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DAMAGE TOLERANCE IN BIOMEDICAL IMPLANTS: CARDIAC VALVES AND ENDOVASCULAR STENTS: R. O. Ritchie, Department of Materials Science and Engineering, University of California, Berkeley, CA 94720-1760

The human heat rate is roughly 40 million beats per year. To prosthetic implants such as mechanical heart valves and endovascular stents, this means that they must endure almost 10^9 fatigue cycles during the patient's lifetime. To prevent premature mechanical failures of such devices, which inevitably lead to patient fatalities, considerations of damage-tolerant design and life-prediction methodologies represent a preferred approach. In this presentation, a damage-tolerant approach to life prediction and "quality control" for both metallic and ceramic heart valve prostheses is presented, based on the notion that the useful life of the device is governed by the time for incipient defects in the material to propagate, by stress corrosion or more critically fatigue, to failure. Based on these analyses, the relative benefits of metallic (Co-Cr, Ti-6Al-4V) vs. ceramic (pyrolytic carbon) valves are discussed. Finally, analogous considerations are presented for endovascular stents, particularly those processed by laser cutting of the superelastic Ni-Ti alloy Nitinol. Again, the relative benefits of Nitinol vs. more traditional metallic implant materials (stainless steel, Co-Cr, titanium, titanium alloys) are discussed.