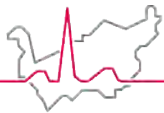


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1er Symposium du Trauma Center Valaisan

Prise en charge des fractures du bassin instables

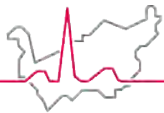
Dr Ph. Zermatten



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Sommaire

- **Introduction**
- **Classifications**
- **Quiz time**
- **Algorithme**
- **Facteurs prédictifs de mortalité**
- **Take home messages**



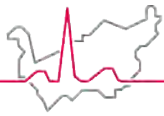
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Introduction

- **# bassin = source la plus fréquente de décès après un traumatisme contondant**
- **Causes principales du décès:**
 - exsanguination précoce
 - choc prolongé (transfusion massive)

- **# bassin hémodynamiquement instables le plus svt associées à:**
 - lésions des plexi veineux pré-sacrés (28-47%)
 - saignement des surfaces fracturaires

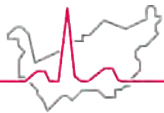
- **... mais peuvent être également associées à:**
 - lésions artérielles (<15%)



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Classifications

- **Pennal**
- **Young & Burgess**
- **Tile/AO**
- **Denis**



Classification de Pennal

Traumatismes du bassin

- Classification de Pennal (mécanismes)
 - compression latérale
 - compression antéro-postérieure (open-book)
 - cisaillement vertical



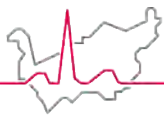
Compression latérale



Compression antero-postérieure

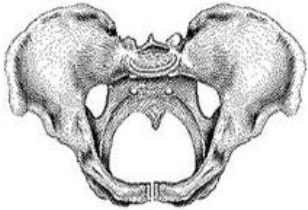
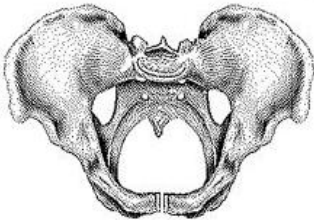
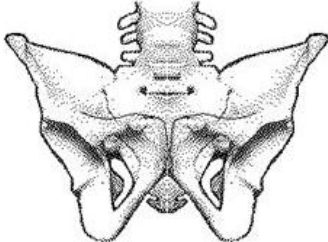


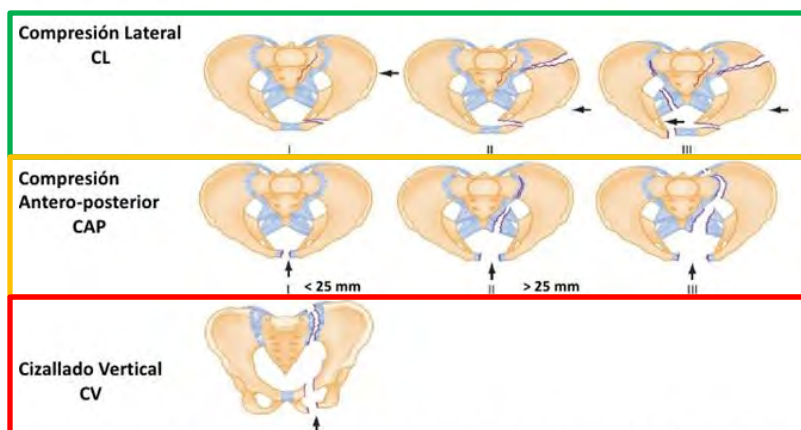
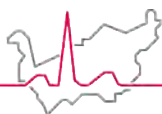
Cisaillement vertical



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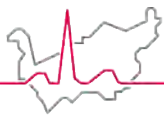
Classification de Young-Burgess

	AP COMPRESSION	LATERAL COMPRESSION	VERTICAL SHEAR INJURY
			
Mortality	20%	7%	?%
Blood (U)	14.8	3.6	1.6



Burgess AR, Young JW, et al: Pelvic ring disruptions: Effective classification system and treatment protocols. J Trauma 1990; 30:848.

Descriptions		Treatment
Anterior Posterior Compression (APC)		
APC I	Symphysis widening < 2.5 cm	Non-operative. Protected weight bearing
APC II	Symphysis widening > 2.5 cm. Anterior SI joint diastasis ⑦ ⑦. Posterior SI ligaments intact. Disruption of sacrospinous and sacrotuberous ligaments. ⑦	Anterior symphyseal plate or external fixator +/- posterior fixation
APC III	Disruption of anterior and posterior SI ligaments (SI dislocation). Disruption of sacrospinous and sacrotuberous ligaments. APCIII associated with vascular injury ⑦ ⑦	Anterior symphyseal multi-hole plate ⑦ or external fixator and posterior stabilization with SI screws or plate/screws
Lateral Compression (LC)		
LC Type I	Oblique or transverse ramus fracture and ipsilateral anterior sacral ala compression fracture.	Non-operative. Protected weight bearing
LC Type II	Rami fracture and ipsilateral posterior ilium fracture dislocation (crescent fracture). ⑦	Open reduction and internal fixation of ilium
LC Type III	Ipsilateral lateral compression and contralateral APC (windswept pelvis). Common mechanism is rollover vehicle accident or pedestrian vs auto	Posterior stabilization with plate or SI screws as needed. Percutaneous or open based on injury pattern and surgeon preference
Vertical Shear (VS)		
Vertical shear	Posterior and superior directed force. Associated with the highest risk of hypovolemic shock (63%); <u>mortality rate up to 25%</u>	Posterior stabilization with plate or SI screws as needed. Percutaneous or open based on injury pattern and surgeon preference.



Classification de Tile/AO






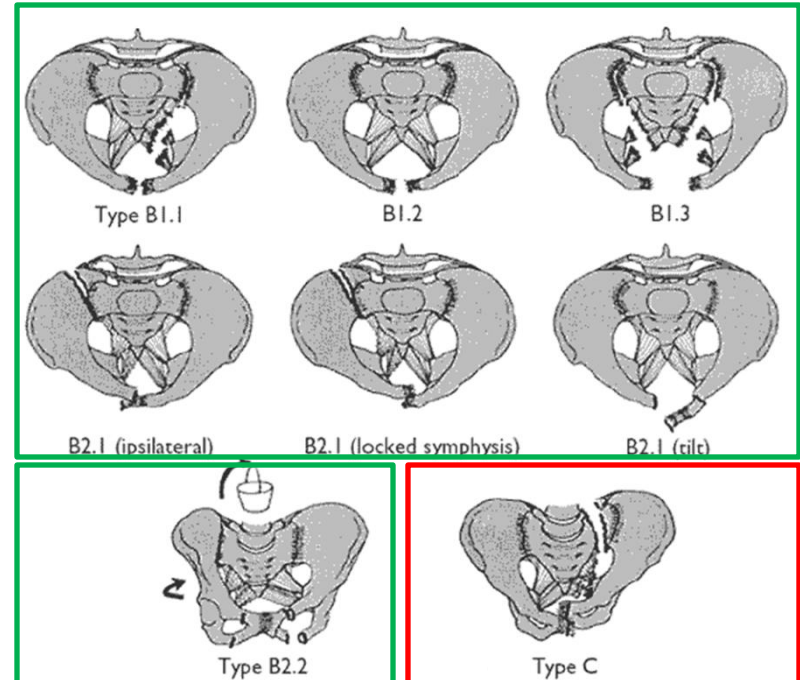
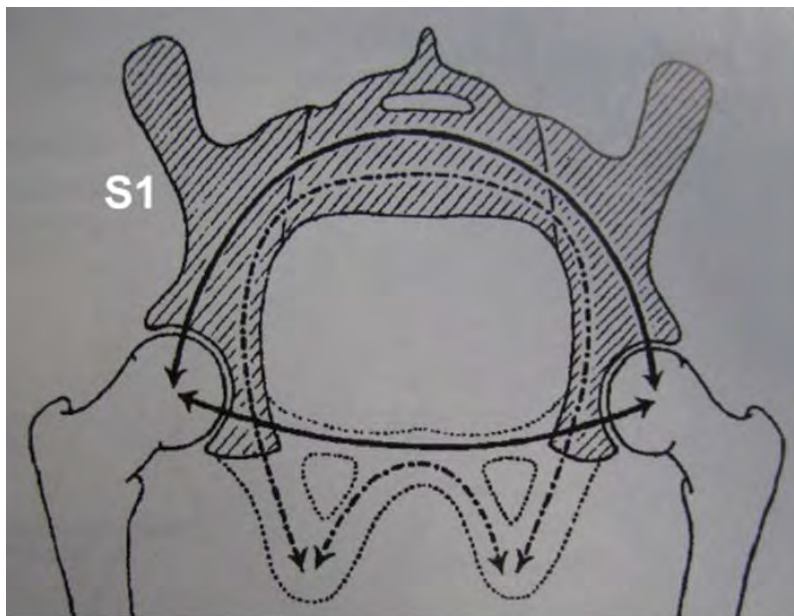
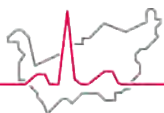
TYPE A	TYPE B	TYPE C
		
Avulsion, Stable Ring	Rotationally Unstable	Rotationally and Vertically Unstable

Table III. Classification of pelvic disruption (Tile)

Type A	Stable A1 - Fractures of the pelvis not involving the ring A2 - Stable, minimally displaced fractures of the ring
Type B	Rotationally unstable, vertically stable B1 - Open book B2 - Lateral compression: ipsilateral B3 - Lateral compression: contralateral (bucket handle)
Type C	Rotationally and vertically unstable C1 - Unilateral C2 - Bilateral C3 - Associated with an acetabular fracture

AO





REVIEW ARTICLE

PELVIC RING FRACTURES: SHOULD THEY BE FIXED?

MARVIN TILE

From the Sunnybrook Medical Centre, Toronto

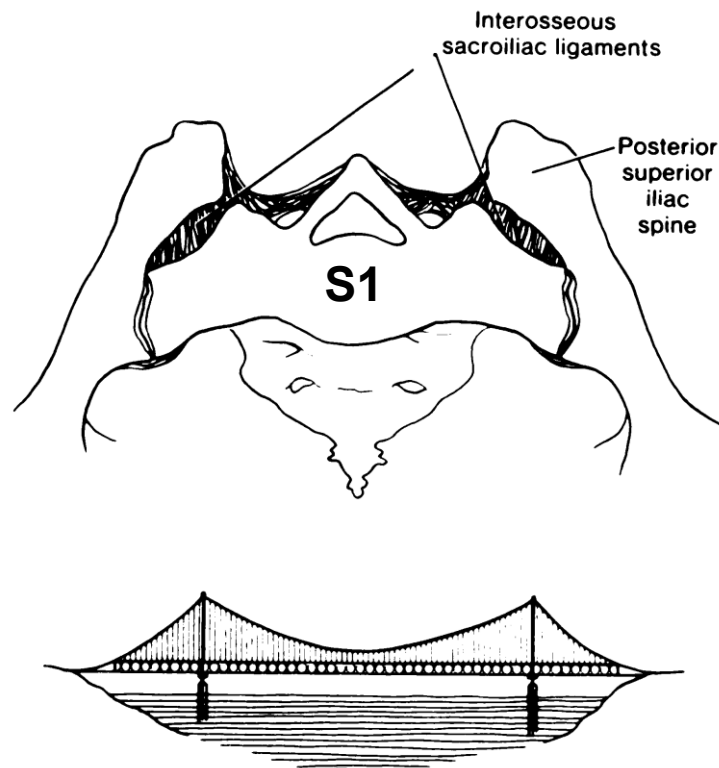
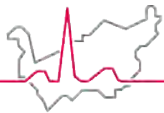


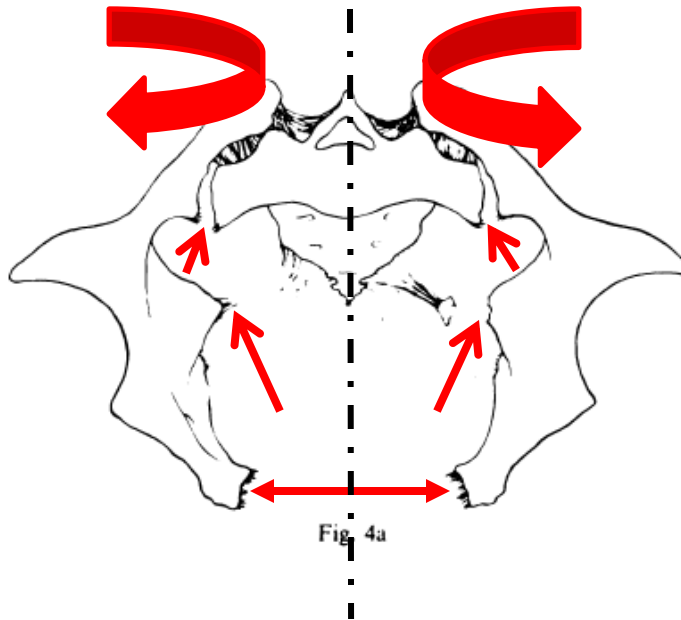
Fig. 1

The ligaments binding the posterior sacroiliac complex. The interosseous sacroiliac ligaments, the strongest in the body, are aligned vertically. The transverse components act as the tension members in a suspension bridge, and join the pillars of the posterior superior iliac spines to the sacrum (from Tile M, *Fractures of the pelvis and acetabulum*, Williams & Wilkins, 1984).

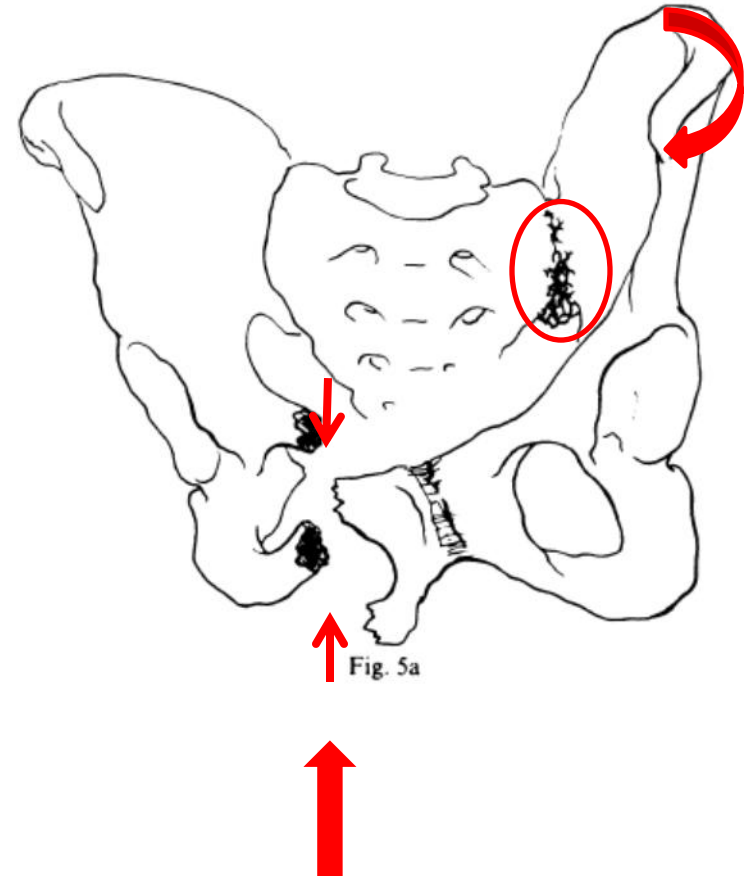


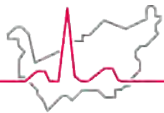
Type B: rotationally unstable

- **B1- Open book**



- **B3- Lateral compression: contralateral (bucket handle)**

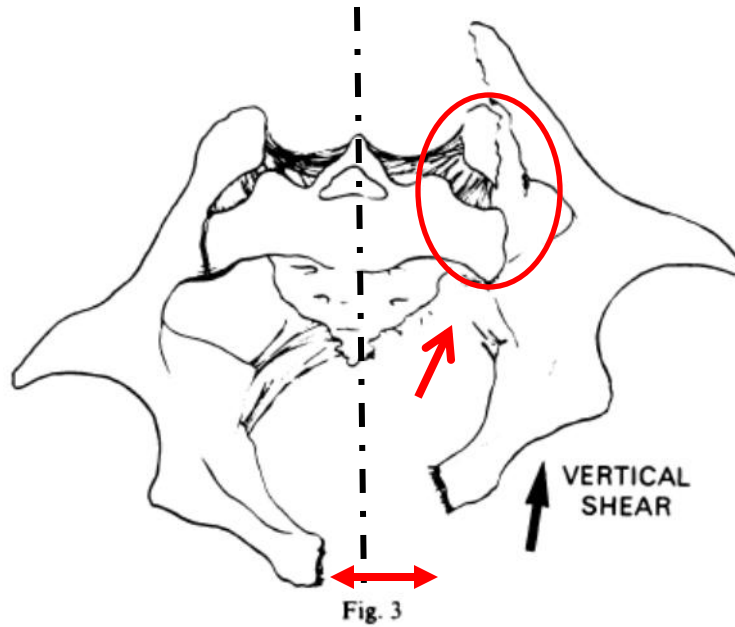




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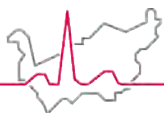
Type C: rotationally and vertically unstable

- **C1- unilateral**

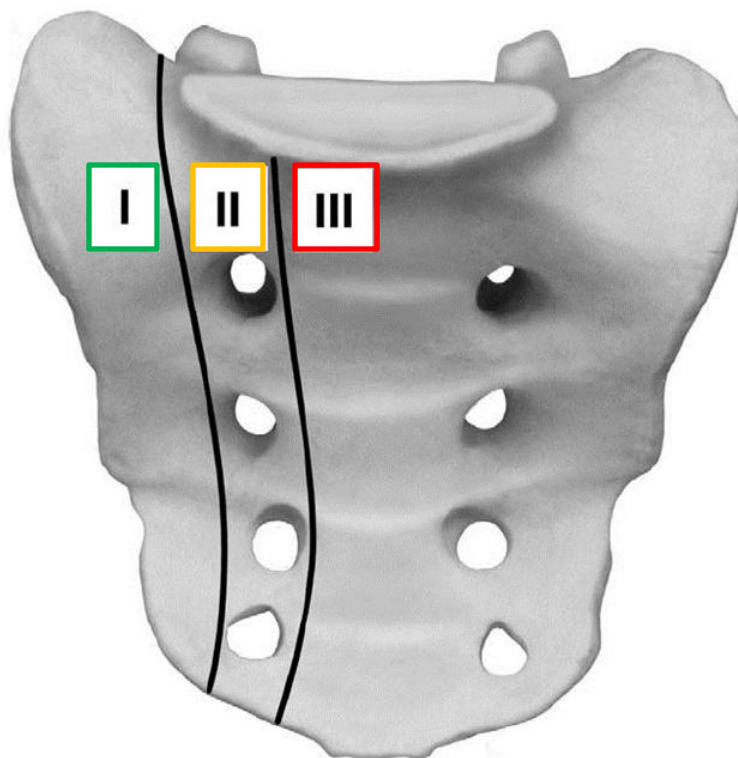


- **C2 -bilateral**

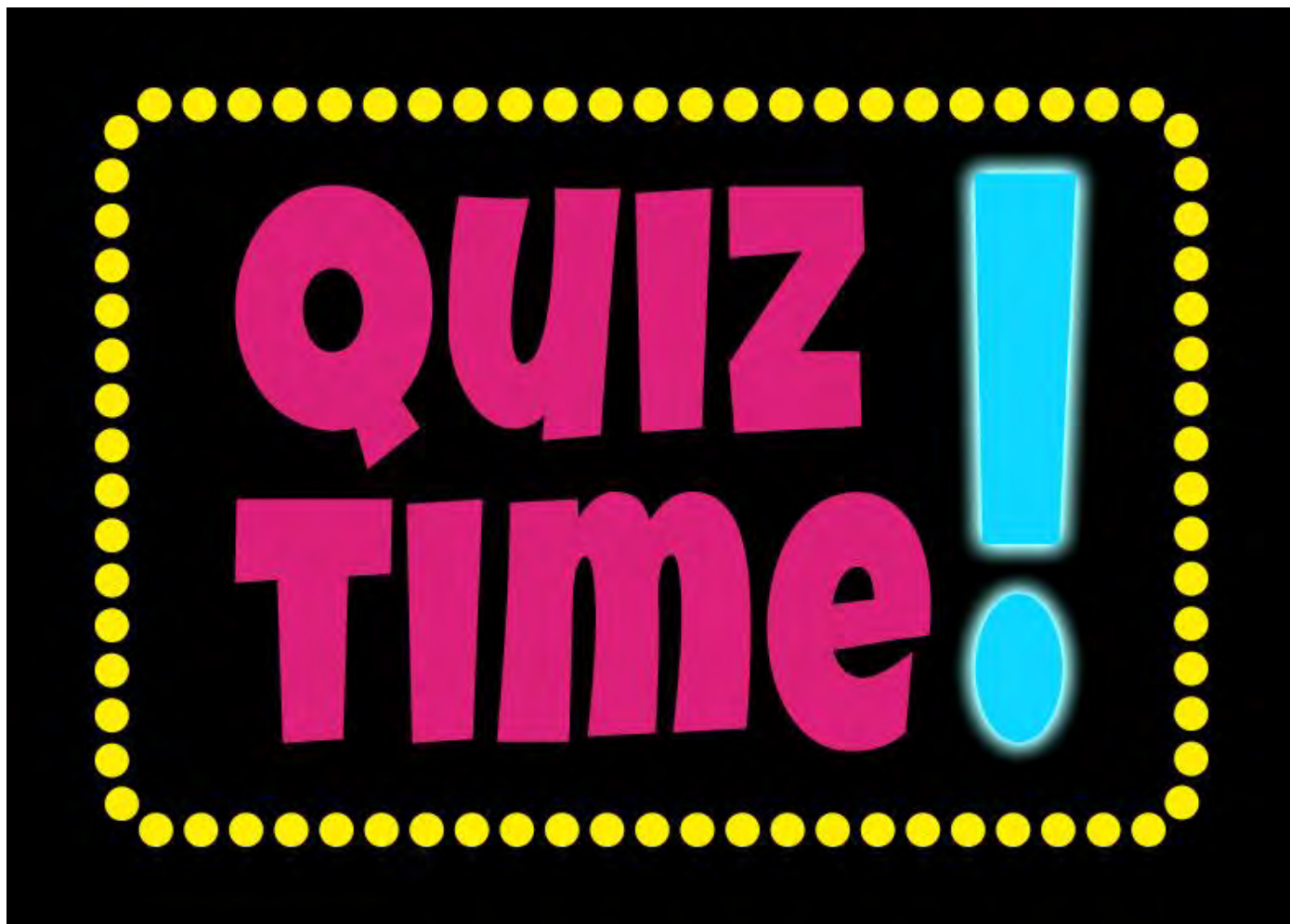
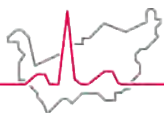


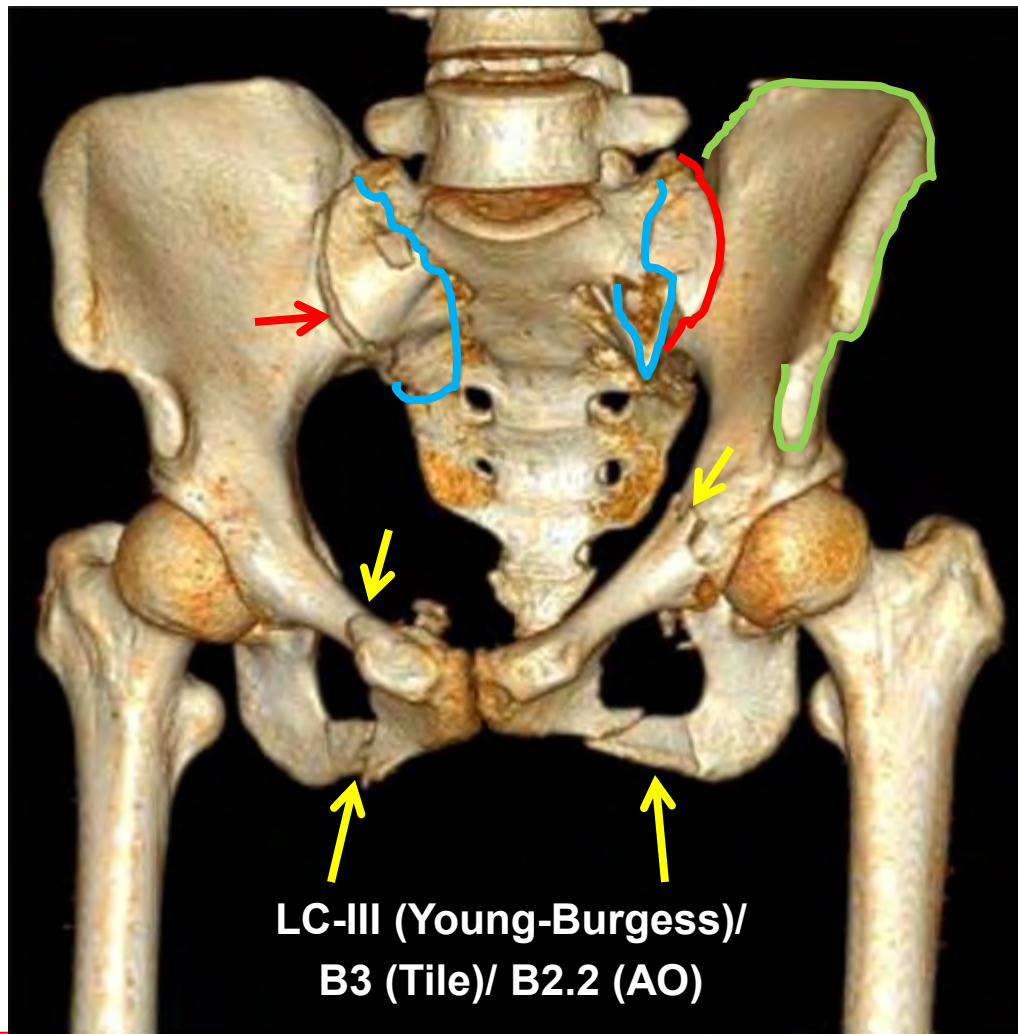
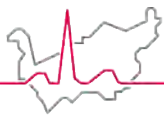


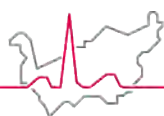
Classification de Denis



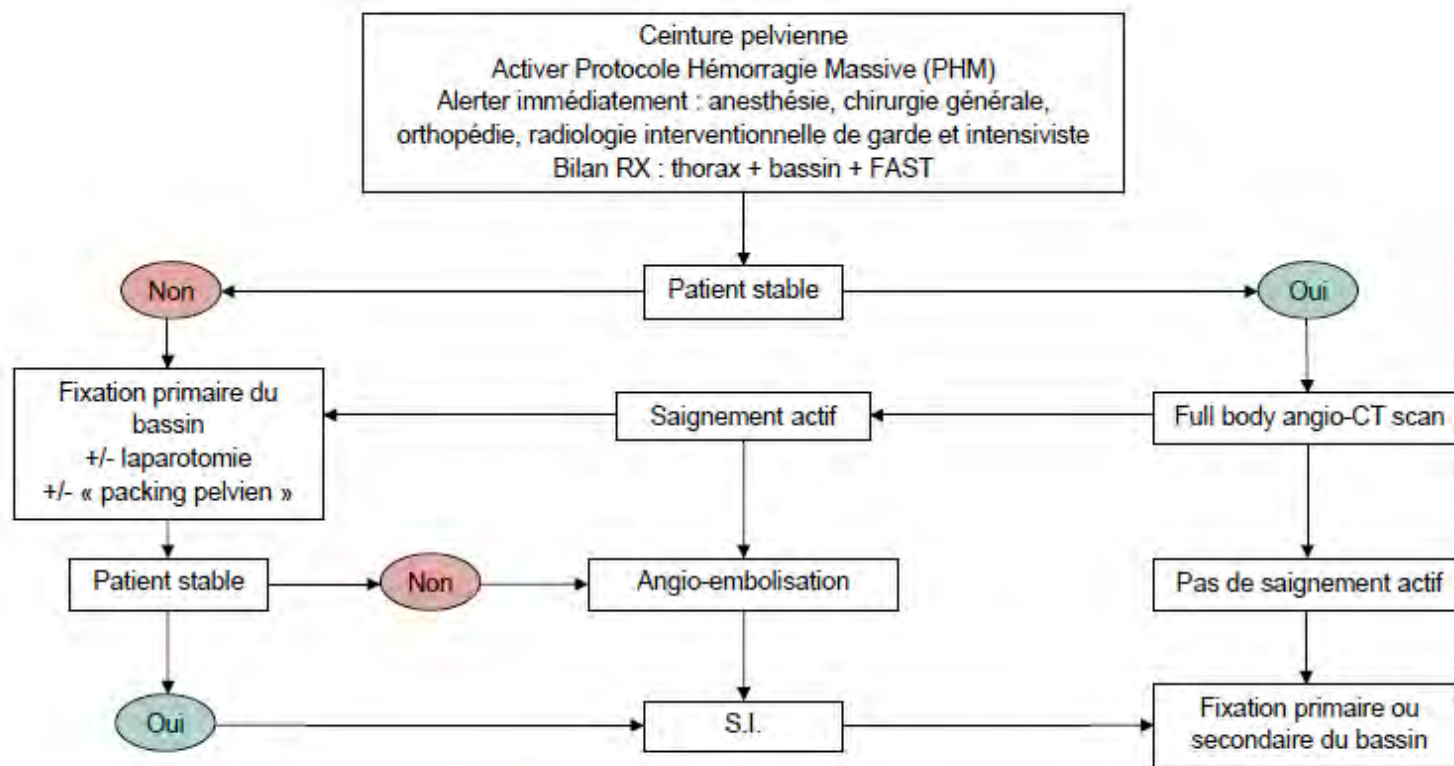
	Denis I	Denis II	Denis III
Frequencies	50%	34%	16%
Neurological impairment	6%	28%	60-76%

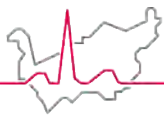






Algorithme



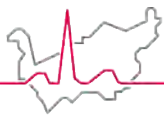


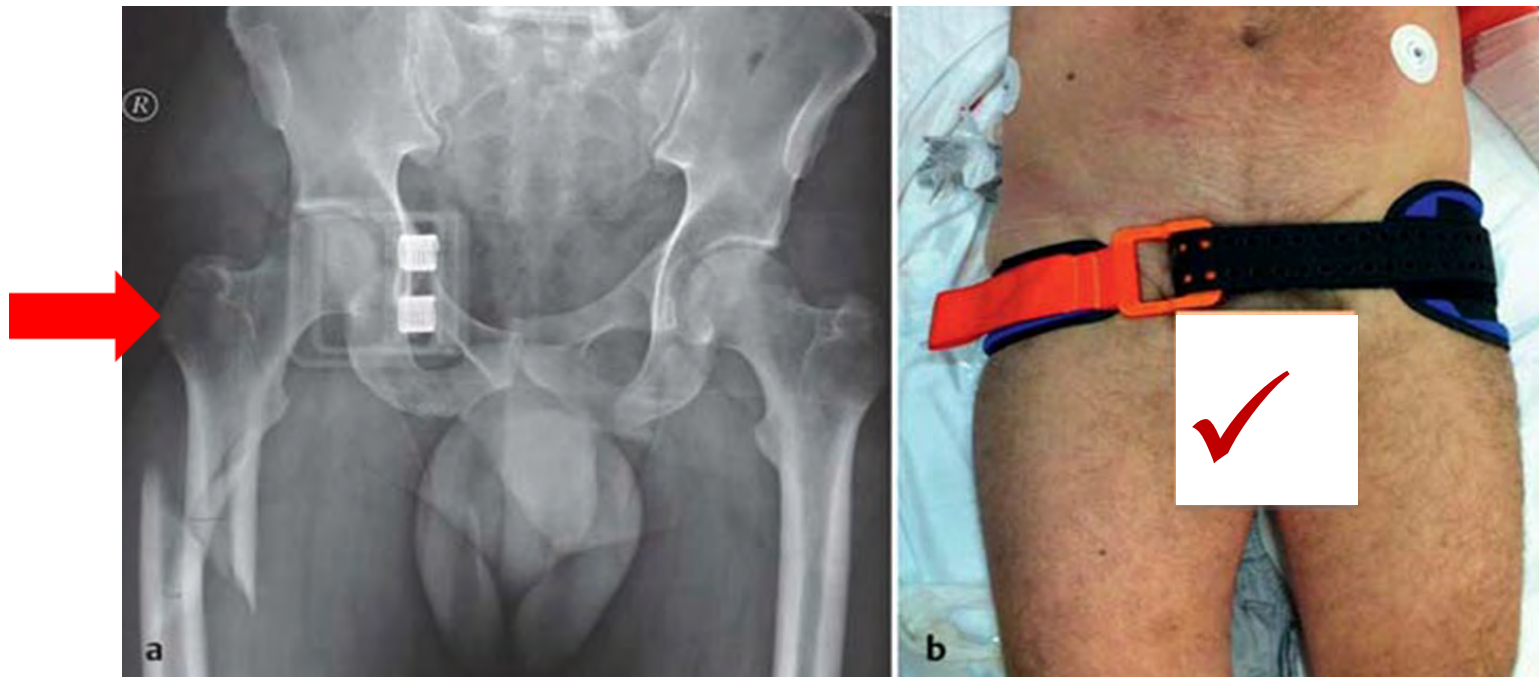
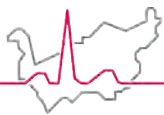
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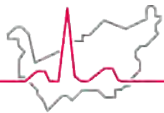
Ceinture pelvienne



Indiquée?







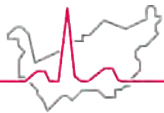
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Alerte

- **Alerter immédiatement le «team déchoc»:**
 - anesthésiste
 - chirurgien
 - orthopédiste
 - radiologue interventionnel
 - intensiviste
- **«Team leader»:**
 - trauma surgeon (US, Germany)
 - emergency department physician (UK, Australia)

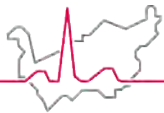
Protocole Hémorragie Massive (PHM)

- **Administration précoce (< 6h) de plasma frais congelé (PFC) + plaquettes:**
 - ↑ survie
 - ↓ consommation de concentrés érythrocytaires (CE)
- **Buts:**
 - prévenir la coagulopathie, l'hémodilution sévère, l'hypothermie
 - ↓ tps de transfusion
- **CAVE:** identité(s) du ou des patient(s) (erreur de transfusion!)
- **Ratio 2:1:1 (EC:PFC:plaquettes)**
- **Transfusion massive**
 - risque d'hypocalcémie (contrôle de la calcémie)
- **Recombinant Factor VIIa (rFVIIa) (?)**



Patient instable

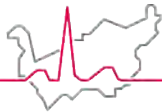
- **$TA_s < 70$ mmHg**
- **Not responding to resuscitation (large volumes of fluid needed to maintain a sBP > 80 mmHg)**
- **Instability =**
 - $RR_{syst} < 90$ mmHg
 - «non responder» = PRBC transfusion no effect



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RX bassin F (+ ceinture pelvienne)

- **Sensibilité + spécificité élevée¹ (controversé!)**
- **Test de la stabilité du bassin à éviter(au déchoc)!²**
 - faible sensibilité
 - douloureux c/o patient éveillé
 - susceptible d'entraîner un nouveau saignement



- **RX bassin (primary survey):**
 - faux négatifs (33%)
- **CT bassin = gold standard:**
 - sensibilité 100%
- **RX ou CT? Ou les deux?**
 - RX = valeur limitée (faux -)
 - CT = gold standard
 - RX + CT c/o patients hémodynamiquement stables

Focused Abdominal Sonography for Trauma

- **Saignement pelvien ou intra-abdominal?¹**
 - «A negative FAST means nothing !»
- **Scores de gravité^{2,3}:**
 - 1 pt/site (Morisson, Douglas, péri-splénique, gouttière pariéto-colique, inter-anse): si **score ≥ 3** \Leftrightarrow **1000 mL**
 - 1 pt/site (sous-phrénique D et G, sous-hépatique, péri splénique, pelvis): si **score ≥ 3** \rightarrow **tx de laparotomie 87%**

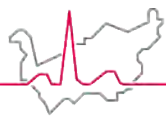
Cathéter vésical

- **Mesure de la diurèse:**
 - fonction rénale
 - réponse du patient aux apports liquidiens
- **Lésions urétrales:**
 - très rare c/o ♀ → **cathéter vésical**
 - c/o ♂ plus fréquent (# type «open book»):
 - si pas de sang au méat, absence d'hématome périnéal, pas d'anamnèse d'hématurie → **cathéter vésical (*prudemment*)**

dans le cas contraire ou si présence de sang dans le liquide drainé lors de la mise en place du cathéter → **urétrographie rétrograde**

si l'urétrogramme + ou si pas possible de passer le cathéter (appeler l'urologue) → **cathéter supra-pubien**

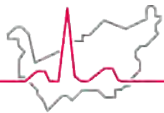
CAVE: interférence avec fixation secondaire # du bassin



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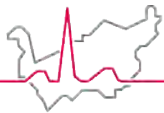
Damage control (DC)





DC: 4 phases

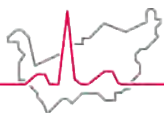
- **Phase I**
 - life-saving procedures (according to ATLS protocols)
- **Phase II**
 - contrôle de l'hémorragie
 - fixation temporaire # bassin + # os longs
 - management des t. mous
- **Phase III**
 - monitoring period (ICU)
- **Phase IV (J5-J10)**
 - fixation définitive #



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Fixation primaire du bassin

- **Early total care (ETC)**
- **Damage control orthopaedics (DCO)**



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C-clamp

The Antishock Pelvic Clamp

REINHOLD GANZ, M.D., ROBERT J. KRUSHELL, M.D.,
ROLAND P. JAKOB, M.D., AND JÜRGEN KÜFFER

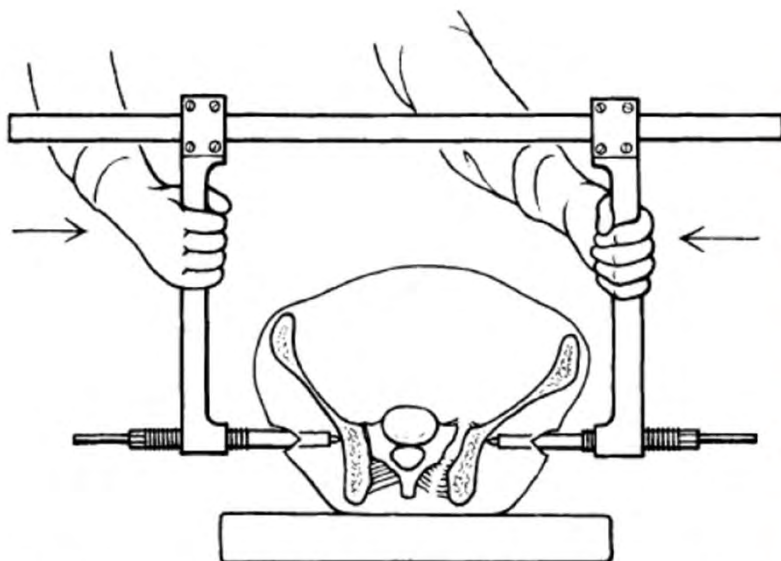


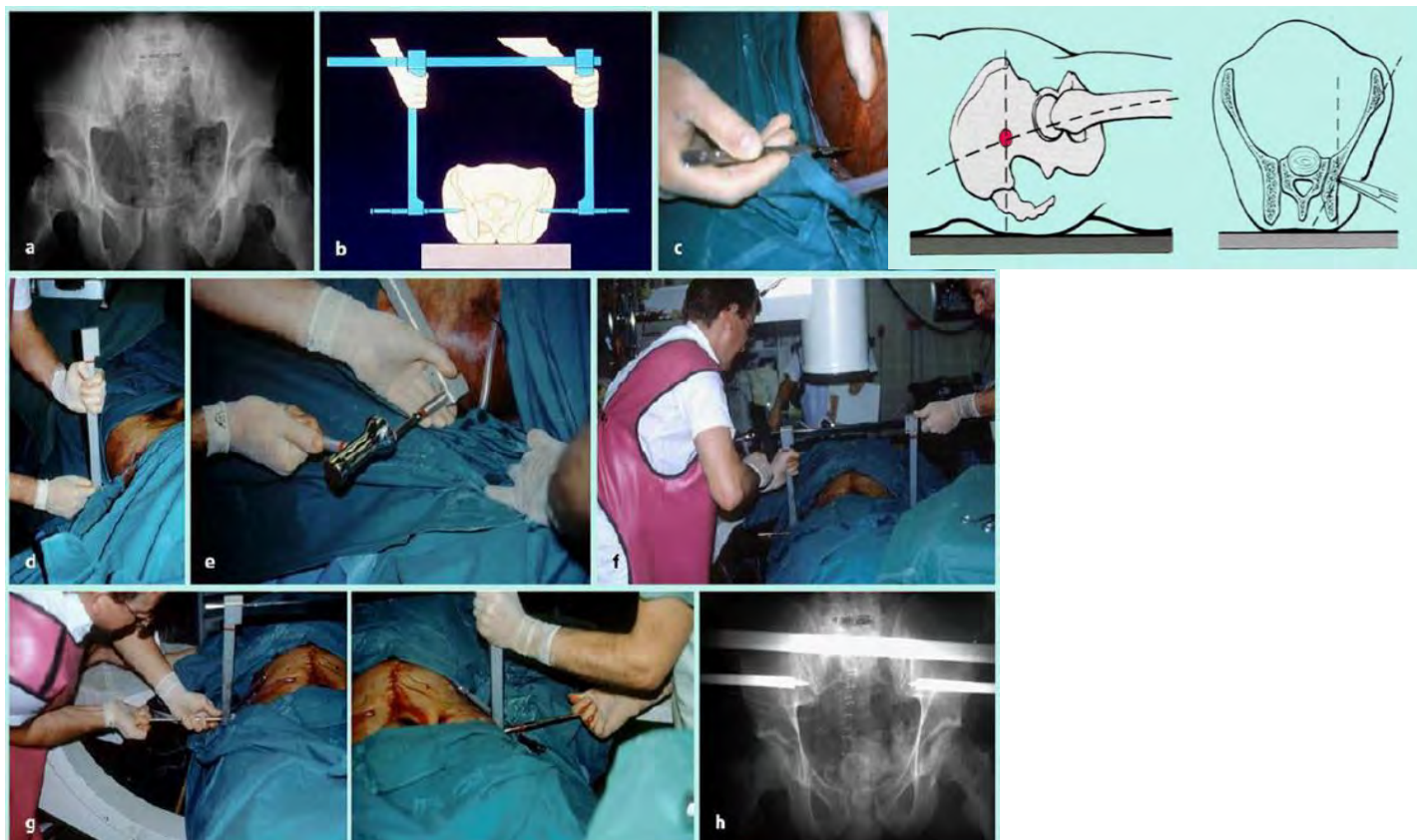
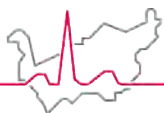
FIG. 3. While an assistant holds the clamp in position, the surgeon slides the sidearms medially until the Steinmann pin touches the outer cortex of the ilium.



From the department of Orthopaedic Surgery, University of Bern, Bern, Switzerland.

Reprint requests to R. Ganz, M.D., Department of Orthopaedic Surgery, University of Bern, CH-3012 Bern, Switzerland.

Received: July 27, 1989.



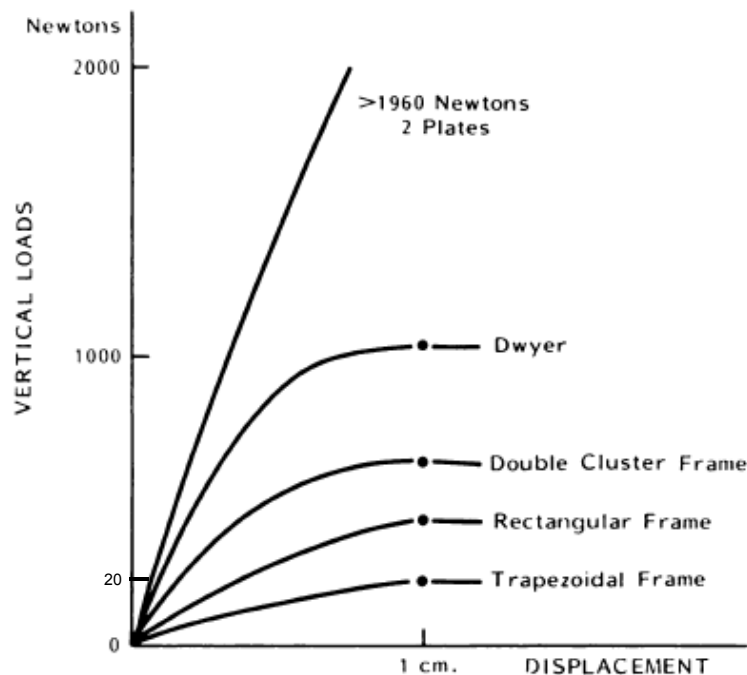
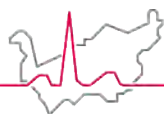


Fig. 8a

Results of biomechanical testing on a vertically stable open book injury produced by division of the symphysis pubis and the anterior sacroiliac ligaments. The external frames all gave adequate fixation for this type of injury, but two plates across the symphysis provided excellent stability.

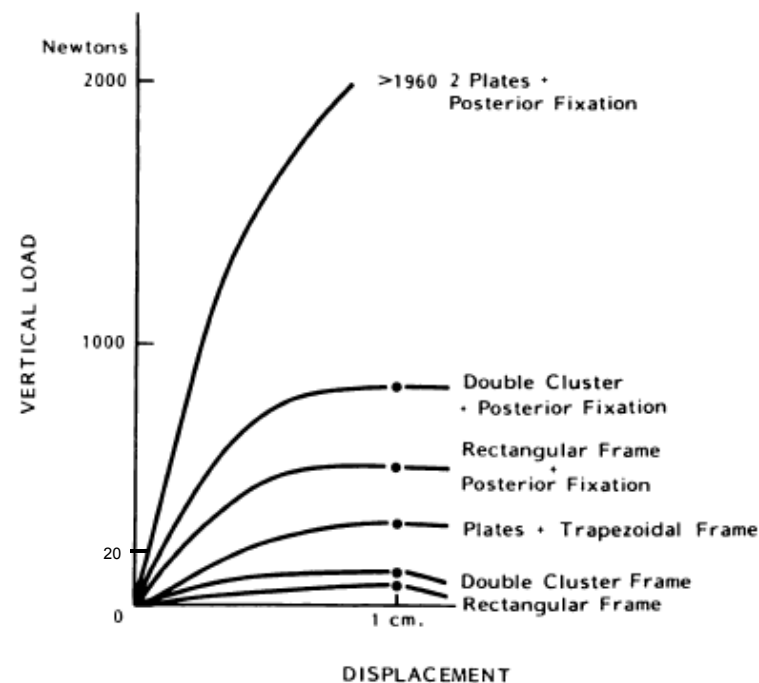
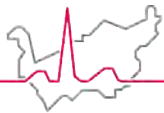


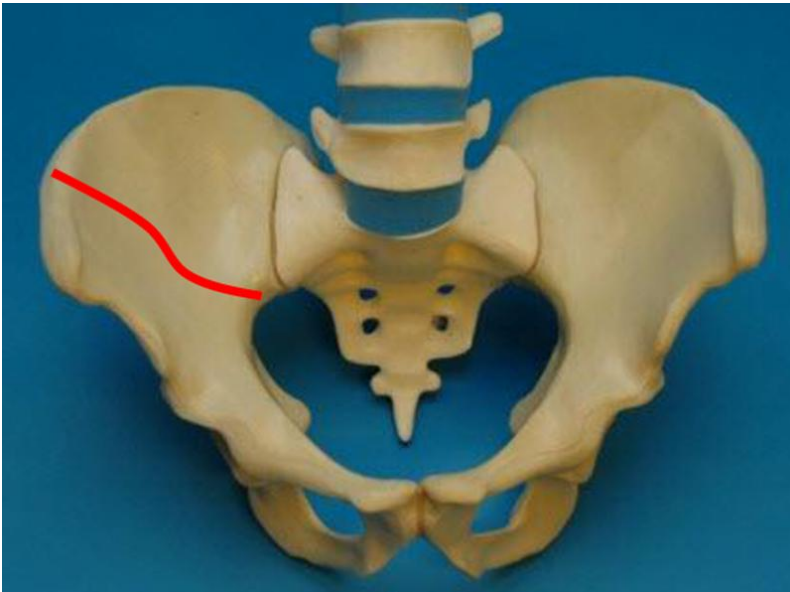
Fig. 8b

Results of fixation of an unstable vertical shear injury produced in the laboratory by division of the symphysis pubis, fracture of the ilium posteriorly, and division of the pelvic floor ligaments. All forms of anterior fixation failed under 20 kg load (1 kg = 10 newtons), posterior internal fixation proving far superior. Internal stabilisation of the unstable posterior injury and of the symphysis pubis produced excellent stability of the pelvic ring. (From Tile M., *Fractures of the pelvis and acetabulum*, Williams & Wilkins, 1984)

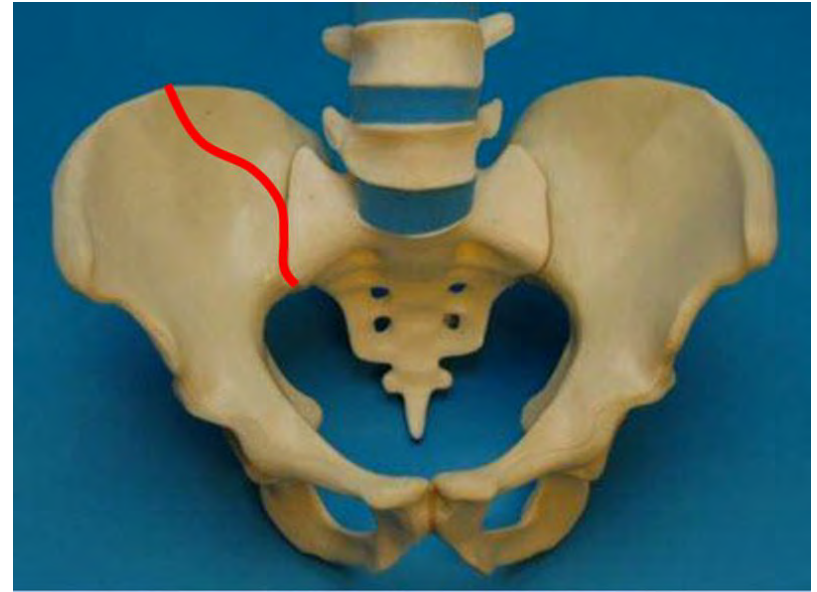


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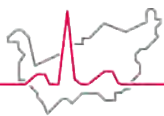
C-clamp: contre-indications absolues



Transiliac #

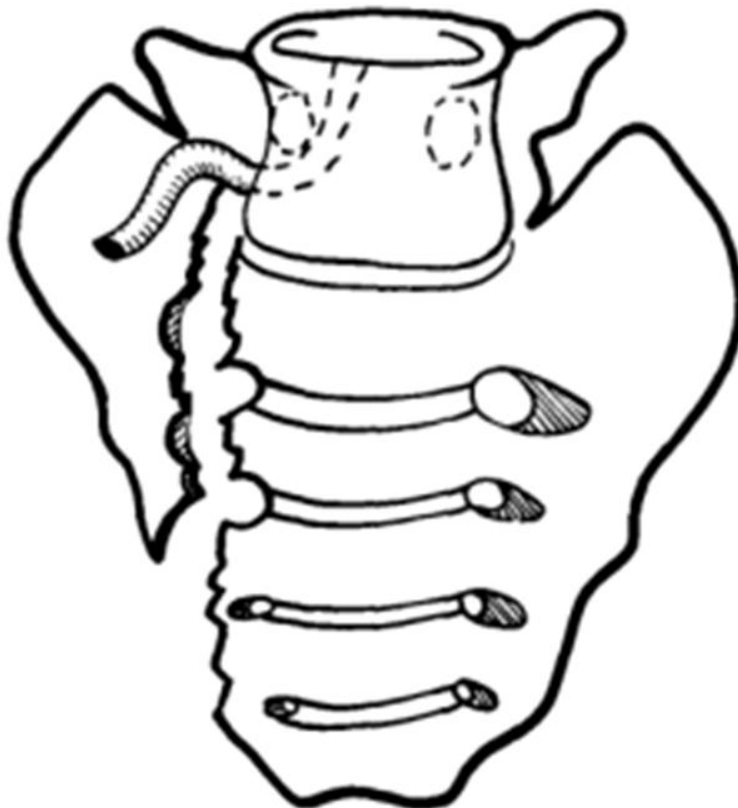


Transsacroiliac or «crescent» #



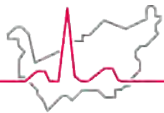
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C-clamp: contre-indication relative



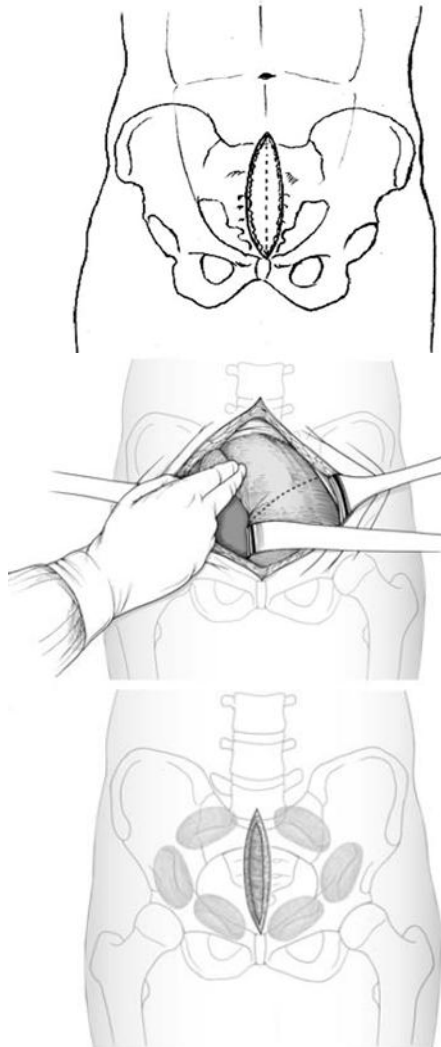
Laparotomie +/- «pelvic packing»

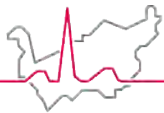
- **Si saignement intra-abdominal + patient instable:**
 - laparotomie exploratrice (ceinture pelvienne en place !)
 - fixation du bassin (C-clamp, fix ex)
 - +/- «pelvic packing»
- **Si saignement rétro-péritonéal + patient instable:**
 - fixation du bassin (C-clamp, fix ex)
 - +/- laparotomie exploratrice
 - +/- «pelvic packing»
- **Si saignement artériel + patient stable:**
 - angio-embolisation



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Preperitoneal Pelvic Packing (PPP)

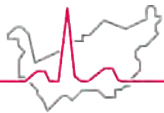




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Inconvénients du PPP

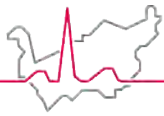
- **Procédure relativement invasive**
- **Risque d'infection (site d'incision)**
- **↑ risque de syndrome de compartiment abdominal**



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Full body angio CT scan

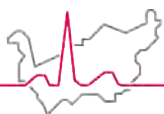
- **↓ tx de mortalité et ↓ tps de déchocage¹**
- **Précise le diagnostic clinique (73%) et permet de détecter des lésions non suspectées cliniquement (66%)²**



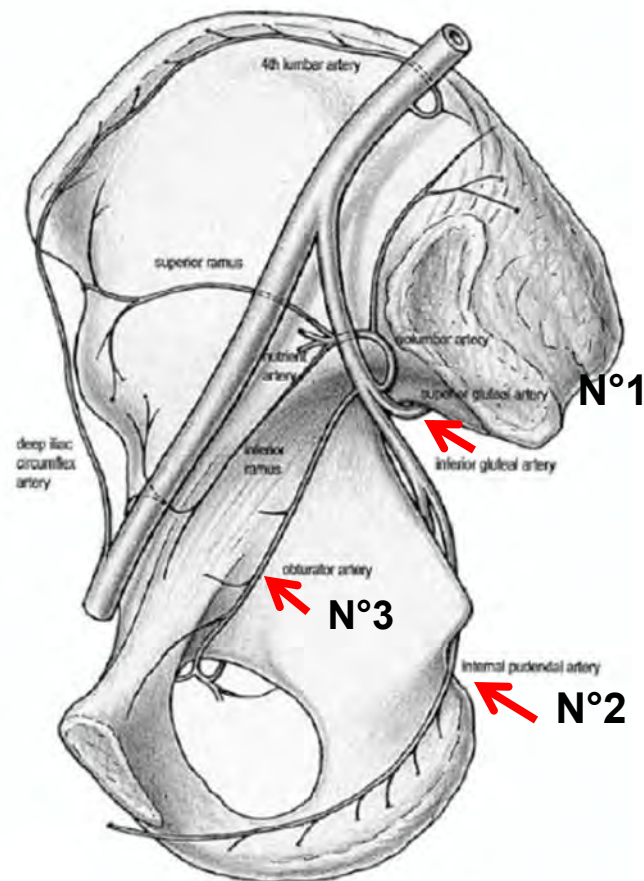
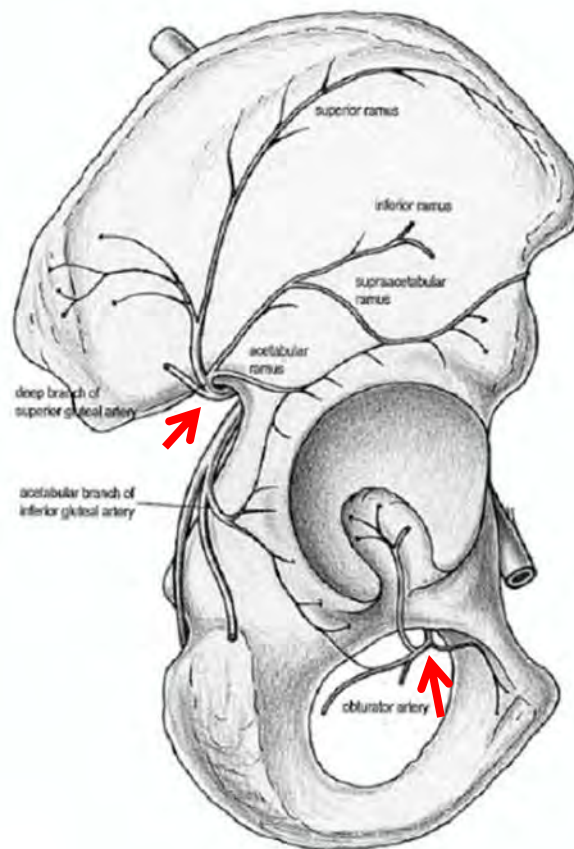
Hôpital du Valais
Spital Wallis

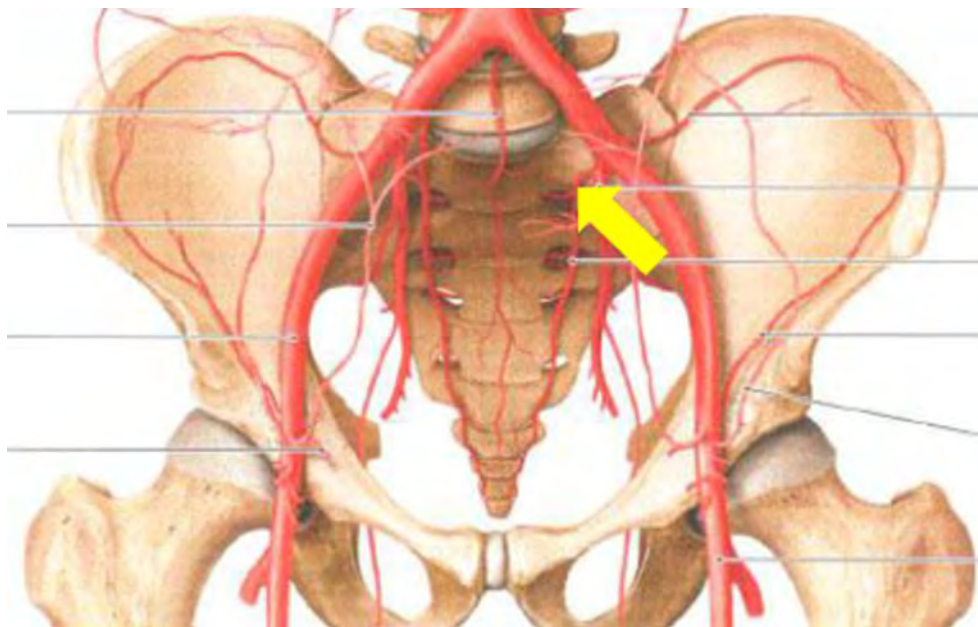
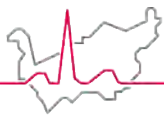
Angio-embolisation

- **< 10% # bassin**
- **Embolisation non-sélective des aa. iliaques int.**
 - ↓ délai (hémostase)
 - complications ischémiques
- **Embolisation sélective**
 - «skilled angiographer»
 - ↓ complications ischémiques, mais chronophage !!!



Sources de saignement artériel

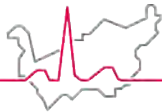




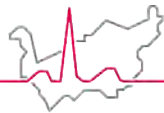
a. sacrée lat.
N°4

Inconvénients de l'angio-embolisation

- **Retarde les interventions d'importance vitale (laparotomie, craniotomie, ...)**
 - 50-190 min. même dans les mains d'un radiologue parfaitement entraîné
- **Pas de traitement simultané d'autres lésions possible**
- **Nécrose tissulaire**
 - aa. iliaques int. (embolisation non sélective) avec un risque d'infection plus élevé en cas d'ostéosynthèse



- **Tx de mortalité élevé malgré un contrôle efficace du saignement**
 - délai (risque d'exsanguination si autres sources d'hémorragie pas contrôlées à temps!)
 - réaction allergique (PDC)
 - ↑ créat.
 - IR
- **Tx de récurrence (7.5-22.6%)**
 - après embolisation
 - angiographie initialement négative (vasospasme, hypotension)

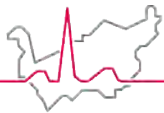


Fixation secondaire

Table V. Indications for open reduction and internal fixation of (vertically) unstable pelvic fractures

-
- 1. Anterior** for disruption of the symphysis pubis (fractures of the rami)
 - To improve pelvic stability
 - In association with a laparotomy
 - For bone protruding into the perineum (tilt fracture)
 - In association with an acetabular fracture which requires open reduction

 - 2. Posterior**
 - Inadequate reduction of the posterior injury (especially sacroiliac dislocation)
 - Presence of an open posterior wound (never for perineal wound)
 - In association with an acetabular fracture which requires open reduction
-



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Facteurs prédictifs de mortalité

- **Genre (♂)**
- **Type # bassin (Tile C, lésions associées)**
- **[Hb] (6.7 ± 2.9)**
- **TAs (77 ± 27)**
- **ISS (35 ± 16)**
- **Lactactes (8.6 ± 2.5)**

TABLE 2. Statistically Significant Findings

Outcome Variable	Comparison Group 1	Comparison Group 2	P Value
Mortality	Unstable fractures, 11.5%	Stable fractures, 7.9%	<0.05
Abdomen injury, AIS score ≥ 2	Unstable fractures, 16.6%	Stable fractures, 9.7%	<0.05
Chest injury, AIS score ≥ 2	LC fractures, 41.8%	APC fractures, 32.9%	<0.05
Transfusion requirements (units)	Unstable fractures, 4.9	Stable fractures, 2.4	<0.05
	APC fractures, 4.9	LC fractures, 2.8	<0.05
	LC3 fractures, 5.4	LC1 fractures, 2.4	<0.05
	APC3 fractures, 7.2	APC1 fractures, 2.2	<0.05
	APC3, APC2, LC3, LC2, CMI fractures, 5.1	APC1, LC1, VS fractures, 2.4	<0.05

AIS, Abbreviated Injury Severity; LC, lateral compression; APC, anteroposterior compression; CMI, combined mechanism injury; VS, vertical shear.

- **5340 patients**
- **F-U médian 13 j (0-1117)**
- **64/238 † (27%) dus à # bassin**
- **Cause principale de décès:**
 - **hémorragie massive (34%)**
- **Non-survivants**
 - **# type C, # complexes**
 - **lésions associées (cave# ouvertes!)**
 - **♂ = 56% ($p < 0.001$)**

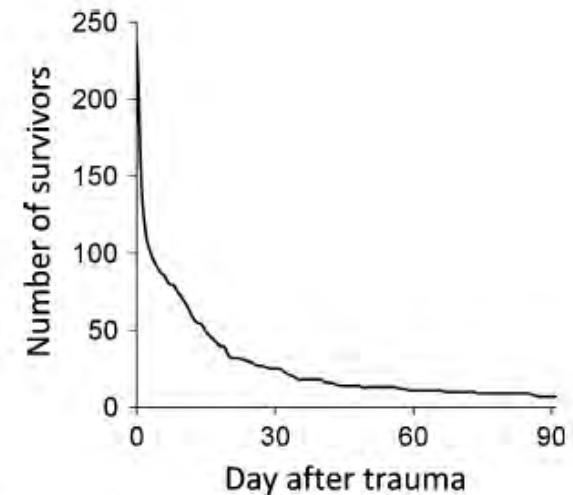
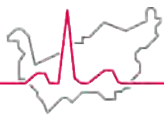


Fig. 3 The graph shows the survival curves of patients who died with pelvic ring fractures. More than 50% of patients who did not survive died within the first 2 days after trauma, while 3% of patients died later than 3 months after trauma.



Abbreviated Injury Score (AIS)

Regions	AIS*	AIS Meaning
Head, Neck, C-spine	1	Minor
Face including nose, mouth, eyes, ears	2	Moderate
Thorax, thoracic spine, diaphragm	3	Serious
Abdomen and Lumbar spine	4	Severe
Extremities including pelvis	5	Critical
External soft tissue injury	6	Maximal (Currently untreatable)

*Abbreviated Injury Score

Calculate AIS for most severely injured body part in each region

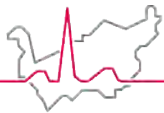
Injury Severity Score is calculated as sum of square of AIS for each body region

Maximum Score is 75

If any body region is assigned a 6, the overall ISS is automatically 75

Lactates à l'admission

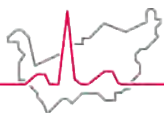
- **Normal range:** 0.6 - 2.0 mmol/l
- **Survivors w/o pelvic packing:** 2.8 ± 1.1 mmol/l
- **Survivors with pelvic packing:** 4.8 ± 1.7 mmol/l
- **Non-survivors (within 1st hour):** 8.6 ± 2.5 mmol/l



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Take home messages

- **# bassin = svt cause de l'instabilité hémodynamique → ceinture pelvienne!**
- **Ne pas perdre de tps!**
- **Damage control**
 - stabilisation # bassin instables (C-clamp, fix ex)
 - +/- laparotomie +/- pelvic packing
 - +/- angio-embolisation
- **Fixation secondaire (J5-J10)**



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Merci pour votre attention !



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