

III OGÓLNOPOLSKA KONFERENCJA

# IMPLANTY 2021

koncepcja a realia we współczesnych rozwiązaniach

## 18 CZERWCA

### FAILURE ANALYSIS OF ORTHOPEDIC IMPLANTS

Mateusz Kopec<sup>1,2\*</sup>, Ved P. Dubey<sup>1</sup>, Adam Brodecki<sup>1</sup>, Zbigniew L. Kowalewski<sup>1</sup>

<sup>1</sup>Institute of Fundamental Technological Research, Polish Academy of Sciences, Pawińskiego 5B, 02-106 Warsaw, Poland.

<sup>2</sup>Department of Mechanical Engineering, Imperial College London, London SW7 2AZ, UK.

\* Corresponding author: mkopec@ippt.pan.pl

**Abstract:** - Orthopedic implant failure is a complex issue with difficult management that requires a prompt investigation and prevention. Failure analysis is vital, as the examination of recovered fractured implants provides insight into implant failure processes and how to avoid such events. A fracture behavior of the following orthopedic implants, which were failed in the human body – locking plate (pure titanium), femoral implant (pure titanium), pelvic implant (Ti-6Al-4V alloy) and femoral implant (X2CrNiMo18 14-3 steel) - were studied using the light microscopic analysis combined with the scanning electron microscopy (SEM). The implants were found to be fractured primarily as a result of mechanical overloads caused by repeated, prohibited excessive loads. Production defects, presence of inclusions and excessive tight connections of screw and threaded holes were also contributing factors in implant failures. The implants were exposed to a variety of loading conditions, including excessive fatigue loads and additional interactions induced by screws placed in their threaded holes. The findings of this study lead to the conclusion, that often the designs of orthopedic implants currently applied are insufficient to transmit mechanical loads acting on them as the weight of treated patients is gradually increasing and also their physical activities are becoming more intensive.

**Keywords:** medical fixation devices; orthopedic implants; SEM; fracture analysis; titanium alloy; stainless steel

