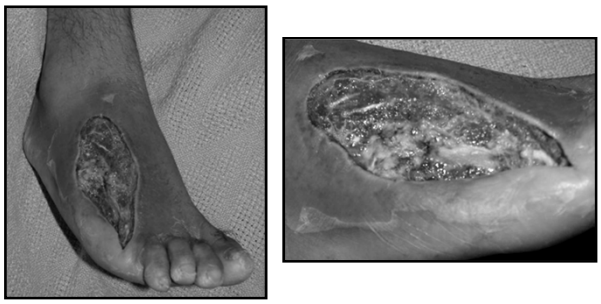


Sural Flaps

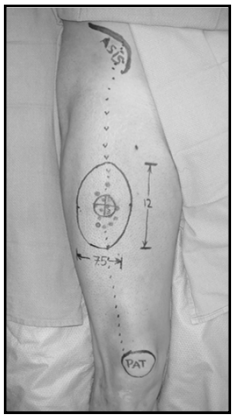


Photos courtesy of Rajiv Chandawarkar, MD

Free ALT Perforator Flap



Photos courtesy of Jeffrey Janis, MD



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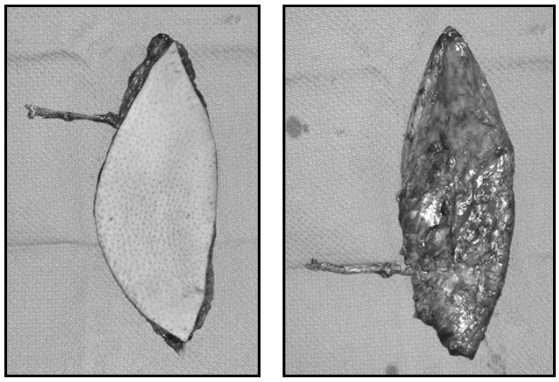

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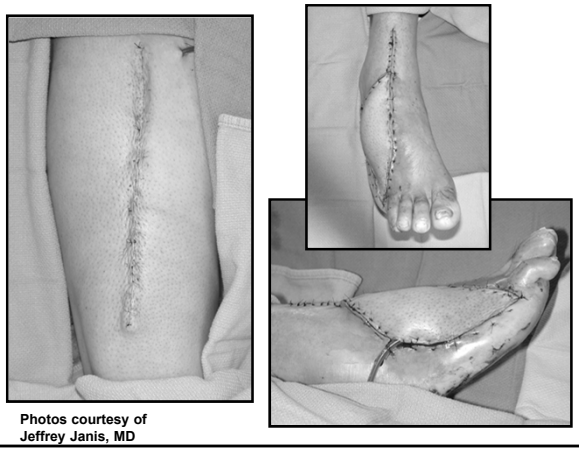

Photos courtesy of
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Overall Challenge

THINK CREATIVELY ON DISEASE MANAGEMENT RATHER THAN EPISODE MANAGEMENT

EMPLOY INNOVATIVE COST CUTTING – QUALITY ENHANCING METHODS

MONITOR/MEASURE/INCENTIVIZE

SAVE 700B IN 10 YEARS……
……WHOSE COST CURVE WILL BE BENT