

26TH ANNUAL
TAMPA
SHOULDER COURSE
ARTHROPLASTY & SPORTS



Tampa Marriott Waterside Hotel | Tampa, FL

ARGUMENT FOR STEMLESS

George S. Athwal, MD, FRCSC
Professor of Surgery

ROTH | MCFARLANE
HAND & UPPER LIMB CENTRE
ST. JOSEPH'S HEALTH CARE LONDON

26TH ANNUAL
TAMPA
SHOULDER COURSE
ARTHROPLASTY & SPORTS



**STEMLESS
IS THE WAY TO GO...**

STEMLESS IS THE WAY TO GO...

Bone preservation

OR time

Decrease blood loss

Decreased fracture rate

Less pain

More anatomic

Technically easier

BASIC SCIENCE



FINITE ELEMENT ANALYSIS

- Computerized model
- Predict
 - React to stresses
 - Fail or Deform



STRAIN ENERGY DENSITY

$U_{REF} = \text{INTACT SED}$



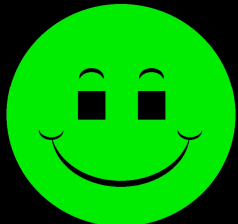
= RESORB

$U < (0.45)U_{REF}$
(55% less SED)



= STATIC

$(0.45)U_{REF} < U < (1.55)U_{REF}$
(within $\pm 55\%$ SED)



= REMODEL

$U > (1.55)U_{REF}$
(55% more SED)



Comparison of proximal humeral bone stresses between stemless, short stem, and standard stem length: a finite element analysis

2016



Najmeh Razfar, MESC^{a,b,c}, Jacob M. Reeves, MESC^{b,c}, Daniel G. Langohr, MASc^{a,b,c}, Ryan Willing, PhD^d, George S. Athwal, MD, FRCSC^{a,b,c,*}, James A. Johnson, PEng, PhD^{a,b,c}

Comparison of proximal humeral bone stresses between stemless, short stem, and standard stem length: a finite element analysis

2016

JOURNAL OF
SHOULDER AND
ELBOW
SURGERY
www.elsevier.com/locate/jymse

Najmeh Razfar, MESC^{a,b,c}, Jacob M. Reeves, MESC^{b,c}, Daniel G. Langohr, MASc^{a,b,c},
Ryan Willing, PhD^d, George S. Athwal, MD, FRCSC^{a,b,c,*}, James A. Johnson, PEng, PhD^{a,b,c}

- **HYPOTHESIS:**

- **Shorter & smaller** implants will better mimic the intact **bone** of the proximal humerus

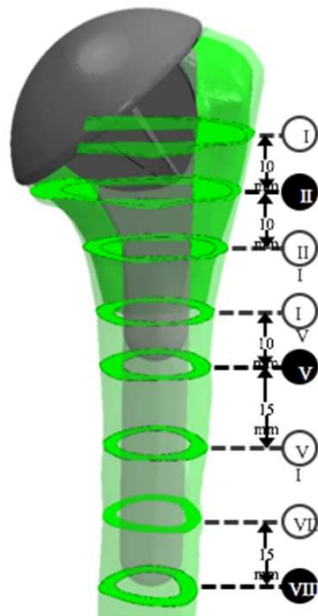
IMPLANT DESIGN



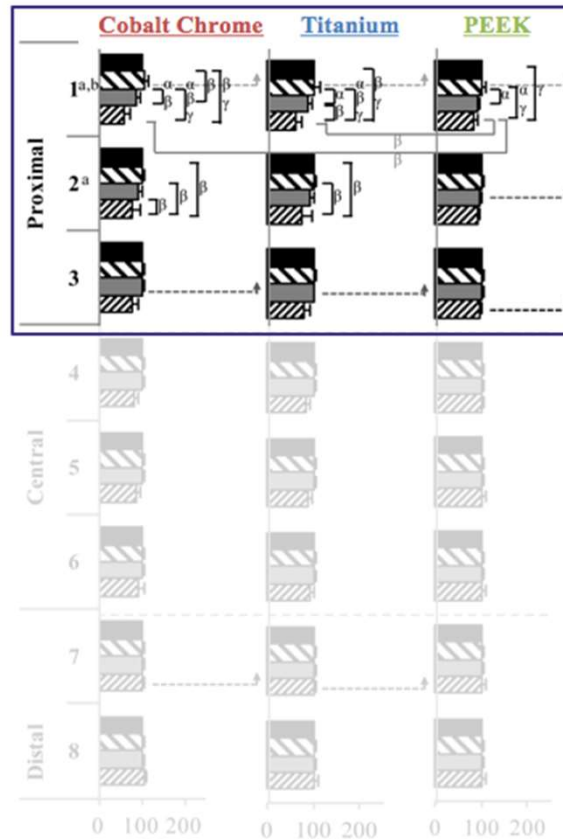
RESULTS

BONE STRESS

INTACT = STEMLESS



Material Main Effect:
a CoCr vs. PEEK; **b** Ti vs. PEEK
 $p \leq 0.03$
Length Main Effect:
 α $p \leq 0.045$
Material-by-Length:
 β $p \leq 0.025$
Material-by-Length-by-Abduction:
 \ast $p = 0.019$
Length-by-Abduction:
 γ $p = 0.017$



Arrow indicates when implant's mean stresses meet/exceed the intact stresses.

Average Von Mises Stress [% Intact]

BONE STRESS

Reducing Stem Length



Better Mimics Native Bone Stresses



Decreases Stress Shielding



STEMLESS



Schulich
MEDICINE & DENTISTRY



STEMLESS



#1

2015

#4

2019

#3

2018

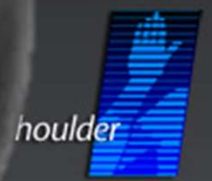
#5

2019



#2

2017

Schlich
MEDICINE INDUSTRY



STEMLESS OUTCOMES

Author	Implant	n	f/u (years)	Constant Score	Revision rate
Huguet et al. JSES 2010	TESS 	63	3	75	0%
Berth et al. JOT 2013	TESS 	41	6	69	0%
Bell et al. IJSS 2014	Affinis Short Stem 	38/12	1/2	75/86	2%
Habermeyer et al. JSES 2015	Eclipse 	78	5	75	9%
Churchill et al. JBJS 2016	Simpliciti 	149	2	71	2%
Collin et al. Int Orth 2017	Simpliciti 	47	3	69	4%

**0-9%
Revision
Rate!!**

REVISION RATE

Author	Implant	n	f/u (years)	Constant Score	Revision rate
Huguet et al. JSES 2010	TESS 	63	3	75	0%
Berth et al. JOT 2013	TESS 	41	2	65	0%
Bell et al. IJSS 2014	Affinis Short Stem 	38/12	1/2	75/86	2%
Habermeyer et al. JSES 2015	Eclipse 	78	5	75	9%
Churchill et al. JBJS 2016	Simpliciti 	149	2	81	2%
Collin et al. Int Orth 2017	Simpliciti 	47	3	69	4%

No Humeral Loosening

No Humeral Loosening

No Humeral Loosening

No Humeral Loosening

No Humeral Loosening

No Humeral Loosening

REVISION REASONS

- Rotator cuff tear
- Subscapularis failure
- Infection
- Instability
- Glenoid loosening



REVISABILITY

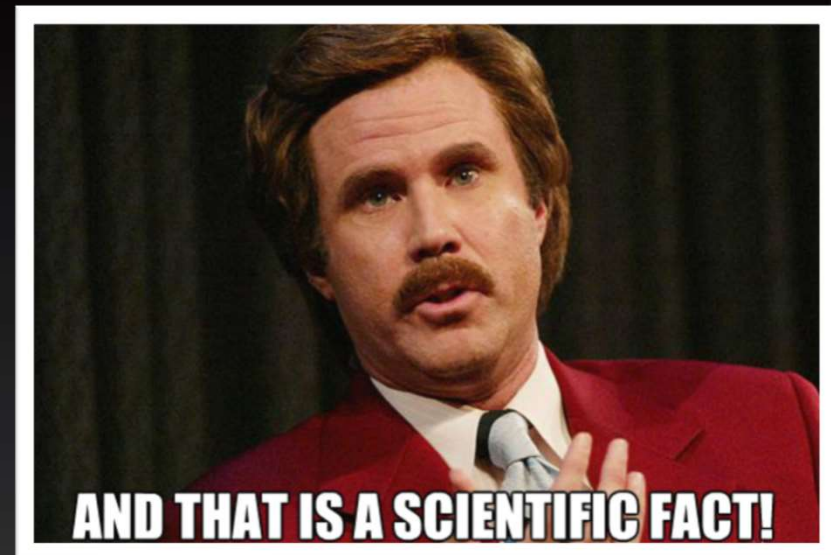
- Holschen et al 2017 *Musculoskeletal Surg*
- 60 Revisions TSA to RTSA
 - 40% stemless to RTSA
 - 60% stemmed implant to RTSA
- > 2 years follow-up

HOLSCHEN ET AL 2017

- Stemless versus Stemmed Revisions
 - Surgical time 84 vs 98 min $p < 0.01$
 - Humeral component removal difficulties
 - 17% versus 31%
 - Constant score $p = 0.03$
 - ASES score $p = 0.01$

SUMMARY

- Stemless is the way...
...and it is here to stay
- Primary fixation
- Easier revision!





THANK

**Jan 20-22
2022**

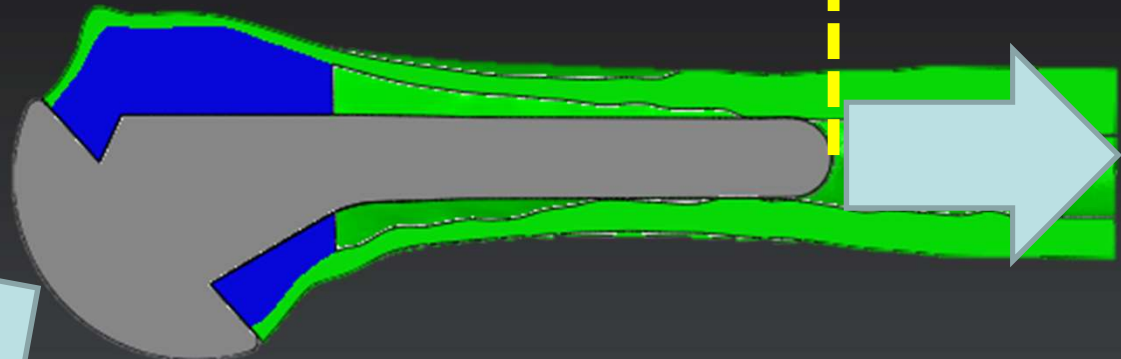
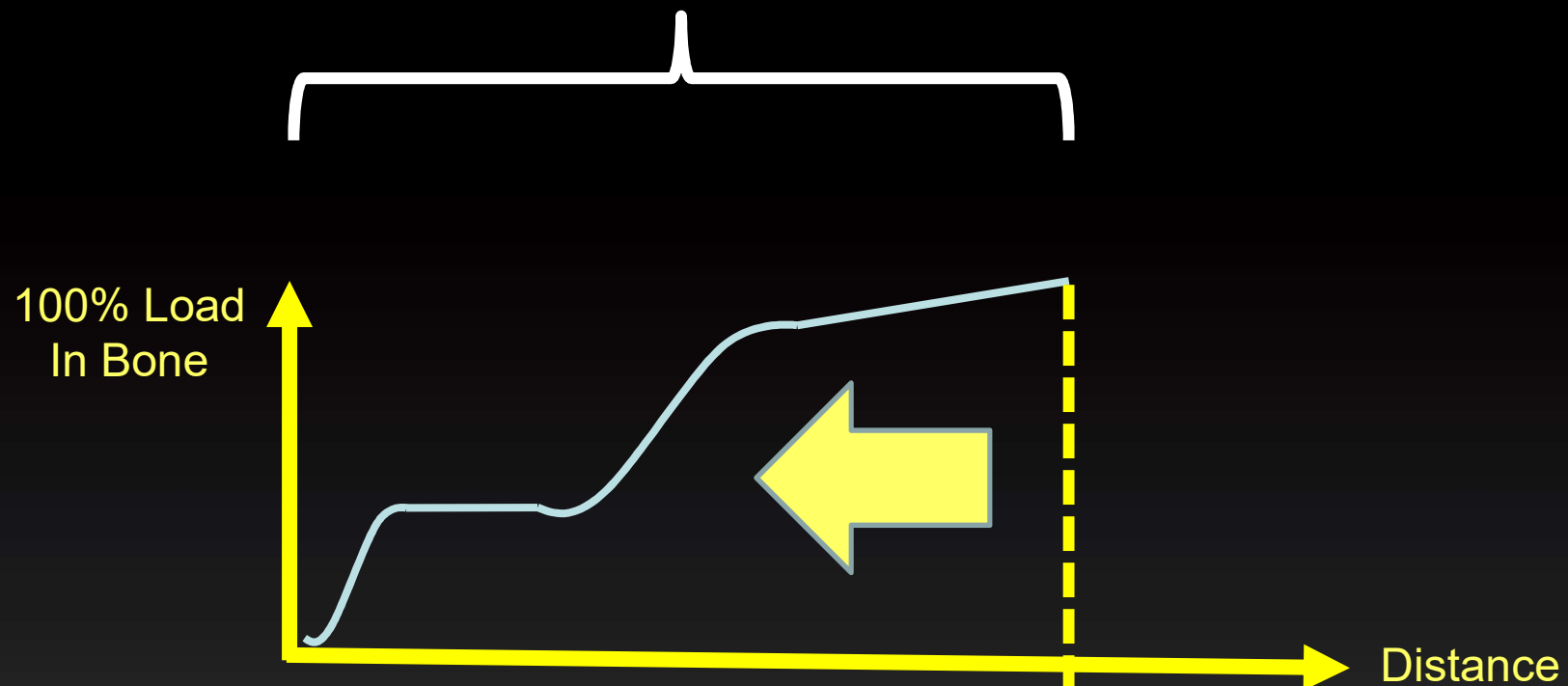
YOU



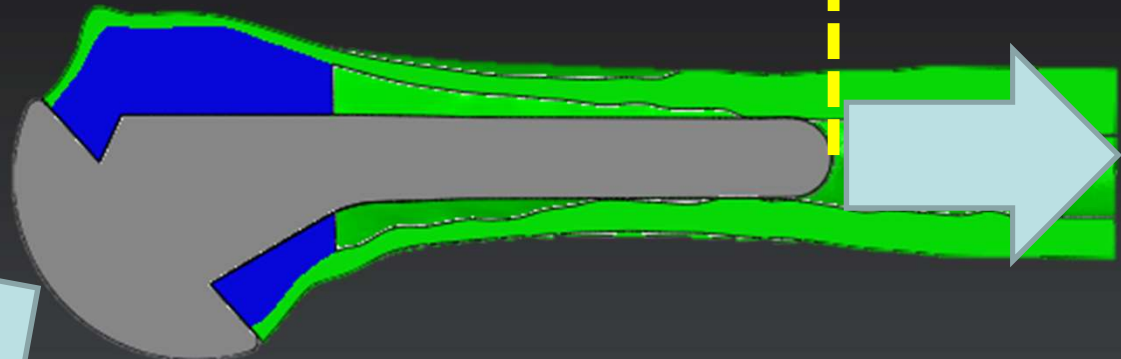
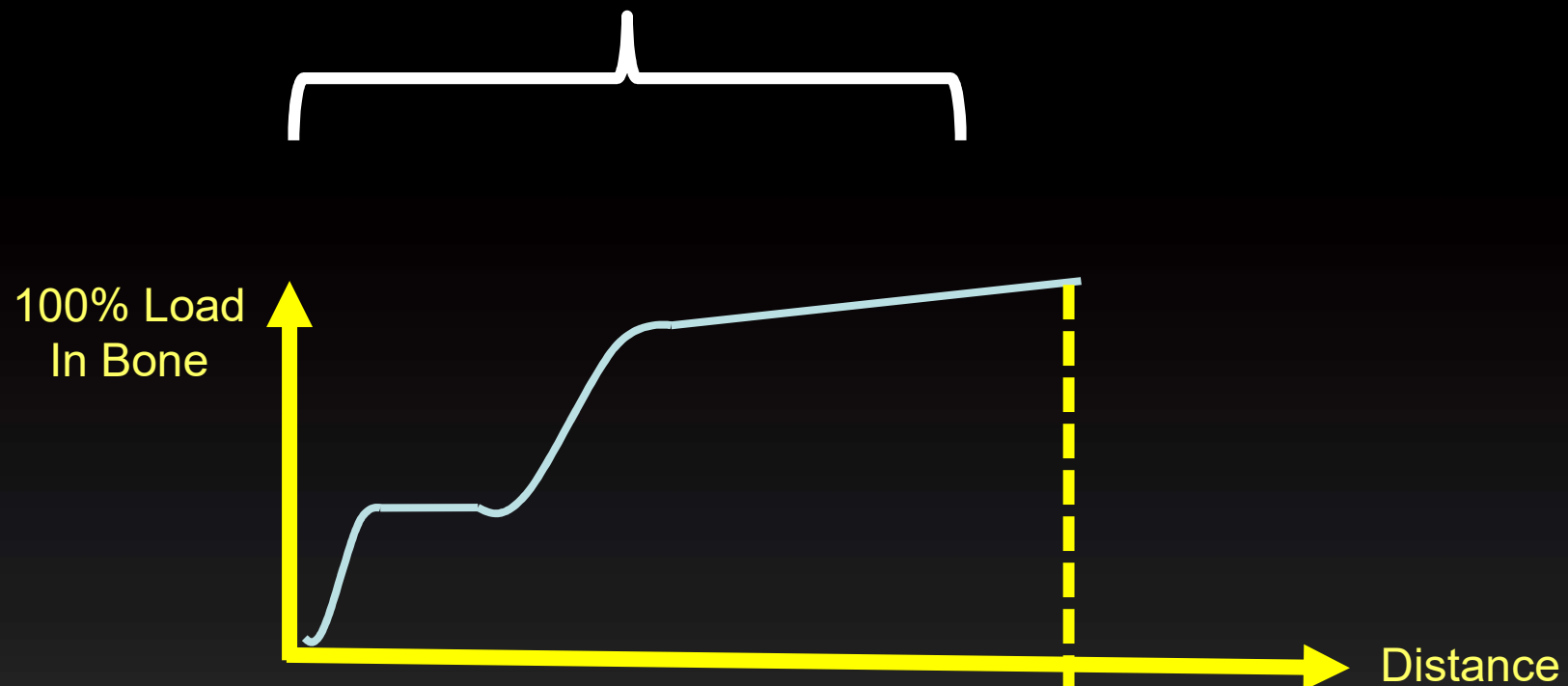
Utah, USA

HOW DOES LOAD TRANSFER & STRESS SHIELDING OCCUR?

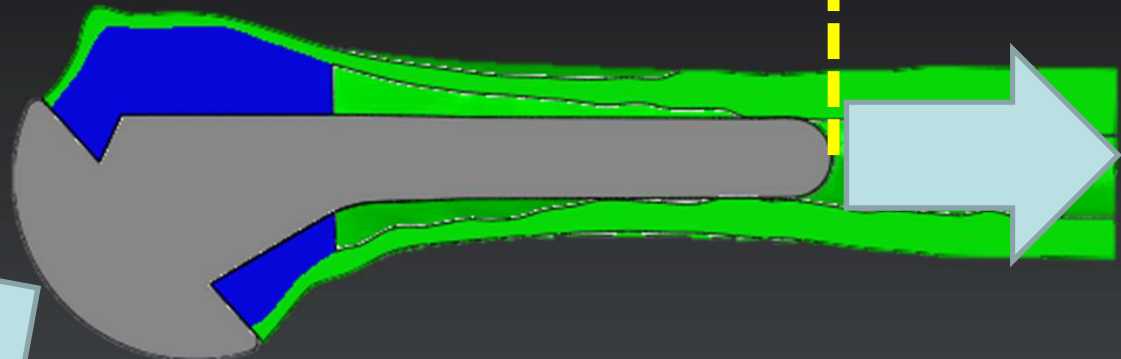
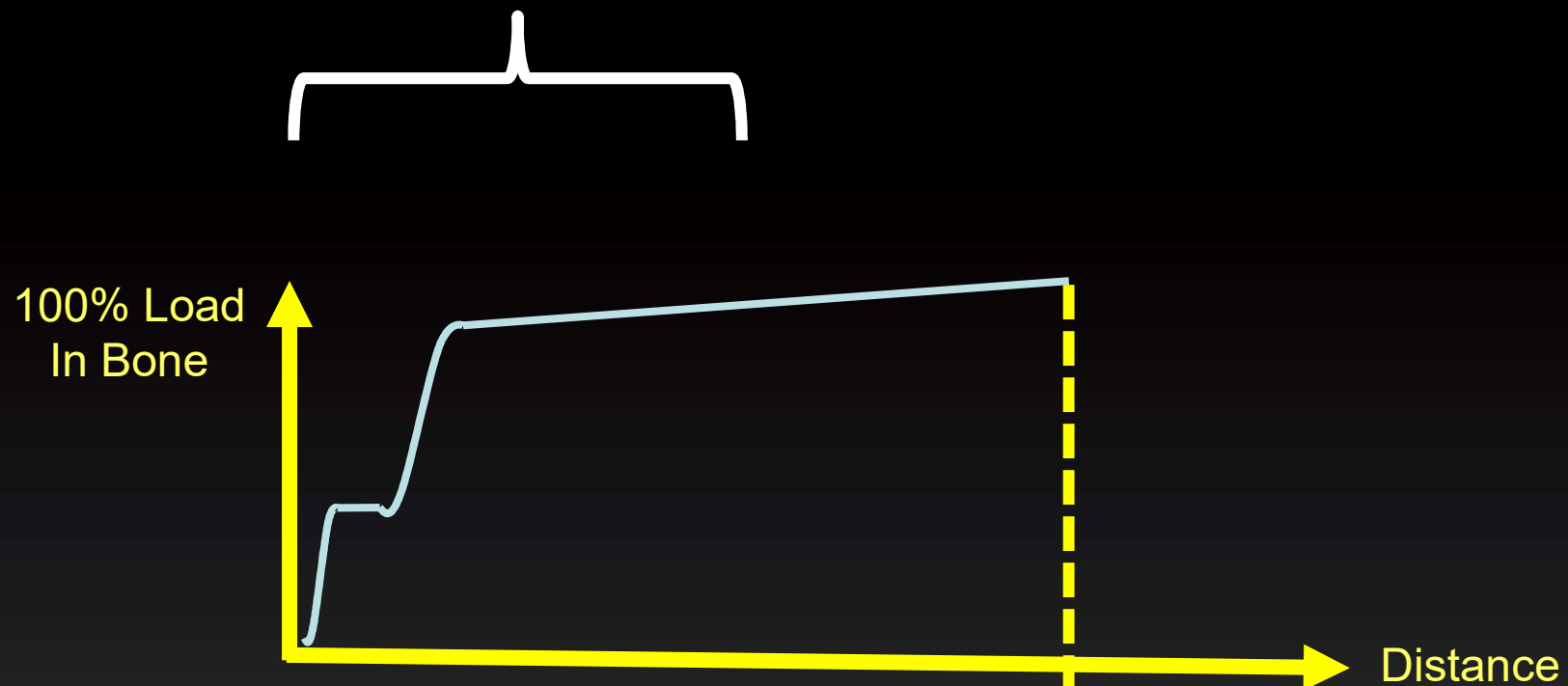
ZONE OF STRESS SHIELDING



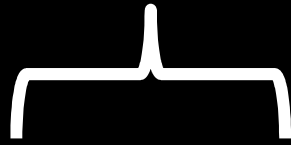
ZONE OF STRESS SHIELDING



ZONE OF STRESS SHIELDING

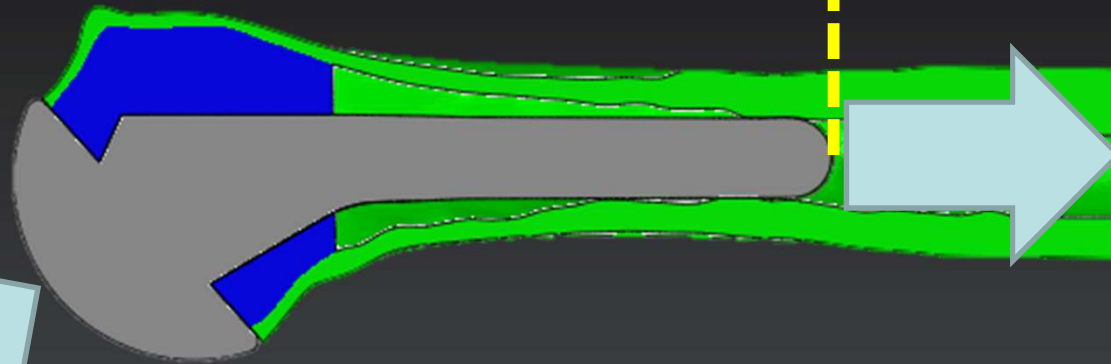
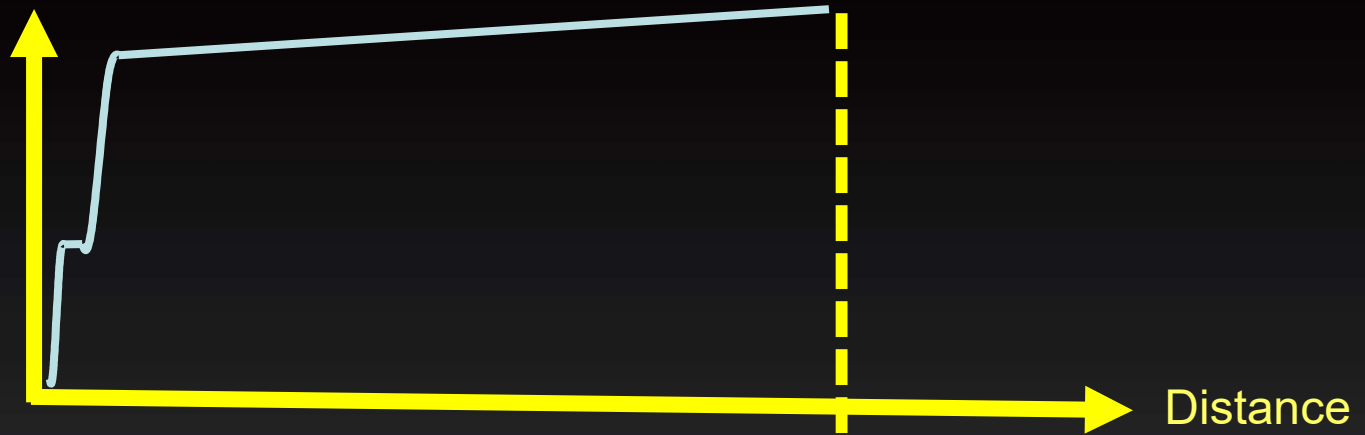


ZONE OF STRESS SHIELDING



Proximal coating
Distal polished

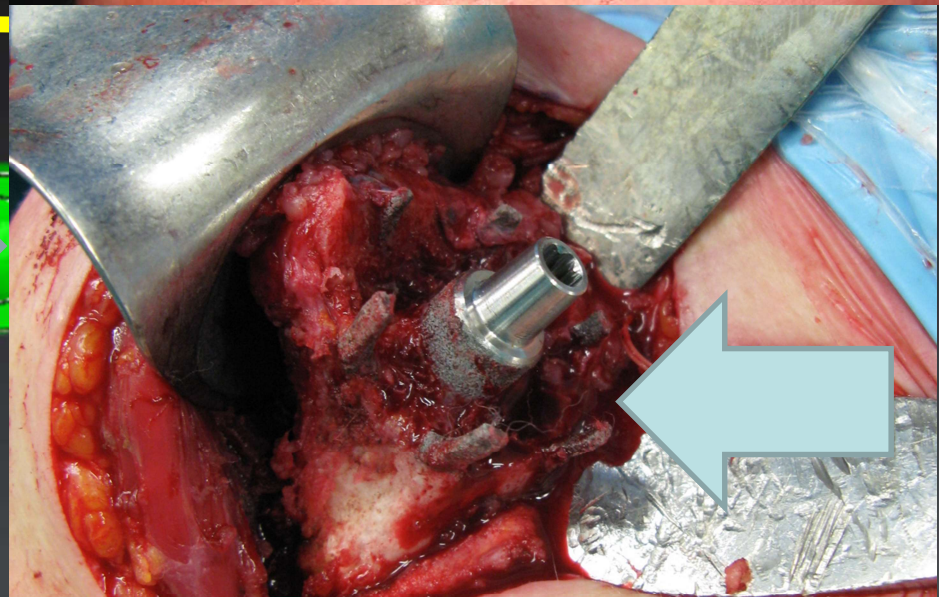
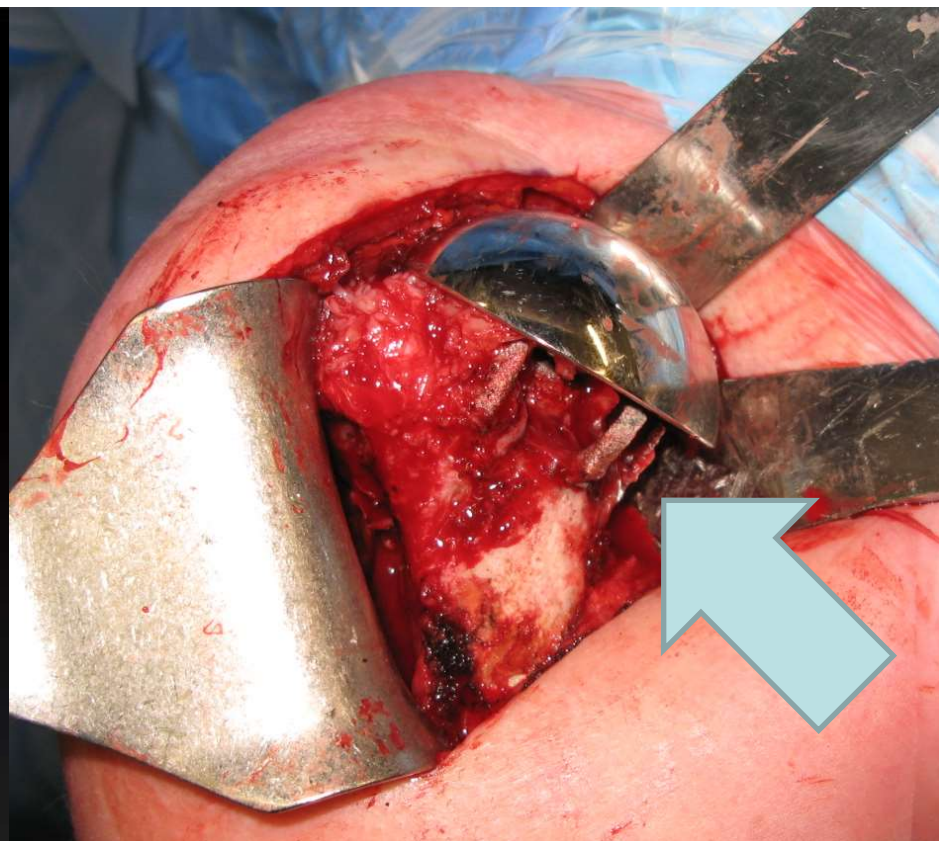
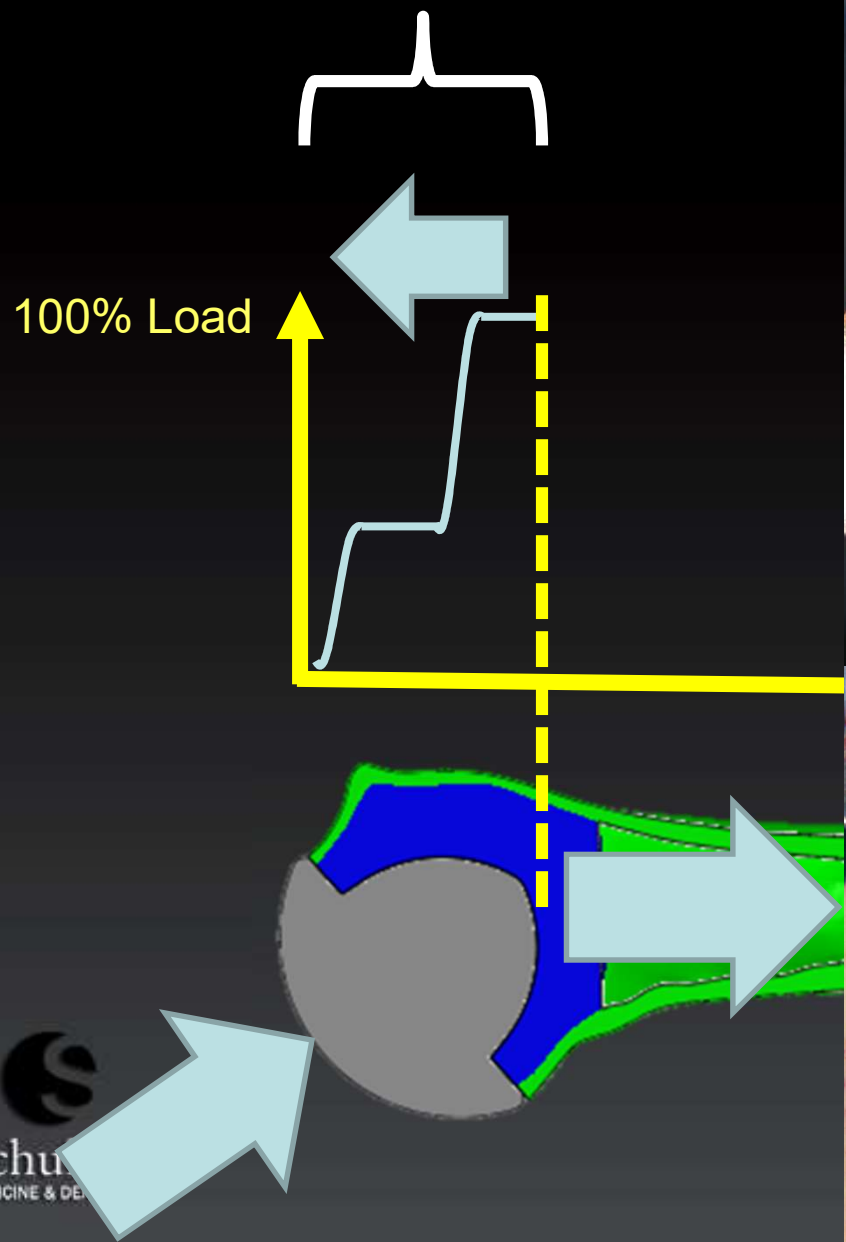
100% Load
In Bone



HULC Shoulder



ZONE OF STRESS SHIELDING



BASIC SCIENCE SUMMARY

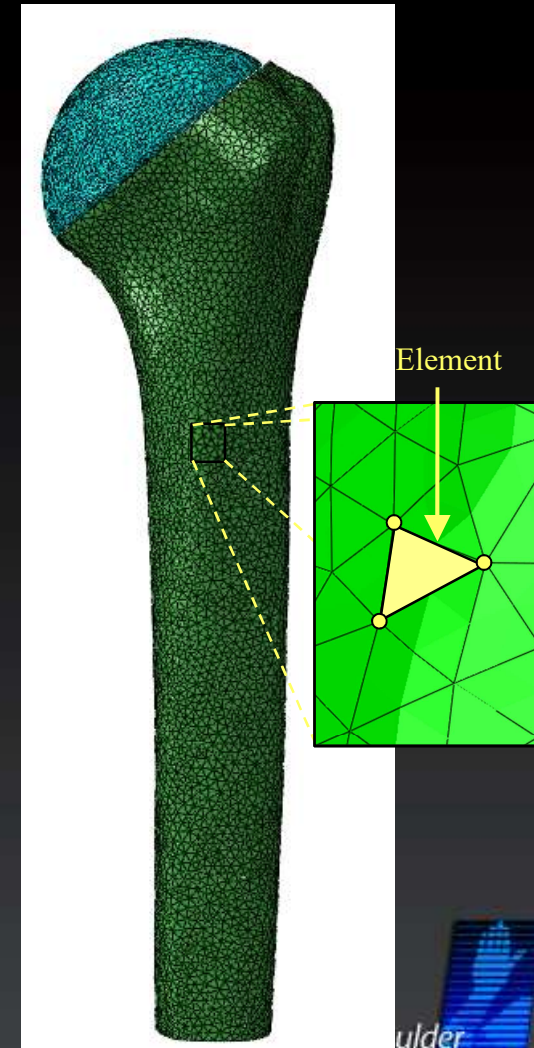
- Reduced stem length
 - ↑ Load transferred proximally
 - ↓ Stress shielding

FINITE ELEMENT ANALYSIS

COMPLEX 3D STRUCTURE



INDIVIDUAL ELEMENTS



Schulich
MEDICINE & DENTISTRY



1970

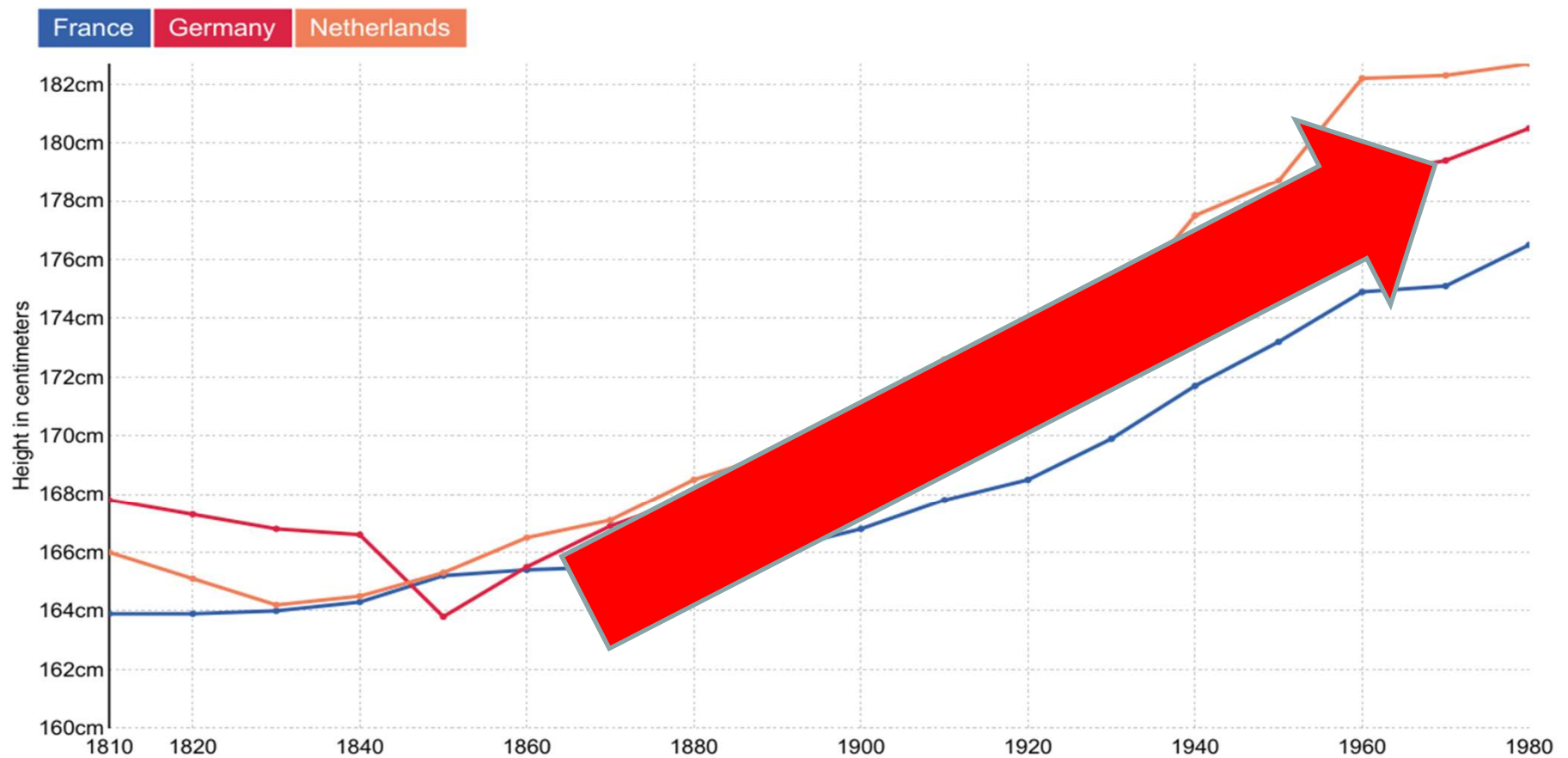


2019



HUMAN HEIGHT

Average height of men by year of birth, 1810 to 1980

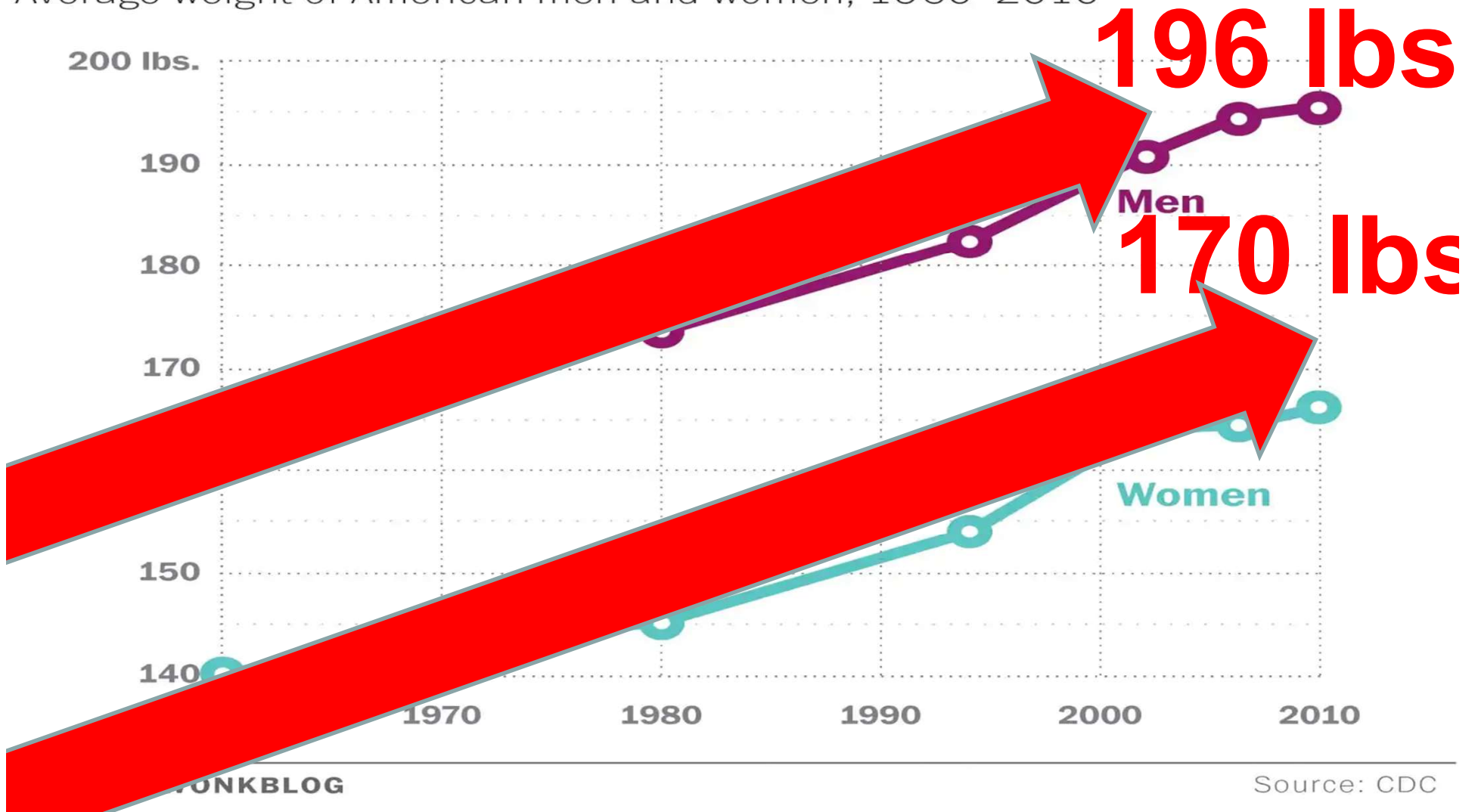


Data source: [University of Tuebingen: Height datahub](#)

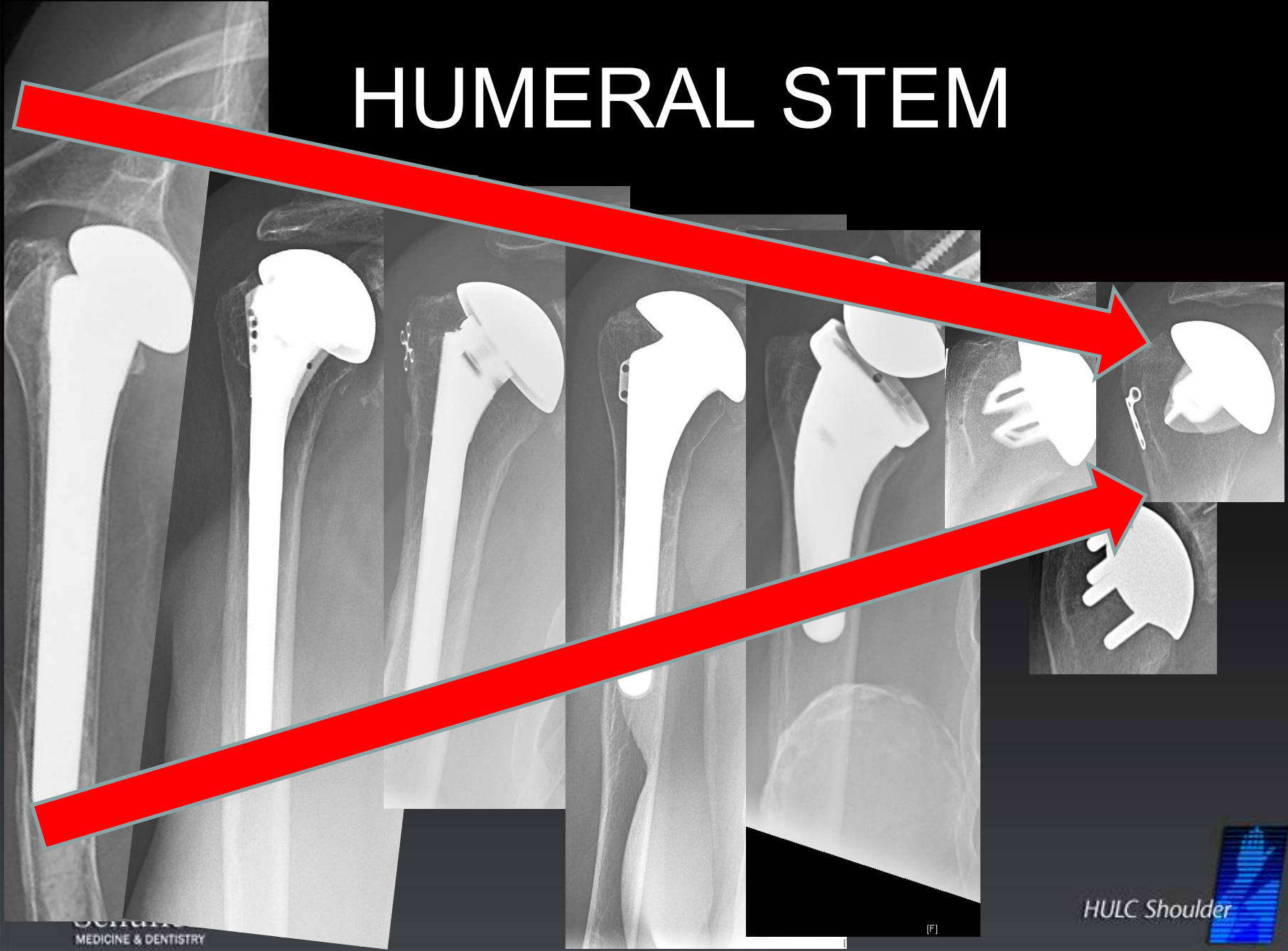
OurWorldInData.org/human-height/ • CC BY-SA

HUMAN WEIGHT

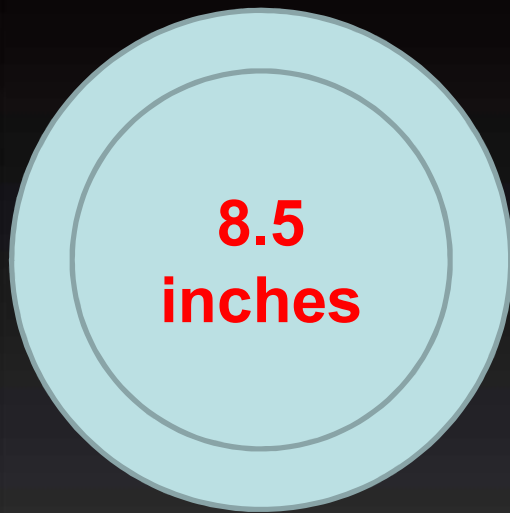
Average weight of American men and women, 1960–2010



HUMERAL STEM

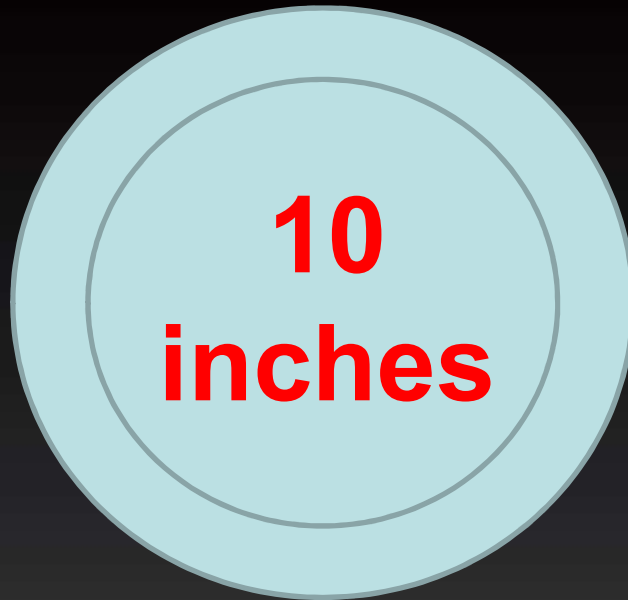


DINNER PLATE



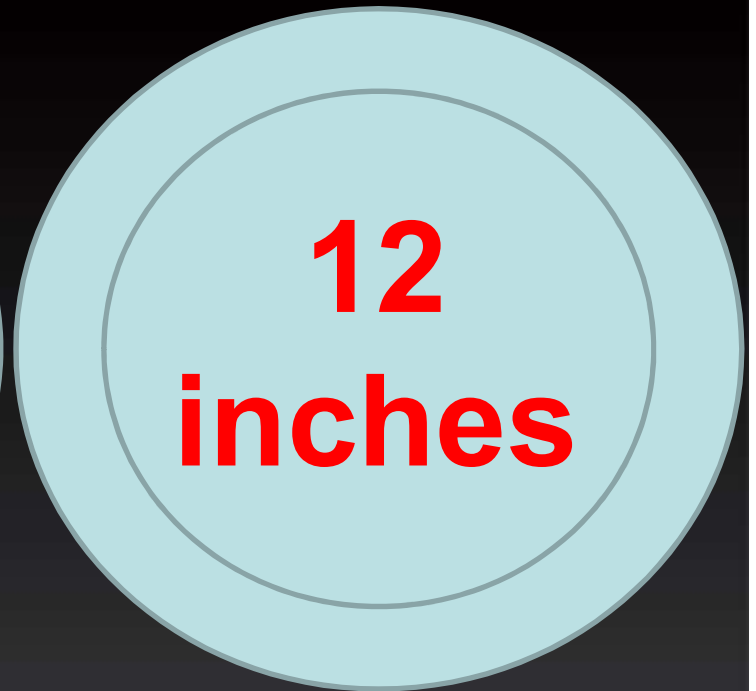
**8.5
inches**

1960



**10
inches**

1980



**12
inches**

2020

