



REVISION SHOULDER ARTHROPLASTY AND THE MANAGEMENT OF PROXIMAL HUMERAL BONE LOSS: A NOVEL CLASSIFICATION SYSTEM PROVIDING INDICATIONS FOR THE TREATMENT

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Causes of PHBL

- Infection
- Stress shielding
- Difficult stem removal
- Aseptic loosening of previous implant
- Osteolysis secondary to wear debris
- Neoplasias



PHBL leads to...

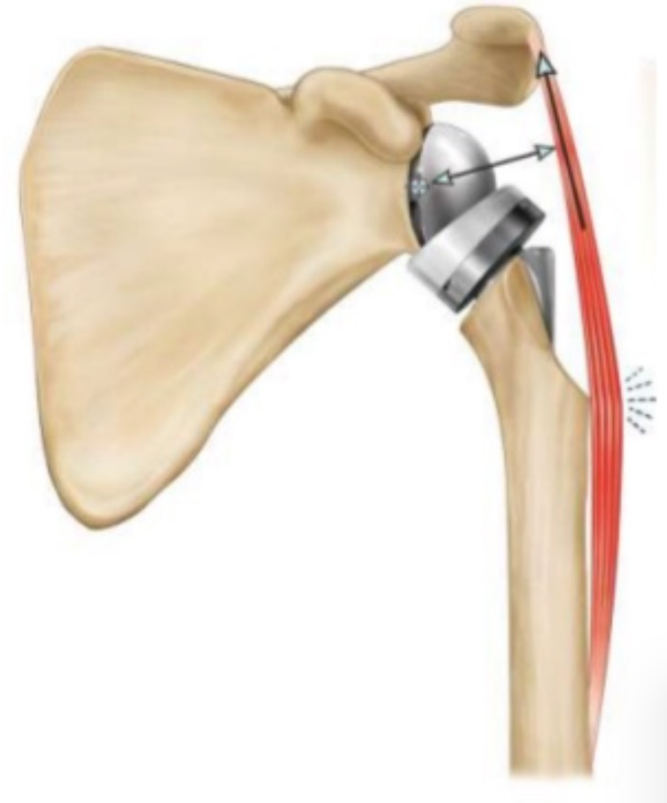
- 1. Postoperative instability**
- 2. Humeral stem loosening**
- 3. No cuff attachment**



Instability

Decreased Soft tissue Tension

Deltoid Wrapping --

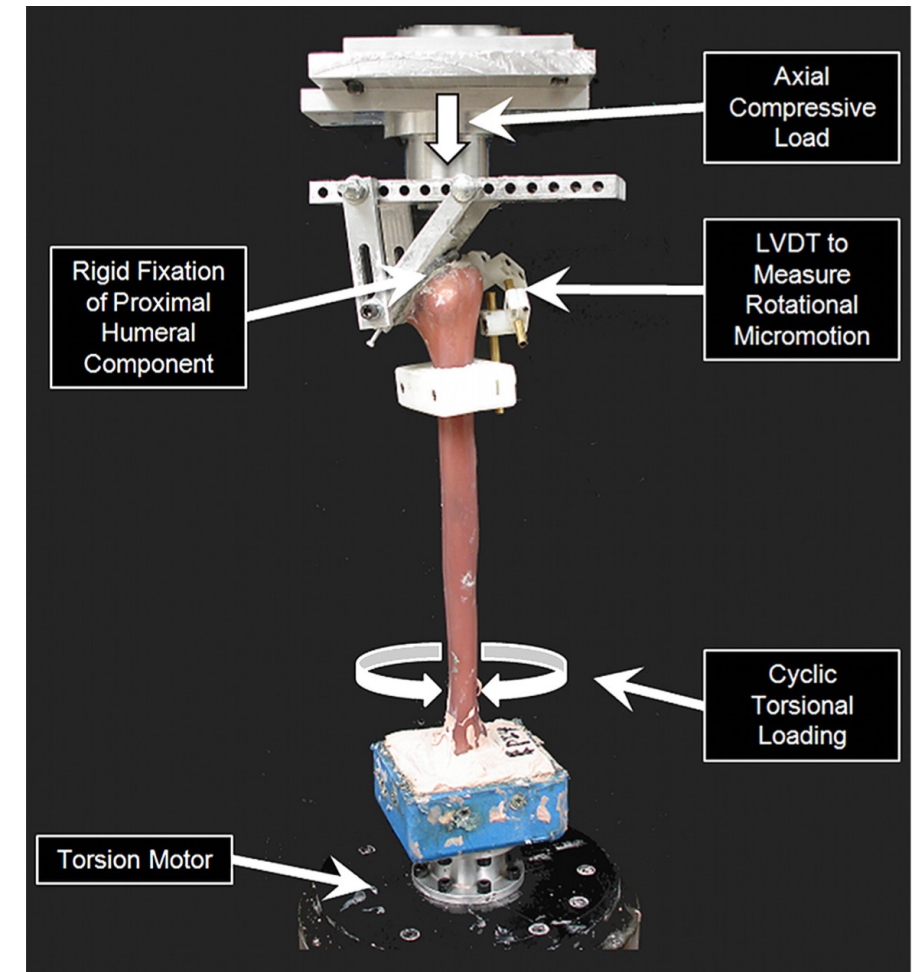


Humeral stem loosening

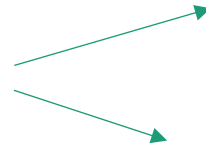
Biomechanical analysis has shown:
increased bending and torsional forces are exerted
on the humeral component when **significant bone**
loss is present

**Torsional stability of modular and non-modular reverse
shoulder humeral components in a proximal humeral
bone loss model**

Derek Cuff, MD^a, Jonathan C. Levy, MD^b, Sergio Gutiérrez, PhD^c,
Mark A. Frankle, MD^{d,*}



No cuff attachment



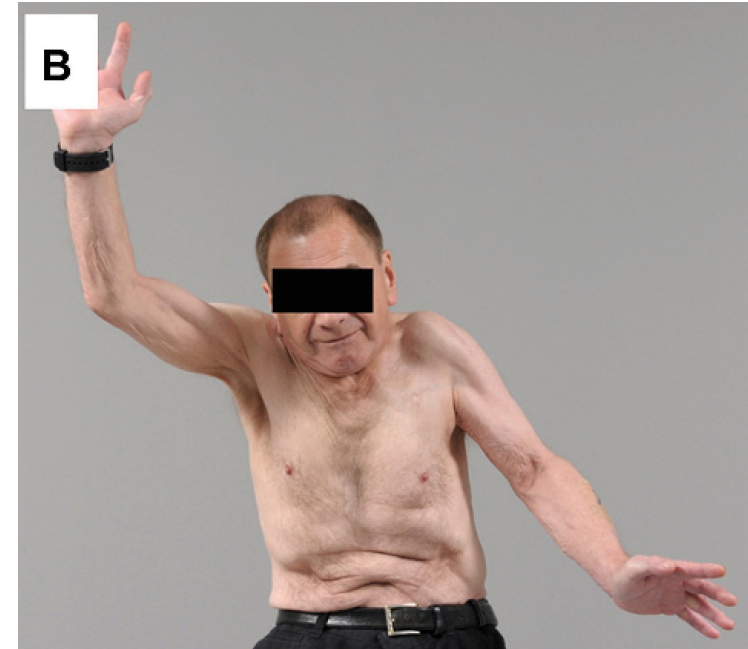
Reduced functional outcomes

Important deficit in external rotation



The effect of proximal humeral bone loss on revision reverse total shoulder arthroplasty

Scott P. Stephens, MD^{a,*}, Kevin C. Paisley, DO^b, M. Russell Giveans, PhD^c, Michael A. Wirth, MD^d



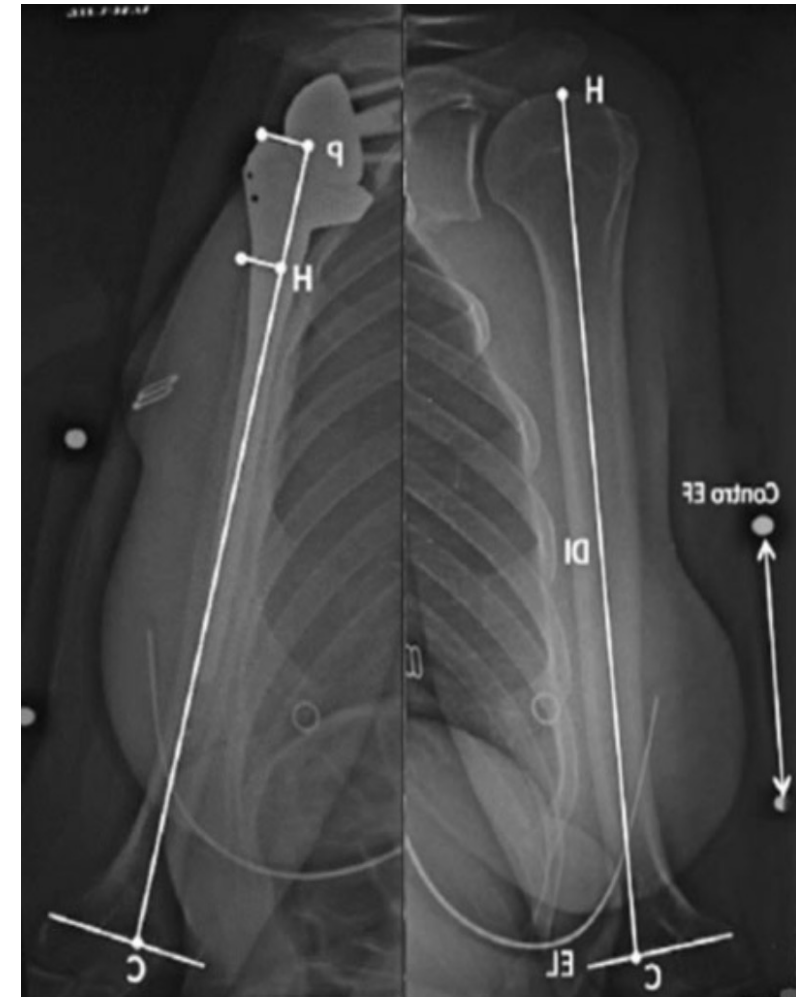
PREOPERATIVE ASSESSMENT

Läderrmann et al

1. RADIOGRAPHS

- AP
- AXILLARY
- BILATERAL FULL-LENGTH BOTH HUMERI WITH MARKERS

2. CT SCAN (with 3D reconstruction)



PREOPERATIVE ASSESSMENT

Signs of Loosening/ Risk of loosening:

- Radiolucent line formation



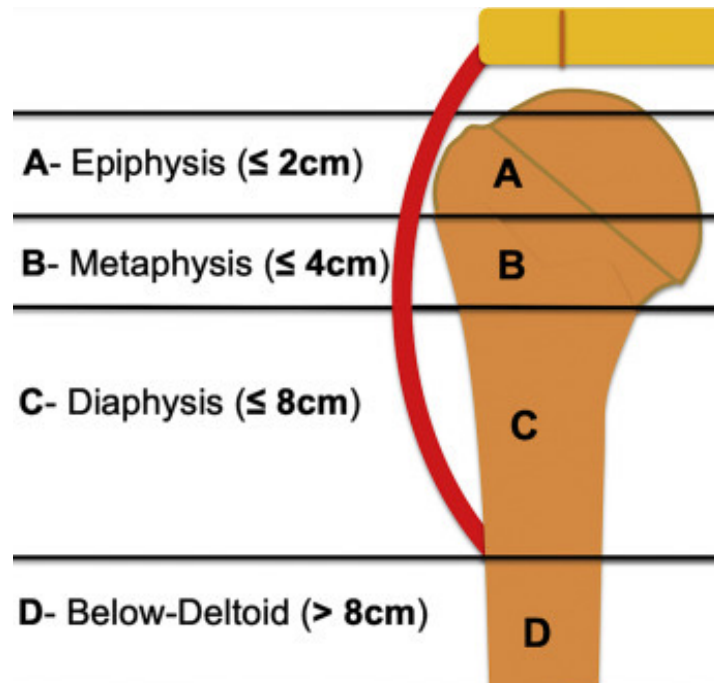
Inflammation-related laboratory data:

- Normal laboratory values do not exclude an infection
- If suspicion for infection is high → shoulder aspiration/ biopsy should be obtained before surgical planning

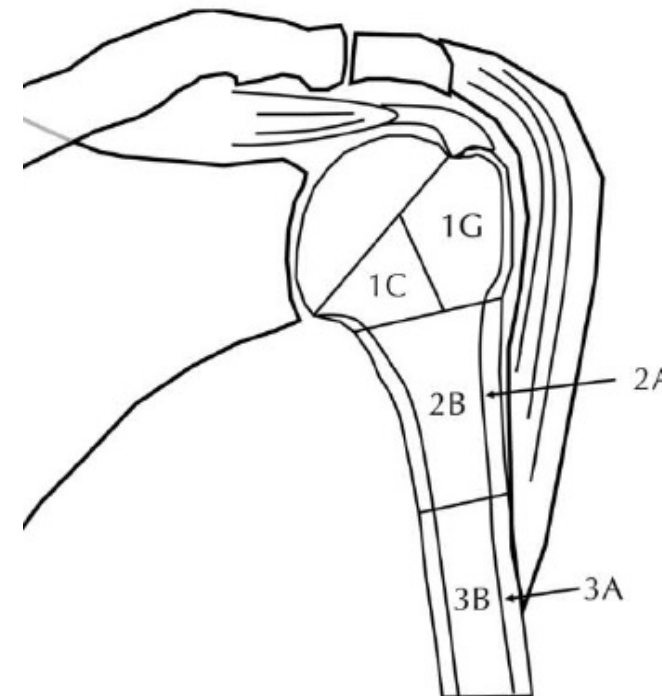


PREOPERATIVE ASSESSMENT

BOILEAU CLASSIFICATION 2016-2020



PHAROS CLASSIFICATION 2019



- 1C : calcar
- 1G : Greater Tub.
- 2A:Cortical Thinning
- 2B:Canal bone loss
- 3A:Cortical thinning
- 3B:Canal bone loss

1. Boileau P, Raynier JL, Chelli M, Gonzalez JF, Galvin JW. Reverse shoulder-allograft prosthesis composite, with or without tendon transfer, for the treatment of severe proximal humeral bone loss. J Shoulder Elbow Surg. 2020;29(11):e401-e15DOI: 10.1016/j.jse.2020.03.016.

2. Chalmers PN, Romeo AA, Nicholson GP, Boileau P, Keener JD, Gregory JM, et al. Humeral Bone Loss in Revision Total Shoulder Arthroplasty: the Proximal Humeral Arthroplasty Revision Osseous InSufficiency (PHAROS) Classification System. Clin Orthop Relat Res. 2019;477(2):432-41DOI: 10.1097/CORR.0000000000000590.

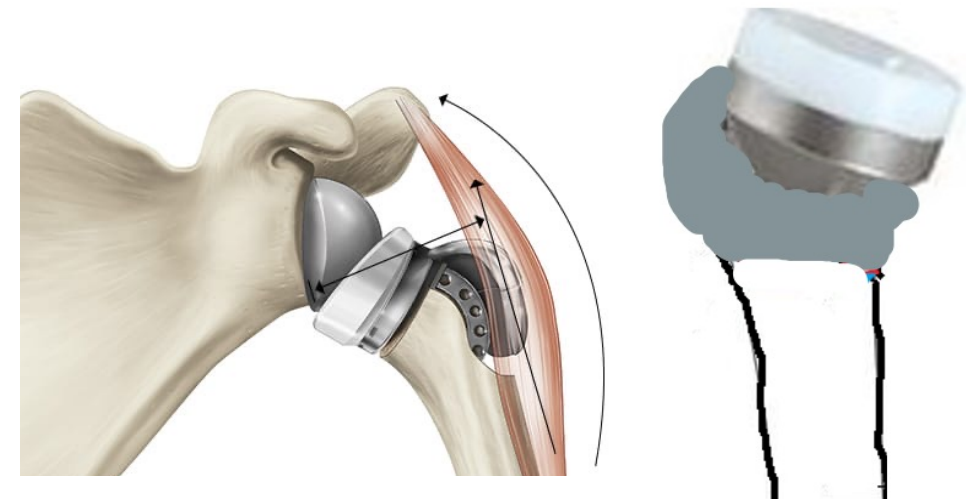
Standard Implants

WHO: PHAROS 1 / BOILEAU A-B / Chacon < 5 cm

HOW

HUMERAL Side

- Thicker polyethylene/tray
- Proud Stem
- Cementoplasty
- Metaphyseal augment



PHAROS > 2 / BOILEAU > C / Chacon > 5 cm

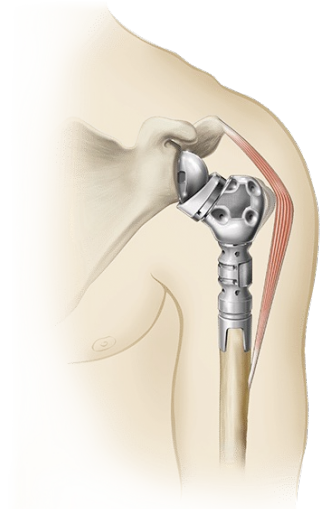
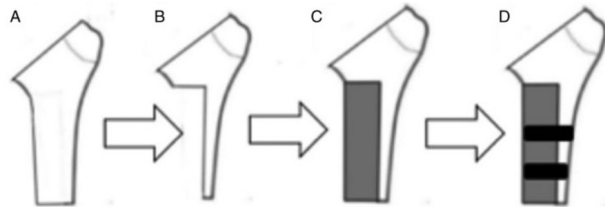
ALLOGRAFT PROSTHETIC COMPONENTS



MODULAR SEGMENTAL PROSTHESIS



(APC)

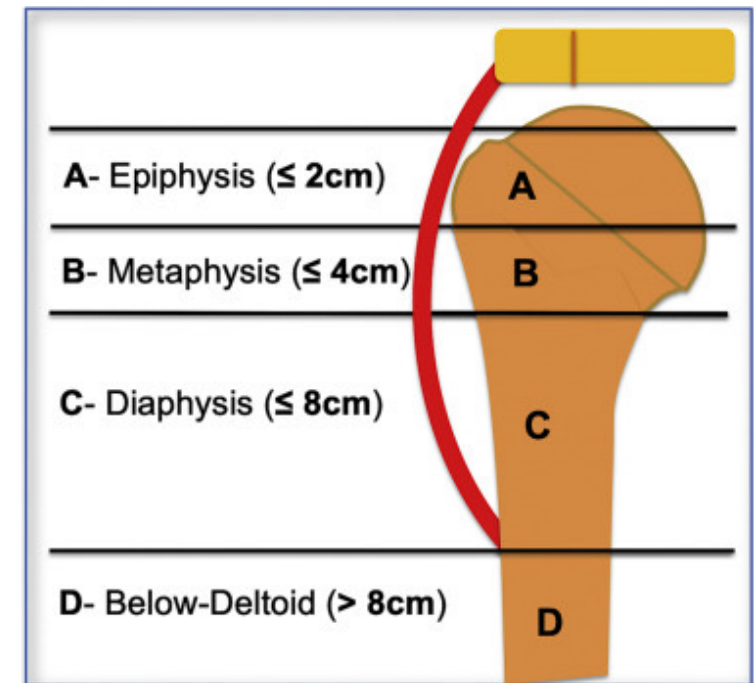


Bone loss is categorized as either less than or exceeding 5 cm, measured from the top of the medial humeral tray to the medial humeral shaft. The authors consider this 5 cm threshold as the point at which an allograft prosthesis composite (APC) should be considered.

McLendon et al

Using a 4 cm threshold for deciding between "cementoplasty reconstruction" and APC

Boileau et al





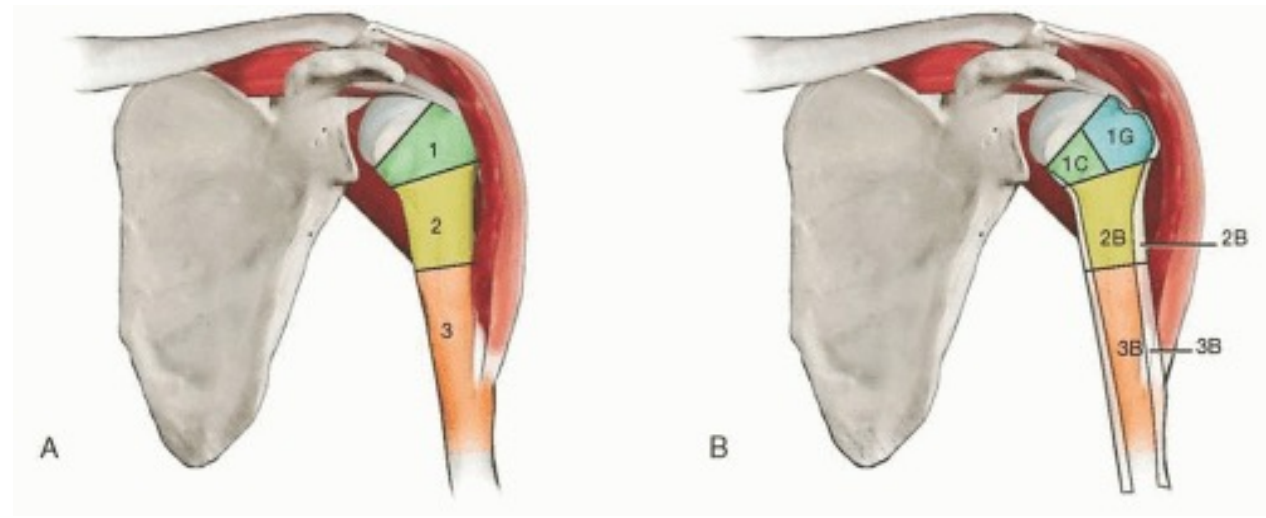
These classifications use a specific absolute and arbitrary value, which may not always be directly applicable to the variations found among individuals

Cross-sectional anatomical study conducted on **174 humeri** → **Mean maximum length of the humerus was 304.56 ± 14.16 mm and 276.60 ± 10.89 mm in males and females** → **3cm differences**

“PHAROS classification

Useful to anticipate the complexity of humeral reconstruction, but without guiding the surgeon's decision-making regarding the choice of surgical techniques and implants to address the bone loss and achieve a successful revision of the shoulder arthroplasty.

QUALITATIVE



NEW HUMERAL BONE LOSS CLASSIFIATION

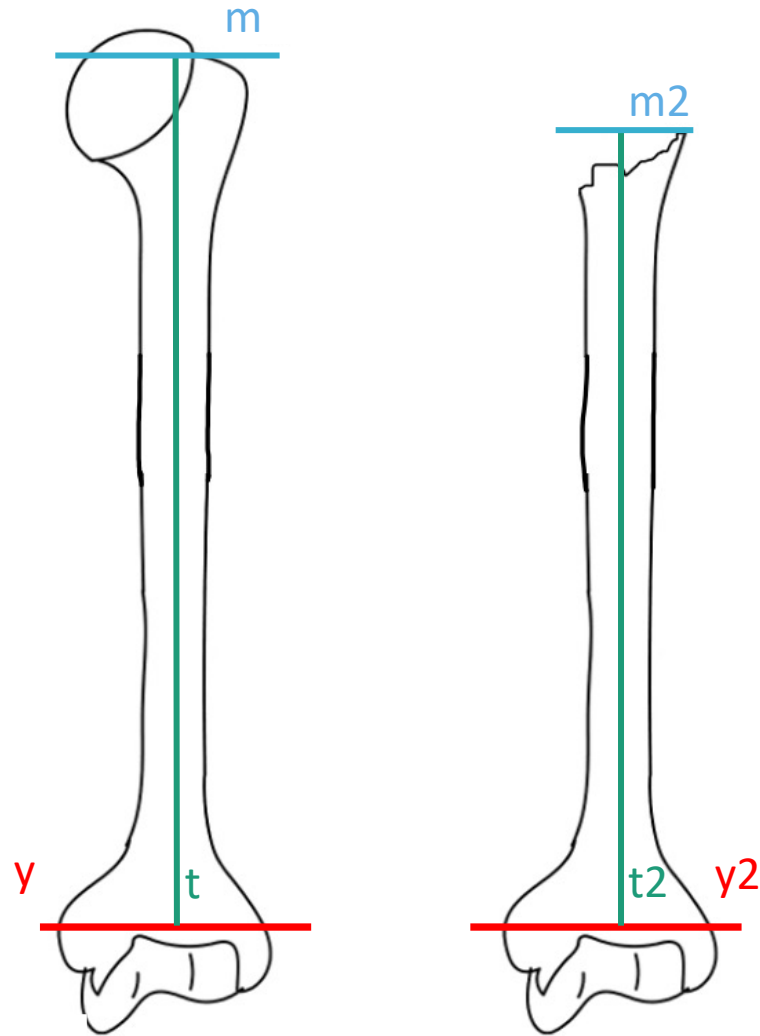
New percentage-based classification of proximal humeral bone loss

Correlated with guiding the treatment choice

Numerical-quantitative metric (percentage of bone loss in %)

QUANTITATIVE
&
PERSONALIZED

Consider anatomical differences among individuals while offering a precise and readily understandable measure for outline a personalized and efficient preoperative strategy

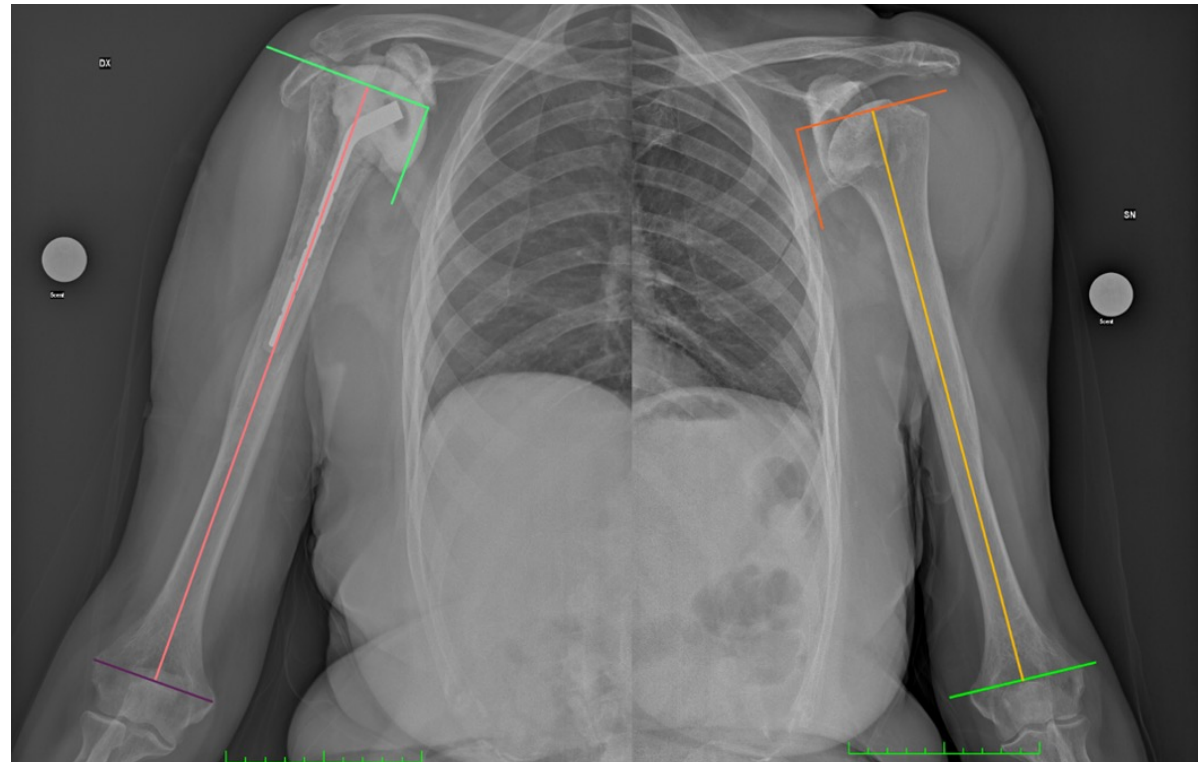


Schematic representation of the measurement of proximal humeral bone loss expressed as a percentage

$$X = (m2/m) \times 100$$

X = Humeral Bone Loss (%).

Bilateral XRay with measurements to predicted the percentage of bone loss



NEW HUMERAL BONE LOSS CLASSIFIATION

- **Type A:** Proximal Humeral Bone Loss $<5\%$ - Treatment: increase in **size of the metal liner and/or polyethylene;**
- **Type B:** Proximal Humeral Bone Loss $>5\%$ and $<15\%$ - Treatment: increase in **size of the metal liner and polyethylene + Cementoplasty;**
- **Type C:** Proximal Humeral Bone Loss $>15\%$ and $<40\%$ - Treatment: **APC / Minimal Tumoral Prosthesis**
- **Type D:** Proximal Humeral Bone Loss $>40\%$ - Treatment: **Massive Tumoral Prosthesis**

NEW HUMERAL BONE LOSS CLASSIFIATION

CONTROLATERAL TOTAL HUMERUS	RESIDUAL HUMERUS (cm)	HUMERAL BONE LOSS (%)
31	25	19,35483871

THANK YOU



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