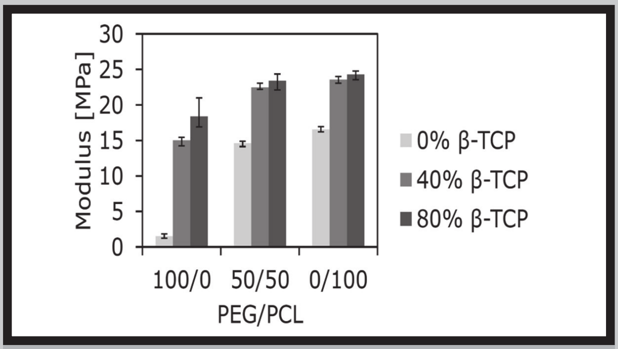

FIG. 3. Modulus of composite samples.

Compressive tests were carried out on dry samples. The modulus was calculated on basis of force-strain relationship curvatures. The results are shown in the FIG. 3.

The above results show an increase of modulus with increasing PCL and β-TCP content. These results comply with previously carried out research [7]. Both PCL and β-TCP can be used to manipulate mechanical properties. However the values are much lower than in case of cancellous bone of which Young's Modulus amounts to 60-260 MPa [8].

Conclusions

Porous composite materials containing bioactive ceramics were synthesized and characterized. They have potential to be applied as injectable biomaterials. However there is still need to investigate their properties considering tissue engineering application.

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APPLICATION OF INJECTION METHOD TO MODIFY TITANIUM ALLOY Ti6Al4V

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Abstract

In the present work, the samples were subjected to a comparative analysis of the titanium alloy Ti6Al4V prepared by various methods. The research included a comparison of the following properties of manufactured elements: microstructure, phase composition and surface roughness. The test results clearly showed that these properties are different when using different method of casting. These changes allows the use of prepared elements in medicine.

Keywords: *biomaterials, titanium alloy Ti6Al4V, massive amorphous alloy*

[Engineering of Biomaterials, 128-129, (2014), 91-92]

Introduction

Long-term studies lasting over metallic materials suitable for biomedical applications have shown, that a group of alloys based on titanium is safe to implant applications. Since the forties of the last century there are attempts selecting the ideal chemical composition of the alloy, which would be completely neutral to the human body. One of the most widely used implant material is titanium alloy Ti6Al4V, although that alloy doesn't have only advantages [1,2]. Currently, studies are carried out of the attempt to obtain amorphous materials based on titanium, thereby resulting in improved mechanical properties, more developed surface, higher biochemical resistance. Obtaining materials with such properties allows the injection method, which the liquid is injected into the metallic copper mold cooled with a suitable rate [3,4].

Materials and methods

The first test sample was cut by waterjet from purchased rod made of titanium alloy Ti6Al4V, the second was produced by a novel method of injection. The chemical composition of materials tested are given in TABLE 1.

Samples were subjected to microscopic analysis, qualitative X-ray analysis, assessment of surface topography.

TABLE 1. Chemical composition of titanium alloy Ti6Al4V.

Chemical composition	Al	V	C	Fe	O	N	H	Ti
%	6	4	0,03	0,1	0,15	0,01	0,003	rest

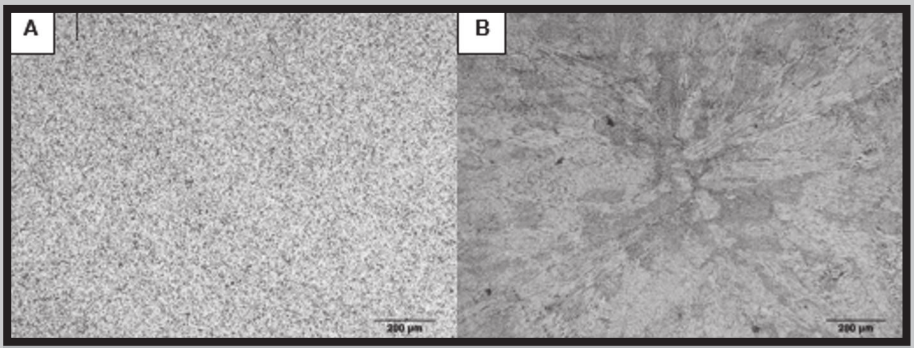

FIG. 1. Microstructure of titanium alloy Ti6Al4V produced by: a) conventional method, b) injection method.

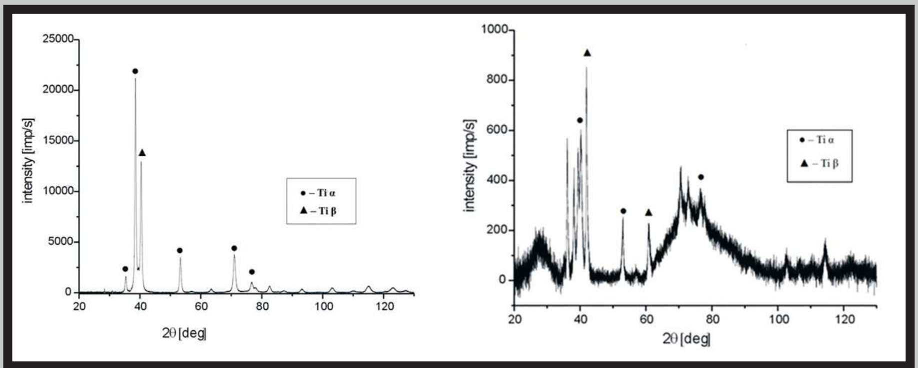

FIG. 2. Diffraction patterns of titanium alloy Ti6Al4V produced by: a) conventional method b) injection method.

TABLE 2. Summary of roughness parameter Ra of surface samples.

Sample	Numer of masurement	Parametr					
		R_t	RS_m	R_z	R_a	R_p	R_{max}
Conventional method	masurement I	3,21	0,02	1,86	0,19	1,71	3,21
	masurement II	6,46	0,03	3,47	0,31	2,55	6,50
	masurement III	2,24	0,01	1,59	0,33	0,99	2,56
	Average	3,97	0,02	2,31	0,28	2,08	4,09
Injection method	masurement I	2,53	0,11	1,78	0,44	1,30	2,53
	masurement II	2,48	0,08	1,40	0,34	1,50	2,48
	masurement III	2,96	0,09	1,74	0,42	1,21	2,81
	Average	2,66	0,09	1,64	0,4	1,34	2,61

Results and discussion

Samples were submitted for microstructure using an optical microscope Axiovert. The resulting microstructures are shown in FIG. 1.

Microstructural observations using light microscopy of samples produced by two methods allowed for finding, that the samples obtained by the conventional method have a crystal structure typical of a two-phase materials. Material produced by injection is characterized by a lack of regularity and short-range ordering.

The samples were prepared by two methods was subjected qualitative X-ray analysis, in order to determine the phase composition. Graphical representation of the X-ray studies show the diffraction patterns presented in FIG. 2.

The diffraction pattern of the titanium alloy produced by the conventional method shows crystal structure, and discloses the two peaks of the titanium phase. For samples produced through injection, diffraction pattern has a characteristic waveform for the partly crystalline material. There are wide angle peaks forming the typical backdrop of amorphous samples, as well as occur peaks of the crystallite phase.

In order to determine the surface topography, and its parameters studies were carried out with using a Hommel T1000 profilometer. Determination of surface roughness parameter R_a made in contact with the test surface by the engagement of the needle with a differential measuring arrangement. The results roughness parameter R_a are shown in TABLE 2.

Analyzing the arithmetic average ordinates of profile R_a, obtained during the study of surface geometry can be stated that a smaller development of the surface characterized samples produced by conventional method as compared to the samples produced by injection method.

Conclusions

Microstructural observations allowed the determination of the structure depending on the method of production. Traditionally manufactured titanium alloys have a crystal structure, with regular arrangement of grains, while the injection method allow produce a massive amorphous materials, with lack of regularity, this material is present in only a long-range ordering. Confirmation of the structural test records are obtained with a qualitative analysis of the diffraction of X-ray. Evaluation of surface topography allowed to state, that elements produced by the injection have higher surface roughness, than the same alloys produced by the conventional method, which from the point of view of application components such implants is very advantageous phenomenon.

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