# Professor Anthony Freemont

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Emeritus Professor of Pathology

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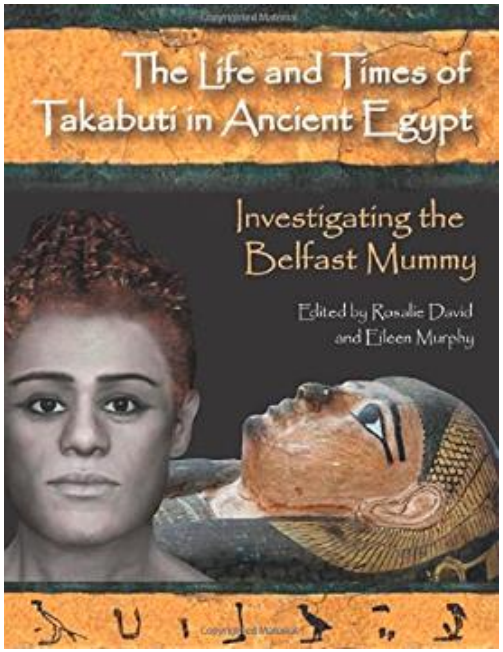
(Procter Professor of Pathology, Professor of Osteoarticular Pathology, Professor of Biomedical Egyptology, on retirement in 2021)




**MITOCHONDRIAL DNA OF TAKABUTI**
**DR K DROSOU & PROF A FREEMONT.**

**TAKABUTI'S HEALTH: PROTEOMICS – PROF A FREEMONT**

www.nature.com/scientificreports

scientific reports

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OPEN

# The first reported case of the rare mitochondrial haplotype H4a1 in ancient Egypt

Konstantina Drosou[1,2✉], Thomas C. Collin[3], Peter J. Freeman[4], Robert Loynes[1] & Tony Freemont[1]

Takabuti, was a female who lived in ancient Egypt during the 25th Dynasty, c.660 BCE. Her mummified remains were brought to Belfast, Northern Ireland, in 1834 and are currently displayed in the Ulster Museum. To gain insight into Takabuti's ancestry, we used deep sampling of vertebral

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Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep


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## Enhancing mummy 'palaeobiographies' through the use of multidisciplinary techniques and approaches

K.N. White [a,b,*], D. Chiasserini [c], R. Loynes [a], A.R. David [a], B.E. van Dongen [b], K. Drosou [a], R. Forshaw [a], S. Fraser [b], P. Causey-Freeman [d], J. Metcalfe [a], E. Murphy [e], M. Regan [f,h], P.J. Reimer [e], D.G. Tosh [h], A. Whetton [g], A.J. Freemont [a]

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[c] The Stoller Biomarker Discovery Centre, University of Manchester, UK
[d] Informatics, Imaging and Data Sciences, University of Manchester, UK
[e] Archaeology and Palaeoecology, School of Natural and Built Environment, Queen's University Belfast, UK
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[g] School of Veterinary Medicine University of Surrey, Guildford, UK
[h] National Museums Northern Ireland, Belfast, UK

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Initial report on Mr Bayoh's

**isolated**

left

**1st rib**

fracture

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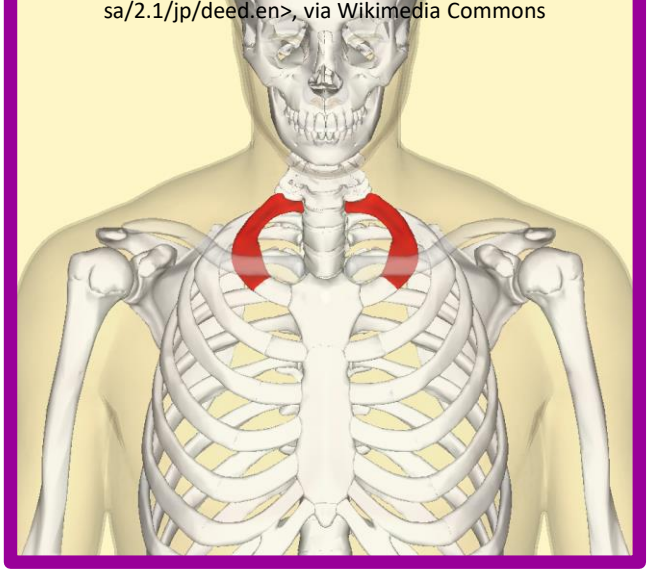
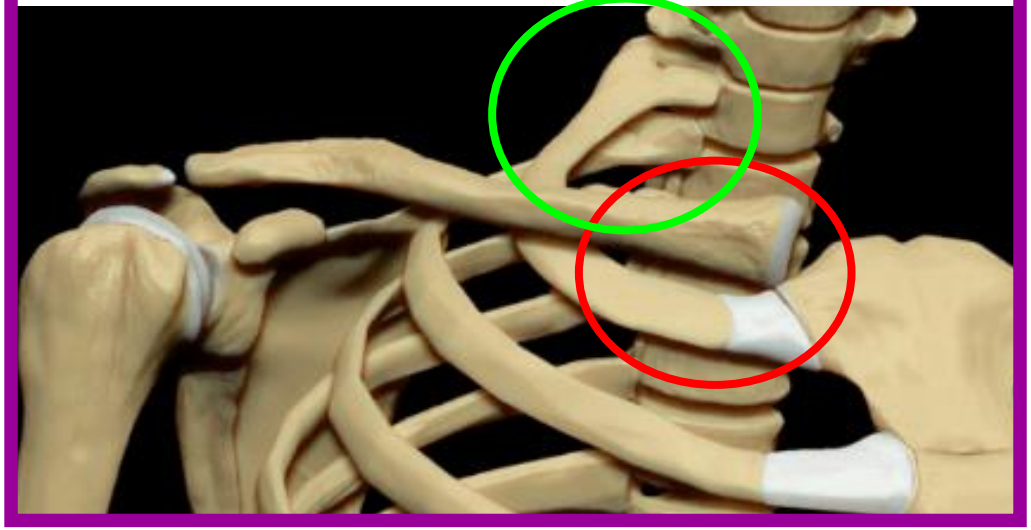
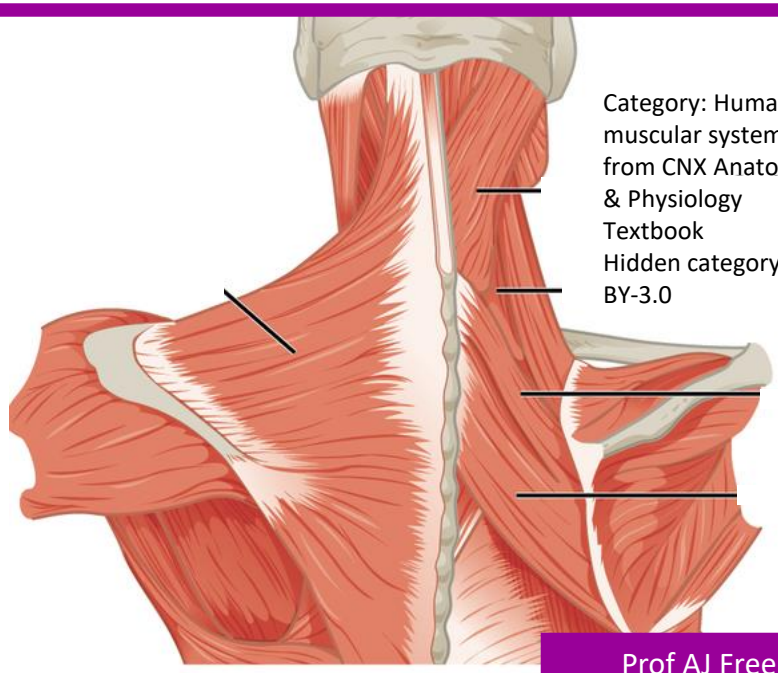


Anatomography, CC BY-SA 2.1 JP <https://creativecommons.org/licenses/by-sa/2.1/jp/deed.en>, via Wikimedia Commons

By DrJanaOfficial - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/wiki/File:Clavicle_3d_Model.gif



Henry Gray (1918) Anatomy of the Human Body 20th edition
Henry Vandyke Carter (1831–1897)



Category: Human muscular system from CNX Anatomy & Physiology Textbook
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On 27th April 2017 I received 6 microscope slides, stained H&E and Perl's. I reviewed the slides and noted:

- Part of a fractured bone.
- Tissue decomposition.
- Appearances suspicious of bleeding into the fracture and adjacent bone marrow/soft tissues.
- Osteocyte necrosis in bone adjacent to the fracture line.

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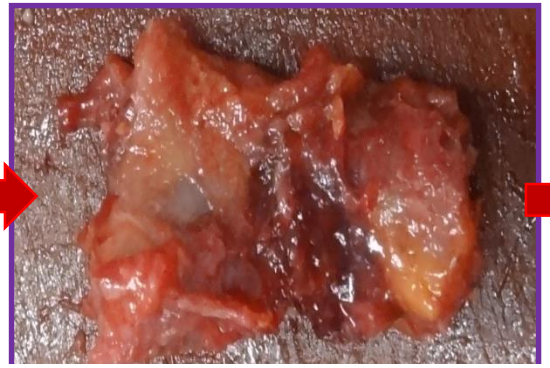
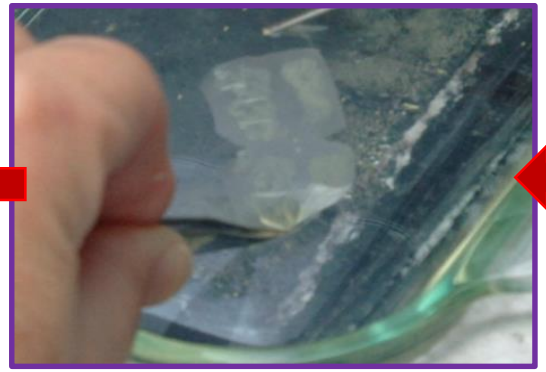
# Making a microscope slide



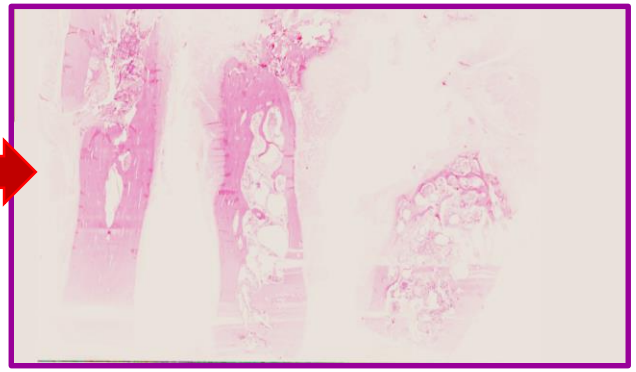
Tissue block

Flickr images uploaded by Flickr upload botCC-BY-SA-2.0Files from Ed Uthman Flickr stream



Wiki Lubi e-podręczniki - przyrodniczeCC-BY-3.0Self-published workUploaded via Campaign:e-podrecznikiPhotos by Witia

Staining



Waugh d. CC-BY-SA-4.0Self-published work

**Received 6 slides made from 1 block 3 stained H&E & 3 Perls**

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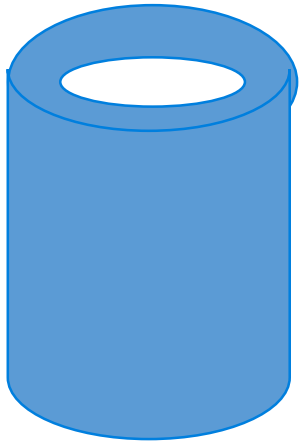

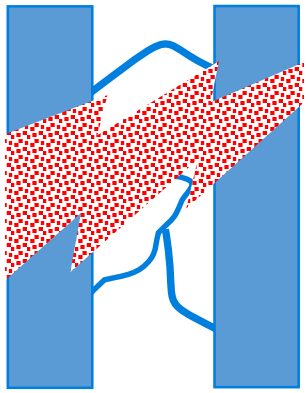

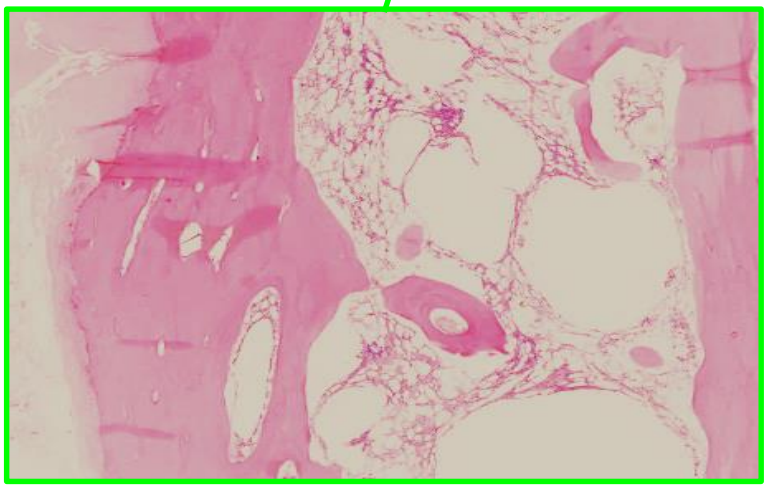

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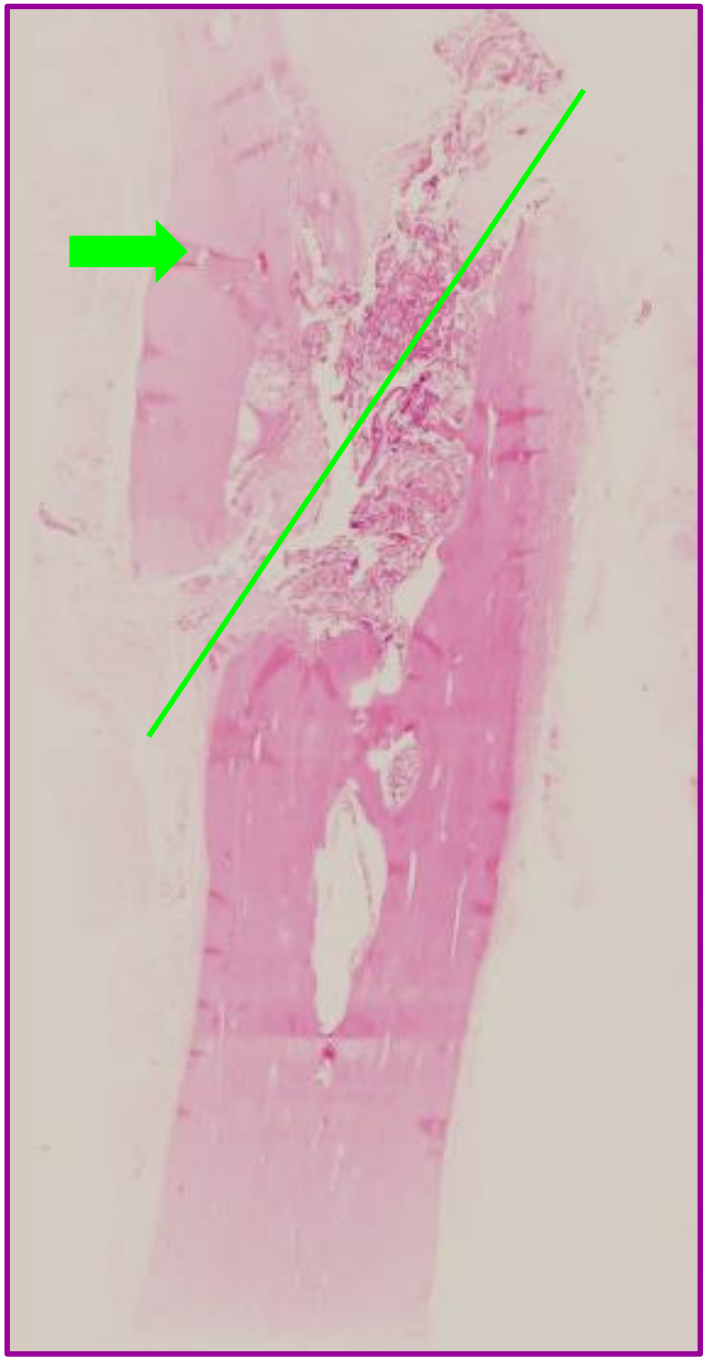

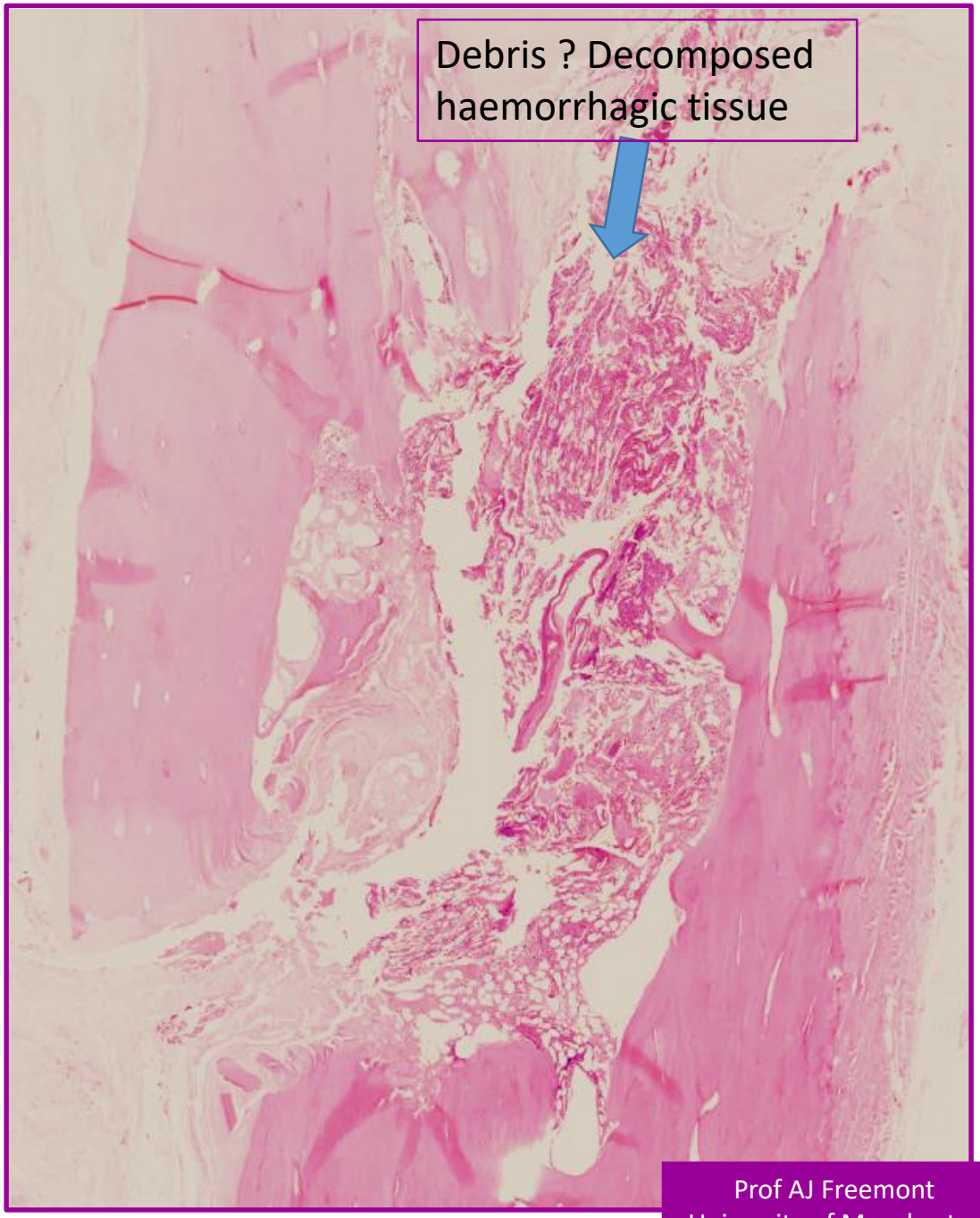


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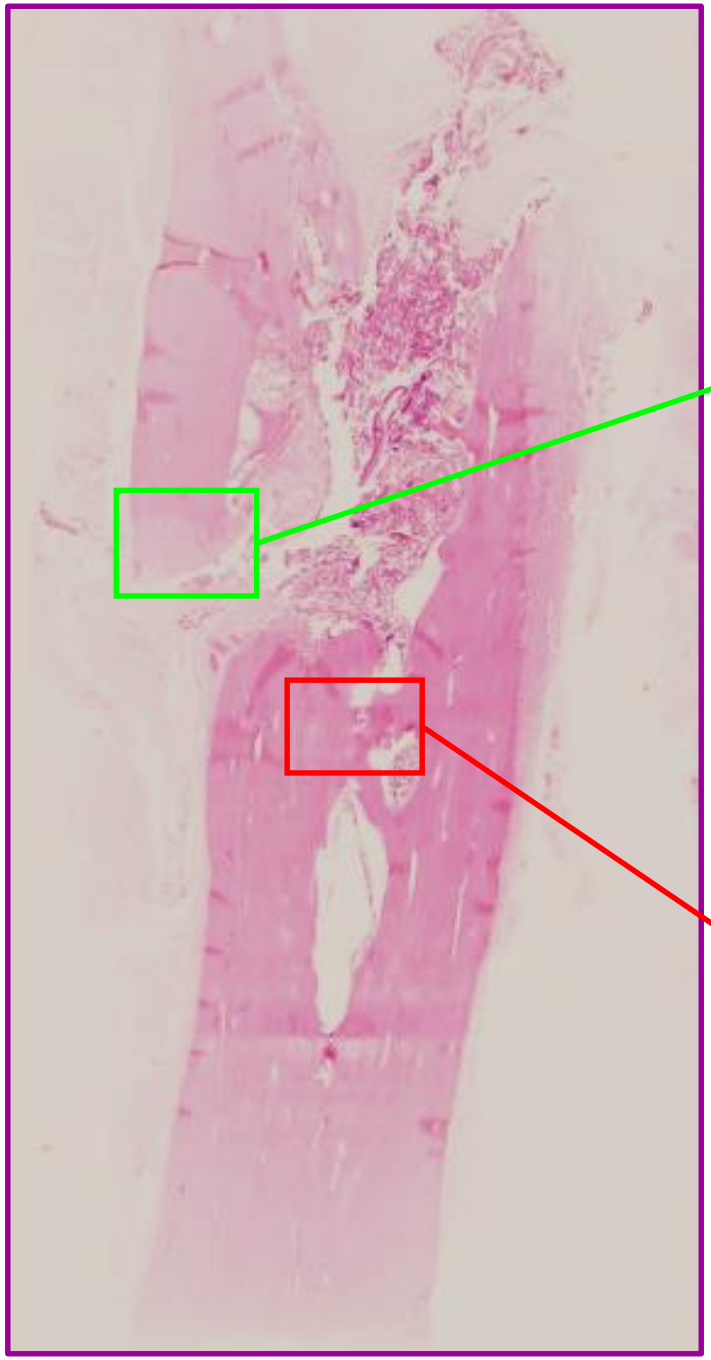

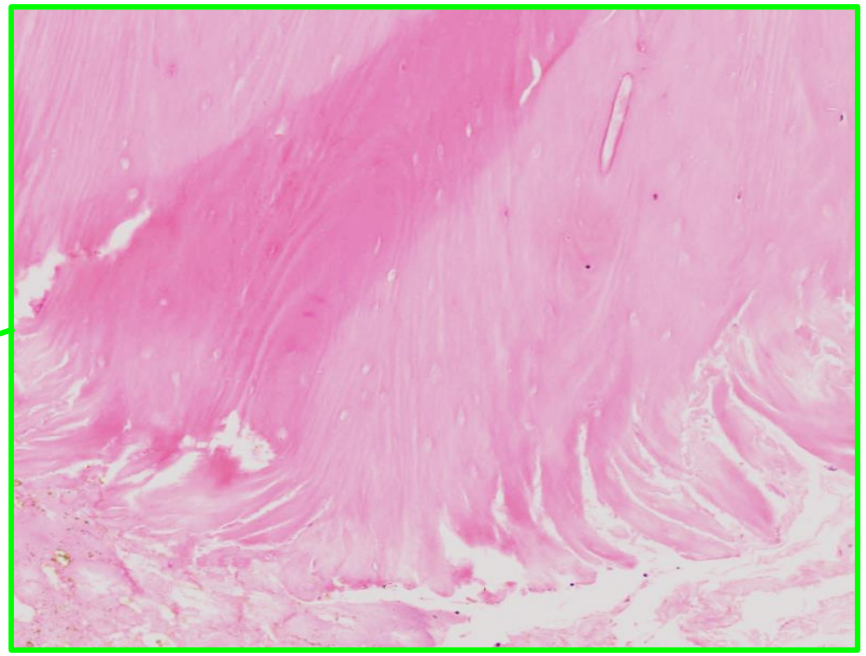

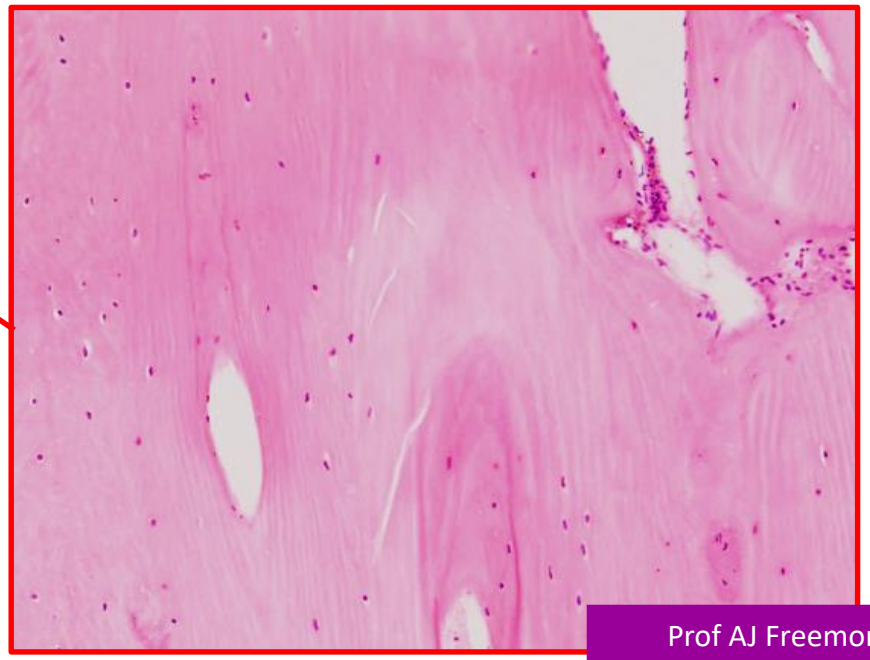

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**Is fracture present?** ✓

**Why decomposition present?** ?

**How old is fracture?**

- Osteocyte Necrosis (in life) ✓

  ( >2 hours before death)

- Bleeding (Haemorrhage) ? - Decomposition
  - Present (amount/distribution) ?
  - ? Fibrin (>6 hours before death) ?
- Evidence of bone healing X

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# Subsequent studies in 2017

Why decomposition present?

Components of haemorrhage?

- Haemorrhage present – Red blood cells
- Fibrin allows aging – visible >6hours old

**Special Stains – Identifying molecular structure using colour chemistry on extra sections**

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# Why was decomposition present?

- Initially no fracture on x-rays/autopsy
- Sensitive imaging: isolated 1st rib fracture
- Further autopsy 25 days after the first
- Local tissue decomposition had started
- Not unusual in refrigerated bodies

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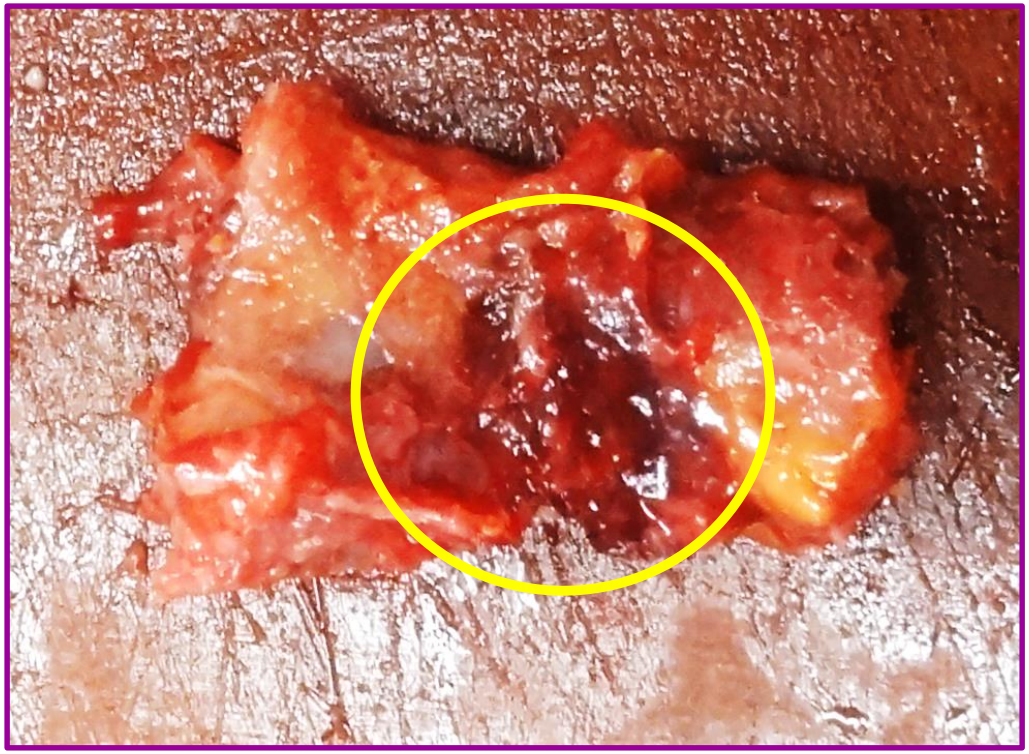
**Nature of any haemorrhage?**

- Red blood cells (number/distribution)
- Fibrin (also aging)

**Nature of debris in fracture line?**

**Fungi of decomposition present?**

# Sent images of fractures site



Area circled: Dark red, supporting possible ante mortem haemorrhage

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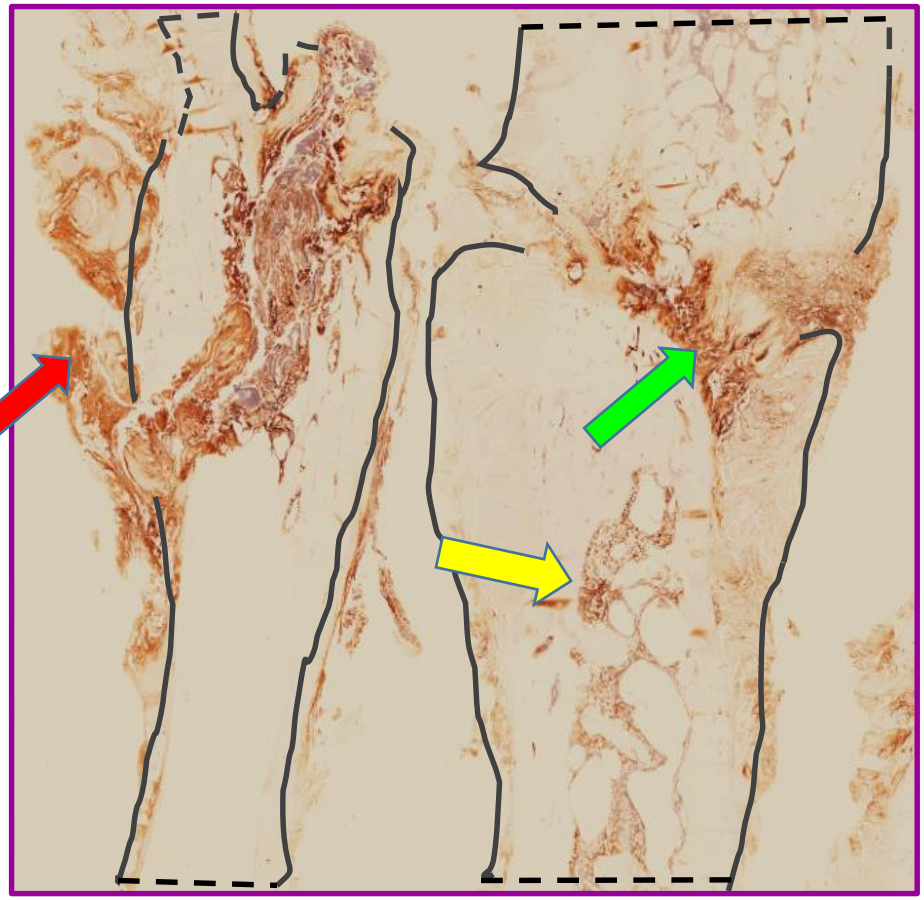
# Red blood cells doughnut shaped balloons.
# Surface of the “balloon” – Glycophorin A (GlyA)
# Decomposition: balloon bursts - surface fragments
# Recognise GlyA using brown stain (IHC)

CC-PD-MarkNational Institutes of Health images PD US NIH. https://commons.wikimedia.org/wiki/File:Redbloodcells.jpg



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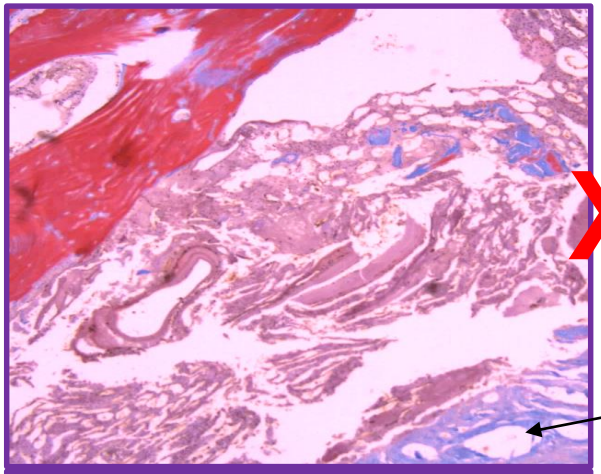


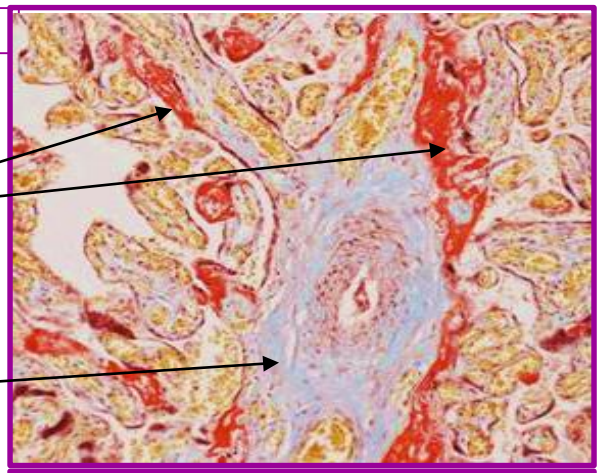
http://www.histologicaltechniques.com/MSB.html

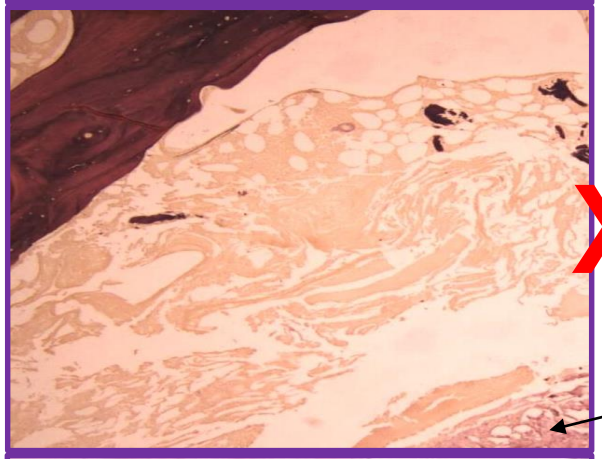
**MSB**

Visible fibrin

Orange-red

Collagen blue





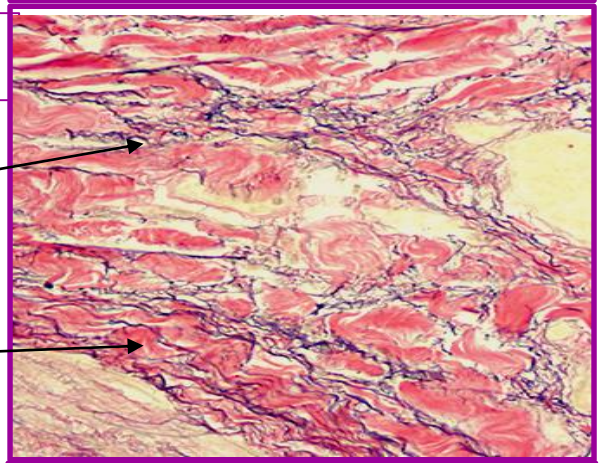
https://histolab.e-line.nu/en/nya_e-line/Chemicals/Farglosningar_och_pulver/Elastic_Van_Gieson_Stain_Kit_%28Miller%29_%28EVG%29_500_test?id=AS-RRSK11-500

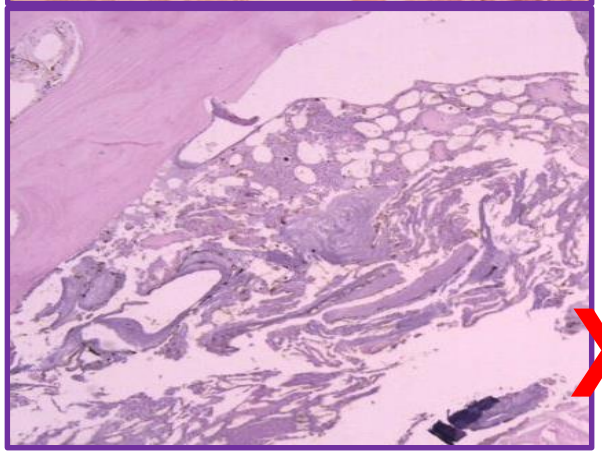
Elastin

**EVG**

Collagen

brick red





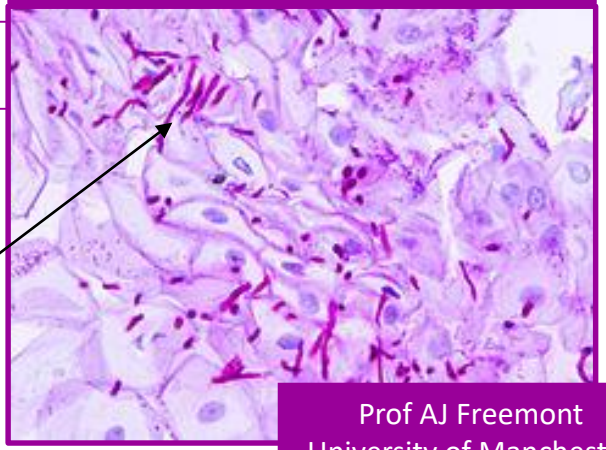
• License migration redundant GFDL CC-BY-SA-3.0-migrated

•Shttps://commons.wikimedia.org/wiki/File:Esophageal_candidiasis_(2)_PAS_stain.jpg

**PAS**

Fungi

Purple-Magenta



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# My view of fracture in 2017

- Solitary left first rib fracture
- Fracture occurred in life

  Amount/distribution of bleeding [GlyA]
  Presence of osteocyte necrosis

- Fracture probably occurred between 2 and 6 hours before death.

  >2 hours: osteocyte necrosis
  <6 hours: no visible fibrin

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# Cause of an isolated first rib fracture generally and in this case

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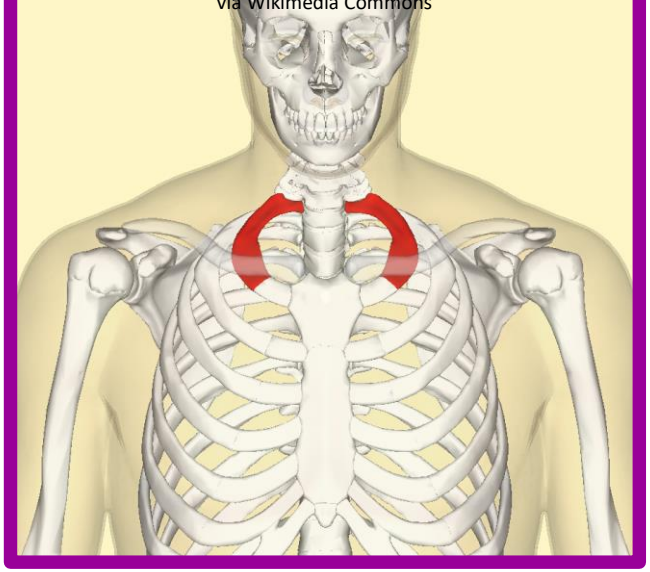
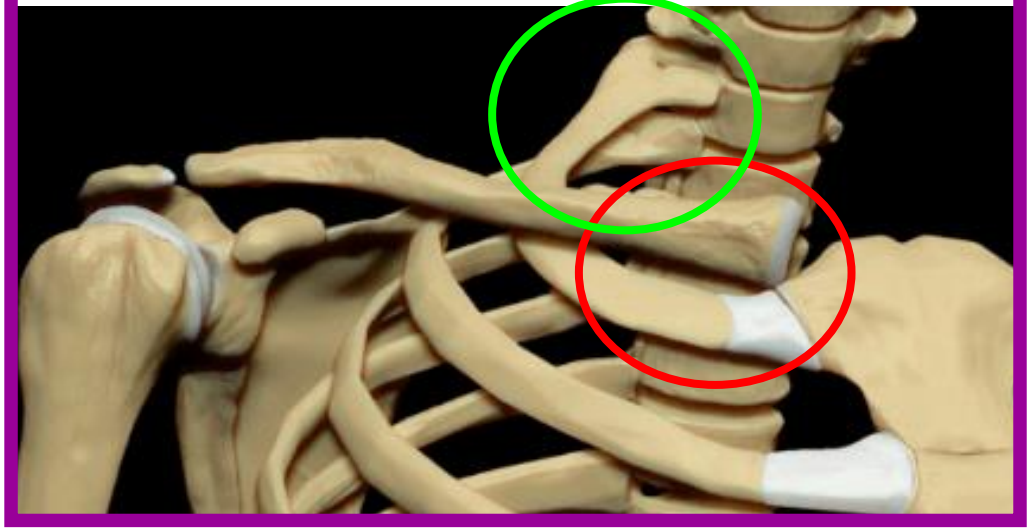
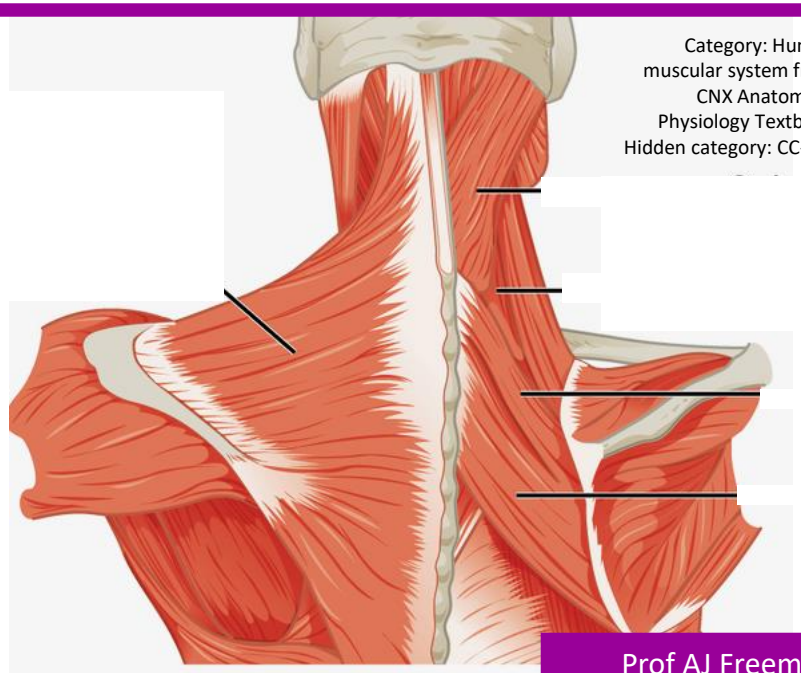


Anatomography, CC BY-SA 2.1 JP <https://creativecommons.org/licenses/by-sa/2.1/jp/deed.en>, via Wikimedia Commons

By DrJanaOfficial - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/wiki/File:Clavicle_3d_Model.gif



Henry Gray (1918) Anatomy of the Human Body 20th edition Henry Vandyke Carter (1831–1897)



Category: Human muscular system from CNX Anatomy & Physiology Textbook
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# Causes of isolated 1st rib fracture (either side)

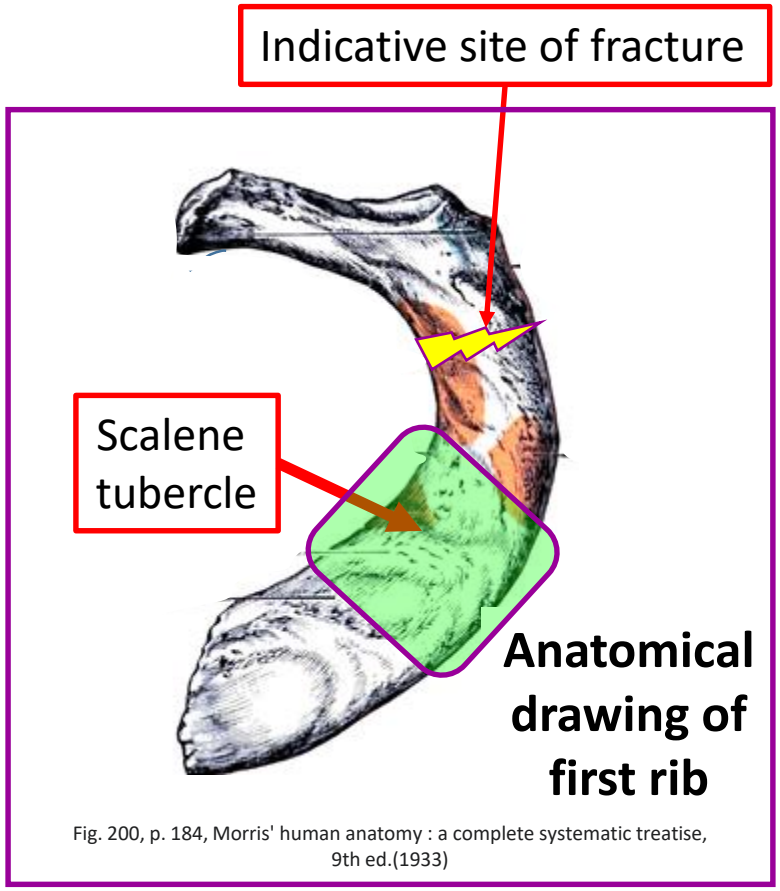


Fig. 200, p. 184, Morris' human anatomy : a complete systematic treatise, 9th ed.(1933)

- Direct external trauma (e.g. a kick directly to the rib)
- Indirect trauma e.g.:
  - falling on an outstretched arm
  - blow to the shoulder
  - Fracture caused by violent muscular contraction (Almost restricted to green area on diagram)

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**Based on witness statements available at time, my knowledge and understanding, and my findings:**

- Direct external trauma – **Unlikely**

  Isolated fracture, no reported event

- Falling on outstretched arm (or equivalent) – **Likely**

  Altercation with friend and interactions with police

- Blow to the shoulder (or equivalent) – **Possible**

  ? fallen/been brought down onto shoulder

- Violent muscular contraction – **Unlikely**

  Press up + heavy weight on body: fracture site inconsistent

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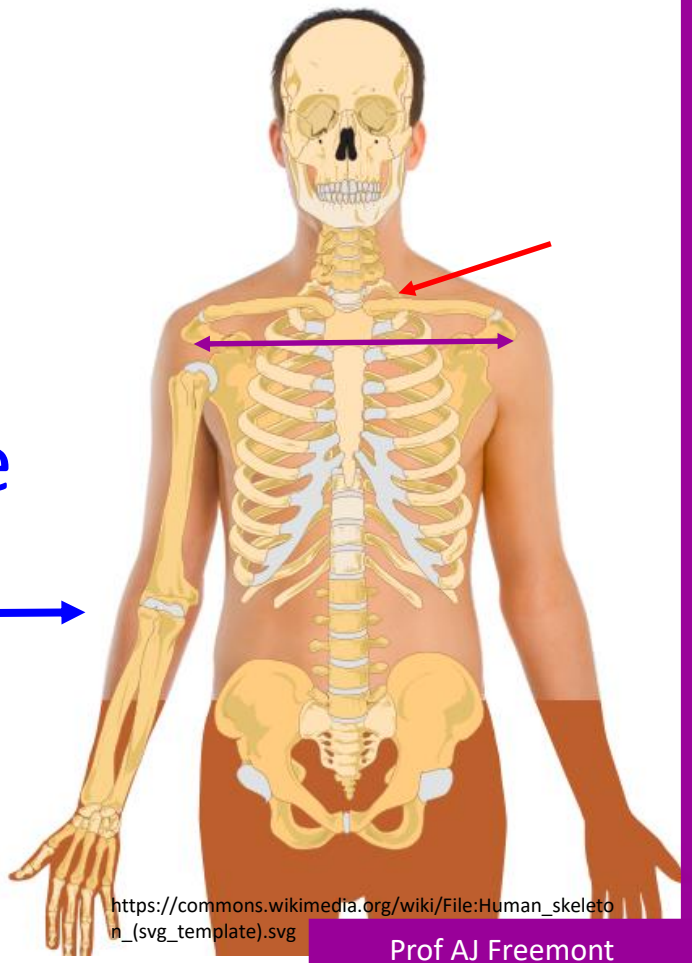
# Other hypothesised causes

- Handcuffs - **Unlikely**
  Forces inconsistent
- Fight - **Possible**
  Fall or equivalent
- Press up – **Unlikely**
  Fracture in wrong site
- Squeeze – **Unlikely**
- CPR - **Unlikely**
  See next slide



https://commons.wikimedia.org/wiki/File:Human_skeleton_(svg_template).svg

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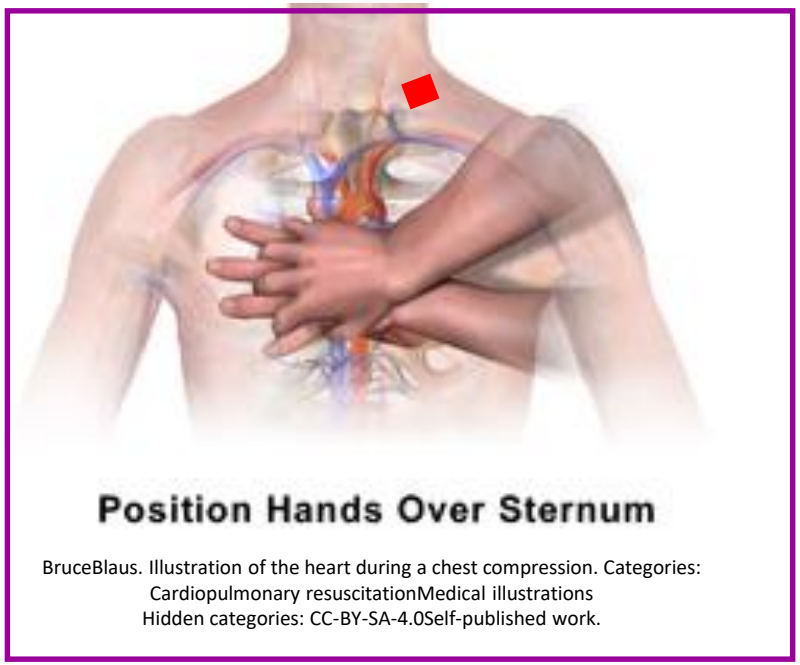
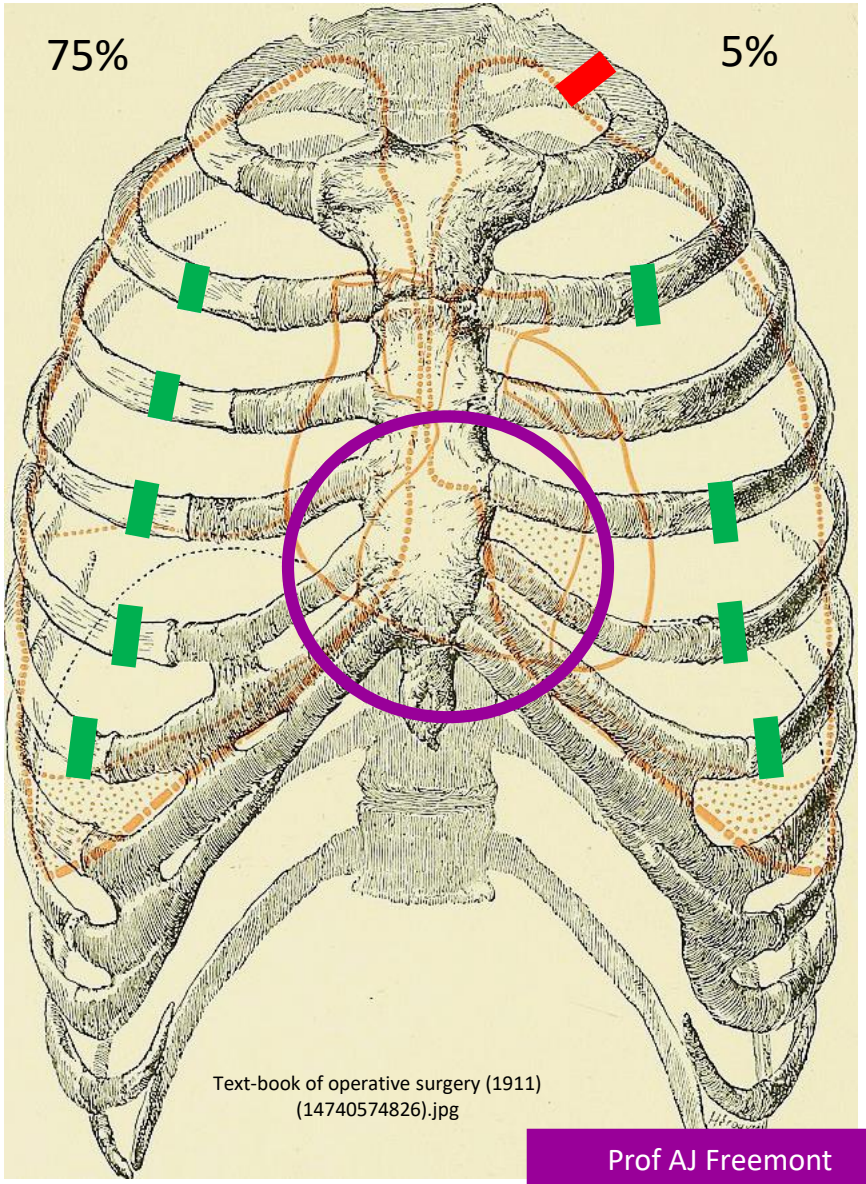
# COULD ISOLATED FRACTURE OF THE 1ST RIB BE CAUSED BY CPR?




BruceBlaus. Illustration of the heart during a chest compression. Categories: Cardiopulmonary resuscitationMedical illustrations
Hidden categories: CC-BY-SA-4.0Self-published work.

Video by Bangkok Hospital Phuket. Mikael Häggström (talk | contribs)Category: Cardiopulmonary resuscitation
Hidden categories: CC-BY-3.0Animated GIF files




Text-book of operative surgery (1911) (14740574826).jpg

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# New data have provided new insights

- Review of new scientific data from 2017
- New information from Inquiry team

- **Clearer timeline of events**.
  - What happened and when in the 6-12 hours before death
  - Management of collapse and arrest.
- **Toxicology analysis**
- **More evidence on aging fractures**
  - Published data on aging fractures
  - Osteocyte apoptosis biology

# Events in the 6-12 hours before death

## Where and how fracture might have occurred

Altercation with friend or police

## Greater understanding of collapse and cardiac arrest

- When heart stopped pumping
- No cardiac arrest until hospital
- Hospital CPR: systolic pressure: 70-140mmHg

**Time of death - 09.04  3/5/15**

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# Toxicology analysis

**Psychostimulants:** MDMA and αPVP

- Altered pain perception
- Behaviour changing

**Synthetic Androgen**: Nandrolone or similar

- Direct effect on osteocyte apoptosis
- May change time closest to death that apoptosis might 1st be seen

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# More evidence on aging fractures?

- Published data on aging fractures

Histopathology

*Histopathology* 2019, **75**, 74–80. DOI: 10.1111/his.13850

**Histological ageing of fractures in infants: a practical algorithm for assessing infants suspected of accidental or non-accidental injury**

Anie Naqvi,[1] Emma Raynor[1] & Anthony J Freemont[2]
[1]*University of Manchester Medical School, and* [2]*School of Biological Sciences, University of Manchester, Manchester, UK*

Osteocyte apoptosis: 1 hr before death in infants

Unpublished: Adults: 2hrs. Too few cases for publication

- Osteocyte apoptosis biology

Discussed in toxicology

# My view of fracture in 2023

- Solitary left first rib fracture
- Occurred in life
- Occurred <6 hours before death (09.04)
- Nandrolone effects & data from infants - could have occurred <2hrs before death
- Probably occurred in altercation with friend/police: ~2.5/1.75hr before death
- Caused by indirect injury: favour fall onto outstretched arm or equivalent

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