TARGET ORTHO

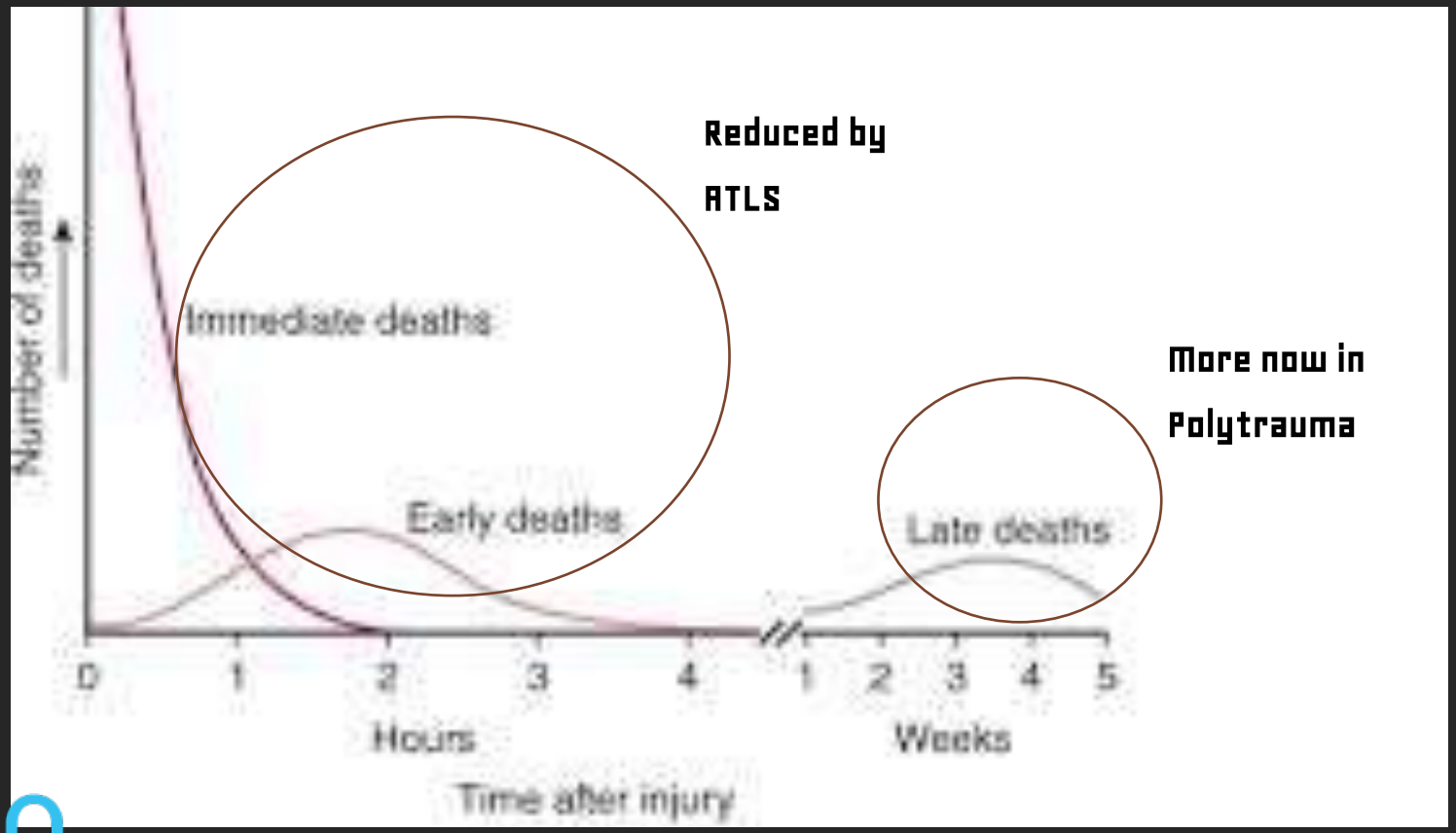
POLYTRAUMA , DCO AND TRAUMA SCORES

BY DR DAIVIK T SHETTY

INTRODUCTION

- LARGEST KILLER IN THE WORLD
- MORE IN YOUNGER AGE GROUP

TRIMODAL PEAK OF DEATH



DEFINITION

- CONTROVERSIAL

- "at least two severe injuries of the head, chest or abdomen, one of them in association with an extremity injury"

- "a patient with two or more injuries, one of them being potentially life threatening"....

- 2 or more regions with ISS score > 15

TRAUMA SCORES

WHY ARE SCORING SYSTEMS NEEDED ?

- Ability to predict outcome from triage
- Facilitate rational prehospital triage decisions
- An aid for the clinical management of patients
- Case mix adjustment for evaluative research
- Tool for comparative audit
- Mechanism to decide resource allocation
- Objective information for end-of-life decision making

IDEAL SCORE SYSTEMS

- TO SERVE PURPOSE OF QUALITY IMPROVEMENT – AN IDEAL SCORE MUST FACTOR
- SEVERITY OF INJURY
- PHYSIOLOGICAL DERANGEMENTS
- PATIENT DEMOGRAPHICS
- MECHANISM OF INJURY
- COMORBID CONDITION
- **PATIENT OUTCOME = ANATOMICAL INJURY + PHYSIOLOGICAL SCORE + PATIENT RESERVES**

PHYSIOLOGICAL	ANATOMIC	COMBINED
REVISED TRAUMA SCORE (RTS)	ABBREVIATED INJURY SCORE (AIS)	TRAUMA SCORE – INJURY SEVERITY SCORE
ACUTE PHYSIOLOGY AND CHRONIC HEALTH EVALUATION (APACHE)	INJURY SEVERITY SCORE (ISS)	A SEVERITY CHARACTERIZATION OF TRAUMA (ASCOT)
SEQUENTIAL ORGAN FAILURE ASSESSMENT (SOFA)	NEW INJURY SEVERITY SCORE (NISS)	INTERNATIONAL CLASSIFICATION OF DISEASES INJURY SEVERITY SCORE (ICISS)
SYSTEMIC INFLAMMATORY RESPONSE SCORE (SIRS)	ANATOMIC PROFILE (AP)	GANGA HOSPITAL OPEN INJURY SCORE (GHOIS)
EMERGENCY TRAUMA SCORE	ICD BASED INJURY SEVERITY SCORE (ICISS)	
	TRAUMA MORTALITY PREDICTION MODEL (TMPM)	

ABBREVIATED INJURY SCORE

- PUBLISHED BY ADVANCEMENT OF AUTOMOTIVE MEDICINE [AAAM]

- IT IS A CONSENSUS DERIVED, EVIDENCE BASED, GLOBAL SEVERITY SCORING SYSTEM THAT CLASSIFIES EACH INJURY BY BODY REGION ACCORDING TO ITS RELATIVE IMPORTANCE ON A 6 POINT ORDINAL SCALE DEVELOPED FOR GRADING INJURY

ABBREVIATED INJURY SCORE- 1971

PUBLISHED BY ADVANCEMENT OF AUTOMATIVE MEDICINE [AAAM]

NUMBER	REGION
1	EXTERNAL SKIN
2	HEAD WITH FACE
3	NECK
4	THORAX
5	ABDOMEN WITH PELVIS
6	SPINE
7	EXTREMITY

ABBREVIATED INJURY SCORE- 1971

SCORE	SCALE
1	MINOR
2	MODERATE
3	SERIOUS
4	SEVERE
5	CRITICAL
6	UNSURVIVABLE
9	UNKNOWN

PROBLEM WITH AIS

- FAILS TO ACCOUNT FOR CUMULATIVE EFFECT OF INJURY IN DIFFERENT BODY REGIONS
- NON-LINEAR RELATIONSHIP BETWEEN MAXIMUM AIS AND MORTALITY
- SUMMATION OF AIS SCORE INADEQUATE

AIS 4 + AIS 3 WITH MORTALITY 24%

AIS 5 + AIS 2 WITH MORTALITY 54%

INJURY SEVERITY SCORE

HEAD AND NECK
FACE
CHEST
ABDOMEN AND PELVIS
EXTREMITIES OR PELVIC GIRDLE
EXTERNAL

INJURY SEVERITY SCORE

- **SUM OF THE SQUARES** OF THE HIGHEST AIS GRADE IN EACH OF THE **3 MOST SEVERLY INJURED AREAS**

$$A^2 + B^2 + C^2$$

- MAX SCORE 75

- BAKER ET AL — 1974

ISS

- MAX SCORE IS 75

- IF ONE AREA IS **AIS 6** , THEN AUTOMATICALLY ISS IS **75**

- **MINOR = 1-8 , MODERATE = 9-15 , SEVERE 16-24 , VERY SEVERE = > 25**

LD50

- LETHAL DOSE FOR 50% OF THE POPULATION TO DIE

AGE GROUP	WOULD SURVIVE UPTO ISS
15-44 YEARS	40
45-64 YEARS	29
AGE >65 YEARS	20

ISS

- REDUCE GREATER VARIABILITY OF INJURY PATTERNS TO A SMALLER RANGE THAT CAN BE USED IN OUTCOME RESEARCH

- CORRELATES WELL WITH MORTALITY BUT WITH NON-LINEAR RELATIONSHIP

- VALID FOR BLUNT AND PENETRATING INJURIES IN > 12 YEARS AGE

ALL PATIENTS WITH SAME ISS DOES NOT MEAN SAME MORTALITY

AIS	ISS	MORTALITY
4,1,0	17	18 %
3,2,2	17	2.6 %

FOR ALL PATIENTS WITH AIS , MORTALITY IS NOT SAME

BODY REGION	AIS	MORTALITY
FACE	3	2.3
THORAX	3	6.1
ABDOMEN	3	10.5

OTHER LIMITATION

- NOT DESIGNED TO PREDICT DISABILITY OR OTHER OUTCOMES
- COSTLY, TIME CONSUMING, REQUIRES TRAINING FOR CAPTURING OF DATA AND CALCULATION OF SCORES
- UNDERESTIMATES MORTALITY RESULTING FROM MULTIPLE INJURIES TO A SINGLE BODY REGION

Region	Injury Description	AIS	Square Top Three
Head & Neck	Cerebral Contusion	3	9
Face	No Injury	0	
Chest	Flail Chest	4	16
Abdomen	Contusion of Liver	4	
	Complex Rupture Spleen	5	25
Extremity	Fractured femur	3	
External	No Injury	0	

ANATOMIC PROFILE SCORE

- MODIFICATION OF AIS AND ISS

- USES ONLY 4 REGIONS

BRAIN
SPINAL CORD
THORAX
NECK
ALL SERIOUS INJURIES
ALL OTHER NON-SERIOUS INJURIES

THE AP SCORE IS THE SQUARE ROOT OF THE SUM OF SQUARES OF ALL AIS SCORES IN A REGION

modified ANATOMIC PROFILE [mAP]

Figure 5. Component definitions of the modified Anatomic Profile.

Component	Body region	AIS severity
mA	Head/brain	3-6
	Spinal cord	3-6
mB	Thorax	3-6
	Front of neck	3-6
mC	All other	3-6

mA, mB, mC scores are derived by taking the square root of the sum of the squares for all injuries defined by each component

NEW INJURY SEVERITY SCORE

- SUM OF SQUARES OF THE THREE MOST SEVERE INJURIES, REGARDLESS OF BODY REGION REQUIRED

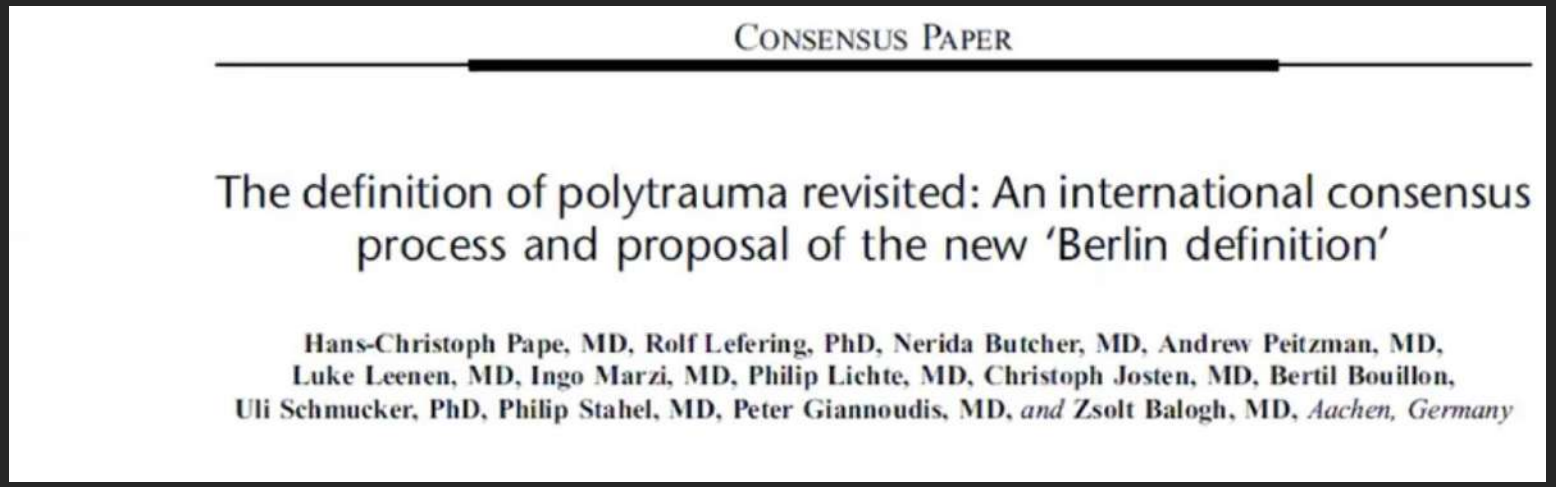
- NISS WILL BE EQUAL TO OR HIGHER THAN ISS

- OSLER ET AL – 1997

NISS

Region	Injury Description	AIS
Head & Neck	Cerebral Contusion	3
Face	No Injury	0
Chest	Flail Chest	4
Abdomen	Contusion of Liver Complex Rupture Spleen	4 5
Extremity	Fractured femur	3
External	No Injury	0

POLYTRAUMA DEFINITION



CONSENSUS PAPER

The definition of polytrauma revisited: An international consensus process and proposal of the new 'Berlin definition'

Hans-Christoph Pape, MD, Rolf Lefering, PhD, Nerida Butcher, MD, Andrew Peitzman, MD, Luke Leenen, MD, Ingo Marzi, MD, Philip Lichte, MD, Christoph Josten, MD, Bertil Bouillon, Uli Schmucker, PhD, Philip Stahel, MD, Peter Giannoudis, MD, *and* Zsolt Balogh, MD, *Aachen, Germany*

CURRENT DEFINITION – POLYTRAUMA [BERLIN]

- TWO INJURIES THAT ARE GREATER OR EQUAL TO 3 ON AIS

- AND ONE OR MORE ADDITIONAL DIAGNOSIS

1. *HYPOTENSION SBP </= 90 mm hg*
2. *UNCONSCIOUSNESS GCS score </= 8*
3. *ACIDOSIS base deficit </= 6.0*
4. *COAGULOPATHY PTT >/= 40 seconds , INR >/= 1.4*
5. *AGE >/= 70 years*

Mangled Extremity Severity Score [MESS]

- USED TO DESCRIBE WHETHER TO AMPUTATE OR NOT

- THE INJURY SEVERITY SCORE DOES NOT HAVE ANY IMPACT ON THE MANGLED EXTREMITY SEVERITY SCORE

TABLE 12-4 Mangled Extremity Severity Scoring System (MESS)

Criterion	Score
Skeletal/Soft Tissue Injury	
Low energy	1
Medium energy	2
High energy	3
Very high energy	4
Limb Ischemia	
Pulse reduced or absent but normal perfusion	1[a]
Pulseless, diminished capillary refill	2[a]
Cool, paralyzed, insensate, numb	3[a]
Shock	
SBP always >90 mm Hg	0
SBP transiently <90 mm Hg	1
SBP persistently <90 mm Hg	2
Age (yr)	
<30	0
30–50	1
>50	2

[a]Double value if duration of ischemia exceeds 6 hours.

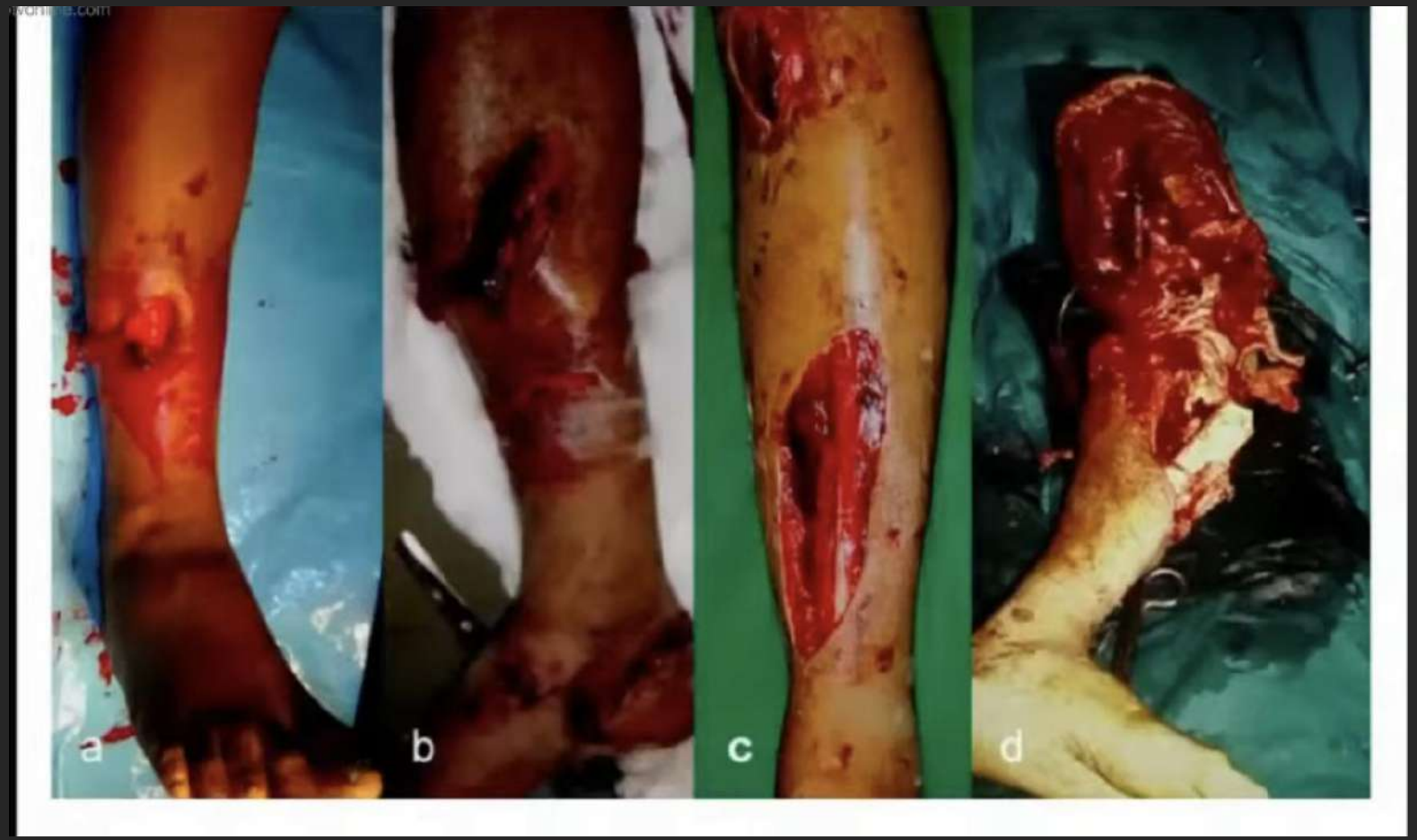
SBP, systolic blood pressure.

SALVAGE — PREDICTIVE SCORES

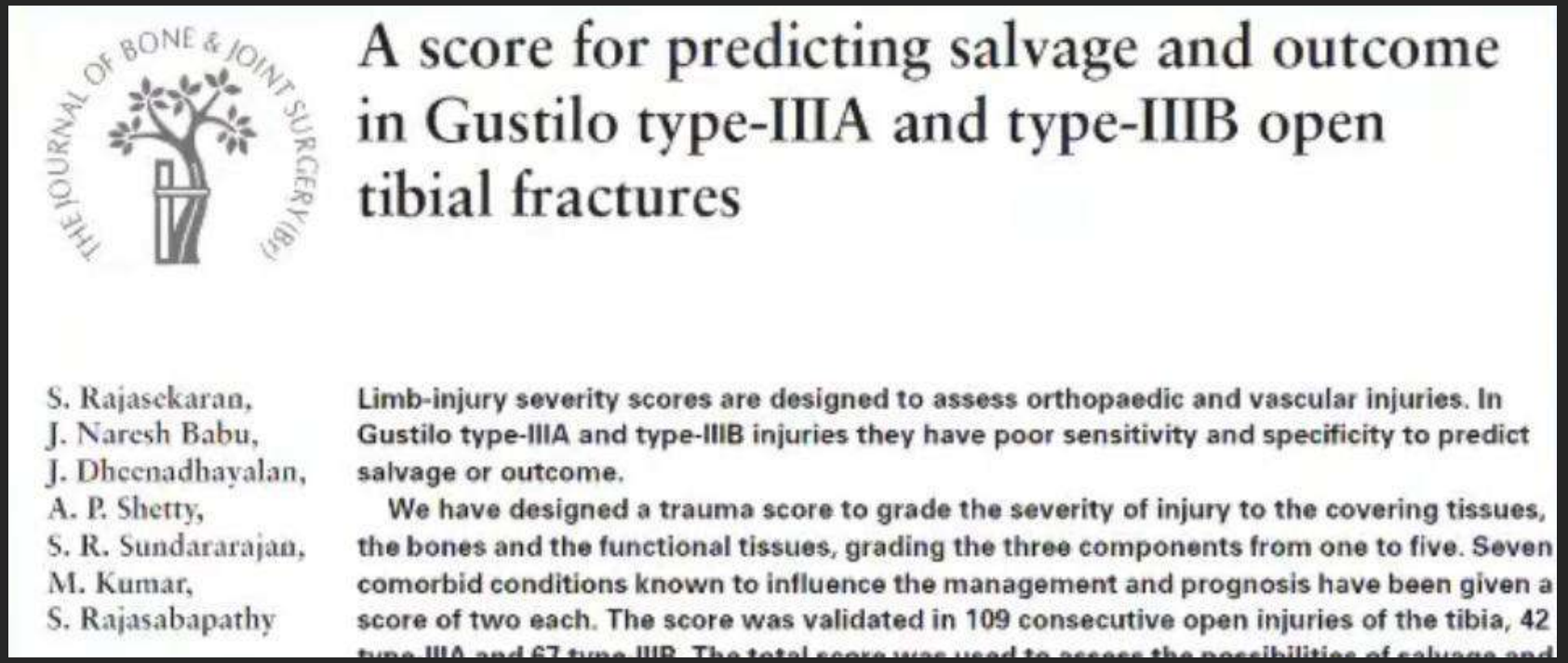
- MANGLED EXTREMITY SEVERITY SCORE [MESS]
- LIMB SALVAGE INDEX [LSI]
- PREDICTIVE SALVAGE INDEX [PSI]
- HANNOVER FRACTURE SCALE — 97 [HFS-97]
- OTA — OFC SCORE

Gustilo type	I	II	IIIA	IIIB	IIIC
Energy	Low energy	Moderate	High	High	High
Wound Size	<1cm	>1cm	>10cm	>10cm	>10cm
Soft tissue	Minimal	Moderate	Extensive	Extensive	Extensive
Contamination	Clean	Moderate contamination	Extensive	Extensive	Extensive
Fracture pattern	Simple Fx pattern with minimal comminution	Moderate comminution	Severe Ccommunition or segmental fractures	Severe comminution or segmental fractures	Severe comminution or segmental fracture
Periosteal stripping	No	No	Yes	Yes	Yes
Skin coverage	Local coverage	Local coverage	Local coverage including	Requires free tissue flap or rotational flap coverage	Typically requires flap coverage
Neurovascular injury	Normal	Normal	Normal	Normal	Exposed fracture with arterial damage that requires repair

ALL ARE GUSTILO 3B INJURIES !



Ostern and Tscherne classification of soft tissue injury in closed fractures	
Grade 0	• Minimal soft tissue damage • Indirect injury to limb (torsion) • Simple fracture pattern
Grade 1	• Superficial abrasion or contusion • Mild fracture pattern
Grade 2	• Deep abrasion • Skin or muscle contusion • Severe fracture pattern • Direct trauma to limb
Grade 3	• Extensive skin contusion or crush injury • Severe damage to underlying muscle • Compartment syndrome • Subcutaneous avulsion



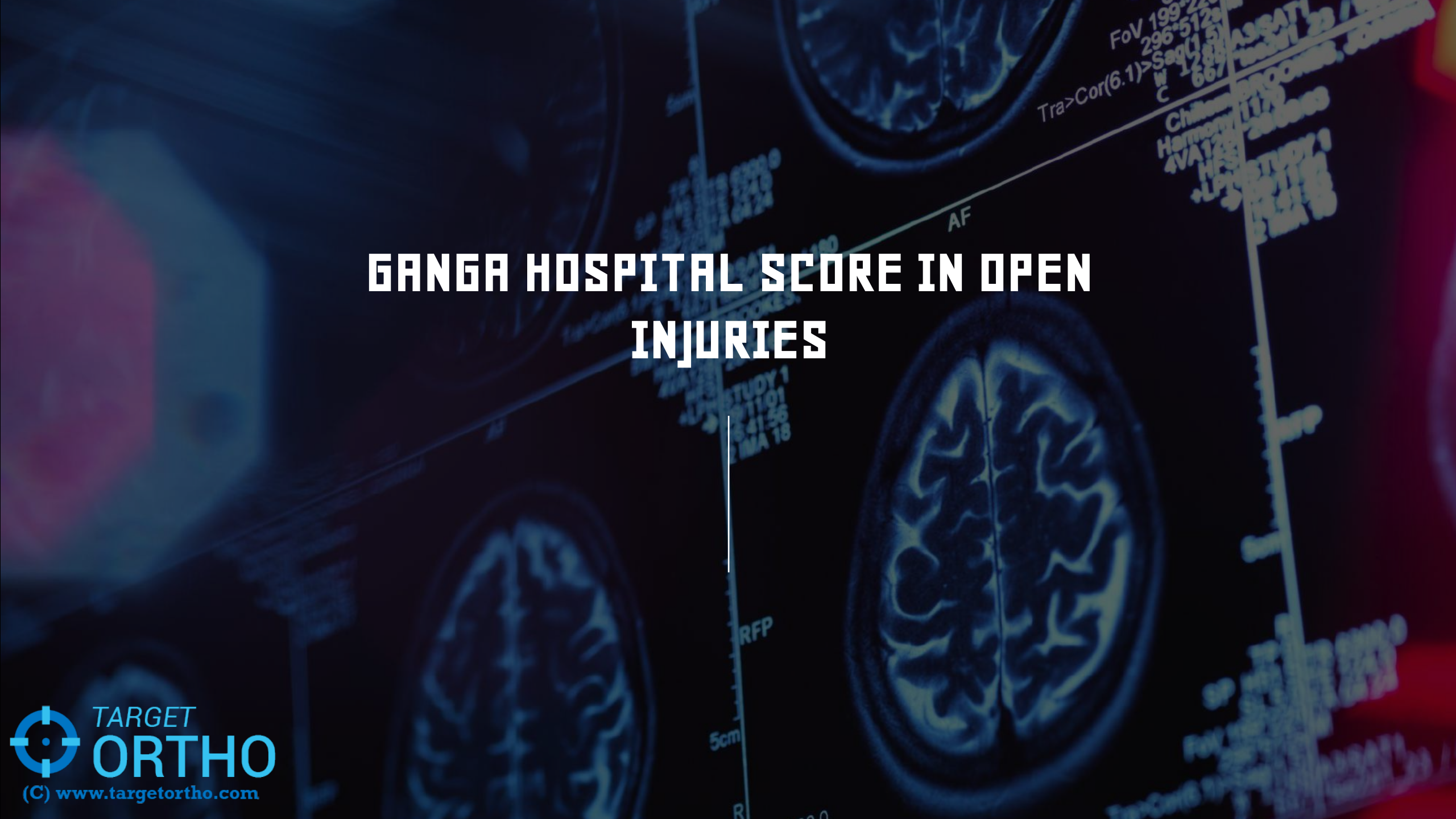
A score for predicting salvage and outcome in Gustilo type-IIIA and type-IIIB open tibial fractures

S. Rajasekaran,
J. Naresh Babu,
J. Dheenadhayalan,
A. P. Shetty,
S. R. Sundararajan,
M. Kumar,
S. Rajasabapathy

Limb-injury severity scores are designed to assess orthopaedic and vascular injuries. In Gustilo type-IIIA and type-IIIB injuries they have poor sensitivity and specificity to predict salvage or outcome.

We have designed a trauma score to grade the severity of injury to the covering tissues, the bones and the functional tissues, grading the three components from one to five. Seven comorbid conditions known to influence the management and prognosis have been given a score of two each. The score was validated in 109 consecutive open injuries of the tibia, 42 type-IIIA and 67 type-IIIB. The total score was used to assess the possibilities of salvage and

GANGA HOSPITAL SCORE IN OPEN INJURIES



ADVANTAGE OF GANGA SCORE

- ALL OTHER SCORES ARE DESIGNED TO ASSESS ISCHEMIC LIMBS WITH COMBINED ORTHOPEDIC AND VASCULAR INJURY

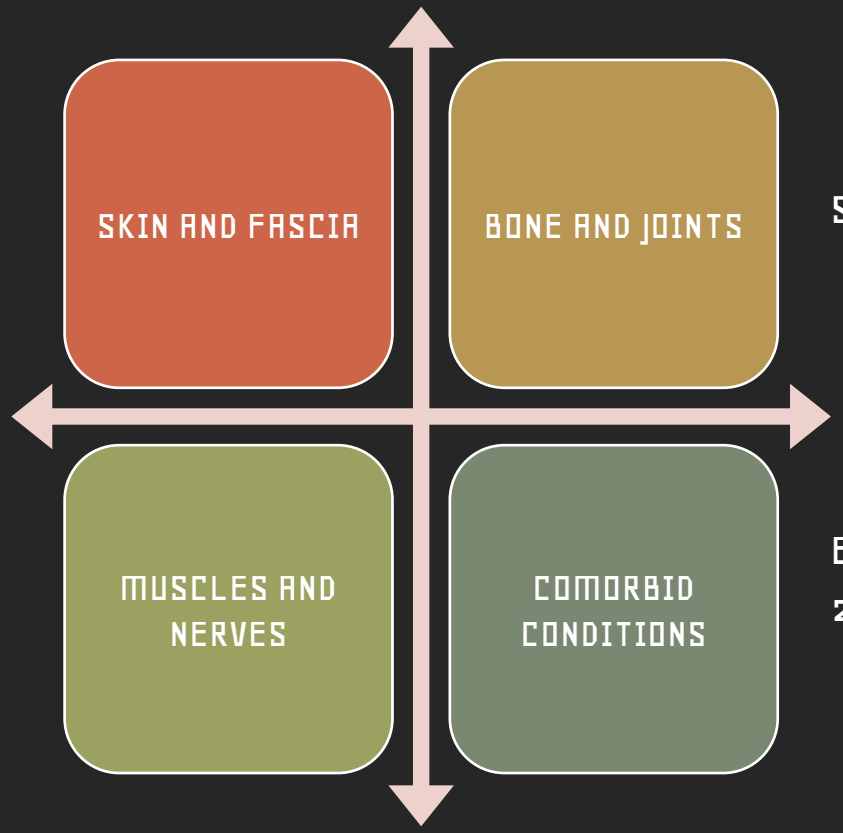
- NO SPECIFIC SCORE TO EVALUATE SEVERELY INJURED LIMBS WITHOUT VASCULAR INJURIES

- NO SCORE TO PROVIDE GUIDELINES IN RECONSTRUCTION

GANGA SCORE

SCORES 1 TO 5

SCORES 1 TO 5



SCORES 1 TO 5

EACH CONDITION
2 POINTS

SKIN AND COVERING TISSUE

FUNCTIONAL TISSUES – MUSCULOTENDINOUS AND NERVE UNITS

SKELETAL STRUCTURES – BONE AND JOINTS

COMORBID CONDITIONS – add 2 points each

- Injury debridement interval > 12 hours
- Sewage or organic contamination / farmyard injuries
- Age > 65 years
- Increased anesthetic risk
- Injury severity score > 25 / fat embolism
- Hypotension with systolic BP < 90
- Another major injury to same limb , compartment syndrome

Ganga Hospital Open Injury Score

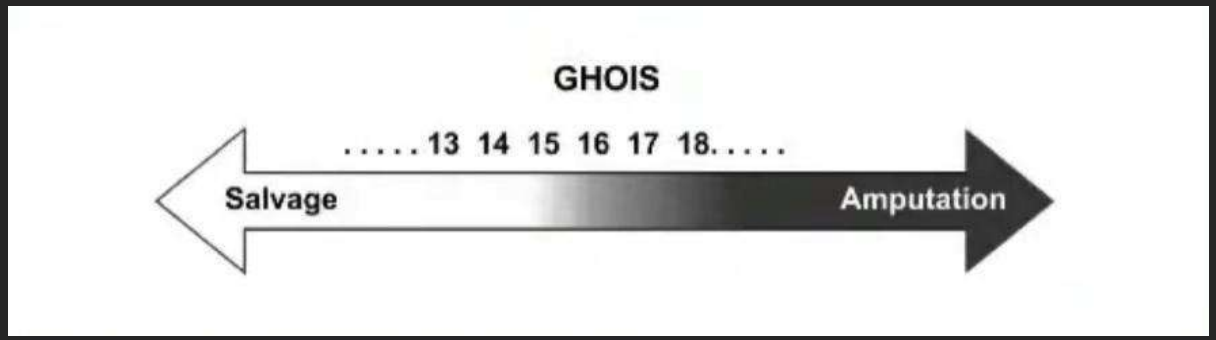
- Provides global assessment of the severely injured limb and the patient
- All components of the limb and comorbid factors are assessed separately and together
- INDIVIDUAL SCORE – provides guidelines in treatment
- TOTAL SCORE – helps decide salvage and prognosticate outcome

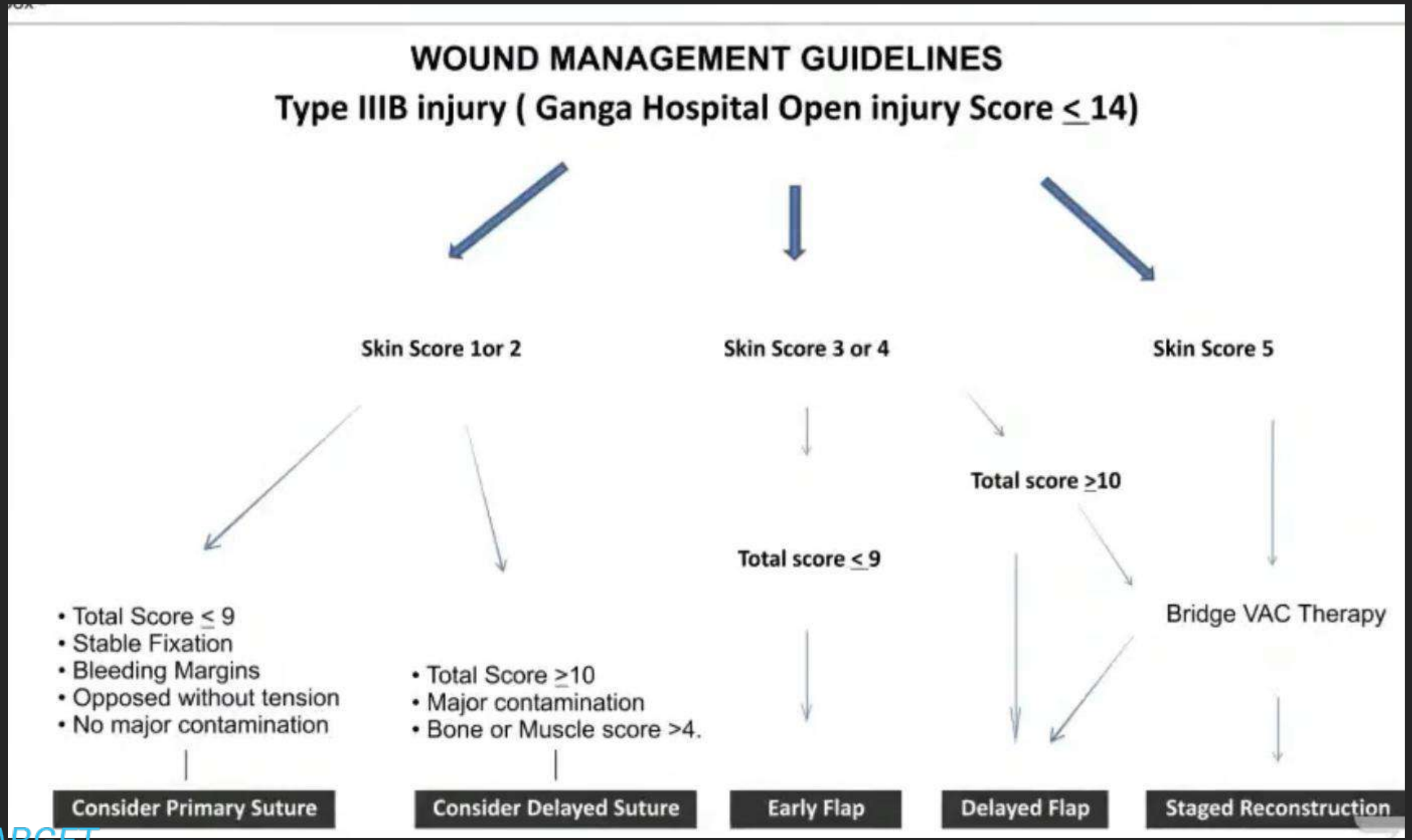
SALVAGE RECOMMENDATIONS

BELOW 14 – ATTEMPT SALVAGE

17 AND ABOVE – REQUIRE AMPUTATION

15 AND 16 – GREY ZONE





CAN DECIDE TIME AND NATURE OF RECONSTRUCTION IN OPEN INJURY

EARLY TOTAL CARE

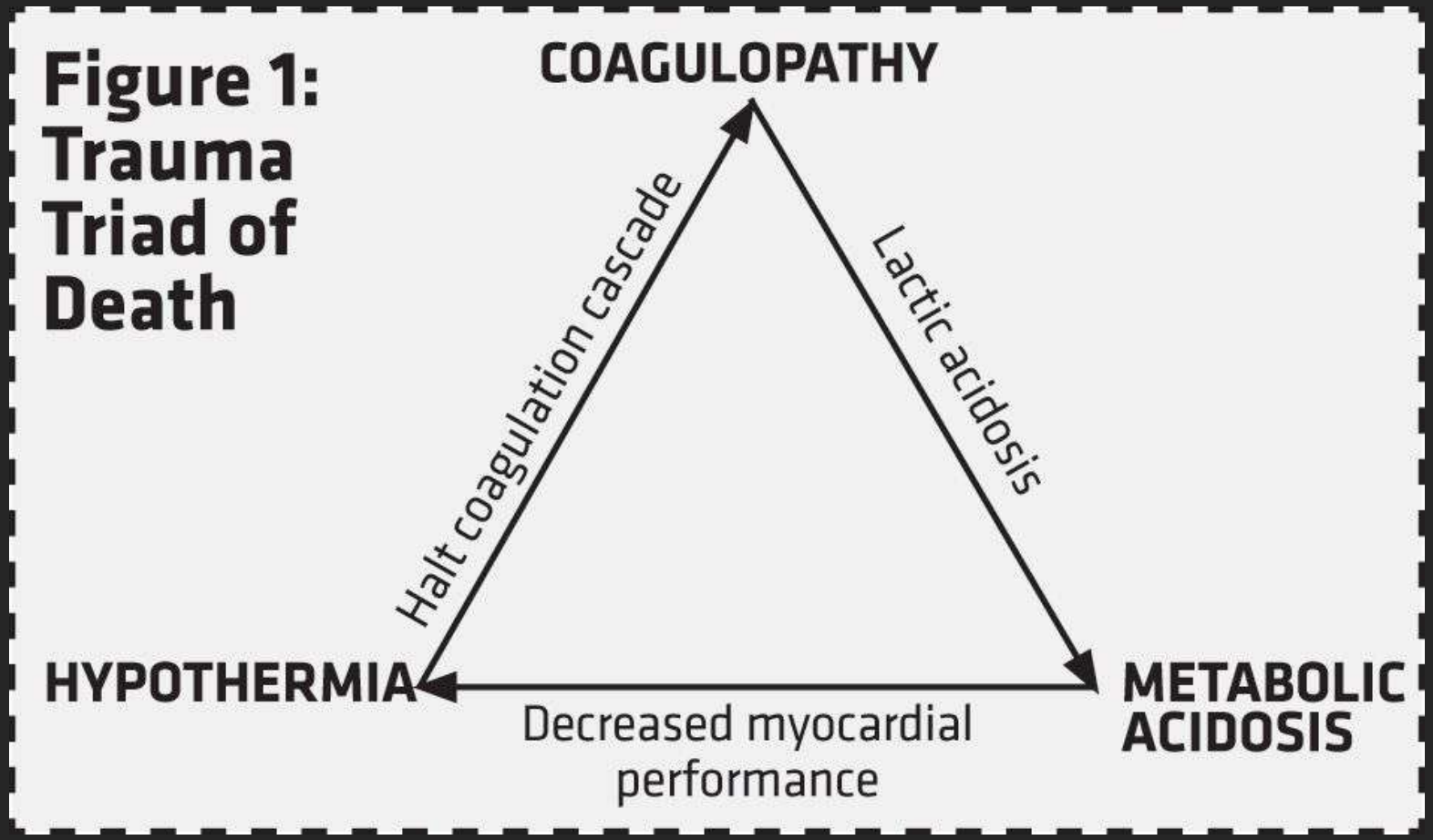
- EARLY AND DEFINITIVE STABILIZATION OF LONG BONES

- ADVANTAGES
  - REDUCTION OF ARDS
  - REDUCTION OF MULTIPLE ORGAN FAILURE
  - REDUCTION OF FAT EMBOLISM
  - REDUCTION OF THROMBOSIS
  - BETTER FUNCTION THROUGH EARLY MOBILIZATION

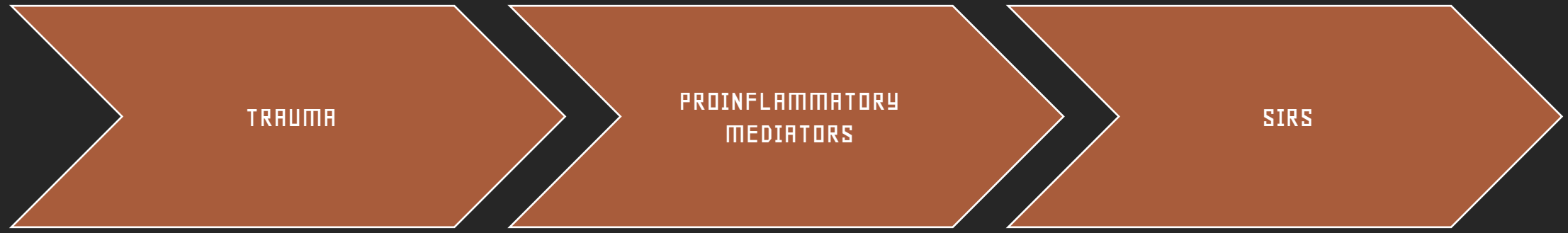
CAUSES

- MODS – SIRS

- SEPTICEMIA



PATHOPHYSIOLOGY



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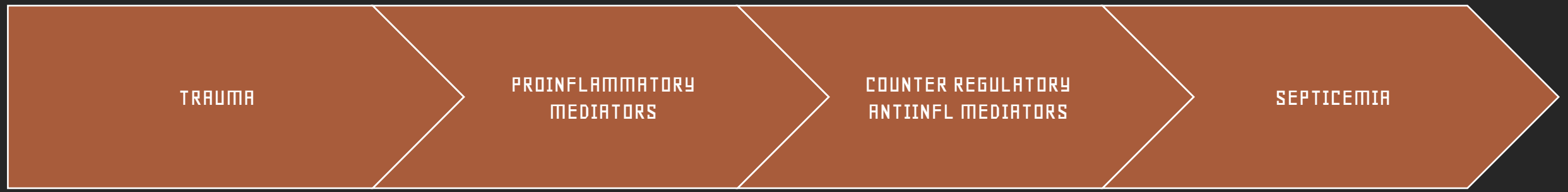
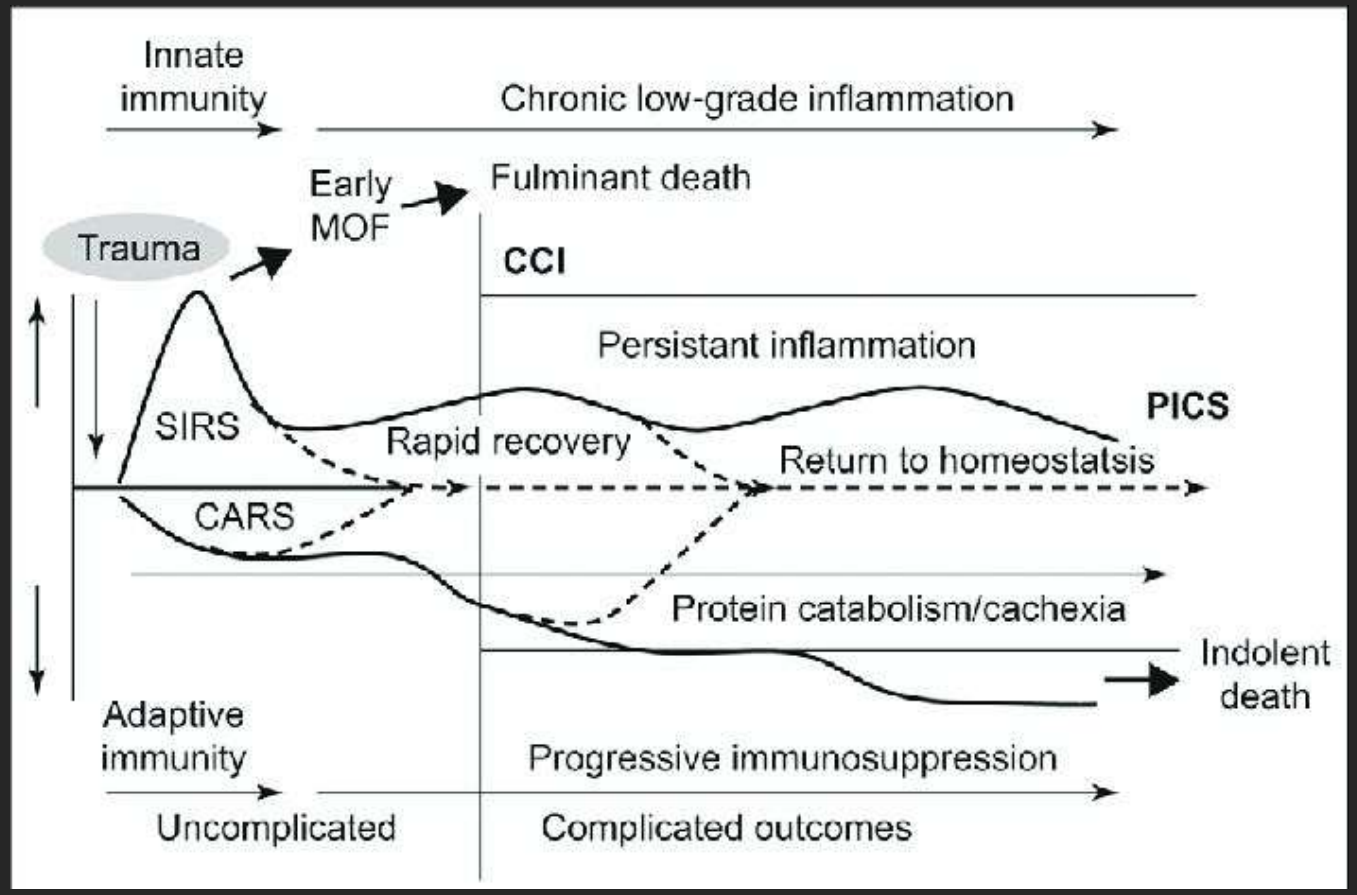
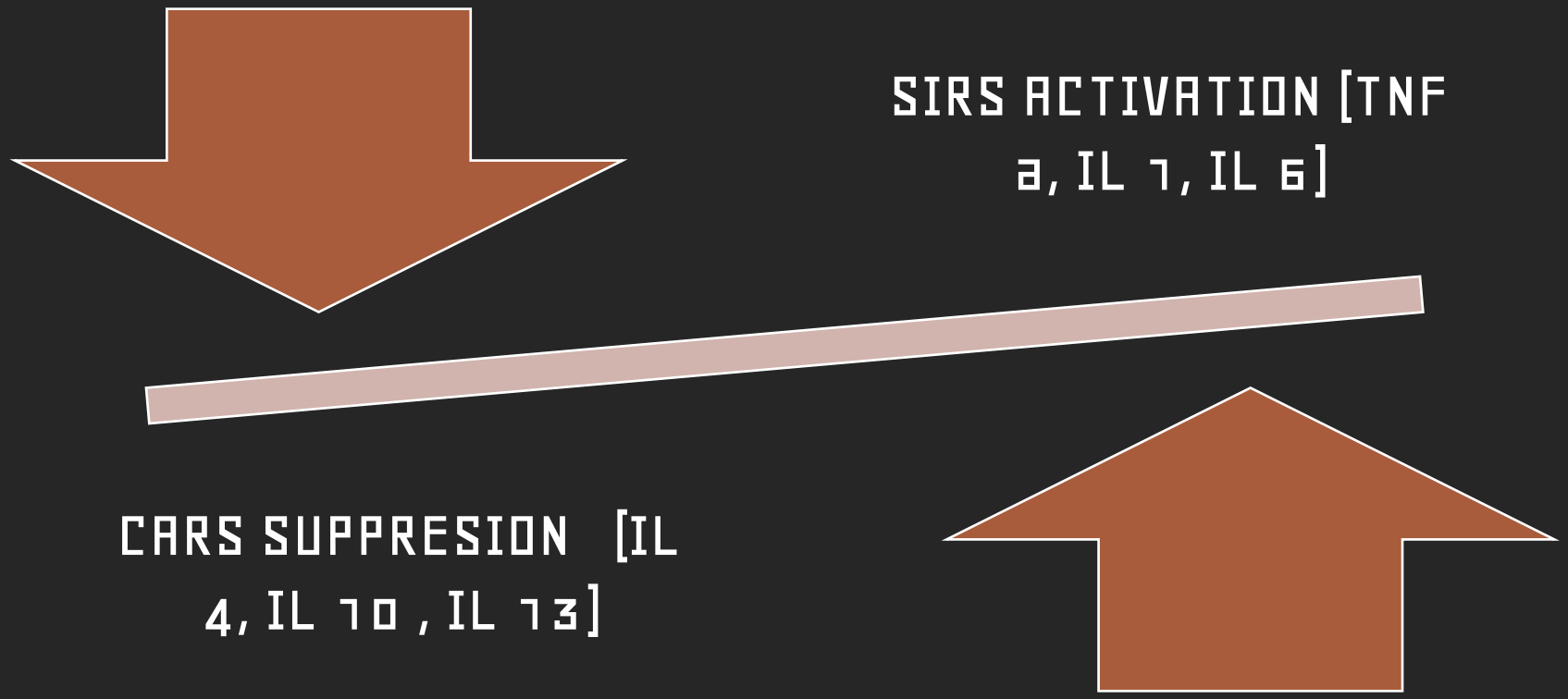


TRAUMA → PRO-INFLAMMATORY MEDIATORS → Systemic Inflammatory Response Syndrome → MODS

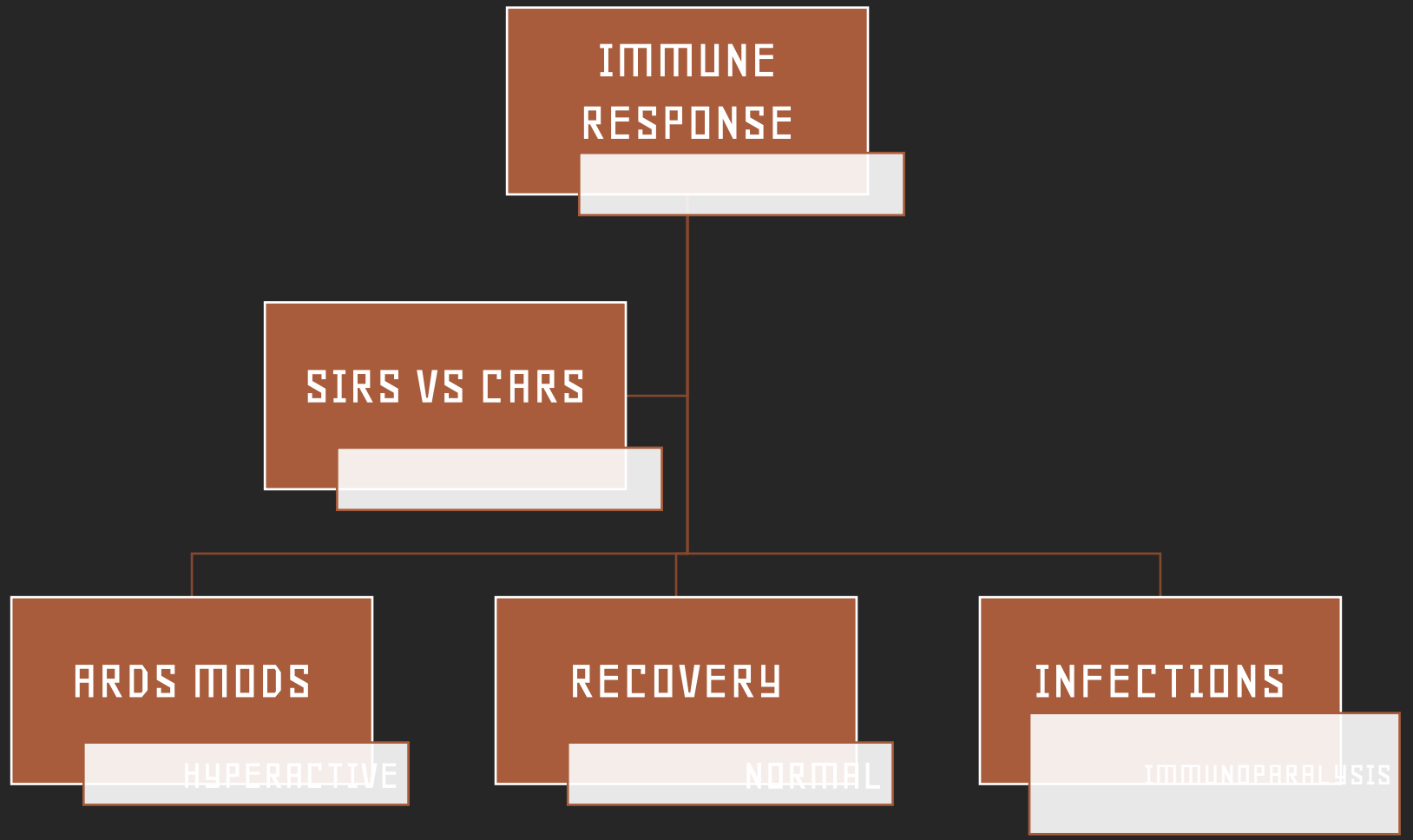


TRAUMA → PRO-INFLAMMATORY MEDIATORS → HIGH COUNTER REGULATORY ANTI-INFLAMMATORY MEDIATORS [CARS] → IMMUNO-DEFICIENCY SEPTICEMIA

REGULATION OF POST TRAUMATIC INFLAMMATION



SHOCK, TRAUMA, HEMORRHAGE, SURGERY

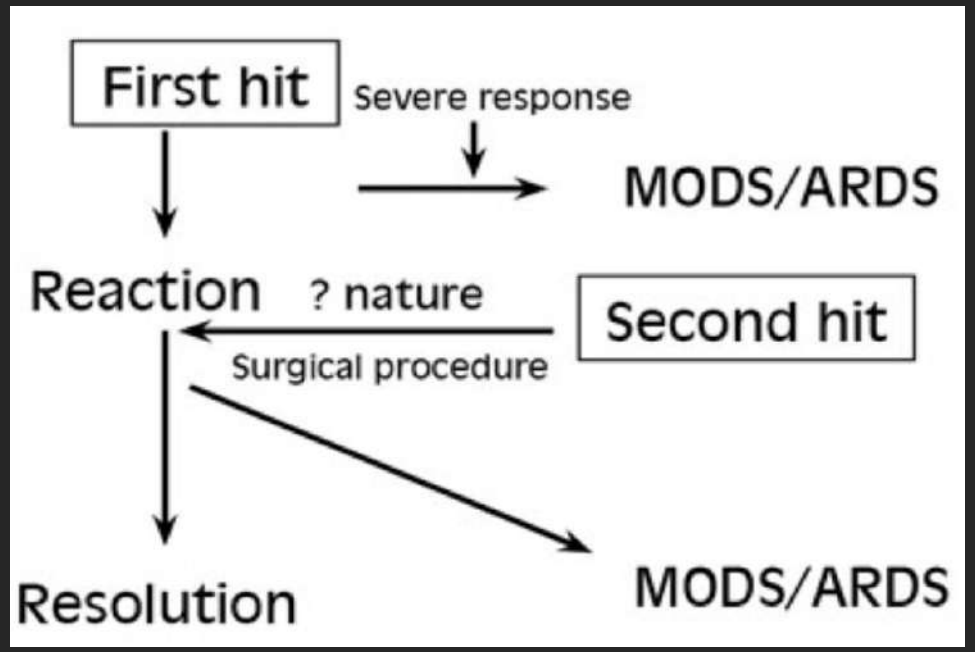


FIRST AND SECOND HIT PHENOMENON

26/11

FIRST HIT

SECOND HIT



1ST HIT – TRAUMA

PRO-INFLAMMATORY MEDIATORS

2ND HIT –

SURGERY

BLOOD TRANSFUSION

HYPOXEMIA

FAT EMBOLISM

PAIN

US NAVY – 'DAMAGE CONTROL'

CENTRAL GOAL –
"Survival of the ship until it reaches the port where definitive repairs can be safely performed"

DAMAGE CONTROL ORTHOPEDICS

AN APPROACH THAT CONTAINS AND STABILIZES ORTHOPEDIC INJURIES
SO THAT THE OVERALL PHYSIOLOGY CAN IMPROVE

DAMAGE CONTROL ORTHOPEDICS

- DECREASES THE CHANCE OF A SECOND HIT

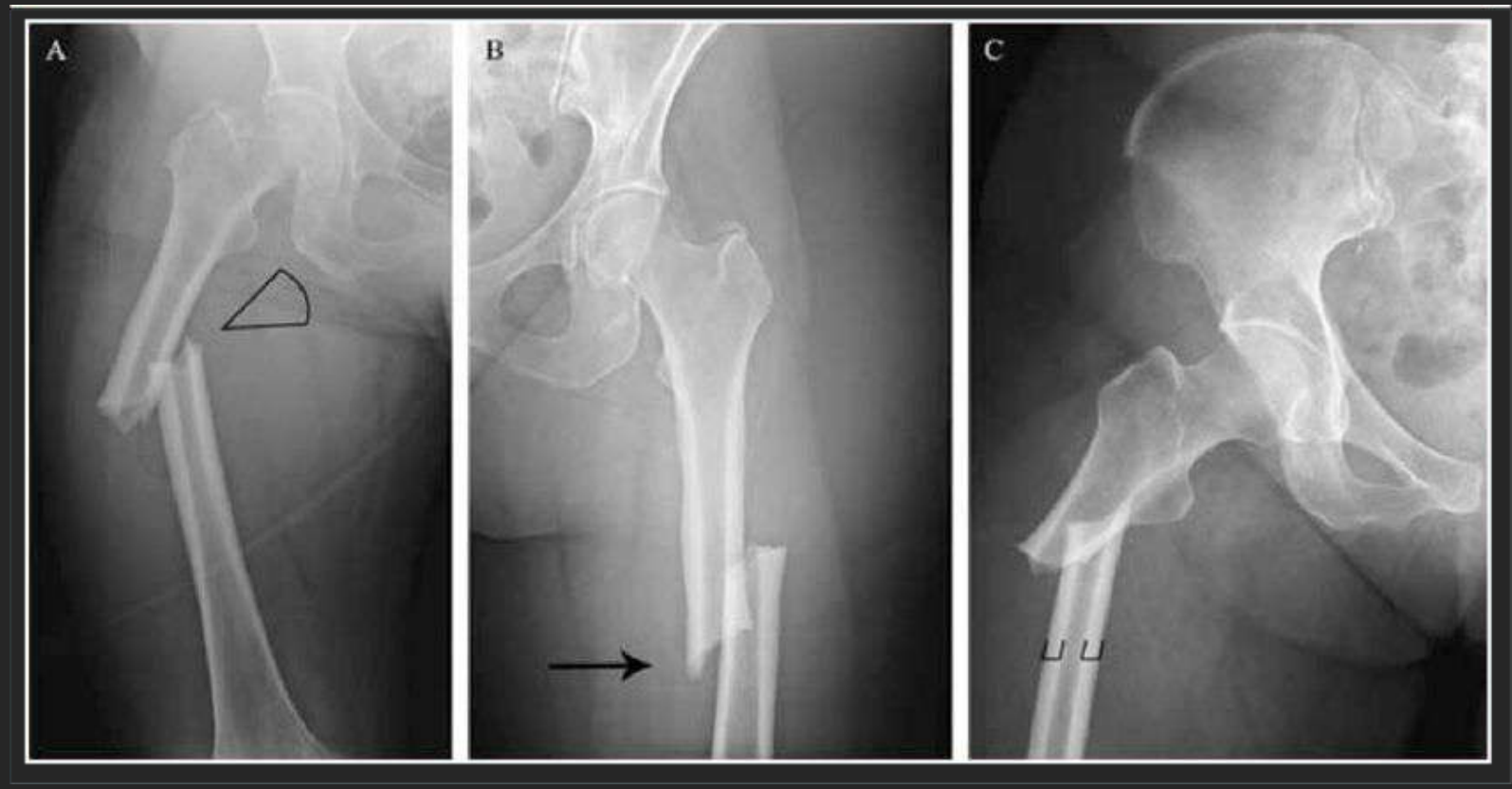
- **24-72 HOUR** PERIOD AFTER INITIAL INJURY APPEARS TO BE MOST AT RISK TIME

- IN DCO, ***RECOMMENDED TO DO AS LITTLE AS POSSIBLE BUT SUFFICIENT ENOUGH TO SAVE THE PATIENTS LIFE !***

CLINICAL CASE

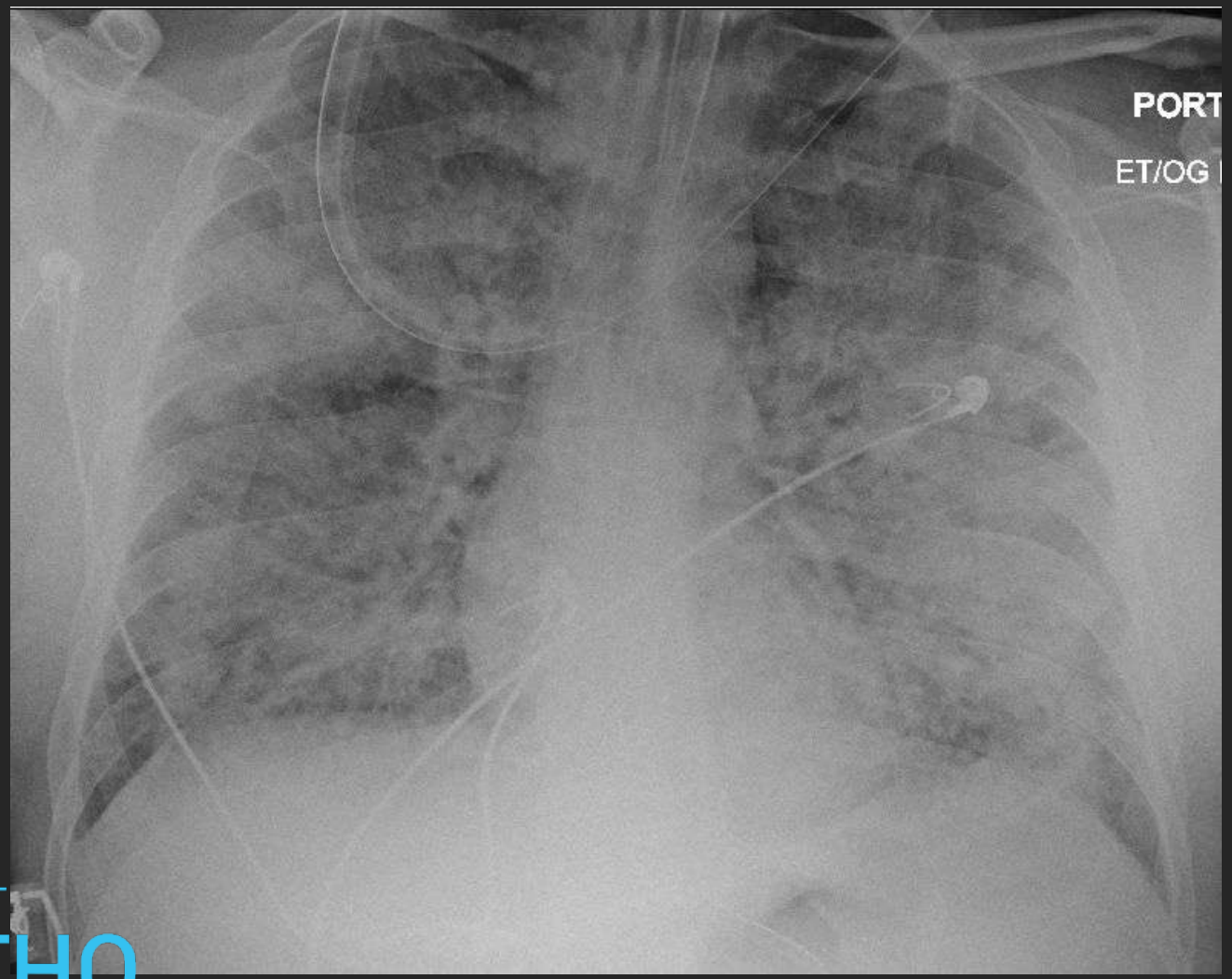
- 18YR OLD , RTA

- PULMONARY CONTUSION
- BILATERAL FEMORAL #



BILATERAL FEMORAL NAILING

96 HOURS POST SURGERY



ARDS

MULTI-ORGAN FAILURE

The fracture always has a patient attached to it !!

4 phases of DCO

ACUTE PHASE	LIFE SAVING PROCEDURES
2ND PHASE	CONTROL OF HEMORRHAGE -TEMPORARY STABILIZATION OF MAJOR SKELETAL FRACTURES -MANAGEMENT OF SOFT TISSUE INJURIES
3RD PHASE	MONITORING PERIOD IN ICU
4TH PHASE	DEFINITIVE FRACTURE FIXATION

WHAT IS DONE?

- EMERGENCY LIFE SAVING PROCEDURES ANYTIME

- 1ST 2 DAYS – FRACTURES

UPPER LIMB – SPLINT

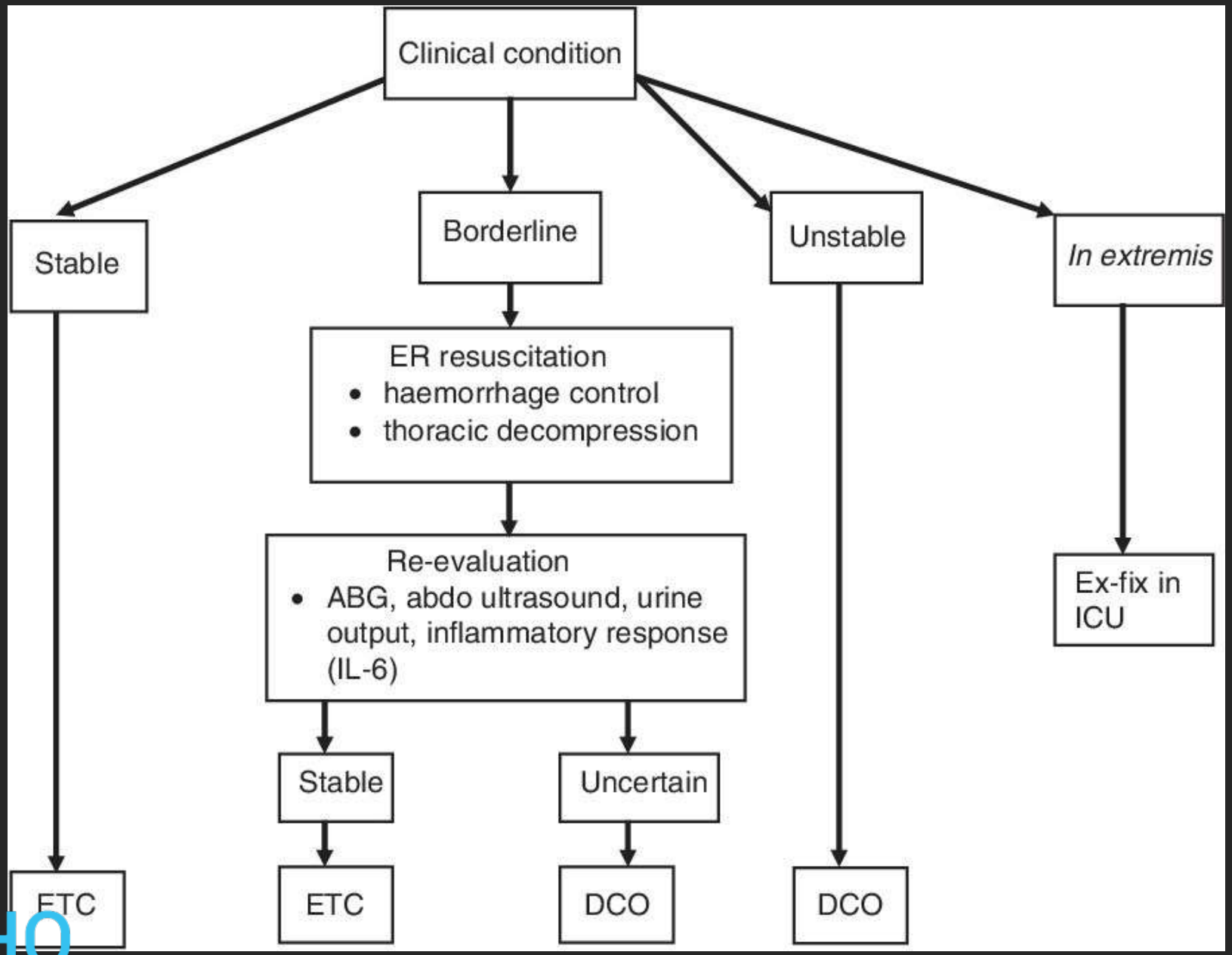
LOWER LEG – BELOW KNEE – SPLINT

LOWER LIMB – FEMUR – EXTERNAL FIXATOR

PELVIS - EXTERNAL FIXATOR

	Parameter	Stable (grade I)	Borderline (grade II)	Unstable (grade III)	In extremis (grade IV)
Shock	BP (mmHg)	≥100	80–100	60–90	<50–60
	Blood units (2 h)	0–2	2–8	5–15	>15
	Lactate levels	Normal range	Approx 2.5	>2.5	Severe acidosis
	Base deficit (mmol/L)	Normal range	No data	No data	>6–18
	ATLS classification	I	II-III	III-IV	IV
	UO (mL/h)	>150	50–150	<100	<50
Coagulation	Platelet count (μg/mL)	>110000	90000–110000	<70000–90000	<70000
	Factor II and V (%)	90–100	70–80	50–70	<50
	Fibrinogen (g/dL)	>1	Approx 1	<1	DIC
	D-Dimer	Normal range	Abnormal	Abnormal	DIC
Temperature		>35°C	33–35°C	30–32°C	30°C or less
Soft tissue injuries	Lung function, PaO2/FiO2	>350	300	200–300	<200
	Chest trauma scores, AIS	AIS I or II	AIS ≥ 2	AIS ≥ 2	AIS ≥ 3
	TSS	O	I-II	II-III	IV
	Abdominal trauma (moore)	≤II	≤III	III	≥III
	Pelvic trauma (AO classification)	A	B or C	C	C (crush, rollover with abd trauma)
	Extremities	AIS I or II	AIS II-III	AIS III-IV	Crush, rollover, extremities

Abbreviations: BP: blood pressure, ATLS: advanced trauma life support, UO: urine output, TTS: thoracic trauma score, AIS: abbreviated injury scale, DIC: disseminated intravascular coagulation.



EARLY DEFINITIVE FIXATION

- pH > 7.25
- BASE DEFICIT > -5.5
- LACTATE < 4.0
- NORMOTENSIVE

- IF CRITERIA IS NOT MET WITHIN 8 HOURS = DCO

BORDERLINE

Borderline patients	Factors with poor outcome
ISS > 40 ISS >20 with AIS thorax >2 Abdominal / pelvic injury with shock Bilateral lung contusion Bilateral femoral fracture Severe head injury Raised ICP or rise intra-operatively Initial PAWP >24mmHg Rise >6mmHg on nailing	Hemodynamic instability Coagulopathy Hyopthermia (<35'C) Acidosis (pH <7.24) Massive transfusion (10u) Expected Operative time >6h Raised inflammatory markers

ADVANTAGES OF DAMAGE CONTROL ORTHOPEDICS

- ATTEMPTS TO LIMIT SECOND HIT
- ALLOWS DEFINTIVE PLANNING OF POLYTRAUMA
- SHORTER OVERALL STAY IN ICU
- REDUCES INCIDENCE OF ARDS/MOF
- EARLY REHAB – BETTER FUNCTION

TIMING OF INTERVENTION

PHYSIOLOGIC STATUS	SURGICAL INTERVENTION	TIMING
RESPONSE TO RESUSCITATION	LIFE SAVING PROCEDURES	DAY 1
HYPER INFLAMMATION	SECOND LOOK ONLY	DAY 2-4
EQUIVALENCE/ NORMAL	WINDOW OF OPPORTUNITY – DEFINITIVE SURGERY	DAY 5-10
IMMUNOSUPPRESION	NO SURGERY	DAY 10-20
RECOVERY	SECONDARY RECONSTRUCTION	DAY 21 ONWARDS