Zirkonzahn®

Human Zirconium Technology

ZIRCONIA – INFORMATION FOR DENTISTS

FAQ'S – from the dental practice

ENGLISH

Zr

Facts and Answers

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What is Zirconia?

- Zirconium ($ZrSiO_4$) belongs to the mineral group of silicates and was discovered in 1789 by the German chemist M. H. Klaproth.
- Zirconium dioxide (zirconia ZrO_2) is a natural compound of the element zirconium which occurs in nature. It has been used in dentistry for up to 15 years. Zirkonzahn zirconia is partially stabilised with yttrium and enriched with aluminium. This process lends the material the desired characteristics of high flexural strength (> 1400 MPa*), hardness (1200 HV*) and a Weibull modulus of 15.84*.
  (* Zirkonzahn ICE Translucent Zirconia values)

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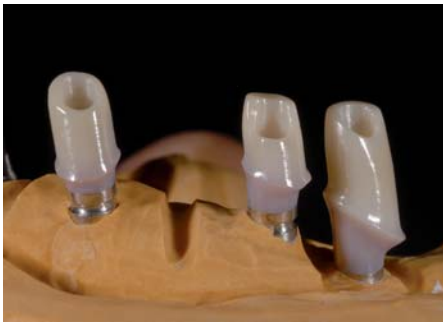
Where is it used?

- Zirconia has already been used over 40 years for industrial purposes. It is exceptionally durable and 100% biocompatible. For these reasons it is used increasingly in surgery for ear-, finger- and hip prostheses. Applications for dentistry are found in zirconia pins, crowns, bridges and implants. The material's natural white base allows individual colouring in prescribed dentin shades. The biotechnical characteristics of zirconia result in high quality crowns, bridges and implants with excellent biocompatibility and aesthetic appearance.



Are metal-free/full zirconia restorations possible?

- Replacement of conventional (precious) metal-based restorations with zirconia is entirely possible, but should only be carried out by dental technicians who have undertaken special training in this field.
- Zirkonzahn has also developed a new material called Prettau Zirconia. It displays a high amount of translucency and is very attractive for use in 100% full-zirconia restorations. Colouring requires a special technique which needs to be learned.

Can removable dental prostheses be made from zirconia?

- Yes, if the physical properties of zirconia are considered and it's parameters observed correctly, a trained dental technician can produce such restorations

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Zirconia science

Zirconia science

- The raw base material for the production of zirconium dioxide is the mineral zirconium ($ZrSiO_4$). Zirconium dioxide is produced in a chemical process using additives. Distinctions are made between sinter additives which influence the actual sinter process and characteristics of the final material, and auxiliary additives which facilitate workability. So-called “green blocks” are produced through a certified manufacturing process.
- Sinter additives remain in the zirconium oxide, while the auxiliary additives (mainly volatile organic compounds apart from water) are removed from the material before sintering, leaving no residue. The green blocks are stabilised in a pre-sinter process to a degree that allows machining with tungsten milling tools. Framework milled from the chalky green blocks is enlarged by about 25%. Shrinkage during the final sinter fire at 1500°C results in the frame’s final 1:1 size. The sinter process effects a shrinkage of 20%. Through it the frame acquires the final flexural strength and hardness by compaction of the material particles.

Enzo Luciano (Italy)

- This is achieved by temperature-dependent diffusion processes with varying degrees of surface-, grain boundary- and volume diffusion. If the solidifying diffusion process happens too slow, sintering can be carried out under pressure in addition. This is called hot pressing or hot isostatic pressing (“hipping“) the zirconia. Chemical composition and processing methods very much determine the quality characteristics of the end product.

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Zirconia science

Zirconia science

- There is a difference between fully stabilised zirconia (FSZ) and partially stabilised zirconia (PSZ). Partial stabilisation can be created by adding 3-6% CaO, MgO or T_2O_3. Depending on production methods, the cubic, tetragonal or monocline modification can be stabilised. Partially stabilised zirconia displays high resistance to temperature changes which makes it suitable for use in an environment subject to high temperatures.
- By adding 10-15% CaO and MgO, the cubic makeup of zirconia can be stabilised from absolute zero to fully stabilised zirconia. This makes the material thermally and mechanically resistant to temperatures up to 2600°C. Due to low heat conductivity and a high thermal expansion coefficient fully stabilised zirconia has a lower resistance to temperature changes than partially stabilised zirconia. A composition of 95% ZrO_2 + 5% Y_2O_3 presents the ideal material for dental restorations.

ICE TRANSLUCENT ZIRCONIA & ICE PRETTAU ZIRCONIA

Both types can be used for manufacture of crown- and bridgework. Due to its high translucency ICE Prettau zirconia is especially suited for 100% full- zirconia restorations.

ICE ZIRCONIA

COMPOSITION		Specifications
$Zr O_2$ (+HfO_2)	% :	Main component
$Y_2 0_3$	% :	4.95 ~ 5.26
$Al_2 0_3$	% :	0.15 ~ 0.35
$Si0_2$	% :	Max. 0.02
$Fe_2 0_3$	% :	Max. 0.01
$Na_2 0$	% :	Max. 0.04
Density (g/cm^3) sintered		6,05
Hardness (HV10)		>1250
Weibull module		> 15,84
Flexural strength R.T. (MPa) Transl.		>1400 (MPa)
Flexural strength R.T. (MPa) Prettau		>1200 (MPa)

Zr

FAQ’s from the dental practice

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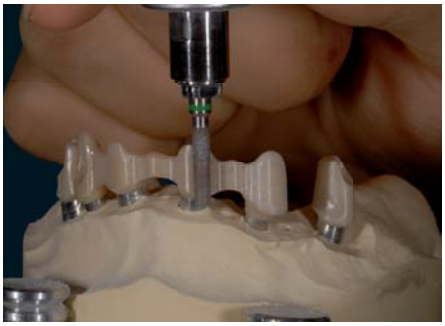
How durable is porcelain-veneered zirconia framework compared to PFM restorations?

- There are no disadvantages compared to PFM technology provided the restoration fits well and veneer porcelain support is adequate.

Should zirconia restorations be water cooled when frame adjustments are made?

- Water cooling is recommended but not essential. Avoid spot heating when trimming or polishing.



How does the ageing process of zirconia and related loss of strength compare with conventional metal-ceramic?

- All materials age, even metals. The flexural strength of metal before ageing is about 500 MPa. ICE zirconia is about 1400 MPa. Even with an assumed strength degradation of 30% (which noone has proven so far) zirconia still maintains 980 MPa.

Why is the ICE Zirconia shrinkage factor always consistent ?

- A Zirkonzahn company secret.

How is the connection between veneer porcelain and zirconia achieved?

- Mechanical retention, compressive adhesion and surface fusion.

Who has recorded long-term studies & experiments for zirconia restorations?

- The University of Zurich has recorded promising positive long-term studies involving an unprecedented 12 years of zirconia research.

How should zirconia restoration be cemented?

- Phosphate or glass ionomer cement. Conventional cementation as the material cannot be etched.

Strength comparison of zirconia vs. metal-ceramic.

Zirconia is more fracture resistent but less flexible than precious metal.

- What are the indications and contraindications?

Indicated for all fixed or removeable prostheses

- Contra-indicated where vertical dimensions are minimal.

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Aesthetic comparison of zirconia vs. metal frame work

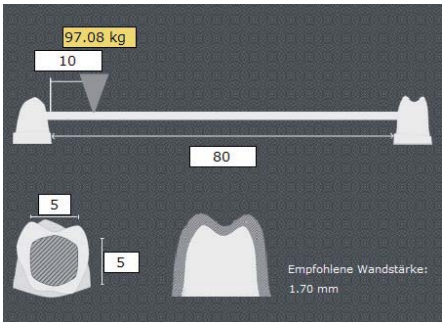
- ICE zirconia framework is translucent and far superior to the opaque appearance of metal-ceramic.

Can margins be modified after try-in?

- Margin extensions are possible by adding porcelain shoulders. If in doubt about margin definition, verify mock-up frame fit in situ first before milling.

Why do bridges break?

- Bridges may break when fundamental frame-design errors are committed. Zirkonzahn provides a connector-strength calculation table for bridgework. A free download of the table is available from www.zirkonzahn .com.



Zirconia framework seems to lack friction and doesn’t stay put when tried in situ.

- Actual friction fit can be created technically but is not recommended. Use a smear layer of vaseline inside the frame during try-ins.

Is Zirconia radioactive?

- Every physical thing is radioactive! The human body radiates 6000 Bq of radioactivity. 1g of zirconium dioxide measures about 0.4 Bq. A crown weighs approx. 1 gr. Metal-ceramic restorations may radiate up to 2 Bq/gr.

Crown margins of zirconia restorations are too bulky.

- Not a material fault but a processing problem. After milling / before sintering the technician must thin out the margins at the green stage.

How does cost compare with metal-ceramic?

- Zirconia restorations are equal to or marginally more expensive than metal-ceramic restorations.

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FAQ’s from the dental practice

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How good is the fit of zirconia restorations?

- When milled correctly, Zirkonzahn systems produce a fit to one hundredth of a degree. The marginal fit is 20 µm –the same as gold alloy.

What about chair-side adjustments of zirconia restorations?

- No problem as long as grinding is performed under water cooling. Any resulting sharp edges must be smoothed over and rounded.

What are the applications for Prettau zirconia?

- Prettau zirconia is extra translucent. Applicated for aesthetic 100% full-zirconia restorations when used in conjuction with the specific Prettau colouring technique. Particularly suitable for implants and in cases of heavy occlusion (bruxism) to avoid chipping (absence of veneer porcelain).

Is a knife-edge preparation safe for zirconia restorations?

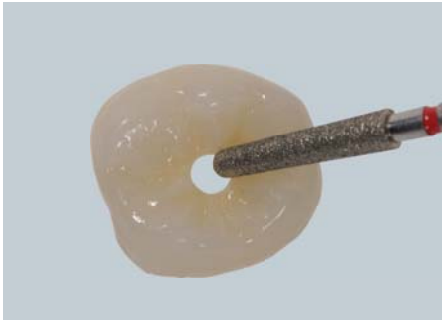
- Zirkonzahn has no reservations about knife-edge preparations in particular. Any preparation style is possible.
- No special prep technique required.

Will a zirconia crown be compromised by trepanation (root canal treatment)?

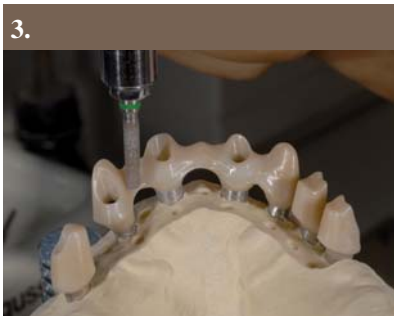
- Frame damage will not occur as long as suitably sharp tools are used in combination with water-cooling.

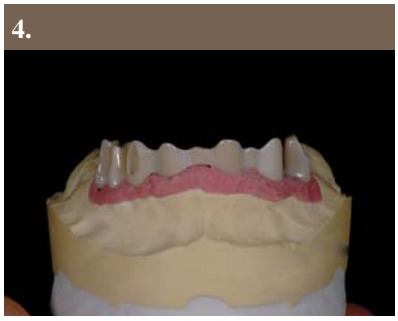
What rotary tools are used for trepanation of zirconia crowns?

- Zirconia abrasives i.e diamonds are recommened.



1. Original situation
2. First the entire denture is duplicated with FRAME epoxy-resin and then reduced down to bar/abutment dimensions





3. Abutments and bar connectors are milled with diamond burs
4. Surface refinement to high gloss finish using extra-fine burs and diamond polishing paste

5. The bridge frame is duplicated over the bar sub-structure a second time using FRAME epoxy-resin. Only the front teeth are prepared for porcelain veneering
6. Sintered bridge

7. Bridge fitted over bar sub-structure
8. In-situ try-in

9. First build-up of the anteriors with ICE veneer porcelain
10. Application of pink veneer porcelain ICE Tissue

11. Removable bridge

12. Removable bridge with bar sub-structure

13. Completed case – occlusal view

14. Bar sub-structure fixed in situ

15. Bridge ready for cementation

16. Part-permanent cementation with Temp Bond

Completed case

ICE Zirconia and ICE Zirconia ceramic

Zilio Aldo, Venice

Zirkonzahn®

ZIRCONIA – INFORMATION FOR DENTISTS

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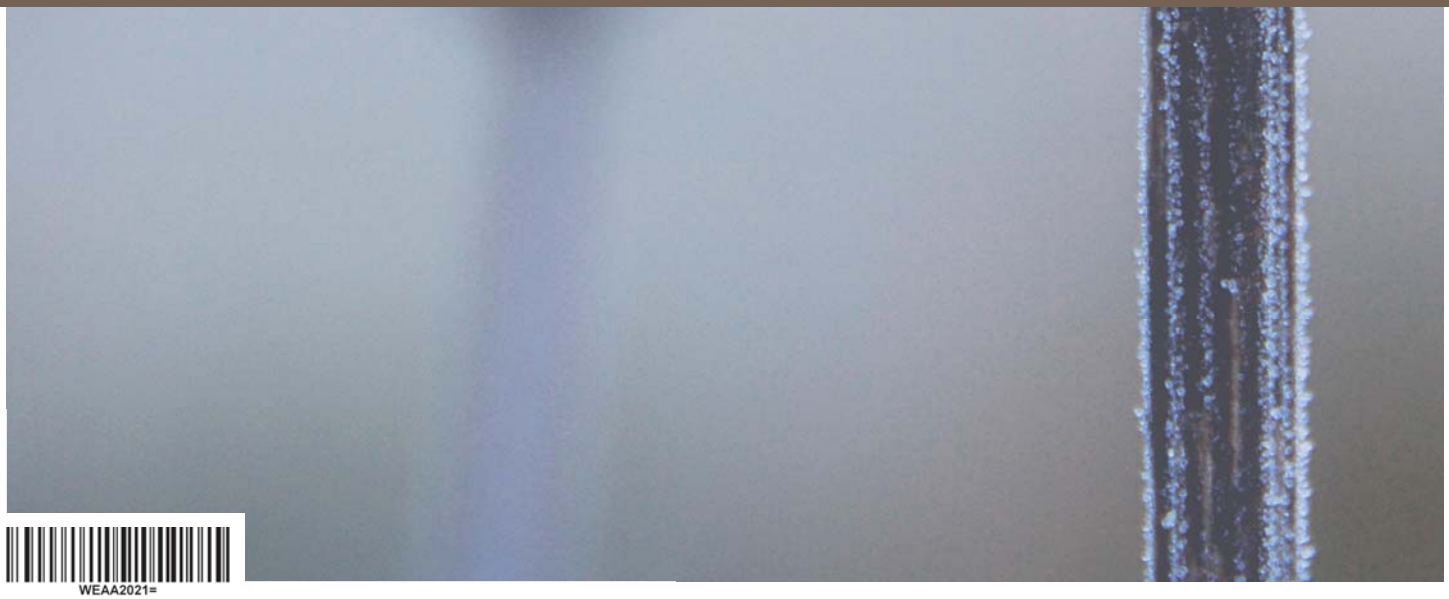

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