ORTHOPAEDIC TRAUMA

An Evolution in Care

SICOT/SIROT 2008

XXIV Triennial Word Congress

Hong Kong

Orthopaedic Trauma

Concept to Reality

- In the beginning
- Vision
- Problems and Changes
- Reality
- Future Challenges

Where did it start ?

- Post WWI/II developments in trauma care
  - Shock and blood transfusion
  - Anesthesia
  - Wound care and antibiotics
  - Other specialties: NS, OS, Plastics
- Bohler – centralization of care, ↑result
- Development of trauma systems in the 60s

Result: 1. Need for systematic delivery of care to the injured

2. Best method to assure delivery?

Pre 1960

- Fracture management: delayed
  - Isolated fractures: delayed for union
  - Polytrauma + fractures: too sick, union

- Sporadic attempts at early fracture care
  - Kuntscher with nail in Germany 1950s
  - Allgöwer in Switzerland 1958

ETC – The beginning

- Müller, Allgöwer &Willenegger
  - Easier , better outcomes
  - Polytrauma: fewer pulmonary deaths
  - With femur fracture key to saving life

Operative Fracturenbehandlung 1963

- Ruedi and Wolff, Riska:
  - ↓ fat emboli syndrome

Helv Chir Acta 42:507-12,1975
Injury 6:110-16, 1976

- Wolff
  - Outlined protocol for ETC, including mechanical ventilation (0.08% vs 30% mortality)

Unfallheilkunde 81:425-42, 1978

Trauma Care Model

- 1970 - Harald Tscherne began the Hannover Trauma system
- The trauma surgeon developed:
  - General surgeon with fracture treatment skill
  - Team management concept
  - Specialty surgical backup

The Spread

- European success spread 70's
- AO provided an international interaction
  - Courses and interaction of faculty
- 1973 first NA trauma centers appeared
  - Run by general surgeons with specialty consultation

Result: A need for orthopedic surgeons to start fixing a high volume of fractures with implications on an evolving system of specialization

Border – Buffalo: 1980s

Crucifix position:
prolonged immobilization

- Gut origin septic state
- Macrophage damage
  - ARDS, MOF

Ann Surg 206: 427 – 448, 1987

Early Total Care

- 1982 - Goris
- 1985 - Johnson
- 1985 - Seibel
- 1986 - Meek

	ETC	Traction
#	179	149
ISS	49	45
Mortality	**4.9%**	**26%**

Bone and Johnson

- Early vs Delayed Stabilization of Femoral Fractures - *JBJS 1989*
  - 46 early vs 37 late multiple injury patients
  - Reported higher incidence (non-significant) of pulmonary complications in the delayed group

The injured patient with long bone fractures needed **early total care** but who would do it?

North American

- Trauma system development fragmented
  - General surgery lead
  - Specialties – different priorities
  - Fracture care not a priority but a necessity

Results: Appearance of few orthopaedic trauma programs

Ted Hansen

Harborview

Seattle

Augusto Sarmiento

USC

Los Angeleas

Michael Chapman

UC Davis

Sacramento

Bruce Browner

Shock Trauma

Baltimore

Ramon Gustilo

Hennepin

Minneapolis

Charles Edwards

Established trauma system in Toronto – interdisciplinary with ortho trauma surgeons as trauma team leaders and running the program

McMurtry, 1980s

Robert Meek

UBC

Vancouver

Orthopaedic Surgery

More fractures

Less interest

Increasing demand

Orthopaedic Traumatologist

- Acute care management of the injured patient
  - Involvement in resuscitation
  - Understands trauma pathophysiology
- Participates in clinical decision making
  - Integral part of team
- Fracture surgeon
- Reconstructive surgeon for complications of MSK trauma
- Full time >75%

Fracture Surgeon

- No acute care involvement
  - Referral base practice
  - Guided by trauma surgeons
- Purely acts a consultant
- +/- full time
- Only fixes fractures
  - sub specialized or general

Relationship

- Orthopaedic Traumatologist
  - at level 1/2 Trauma Centers
  - Involved in trauma program management
  - Involved in acute care trauma aspects
- Fracture surgeon
  - At all levels of Trauma Centers/hospitals
  - Only involved in fracture care
  - Referral based practice

Orthopaedic Trauma

Vision

Excellence in musculoskeletal injury care

Orthopaedic Trauma

- Goals
  - Patient driven
    - clinical relevant - patient's and injury's physiology
  - Based on education and research
    - AO, COTS, DGU,OTA, SICOT and others
    - Evidence based driven
  - Cost, resource effective
  - Available to all

Orthopaedic Trauma

- Impediments
  - Dogma and myths
  - Acceptance
  - Resource
  - Lifestyle issues

What were the “principles”?

<u>Early Total Care – The 80 - 90’s</u>

- Manage all LE long bone fractures (<24Hrs)
- Rapid (< 6 hours) debridement of open fractures
- All open fractures left open
- Emergency ORIF of certain fractures
  - Femoral neck. talus
- Expanding indications for fracture ORIF
  - pelvis , acetabulum
- Increased complexity of instrumentation
  - Locking nails, angular stable fixation

Problems

- Lack of trauma system
  - Inconsistent volumes
  - “cherry picking” in the community
  - Competition between institutions within cities/regions

Problems

- Few orthopaedic traumatologists
  - Over worked
  - No intellectual support
  - Unable to “fight” for their needs as too busy

Problems

- “Standard of care” for community
  - Standard improved in community
  - No support as other surgeons threatened
  - Lost working colleagues as not willingly to try
  - Medical legal implications

Problems

- “No hospital resource”
  - Not a priority in any department Ortho, Gen Surgery
  - An orphan
  - Poor reimbursement ?
  - Does not fit perceived surgical practice model
  - Stresses the infra structure

Problems

- Not accepted by orthopaedic leadership
  - Not elective
  - Perceived as obnoxious
  - Right of passage as the new surgeon
  - Doing major complex fracture surgery at inappropriate times - bad care
  - Lack of support for equal call schedule
  - Early burnout or disillusionment

Problems

- Increasing population, injury rate, risks
  - Volume increases
  - Compounds other issues
  - Clinic and follow-up support
  - Blood Borne pathogenic disease
  - Malpractice

Problems

- Lack of trauma system
- Few ortho traumatologists
- “Standard of care” for community
- No hospital resource
- Not accepted by orthopaedic leadership
- Increasing population, injury rate, risks

Result: Frustration, poor career opportunities, unacceptable lifestyle

1990s

- Defined a standard of care
- Failed to have the resource and manpower to maintain it
- No evidence to support the “dogma or standards of care”

Change was on the way . . .

- Critical assessment of our dogmas and myths
- Improved acceptance of subspecialty
- Improved resource allocation
- Off hours surgery↑complications

Dogmas and Myths

- Open Fracture
  - Must be treated with in 6 hours

    JOT. 121,1995; Plast Recon Surg. 68 1981; JTrauma, 25,1983
- Timing of Debridement
  - Debridement most important
  - Wound type drives timing
  - ASAP with stable patient and appropriate OR

    JOT. 484,2002; JOT 532, 1993; JTrauma 949. 2003

Dogmas and Myths

- Open Fracture
  - Never Closed – packed open
    - At least one moreOR session
  - Closure of wound – now allowed
    - No↑of infection
    - Still allows repeat debridements
    - Wound debridement driven
    - Allowed better OR time management
    - ↓ costs

Delong; J Trauma 1049, 1999

Gopal; JBJS 82B, 959, 2000

OTA study submitted

Dogmas and Myths

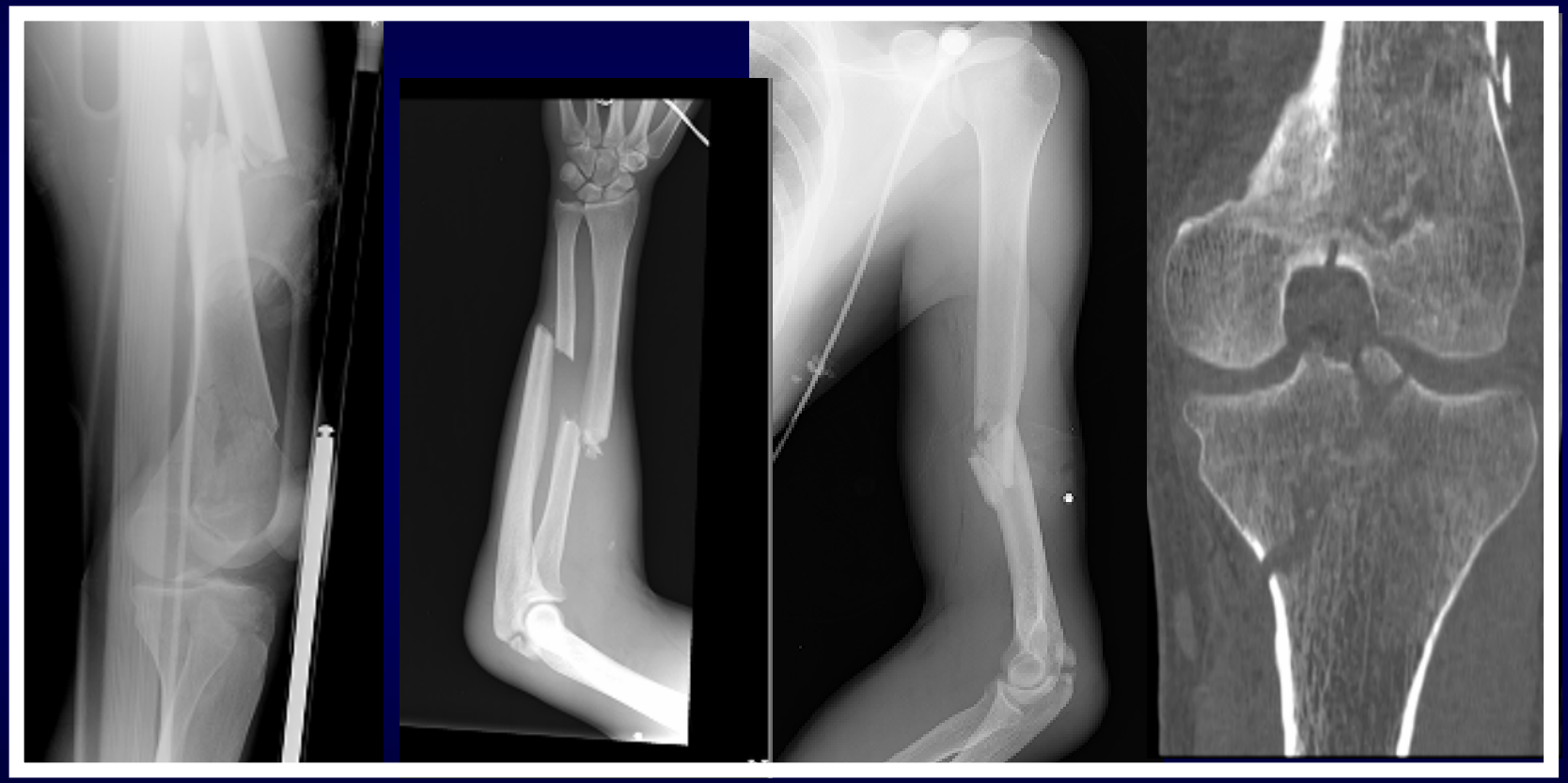
- Fractures requiring Emergency ORIF
  - Young femoral neck fracture
    - Not emergency
    - Must be done ASAP with competent surgeon and team
    - No↑AVN, complications

Jain JBJS 84A, 1605, 2002

  - Displaced Talar neck fracture
    - Not emergency

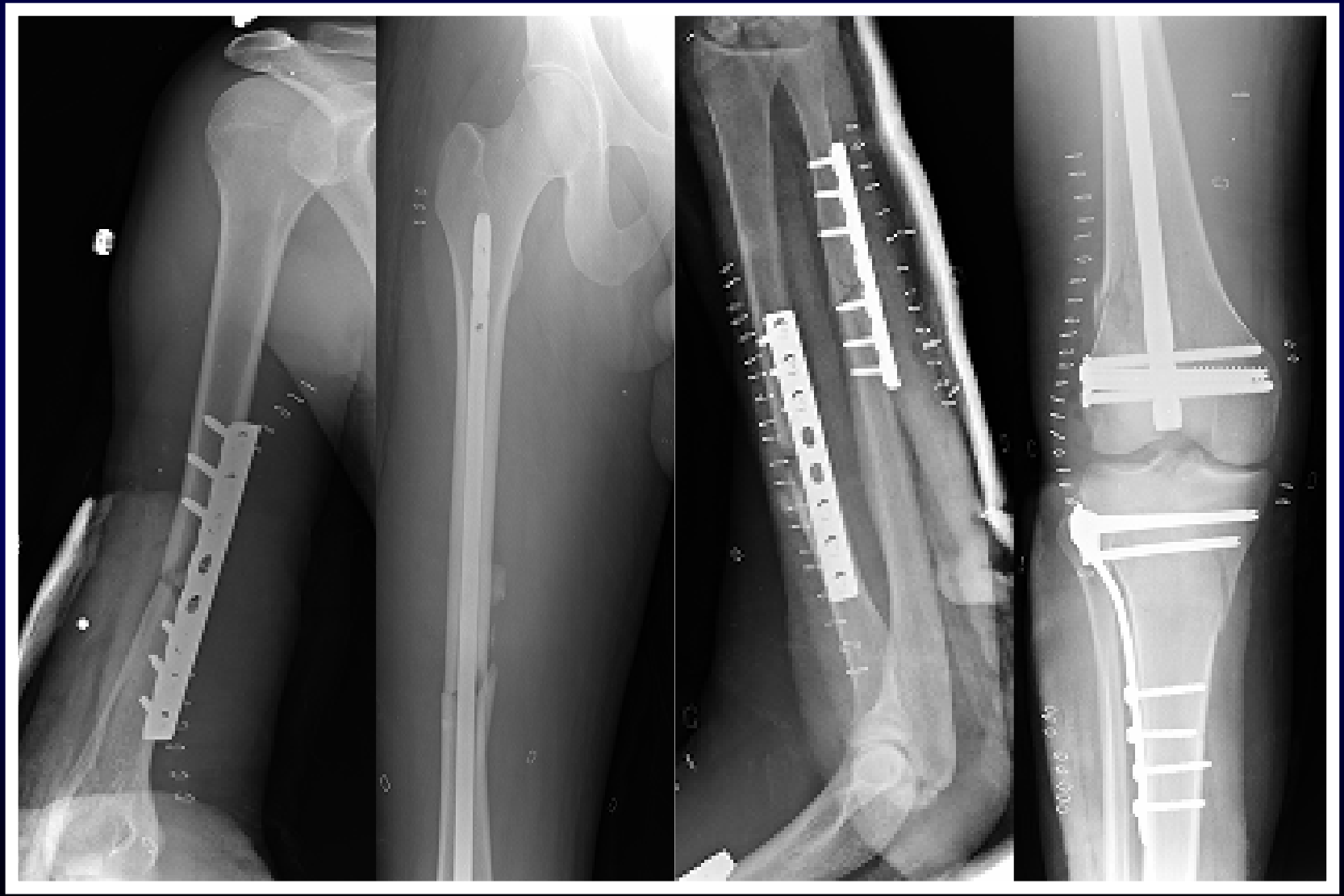
Meinberg OTA 2003

32 yr ♂, car vs tree at 80mph
no other injuries vs head injury +pulmonary contusion and liver laceration



Open fractures

2 teams, 4 hours, home in 5 days or ICU → ARDS, MOFS +/- death



Dogmas and Myths

<u>Early Total Care</u>

- Created long surgeries at inappropriate times
  - Stressed resource
  - ? Complication rate
- Not for all patients
- Not for all fractures surgeons, hospitals
- Has its place but can be planned

Damage Control - Orthopaedics

- A New “Dogma”
  - Does allow for rapid stabilization for ill patients
  - Does allow for rapid stabilization of soft tissues
  - Does allow surgeons who are not comfortable with injury or patient to provide temporary care and transfer
  - Not for all patients, not an excuse for laziness

J Trauma 34 540, 1993; Ann Surg 222 (1995) 470

Fracture Care is NB

- Stabilization is imperative
  - decrease pain, prevents further injury,
  - ↓ antigenic load, toxic products

BUT

- Type and extent determined by
  - Physiological status of patient
  - Method with least impact on physiology
  - Co-operative team play

Type of Stabilization

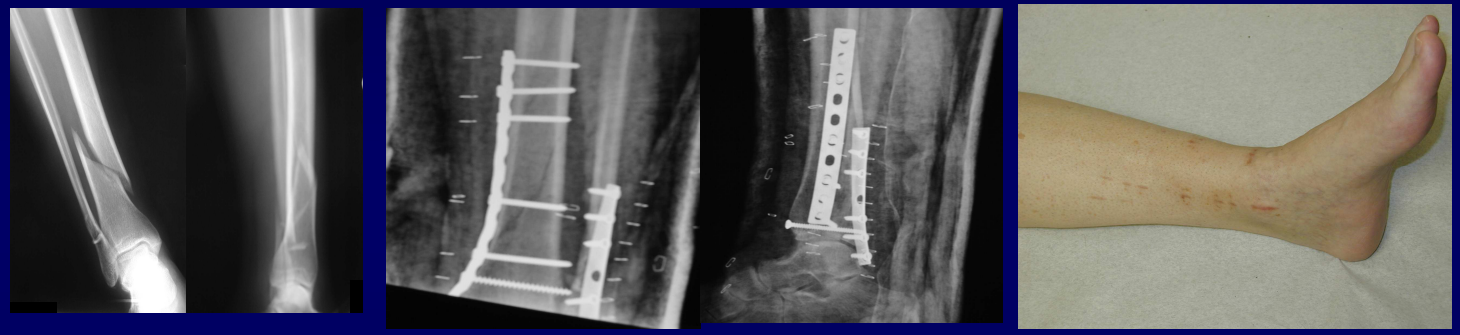
- IM nailing –reamed, unreamed
- DCO – External Fixation
- Skeletal Traction

Acceptance

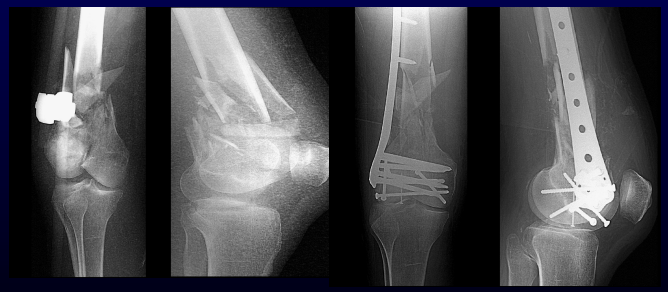
- With increasing Trauma centers and systems
- American College of Surgeons COT recognizes the need for fracture care
- Ortho trauma OR as requirement for Level 1 designations (2006 ACS COT)
- Needed for training residents due to↑ specialization within training programs
- Increasing number of fellowship program

Techniques and Toys

- Percutaneous fracture surgery (MIS)



- Navigation?
- Angular stable fixation/Anatomical Plates



The Future – Cost Effective Care

- Technical aspects well defined
  - Excellent results with conventional surgical techniques and implants
- ??? Need for multiple new implant variations – Evidence for justification of use
  - All cost more

Ideal Development Pathway

1) - Identify a Clinical Need
2) - Develop the concept
3) - Initial design and revision
4) - Dry lab testing – defining mechanical and handling properties
5) - Clinical Studies: Handling/Trials
6) - If “superior” released

Direct Cost

	Gold Standard	New Technology
Implant cost	$	$$$
OR Time	$$$	$$$
LOS	$$$$	$$$$
Revisions	$	??
Removal rate	$	??

Implant Cost

Implants	List Price
Femoral Blade – 9 hole with screws	$550
Femur distal femur plate – 9 holes with screws	$3250
Difference	**$2700**

At my hospital, 6 distal femurs are done a month

Extra cost is 6 X $2700 = $16,200

For 1 year = 12 X $16200 = $194,400

Indirect Cost

	Gold Standard	New Technology
Company R&D	None	$$$
Surgeon Education	None	$$$
OR staff Re-training	$	$$$
OR re-tooling	None	$$$$
New Inventory	None	$$$$$$

Other Issues

	Gold Standard	New Technology
Radiology Use	+	+++
Radiation Exposure	+	+++
Resident Education	++++	Might be negative
Learning Curve Results	NA	- - - -
Clinical outcomes	Excellent	Prob Excellent

“Distal Femur Fractures”

	New Technology	95º Blade Plate
# fractures	62	57
ROM	3 - 110	88% >100
Union (t)	96.8%(13)	96.4%(10.7)
Other proc	2 bone grafts	2 delayed unions
Infection	3.2%	0

Proximal Tibial Fractures

	New Technology	Conventional
Union	89%	83%
ROM	1 - 112	1 -125
Infection	4.6%	5.7%

Level of Evidence Summary

Level	#	#

Analysis: Data only shows that we're probably not hurting the patients

The Current Status of Locking Plating: The Good, the Bad, and the Ugly

Strauss, Schwarzkopf, Kummer and Egol

JOT 22, 7: 479 -486, August 2008

Implant Costs

Implant	Cost Anat/lock	Cost standard	Difference
Proximal Tibia 6 h	2342	839	1503
3.5 plate 12 h	962	400	562
4.5 plate 12h	1224	398	1224
Volar plate	1317	220	1097
Hip fracture	CMN 2805	DHS 889	1916
Distal Humerus	2951	867	2084

- At CMC taking last year's selected fracture volumes for IT fractures, distal femur fractures, proximal tibia, distal radius and distal humerus, our excess cost for new technology implants =

$536,026.00

The Future – Cost Effective Care

- Technical aspects well defined
  - ??? Need for multiple new implant variations – Evidence for justification of use
  - All cost more
- Biology will be the future but can it be afforded and done correctly
  - Bone substitutes
  - Growth factors: BMPs etc
  - Cellular based therapy - MSCs
  - Genetic engineering

Bone Graft Substitutes

- Many types – calcium sulphates, calcium phosphates, coral derivatives
- One company has 13 different variations of calcium sulphates/calcium phosphates
- Not inexpensive
- Are they really what we need?

Bone Substitute Properties

CLASSICAL

- Osteogenic
  - Living graft cells forming bone
- Osteoinductive
  - Transfer of matrix bound growth factors to induce local and derived cells to form bone
- Osteoconductive
  - Permanent or temporary scaffold to act as solid base for bone formation

Bone Substitute Properties NEW

- Promote angiogenesis
- Resorbable
  - variable time frame - ? Best
  - how much
- Delivery Agent
  - morphogens, drugs-antibiotics, cells
- Strength
  - not an issue
- Osteointegation: new bone able to bond to old bone

What do we know????

- The Use of Calcium Phosphate Bone Cement in Fracture Treatment
  - Bajammal, Zlowodzki, Letwica, Tornetta, Einhorn, Buckley, Leighton, Russell, Larsson and Bhandari
  - JBJS 90A, June 2008 pp1186 – 1196
  - Meta analysis of 14 randomized controlled trials **suggesting**: less pain, ↓ loss fracture reduction, ↓infection in distal radial fracture and likely improved functional outcomes
  - Methodological limitations and lack of patient relevant outcomes → large size RCT to show effect

Clinical Consequences

- Clinics flooded with products
- No evidence as to what works
- Millions of dollars spent on these products
- Irresponsibility by surgeons and producers
  - Lack of directed research – what is needed, poor interaction between clinician and scientists
  - Producers not wanting to take risk – develop a new concept – they know what sells and the game is market share

Growth Factors/Cells

- Recombinant PDGF
  - Elective hindfoot fusions and distal radius
  - Outcome: time to heal - ? relevance
- BMPs ???? Dose, application, results
  - BMP7 (OP1) good for tibial non unions (Friedlaender)
  - BMP2 good for open tibias (Geesink)
- MSC
  - Bone marrow aspirates
  - Hernigou concentrating MSC from bone marrow

Where are we now?

- Orthopedic Trauma surgery is here to stay
- Orthopedic Trauma is becoming recognized as a legitimate field (specialty)
- Orthopedic Trauma needs resource like other orthopaedic subspecialties in teaching and non teaching hospitals
- Fractures can be treated by all orthopaedic surgeons who are interested and skilled

Lifestyle

- Less emergency surgery
- More controlled schedule
- More fellowships producing more trained ortho traumatoloigsts
- Community based hospital systems developing
- Better reimbursement
- Better understanding of needs on training programs

So if

- Our lifestyle is acceptable
- Our fracture care is better directed and is more effective
- Recognized as a standard

BUT can we deal with

- the creation of this new standard?
- the changing practice of the orthopedist in the ER
- the burden of Indigent, non insured care(46.6m)

THE BURDEN -USA

- 50 million injured in 2000
- Lifetime costs for these injuries = 406 billion
- Fractures ($ 21b), Sprains ($7.1b) and open wound care ($4.5b) – 3 of the top 10 most expensive diseases
- 3.5 10^6 ER ortho visits in 2004, 885,000 admitted, 8 million office visits

The Future

- Who will look after fractures?
  - Less orthopedist will be interested in treating fractures:
    - subspecialty training – different interests
    - more ortho traumatologists in the community
      - “standard of care issue”
    - practice logistics – time management
    - life style issues
  - Care centralized to larger centers

Perceptions

- Ortho Trauma Side
  - Super specialist
  - No time for simple fractures
  - Works at a tertiary care center
  - Always is being dumped on
- Orthopedist Side
  - Skill level
  - Best for the patient
  - Malpractice issue if expert in community
  - Interest level – should not do something if have no commitment

Solution

- The ideal will never work
- Recognize the need for a “fracture surgeon” or ortho trauma surgeon
- Develop new models for training these individuals
- Remove barriers to taking call
- Alternative payment plans for these surgeons
  - Hospital based practices - all levels
  - Support those who want to take fracture call

The Solution

- Resource
  - Need to assure major level one centers continue to support ortho trauma as hospital based mission
  - Regional referral systems
  - Community hospital have hospital based “fracture surgeons”
  - Training programs and specialty boards develop innovative new ways to address the specialty of ortho trauma and fracture surgery

The Future

- More emphasis on the psychosocial aspects of care
  - Post traumatic Stress, Depression effect outcomes – Starr, Vrahas
  - Outcomes – social/educational status – LEAP Study
  - Better relationships to the community and rehabilitation services to improve return of patients to useful role

Orthopaedic Trauma

- Reality
  - Excellent musculoskeletal injury care - YES
  - Accounting for patient's physiology ?
  - Cost effective - NO
  - Resource effective - Improving
  - Available - Improving

Orthopaedic Trauma

Orthopedic Trauma

It is our heritage

It is now viable and successful

It will only improve