Fretting Corrosion
(Modular Junction)

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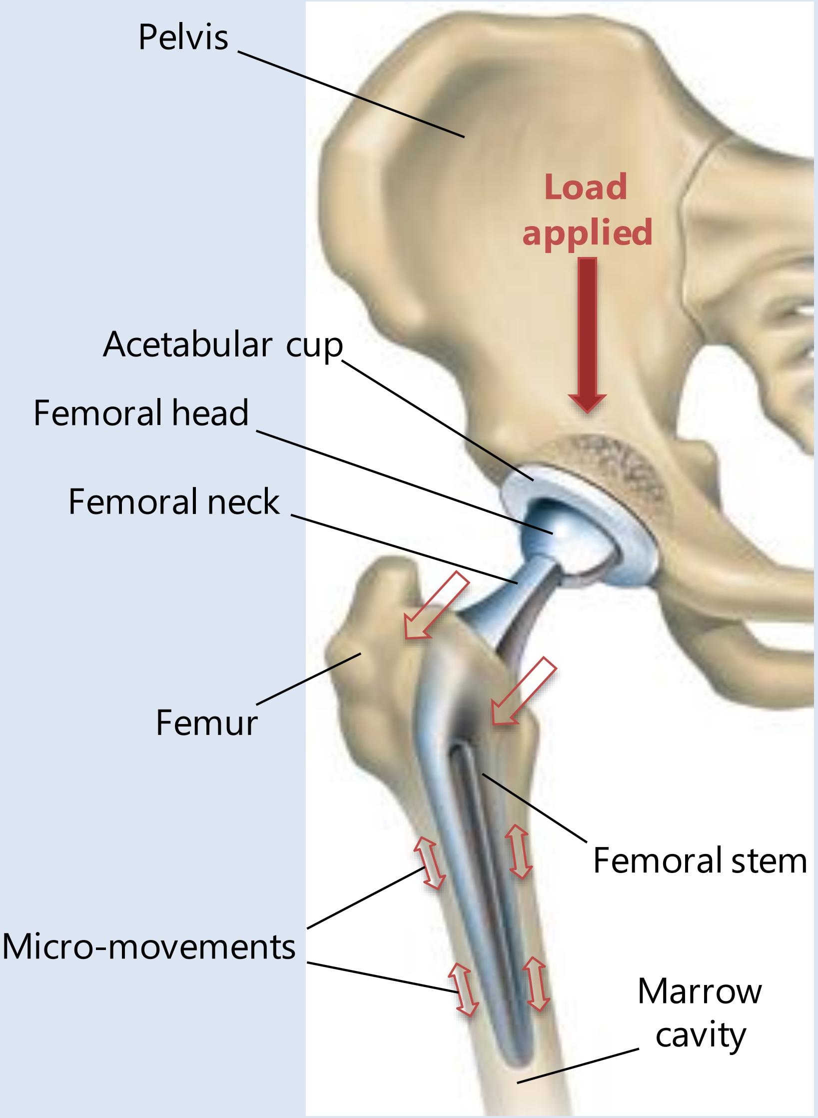
Introduction

- Approximately 250,000 THRs are performed annually in the US
- Currently, the average life span of a hip implant is approximately 15 years
- Modular implant design with a tapered junction gives flexibility in implant assembly and reduces inventory.
- Modular junctions introduce additional interfaces
- The variable loads to which the junction is subjected result in micro-motion may lead to mechanically assisted corrosion.

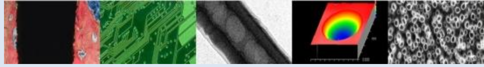


Background

- Fretting is a wear mode occurring under oscillating sliding conditions with a small amplitude and relatively high frequency.
- During the last 20 years fretting and fretting-corrosion behavior of Ti and CoCrMo alloys were investigated
- Lack of understanding still exists on the mechanically assisted corrosion (MAC) and role of wear particles and metal ions at the interface.

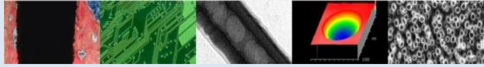
Objectives/hypothesis

- How is material loss influenced by the fretting regime?
- How does it affect the corrosive potential?
- To what extent do fretting and corrosion accelerate each other?
- The central hypothesis is that the synergistic interaction between fretting and corrosion is the main contributor to degradation and will be influenced by the local mechanical and chemical environment



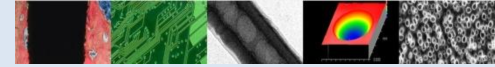
Experimental design

- To identify potential fretting regimes and characterize the tribocorrosion behavior of the Ti and CoCrMo alloy as a function of load and pH by conducting concurrent electrochemical and wear measurements.
- To determine the electrochemical characteristics of the metal interface and the variability of the corrosion kinetics as a function of pH and load under potentiodynamic conditions
- The experiments will be conducted at 4 different pHs 3, 4.5, 7.6, 9 and 4 different loading conditions 50N, 100N, 200N and 400N.



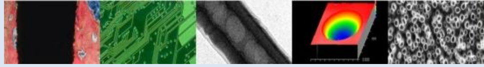
Materials and methods

- A material combination of CoCrMo-CoCrMo and CoCrMo-Ti alloy will be used as the vertical Rod and conforming pins.
- Standard protocol
  - Initial stabilization
  - Tribocorrosion testing
  - Final stabilization
- Electrochemical Impedance Spectroscopy (EIS) will be conducted to understand the changes in the corrosion kinetics.



Anticipated Results

- The optimum load and displacement to achieve the fretting conditions will be identified.
- The influence of pH on the criteria of fretting regimes will be examined.
- The evolution of potential (E), weight loss estimation and EIS results will indicate the variation in the corrosion kinetics under fretting conditions.
- A well understanding on changes in corrosion tendency under fretting conditions will be established.



Future work

- An attempt will be made to discuss the findings with implant industry to formulate potential strategy for the improvements.
- In future studies, the mathematical and computer based modeling tools will be employed to verify the current models.