*Malaysian Orthopaedic Journal 2023 Vol 16, Supplement A*

# Antibiotic Elution and Total Porosity of Vancomycin Impregnated PMMA Beads: An In-vitro Study

[1]Lee ZC; [1]Amber H; [1]Azlina AA
[1]Department of Orthopaedic Surgery, University of Malaya Medical Centre, Kuala Lumpur

## INTRODUCTION:

Elution kinetic of antibiotics from PMMA is the prime factor which determines the antibacterial activity of antibiotic-loaded bone cement.[1]

## MATERIALS & METHODS:

The experimental study is to compare the correlation elution kinetics and total porosity of antibiotic loaded PMMA beads which use liquid-mixed vancomycin PMMA versus powder-mixed vancomycin PMMA. For the powder vancomycin group, 4g of vancomycin powder was mixed with 40g bone cement polymer and 20 ml of liquid monomer. For the liquid vancomycin group, 4g of vancomycin powder was initially mixed with 12 ml of the distilled water then subsequently added with 40g bone cement polymer and 20 ml of liquid monomer. Antibiotic loaded cement was poured into the designed mould to form uniform cement beads of size 5mm and 10mm respectively. Elution rate and total surface porosity were evaluated via elution kinetic testing and micro-CT assessment. Both groups are compared respectively.

## RESULTS:

The total cumulative release after 6 weeks for the liquid-mixed vancomycin PMMA group was 12683.5ng/uL and 5876.52ng/uL for the powder-mixed vancomycin beads. At all-time points, the cumulative release from the liquid mixed vancomycin beads were significantly higher compared with powder mixed vancomycin beads in both size groups ($P < 0.05$). Mean mid surface porosity for the liquid-mixed vancomycin group was 34% and 23% for powder-mixed vancomycin group. Total porosity measurement was documented approximately 1.5 times higher in liquid-mixed vancomycin PMMA beads. Liquid-mixed vancomycin PMMA showed higher total porosity which resulted in a significant elution rate and amount ($P < 0.05$). In addition, total cumulative antibiotic elution was twofold higher in size 10mm cement beads in both liquid and powdered-mixed vancomycin groups ($P < 0.05$).

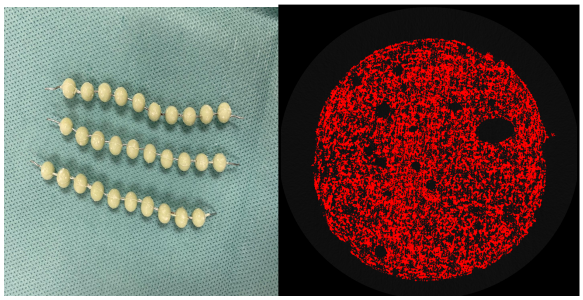

**Figure 1:** PMMA beads formed using designed nickel mould

**Figure 2:** Total mid-surface porosity analysis using Micro-CT of antibiotic loaded PMMA beads

## DISCUSSIONS:

This study implies that liquid-mixed antibiotic PMMA beads have a higher microscopic surface area allowing antibiotic release and surrounding fluids able to penetrate into deeper cement layers, which enhances release of antibiotic content from PMMA shown in the elution profile. It can be explained by the kinetic mechanism of antibiotic release depending on the penetration of dissolution fluids into the polymer matrix and allowing diffusion of the dissolved drug from the antibiotic PMMA into the surrounding environment.

## CONCLUSION:

Increased porosity of antibiotic loaded PMMA by mixing with liquid enhances antibiotic elution rate, providing a sustained release and higher local concentration of antibiotic.

## REFERENCES:

1. Seeley, S.K., Seeley, J.V. & Telehowski, P. (2004). Volume and surface area study of tobramycin-polymethylmethacrylate beads. Clin Orthop Relat Res, 420, 298-303.