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Structural analysis of failures in lame-femoral implants of ASTM F-138 austenitic stainless steel

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Abstract – Structural analysis were carried out on lame-femoral prostheses of ASTM F-138 austenitic stainless steel, correlating its physical characteristics with early replacement of these biomaterials. The tests of Vickers microhardness, roughness, optical microscopy to determine the grain size (ASTM) and the microstructure showed a significant variance in the parameters researched. As a result of these studies we can conclude that the premature failures are due to limitations in the mechanical properties and tribology of these prostheses.

In Brazil, clinical evidence shows a high rate of failure or low expectations regarding the durability of total hip arthroplasties performed by the *Sistema Único de Saúde (SUS)*, resulting in a large number of surgical interventions for review[(1)]. By means of metallography studies tried to correlate the physical characteristics of biomaterials made of ASTM F138 austenitic stainless steel with the early replacement of these prostheses.

The tests performed were Vickers microhardness, roughness, optical microscopy to determine the grain size (ASTM) and the microstructure of the metal. From the profiles of hardness was found that the manufacturing process by mechanical conformation generated high levels of residual stresses that resulted in changes of crystalline phase. Further studies may show the effect of premature wear on the occurrence of prosthetics osteolysis in areas with high gradients of hardness as well as excessive production of debris due to the friction in the physiological environment. A significant heterogeneity of grain size and of high level of strain hardening (presence of twins inside the grains) were characterized in various samples. Almost all samples showed the grain size greater than 4, diverging from technical standards (*ABNT NBR 5832-1 – Implantes para cirurgia – Materiais metálicos – Aços Inoxidáveis Conformados*)[(2)]. Measurements of roughness in the stems of the prostheses after use showed that the surface parameters researched were inadequate when compared to literature recommendations, i.e. roughness tracks were not in accordance to the criteria for selection biomaterials to promote anchorage of the bone cement on the surface of the material, damaging the durability of biofixation.

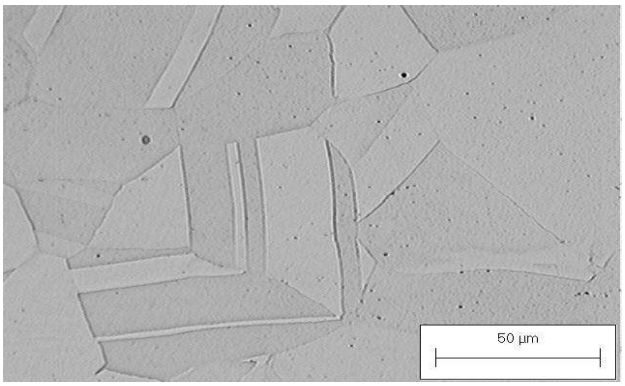

Figure 1: Optical Microscopy of a sample with grain size 6.4. Value exceeding the specifications of standard ABNT NBR 5832-1.

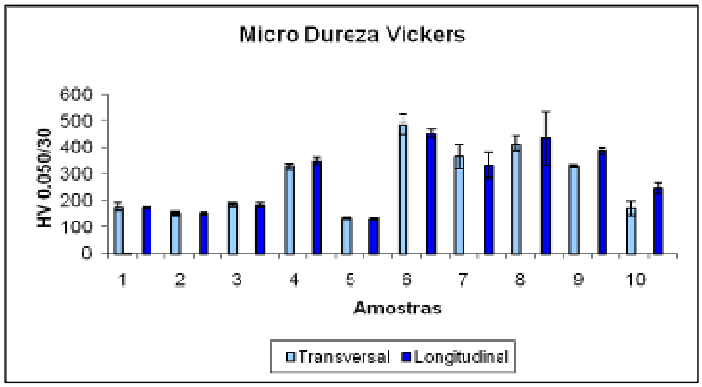

Figure 2: Graph of Vickers microhardness HV 0.050/30.

References

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