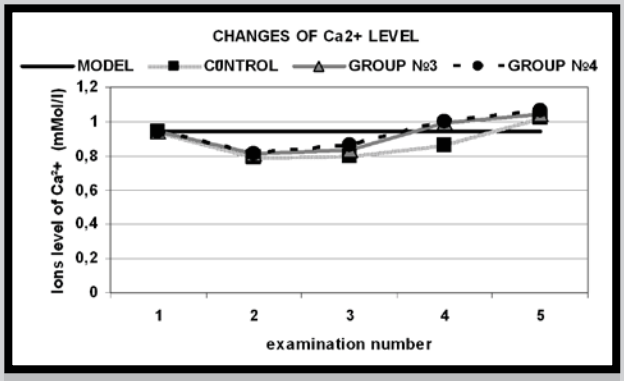

FIG. 2. Changes of ions Ca^{2+} level.

Conclusion

Results we received demonstrated:

1) positive influence of acupuncture and laseracupuncture to the organism homeostasis of experimental animals underwent dental implantations course;

2) insignificant indices advantages of the groups underwent complex treatment combined with acupuncture;

3) necessity and advisability of further studying of acupuncture influence on the oral cavity homeostasis indices and human organism as well as on the osteointegration processes in the system jaw-dental implant.

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THE EVALUATION OF THE INFLUENCE OF HEAD IMPLANT SURFACE ROUGHNESS ON THE WEAR OF UHMWPE CUP

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Abstract

The aim of this study was the evaluation of the influence of head surface roughness on the wear of the acetabular component of implant. The experiments were executed for the combination of UHMWPE (Ultra High Molecular Weight Polyethylene) implant cup and metal head of implant with several different surface roughnesses. Testing method was based on Pin-on-Disc principle. Finally the recommendation for head surface roughness was established. The special experiments were carried out in accredited "Mechanical Testing Laboratory" (quality system ISO 17025) in collaboration with the Academy of Sciences of the Czech Republic and company BEZNOSKA Corporation - developing and producing bone-substitute biomaterials and implants.

[Engineering of Biomaterials, 77-80, (2008), 13-14]

Introduction

No known surgical implant material has ever been shown to be completely free of adverse reactions in the human body. However, long-time clinical experience of use of the biomaterials has shown that an acceptable level of biological response can be expected, when the properties and applications of materials are appropriate. This article deals with specific wear resistance testing of materials used for producing of hip joint replacements. The aim of this study was determined the influence roughness of metal head joint surface on the wear of polyethylene acetabular component. The surface roughness is very important parameter which significantly influences this wear. The special experiments were carried out in accredited "Mechanical Testing Laboratory" (quality system in accordance with EN ISO/IEC 17025) in collaboration with The Academy of Sciences of the Czech Republic and company BEZNOSKA Corporation - developing and producing bone-substitute biomaterials and implants.

Materials and methods

There are several groups of materials used for producing of hip joint replacements. The suitable combinations of materials are described in the international standard EN 12010 [5]. The combination which is very often used is metal head of joint and Polyethylene acetabular component of implant.

The materials used for this study were corrosion proof steel (ISO 5832), chemical composition 15÷17%Cr, 1.25÷2.5%N, max 0.2%C and UHWMPE - Ultra High Molecular Weight Polyethylene (ISO 5834). We decided to use the UHMWPE in "natural stage", without crosslink (radiation) modification.

The method used in this study is called Pin on Disc and is based on the multi directional motion with axial loading. The pin is cylindrical specimen made from UHMWPE. The diameter is 6 mm, the length is 8 mm. The disc is cylindrical specimen too, but with much bigger diameter. The diameter of the disc is 200 mm, thickness is 5 mm. The disc was made from the corrosion proof steel. There were made several groups of these discs with different surface roughness. Required surface roughness (R_a=0.30; 0.15; 0.11; 0.03 μm) was made on the disc by special grinding machine.

The three pieces of pins are fixed in to the rotating satellite. The axial load is applied on the satellite and is all time constant. The disc is rotated too, but the axis of disc rotation is not identical with the axis of satellite rotation. There is the distance between these two axes. This principle is the reason of multi-directional motion between the pin and the disc. As a surrounding medium the distilled water was used. The special device (FIG. 1) for tests executing was made by the cooperating company BEZNOSKA Corporation. The tests were executed 48 hours per each pair of specimens.

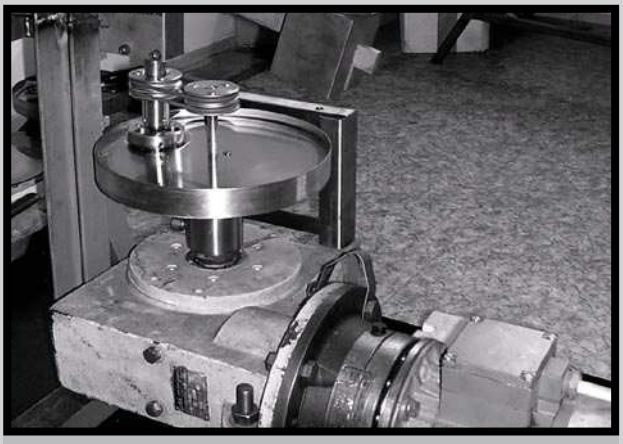

FIG. 1. Pin on Disc testing device.

The evaluation of the influence of implant surface roughness on the wear of implant's cup was based on mass loss measurement. The mass loss was determined from the pins weighting before and after finishing testing. The pins were cleaned in distilled water in ultrasonic washing machine before every weighting. The resolution of used scale was 10^{-5}g. The surface roughness R_a was measured before every testing too.

Results and discussion

The experiments were executed on the 16 pairs of specimens. There were 4 groups of specimens with significant differences of the surface roughness. The measured surface roughness parameters R_a with determined mass loss are shown in the TABLE 1. There is graphic representation in the chart (FIGURE 2).

Conclusions

This study was addict on the evaluation of the influence of metal head joint surface roughness on the wear of UHMWPE acetabular component. The method was based on the principle of Pin on Disc testing with multi-directional motion. The mass loss was used as a measure of the wear.

The dependence of UHMWPE mass loss on the metal head joint surface roughness R_a is significant from measured data. But very important information is that this dependence is much more significant between surface roughnesses R_a greater than 0.10 μm. The mass loss for R_a=0.30 μm is aprox.

TABLE 1. Mass Loss of specimens.

Disc Surface Roughness [μm]	Mass Loss [‰]	Average of Mass Loss [‰]
0.32	101.52	84.97
0.32	98.94	
0.31	67.75	
0.31	71.67	
0.17	7.57	5.59
0.16	5.21	
0.15	5.12	
0.15	4.45	
0.11	2.36	2.20
0.11	2.05	
0.11	2.12	
0.11	2.28	
0.04	1.52	1.34
0.03	1.04	
0.03	1.35	
0.03	1.46	

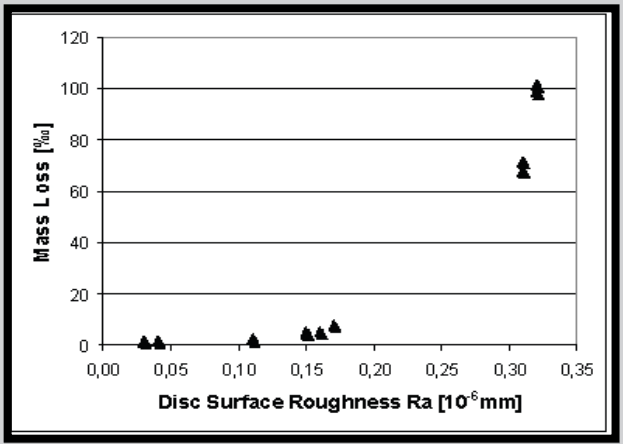

FIG. 2. Mass loss after finishing experiments.

40 times larger than mass loss for R_a=0.11 μm. However the differences between mass loss for surface roughness R_a=0.11 μm and R_a=0.03 μm are much less – only 1.5 times.

These results allow making conclusion that it is not necessary produced joint replacements from specified metal materials with the surface roughness parameter R_a less than 0.10 μm. Moreover producing implant surfaces with R_a less than mentioned value is very expensive.

Acknowledgements

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