

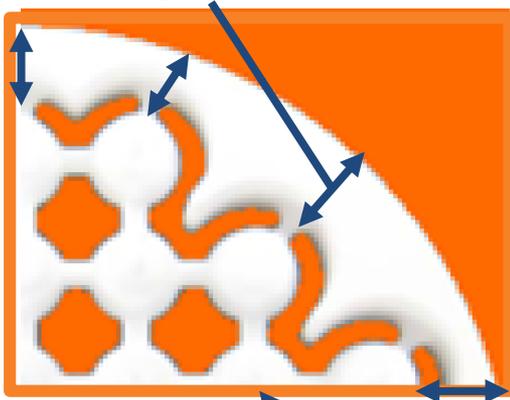
KEROX workshop with DENTAL LABS:

- > optimal milling.
- > Optimal sintering.

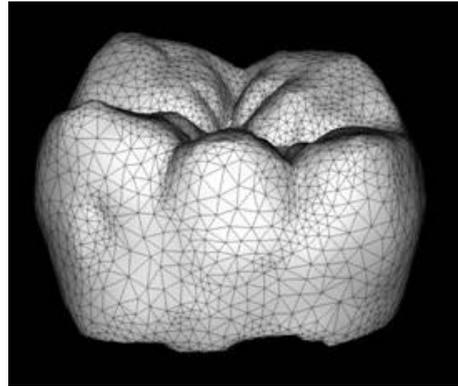


Design instructions

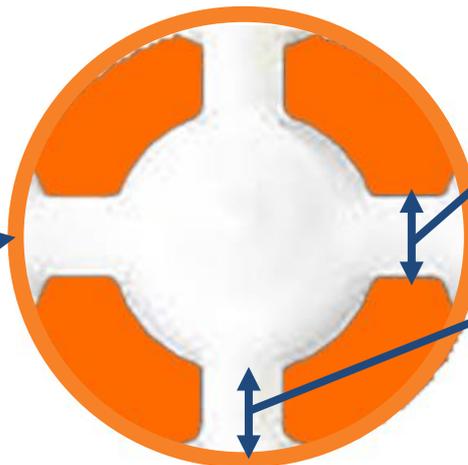
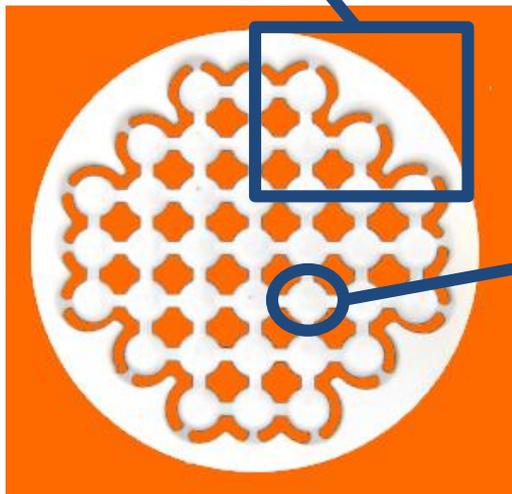
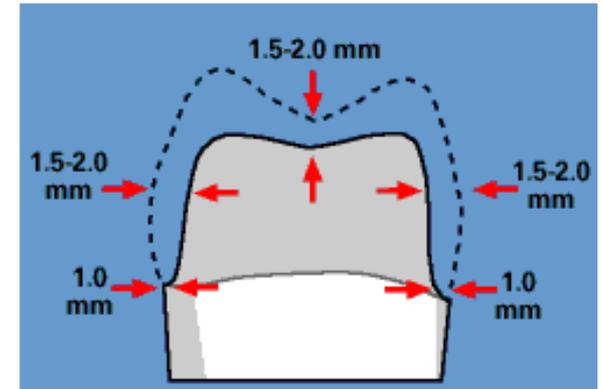
Optimal distance from the edge: 1.5 mm



Use the correct number of meshpoints



Optimal wall thickness



Optimal connector width: 1-2 mm

Optimal connector length: 2-3 mm

Choosing the optimal burr

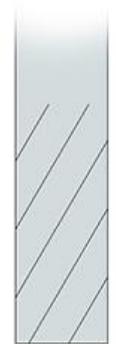


Make sure that your burr is best for the milling process:

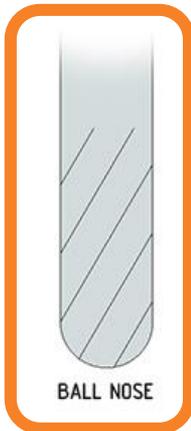
Ball ended milling tool

Neck lenght

Diameter



SQUARE END



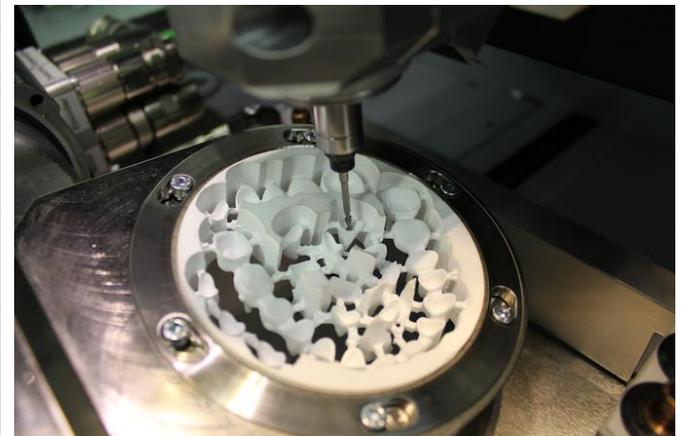
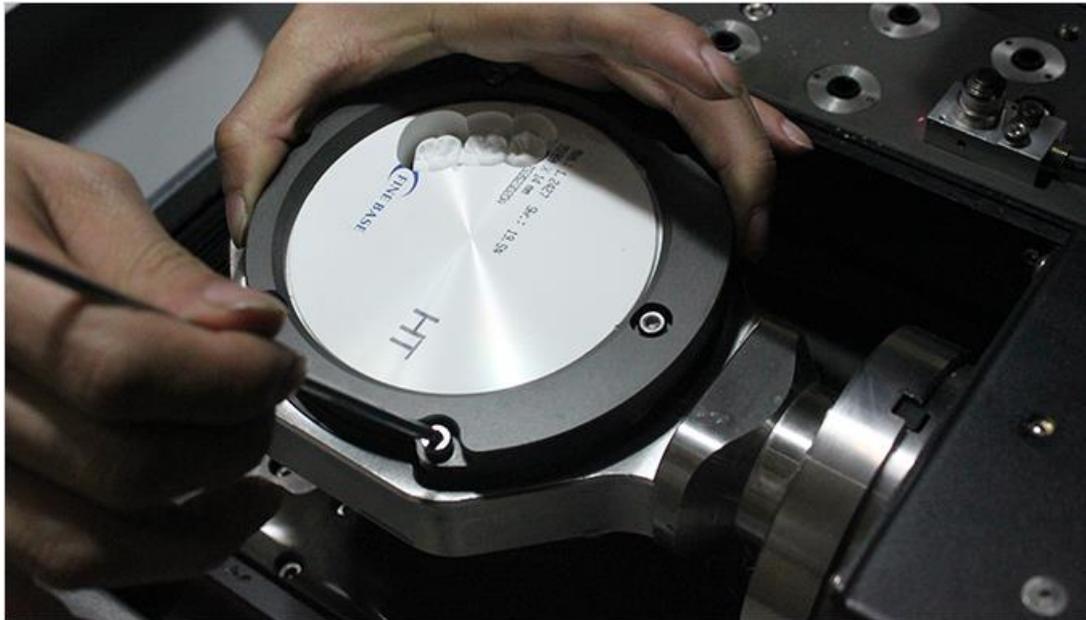
BALL NOSE



CORNER RADIUS



Handle the zircon block with care when you place in the milling machine holder.

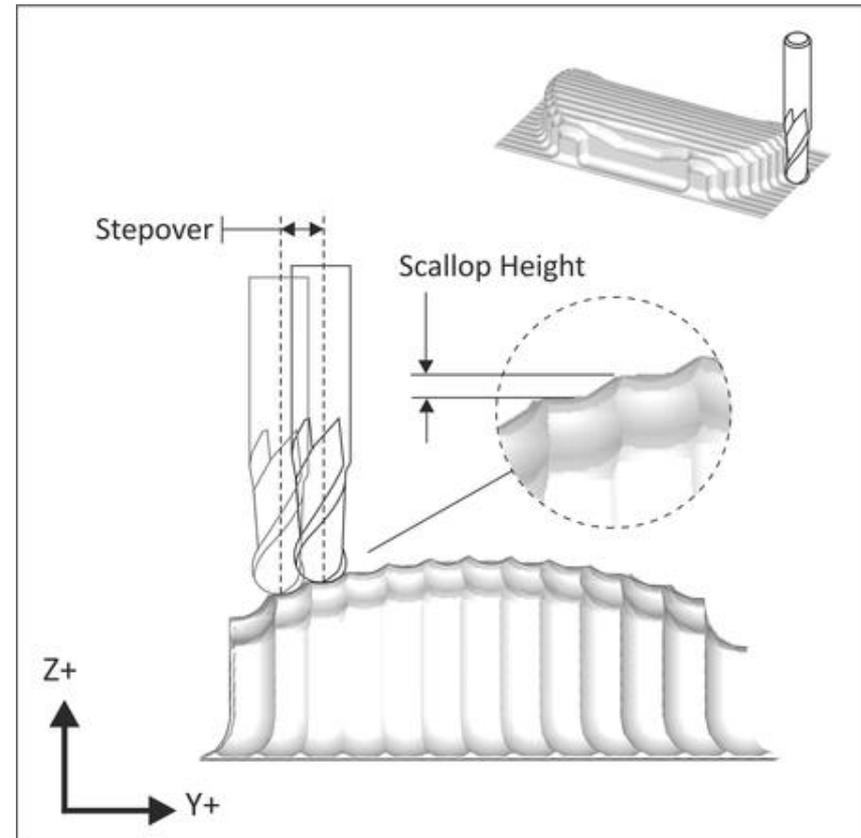


Feedrate:

The feedrate is always changing, depending on the toolpath and the process.

Stepover, milling depth:

The milling depth and the stepover influence how smooth the surface will be



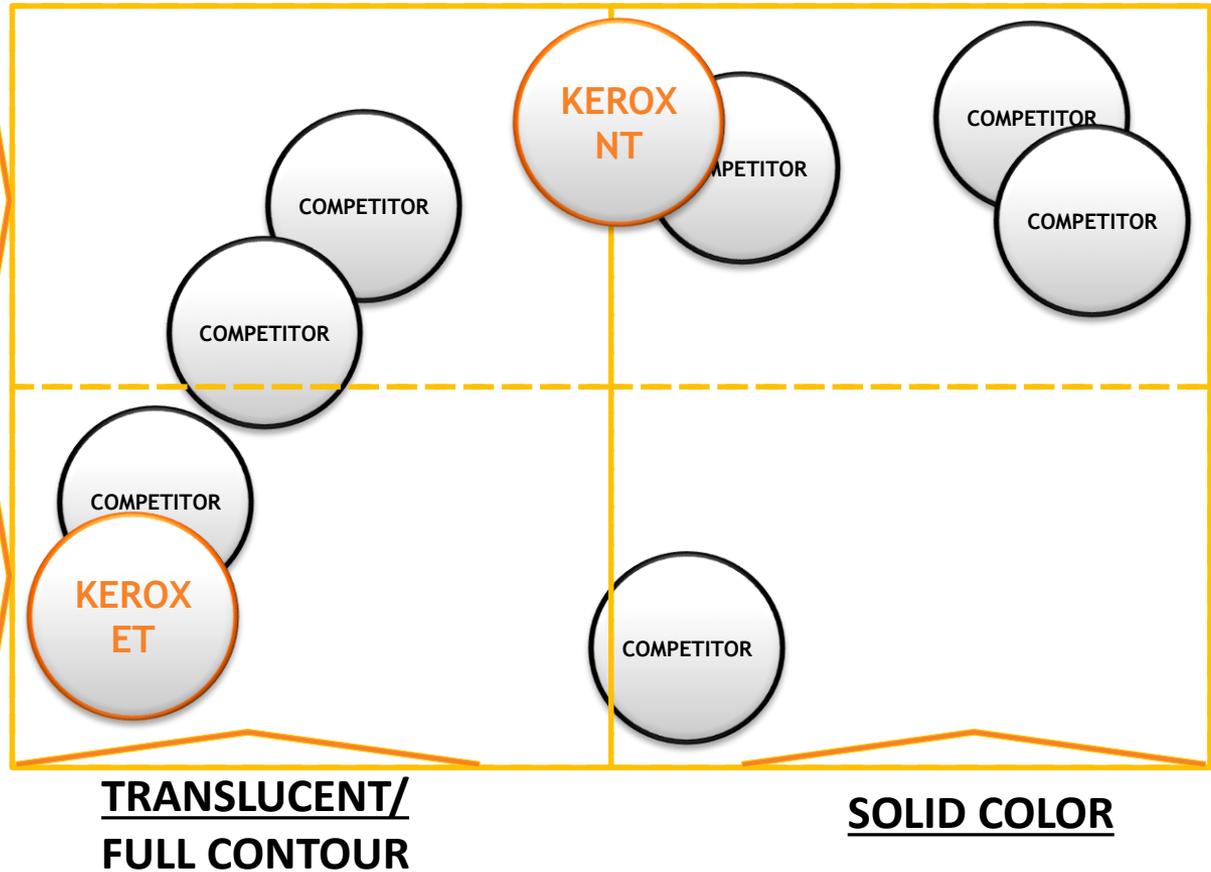
MILLABILITY IS NOT THE SAME FOR ALL ZIRCONIA

Zirconia blanks examined

- Argen/ Sagemax Nexx ZR
- Crystal Diamond HT
- BruxZir milling blank
- Wieland Zenotec ZR
- ZirkonZahn ICE TR
- Dental Direkt
- Metoxit

AGGRESSIVE MILLING
high burr amortization
high stress on machine
and blanks
faster production output

CAUTIOUS MILLING
more burr lifetime
low stress on machine and
blanks
slower production output



Millability – comparison

(Preliminary, milled with Roland DWX50 + Origin/YM)

Aggressive milling:

high burr amortization
high stress on mill machine / spindle
Fast output

RPM ↓
Feed rate ↑

Feed rate ↓
RPM ↑

Cautious milling:

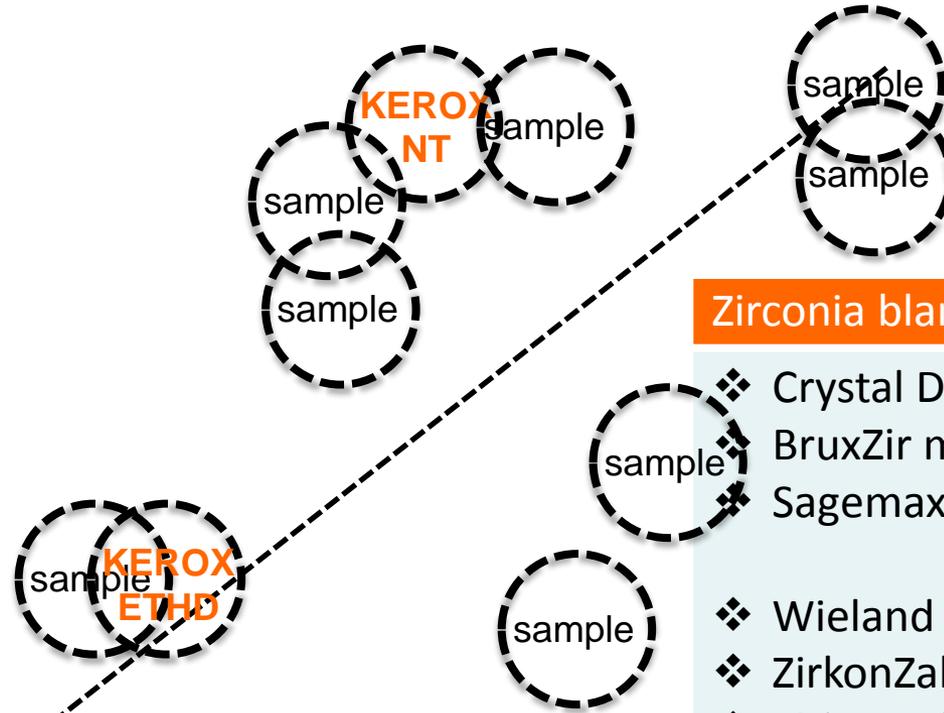
low burr amortization
low stress on mill machine
slow output, full contour

Soft
Esthetics

↓↓ bending strength (Mpa)
↑↑ translucency

Hard
Opaque

g-code



Zirconia blanks examined

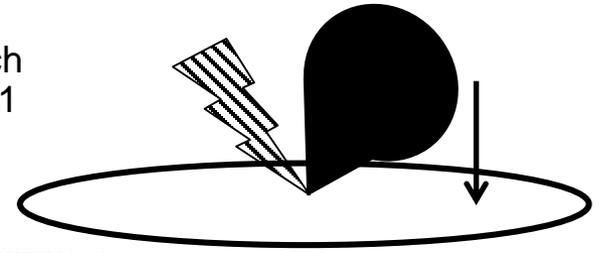
- ❖ Crystal Diamond HT
- ❖ BruxZir milling blank
- ❖ Sagemax Nexx ZR
- ❖ Wieland Zenotec ZR
- ❖ ZirkonZahn Prettau
- ❖ ZirkonZahn ICE TR
- ❖ Dental Direkt
- ❖ Metoxit

Explaining: –too aggressive – optimal– too gentle milling.

Too aggressive milling: **RPM ↑**
Feed rate ↓

Too low RPM, too high feedrate:
Very fast burr amortization
Stress on mill machine / spindle
Fast output.

The mill burr hits the surface with too brute force. With slow speed, too much material is taken out with 1 carve.

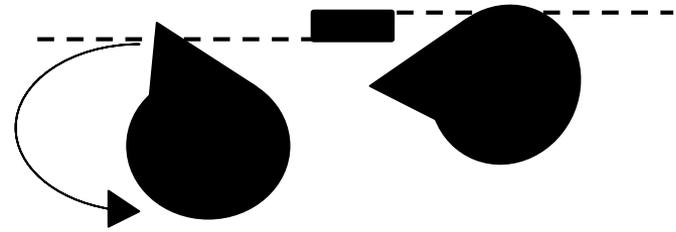


Optimal milling:

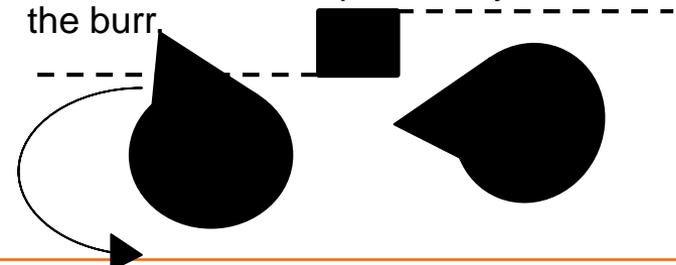
Medium burr amortization
low stress on mill machine
slow output, **full contour**
recommended for **Extreme TR**.

Too small amount of material is carved out per turn. > the Zirconia is fractured by the “push” of the burr.

(1) the cut-angle is too small, so (2) the material is pushed by the back of the burr.



Optimal: (1) the cut-angle is bigger: so (2) the material is **not** pushed by the back of the burr.



Too cautious / too gentle milling:

Too high RPM, too low feedrate:
high burr amortization
„It is like a car pushing its wheels to the pavement at small angle”



RPM ↓
feedrate ↑



Mill tests: handling the CAM system / analyzing the g-code.

Example: DelCan milling track

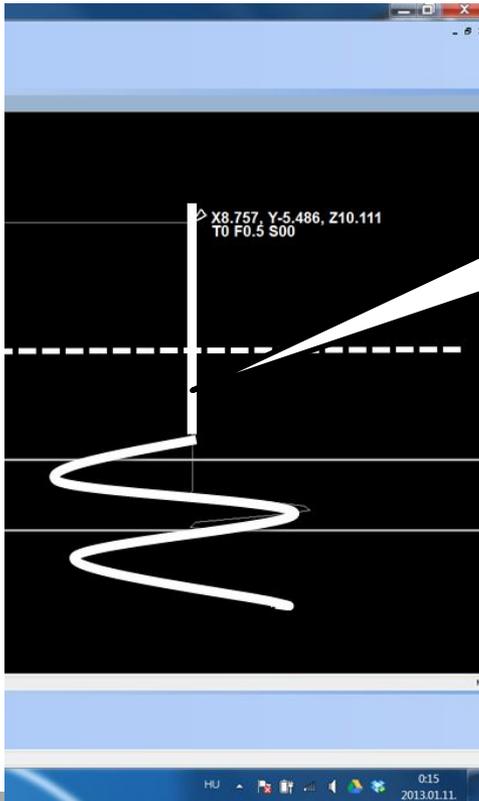
-Hits the surface:
"drop-drill"
(CAM mistake.)

-Vertical travel
-High feed rate

- "Helix" path:
Mill, not Drill

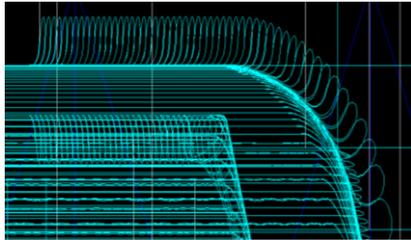
...before, with
incorrect
template

...KEROX fine-
tuned the milling
template

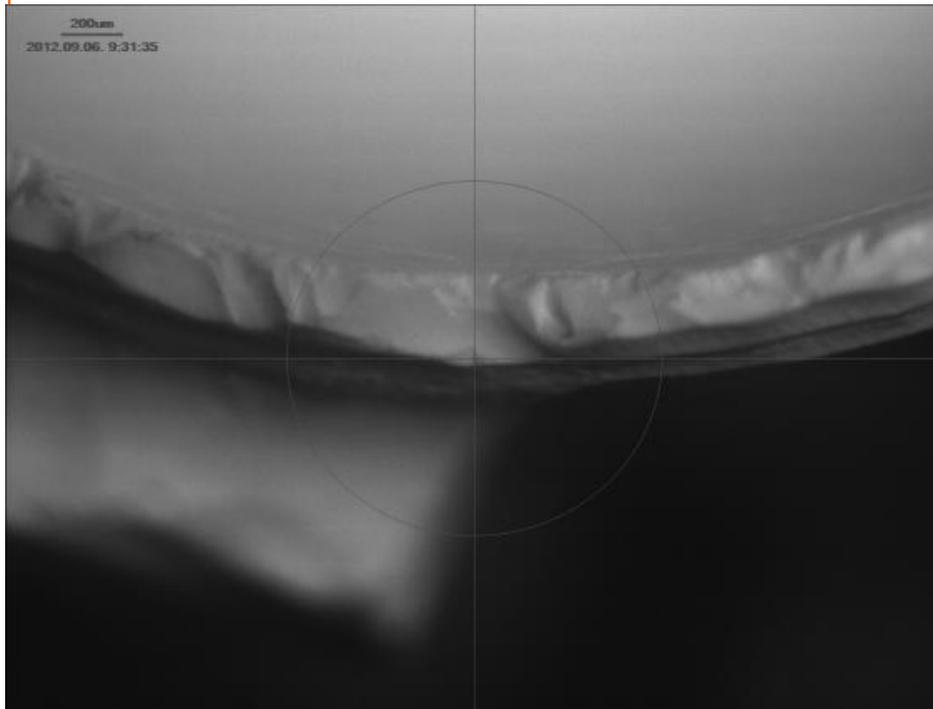


Mill tests:

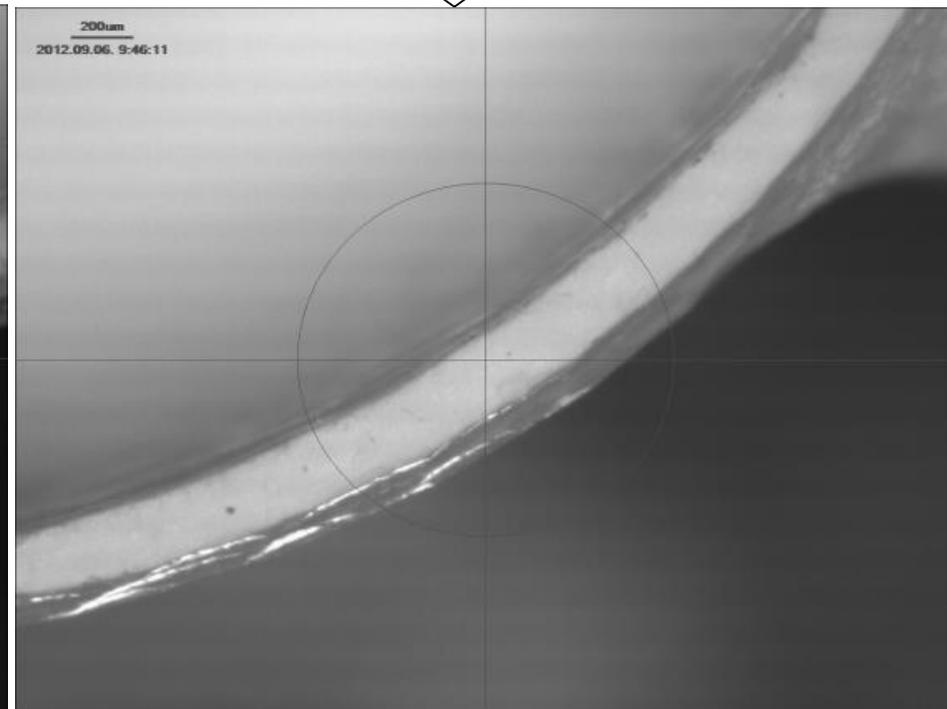
- to improve the efficiency & optimize output of your milling



Adjusting RPM, feed rate, mill depth, # of flutes/edges: dramatic improvement on the cervical edge of the restoration.



...before, with incorrect milling template



...after KEROX fine-tuned milling template (150 micron)

THE PLASTIC FRAMEWORK HAS OPTIMAL SURFACE @ CRITICAL POINTS. GLUE: STRONG HOLDING FORCE (bond between glue and zircon is higher, than glue and frame).

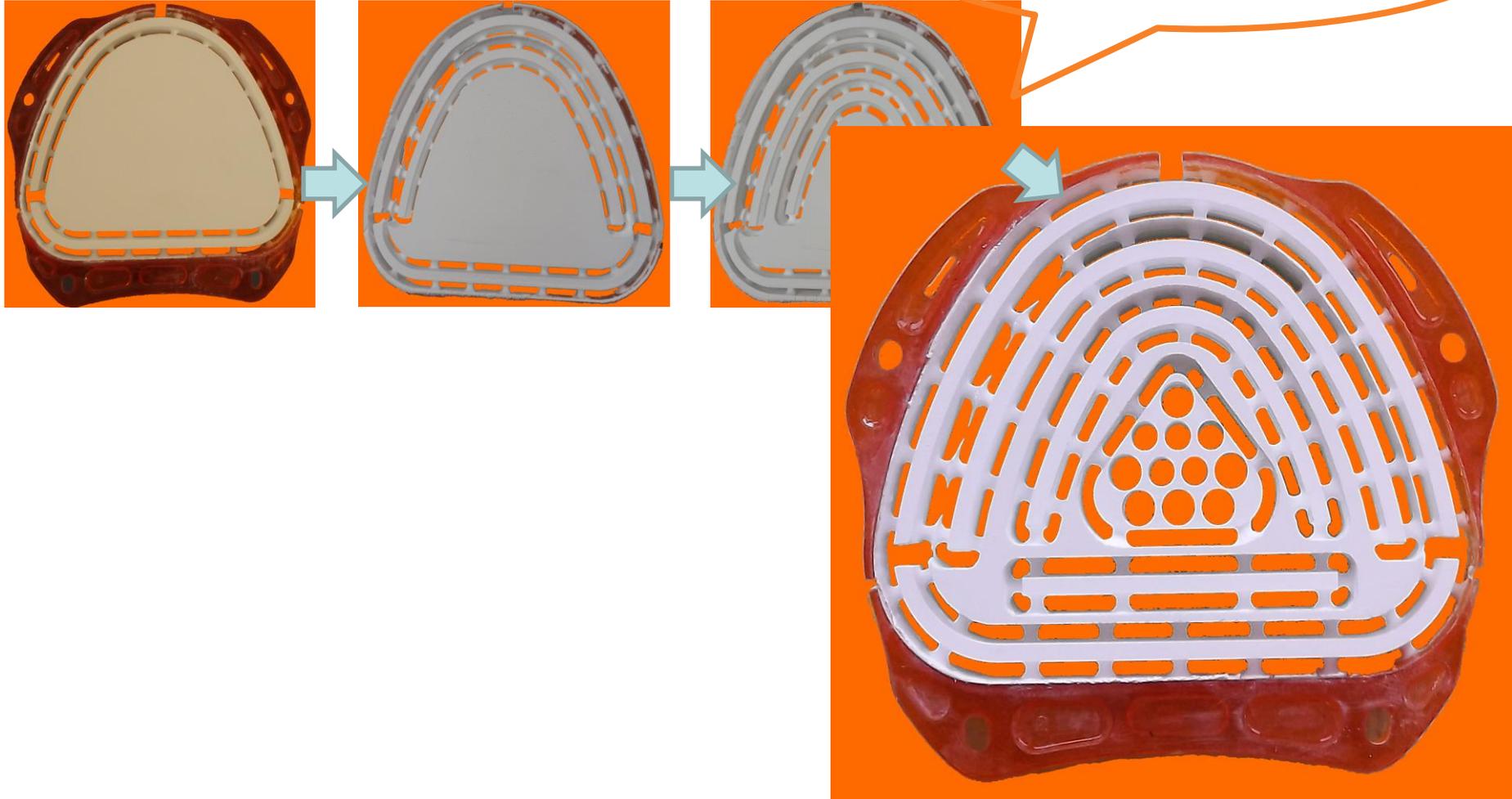
KEROX cooperation with milling center client for mill optimization

Tool diameter	Milling process	Spindle speed	Feed rate	Milling depth	Stepover	Teeth number of the tool	Cooling
2 mm	roughing	19000 RPM	1400 mm/min	1,2 mm	1 mm	2	none
1 mm	finishing	27000 RPM	1800 mm/min	0,3- 0,1 mm*	0,3 – 0,1 mm*	2	none

**= The stepover and the milling depth in the finishing process is not fixed, because the milling path is following the contour of the workpiece geometry.*

Reducing the Zircon surface and frame-zircon connection areas.

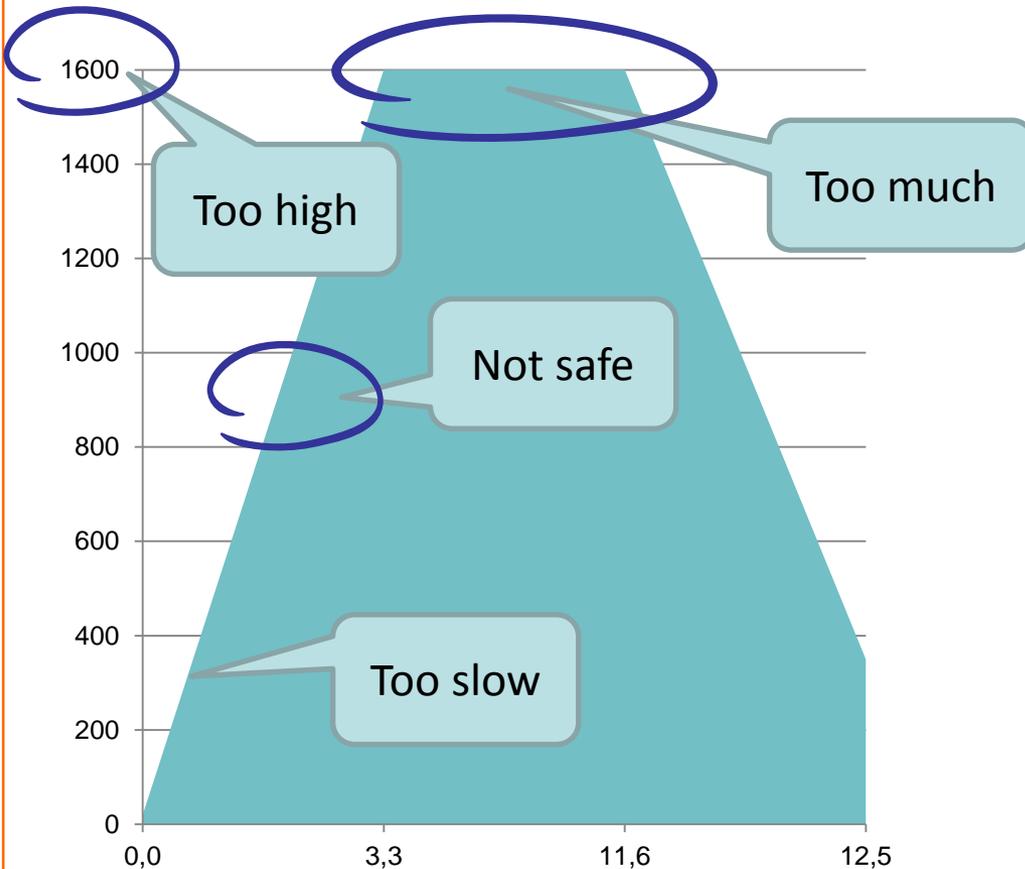
illustration:



KEROX cooperation with milling center client for mill optimization

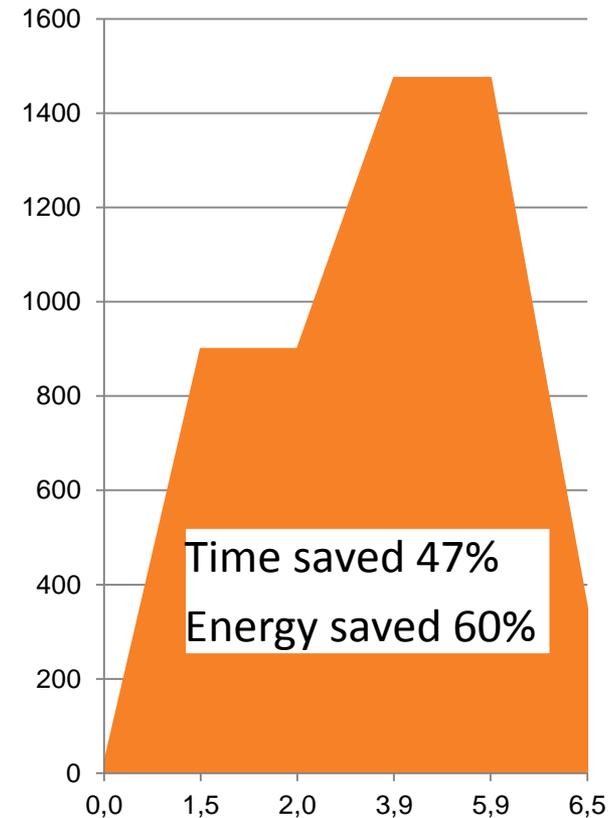
Example: Cut sinter times and energy use

Sinter curve used before KEROX visit



...before, 12.5 hours sinter time

...after KEROX workshop



...with KEROX 6.5 hours sinter time

LABOR OPN 1/2

Cutting speed: result of RPM (Drehzahl) and the F (feedrate, vorschub): =feedrate per edge on the burr (here is 2) * RPM (mm/min.

You cannot adjust

Drehzahl/RPM: **too high: please try:**
 Roughing: max. 30000, Finishing: max. 20000.

If it is water, we don't suggest that. Oil is forbidden for Kerox, and water is also not suggested.

GO Liste der Operationen

Zyklusname	V	Drehzahl	Drehrichtung	Getriebe	Kühlung	V/Zahn	
Roughing D3 at 0	424.1150	45000.0000	CW	↔	0	1	0.0361
Roughing D3 Inside	424.1150	45000.0000	CW	↔	0	1	0.0361
Roughing D3 at 180	424.1150	45000.0000	CW	↔	0	1	0.0361
Semi Finishing D3 Inside	424.1150	45000.0000	CW	↔	0	1	0.0361
Semi finishing D3 at 0 Side	424.1150	45000.0000	CW	↔	0	1	0.0361
Semi Finishing D3 at 180	424.1150	45000.0000	CW	↔	0	1	0.0361
RestMachining D1 at 0 Inside	157.0796	50000.0000	CW	↔	0	1	0.0227
RestMachining D1 at 0 Side	157.0796	50000.0000	CW	↔	0	1	0.0227
RestMachining D1 at 180	157.0796	50000.0000	CW	↔	0	1	0.0227
Finishing ML D1	157.0796	50000.0000	CW	↔	0	1	0.0227
Morphing D1 5axes Iniside	157.0796	50000.0000	CW	↔	0	1	0.0227
3D offset finishing D1 at 0	157.0796	50000.0000	CW	↔	0	1	0.0227
Finishing D1 at 180	157.0796	50000.0000	CW	↔	0	1	0.0227

Ok Abbrechen

Preparation for the workshop:

Kerox needs input info:

- type of milling machine
- type of CAM.
- ”g code” (sent by email).
- prior tel talk with the technician about mill strategy.

Workshop:

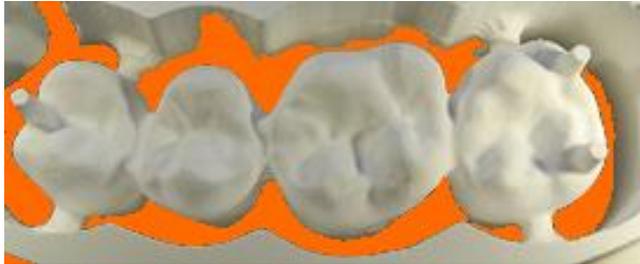
Would take 1=2 hours.

- Milling strategies.
- Milling tracks, trouble-shooting.
- Creating special “templates” for high translucents.
- Material: why TOSOH.
- Sintering trouble-shooting.

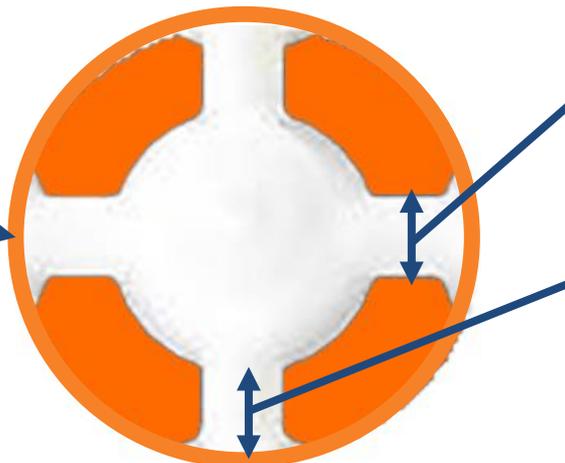
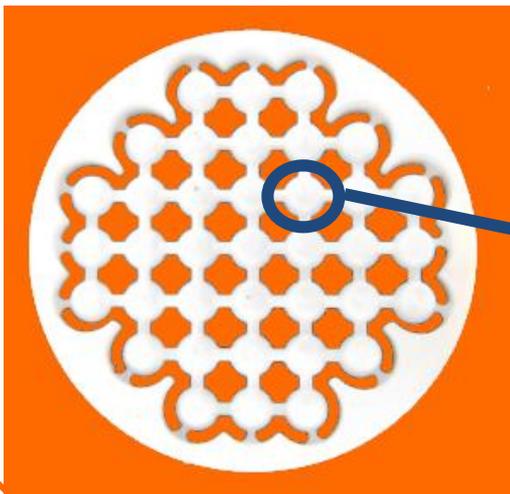
Result, take-aways”:

- Optimized milling strategy of Kerox (and other) Zirconia disks.
- >>less burr amortization.
- >>maximized translucency and esthetics.
- How to talk and what to ask for your CAM provider.
- trouble-shooting lessons.

Optimal General milling settings



Nesting test:



Optimal connector
width:1-2 mm

Optimal connector
length:2-3 mm

Optimal general milling:

- Common surface, grain
- Rough milling
- Twice as fast as the soft milling

Extra soft milling:

- Good surface, grain
- Slow milling
- Recommended for precise milling

Feed rate

Cutting depth

Splinde speed



Feed rate

Cutting Depth

Splinde speed

Optimal General milling strategy

Tool dia.*	Milling process	Splinde speed	Feed (XY)	Feed (Z)	Milling depth	Overstep	Number of tool tooth	Cooling**
3 [mm]	Roughing	30000 [RPM]	2500 [mm/min]	800 [mm/min]	1 [mm]	1,5 [mm]	2-3	No
2 [mm]	Prefinishing	25000 [RPM]	1500 [mm/min]	800 [mm/min]	0,2 [mm]	0,3 [mm]	2-3	No
1 [mm]	Finishing	25000 [RPM]	1000 [mm/min]	800 [mm/min]	0,1 [mm]	0,1 [mm]	2-3	No

Extra soft milling strategy

Tool dia.*	Milling process	Splinde speed	Feed (XY)	Feed (Z)	Milling depth	Overstep	Number of tool tooth	Cooling**
3 [mm]	Roughing	25000 [RPM]	1300 [mm/min]	800 [mm/min]	1 [mm]	1 [mm]	2-3	No
2 [mm]	Prefinishing	25000 [RPM]	1000 [mm/min]	800 [mm/min]	0,2 [mm]	0,2 [mm]	2-3	No
1 [mm]	Finishing	25000 [RPM]	800 [mm/min]	800 [mm/min]	0,05 [mm]	0,05 [mm]	2-3	No

*Recommended tools by Kerox Dental are ball-nosed milling tools!

**Kerox Dental recommend that you don't use cooling liquid which is containing any oil substance!

To capture the **translucency** and **esthetics** of Kerox disk, pls read the following:

- ❖ The ETHD is millable with an average milling strategy, but to reach the optimal quality, we recommend optional milling strategy, advised by Kerox dental.
- ❖ Always keep the recommended minimal wall thickness, connector width and connector length!
- ❖ Cautious milling strategy: generally set your milling by:
RPM ↑ Feed rate ↓ in order to experiment the material.
More instructions: please register for our hotline service.
- ❖ Don't mill in the plastic ring (with '71-er)! It is prudent to leave 1-2mm edge in the Zirkon material.
- ❖ Please register for **KEROX hotline service** by email (sales@keroxdental.net), stating your company name, last order number. Kerox offers a "24 hour response-quarantee" (on weekdays) about compaints.
Kerox may also ask you to send in further info, such as:
 - > faulty disk sent back by post.
 - > milling g-code.
 - > type of milling machine, milling tool you use.
 - > CAM software type.
- ❖ No oil cooling in the milling machine!
- ❖ Dry it *prior to sintering*.
- ❖ No touch by hand on the milled unit right after cleaning.



Thank you for your attention!

KEROX DENTAL

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24 hours response!