

## Polyhydroxybutyrate for orthopaedic use

***Citation for published version (APA):***

Koets, P., Putten, van der, R., Meijer, H. E. H., & Lemstra, P. J. (1996). *Polyhydroxybutyrate for orthopaedic use*. Poster session presented at MaTe Poster Award 1996 : first annual poster contest.

***Document status and date:***

Published: 01/01/1996

***Document Version:***

Accepted manuscript including changes made at the peer-review stage

***Please check the document version of this publication:***

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

***General rights***

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

[www.tue.nl/taverne](http://www.tue.nl/taverne)

***Take down policy***

If you believe that this document breaches copyright please contact us at:

[openaccess@tue.nl](mailto:openaccess@tue.nl)

providing details and we will investigate your claim.

# Polyhydroxybutyrate for orthopaedic use

P. Koets, R. van der Putten, H.E.H. Meijer and P.J. Lemstra



Eindhoven University of Technology,  
Faculty of Chemistry Technology,  
Section Materials Technology,  
P.O. Box 513, NL 5600 MB Eindhoven  
A. Kloeck  
Universitair Instelling Antwerpen,  
Belgium



## Introduction

A shift in emphasis in biomaterials engineering in recent years has moved the focus of attention from materials that will remain completely stable in the biological environment, to materials that will, in some way, alter their properties or biodegrade. Polyhydroxybutyrate (PHB) is a polyester made by micro-organisms and is fully biodegradable. It has been suggested that PHB composites could be suitable for medical applications since they have the advantages of being biodegradable, biocompatible and have the potential for piezoelectric stimulation of new local bone formation. The modulus of elasticity of injection-moulded composite material was found to fall within the range for human bone from certain anatomical sites. However screws made from PHB-composites are not suitable for orthopaedic use because bone-fixation with screws requires a modulus higher than 25 GPa. So another method for fixation is required.

## Objectives

- To develop a new method for biomaterials acting as a scaffold in the fixation of bone fractures.

## Material and methods

### Material

- PHB was supplied by Zeneka BioProducts. Hydroxyapatite was supplied by S.E.C. Italy.

### Methods

- Injection moulding
- Tensile testing with extension meter

## Results

- The blend with 30 vol% Hydroxyapatite possesses a modulus of 8 GPa. For certain bones that are subject to low load bearing circumstances, as in our purpose, a modulus of 8 GPa can be considered satisfactory.
- Screws designed for fixation bone fractures must have a modulus between 20 and 40 GPa.
- So a new design like two bone plates which are fixed with tie-wraps is proposed.

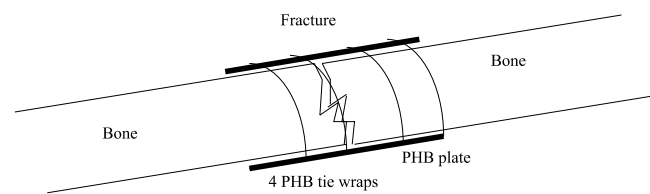


fig. 1 New design for fixation of fractured bones

- *In-vivo* tests are still in progress and the results will be submitted soon.

## Conclusions

Since our composite material combined with the tie-wrap design has so many advantages in contrast to long-term stainless steel implants, it can be concluded that PHB reinforced with hydroxyapatite has considerable potential for use in orthopaedic implants.

## References

- PAVALAINEN, P., KARAHARAJU, E., SLATIS P., AHONEN J. AND HOSTROM T.: Clin. Orthop., bf 136, p287, 1978.  
DOYLE, C. AND BONFIELD W.: Eng. Appl. of New Comp., p114, 1988.  
DOYLE, C., TANNER, E.T., BONFIELD W.: Biomaterials, 12, p841, 1991.