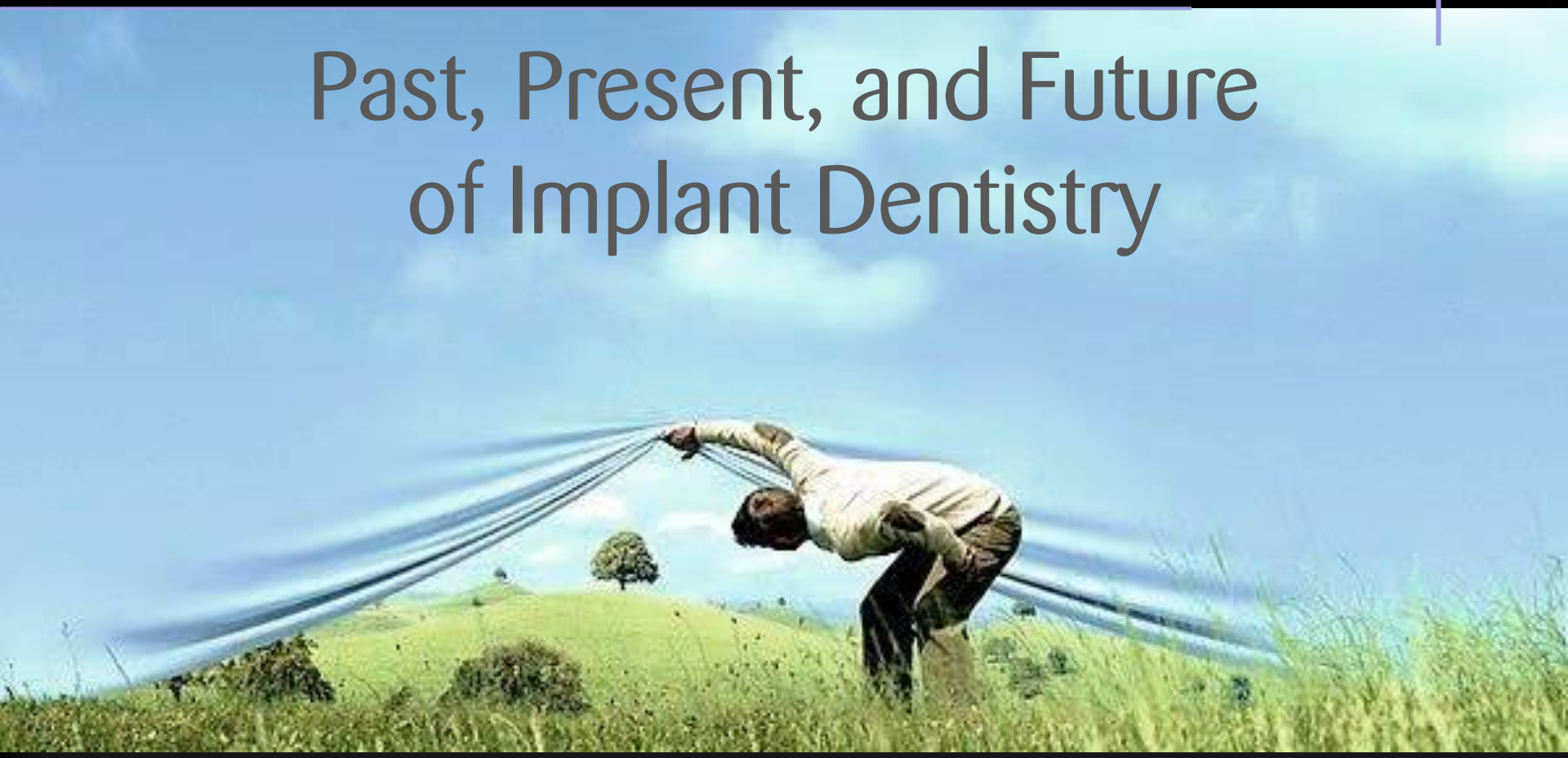
MARCEL J. SCACCHI

Switzerland

Past, Present, and Future of Implant Dentistry



‘65 ‘13

PAST **Discovery** | PRESENT **Development** | FUTURE **Digital**

OSSEOINTEGRATION

Mayans 800 BC

Egyptians 3’000- 1’400 BC

Etruscans 800-100 BC

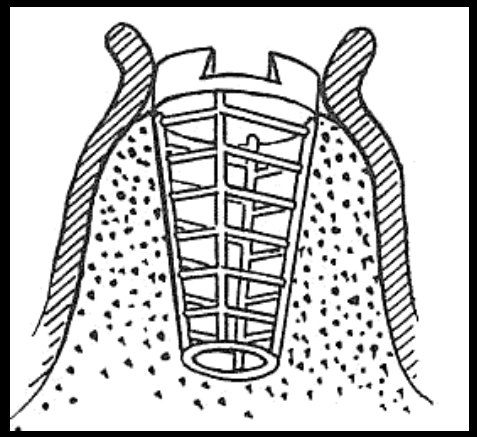
George Washington 1732-1799

Implant Approaches

1913

Greenfield

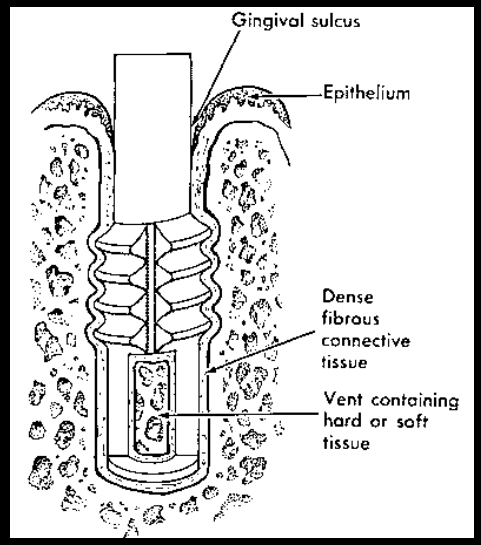
Irido-Platinum Cage



1939

Veneble, Stock

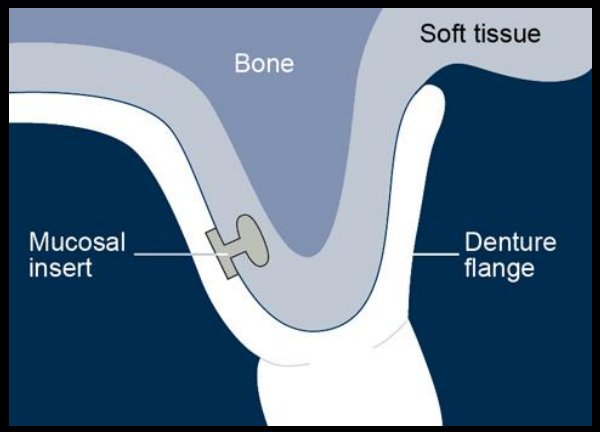
Vitallium Screws

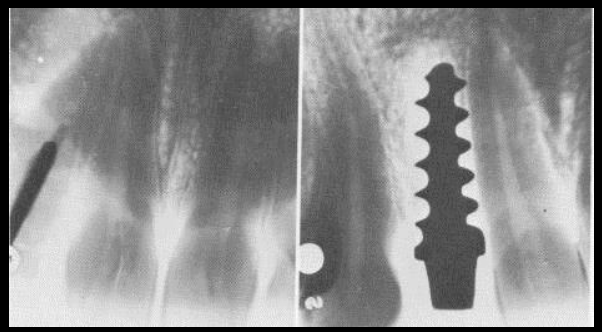


1943

Dahl

Intramucosal Implants

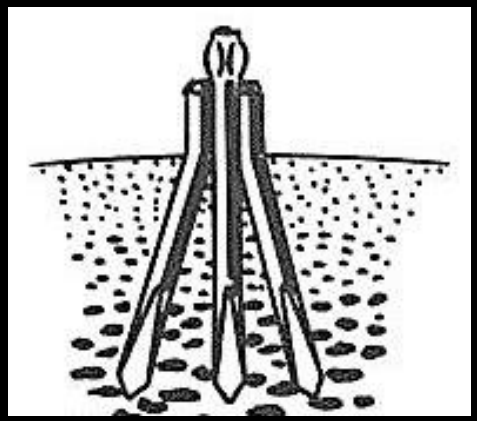




1946

Goldberg, Gershkoff

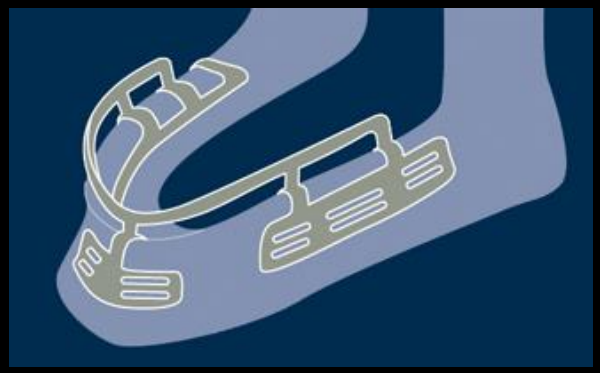
Subperiostal Implants

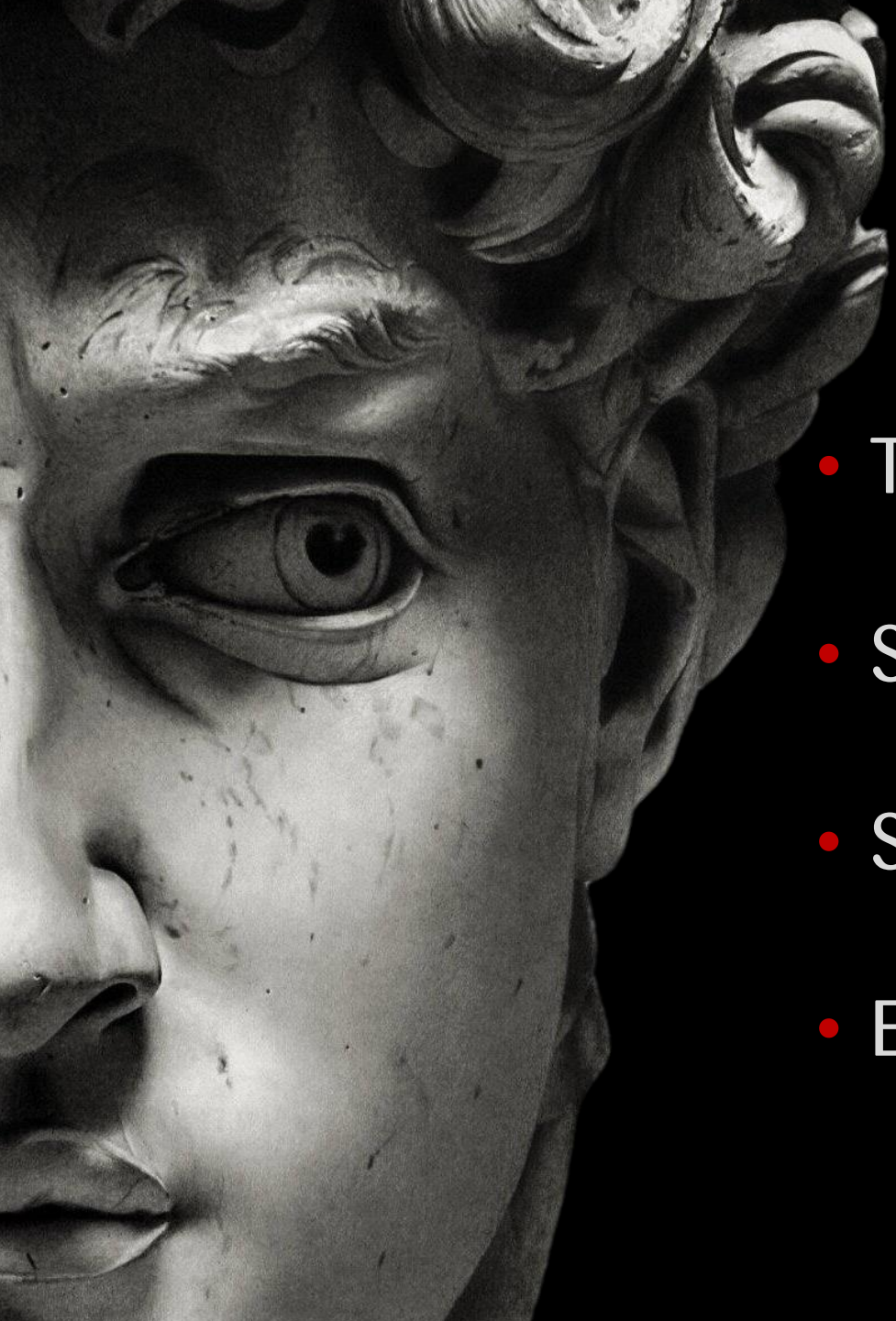


1953

Cherchève, Cowland

Staple Implants

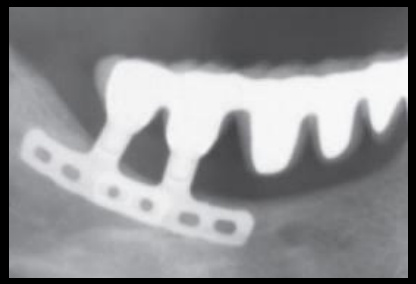


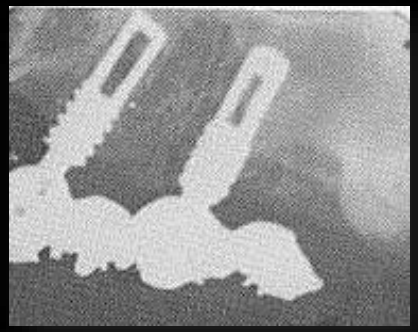


- Transdental
- Submucosal
- Subperiosteal
- Endosseous

- Autoplastic
- Homoplastic
- Heteroplastic
- Alloplastic

Lennart Linkow et al 1963, 1967





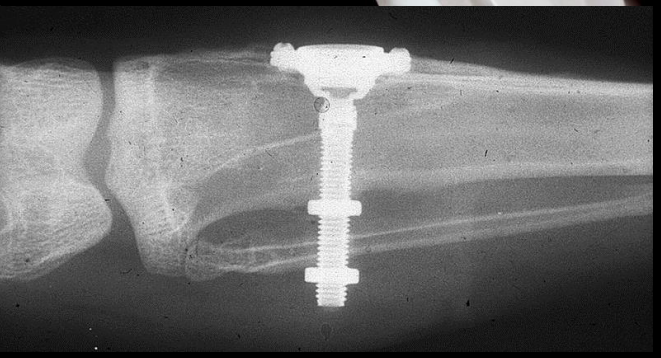
“Blade-Vents” / “Vent-Plants”

- Increase Surface to Distribute Masticatory Forces
- Basic Implant Shape to Cover Different Indications

Kapur KK (1989); Comparisons between fixed partial dentures supported by blade-vent implants and removable partial dentures. *Journal of Prosth Dent 62, 685-703*
- 5 yrs. follow-up of 173 Implants in various indications
- 35 failures, 43 severe bone loss

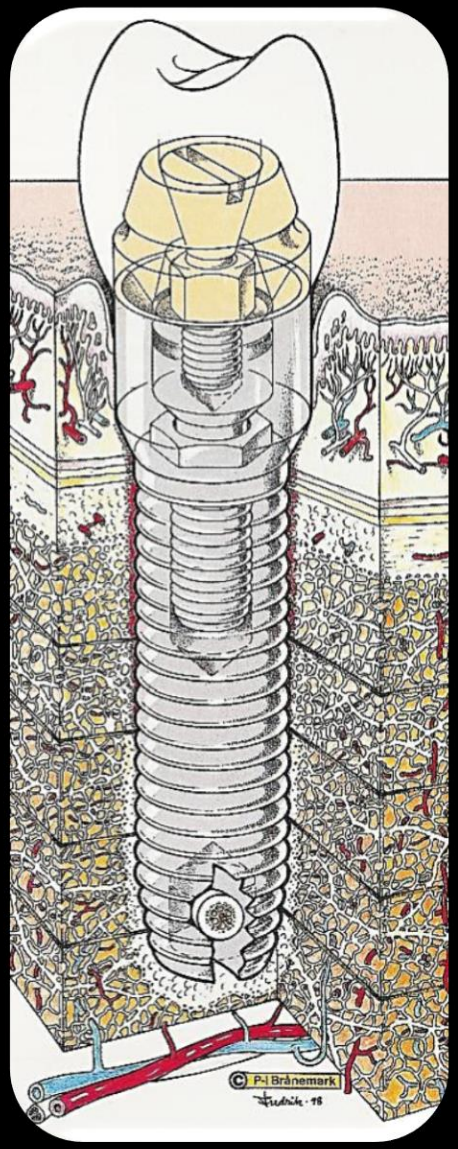
Lew, Cranin, Bastras, Fagan, Turner, Wariner, Lobello, Tramonte, Muratori, Mondani, Pasqualini, Hruska, Vajda, Kaketa, Heinrich, Koch, Grafelmann, Koijima, Börkel, Bender, Mutschelknauss, Doerre, Brinkmann, Maeglin, Herskovits, Formigini, Ledermann, Niznick and many more…

Per-Ingvar Brånemark (Universities of Lund & Gothenborg, Sweden)



- Microcirculation, Tissue Injury and Repair '53
- Observation Chamber, Vital Bone Growth '56
- Tissue Integrated Prostheses Experimental Studies '60

Turning Point



- Viktor Kuikka
- G. Larsson;
  1. Human Recipient
  of Titanium Fixtures

'65

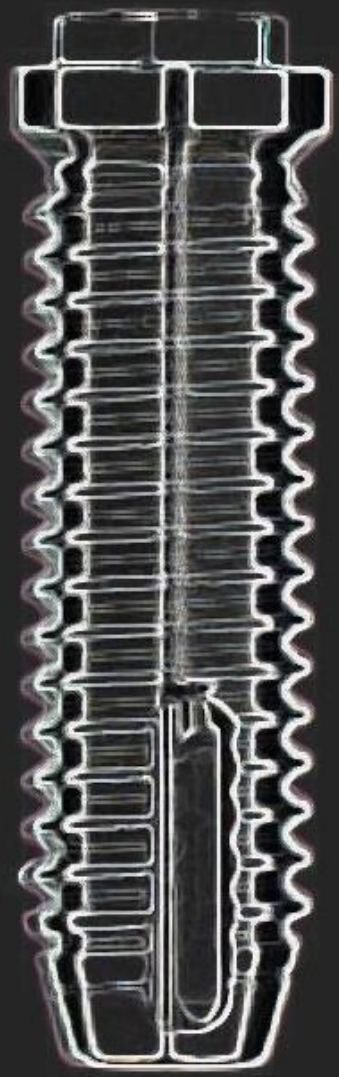
- "os" = bone
  "integro" = to renew

'67

"Direct structural and functional connection between ordered, living bone and the surface of a load-carrying implant at the light microscopic level"

Success Factors

- Complete Sterility
- Avoidance of Contamination
- Minimal Tissue Violence
- Maximal Precision



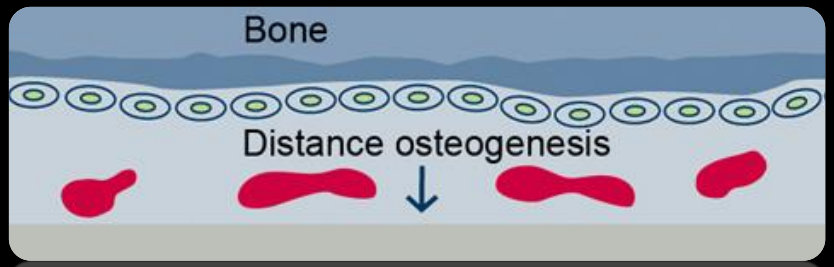
System Characteristics

- Ti Grade 2
- Machined Surface
- 6 Months Healing
- Submerged Approach
- Solid Screw Design

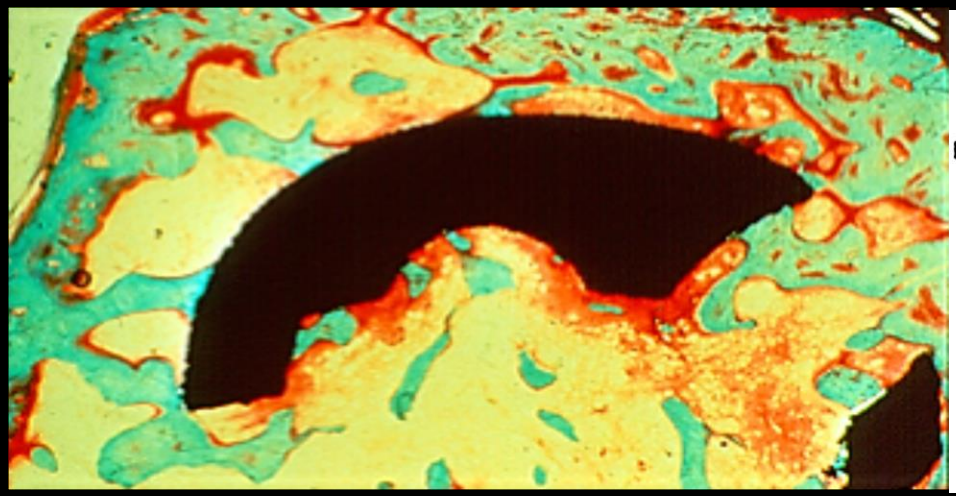
Adell R, Lekholm U, Rockler B & Branemark P-I (1981); A 15-year study of osseointegrated implants in the treatment of edentulous jaws. *Int J of Oral Surgery 6, 387-399*

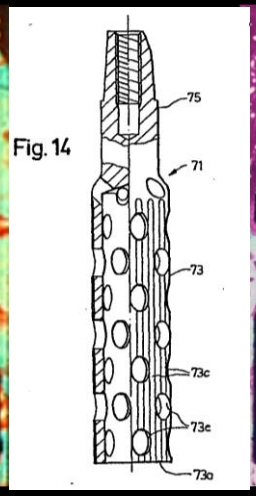
"…whenever any metallic appliance is implanted into bone, a layer of fibrous tissue will always develop…"

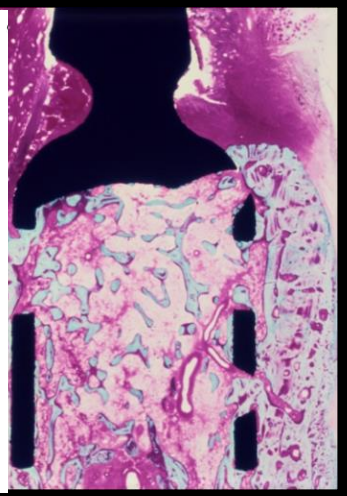
JC Southam (1971)



André Schroeder (University of Berne, Switzerland)







'76 Histologic Evidence of Osseointegration

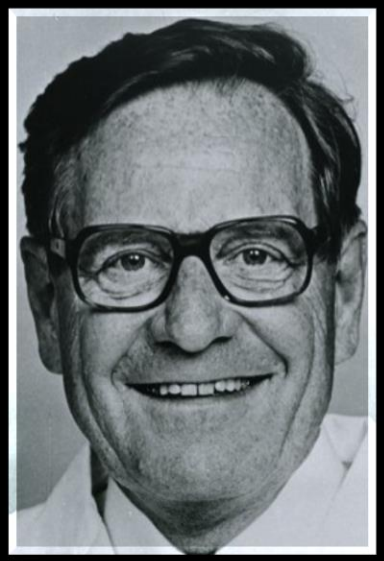
Schroeder A, Pohler O, Sutter F (1976); Gewebsreaktion auf ein Titan-Hohlzylinderimplantat mit Titan-Spritzschichtoberfläche. *Schweiz Monatsschr Zahnheilkunde 86, 713-727*

Schroeder A, van der Zypen E, Stich H, Sutter F (1981); The reactions of bone, connective tissue, and epithelium to endosteal implants with titanium-sprayed surfaces. *Journal of Maxillofac Surgery 9, 15-25*

‘65 ‘13

PAST **Discovery** | PRESENT **Development** | FUTURE **Digital**

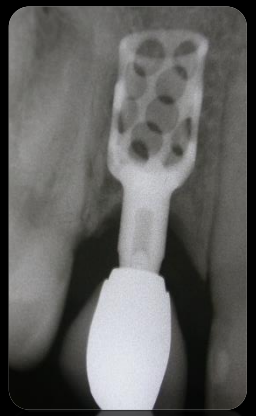
André Schroeder (1918 - 2004)



- Double-Blade Tantalum Implant by Herskovits

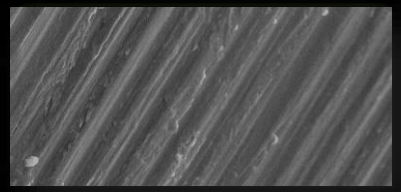
60's

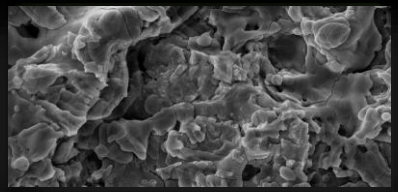
- New Design Hollow-Cylinder



Titanium

smooth surface | rough surface





Bioceramics

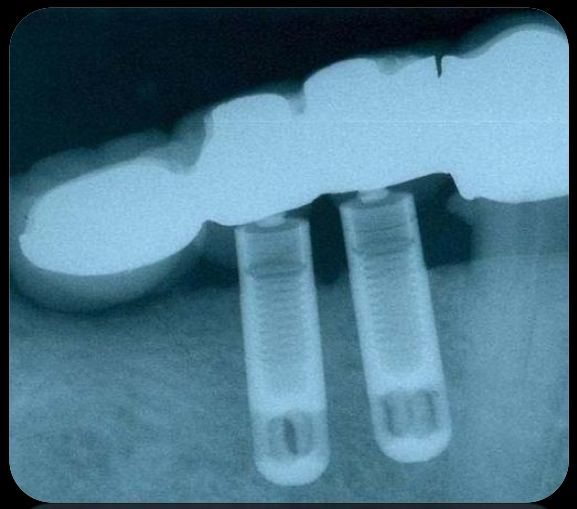
70's

Ceramic & Root Form Implants

Sami Sandhaus

Willi Schulte

Axel Kirsch



1978, Harvard Consensus Conference

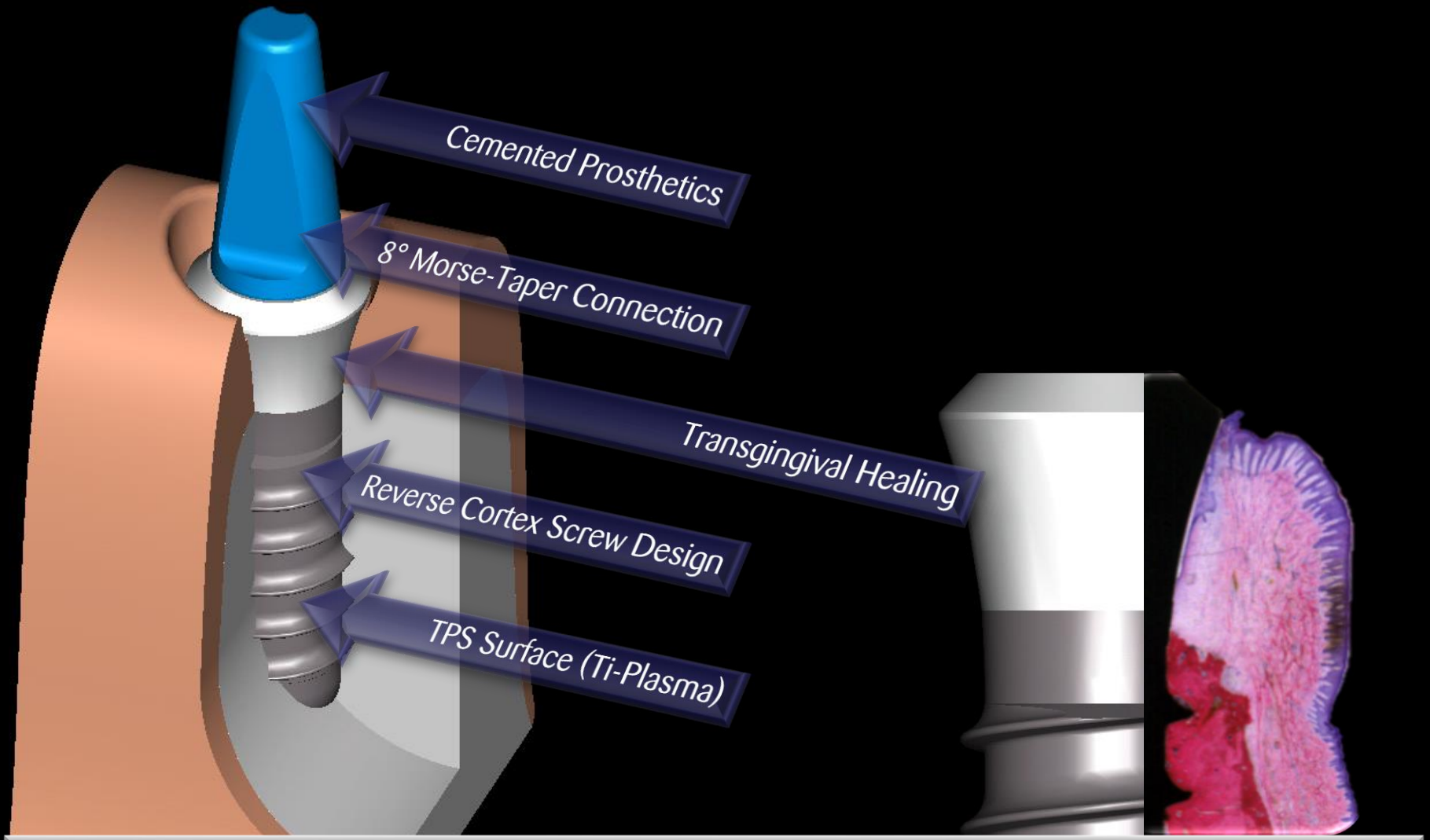
"An implant is successful when it remains embedded and functional for five years. The council believes that dental endosseous implants formed from all types of material should be considered in the new-technique phase and in need of continuing scientific review to obtain additional longitudinal evaluations."

"A genuine leader is not a searcher for consensus but a molder of consensus" *Martin Luther King*

1982, Toronto Conference on Osseointegration

Focus was on one implant design, made from one metal, using one surgical procedure advocated by Dr. P-I Brånemark, and for one indication: the edentulous jaw.

I.T.I. / BONEFIT® Early System Characteristics

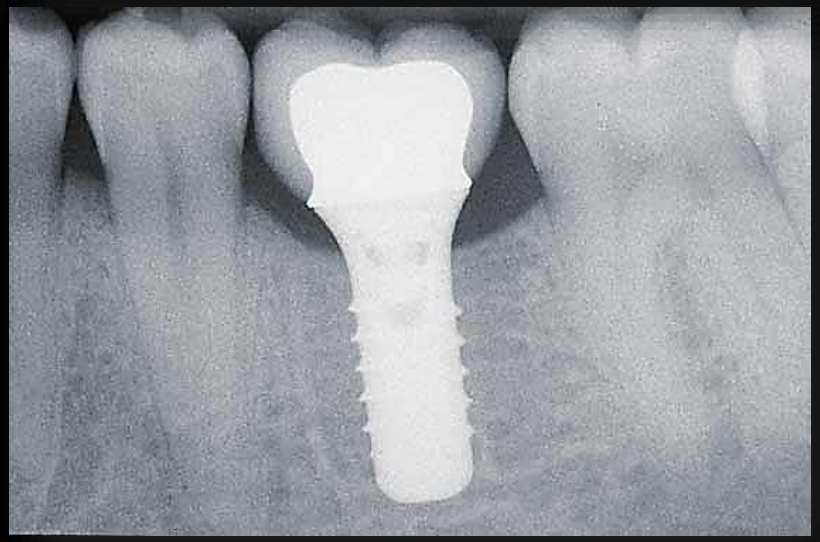


Scacchi MJ, Schär A, Sutter FJ (2000); The history of the ITI dental implant system. Part 1: A review of the literature. Part 2: Future Concepts. *Clinical Oral Implants Research, 11, 8-21 & 22-34*

1988 Cemented Posterior Single Tooth

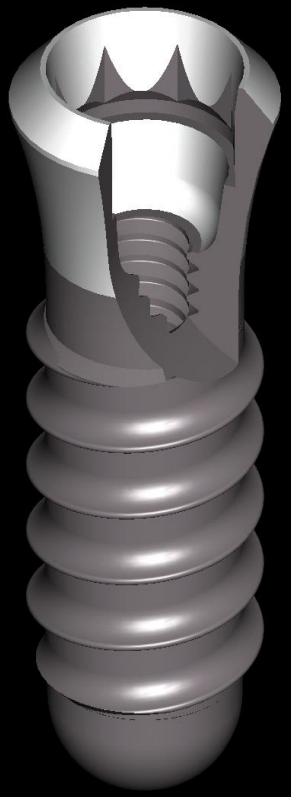
Simplicity
is the ultimate
Sophistication

Leonardo da Vinci



Surgery & Prosthetics D Hess • Technique A Schönenberger

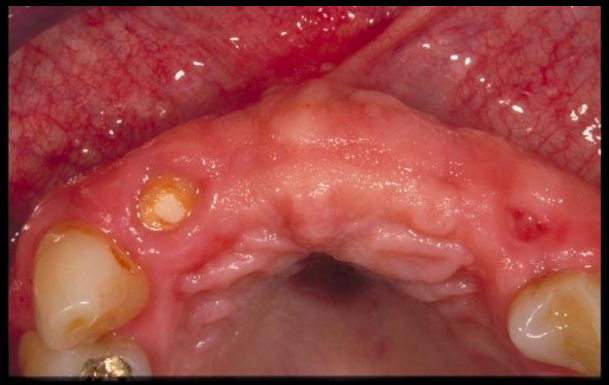
Grade 2	Titanium	Grade 4
Smooth	Surface	Rough
External Hex	Connection	Morse-Taper
Submerged	Healing Mode	Non-Submerged
6 Months	Healing Time	3 Months / 4 Months
Screw-Retained	Prosthetics	Cement-Retained

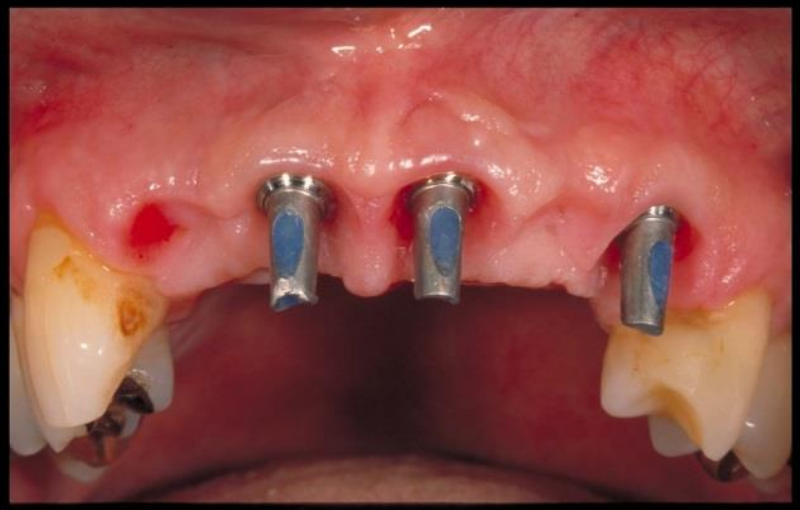


Screw-Retained Anterior Case

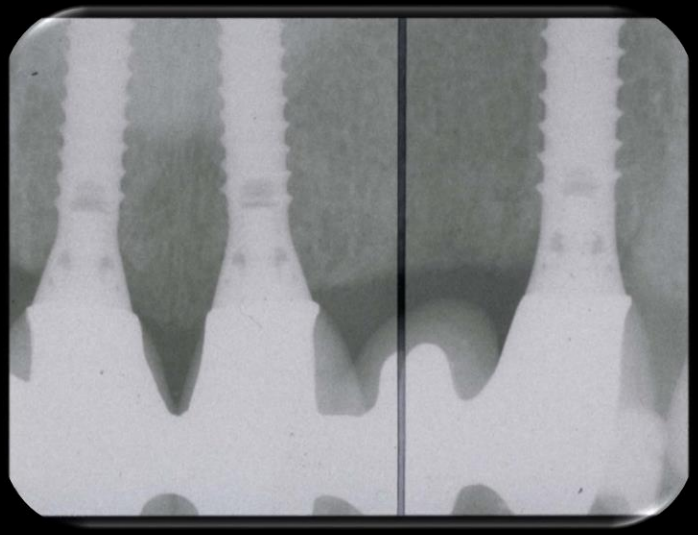
1988 Surgery D Buser • Prosthetics U Belser • Technique A Schönenberger

Cemented Anterior Case





1994 Surgery & Prosthetics D Hess • Technique C van der Velde



1994 Surgery & Prosthetics D Hess • Technique C van der Velde

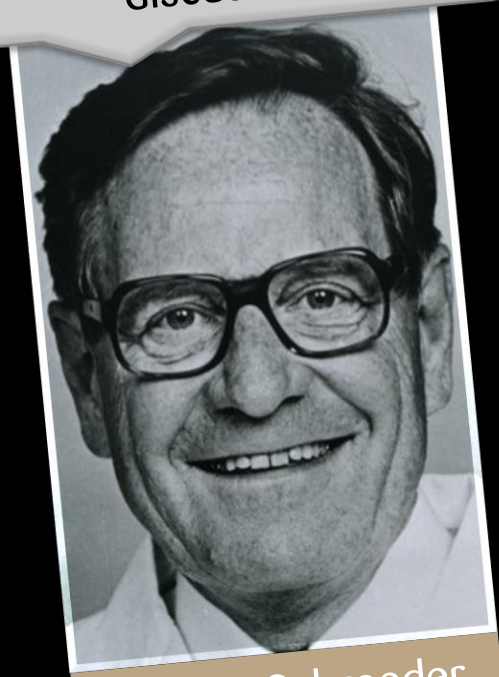
Concept of Osseointegration

- Choice of Material Ti / Bioceramics
- Strict Surgical Protocol
- Standardized Instrumentation
- Submerged or Non-Submerged
- Primary Stability
- Functional Loading, Healing Periods

How to get the message across?

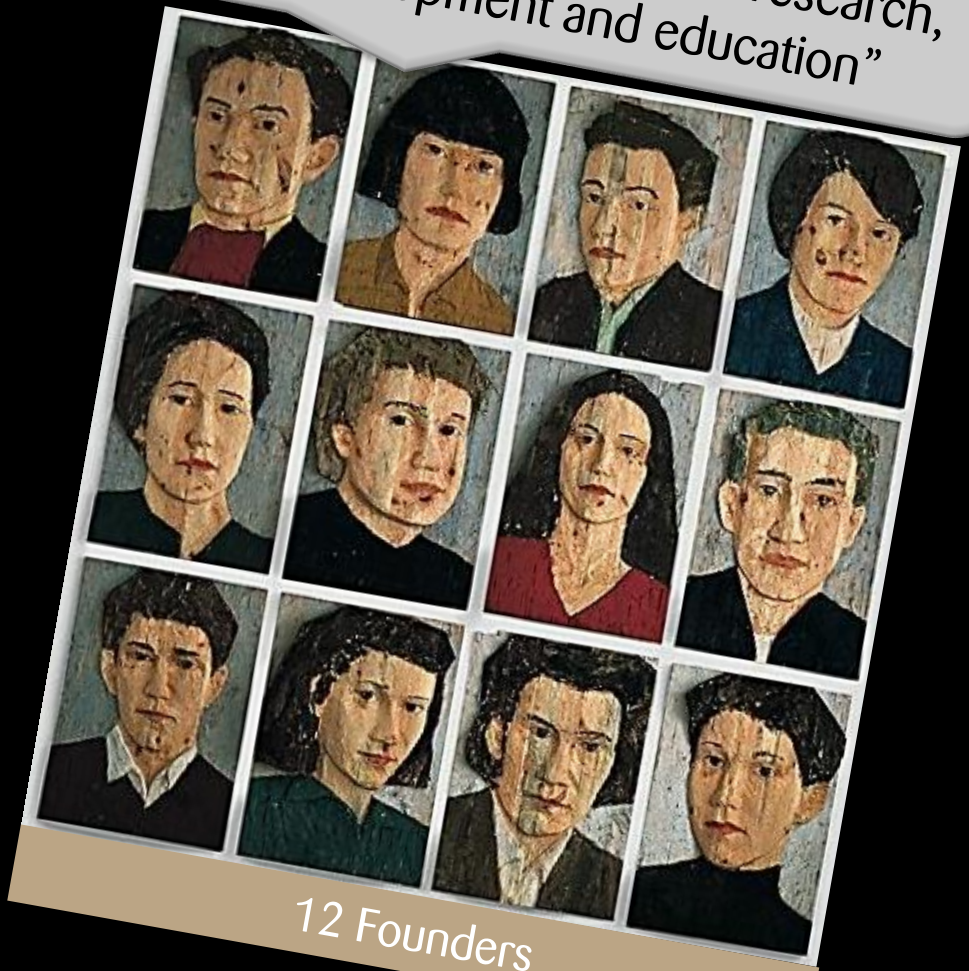
1980

"Medical research needs independence, open space and opportunities for discussion"



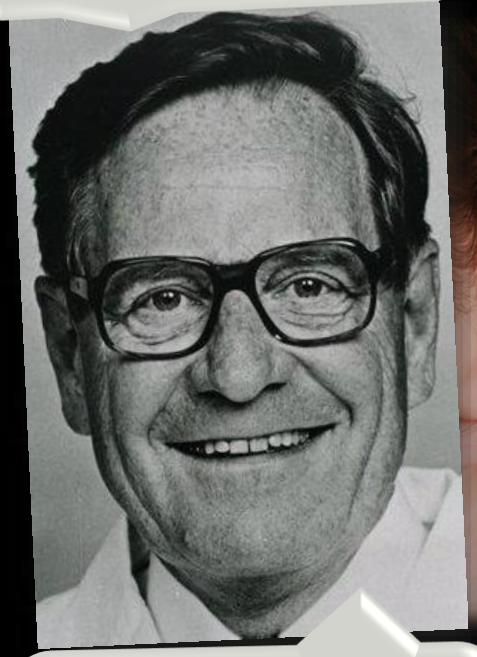
Prof. A. Schroeder

"Let's create a non-profit academic network of clinicians and scientists active in applied implant research, development and education"



12 Founders

"We need Resources"



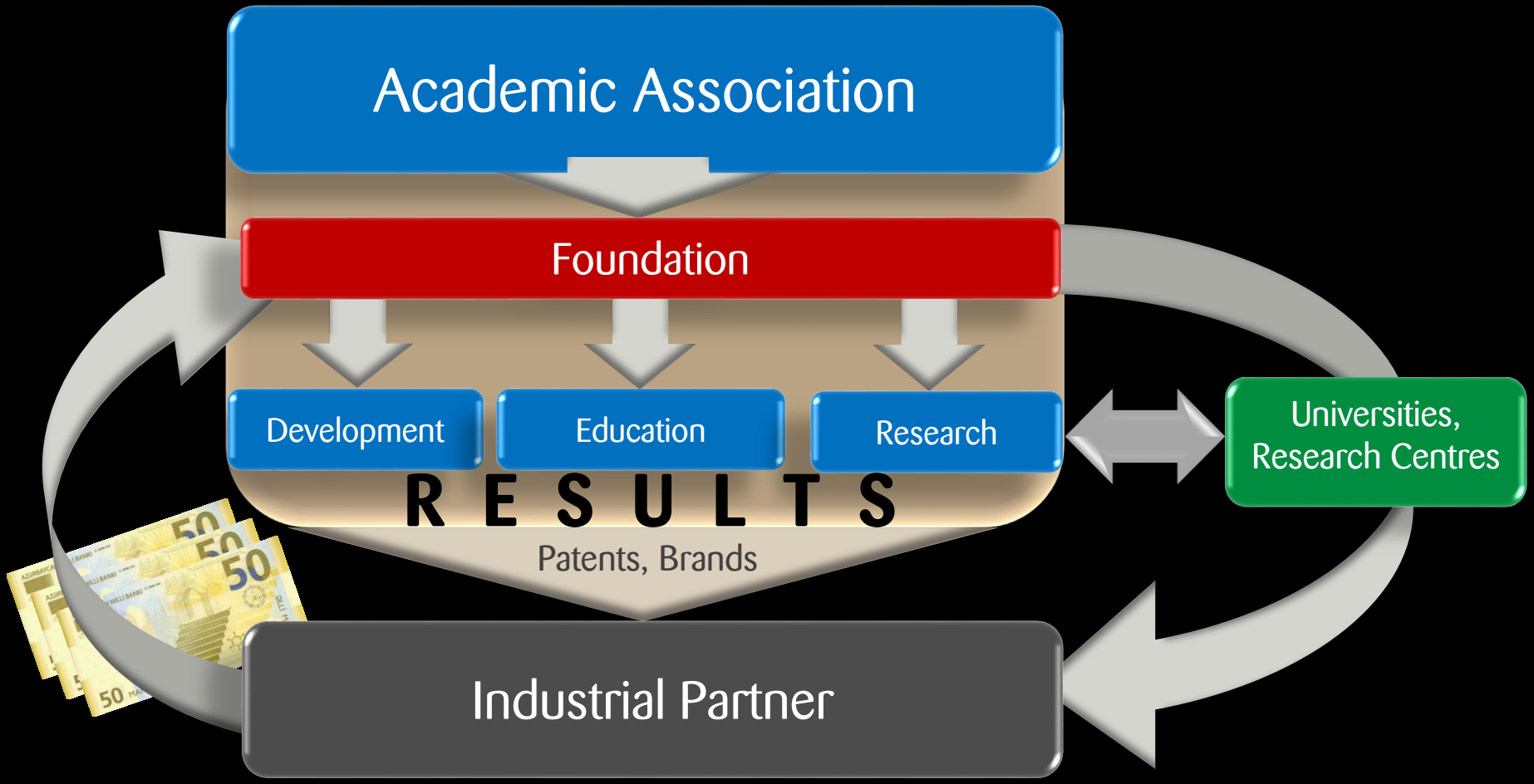
My Offer
- Research Findings
- Product Ideas
- User-Training

"I offer Resources"

My Need
- Research Findings
- Product Ideas
- User-Training

How should a partnership model in a medical device set-up look like in order to create benefits for **ALL** involved ?

Collaboration Model



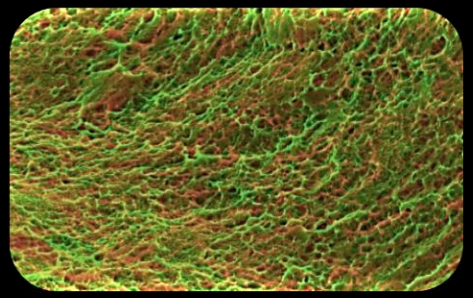
Schlich T (2002); Surgery, Science and Industry: A Revolution in Fracture Care, 1950's-1990's. *Houndsmills, Basingstoke, PALGRAVE MACMILLAN.*

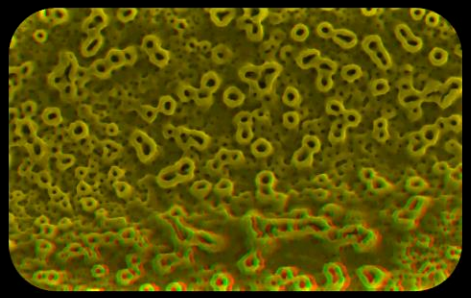
Scacchi MJ, Merz BH, Widmer WT (1999); A Collaboration Role Model for Academia and Industry. *Implantology, 12, 456-468.*

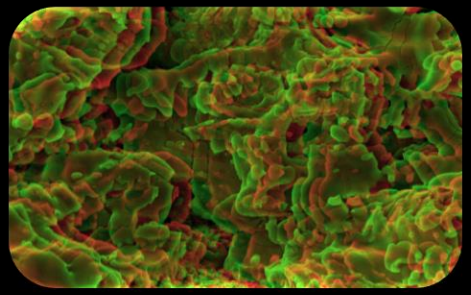
Concept of Collaboration

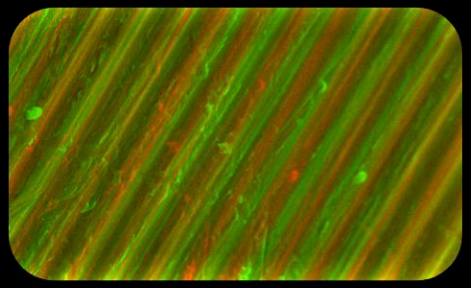
- Certain Degree of Autonomy
- Long-Term Thinking / Acting
- Higher Product Success Rates
- International Collaboration with Local “Coloration”
- Cultural Pattern of Fraternity

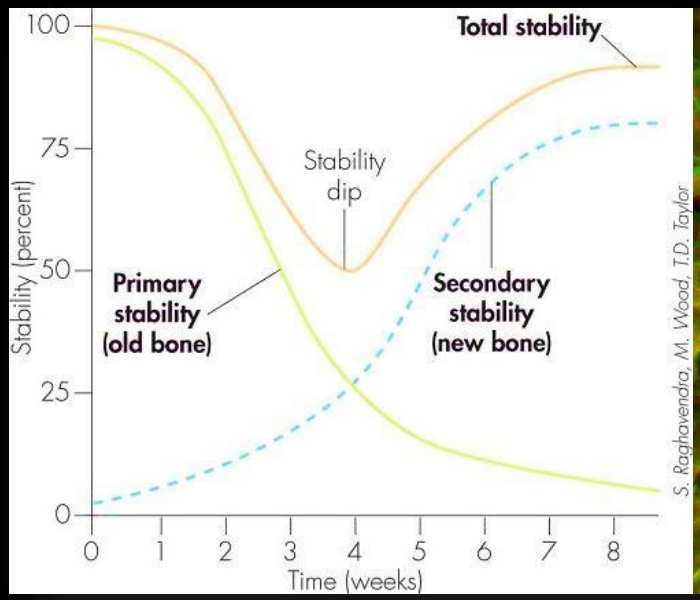
Focus on Implant Surfaces

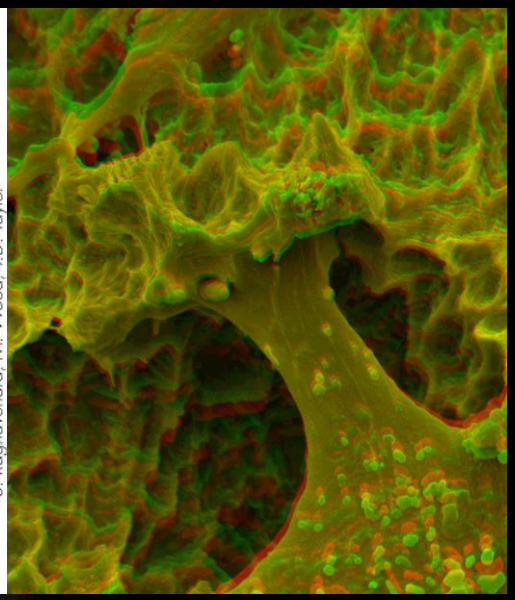












"The improvement of the implant surface with a TPS- or HA-coating, and more recently, roughening of the CP-Ti by blasting or etching procedures obviously improves the rate of osseointegration (BIC)"

*P. Trisi (1993); *Implant Surfaces: Present and Future.* Osteology, 12; 145-156.

G.B. Schneider, H. Perinpanayagam, M. Clegg, R. Zaharias, D. Seabold, J. Keller, C. Stanford (1989); *Implant Surface Roughness Affects Osteoblast Gene Expression.* Annual Research Report, US-University of Iowa.

B. Williams (1989); *Textured Titanium Implants May Be Better Than Smooth Ones.* Devices and Technology Review 45; 245-256.

Osteogenic Response

- Shorter integration time
- Earlier loading techniques
- Shorter treatment times

Buser D, et al (2012);10-Year Survival and Success Rates of 511 Titanium Implants with a Sandblasted and Acid-Etched Surface (SLA): A Retrospective Study in 303 Partially Edentulous Patients.
The present retrospective analysis resulted in a 10-year implant survival rate of 98.8% and a success rate of 97.0%.

2008 Cochran D, et al; A comparison of endosseous implant surfaces.

2004 Geurs N, et al; Influence of implant geometry and surface characteristics on progressive osseointegration.

2002 Testori T, et al; A multi-center prospective evaluation of 2-months loaded OSSEOTITE® implants placed in the posterior jaws: 3-year follow-up results.

2001 Gaucher H, et al; Multi-Center study of OSSEOTITE® implants supporting mandibular restorations: a 3-year report.

1998 Buser D, et al; Removal torque values of titanium implants. A comparison of sandblasted acid-etched to machined and acid-etched screw implants.

1998 Buser D, et al; The interface shear strength of titanium implants with a sand-blasted and acid-etched surface. A biomechanical study.

1998 Cochran D, et al; Bone response to unloaded and loaded titanium implants with a sandblasted and acid-etched surface.

1995 Wong U, et al; Effect of surface topography on the osseointegration of implants in trabecular bone.

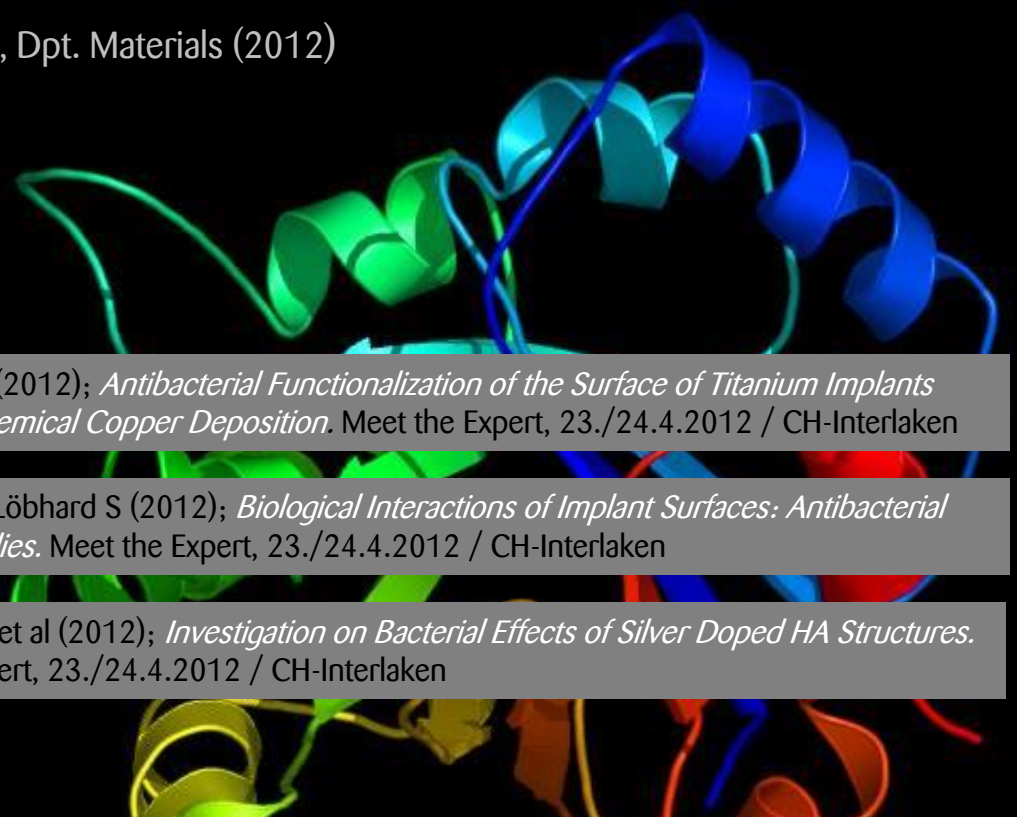
1991 Buser D, et al; Influence of surface characteristics on bone integration of titanium implants.

Development Focus

We have engineered surfaces that present specific cues for the attachment and proliferation of tissue cells, but are at the same time repulsive to bacteria.

Thus offering the potential for implant applications where tissue integration and reduced risk of biofilm formation and infection are key for performance.

Textor M
ETH Zurich, Dpt. Materials (2012)

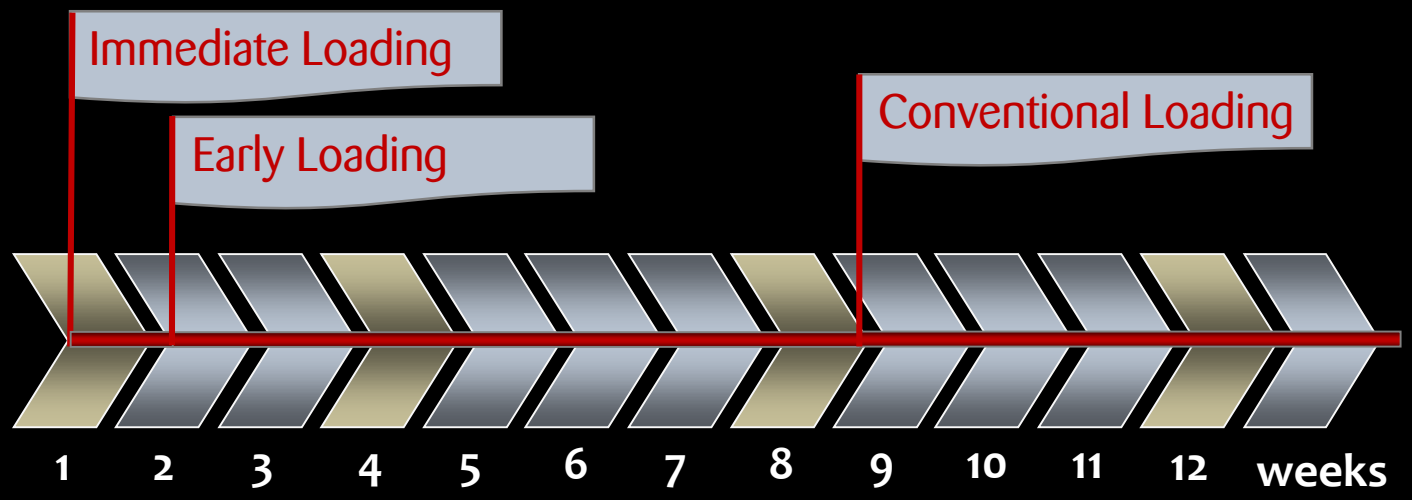


Jung C, et al (2012); *Antibacterial Functionalization of the Surface of Titanium Implants by Electrochemical Copper Deposition*. Meet the Expert, 23./24.4.2012 / CH-Interlaken

Friedrich A, Löbhard S (2012); *Biological Interactions of Implant Surfaces: Antibacterial Efficacy Studies.* Meet the Expert, 23./24.4.2012 / CH-Interlaken

Chavanne P, et al (2012); *Investigation on Bacterial Effects of Silver Doped HA Structures.* Meet the Expert, 23./24.4.2012 / CH-Interlaken

Implant Loading Concepts (Ref: ITI Consensus 2008)



Immediate

- edentulous cases if implants are solidly connected
- 4 implants required in the mandible
- 6 implants required in the maxilla

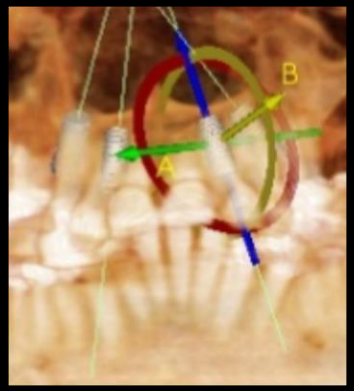
Early

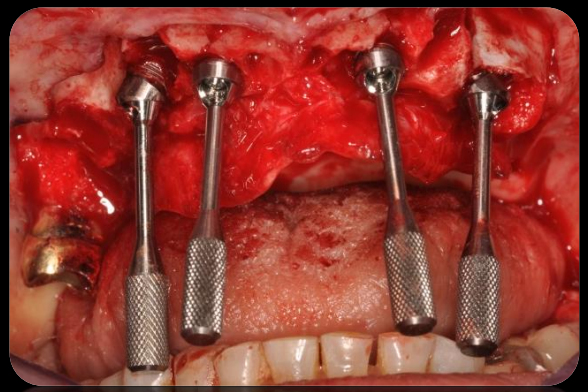
- with good quality bone / adequate bone quantity
- with implants ø 4.3mm or larger

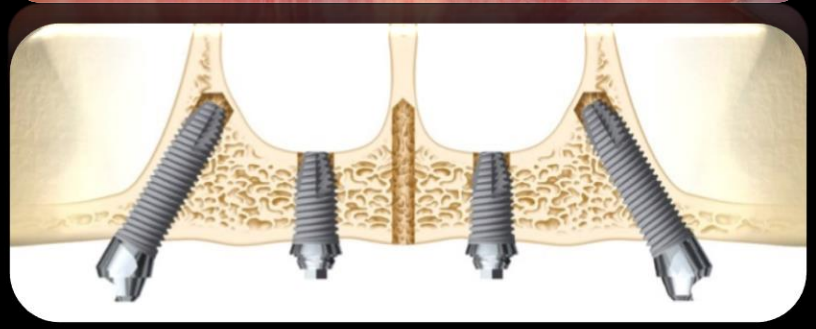
Conventional

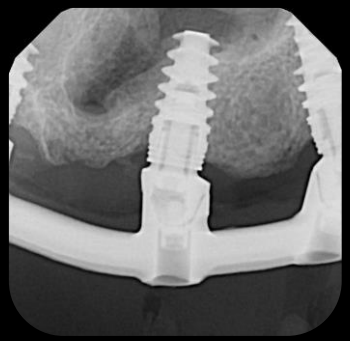
- with cancellous bone quality / limited bone quantity
- with implants smaller than ø 3.8mm
- CAVE: GBR measures

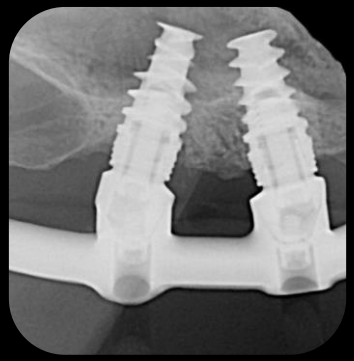
«All-on-Four» Immediate Load Case • 2011 JM Ganeles



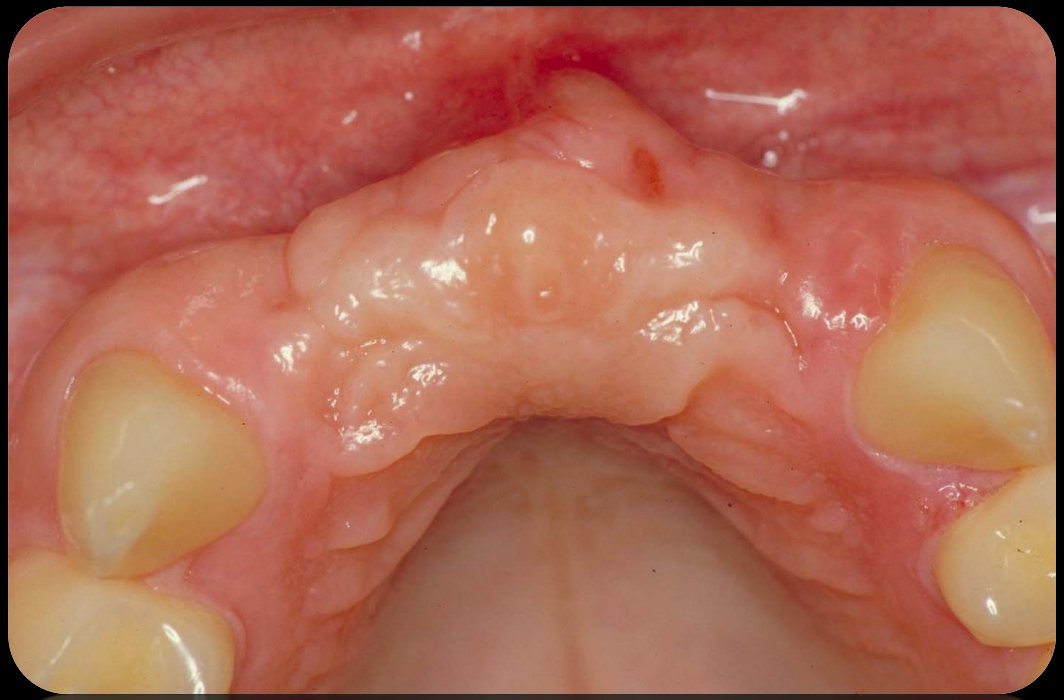








4 Missing Adjacent Teeth in the Anterior Maxilla

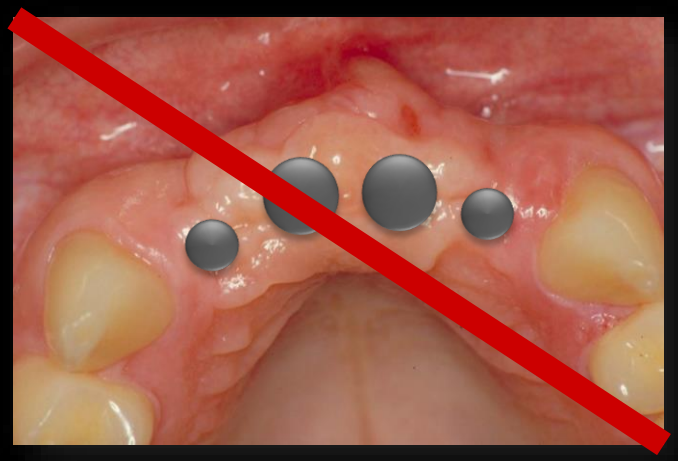


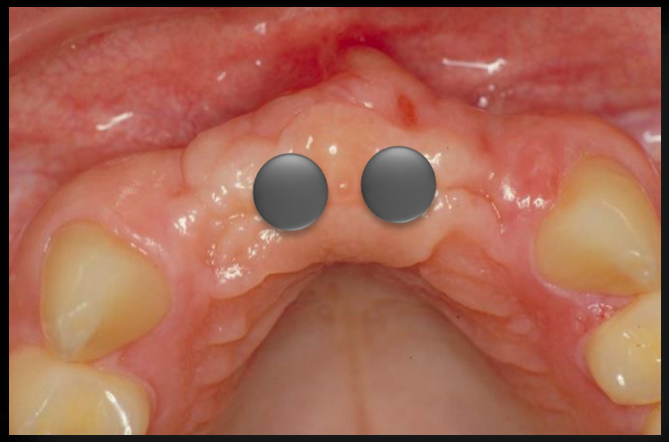
- How many Implants?
- Location?
- What Type?

- Such edentulous spaces are often combined with insufficient bone width
- Two central incisors are less difficult than cases including lateral incisors
- 3 or 4 missing anterior teeth are less demanding than 2 missing teeth next to each other

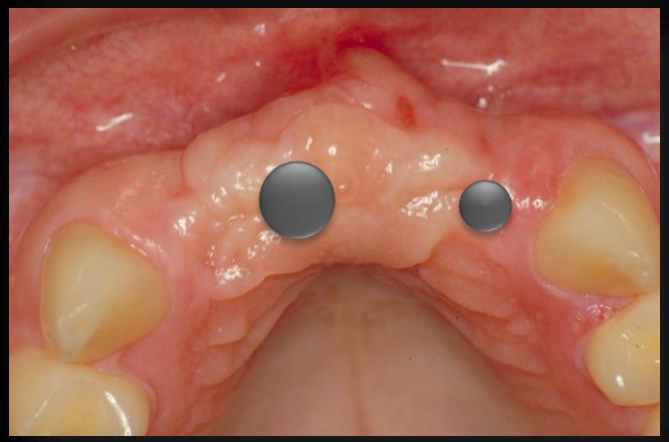
Aesthetic Risk Profile

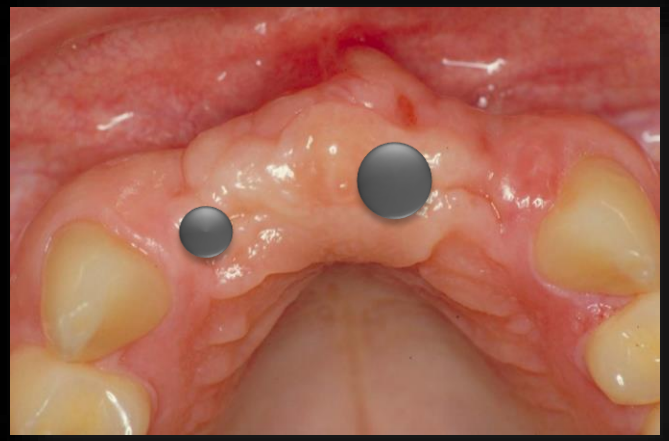
high



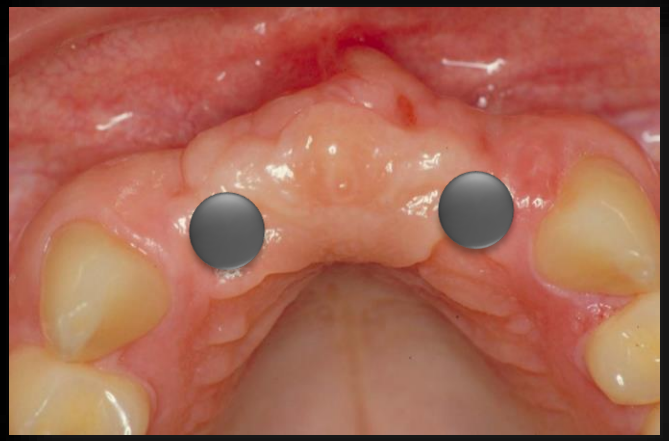


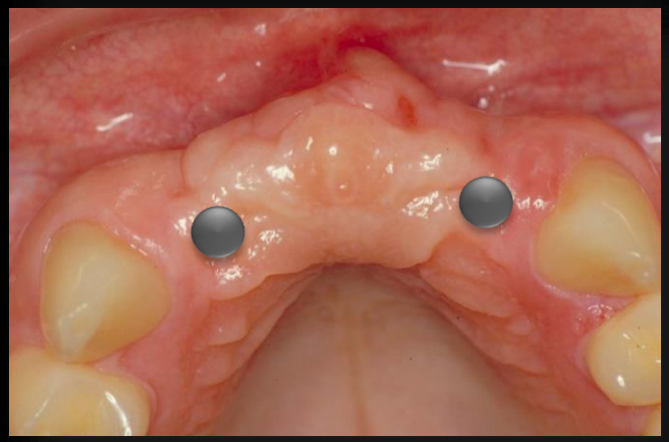
moderate

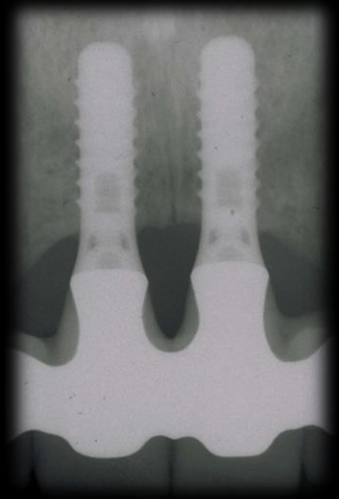




low







2007 Surgery JP Bernard • Prosthetics U Belser • Technique A Schönenberger

(Aesthetic) Risk Assessment

"A risk patient is a patient in whom the strict application of the standard protocol does not offer the expected results" *Franck Renouard, 1999*

Basic Risk Management

- Medical condition of patient
- Minimize risk of failure
- Obtain informed consent
- Develop necessary skills
- Establish maintenance protocol

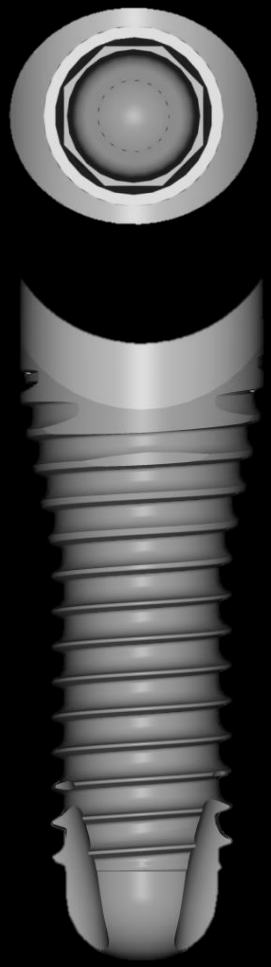
- Aesthetics Risk Protocol (Fradeani M, 2005)
- Aesthetic Risk Profile (Martin W, 2007)

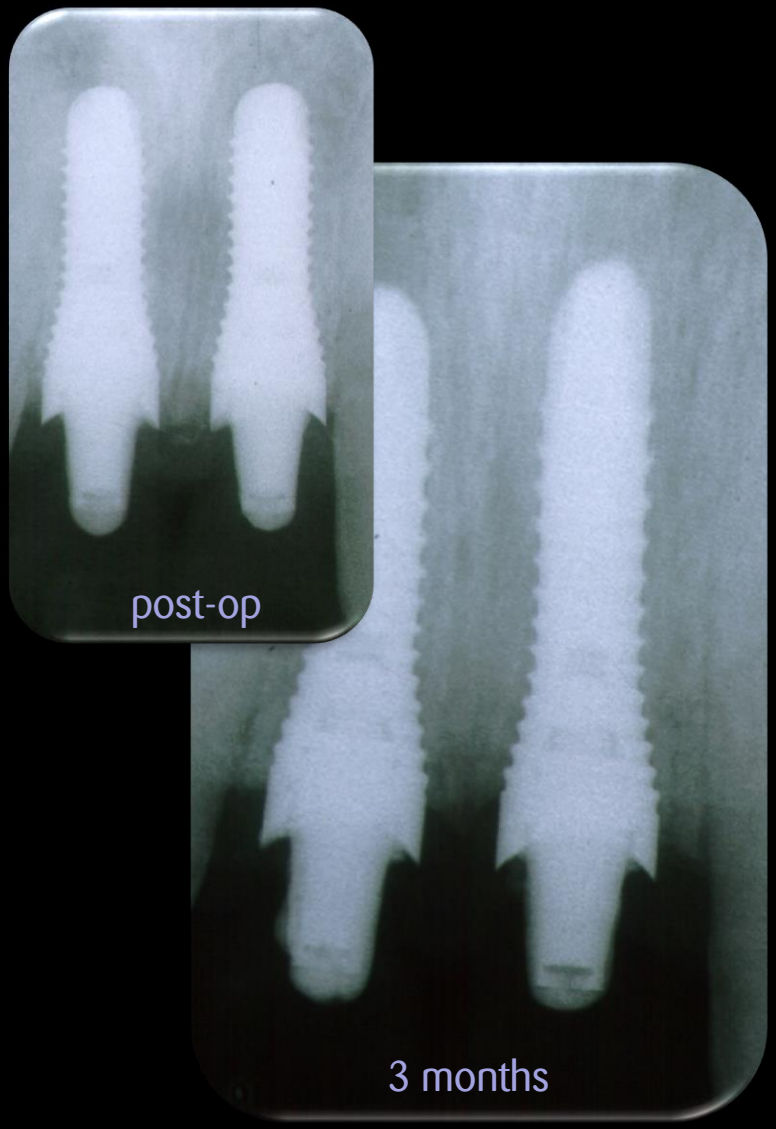
Risks: Screw-Retained Prosthetics

1997 Technique P Müller

Risks: Development Failures

By Courtesy of U Belser





2001 Surgery A Botticelli

GBR - Guided Bone Regeneration

"Implants require sufficient vertical and horizontal bone volume"

1959 Hurley LA et al
1961 Basset CAL et al

1982 Nyman S et al (GTR)
1988 Dahlin C et al

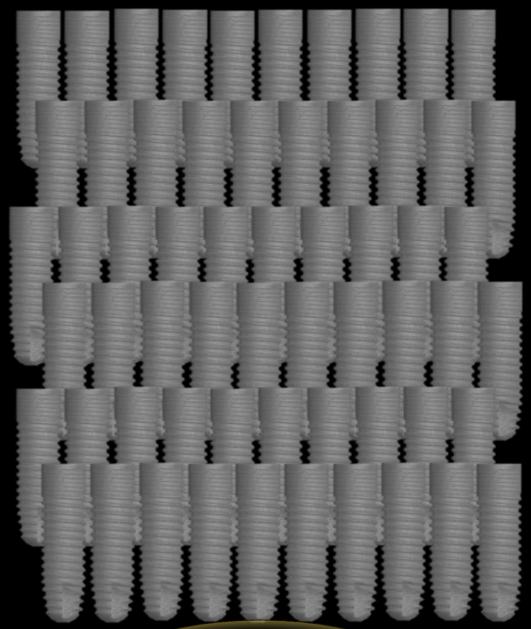
Major Targets

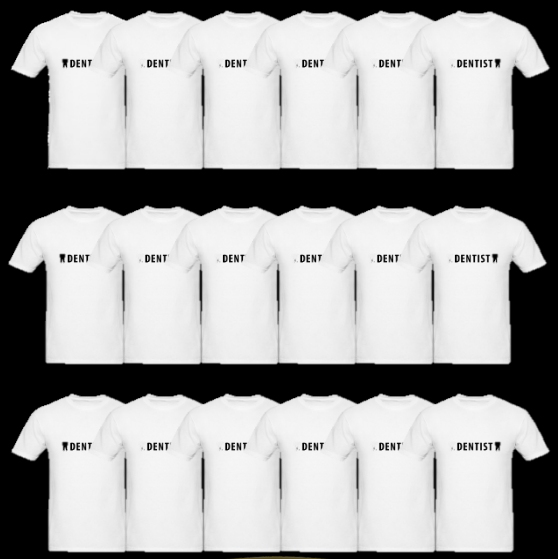
- successful regeneration of bone defects
- high predictability
- low risk for complications
- user-friendly
- patient-friendly

Concept of GBR Procedures

- Mainly Collagen Membranes combined with DBBM
- Approx. 80% Simultaneous Approach (Patient-friendly)
- Good Clinical Results with High Predictability
- Large Defects = Staged Approach

Dental Implant Market Development 1985 - 2010





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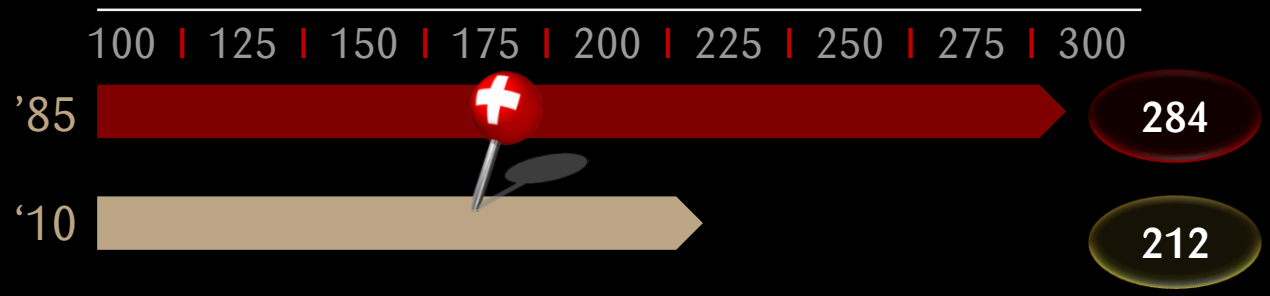
Size of Market

# of Implants

# of Dentists

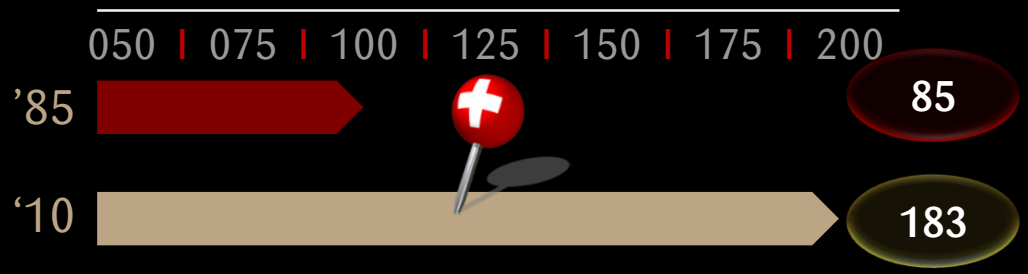
Dental Implant Market Development 1985 – 2010

Avg. Implant Sales Price EUR

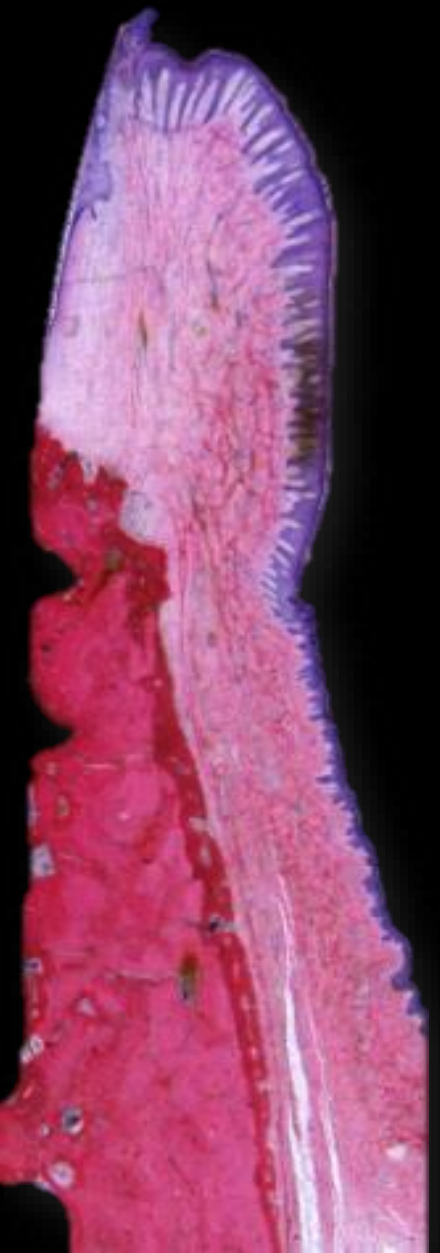


Implant Companies*

Avg. # System Components



Learnings 2000-2010



- **Concept of Peri-Implant Biologic Width**
  - Berglundh & Lindhe 1996; Hermann et al 1997

  OBVIOUSLY NO INFLUENCE
  - one- or two-piece implant
  - healing mode (non-sub. vs. submerged)
  - time-to-loading (immediate or delayed)

  CONTROVERSIAL
  - surface structure
  - abutment material
  - microgap (connection)

- **Ridge Alterations Post Extraction**
  - Araujo et al 2005 a, b; Araujo et al 2006 a, b

- **Aesthetic Risk Assessment**
  - Martin et al 2006

Implant Dentistry Today

- Rapid Expansion of Implant Therapy
  - good scientific documentation
  - application in partially edentulous patients
  - progress with GBR procedures

- Trends (n=1’817)
  - highest indication: single tooth 55%
  - lowest indication: edentulous jaws 5%
  - reduced overall treatment time
  - post extraction sites
  - increasing demand for aesthetic restorations

- GBR
  - local bone augmentation (simultaneous / staged) plays a dominant role in daily practice (52%)

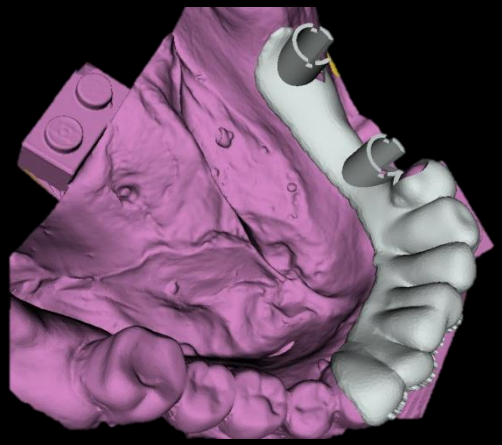
‘65 ‘13

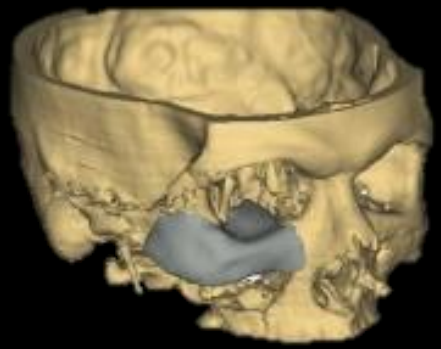
PAST **Discovery** | PRESENT **Development** | FUTURE **Digital**

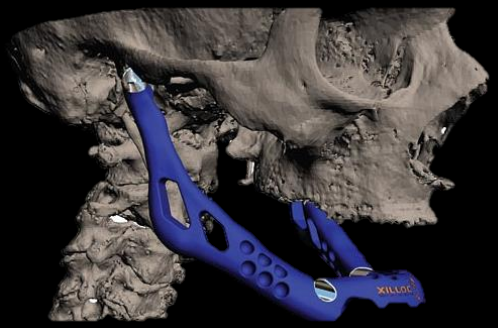
OSSEOINTEGRATION

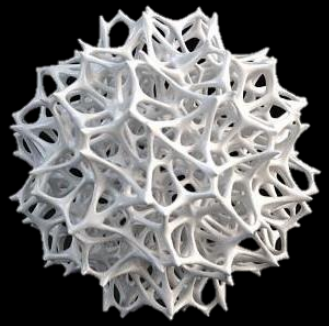
YOUR FUTURE IS CREATED BY WHAT YOU DO ~~NOT~~ TODAY ~~TOMORROW~~

3-D Printing









YOUR FUTURE IS CREATED BY WHAT YOU DO TODAY NOT TOMORROW

Patients	- better informed - more co-morbidities
Dental Profession	- more female dentists - prosthetics determine treatment
Technology	- digitalization changes workflow - modified value chain
Industry & Markets	- geographic shifts - need for implant maintenance
Economic Environment	- US and emerging markets grow - competition for talent

Past, Present, and Future of Implant Dentistry

Marcel J. Scacchi

Picture References
iStockPhoto, marcs group AG, SISCON MEDICAL GmbH, TECHNOSS DENTAL SpA, Prof. Robert Schenk, Prof. André Schroeder, Prof. Daniel Buser, Prof. Urs Belser, Dr. Daniel Hess, CDT Alwin Schönenberger, CDT Pascal Müller, Prof. Andrea Botticelli, Prof. Jan Lindhe, Mercedes Benz Gruppe AG, STRAUMANN HOLDING AG, ITI Foundation, Appenzeller Käseunion, ZITERION GmbH, Palgrave McMillan, Dr. Peter Schüpbach, Scacchi-Sofia Family, 20 Century Fox Corp., Eisenhammer Agency, Tourist Board of Azerbaijan, Dr. Jabbar Hasanov, FRIALIT-DENTSPLY GmbH, National Library of Italy, Guggenheim Inc., CDT Ces van de Velde, Kunstmuseum Bern, NOBEL BIOCARE AG, Stanserhorn AG, topshot GmbH, Helvetia by Night.