



"SME Supply Chain Integration for Enhanced Fully Customisable Medical Implants, using New Biomaterials and Rapid Manufacturing Technologies, to Enhance the Quality of Life for EU Citizens"

Integrated Project for SME's, coordinated by



Dental Case

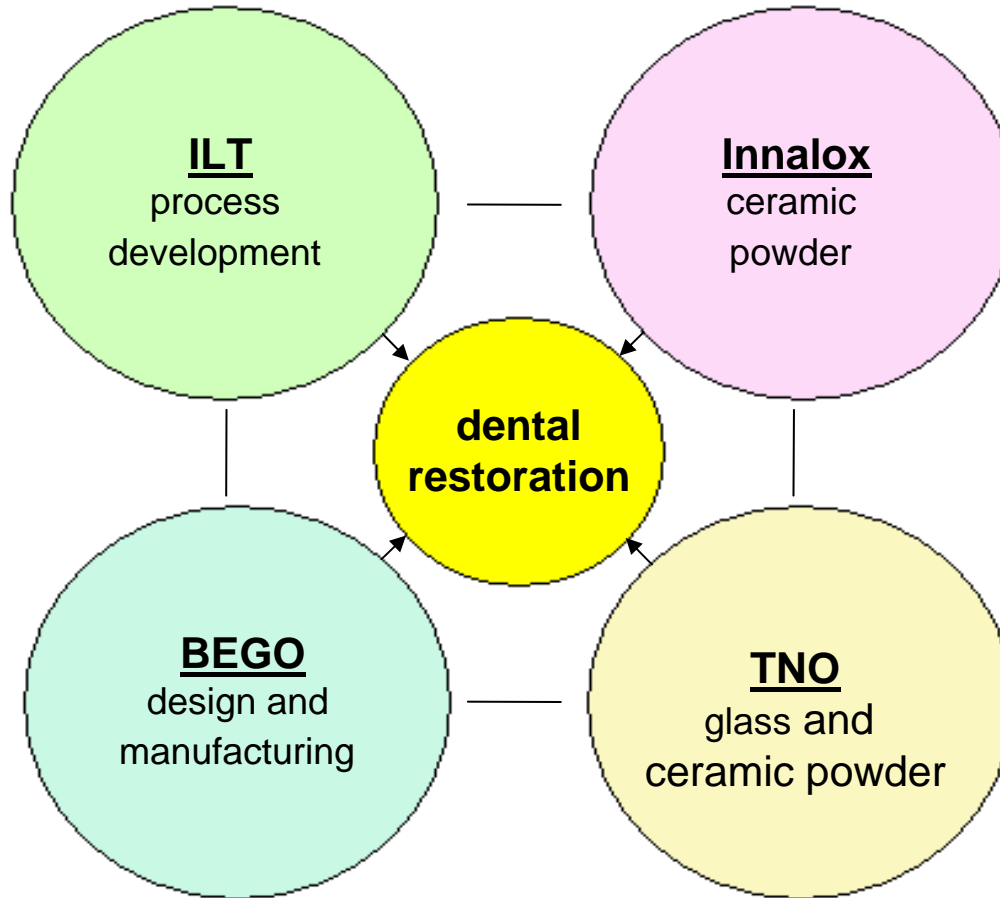
Stephan Dierkes, BEGO
Jan Wilkes, ILT
Jan Welter, Innalox
Fritz Feenstra, TNO

Final Public Event
Barcelona, 21st of January 2011

Aim

The aim of this case was the production of ceramic dental restorations by laser melting

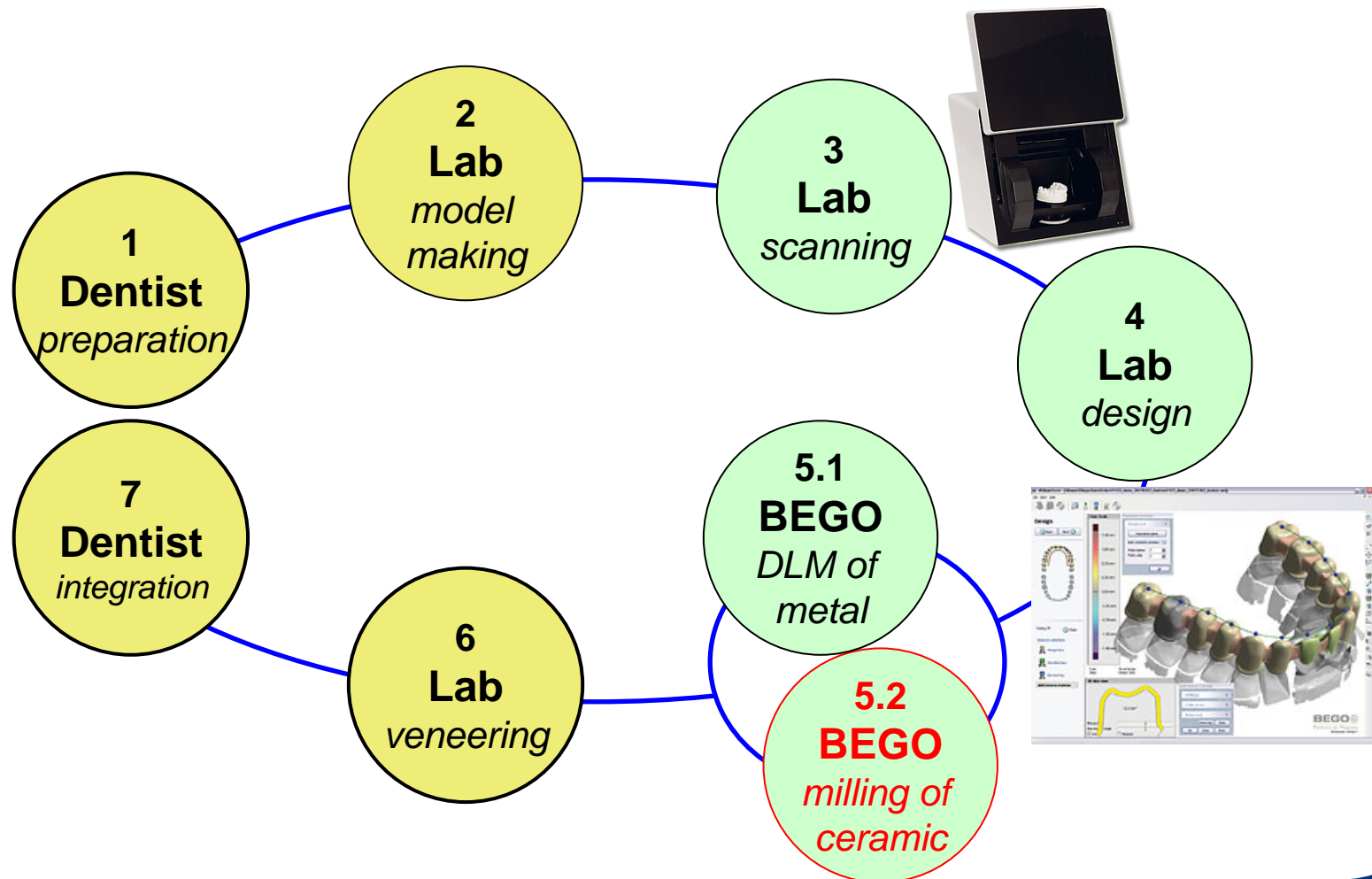
Project partner



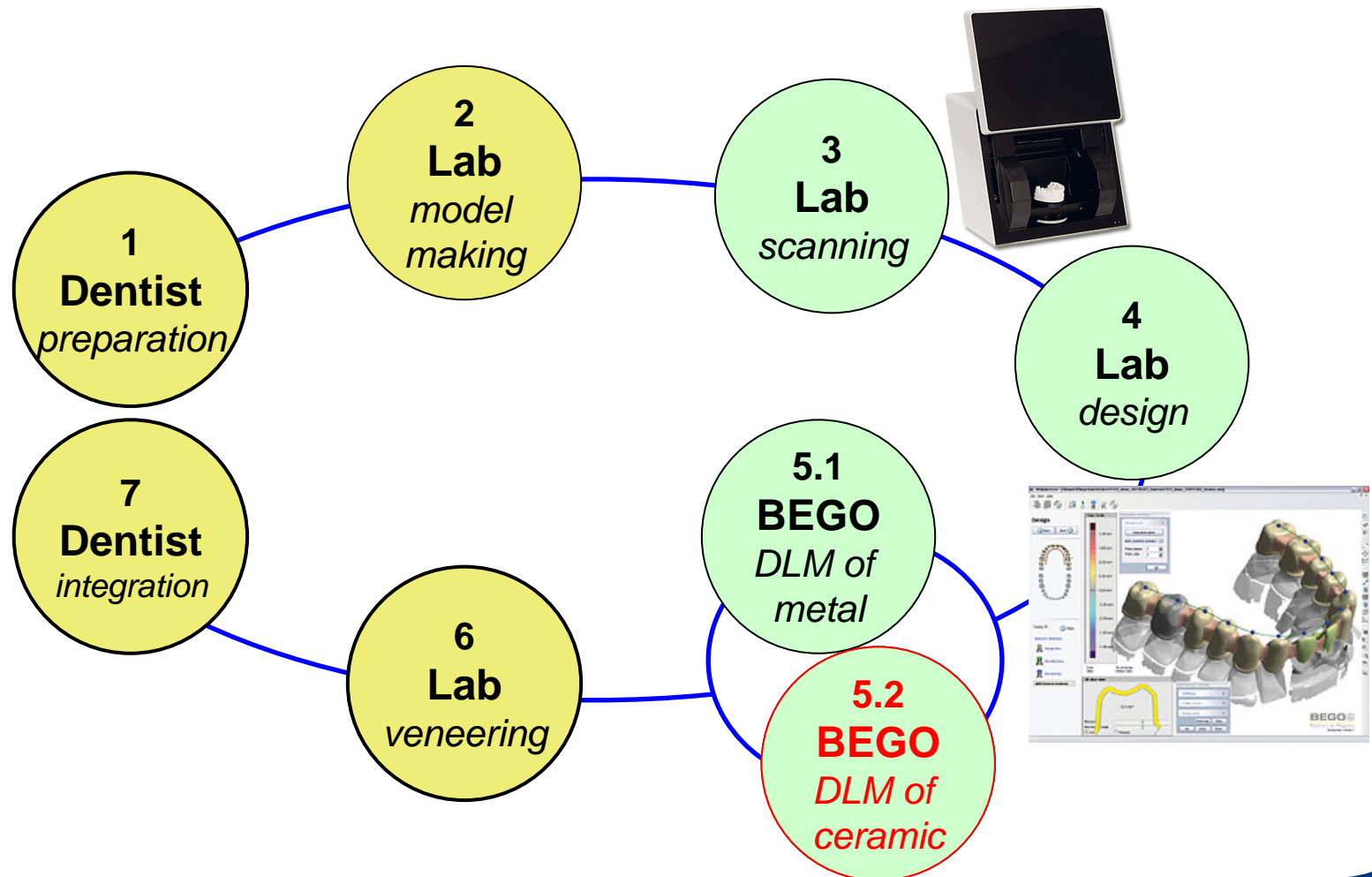
State of the art

- BEGO and ILT developed the laser melting of metal for dental frame works
- since 2002 BEGO produces DLM units of CoCr
- since 2007 BEGO produces milled units of ZrO₂
- so far no ceramic units could be produced by laser melting

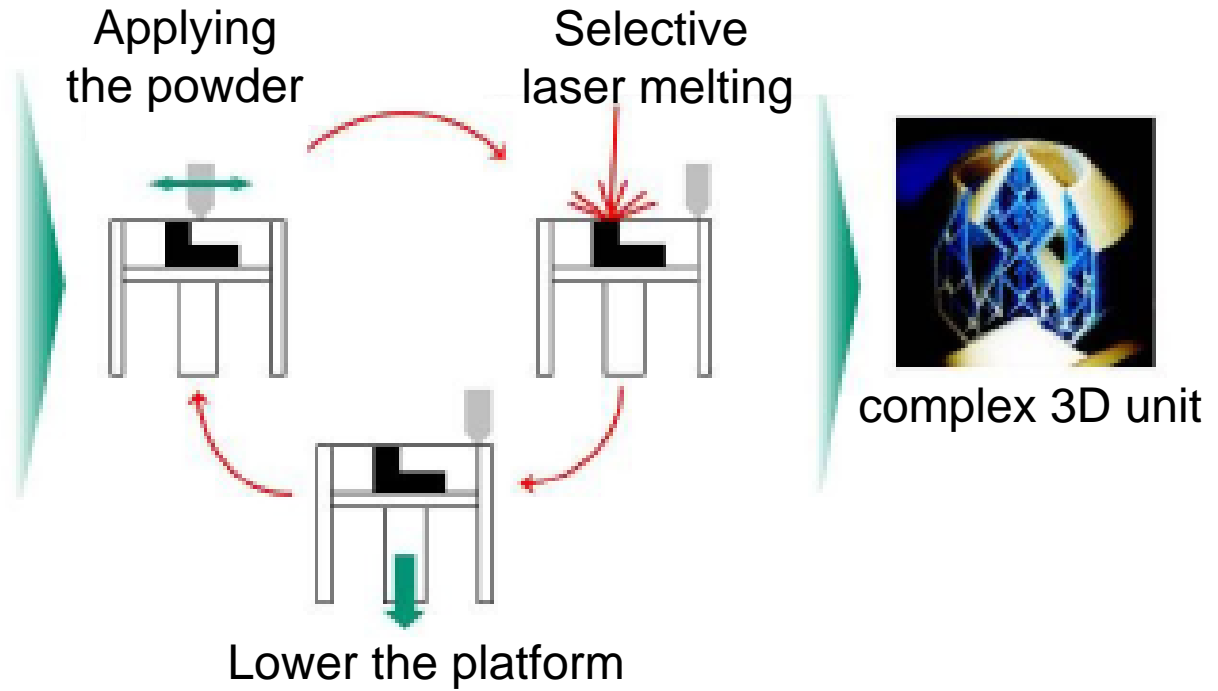
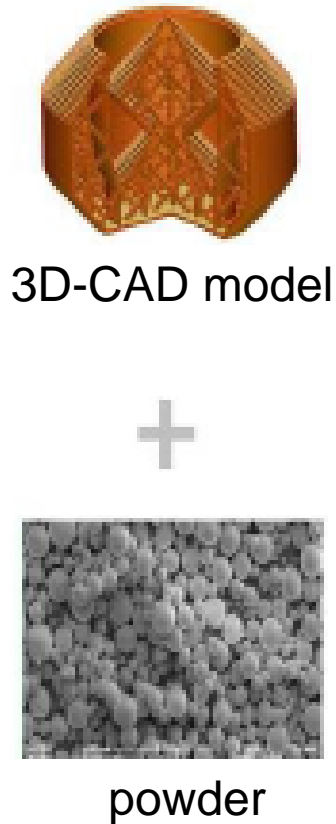
The existing CAD/CAM process chain at BEGO



The planned CAD/CAM process chain at BEGO



Schema of the Direct Laser Melting process



Why laser melting of ceramic?

Advantages of DLM compared with milling:

- economy
 - > exploitation of the raw material ~ 90%
(milling: ~ 10%)
 - > no tool wear
- more complex construction units can be produced
- for ceramic: after the shaping no thermal subsequent treatment is necessary
 - > faster production of the units

Why ceramic for dental restorations?

Dental restoration with a



ceramic frame work



metal frame work

Why ceramic for dental restorations?



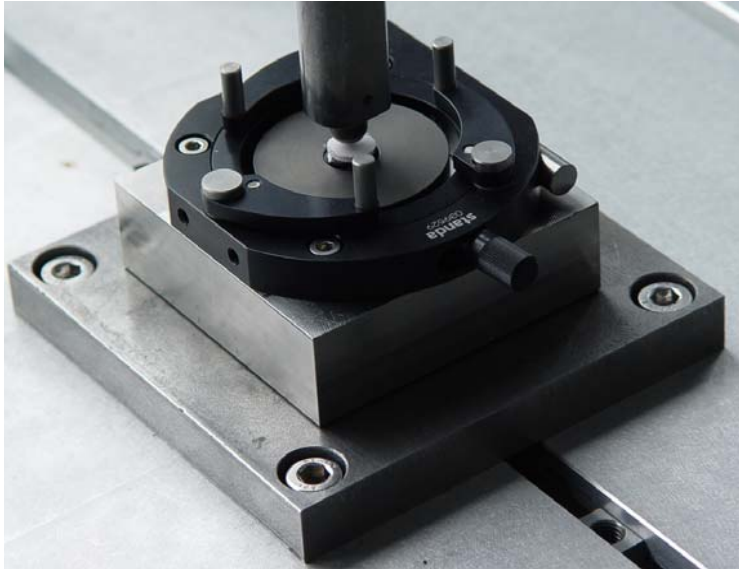
Advantages of ceramic:

- aesthetic
 - > color
 - > translucency
- biocompatibility

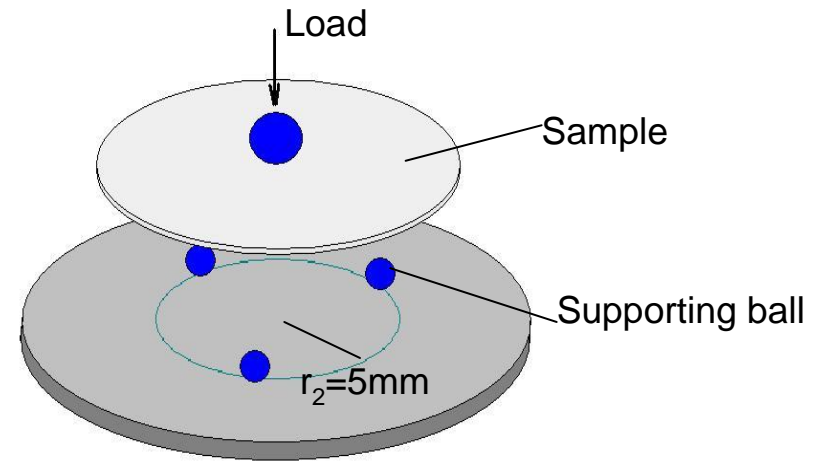
Results: - standard samples
- three unit bridge

Characteristics of the samples – Bending strength

Test setup:



Test schema:



Result: reached bending strengths are **550MPa**

Characteristics of the samples – Porosity

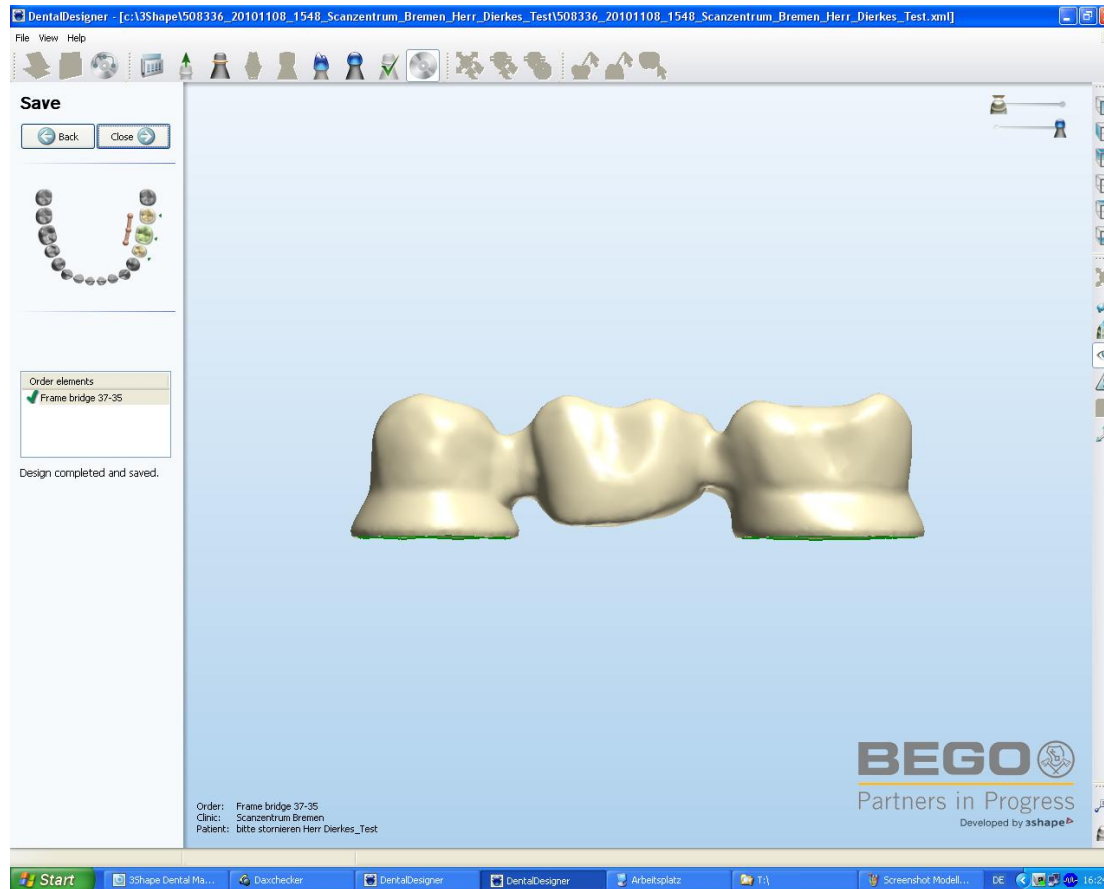
Cross section of a sample:



Result: a density of almost **100%** could be achieved

Characteristics of a bridges

Design of the bridge:



Characteristics of a bridge

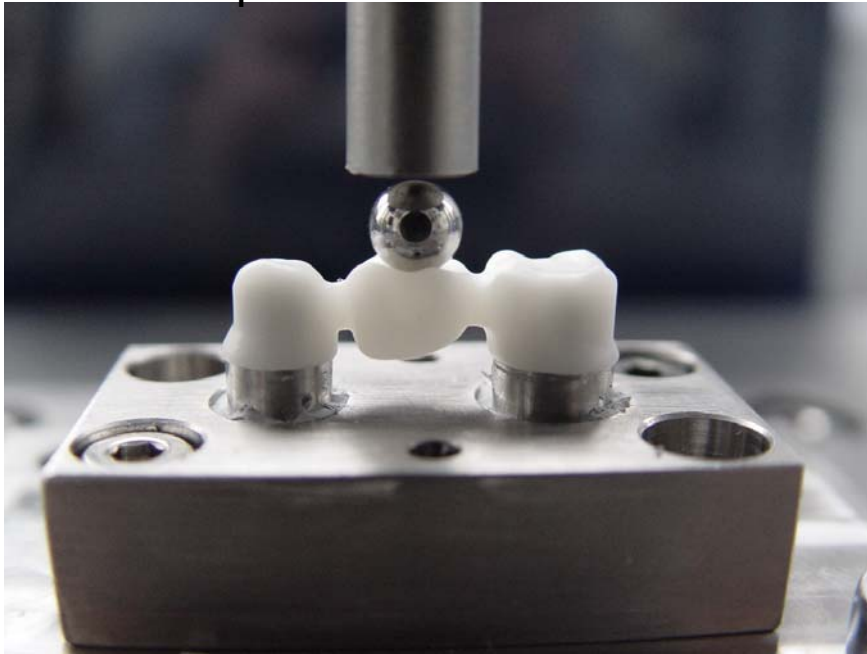
Produced bridges

- by milling (top)
- by laser melting (down)



Characteristics of a bridges – Breaking load

Test setup:

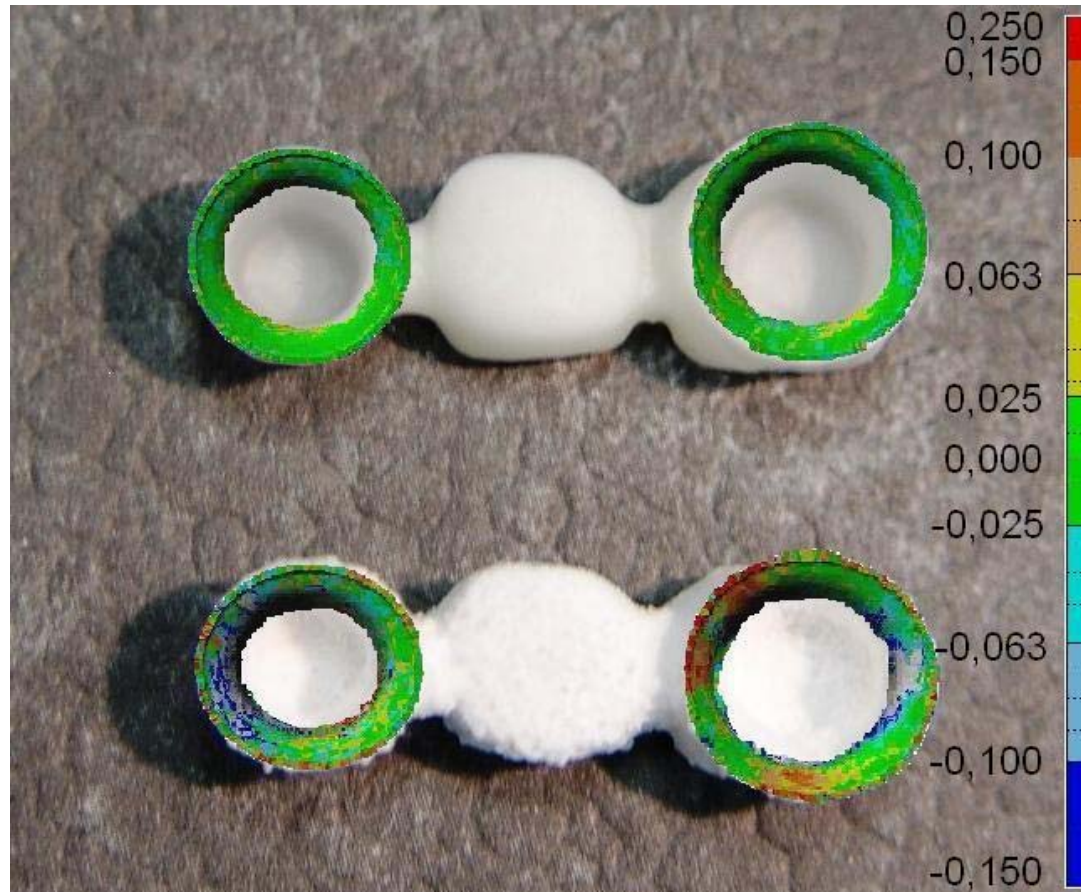


Result:

	DLF	Milled
Sample 1	1435 N	2299N
Sample 2	848 N	1763 N
average	1141,5 N	2031N

Characteristics of a bridges – Fit

Set-actual comparison



Summary

- Ceramic samples could be produced by laser melting for the first time with the following characteristics:
 - density of nearly 100%
 - without glassy phase
 - bending strength up to 550MPa
- The bridges produced by laser melting cannot reach the high standard of the milled bridges concerning the breaking load and the fit. In particular the fit of the DLM bridge is too bad, to produce dental restorations this way
- Further development is still necessary, in order to produce dental restorations by the laser melting process