Accepted Manuscript

Title: Impact of sandblasting on the mechanical properties and aging resistance of alumina and zirconia based ceramics

Authors: Carlos Francisco Caravaca, Quentin Flamant, Marc Anglada, Laurent Gremillard, Jeéronullme Chevalier

PII: S0955-2219(17)30730-6
DOI: https://doi.org/10.1016/j.jeurceramsoc.2017.10.050
Reference: JECS 11537

To appear in: *Journal of the European Ceramic Society*

Received date: 11-10-2016
Revised date: 9-10-2017
Accepted date: 26-10-2017

Please cite this article as: Caravaca Carlos Francisco, Flamant Quentin, Anglada Marc, Gremillard Laurent, Chevalier Jeérox302;me.Impact of sandblasting on the mechanical properties and aging resistance of alumina and zirconia based ceramics.*Journal of The European Ceramic Society* https://doi.org/10.1016/j.jeurceramsoc.2017.10.050

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

<AT>Title: Impact of sandblasting on the mechanical properties and aging resistance of alumina and zirconia based ceramics

Article Type: SI: Bio Bone

<AU>Order of Authors: Carlos Francisco Caravaca; Quentin Flamant, PhD; Marc Anglada, Prof.; Laurent Gremillard, PhD; Jérôme Chevalier, Prof.
<PA>*Corresponding Author: Dr. Carlos Francisco Caravaca* Corresponding Author's Institution: Université de Lyon, INSA-Lyon, UMR CNRS 5510 First Author: Carlos Francisco Caravaca.

<ABS-HEAD>Abstract
<ABS-P>Bioinert zirconia and alumina ceramic devices are widely used, both in orthopaedics and in dentistry. In order to improve their bonding with bone tissues or dental resin cements, their surfaces are often roughened at different scales. In this work, we have investigated the effects of the same sandblasting treatment on alumina, zirconia and a zirconia-toughened alumina, focusing on their mechanical performance and the interplay between surface defects and residual stresses. Additionally, we explored the impact of the treatment on the hydrothermal aging of the two zirconia-containing materials. Residual stresses generated during sandblasting were always predominant over surface defects but their effect varied with the material: while they had a weakening effect on alumina, they reinforced both zirconia-containing materials. Finally, we found that the monoclinic grains at the surface of sandblasted zirconia recrystallized into tetragonal nanograins after annealing and this led to an increased resistance to aging.
<KWD>Keywords: Zirconia; Alumina; Sandblasting; Aging; Fracture strength

<H1>1 Introduction

The use of high-performance ceramics, such as alumina or zirconia, for biomedical devices has been documented since the early seventies [1,2]. They were developed as an alternative to surgical metal alloys [3] and as a way of overcoming the risks of periprosthetic osteolysis and reaction to wear debris from metal-on-polyethylene or metal-on-metal implants for total hip arthroplasty [4,5], as well as early failure due to scratches and third-body wear [4,6,7]. The use of ceramic materials as femoral heads and/or acetabular cups reduces wear rate of bearing components and produces negligible amount of ion release [8]. The clinical success associated to the use of ceramics led to the implantation of more than 12 million ceramic components over the last four decades [9]. High performance ceramics are also gaining popularity in dentistry [10]. This is in particular the case of zirconia, which is now widely used for dental restorations and under strong development for endosseous implants. Nonetheless, both alumina and zirconia can be labelled as ``bioinert'' materials, since they do not cause adverse immunological reaction but neither positive cellular activity: indeed upon implantation, a fibrous non-adherent membrane shields the surface of the implant impeding a direct integration to bone [11,12]. The causes of this shielding are not yet fully clear, but they have been often correlated to micro-motion and migration of the prosthetic component, and lead to clinical loosening [13,14]. This is why, when implanted, the ceramic parts are usually coupled with a metallic structure (so called ‘metal-back’) in total hip arthroplasty (THA). The metal-back shell is usually made of titanium and entrusted with the task of attaching the acetabular cup to bone [15]. Its surface is usually treated to improve its attachment to

Download English Version:

https://daneshyari.com/en/article/7898547

Download Persian Version:

https://daneshyari.com/article/7898547

Daneshyari.com