



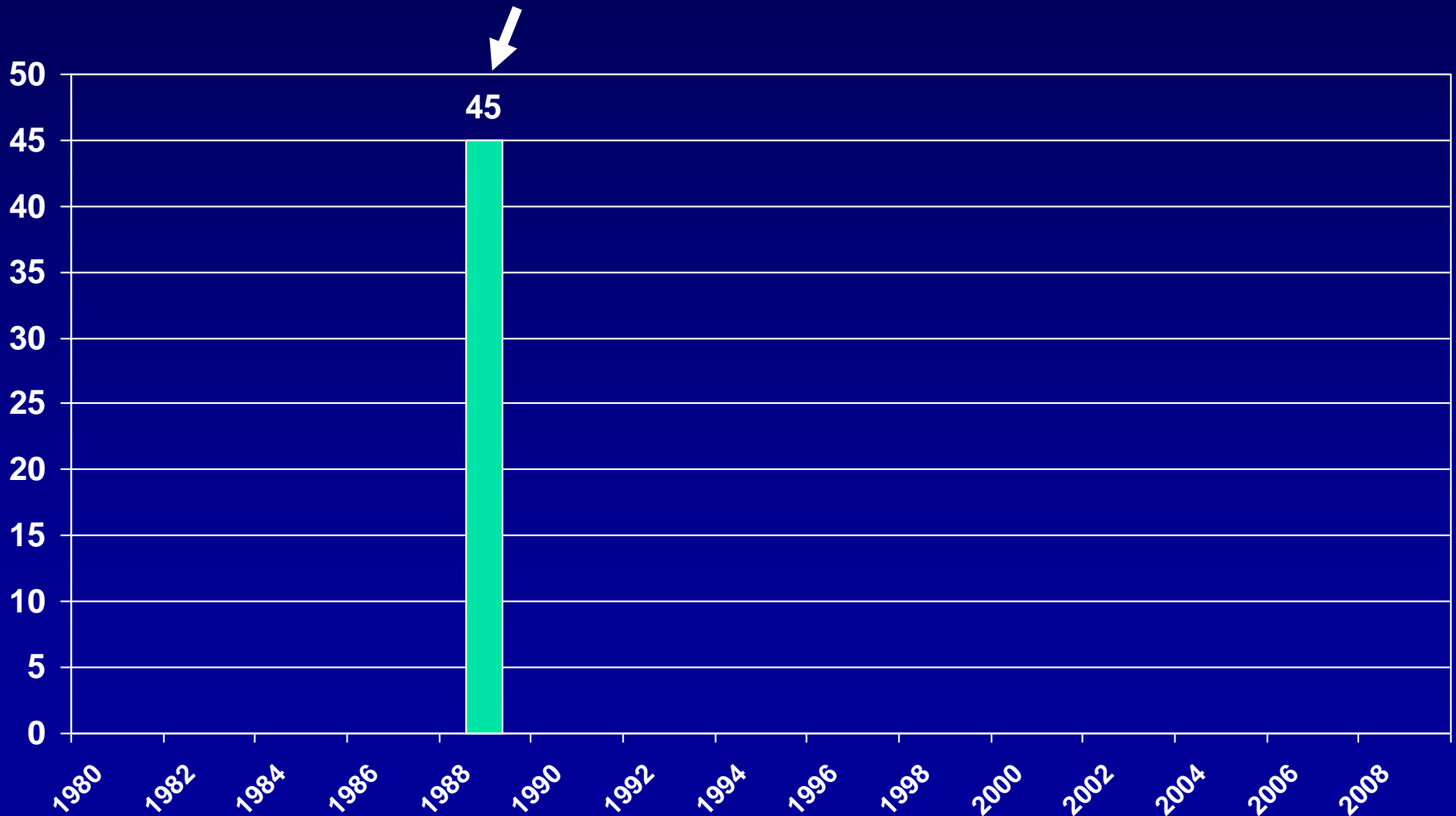
Dental Implants – How many systems do we have and are they documented?

Asbjørn Jokstad, DDS, PhD
Professor and Head, Prosthodontics
Faculty of Dentistry, University of Toronto



Number of dental implants 1988

English CE. Implants. Part three. An overview.
California Dent Assoc J. 1988;16: 34-8.





Review of existing literature

Eckert S et al. Validation of dental implant systems through a review of literature supplied by system manufacturers. J Prosthet Dent 1997;77: 271-9.

Conclusion:

On the basis of the literature supplied by the manufacturers, only one implant system demonstrated scientifically valid long-term success.



Situation, 1999

- 1. The number of implants and implant systems increase continuously worldwide**
- 2. The FDI World Dental Federation is concerned about the quality of all the new implants being marketed**
- 3. The FDI Science Committee is asked to investigate the issue**
- 4. The work is commissioned to prof. A Jokstad**





Implant brands/ systems available in N. America in 1999 (n=98)

REVIEW ARTICLE

Implants and Components: Entering the New Millennium

Paul P. Binon, DDS, MSD¹

The elusive dream of replacing missing teeth with artificial analogs has been part of dentistry for a thousand years. The coincidental discovery by Dr P-I Brånemark and his coworkers of the tenacious affinity between living bone and titanium oxides, termed *osseointegration*, propelled dentistry into a new age of reconstructive dentistry.

Initially, the essential tenets for obtaining osseointegration dictated the atraumatic placement of a titanium screw into viable bone and a prolonged undisturbed, submerged healing period. By definition, this required a 2-stage surgical procedure. To comply, a coupling mechanism for implant placement and the eventual attachment of a transmucosal extension for restoration was explored. The initial coronal design selected was a 0.7-mm-tall external hexagon. At its inception, the design made perfect sense, because it permitted engagement of a torque transfer coupling device (fixture mount) during the

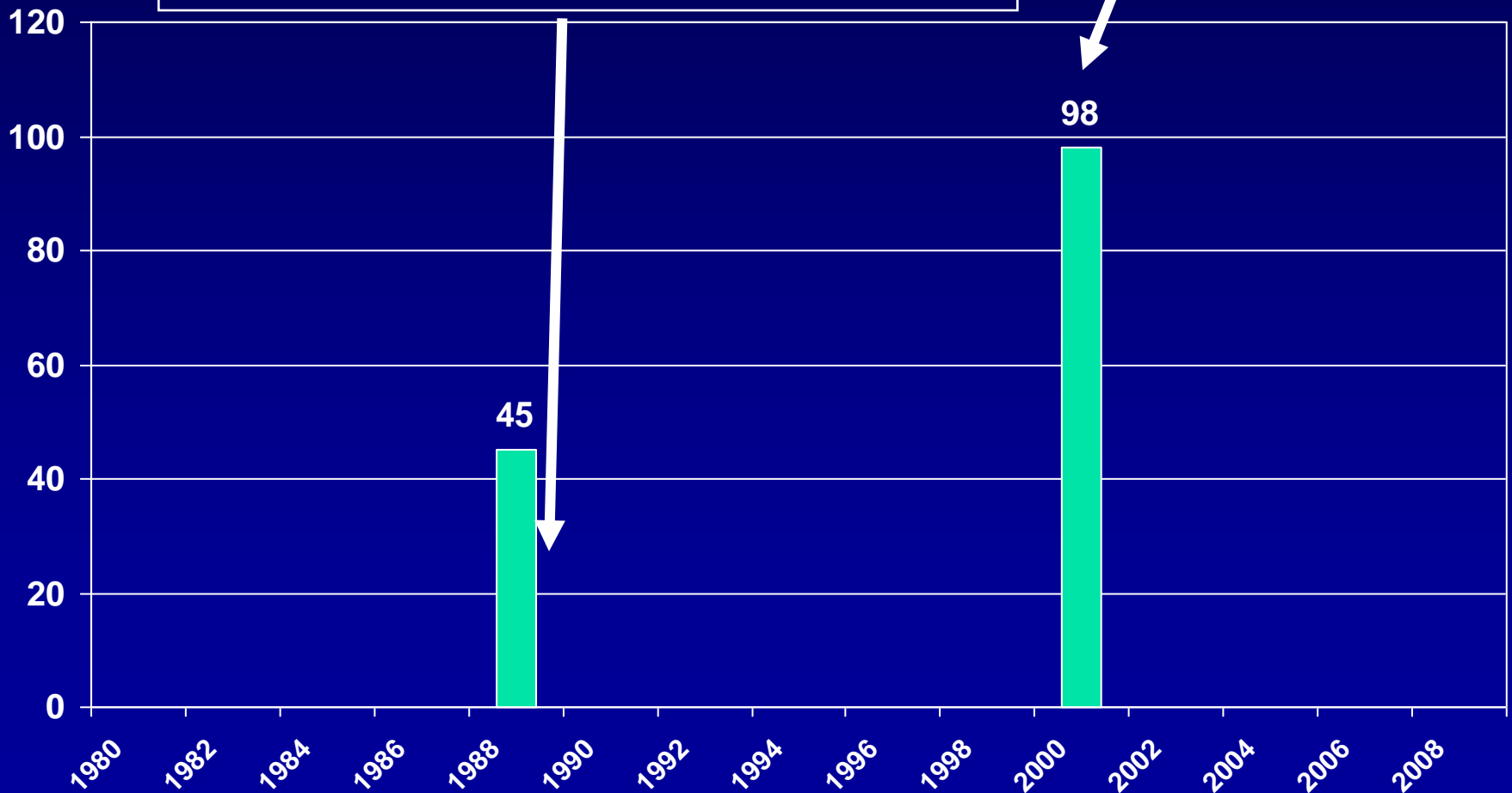
replacement, maxillofacial and a myriad of other applications, limited only by the ingenuity and skill of the clinician.¹¹⁻¹³ The external hexagonal design, ad modum Brånemark, originally intended as a coupling and rotational torque transfer mechanism, consequently evolved by necessity into a prosthetic indexing and antirotational mechanism.^{14,15} The expanded utilization of the hexagonal resulted in a number of significant clinical complications.^{8-11,16-22} To mitigate these problems, the external hexagonal, its transmucosal connections, and their retaining screws have undergone a number of modifications.²³ In 1992, English published an overview of the then-available external hexagonal implants, numbering 25 different implants, all having the standard Brånemark hex configuration.¹⁴ The external hex has since been modified and is now available in heights of 0.7, 0.9, 1.0, and 1.2 mm and with flat-to-flat widths of 2.0, 2.4, 2.7, 3.0, 3.3, and 3.4 mm,



Number of implants 2000

Binon PP. Implants and components: entering the new millennium. *Int J Oral Maxillofac Implants*. 2000;15:76-94.

English CE. Implants. Part three. An overview. *CDA J*. 1988;16: 34-8.



***Jokstad, Brägger, Brunski, Carr,
Naert, Wennerberg. Int Dent J
2003; 53 Sup 2: 409-33***

Asbjørn Jokstad, Oslo, Norway
Urs Braegger, Bern, Switzerland
John B. Brunski, Troy, USA
Alan B. Carr, Rochester, USA
Ignace Naert, Leuven, Belgium
Ann Wennerberg, Gothenburg, Sweden

International
Dental
Journal

6/03
Supplement 2



Quality of Dental Implants

fdi
Published by
FDI World Dental Press



Commercially available implant and implant systems in October 2003:

225 implant brands

78 manufacturers – from all continents

~70 implant brands no longer marketed



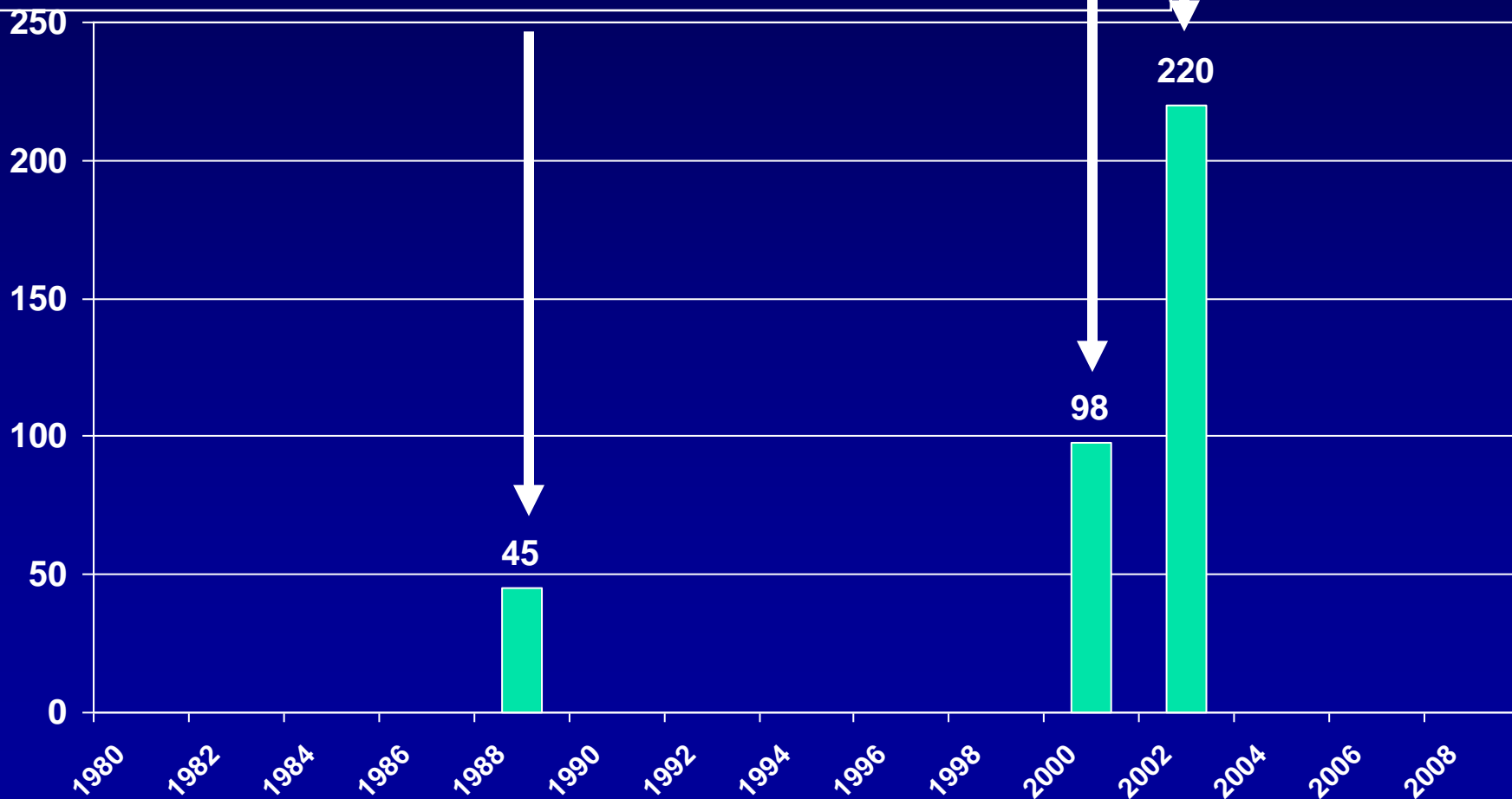


Number of implants 2003

Jokstad A, et al. Quality of dental implants. *Int Dent J.* 2003;53(6 Suppl 2):409-43

Binon PP..Implants and components: entering the new millennium. *Int J Oral Maxillofac Implants.* 2000;15:76-94.

English CE. Implants. Part three. An overview. *CDA J.* 1988;16: 34-8.



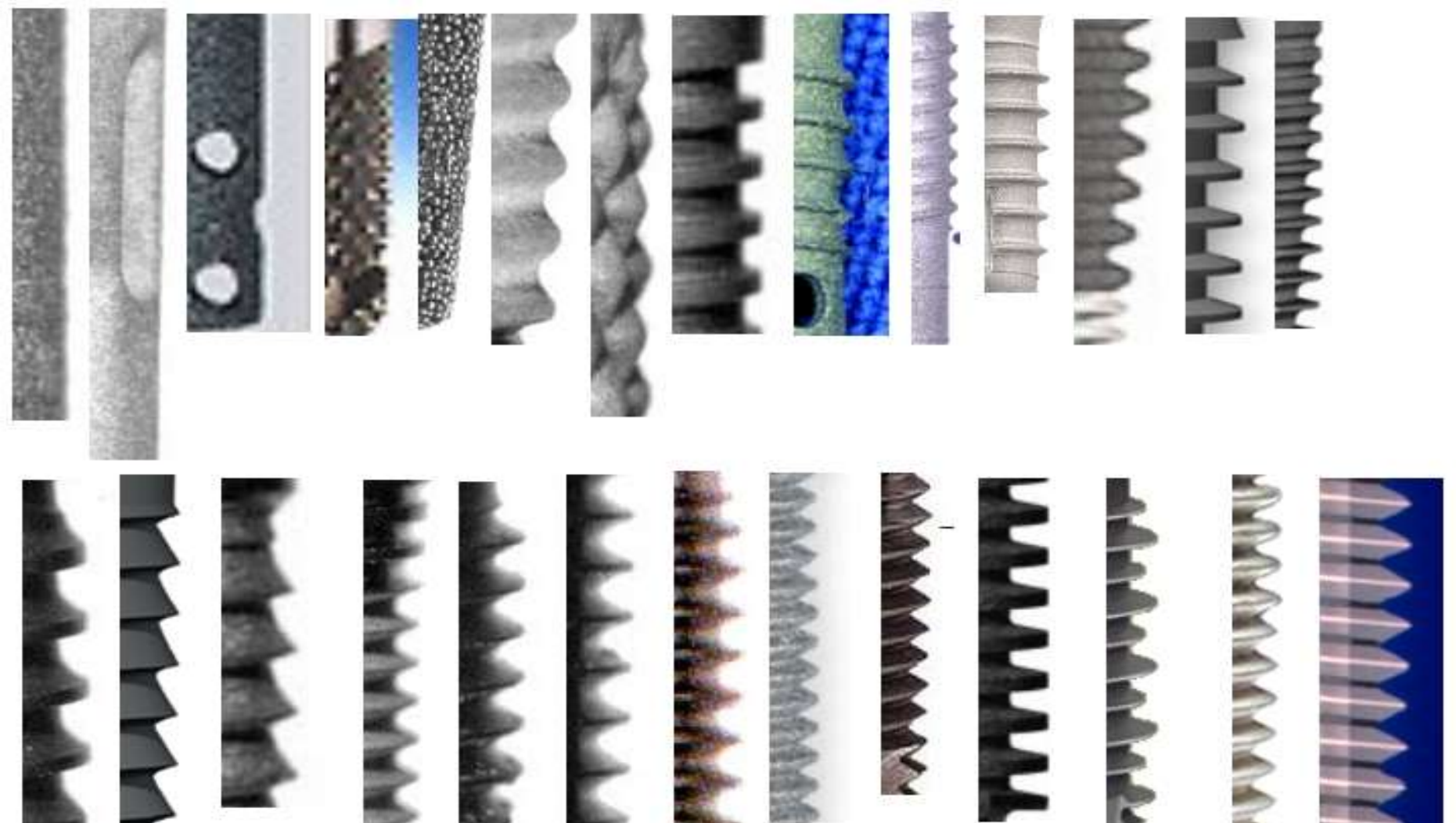


Straight, Tapered, Conical, Ovoid, Trapezoidal, Stepped & combinations ...

Flange design



- Flange vs. no flange
- Straight vs. flared vs. widening
- Height
- Polished vs. threads
- Added features
- Surface topography



- Threads vs. non-threads
- Shape: V- vs. square- vs. reverse buttress- vs. combinations
- Number and size of “lead threads”
- Number and location of grooves, groove forms and groove sizes
- Surface micro-topography
- Thread angle



Apex

- Threaded vs non-threaded
- V-shape vs flat vs curved apex
- Holes, round, oblong
- Apical chamber
- Grooves and groove size
- Flared apex
- Surface topography

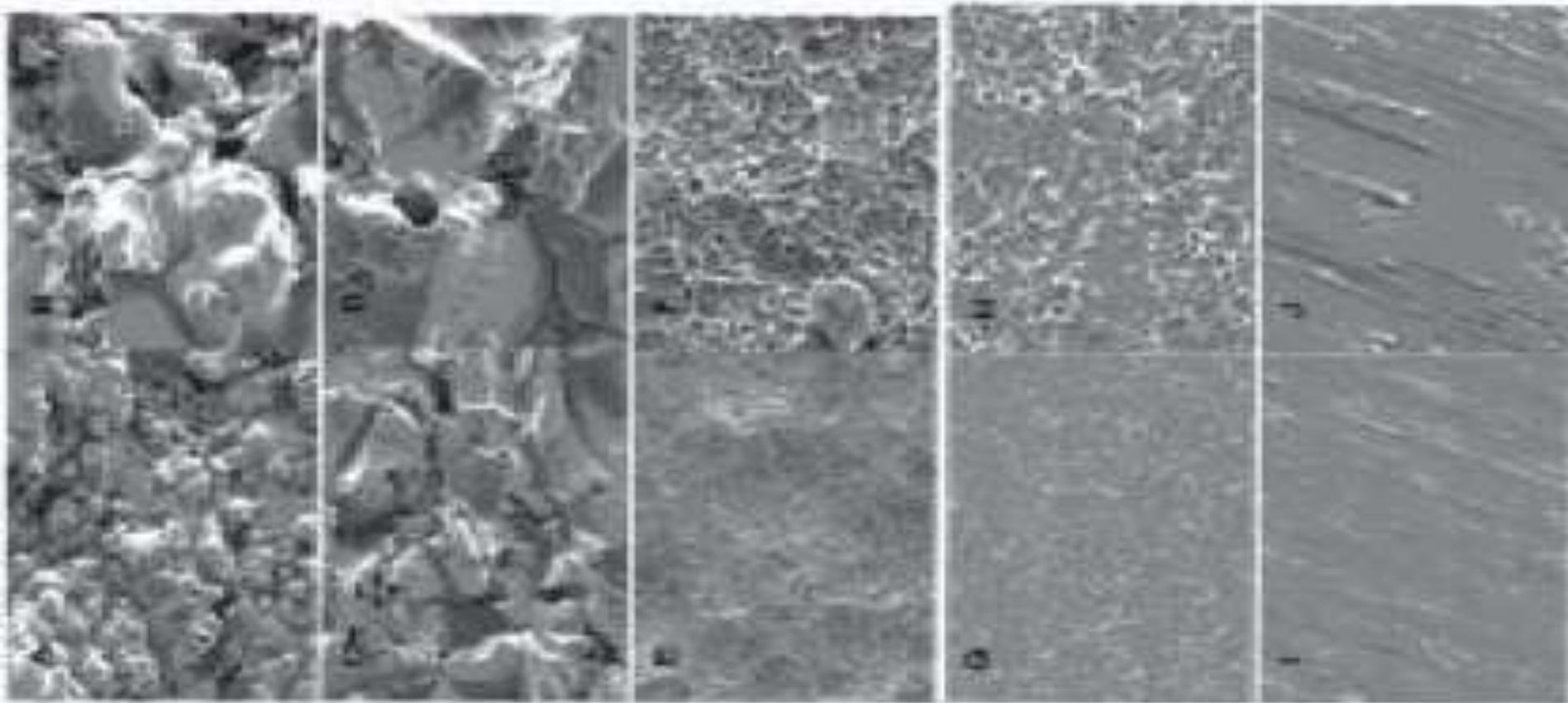


Interface geometry

- External vs Internal
- Hexagonal vs. Octagonal vs cone
- Morse taper
- Rotational vs non-rotational
- Added non-rotational features
- Heights & widths
- Butt vs bevel joints
- Slip-fit vs friction-fit joints
- Resilience vs nonresilience



High (top) and low (bottom) magnification of cpTi surfaces as used for surface characterization.



Plasma-sprayed (TPS);

Grit-blasted

Grit-blasted and dual acid-etched

Dual acid-etched

Machined (turned)

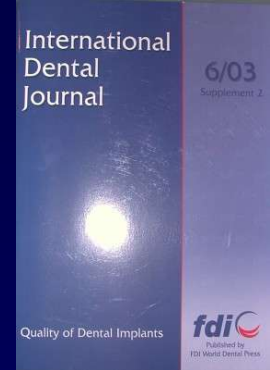
<u>Surface topography</u>	<u>Machining process</u>	<u>Example</u>
Anisotropic with oriented cutting marks	Turned	Brånemark System® MKIII (Nobel Biocare)
Isotropic	Blasted	TiO2 particles (Tioblast®, AstraTech)
Isotropic	Blasted + acid etched	1. Large size Al2O3 particles & HCl & H2SO4 (SLA®, Straumann) - 2. Tricalcium phosphate & HF & NO3 (MTX®, Centerpulse)
Isotropic with high frequency irregularities	Acid etched	HCl / H2SO4 (Osseotite®, 3i)
Isotropic and rough	Hydroxyapatite coated	Sustain® (Lifecore)
Isotropic and rough	Titanium Plasma Sprayed	ITI® TPS (Straumann)
Isotropic with craterous structure	Oxidized	TiUnite® (Nobel Biocare)



Clinical documentation?



Clinical documentation



- A. Implant or implant system with extensive clinical documentation: >4 clinical trials **10**
- B. Implant or implant system with limited clinical documentation, i.e. <4 trials, but of good methodological quality **11**
- C. Implant or implant system with limited published clinical documentation **29**
- D. Implant or implant system with no published clinical documentation. **28**

Quality Assessment of Randomized Controlled Trials of Oral Implants

Marco Esposito, DDS, PhD¹/Paul Coulthard, BDS, MFGDP, MDS, FDSRCS, PhD²/
Helen V. Worthington, BSc, MSc, PhD, FIS³/Asbjørn Jokstad, DDS, PhD⁴

The aim of this study was to assess the quality of randomized controlled trials (RCTs) concerned with the effectiveness of oral implants and to create a trial register. A multilayered search strategy was used to identify all RCTs published by the end of 1999 in any language. The Cochrane Oral Health Group specialist register, PubMed, and personal libraries were searched. Seventy-four RCTs were identified. Forty-three articles, not presenting the same patient material, were independently assessed by 3 researchers using a specially designed form. A statistician assessed all trials for the appropriateness of statistics. The quality of each study was assessed on 7 items, including 3 key domains. Randomization and concealment allocation procedures were not described in 30 articles (70%). Reasons for withdrawals were not given in 10 reports (23%). No attempt at blinding was reported in 31 studies (72%).

The quality of RCTs of oral implants is generally poor and needs to be improved. (INT J ORAL MAXILLO-

The quality of RCTs of oral implants is generally poor and needs to be improved



**How many new
implant systems?**

Number of implants 2006

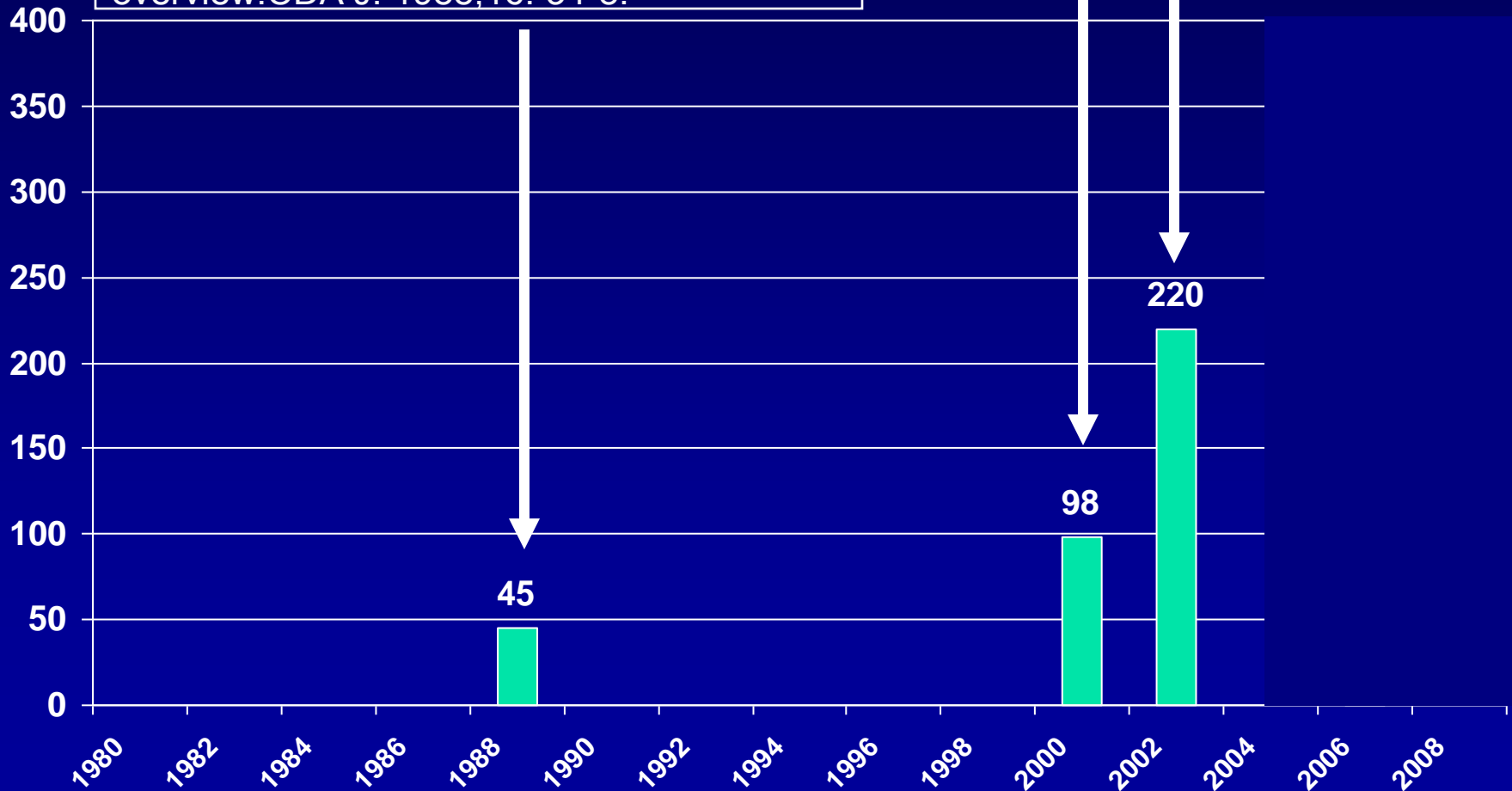


Jokstad A, et al. Quality of dental implants. *Int Dent J.* 2003;53(6 Suppl 2):409-43

Binon PP. Implants and components: entering the new millennium. *Int J Oral Maxillofac Implants.* 2000;15:76-94.

English CE. Implants. Part three. An overview. *CDA J.* 1988;16: 34-8.

Jan 2007





Number of implants 2008

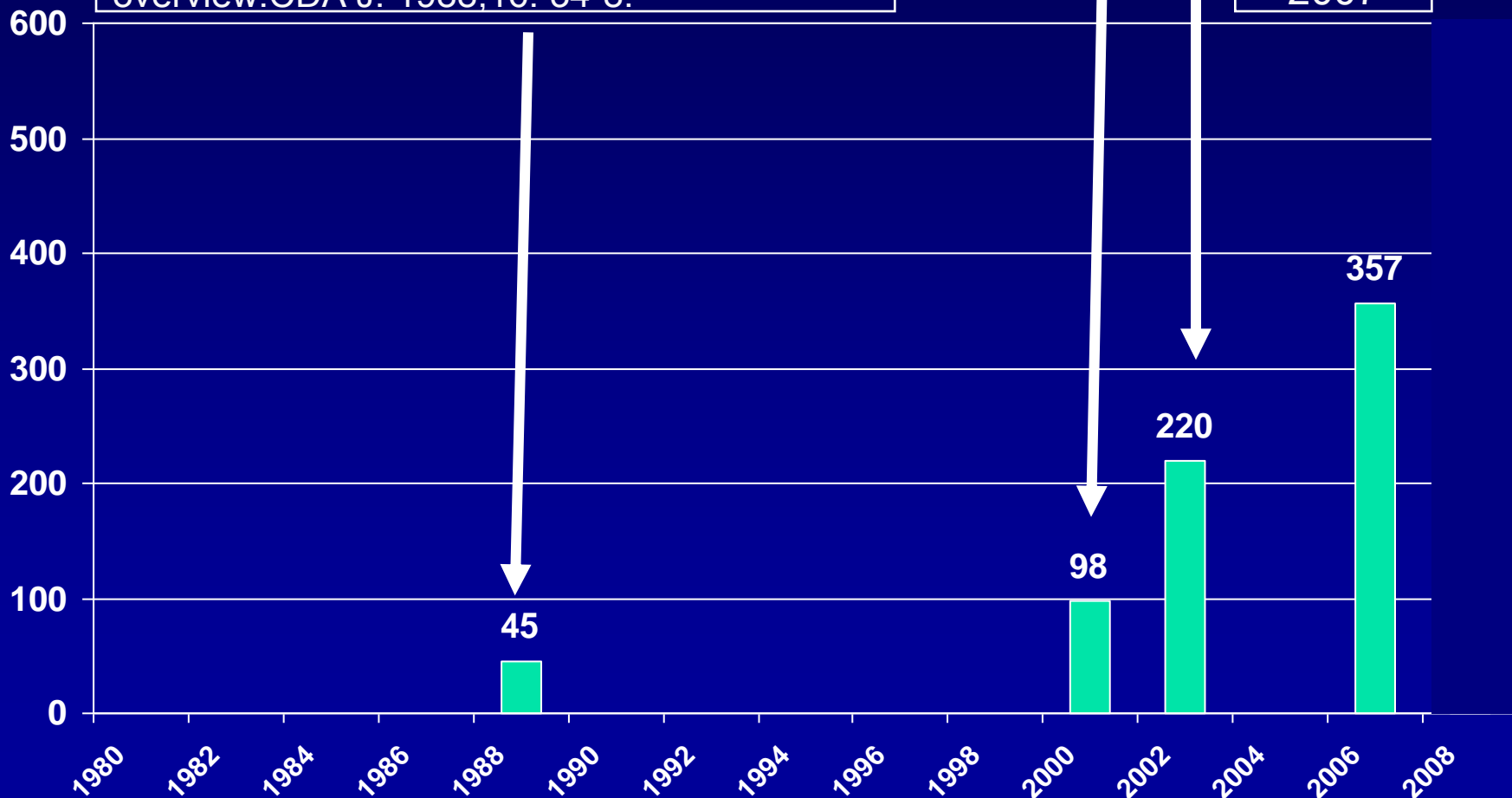
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Binon PP. Implants and components: entering the new millennium. Int J Oral Maxillofac Implants. 2000;15:76-94.

English CE. Implants. Part three. An overview. CDA J. 1988;16: 34-8.

Jan 2007

Jan 2008





Implant Manufacturers

<i>USA:</i>	28
<i>Germany:</i>	25
<i>Italy:</i>	14
<i>Korea:</i>	8
<i>Spain:</i>	8
<i>Brazil:</i>	5
<i>Switzerland :</i>	5
<i>Canada:</i>	4
<i>France:</i>	4
<i>Sweden:</i>	4
<i>Israel:</i>	3
<i>United Kingdom:</i>	3
<i>Other countries:</i>	9



per 2.2007
(n=120)



Implant Manufacturers

<i>USA:</i>	28
<i>Germany:</i>	25
<i>Italy:</i>	14
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<i>Spain:</i>	8
<i>Brazil:</i>	5
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<i>Sweden:</i>	4
<i>Israel:</i>	3
<i>United Kingdom:</i>	3
<i>Other countries:</i>	9

<i>Germany:</i>	32
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<i>Korea:</i>	10
<i>Spain:</i>	10
<i>Brazil:</i>	9
<i>France:</i>	7
<i>Japan</i>	6
<i>Switzerland :</i>	6
<i>Canada:</i>	4
<i>Sweden:</i>	4
<i>Israel:</i>	3
<i>United Kingdom:</i>	3
<i>Other countries:</i>	9



**Feb. 2008?
(n=147!)**

Feb 2007: n=120



**Clinical
documentation of
the new implant
systems?**



Implant systems introduced since October 2003 ?

The screenshot shows the PHI Primary Healing Implant website interface. At the top, there are flags for Italy and the United Kingdom, followed by the PHI logo and the text "Primary Healing Implant™". A "Back" button is visible in the top right corner. Below the logo, there are navigation buttons for "Introducer" and "Instructions". The main content area is divided into two columns. The left column is titled "Products" and lists various dental products: ANALOGUES, BRIMS, CUTTING BLADES, KEYS, BEARS, IMPLANTS, BONE TAPPER, ANHYDROUS, BONE REPAIRS, OVERSTOCKS, SINE RESORTS, INSTRUMENTS, TRANSFER, and SCREWS. The right column is titled "IMPLANTS" and displays a table of implant types with their corresponding codes.

picture	description	code
	RMS implants	VVR
	Smooth titanium implant	VI
	Plasma-sprayed implants	VI
	Gold sanded titanium implant	VO
	Sanded implants	VH



New Implant materials

Willkommen bei Z-Systems

- :: Deutsch
- :: Englisch
- :: Français
- :: Español
- :: Italiano



World's first certified

Dental Zirconiumoxide Implants

Home - Microsoft Internet Explorer provided by Faculty of Dentistry

http://

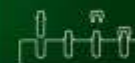


Address http://www.z-systems.co.nz/



World's first certified

Dental Zirconiumoxide Implants



Home

- Research
- Products
- News
- Field cases
- FAQs
- Publications

- Customer
- Contact
- Links

Service Hotline
 Phone: +64(0)9 424 5017
 Fax: +64(0)9 428 3641
 Mobile: +64(0)21 971 5140
 Email: contact@z-systems.co.nz

Username

 Password

 Remember me

Home



Time for a change?
 Metal free dental aesthetics with Z-Systems

Z-Lock ceramic dental implants are revolutionising Europe, and are the only certified ceramic implants available in New Zealand.

[more...](#)



Use existing tools – or go 100% metal-free

You can place Z-Lock ceramic dental implants using most standard implant surgical instruments so set-up costs are minimal. Alternatively you can choose to provide a 100% metal free service using Z-Systems latest technology in ceramic tools.



Certified bio-test

Z-Lock ceramic dental implants have passed all required biocompatibility tests and are certified and approved.

In contrast to titanium, fully ceramic materials have a reduced tendency towards



Cosmetically superior

Can you see white through white?

Z-lock ceramic dental implants have a distinct colour advantage over titanium dental implants which tend to show through the thin buccal gingiva, giving a discoloured

Z-Systems Australasia Limited

Courses

Are you ready for the next generation in implant technology?

[Register](#) today for upcoming courses.

News and Events

New Product - Diamond Bur lot Now Available

Live OP Coating Soon

Abstracts Available for

search...

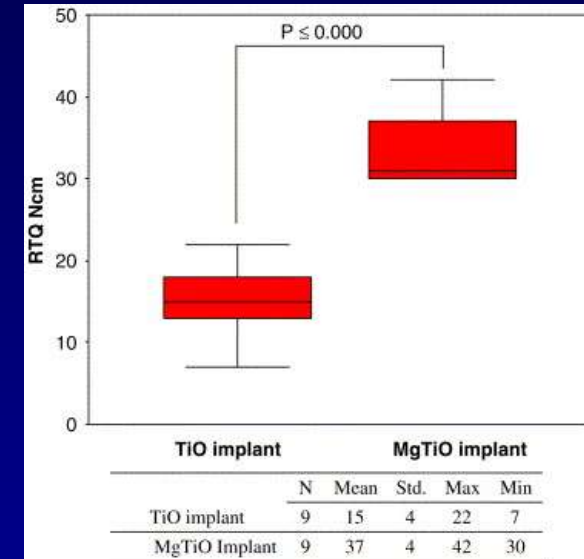


New Implant surface treatment

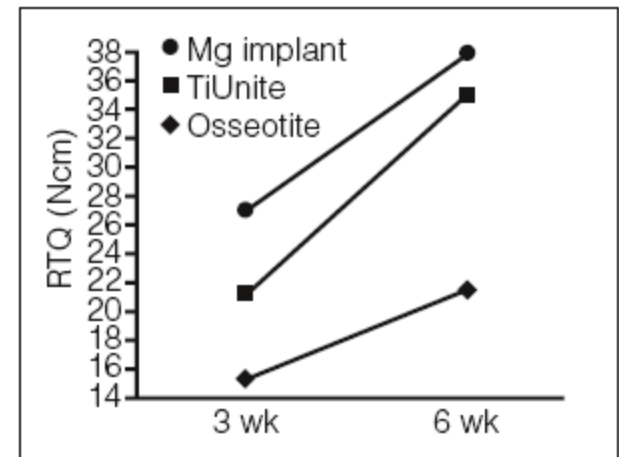
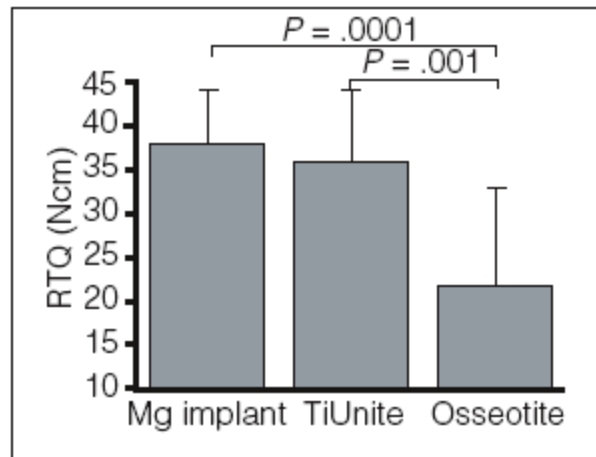
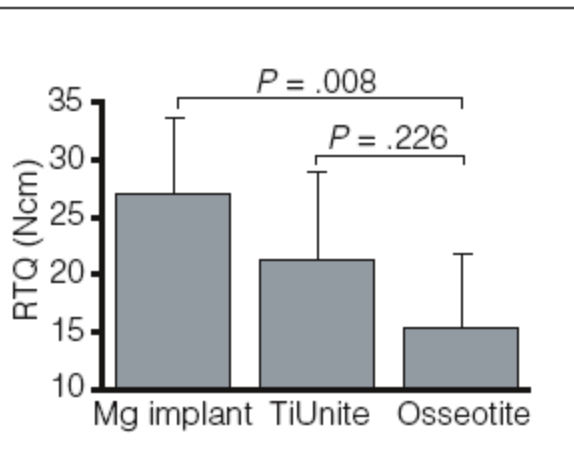
➤ Magnesium ion incorporated, oxidized implants ? Dr Young-Taeg Sul - Korea



Sul YT, et al.
Biomaterials. 2005
Nov;26(33):6720-30

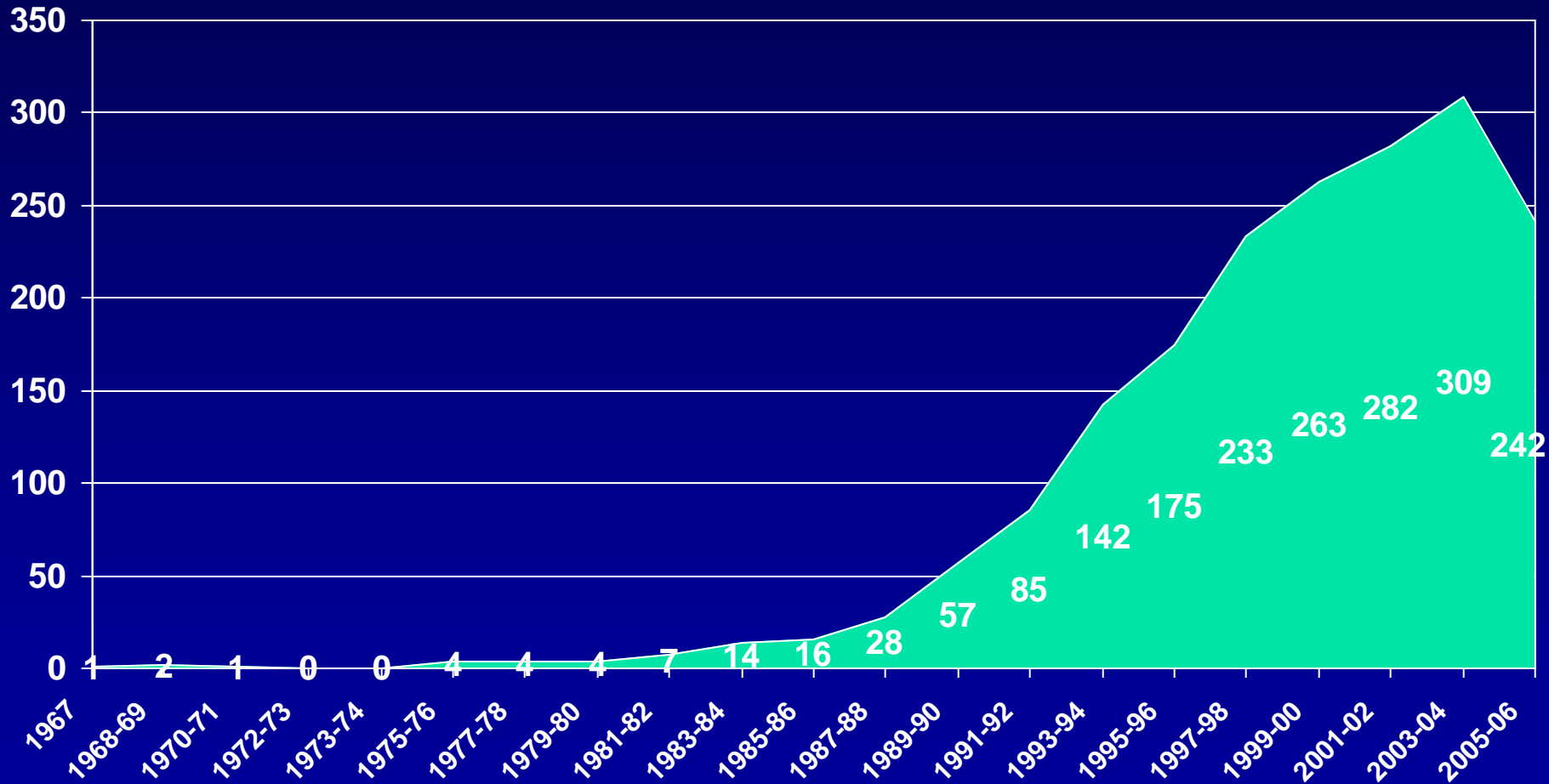


Sul YT, et al. Int J Prosthodont. 2006;19:319-28



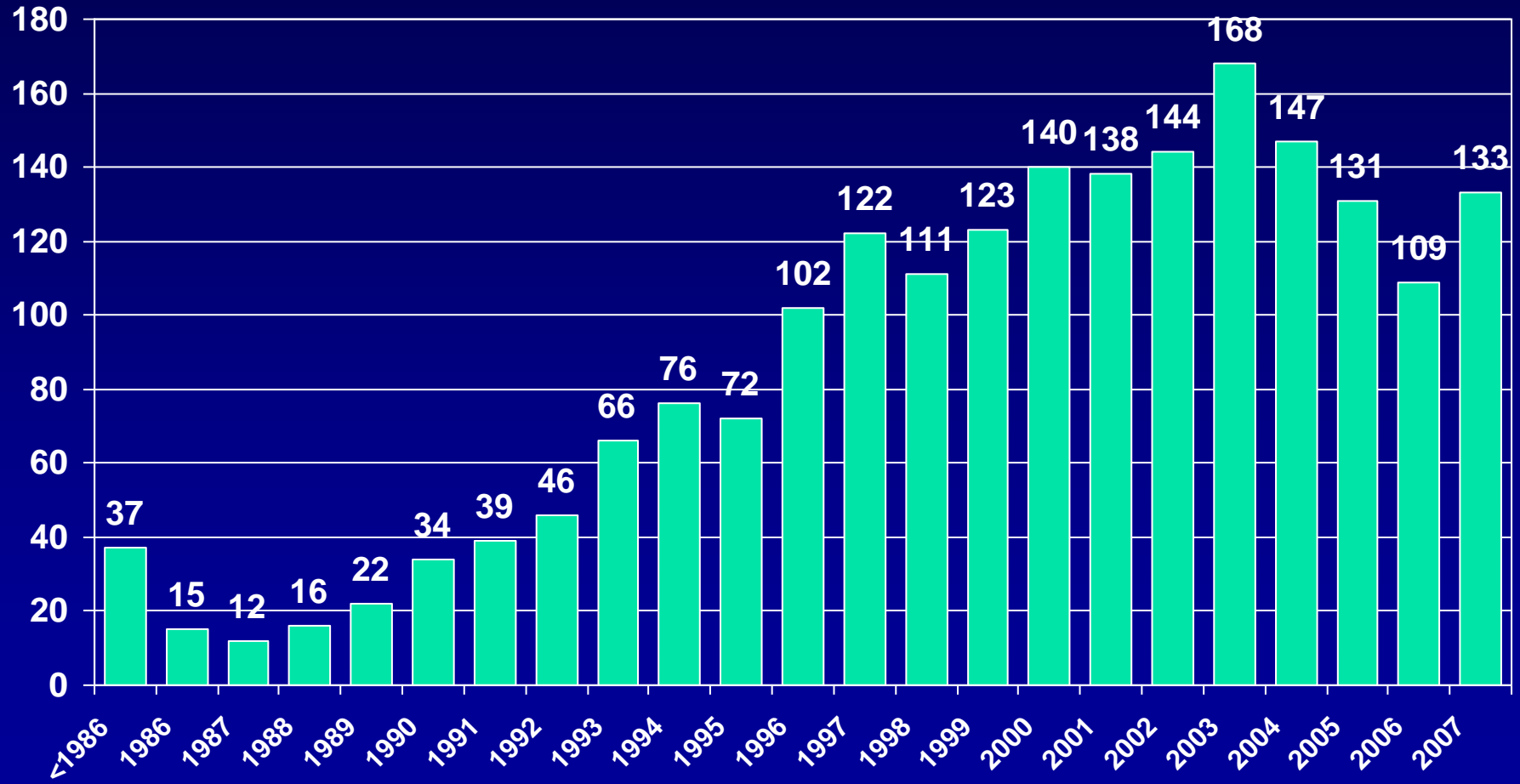


Clinical trials – Dental implants





Clinical trials – Dental implants





Clinical trials – Dental implants

Clinical trials since 2003 = 523

- Brånemark / Replace x8
- ITI /Straumann x4
- 3i/Osseotite x2
- Frialit2/Frialit+/Frialoc/Frios 1
- Astra 1

~75%





www.torontoimplantconference.ca

The Toronto Osseointegration Conference Revisited

25 years since the 1982 Toronto Conference on Osseointegration in Clinical Dentistry

What about the future?

May 8 - 10, 2008
Metro Toronto Convention Centre



Fall
2005



GPs

diagnostics



Medical questionnaire
Consent to obtain more information

Collection, use & disclosure
Consent to use information

Clinical regulations
General consent (for treatment)

Emergency examination chart
Consent for emergency treatment

Medical letter

OD
Chart
audit

(Grad anest) Daily record sheet

(Grad paed)

(oral surg)

(Grad endo)

IPU

(Grad perio)

Undergrad Student

+/- radiographs

+/- report



Master problem

Comprehensive
examination form

Caries
risk

Examination history

Diet

(Gen) Daily record sheet

Referral form

Pros. Consult

Prosthodontics
Graduate / staff

IPU-surgeon

Spring
2006



GPs

diagnostics



Medical questionnaire
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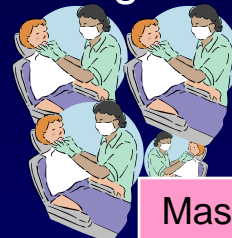
IPU

(Grad perio)

Undergrad Student

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+/- report



Master problem

Comprehensive
examination form

Examination history

Caries
risk

Diet

(Gen) Daily record sheet

Improved Referral form

Pros. Consult

Prosthodontics
Graduate / staff

IPU-surgeon



Fall 2006



GPs

diagnostics



Medical questionnaire
Consent to obtain more information

Collection, use & disclosure
Consent to use information

Clinical regulations
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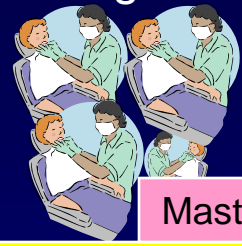
IPU

(Grad perio)

Undergrad Student

+/- radiographs

+/- report



Master problem

Comprehensive examination form

Caries risk

Examination history

Diet

(Gen) Daily record sheet

Pros. Consult

all other

2 implants / student
Uncomplicated
Single crowns
or
mand. ball-overdenture

Improved Referral form

Pros. Consult

Graduate Prosthodontics /staff

IPU-surgeon



Journal of Dental Education 2006: 70: 580-588

Association Report

Teaching Implant Dentistry in the Predoctoral Curriculum: A Report from the ADEA Implant Workshop's Survey of Deans

Vicki C. Petropoulos, D.M.D., M.S.; Nancy S. Arbree, D.D.S., M.S.; Dennis Tarnow, D.D.S.; Michael Rethman, D.D.S., M.S.; Jay Malmquist, D.M.D.; Richard Valachovic, D.M.D., M.P.H.; W. David Brunson, D.D.S.; Michael C. Alfano, D.M.D., Ph.D.

Abstract: In 2004, a survey of the deans of U.S. and Canadian dental schools was conducted to determine the implant dentistry curriculum structure and the extent of incorporating implant dentistry clinical treatment into predoctoral programs. The questionnaire was mailed to the deans of the fifty-six dental schools in advance of the ADEA Implant Workshop conference held in Arizona in November 2004. Out of the fifty-six, thirty-nine responded, yielding a response rate of 70 percent.



Conclusions –predoctoral students

Single-tooth implant restorations & implant-retained overdenture prostheses are performed in most schools

There is no clinical competency requirement for surgical implant placement in all schools and implant prosthodontics in most schools

Prosthodontic specialty faculty are often responsible for teaching implant prosthodontics

Periodontics and oral and maxillofacial faculty are commonly responsible for teaching implant surgery

Support from implant companies is common, with most providing for implant components at discounted costs

There is a lack of adequately trained faculty in implant dentistry, which is a significant challenge in providing predoctoral students with clinical experience with dental implants.



Types of implant-related procedures restored by predoctoral students

Answer	Number of Responding Schools (%)
Single tooth molar	27 (90%)
Single tooth bicuspid	26 (87%)
Implant overdenture with two implants and ball or stud attachment	25 (83%)
Single tooth anterior	18 (60%)
Simple 2-3-4 unit free-standing fixed partial denture	10 (33%)
Implant overdenture with two implants and a bar attachment	5 (17%)
No limit	1 (3%)
Other*	

*"Other" answers given:

- Assessed on a case-by-case basis for complexity.
- We are at the very beginning of a new clinical education program. Many answers reflect what we plan to do but have not reached the point yet of doing.
- No full mouth rehab, but do fixed-detachable mandibular prosthesis.
- Many times two implants will be placed in the posterior region of the mouth. These implants are typically restored as single crowns although occasionally they are splinted together.
- Simple two-unit free-standing fixed partial denture.
- We practically have no limits. The reason we can provide this type of experience is in part due to our surgical support from perio and oral surgery as well as the time that I invest with the students to guide them through the experience. My only specific restrictions are cases that we prefer to be under the supervision of grad prosthodontics, such as: immediate loading, fixed detachable, complex implant supported bar overdenture prostheses, and other full-mouth rehabilitations.



Types of implant-related procedures restored by predoctoral students

Table 3. Types of cases for implant placement (percentages are based on the nine schools that responded to this question)

Answer	Number of Responding Schools (%)
Missing bicuspid	8 (89%)
Missing molar	7 (78%)
Fully edentulous mandible	7 (78%)
Partially edentulous mandible	4 (44%)
Missing anterior tooth	3 (33%)
Partially edentulous maxilla	3 (33%)
Fully edentulous maxilla	1 (11%)
Other (specify)	
No limits	

Comments given:

- One-on-one faculty supervision at placement time.
- We do not *require* surgical experience with patients.



Table 4. Faculty teaching implant prosthodontics

Answer	Number of Responding Schools Out of 35 (%)
Prosthodontic faculty	33 (94%)
General dental faculty	13 (37%)
Other (specify)*	4 (11%)

**"Other" answers:

- Director of implantology: restorative dentist and director, division of operative dentistry
- Oral surgery faculty and residents, periodontal faculty, prosthodontic residents
- Implantology faculty
- Implant center faculty (prosthodontists)

Table 5. Faculty who teach implant surgery to predoctoral students

Answer	Number of Responding Schools (%)
Periodontics faculty	27 (77%)
Oral and maxillofacial faculty	25 (71%)
Prosthodontic faculty	7 (20%)
General dentistry faculty	4 (11%)
Other*	5 (11%)

**"Other" answers:

- Implant Center faculty
- Implant Center faculty surgeons

Table 6. Implant prosthodontic fee schedule

Answer	Number of Responding Schools (%)
Same as crown or denture with separate abutment fee	14 (41%)
Higher than crown or denture	9 (26%)
Other	8 (23%)
Same as crown or denture	5 (14%)
Not applicable	2 (6%)
Other (specify)*	

**"Other" answers:

- Implant is higher than a crown but fee includes surgery. Denture has separate abutment fee.
- Predoctoral fee schedule for implants is under the University Development Program, which provides special reduced fees, i.e., a single implant crown (including surgical and prosthodontic fees) is ~equivalent to the cost of a three unit FPD in the student clinic.
- Structured to be similar to crown fee so that this could be a viable option for patients who have the choice.
- For the overdentures, we charge as a package (placement of the two implants, two abutments, and the two dentures).
- We charge the standard rate for the prosthesis and an additional \$200 for the implant service regardless of the number of implants used.
- Student fee: implant and crown equals 3 unit FPD at student rate.
- Separate fee for implant placement and abutment installation.
- The actual fee for the crown or the denture is the same. Obviously, there is the additional fee of the workup, surgical template, tomo or CT, and abutment (and any necessary bone grafting procedures).



Student Information

UNDERGRADUATE IMPLANT MANUAL

Discipline of Prosthodontics

Faculty of Dentistry
University of Toronto

2007



INDEX

	Page
DEFINITIONS.....	6
PRE-SURGICAL CONSIDERATIONS	
Assessment Criteria for Selection Sites for Implant-Supported Prosthesis.....	7
Assessment of Edentulous Mandibles for Implant-Supported Complete Lower Dentures (S-CLAD).....	8
Assessment of Partially Edentulous Patients for Single-Tooth Implants.....	19
Patient History Sheet for Undergraduate Use.....	22
POST-SURGICAL CONSIDERATIONS	
Implant-Supported Complete Lower Dentures Components Used in the Fabrication of an Implant-Supported Complete Lower Denture (S-CLAD).....	27
The Impact of Design of the Fabrication of an Implant-Supported Complete Lower Denture (S-CLAD) With Ball Abutments.....	34
The Effect Evaluation of Modifying a Conventional Complete Lower Denture into an Implant-Supported Complete Lower Denture (S-CLAD) With Ball Abutments.....	37
Implant-Supported Single-Tooth Crowns Components Used in the Fabrication of Implant-Supported Crowns and Fixed Partial Dentures.....	38
Distal-Level Impression Techniques I (Distal-Spec Tray) for Implant-Supported Single-Tooth Crowns or Fixed Partial Dentures.....	37
Distal-Level Impression Techniques II (Distal-Spec Tray) for Implant-Supported Single-Tooth Crowns or Fixed Partial Dentures.....	38
Abutment-Level Impression Techniques for Implant-Supported Single-Tooth Crowns or Fixed Partial Dentures.....	39

Definitions (Discipline of Prosthodontics Terms - R. J. Prosthodontics Society 2007)

Abutment, dental (implant)	The portion of a dental implant that serves to support another crown or fixed or removable dental prosthesis. Implants designed to support dental implants, especially those used with traditional dental implants, are changed to other abutment design or use before a definitive dental prosthesis is fabricated. Each a preliminary abutment is tested on a crown or bridge at hand. The abutment chosen to support the definitive prosthesis is termed a definitive abutment. Conical implant abutments (implants) are described by their form (e.g., cylindrical (Fig. A), ball (Fig. B), bevel, conical (e.g., conical abutment, circumferential crown), or special design factors (e.g., internal ball lock, internal ball lock, ball, ball).
Abutment level impression	A complete crown or tray at coronal or occlusal of an implant made at the height of the abutment above directly using conventional crown and bridge techniques, or indirectly using an abutment impression mold.
Abutment level impression	Removes the abutment to the implant crown, usually followed by a change to 37 mm.
Abutment type impression	A replica of a portion of an implant abutment made of wax, stainless steel, or plastic.
	A. Full crown and abutment B. Abutment and abutment C. Full abutment and abutment



Undergraduate implant Manual

Student Kits



Student Information

Faculty of Dentistry
University of Toronto

Prosthodontics

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Imagery Staff: Dr. Gerald Baker, Dr. Peter Brook, Dr. Catherine Chiles, Dr. Esther David, Dr. Albert Hershkov

General Information

Faculty of Dentistry
University of Toronto

September 2007

Implant Prosthodontics in the undergraduate clinics

Faculty of Dentistry
University of Toronto

Treatment Plan (Case # 0202)

Patient Name: CC, TP Implants, Implantation Date Approved: 14 June 2007

Item	Qty	Description	Unit	Material	Supplier
1	1	Implant	1	ITI	ITI
2	1	Implant	1	ITI	ITI
3	1	Implant	1	ITI	ITI
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100	1	Implant	1	ITI	ITI

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University of Toronto

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Prosthodontics

The following documentation package has been prepared to provide you with the guidelines for providing your patient with implant-supported prosthesis.

General information to patients and undergraduate students: 3

Patient information about implant-supported overdenture in the lower jaw: 4

Patient information about implant-supported single crowns: 5

Sample form, request for radiographs: 11

Sample form, overdenture mandible: 22

Sample form, single tooth mandible and maxilla: 23

Checklist, treatment progress for implant prosthesis: 34

Consent form for implant surgery: 35

Postoperative instructions following implant surgery: 36

Form for the Nobel Biocare "Implant Tracker Database": 37

Instructions for patients who will be receiving oral radiation: 38

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- Patients requiring other types of implant supported prosthesis can be referred to Graduate Prosthodontics. The Dental Faculty Internal Referral Form must be used before the patient visit.
- The fee is substantially higher.
- The waiting time for consultation or receiving for patients is 1-2 weeks.
- The waiting time for treatment begins at approximately 3-4 weeks after consultation. This time will be longer if there is a need for surgical imaging studies such as tomography, or a need to examine existing pathology of adjacent teeth or soft tissue.
- Overall treatment time is about 7-8 months. This depends on the work being treated - multiple or single mandible or maxilla.

Cost estimates (Implantina)

Implant Prosthodontics in the undergraduate clinics