INFLUENCE OF INCUBATION TIME ON THE SURFACE OF NASAL SPLINT USED IN OTORHINOLARYNGOLOGY

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Introduction

The time of contact of biomaterials with patient environment has important influence on development of biofilm (bacterial adhesion) on an implant surface. The tests of biofilm formation on nasal splints used at the conclusion of nasal septal surgery to determine the optimal time frame for the removal of nasal packing material are important for safety of patients [1,2,4]. An analysis of levels of wettability and surface free energy become significant aspects in testing of biomaterials, from the point of view of bioactivity [6].

Materials and Methods

The object of the study was a nasal splint of Atos Medical implant used in procedure of stabilized the nasal septum. The changes of surface free energy (γ_S SFE), its components (dispersive γ_s^d, polar γ_s^p, γ_s^+ basic, γ_s^- acidic) by using analytical Owens-Wendt (OW) and van Oss-Chauhury-Good (vOCG) models were estimated [3]. Three measurements liquids: (W) distilled water (Poch S.A.), (D) diiodomethane (Merck sp. z o.o.) and (G) glycerin (Chempur) were used. The contact angle values were measured with the use of sessile drop method by the See System computer-based instrument produced with Advex Instruments. The volume of liquids drops was 0.5 µl, each test was repeated ten times in room temperature of 22±1°C. The samples of nasal splint were storage in closed containers by 30, 60 and 420 days in 0.9% NaCl solution (Polpharma) in 40°C temperature (in heat chamber Advantage-Lab E2 of Advantage-Lab), as simulated body conditions. The results were compared with reference sample (0 days incubation). The DLVO theory (Derjaguin-Landau-Verwey-Overbeek) was used to predict the interaction between implant (nasal splint) and patient [5].

Results and Discussion

The average values of contact angles (FIG. 1 with ±SD) were used to determine the SFE and its components by OW and vOCG models (TABLE 1).

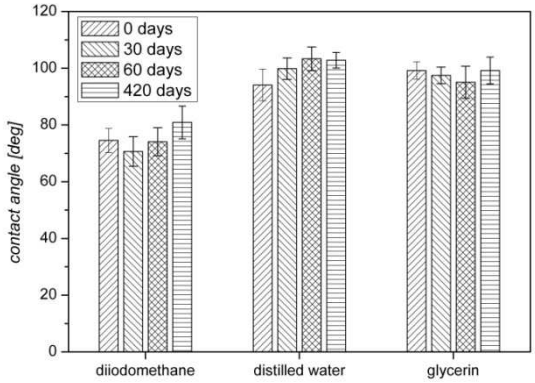

FIG. 1. The influence of incubation time on values of contact angle of silicone nasal splint.

The results showed an influence of incubation times on the values of contact angles. After 30 days of incubation the value of SFE was quasi-stabile, but dispersive component increased a little. It decreased over time, until exceeding the value of the left limit of nonadhesive (FIG. 2 – 420 days, blue dot in area medium of interaction). According to [6] the optimum surface free energy for which bacterial adhesion force is minimum can be derived by using the DLVO and for PTFE is 25-30 mN/m. Our values of SFE were quite similar to these given in [5].

TABLE 1. The influence of incubation time on values of SFE and its components mJ/m^2 of nasal splint.

days	M/(L)*	γ_S	γ_s^d	γ_s^p	γ_s^+	γ_s^-
0	OW/(W-D)	23,5	20,4	3,2	-	-
30		23,8	22,5	1,3	-	-
60		21,5	20,6	0,9	-	-
420		18,6	17,0	1,6	-	-
0	vOCG/ (W-D-G)	25,6	20,4	5,2	0,6	10,9
30		24,7	22,5	2,2	0,3	4,5
60		20,6	20,6	0,0	0,0	1,8
420		17,5	17,0	0,5	0,0	3,7

*M – method, L- liquids

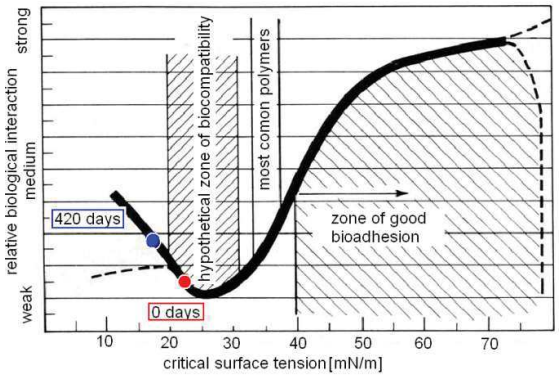

FIG. 2. Theoretical relative biological interaction.

Conclusions

The mechanisms adhesion of biofilm to laryngological material depends on many factors associated with a substrate, including SFE. This method allows to estimate a potential for reducing both bio- and mineral fouling [5]. The values of SFE and its components obtained by OW and vOCG methods were similar, but the vOCG method can be used for evaluating bacterial adhesion forces by DLVO method. Time of contact splint material with biological environment is very important issue. It could be concluded that extremal long-term simulation of contact nasal splint with body started the bioactivity process.

References

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