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The Physico-Chemical Qualities of ß-Tricalciumphospates

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Authors: Prof. Dr. med. dent. Dipl.-Chem. Alfred Johannes Patyk[1], Dr. med. dent. Kay Pehrsson[2], Prof. Dr. Dr. Alfons Hüls[1], Prof. Dr. Dr. Hans Georg Jacobs[2]
Georg-August-University, [1]Dept. of Prosthodontics, [2]Dept. of Oral Surgery, Goettingen Germany

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Introduction

Besides autologous bone, bone substitutes are an important appliance in dentoalveolar implantology of atrophic areas. About twenty years ago, calcium phosphate compounds were first used clinically as bone substitution materials. Because of its high resorption rate in the process of local bone remodelation nowadays mostly the ß-phase is used. The physico-chemical properties of the bone subsitute, such as chemical purity, crystallinity and microstructure are of great significance for the reaction of the embedding bone.

Objective

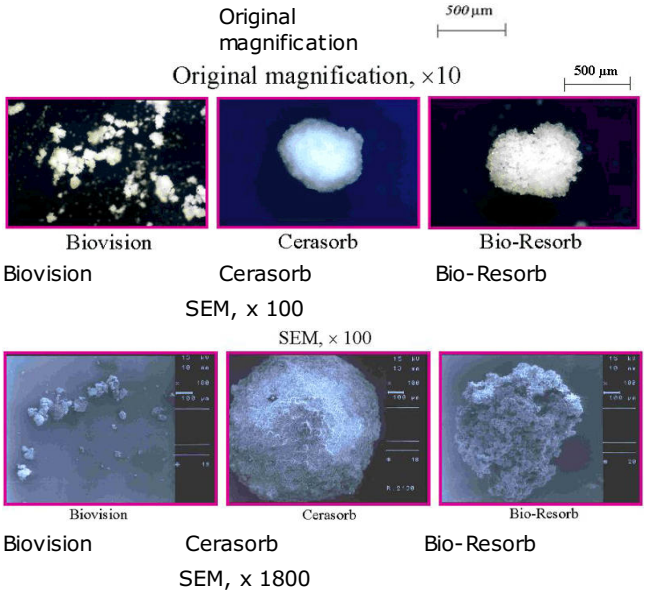
In this study, three commercial ß-TCP preparations were examined in regard of their physico-chemical properties. The results are fundametal for further investigations of the correlation between pysico-chemical characteristics and biological performance in test animals.

Material and Method

The ß-TCP preparations Cerasorb®, Bio-Resorb® and Biovision® were examined in regard of their crystallinity (Scanning Electron Microscopy), external porosity (Section Preparations) and chemical composition (X-Ray-Diffraction).

Results

Optical- and scaning-electron-microscopic description of the surface

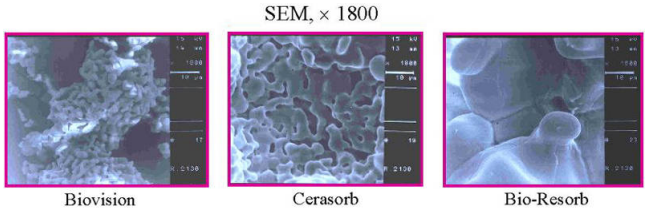


Biovision Cerasorb Bio-Resorb

SEM, x 100

Biovision Cerasorb Bio-Resorb

SEM, x 1800

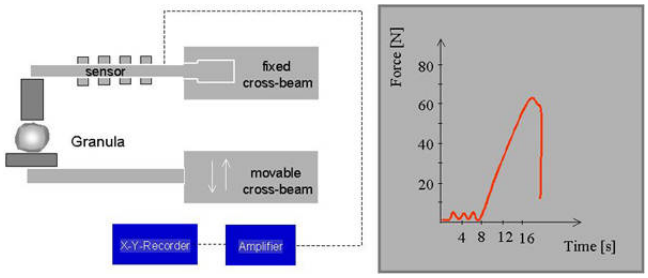


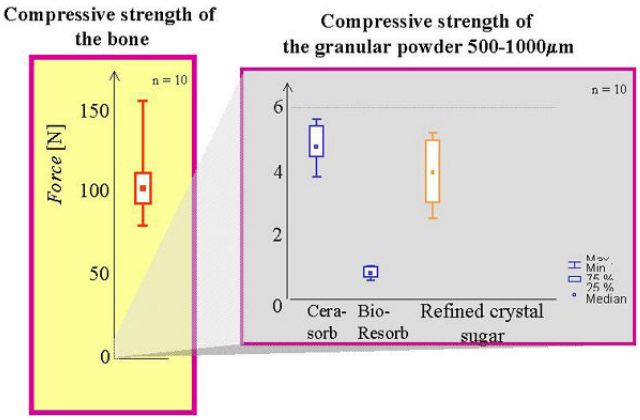
Biovision Cerasorb Bio-Resorb

Clearly visible differences in the crystallinity:

- compact body in the case of Cerasorb, formed by a scaly take up of crystals without cavities
- light structure in the case of Bio-Resorb by a kind of sintered conglomeration
- no distinctive macro-structure in the case of Biovision, loose collection of single crystals and small groups

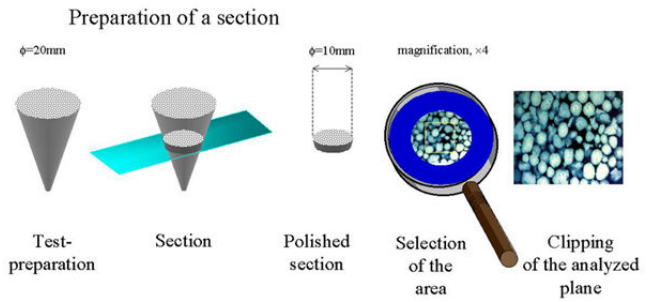
Compressive strength of the granular powder

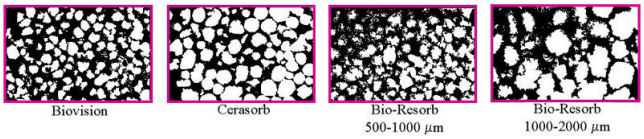




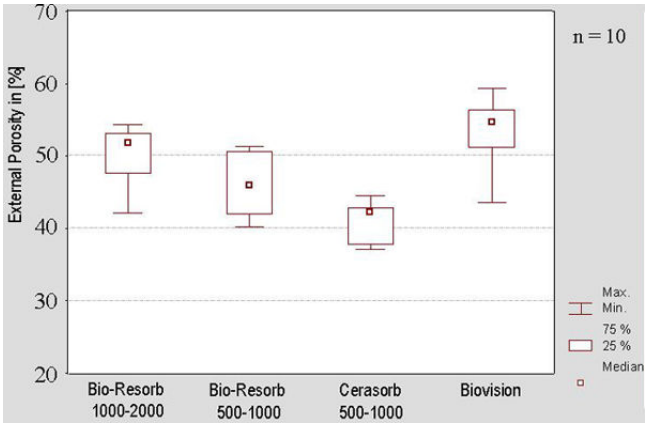
The compressive strengths are, compared to human bone, clearly visible lower.

Determination of the external Porosity in selected areas of sections



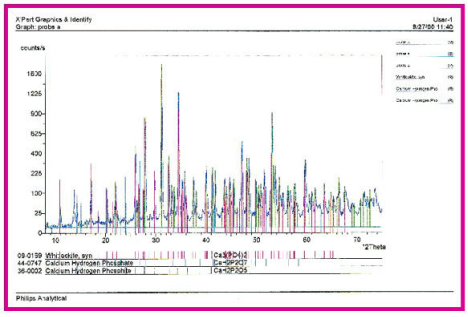


Biovision	Cerasorb	Bio Resorb 500-1000 µm	Bio Resorb 1000-2000 µm



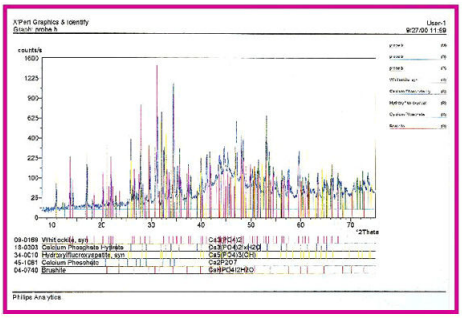
A low external porosity defines a high particle density of the material in the osseous defect. The external porosity of all preparations is comparable. It varies in the range between 45 and 53%

X-Ray-Diffraction



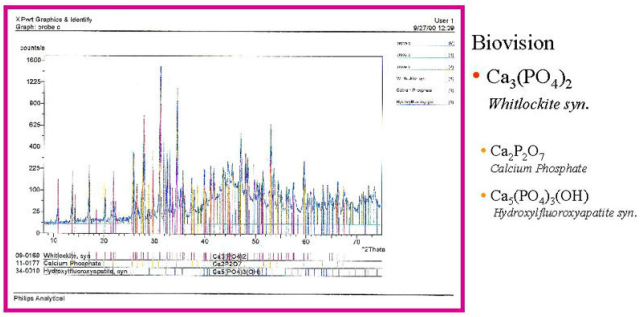
Cerasorb

- $Ca_3(PO_4)_2$
  Whitlockite syn.
  - $CaH_2P_2O_7$
    Calcium Hydrogen Phosphate
  - $CaH_2P_2O_5$
    Calcium Hydrogen Phosphite



Bio-Resorb

- $Ca_3(PO_4)_2$
  Whitlockite syn.
  - $Ca_3(PO_4)_2xH_2O$
    Calcium Phosphate Hydrate
  - $Ca_5(PO_4)_3(OH)$
    Hydroxylfluoroxyapatite syn.
  - $Ca_2P_2O_7$
    Calcium Phosphate
  - $CaHPO_4x2H_2O$
    Brushite



Biovision

- $Ca_3(PO_4)_2$
  Whitlockite syn.
  - $Ca_2P_2O_7$
    Calcium Phosphate
  - $Ca_5(PO_4)_3(OH)$
    Hydroxylfluoroxyapatite syn.

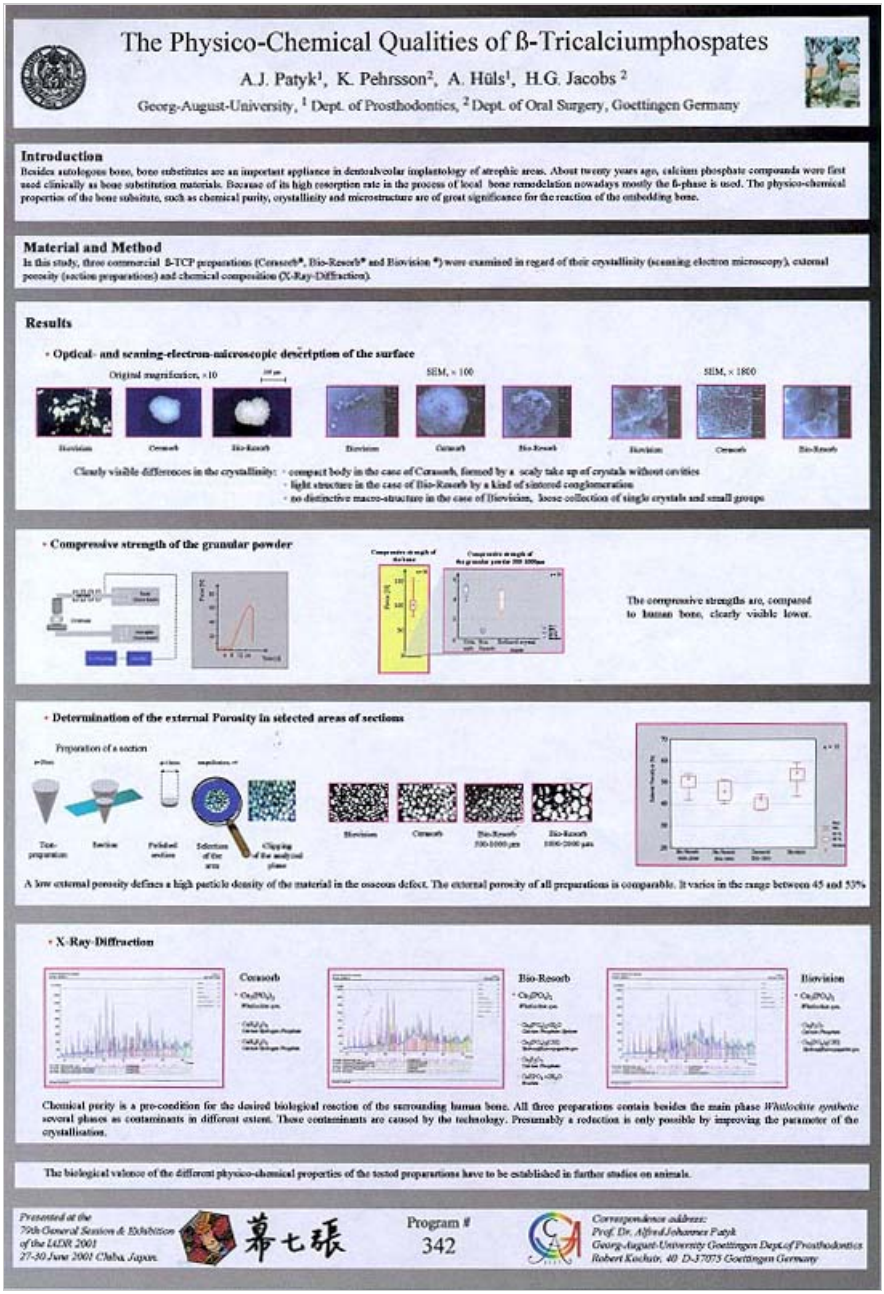
Chemical purity is a pre-condition for the desired biological reaction of the surrounding human bone. All three preparations contain besides the main phase *Whitlockite synthetic* several phases as contaminants in different extent. These contaminants are caused by the technology. Presumably a reduction is only possible by improving the parameter of the crystallisation.

The biological valence of the different physico-chemical properties of the tested preparartions have to be established in further studies on animals.

This Poster was submitted by Prof. Dr. med. dent. Dipl.-Chem. Alfred Johannes Patyk.

Correspondence address:
Prof. Dr. med. dent. Dipl.-Chem. Alfred Johannes Patyk
Georg-August-University
Dept. of Prosthodontics
R. Kochstr. 40
37075 Goettingen

Poster Faksimile:



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In this study, three commercial ß-TCP preparations (Cerasorb®, Bio-Resorb® and Biovision ®) were examined in regard of their crystallinity (scanning electron microscopy), external porosity (section preparations) and chemical composition (X-Ray-Diffraction).

Results

- **Optical- and scaning-electron-microscopic description of the surface**

Original magnification, ×10 — SEM, × 100 — SEM, × 1800

Biovision — Cerasorb — Bio-Resorb

Clearly visible differences in the crystallinity:
- compact body in the case of Cerasorb, formed by a scaly take up of crystals without cavities
- light structure in the case of Bio-Resorb by a kind of sintered conglomeration
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- **Compressive strength of the granular powder**

The compressive strengths are, compared to human bone, clearly visible lower.

- **Determination of the external Porosity in selected areas of sections**

Preparation of a section

Test-preparation — Section — Polished section — Selection of the area — Clipping of the analyzed plane

Biovision — Cerasorb — Bio-Resorb 500-1000 µm — Bio-Resorb 1000-2000 µm

A low external porosity defines a high particle density of the material in the osseous defect. The external porosity of all preparations is comparable. It varies in the range between 45 and 55%

- **X-Ray-Diffraction**

Cerasorb — Bio-Resorb — Biovision

Chemical purity is a pre-condition for the desired biological reaction of the surrounding human bone. All three preparations contain besides the main phase *Whitlockite synthetic* several phases as contaminants in different extent. These contaminants are caused by the technology. Presumably a reduction is only possible by improving the parameter of the crystallisation.

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Correspondence address: Prof. Dr. Alfred Johannes Patyk Georg-August-University Goettingen Dept. of Prosthodontics Robert Koch str. 40 D-37075 Goettingen Germany