Water Absorption of Poly(methyl methacrylate) Measured by Vertical Interference Microscopy

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Résumé en anglais	PMMA (poly(methyl methacrylate)) is widely used to prepare orthopedic cements. They are in direct contact with cells and body fluids. PMMA, despite its hydrophobic nature, can absorb ?2% w/w water. We have evaluated by vertical interference microscopy if water absorption can produce a significant swelling in different types of PMMA blocks: pure, with a plasticizer, with a cross-linker, and in two types of commercial bone cements. Graphite rods which do not swell in water were used as internal standard. Hardness, indentation modulus, plastic, and elastic works were determined by nanoindentation under a 25mN fixed force. Vertical interference microscopy was used to image the polymer in the dry state and hydrated states (after 24 h in distilled water). On the surface of the polished polymers (before and after hydration), we measured roughness by the fractal dimension, the swelling in the vertical and the lateral directions. For each polymer block, four images were obtained and values were averaged. Comparison and standardization of the images in the dry and hydrated states were done with Matlab software. The average value measured on the graphite rod between the two images (dried and hydrated) was used for standardization of the images which were visualized in 3D. After grinding, a small retraction was noticeable between the surface of the rod and the polymers. A retraction ring was also visible around the graphite rod. After hydration, only the pure PMMA and bone cements had a significant swelling in the vertical direction. The presence of polymer beads in the cements limited the swelling in the lateral direction. Swelling parameters correlated with the nanoindentation data. PMMA can swell by absorbing a small amount of water and this induces a swelling that varies with the polymer composition and particle inclusions.
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