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Progress in Science
and Education
with Ceramics

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Progress in Science
and Education
with Ceramics

PROSEC North America

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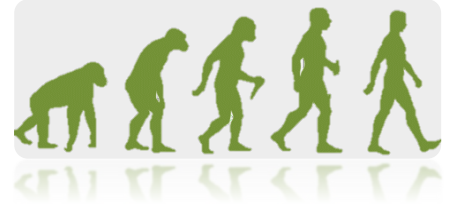


Development and expected potential of metal-free restorations on teeth and implants



History

The times they are a changing....



First metal ceramic
VITA VMK

Glas-infiltration
VITA In-Ceram AL (Al_2O_3)

1. Dental CAD/CAM -
Siemens Cerec 1

1962

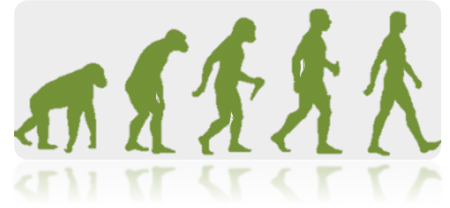
1985

1986



History

The times they are a changing....



Finestructure-
Feldspar based ceramics

Sinter-ceramics -
Porous zirconia (Y-ZrO₂)

Glasceramic -
Lithium-(di)-silicat

1991



2002

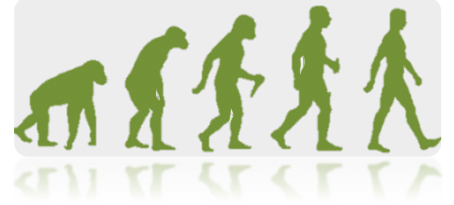


2005



History

The times they are a changing....



Composite -
High filled

Hybrid Ceramic –
Dual-Network-Structure

New developments

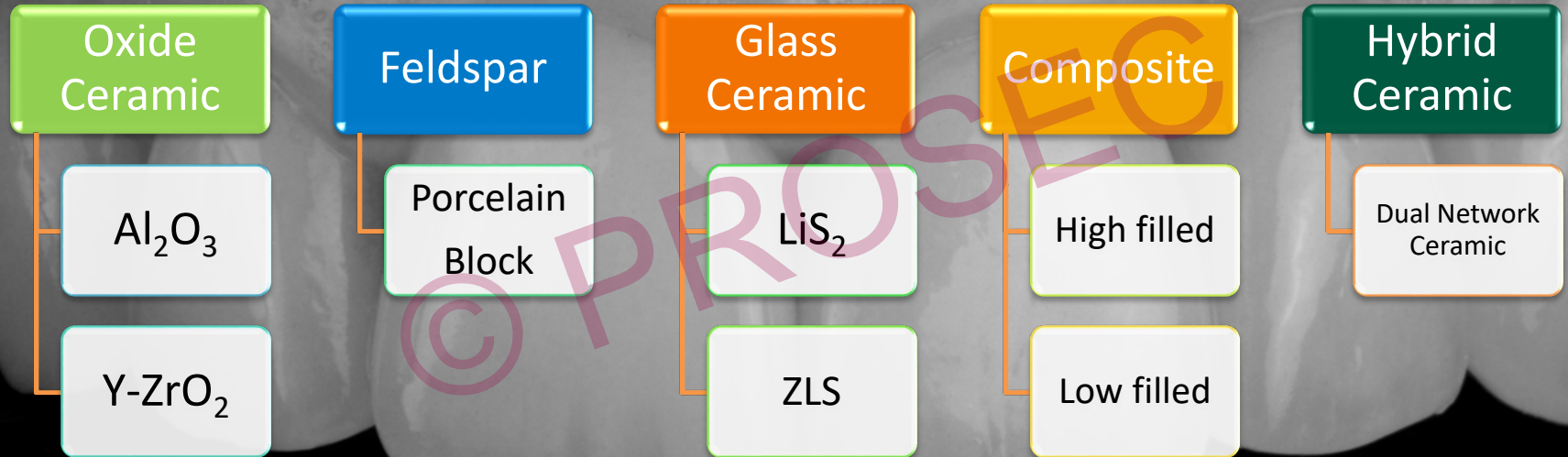
2010

2013

202.?



Material Cluster





Materials

Teeth and Implants



Teeth and Implants

Materials



ZIRCONIA

OVERVIEW

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Zirconia

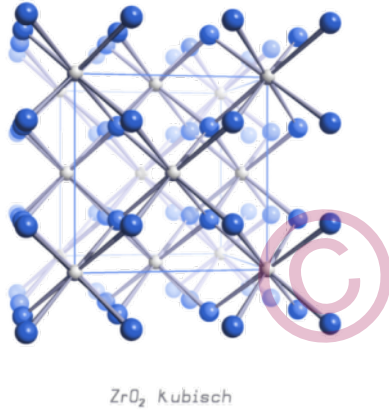
Yttria partially stabilized zirconia (Y-TZP)

- **VITA YZ[®] T** – Translucent Zirconia
- **VITA YZ[®] HT** – High Translucent Zirconia
- **VITA YZ[®] ST** – Super Translucent Zirconia
- **VITA YZ[®] XT** – Extra Translucent Zirconia

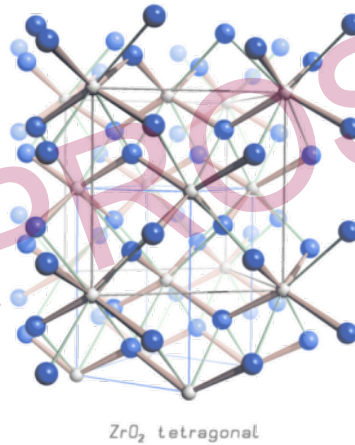
Zirconia

Yttria partially stabilized zirconia (Y-TZP)

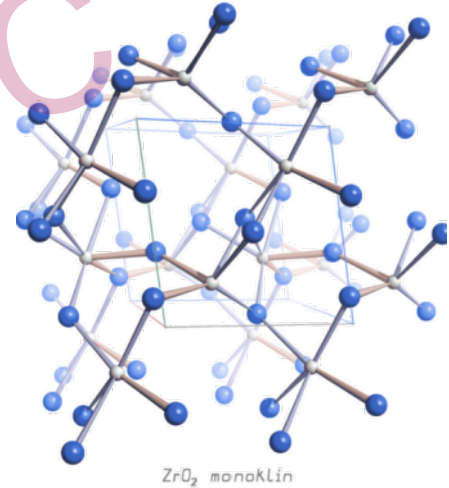
cubic



tetragonal



monoclinic



Melting $\rightarrow$ 2680°C cubic

$\rightarrow$ 2370°C tetragonal

$\rightarrow$ 1170°C monoclinic

Dr. E. Keller, University of Freiburg; Software: Schakal

Zirconia

Yttria partially stabilized zirconia (Y-TZP)

Property	Unit	VITA YZ T	VITA YZ HT	VITA YZ ST	VITA YZ XT
Y ₂ O ₃	wt% mol%	5,2 3,0	5,2 3,0	7,3 4,0	9,3 5,0
Al ₂ O ₃	wt%	~ 0,3	< 0,1	< 0,1	< 0,1
CTE (20-500°C)	10 ⁻⁶ ·K ⁻¹	ca. 10,5	ca. 10,5	ca. 10,3	ca. 10,0
3-Point-bending strength	MPa	ca. 1200	ca. 1200	> 850	> 600
Translucency* (1mm)	%	32	42	46	50

*Source: Tosoh Corporation, (Technical Report, 08/2017, [10] cf. p. 34)

Zirconia

Yttria partially stabilized zirconia (Y-TZP)

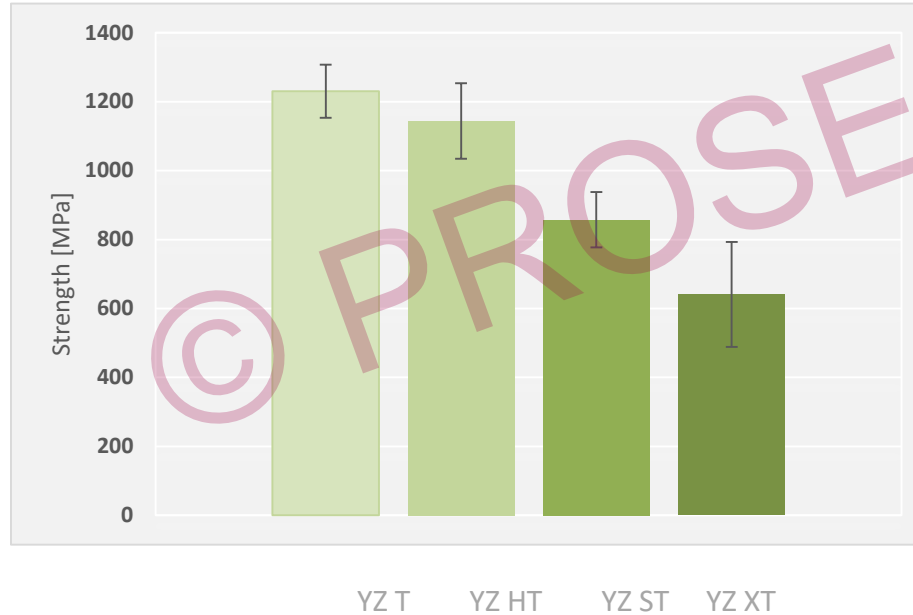
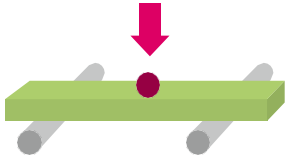
Average values with regard to the determined translucency		
VITA YZ T	32 %	
VITA YZ HT	42 %	
VITA YZ ST	46 %	
VITA YZ XT	50 %	



Source: External study, Tosoh Corporation, (Technical Report, 08/2017, [10] cf. p. 34)

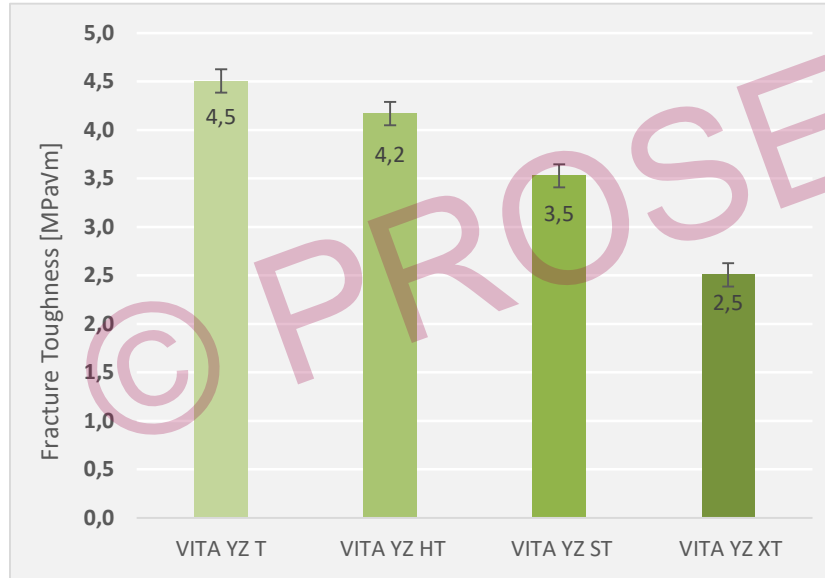
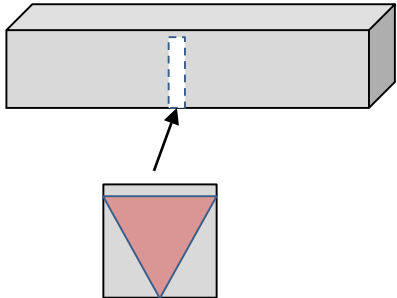
Zirconia

Yttria partially stabilized zirconia (Y-TZP)



Zirconia

Yttria partially stabilized zirconia (Y-TZP)





Learn from the best to
ensure success
Reasons we will be
successful

ZIRCONIA

Issue 764
Monday Jun 14, 2010

#C05daynews



WORKFLOW

Bonding is defined as the process of coming up or making a unique name or design for a certain product. Having a good brand strategy allows you to have a major advantage in getting a large increase in your market competition. Your brand tells your customers what they can have or expect from the products and services you offer.

As you innovate or see the experience (how-to) ideas offer a high-cost, high-quality product in a slow-cost, high-value product to its competitors. In fact, you should consider an offering that your customers need you to be the high in the market. Innovation is the main foundation of your brand. All the promotional content should be connected with your brand to communicate with your brand having a professional value.

As you innovate or see the experience (how-to) ideas offer a high-cost, high-quality product in a slow-cost, high-value product to its competitors. It's impossible to be both. You should consider an offering that your customers need you to be. Your brand is the main foundation of your brand. All the promotional content should be connected with your brand.

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World Bank's stock at all-time high

Putting your strategic plan action to have your marketing plan should be a marketing strategy. It is a plan that outlines the steps you will take to achieve your marketing goals. It is a plan that outlines the steps you will take to achieve your marketing goals. It is a plan that outlines the steps you will take to achieve your marketing goals.

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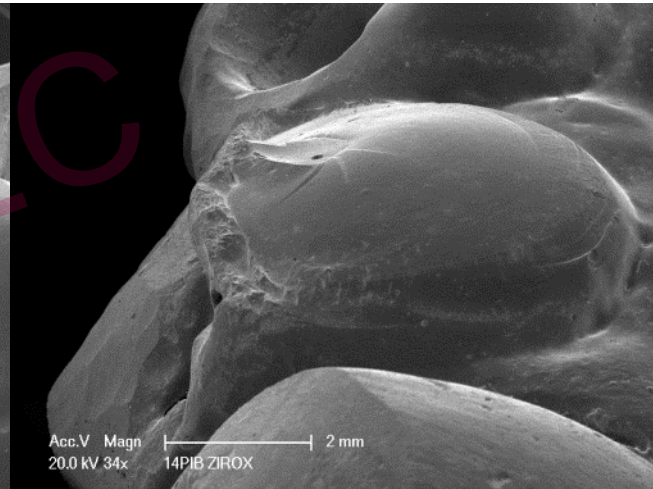
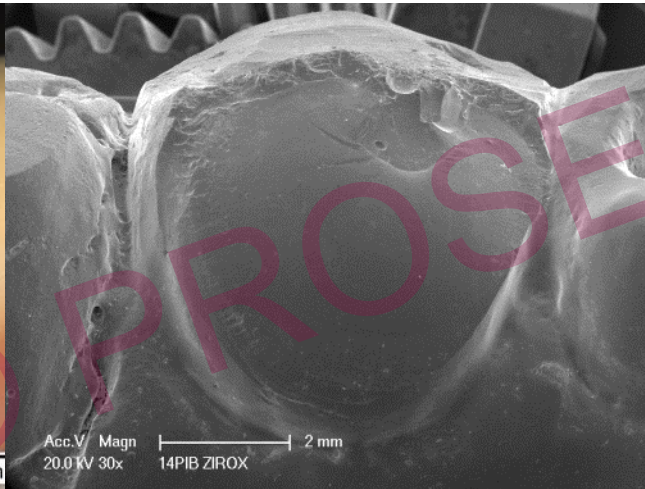
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US rate rise causes trouble in job growth

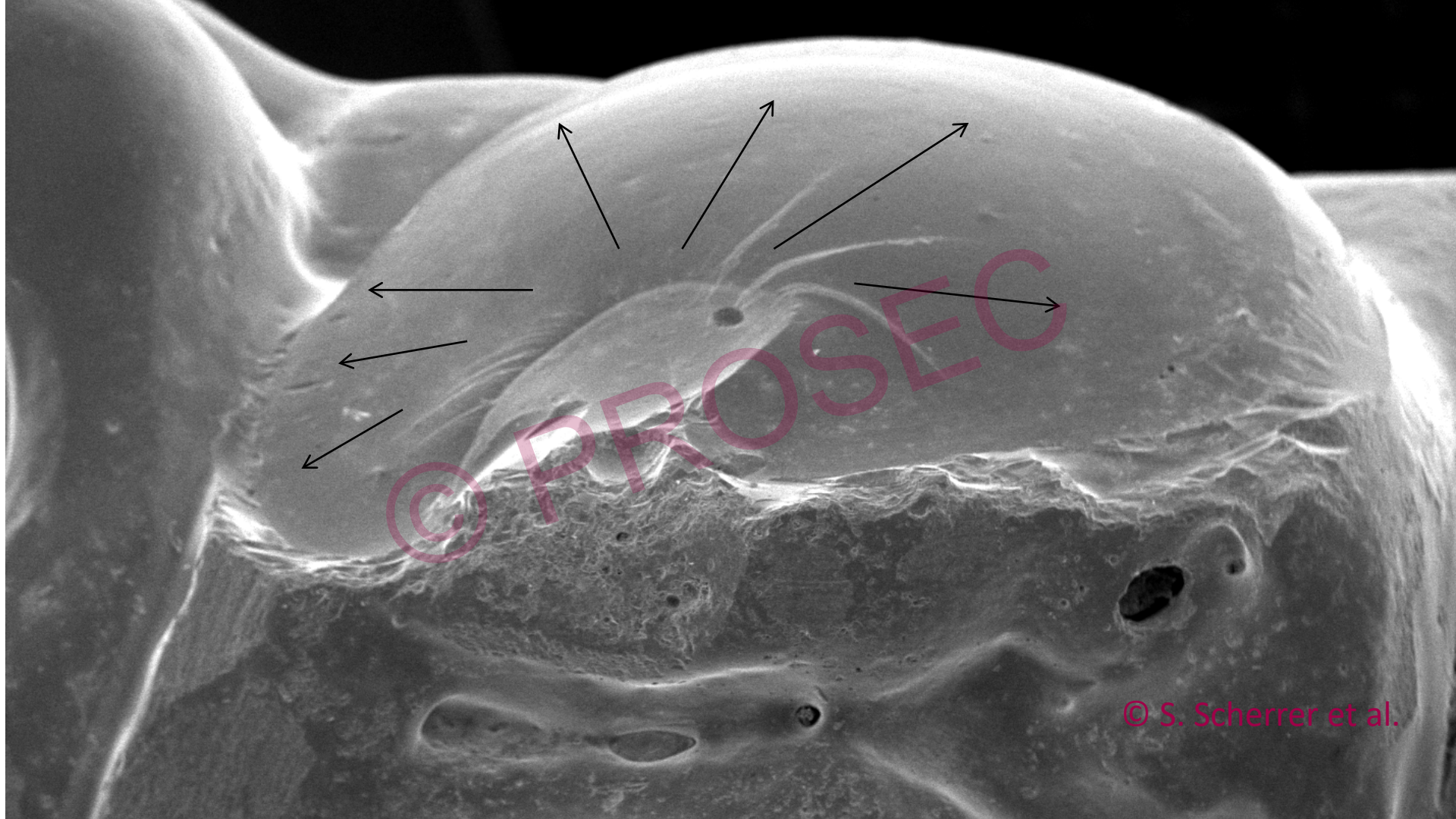
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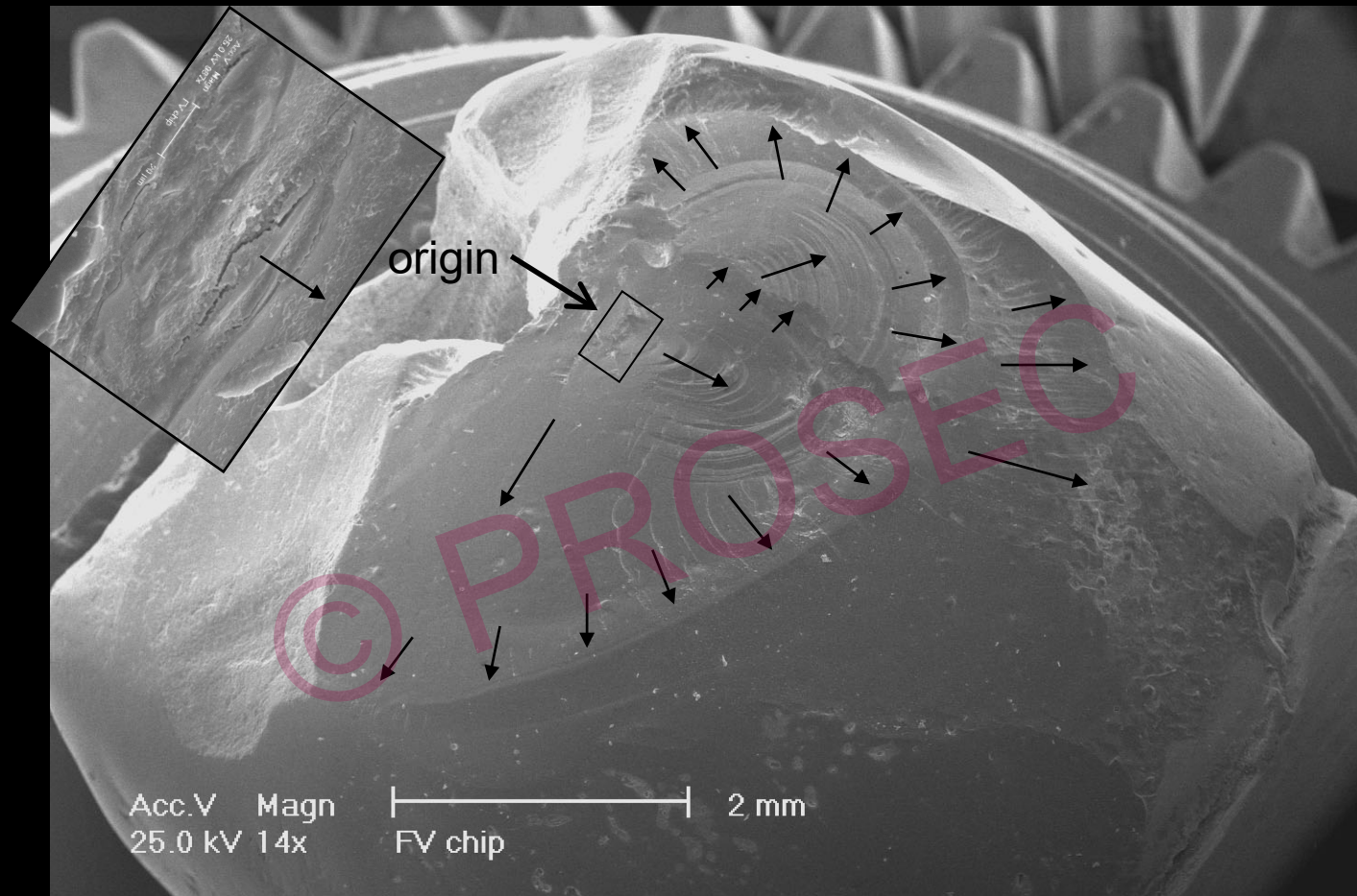
Zirconia

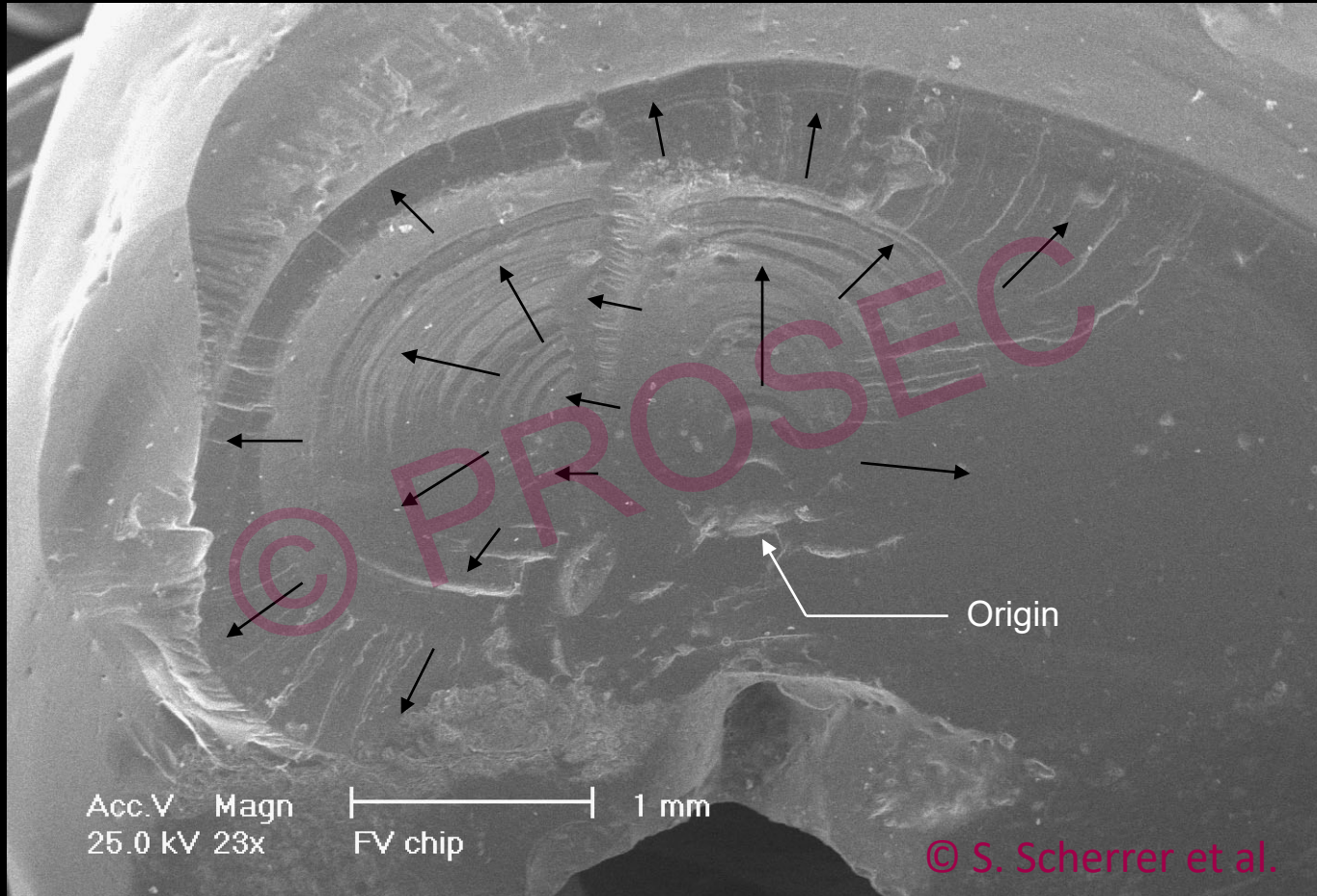
Chipping



© S. Scherrer et al.







Zirconia

Clinical Study: 5 Year Analysis CERAMIC.IMPLANT



Zirconia

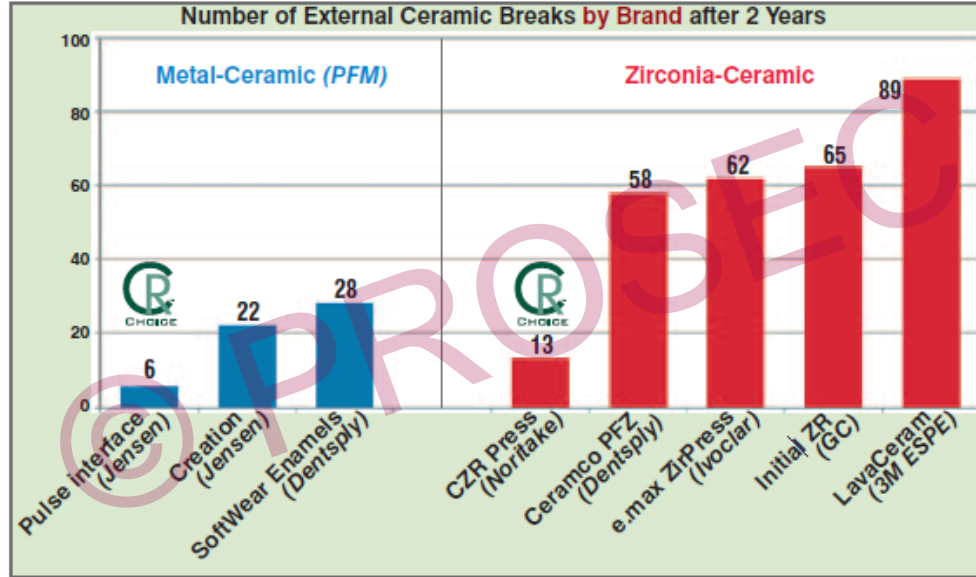
Clinical Study: 5 Year Analysis CERAMIC.IMPLANT

Results:

- One-piece Zirconia implants show similar survival rates as titanium ones.
- There is no long-term data of short-, narrow- and two-piece Zirconia implants available.
- Monolithic lithium disilicate crowns and monolithic Zirconia restorations can be recommended (for teeth and implants).

Zirconia

Chipping



Summary: *PULSE INTERFACE pressed to metal* and *CZR PRESS pressed to zirconia* had significantly fewer breaks at 2 years. The superior performance of these 2 ceramics calls attention to their formulations as well as the pressing process. However, e.max ZirPress used the same pressing process as CZR Press but had 5 times more breaks, directing attention to ceramic formulation as a key factor.

© CRA Newsletter
06/2010

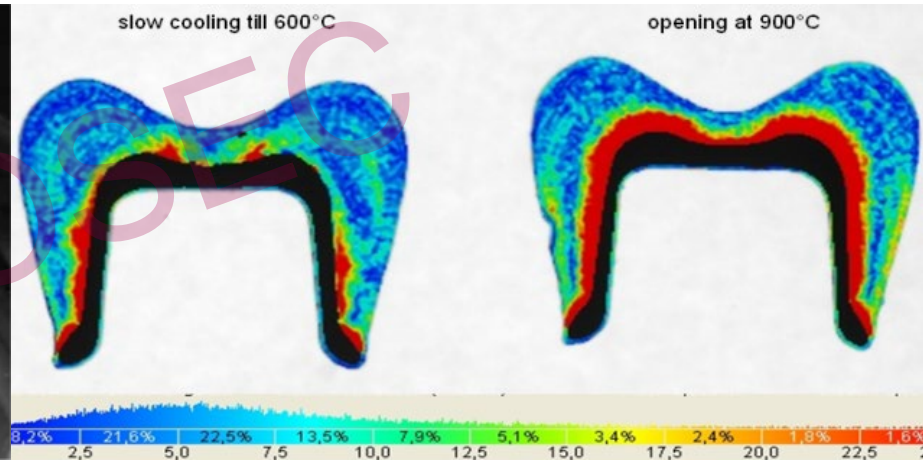
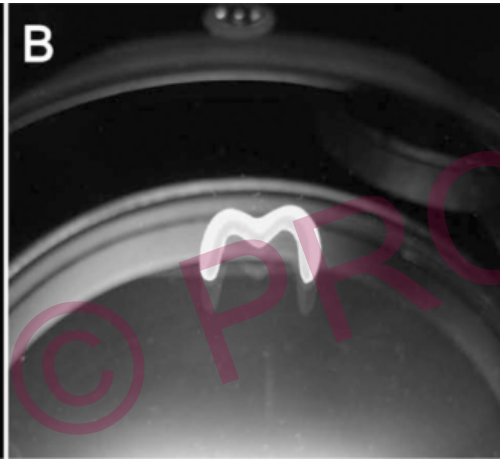
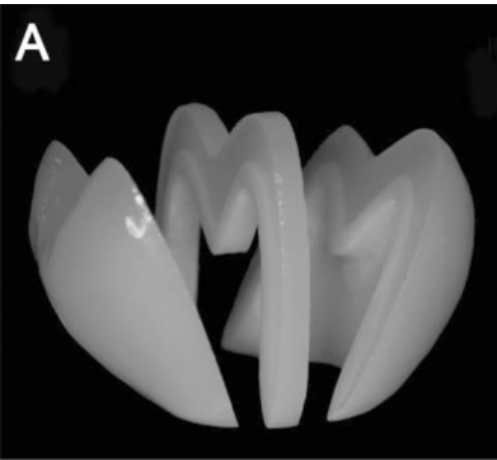
Zirconia

Chipping

Study	Period [years]	Units	Samples	Framework fracture [no.]	„Chipping“ fracture [%]
Tinschert	3	3-10	65	0	6
Sailer	5	3-5	33	8	15
Beuer	2	3	21	5	0
Pospiech	2	3	38	0	3
Ortrop	3	1	204	0	2
Zembic	3	Implant	18	0	0
Molin	5	3	19	0	36
Larsson	1	2-5	13	0	54

Zirconia

Chipping



Zirconia

Chipping

- Temperature stresses only develop during freezing in materials
- The temperature gradients of the individual materials induced stresses.
- Highest stresses with fast external cooling and poor thermal conducting materials.
- It occurs only with materials at temperatures after their TG



Zirconia

Cut-Back with VITA Lumex®





Zirconia

Overview by Ed McLaren



Zirconia

Stained and glazed





Zirconia

Clinical studies with monolithic zirconia

Restaurations	Period [years]	Units	Author	Year	Result
MZ (= monolithic zirconia) PFM (Enamel to Enamel Control)	1	10 MZ 10 PFM	Munhe et al.	2015	Abrasion stability PFM>MZ>Enamel
MZ (Ceramic and Enamel Antagonist)	2	14 MZ (3M LAVA Plus)	Lohbauer et al.	2016	Acceptable results for MZ after 2 years
MZ (Enamel to Enamel Control)	2	20 MZ (Zenostar ZR T)	Stober et al.	2016	Less abrasion with MZ to Enamel than between Enamel to Enamel
MZ (Ceramic and Enamel Antagonist)	2	13 MZ (3M LAVA Plus)	Hartkamp et al.	2017	Acceptable results for MZ after 2 years
MZ PFM (Enamel to Enamel Control)	1	16 MZ (3M LAVA Plus) 14 PFM	Esquil-Upshaw et al.	2018	Enamel Abrasion is comparable between MZ and PFM

MZ = monolithic zirconia

PFM = porcelain fused to metal or to zirconia



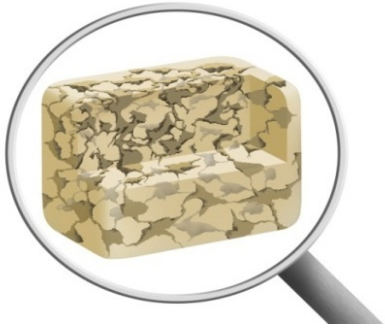
HYBRID CERAMICS

OR COMPOSITE?

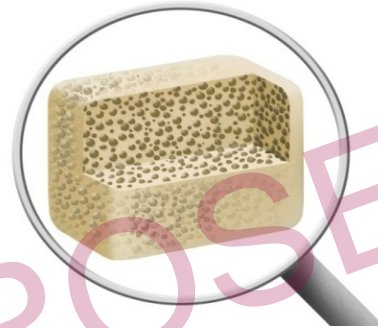
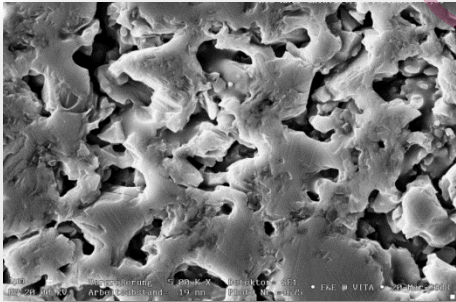
1 2 3 4 5 6 7

1 2 3 4

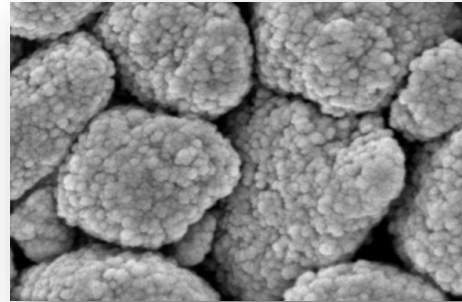
HYBRID CERAMIC or Composite?

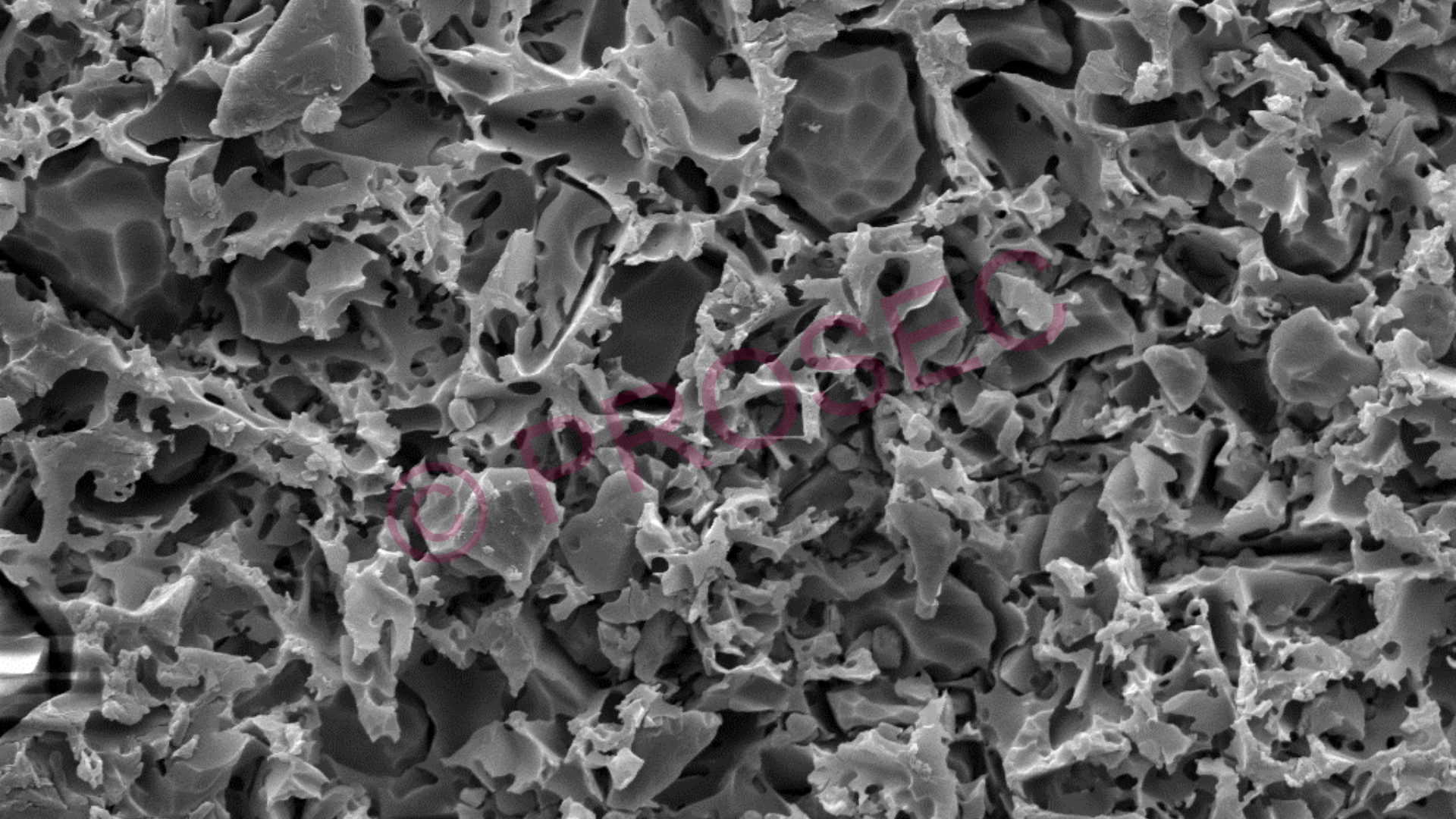


Dual-Network



**Composite: Polymer with many
filler particles**





HYBRID CERAMIC

or Composite?



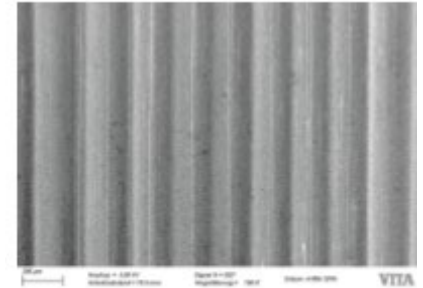
VITA ENAMIC



VITABLOCS



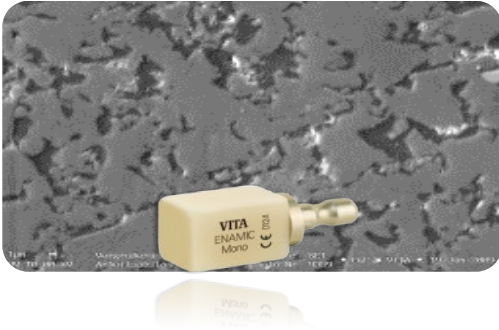
Lava Ultimate



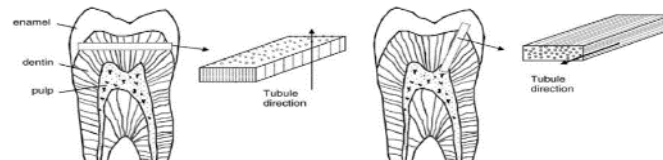
Shofu HC

HYBRID CERAMIC

or Composite?

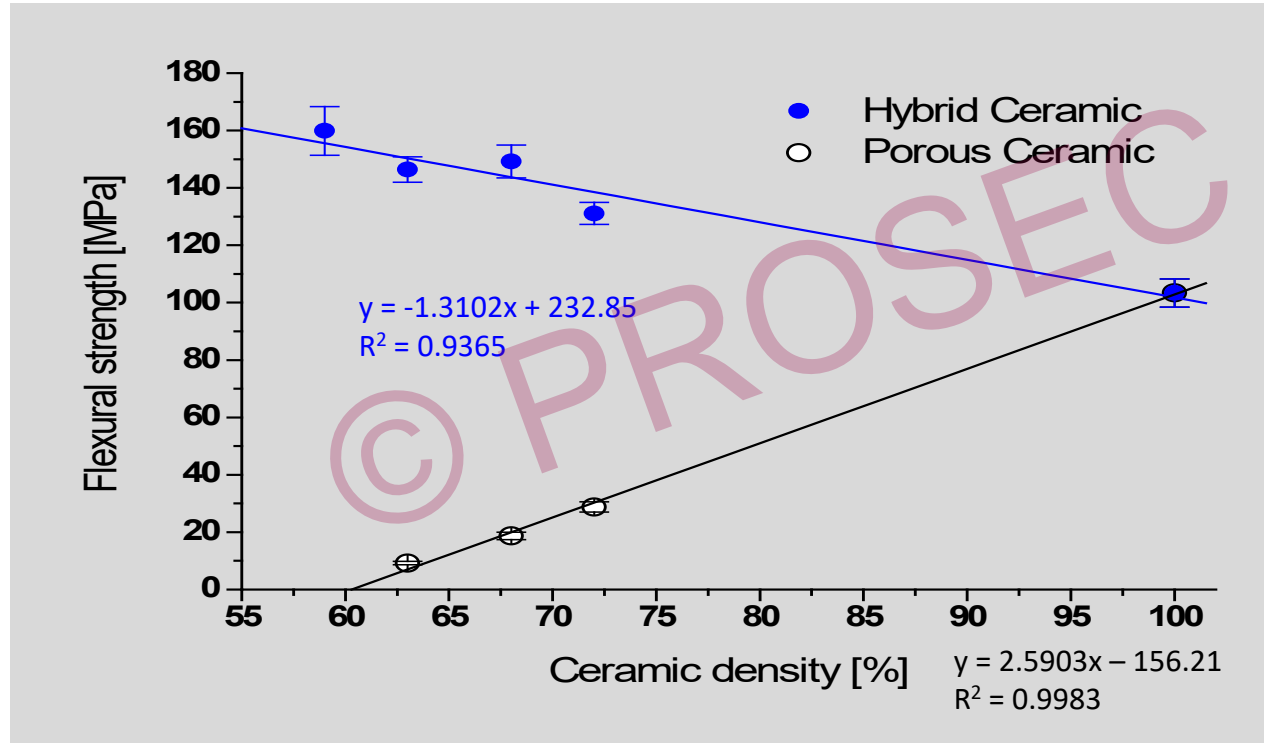


	E-modulus [GPa]	Flexural strength [MPa]	Vickers Hardness [GPa]	K1C [MPaVm]
In-Ceram Alumina	211.8	402.1	11.8	3.6
Y-TZP [zirconia]	184.2	1358.5	13.9	5.0
IPS e.max CAD	79.8	344.1	6.0	2.3
VM 9 [ven. porcelain]	57.2	122.6	6.3	1.0
VITABLOCS Mark II	57.2	137.8	6.2	1.3
Brilliant Crios	10.3	198	4.3	0.9
ENAMIC	31.7	144.4	2.4	1.4
Dentin	16.0 - 20.3	109 - 160	0.6 - 0.9	2.2 - 3.1
Enamel	48.0 - 105.5		3.0 - 5.3	0.6 - 1.5



HYBRID CERAMIC

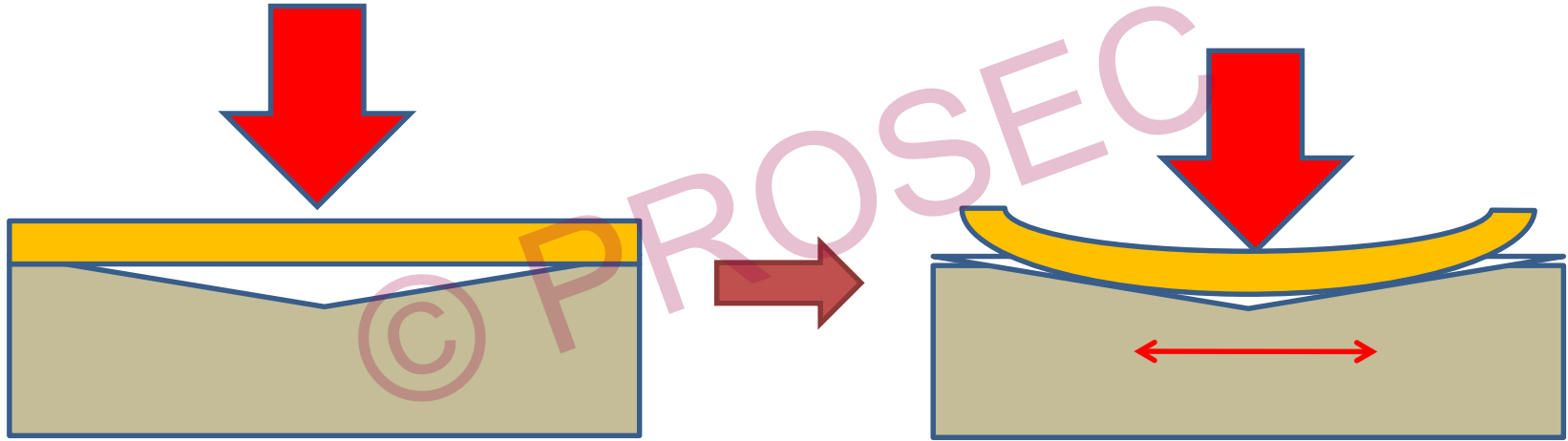
or Composite?



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HYBRID CERAMIC or Composite?



©Swain 2013

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HYBRID CERAMIC or Composite?



HYBRID CERAMIC

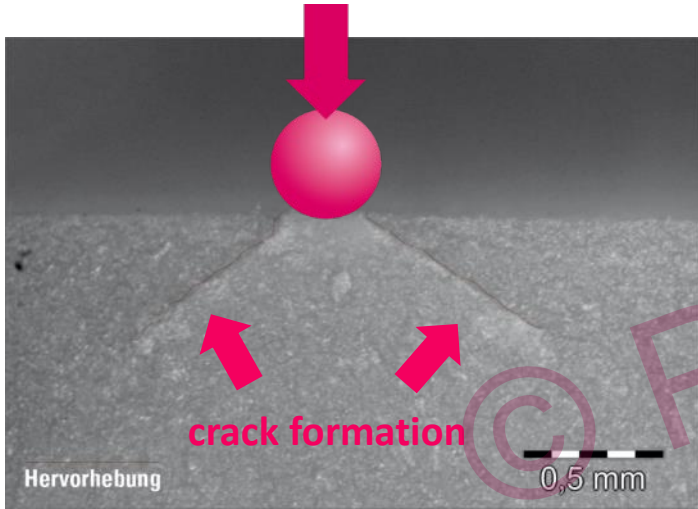
or Composite?

- Magne P, Silva M, Oderich E, Boff L, Enciso R. Damping behavior of implant-supported restorations. Clin. Oral Impl. Res. 24, 2013, 143–148
- Menini M, Conserva E, Tealdo T, Bevilacqua M, Pera F, Signori A, Pera P. Shock absorption capacity of restorative materials for dental implant prostheses: an in vitro study. Int J Prosthodont. 2013 Nov-Dec;26(6):549-56.
- Stegaroiu R1, Khraisat A, Nomura S, Miyakawa O. Influence of superstructure materials on strain around an implant under 2 loading conditions: a technical investigation. Int J Oral Maxillofac Implants. 2004 Sep-Oct;19(5):735-42.
- Bassit R1, Lindström H, Rangert B. In vivo registration of force development with ceramic and acrylic resin occlusal materials on implant-supported prostheses. Int J Oral Maxillofac Implants. 2002 Jan-Feb;17(1):17-23.

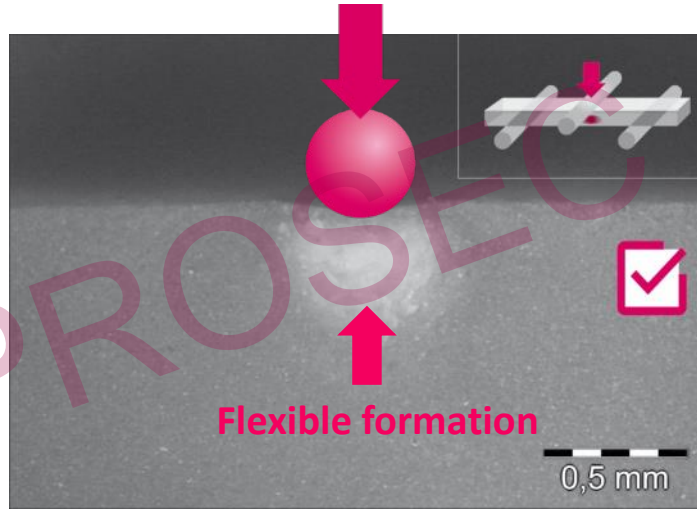


**Advantages for materials with
shock absorbing behavior**

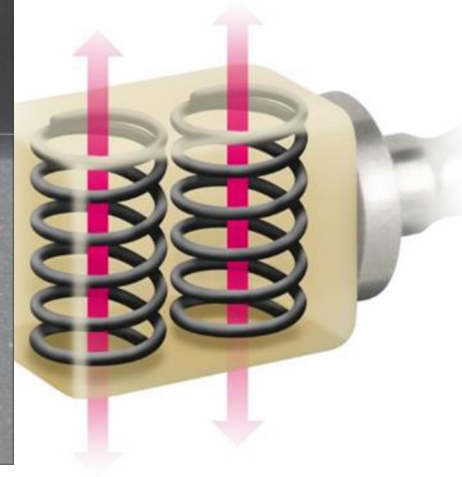
HYBRID CERAMIC or Composite?



Traditional silicate ceramic



VITA ENAMIC hybrid ceramic



Source: Internal study VITA R&D; Cross section of the fractured surface after pre-damaging material with a tungsten carbide ball

Conclusion: Following prior damage and loading, VITA ENAMIC reveals plastic deformation and, accordingly, **a certain level of damage tolerance – shock absorbing!**

HYBRID CERAMIC

or Composite?

Menini et al: Comparison restorative materials

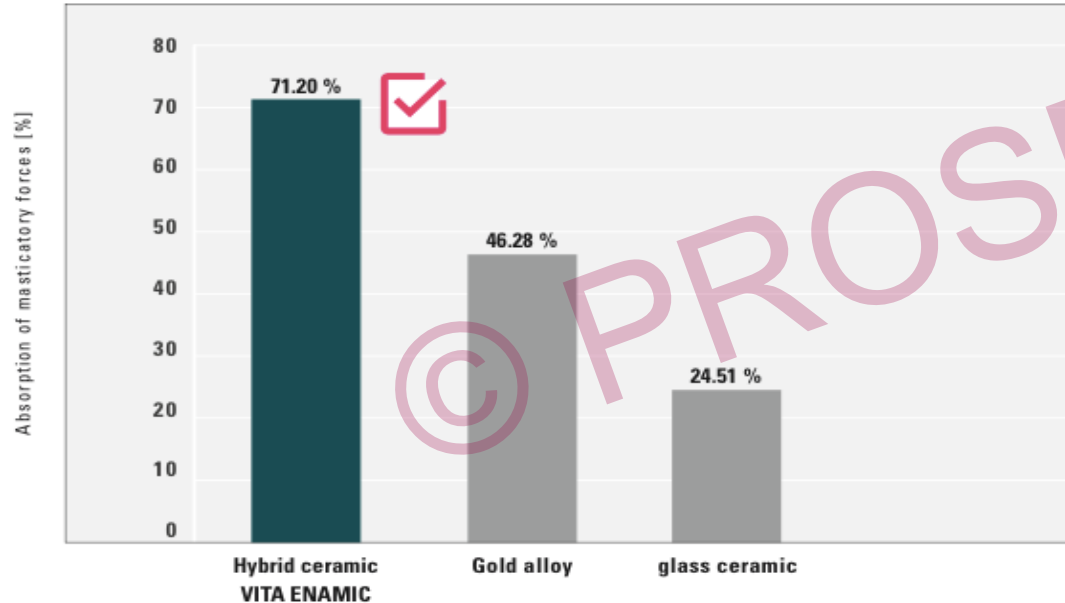
product name	material	mean force (N)	SD (N)	modulus of elasticity MPa	Delta of force vs. Zirconia
Procera Zirconia	oxide ceramic	641,8	6,8	210000	100% (reference)
IPS Empress 2	lithium disilicate ceramic	484,5	5,5	96000	-24,51%
Ney-Oro CB	high precious alloy	344,8	5,7	77000	-46,32%
Finesse	leucite feldspar ceramic	344,8	3,5	70000	-46,32%
Experience	micro filled composite	293,6	16,3	13000	-54,25%
Adoro	micro filled composite	236	4,2	7000 +/- 500	-62,23%
Signum	micro filled composite	187,4	6,7	3500	-70,80%
VITA ENAMIC	Hybrid ceramic	184,86	3,92	31700	-71,19%
Easytemp 2	PMMA	39,3	2,3	2300	-93,88%
AcryPlus V	PMMA	28,3	4,2	N/A	-95,59%

Menini M, Conserva E, Tealdo T, Bevilacqua M, Pera F, Signori A, Pera P. Shock absorption capacity of restorative materials for dental implant prostheses: an in vitro study. Int J Prosthodont. 2013 Nov-Dec;26(6):549-56.

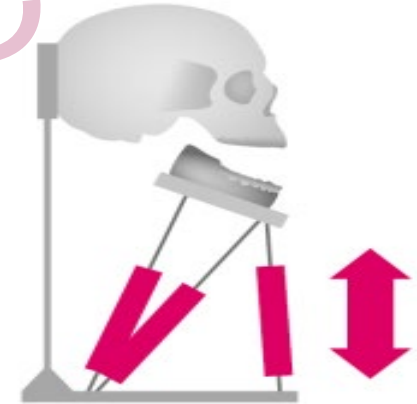
HYBRID CERAMIC

or Composite?

Absorption of masticatory forces compared to zirconia (ZrO_2)



Source: University of Genoa, Department for fixed and implant-prosthetic restorations, Dr. Maria Menini et al., Genoa, Italy ([8], cf. p. 35)



Zirconia

Rapid Layer Technology with VITA Enamic®

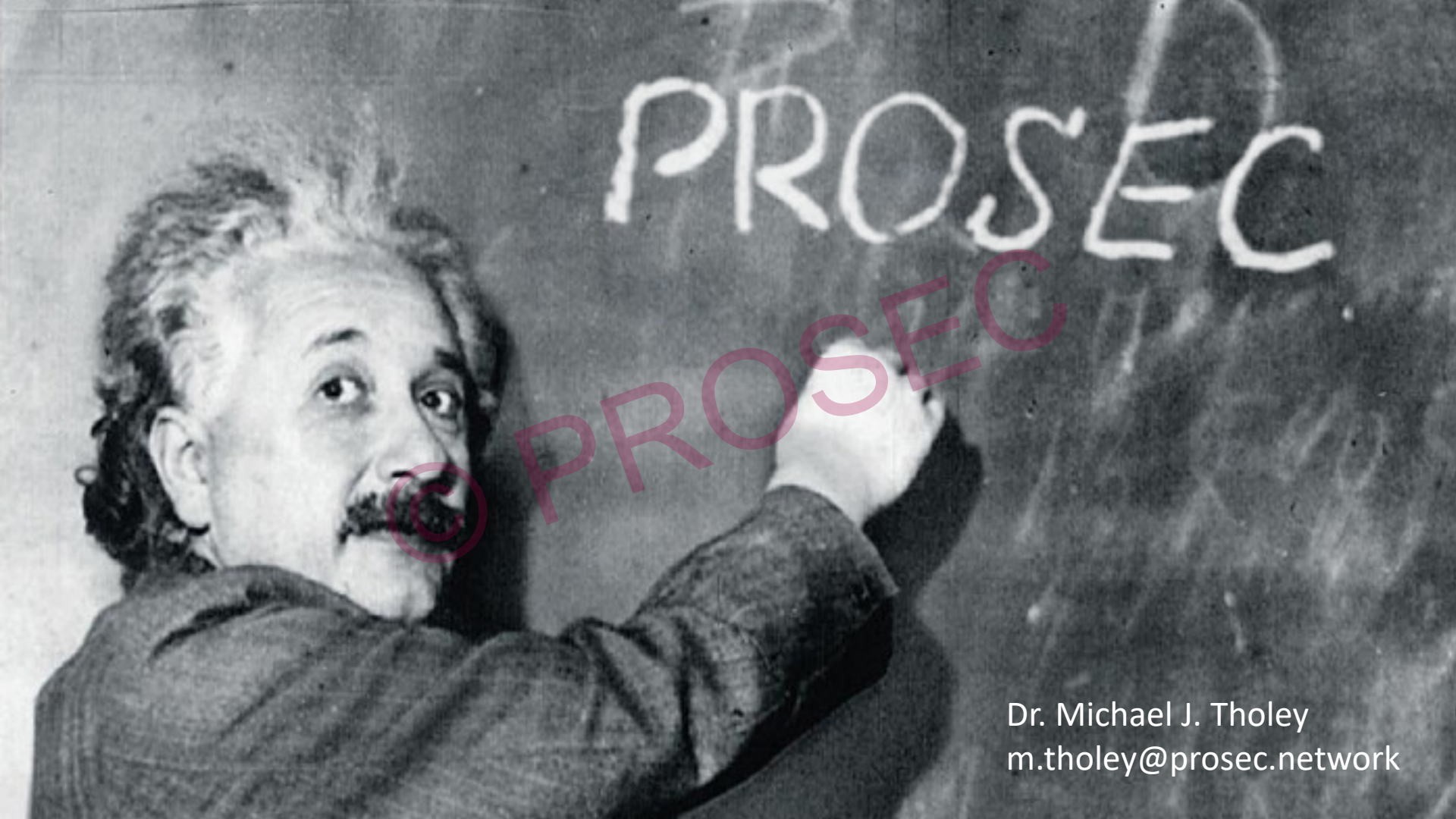


Zirconia

Rapid Layer Technology with VITA Enamic®





A black and white photograph of Albert Einstein, looking over his shoulder with a surprised expression while writing the word 'PROSEC' on a chalkboard with his right hand. A large, semi-transparent red watermark with the text '© PROSEC' is overlaid diagonally across the center of the image.

PROSEC

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