Case Study:
Rapid Manufacturing of Dental Restorations

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sirona.

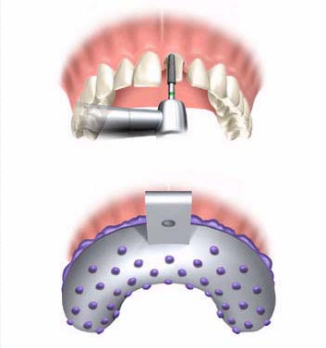
The Dental Company

Content

- Who we are?
- What does e-manufacturing mean for the Sirona production centre »infiniDent«?
- What are our products for Rapid Manufacturing?
- Why do we need the DMLS process for RM?
- What kind of development tasks we worked on?
- What are the results of the development partnership between EOS and Sirona?
- What should be improved for the DMLS process?

e-manufacturing
Central Production »infiniDent«

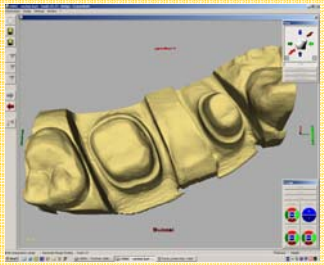
Dentist



Preparation and impression

Dental Lab

Scanning of the model



CAD-design of the restoration

Sending the CAD-data via internet

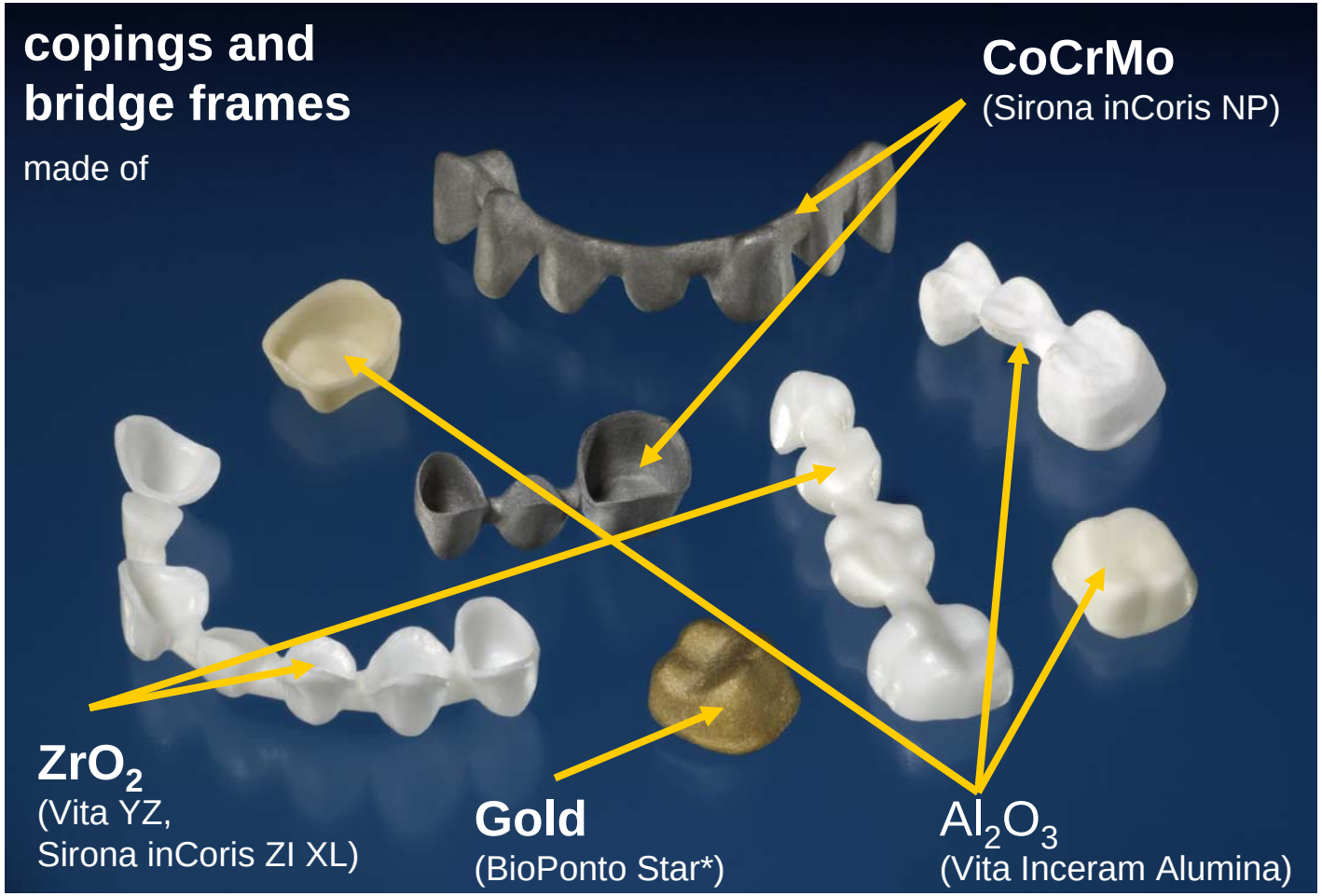
Ceramic layering/veneering

infiniDent

production

shipment

Materials and Applications of »infiniDent«



dental restorations

- are customized products with lot size „1“ and individuell complex geometries.
- must be biocompatible, fit and distortionless.

* via Bego Medical

sirona.

Why Direct Metal Laser Sintering (DMLS)?

situation

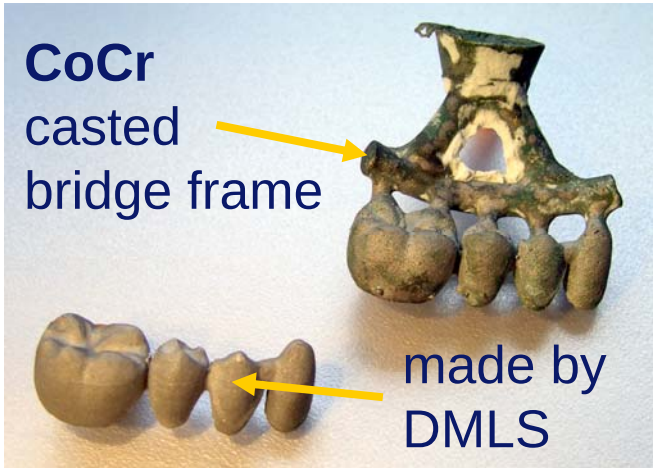
- market consumption: in Germany > 20 % of all copings and bridge frames were made of non-precious alloys (basis CoCr)
- CoCr-alloys are difficult to machine by cutting (milling, grinding)
- casting of CoCr-alloys is uneconomical under industrial conditions
- dental restorations are customized products with complex geometries
- Bego Medical as partner of infiniDent was single seller of laser sintered restorations

objective

- development of an industrial rapid manufacturing process for the economic production of customized dental CoCr-restorations

Advantages of the DMLS Process

- small and medium lot sizes producable
- CAM-step is nearly independent from the geometry -> in comparison to cutting processes minimized work for data preparation
- material input = part volume -> no cutting waste
- sufficient precision for dental applications by the solution of the laser scanning system, a layer thickness of 20 µm and material with adaptive grain distribution
- increased part surface (roughness) made by DMLS with advantages for improved retension and adhesion between metal and ceramic
- in comparison to the traditional casting less post-processing



Partnership between EOS and Sirona

cooperation and teamwork in the fields of

- material,
- process,
- equipment (EOSINT M270),
- post-processing und
- dental Know-how.

Development Steps (1/2)

material adaptation

- consideration of patent rights (i.e. composition) and technical as well as dental requirements (i.e. process capability, CET)

preparation of process equipment EOSINT M270

optimization of the equipment and the software

- reducing of non-productive time -> increasing process speed (minimization of delay times)
- simplify the data preparation

evidence of technical and economical feasability

- economic building volume > 18 cm^3 per job

Development Steps (2/2)

process development

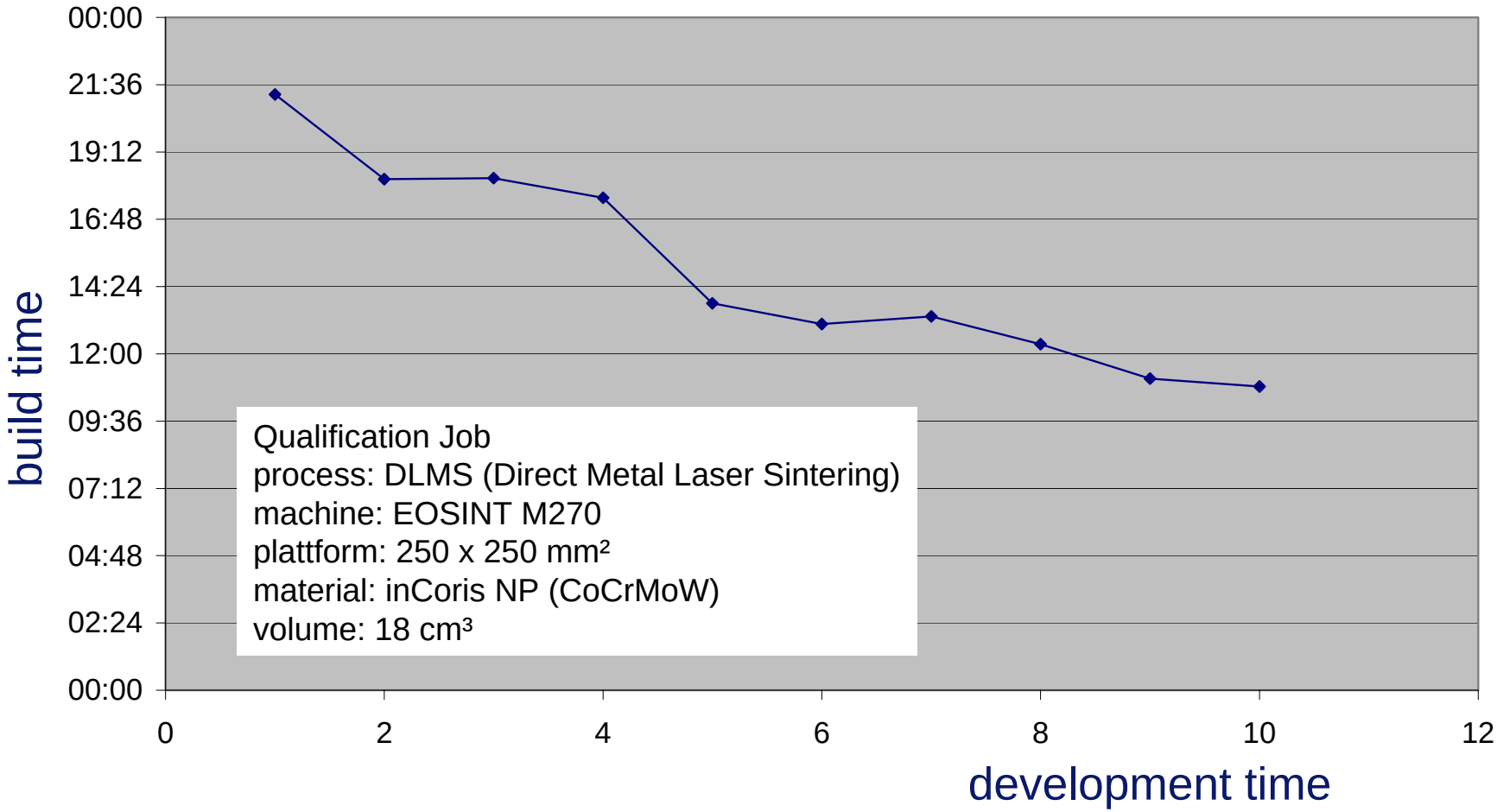
- basic development of process know-How -> reduction of process time
- setup of the fitting precision
- optimization of the skin core principle especially for the reduction of thermal tensions
- improving the support design in relation to the post processing

development of post processing

- setup of an acceptable shipment part quality

CE-certification of the materials

Development of Build Time



Results

- **CE-certified** dental CoCr-material
- qualitative and **economical** acceptable production process with
- **matching (good fit) copings and bridges** frames
- **without distortion** in comparison to our competitors
- **partly automized** data preparation and post processing
- **advantages** compared to dental casting processes
- **successful** testing by our customers provides an acceptable shipment part quality

- **official market introduction in April 2006**

Conclusion

- DMLS as RP-process would be developed to a Rapid Manufacturing process in range of app. 2 years
- development results based on the material and process competence of both partners and the succesful cooperation with EOS
- potential of further development of DMLS is still high
- EOSINT M270 is usable for the production of customized dental restorations and small and medium lot sizes.
- optimization needs are for
  - further reduction of building time and
  - post-processing outside the machine as well as
  - a more suitable machine handling in view of an industrial production (i.e. the powder handling)

Thank You
For Your
Attention

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