



# On Simulator Wear and Contact Mechanics of Reverse Total Shoulder Arthroplasty

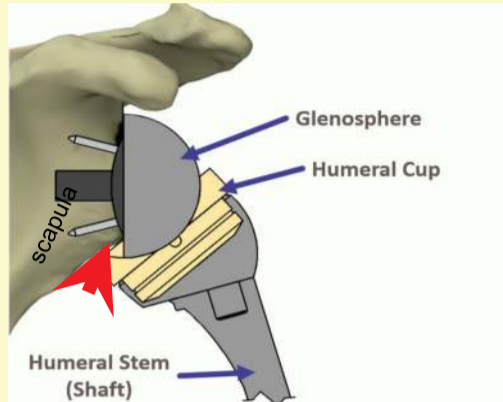
MW Griffiths<sup>1</sup>, GDG Langohr<sup>1</sup>, GS Athwal<sup>1</sup>, JA Johnson<sup>1</sup>, JB Medley<sup>2</sup>

<sup>1</sup>Roth|McFarlane Hand & Upper Limb Centre, Western University, London, Canada

<sup>2</sup>University of Waterloo, Waterloo, Canada

## BACKGROUND

Reverse total shoulder arthroplasty (RTSA) cups can contact the scapula



Causing scapular notching cup damage



**Purpose:** Examine the effect of scapular notching damage on the wear of non-XLPE cups in RTSA

## HYPOTHESIS

As previously suggested [1, 2], humeral cup damage will not substantially increase the wear rate

## MATERIALS & METHODS

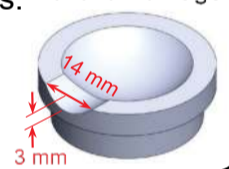
High-mobility DePuy Delta XTEND RTSA 38 mm

Alpha calf serum diluted to 30 g/L with PBS + 1.5 g/L sodium hyaluronate (HA) + AA [3, 4]

Wear simulator, 900 N peak load, n=5 for wear, n=3 load-soaks (gravimetric measurement)

Successive damage simulations: Level 3 Damage

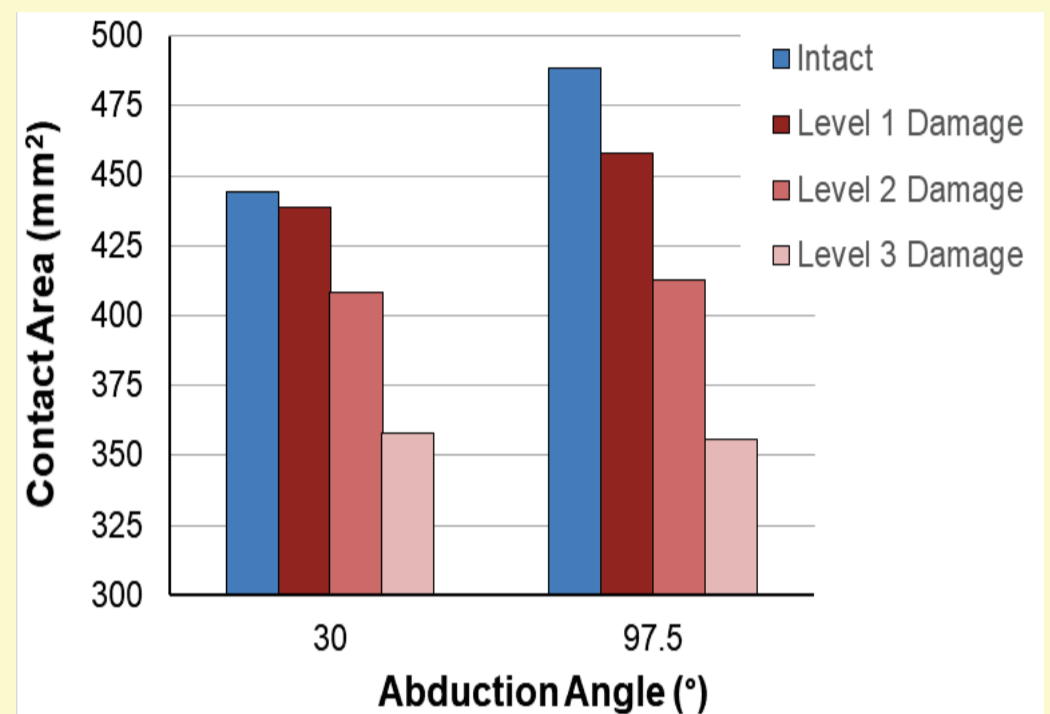
Damage Level	Imposed (Mc)	Width (mm)	Depth (mm)
1	0.25 – 0.50	10.0	1.0
2	0.50 – 0.75	12.0	2.0
3	0.75 – 1.00	14.0	3.0



Wear Station

FEA using ABAQUS v6.14, 900 N load, 30° and 97.5° abduction angles → contact area

## RESULTS (continued)

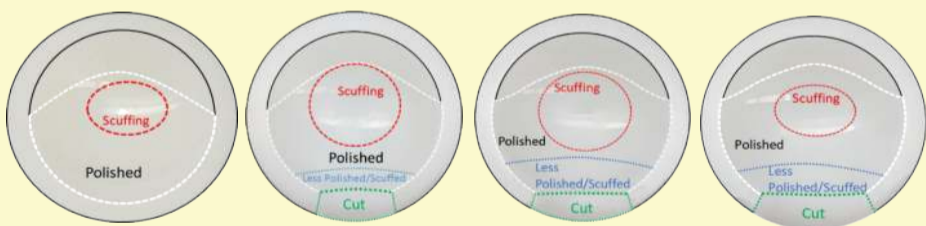


## DISCUSSION

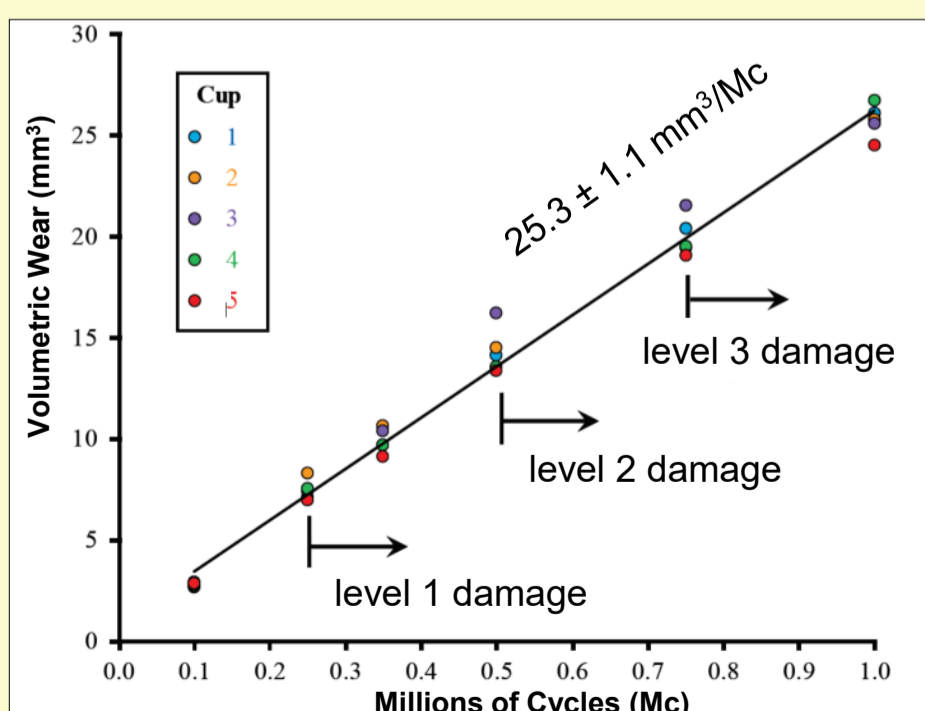
- Similar wear rates in the present study (25 mm<sup>3</sup>/Mc) to non-XLPE cup wear (19 mm<sup>3</sup>/Mc) in a hip simulator study by Affatato et al [5]
- Increasing simulated scapular notching cup damage did not have much effect on wear rate over 1 Mc
- Cup damage decreased nominal contact area (and increased contact stress, especially at the edge of the cut region)
- While the higher contact stress increased wear particle production, the reduced contact area seemed to counteract this effect over 1 Mc

## RESULTS

Wear morphology for simulated scapular notching cup damage



Intact (at 0.25 Mc)    Level 1 damage (at 0.50 Mc)    Level 2 damage (at 0.75 Mc)    Level 3 damage (at 1.00 Mc)



## CLINICAL RELEVANCE

The non-XLPE cups in RTSA may be able to sustain various levels of scapular notching damage without increased wear. However, the wear rate was as high as for hip implants with non-XLPE cups and so wear may eventually be a problem for RTSA with non-XLPE cups as suggested by Lewicki et al [6].

## REFERENCES

- [1] Langohr et al (2016) IMechE Pt H, Eng in Med
- [2] Griffiths (2017) MES thesis, Western University
- [3] DesJardins et al (2006) IMechE Pt H, Eng in Med
- [4] Brandt et al (2010) J Biomed Mat Res
- [5] Affatato et al (2016) Mech Behav Biomed Mat
- [6] Lewicki et al (2017) J or Orthop Res

## ACKNOWLEDGEMENTS

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

