WEAR CHARACTERISTICS OF ULTRA-HIGH MOLECULAR WEIGHT POLYETHYLENE ON PRODUCTION OF INFLAMMATORY CYTOKINE

Y. Nakanishi [a*], Y. Fujiwara [a], Y. Nakashima [a], Y. Komohara [a], H. Higaki [b]
*y-naka@mech.kumamoto-u.ac.jp
[a] Kumamoto University,
2-39-1 Kurokami Chuo-ku Kumamoto 860-8555, Japan
[b] Kyushu Sangyo University,
2-3-1 Matsukadai Higashi-ku Fukuoka 813-8503, Japan

KEYWORDS
Biotribology; Texturation; Wear; Artificial joint

INTRODUCTION

Macrophages ingest polyethylene wear debris from bearing surfaces in artificial joints, subsequently releasing inflammatory cytokines, thereby triggering tissue reactions that may ultimately result in joint loosening.

This study discusses the impact of material characteristics of ultra-high molecular weight polyethylene and surface texturing on the counterface on the production of inflammatory cytokine by macrophages.

MATERIALS AND METHODS

Figure 1 shows a schematic illustration of the wear testing setup. The pin was crafted from ultra-high molecular weight polyethylene (GUR1020), with options including gamma-ray irradiation or the addition of vitamin E. The disc was composed of a Co-28Cr-6Mo alloy (ASTM F-75), available with either a mirror-finished surface or a textured surface. The polyethylene wear debris were administrated into a specially designed microchamber device capable of quantitatively and time-dependently assessing the production of inflammatory cytokines.

RESULTS AND DISCUSSION

The results clearly indicated that the outcomes were influenced by the material characteristics of polyethylene, attributed to the relative displacement within the polymer main chain of polyethylene. It was hypothesized that large debris triggered a rapid production of cytokines, while small debris led to a higher overall production of cytokines. These mechanisms could be further elucidated through discussions on the phagocytic action by the macrophage and the configuration of the debris within a phagosome.

ACKNOWLEDGMENT

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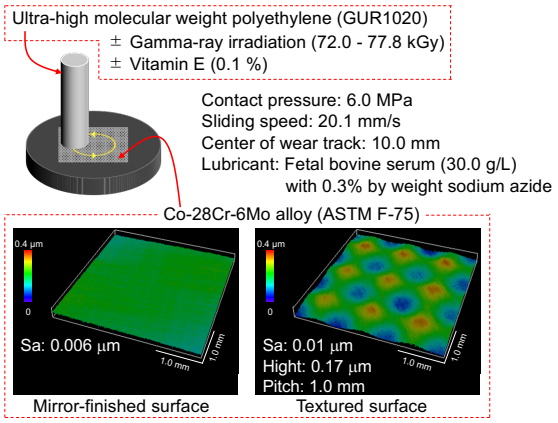

Fig.1 Pin-on-disc wear machine and operating condition

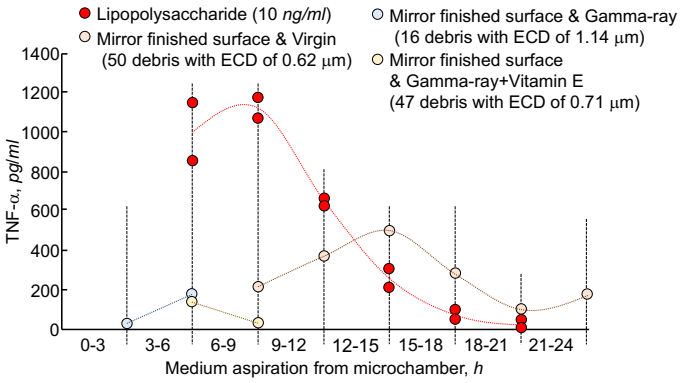

Fig.2 Production of inflammatory cytokines (TNF-α) by administration of polyethylene wear debris. ECD: mean equivalent circle diameter obtained from wear testing

REFERENCES

[1] Nakanishi, Y. et al., "I Microchamber device for studying phagocytosis of ultra-high molecular weight polyethylene particles by human monocyte-derived macrophages," Wear, 523, 2023, 204749.