Surface adhesion effects of PMMA (Poly(methyl methacrylate)) of Medical grade UHMWPE (Ultra-High Molecular Weight Polyethylene) after cold plasma treatment

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***Abstract*—By 2030, the demand for primary total hip arthroplasties is estimated to grow by 174% to 572,000. The demand for primary total knee arthroplasties is projected to grow by 673% to 3.48 million procedures. Osteoarthritis can be debilitating and severely impact your quality of life, so total knee replacements (TKR) are necessary. The common complications with TKR's specifically are a loosening or fracture of the device components (bone cement failure) as well as swelling and infection of the join area. For over four decades, ultra high molecular weight polyethylene (UHMWPE) has been used as one-half of the metal- or ceramic-on-plastic bearing couple in total joint replacement (TJR) components due to its toughness, durability, and biological inertness. UHMWPE is adhered to bone with an acrylic bone cement, polymethylmethacrylate (PMMA). Acrylic bone cements have still play a key role in the anchorage of prostheses to the surrounding bone in cemented arthroplasties. Through surface modification by means of oxygen and helium atmospheric plasma treatment, increasing the surface energy could prove for improved adherence of PMMA to biomaterials and reduce the risk of a factor of bone cement failure. The plasma is generated in the showerhead attachment of the reactor which used a center electrode, connected to a radio-frequency power source as the gas mixture surrounds the electrode and is ionized. This produces species such as NO, OH, and ionized O2 that interact with the surface of materials and modify them. The surface area and distance of the sample is optimized to allow for a single pass of the showerhead. Two samples will be adhered together with a constant volume of PMMA and a standardized weight will be applied and a standardized time will allow to dry. The adhesion portion of the experiment is expected to be performed by a tensile tester machine. A perpendicular tensile force is then applied and gradually increased until the coating is detached. This raw data is the assessed for the maximum stress applied. Through these results and with a large enough sample size and statistical analysis, we can detect a significant change in how well PMMA adheres to UHMWP, how cold plasma treatment effects adhesion, and allow for the possibly other biomaterials like nickel-titanium alloys to be replicated in the future. This research aims to reduce bone cement**

failure as we explore oxygen and helium atmospheric plasma treatment, in order to increase the surface energy and consequently strengthen the bond between the biomaterials.