

# Submicron-sized UHMWPE wear particle analysis from revised SB Charité III total disc replacements

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- Submicron-sized particles are critical in the activation of the phagocytic inflammatory response in THA/TKA.
- Presence of ultra-high molecular weight polyethylene (UHMWPE) wear particles and inflammatory reactions around retrieved total disc replacements (TDRs) has been shown. Punt et al. Biomaterials 2009, 30(11):2079-84
- Limitation of the previous study: inability to quantify submicron-sized UHMWPE particles by polarized light microscopy.

# Aim of the study



- To quantify and determine the **concentration, size and shape** of **submicron UHMWPE wear particles** in periprosthetic tissues retrieved from TDR using scanning electron microscopy.

# Methods (1)



- Periprosthetic fibrous tissue
  - *TDR SB Charité III revision*
  - *Control tissue: THA revision*

	TDR (n=5)	THA (n=5)
♀ : ♂	3:2	2:3
Average implantation time (year)	9 (range 6-12)	14 (range 11-15)
Revision reason	Back and leg pain Subsidence	Osteolysis Wear

# Methods (2)

- Scanning Electron Microscopy, SEM (FEI XL30)
  - UHMWPE particles
  - 50-1000 nanometer range

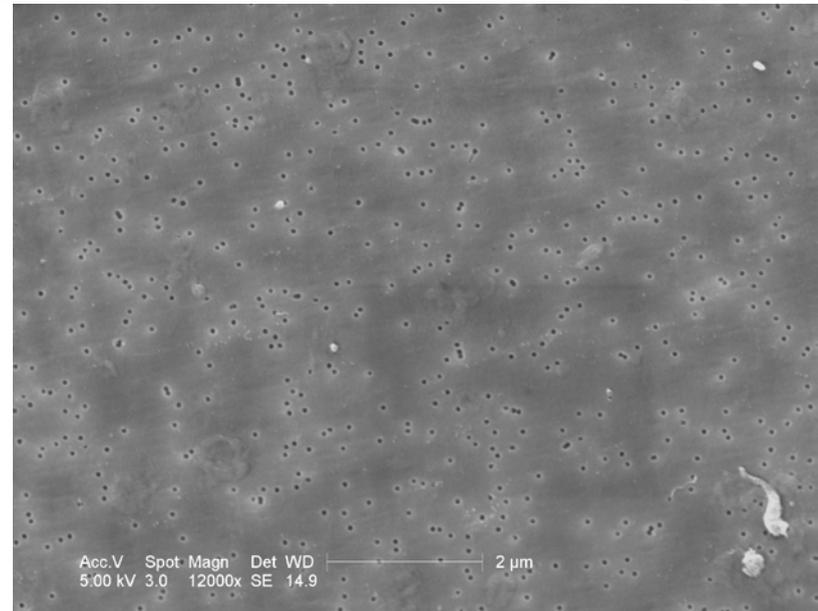
- Outcomes

## Concentration

**Size:** Equivalent Circle Diameter, **ECD** ( $2 \cdot \sqrt{(\text{area}/\pi)}$ )

**Shape:** Aspect Ratio, **AR** (major axis length/minor axis length)

- SPSS 16.0: nonparametric Mann-Whitney tests



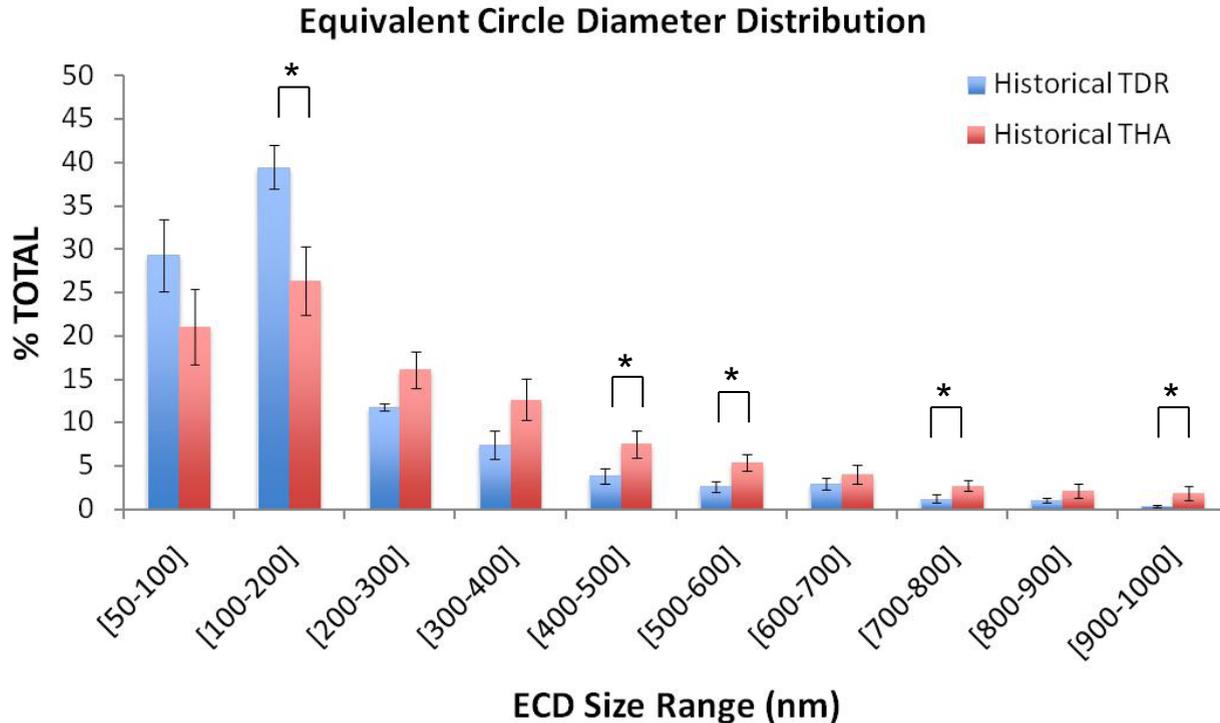
*SEM of wear particles isolated from TDR tissue*

# Results: concentration



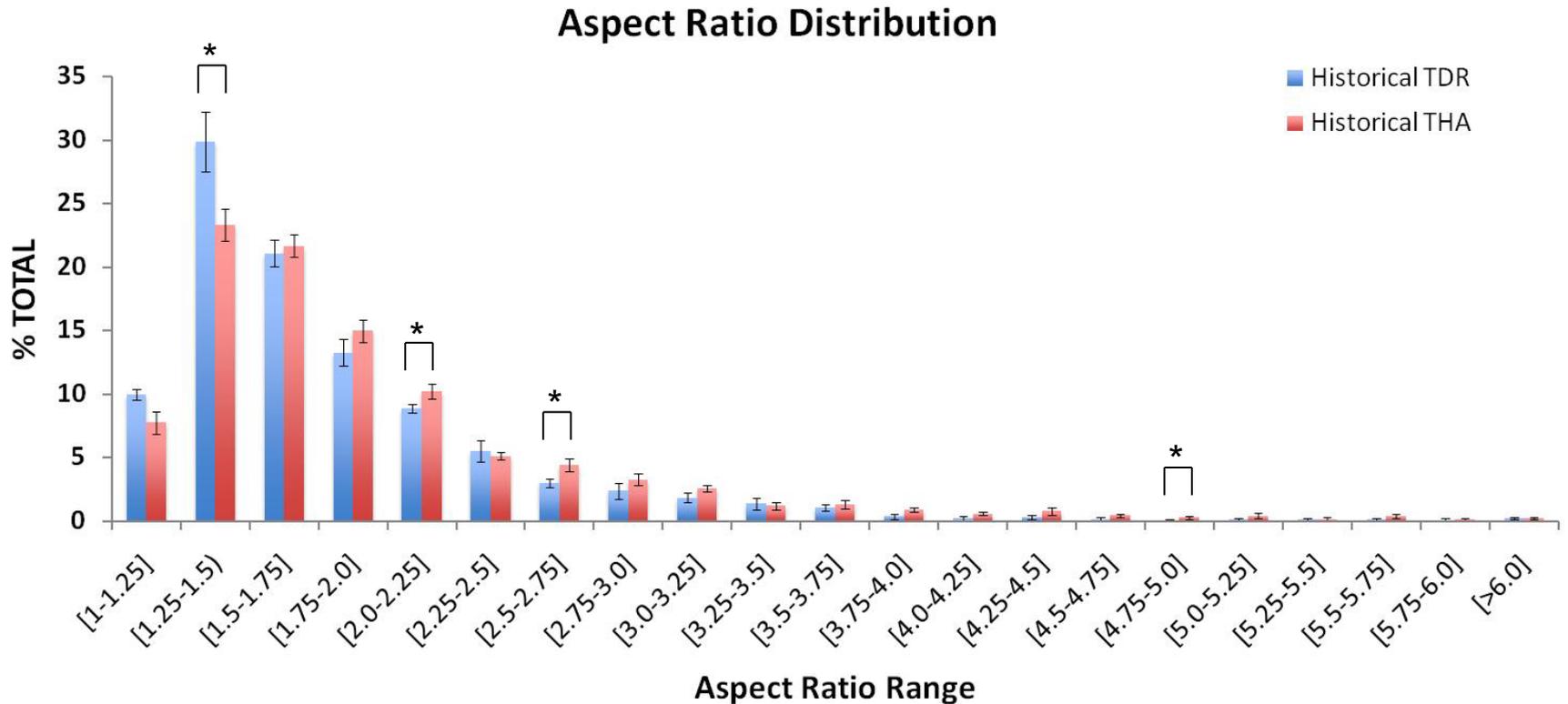
	Tissue weight (gram)	# particles / gram(x 10 <sup>9</sup> )	# particles per year ( x 10 <sup>9</sup> gram/year)
<b>TDR</b>			
Maa003	0.0267	1.777	0.285
Maa009	0.0238	1.479	0.145
Maa010	0.0223	1.751	0.207
Maa013	0.0224	1.493	0.117
Maa018	0.0207	1.187	0.112
<b>MEAN</b>		<b>1.537</b>	<b>0.173</b>
<b>THA</b>			
H005	0.0252	2.198	0.168
H120	0.0246	2.265	0.145
H209	0.0285	9.138	0.593
H134	0.0263	3.188	0.290
H426	0.0240	1.776	0.125
<b>MEAN</b>		<b>3.713</b>	<b>0.264</b>
<b>p-value</b>		<b>0.016</b>	<b>0.251</b>

# Results: size



- Highest frequency of particles was in the 50-200 nm range for both TDR and THA.
- TDR shows significantly more particles in the 100-200 nm range ( $p=0.02$ ), and less particles between 400-500, 500-600, 700-800 and 900-1000 nm ranges ( $p<0.05$ ).

# Results: shape



- Most frequent AR was in the 1.2-1.6 range, for both TDR and THA.
- Decreased number of particles with AR 1.25-1.5, and increased number of particles with AR 2-2.25, 2.5-2.75, 4.75-5 in THA tissue ( $p=0.047$ ).

- In THA tissues, submicron sized UHMWPE particles have been shown to be critical in influencing the phagocytic inflammatory response, which contributes to the development osteolysis
- Osteolysis rarely observed after TDR
- Differences between spine and hip
  - *Loading and kinematics*
  - *Synovial joint*

# Conclusion



- Submicron-sized UHMWPE particles are present in spinal periprosthetic revision TDR tissue.
- UHMWPE wear particle concentration, size and shape were decreased in TDR tissues compared to THA, which might preferentially contribute to pain rather than osteolysis.

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See also: Oral Presentation 13, Special Poster 58



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# Disclosure declaration



- None of the authors has any potential conflict of interest.