New discoveries in *osseointegration* on the surface of the dental implant

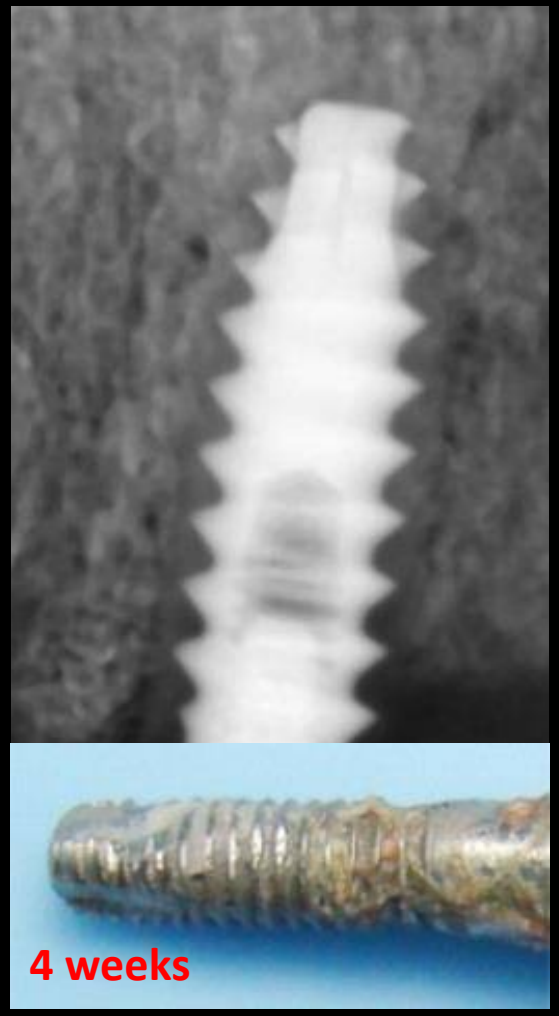
Dr. Alejandro Aguilar
Rpoberto Benito Palma , M in C

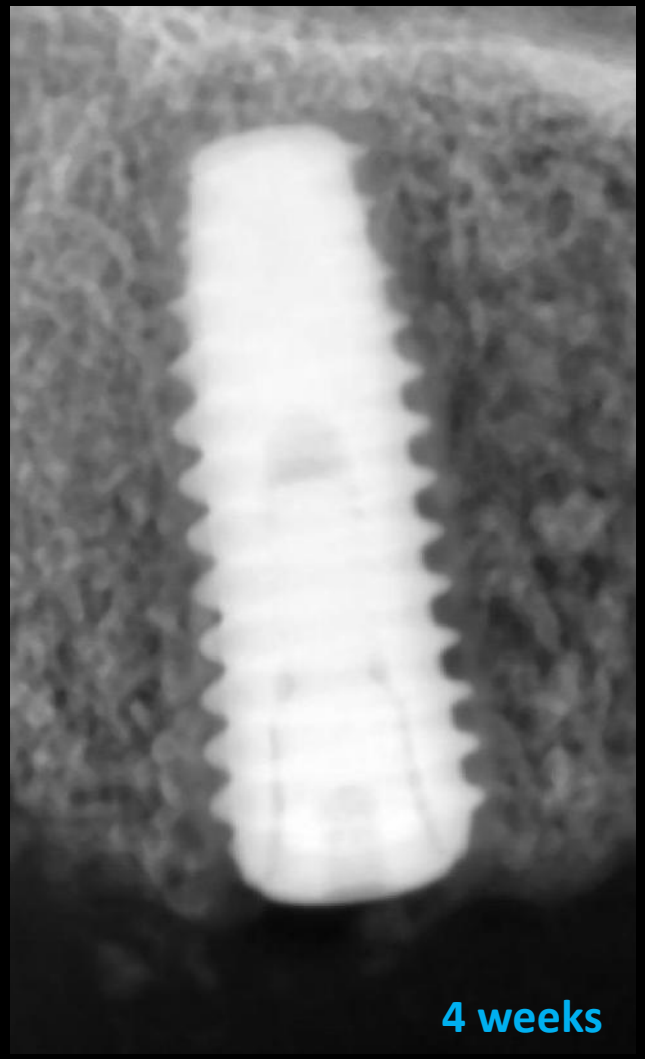
Comparative study of the osseointagration of six brands of dental implants during the first four weeks

Dr. Alejandro Aguilar

Why ?

The nemesis of our daily practice



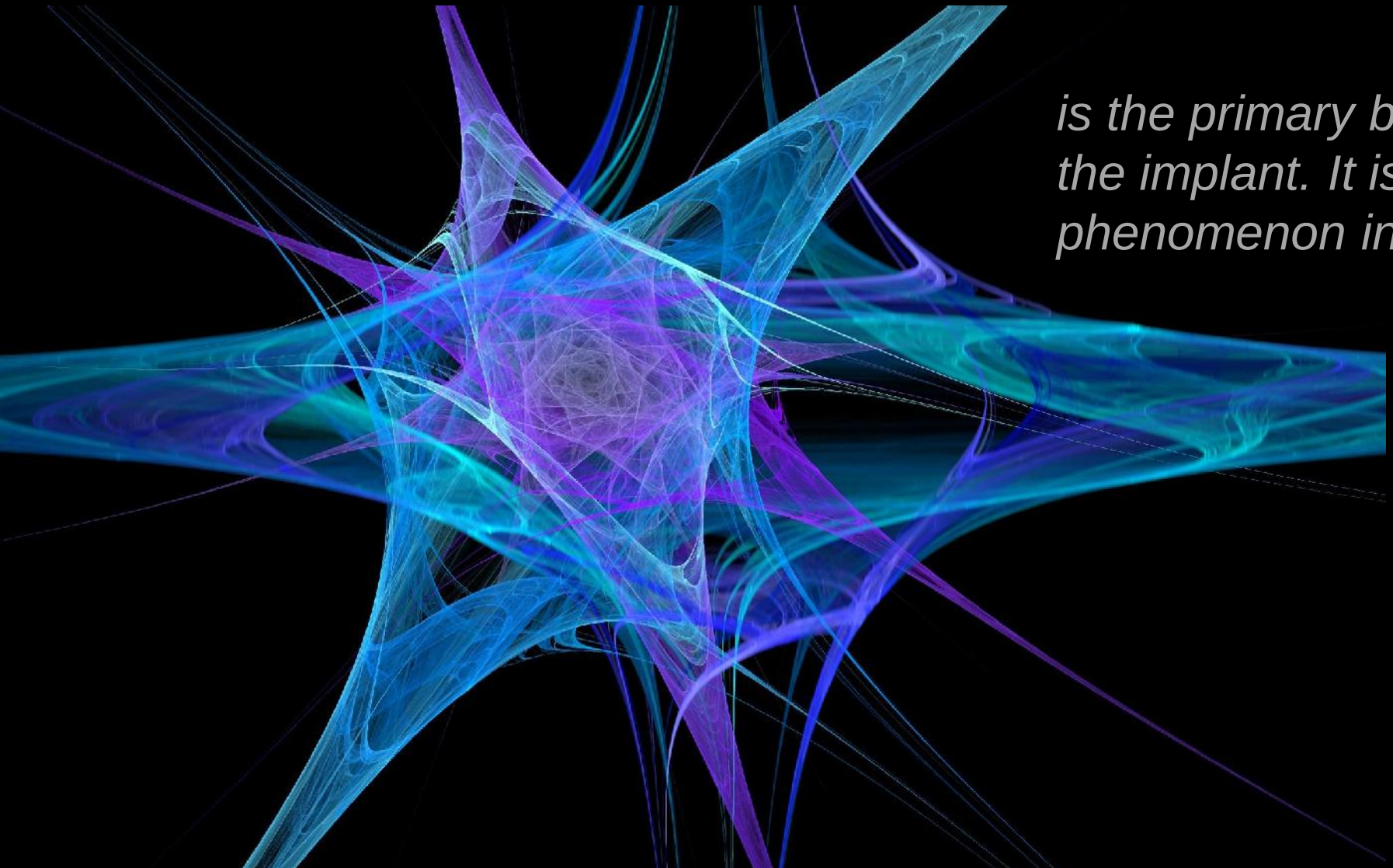


The *two* most important factors in bone formation in implantology

Osseointegration

Architecture of the bone matrix

Osseointegration



is the primary basis for the success of the implant. It is the most important phenomenon in implantology.

MC Roberto B Palma.
Comparative study of the osseointegration of six Brands of dental implants during the first four weeks 2013-2014 Research and Education Center Mexico City

Architecture of the bone matrix

It is the scaffold form that allows the bone to withstand the forces exerted by the implant during its function.

Dr. Alejandro Aguilar
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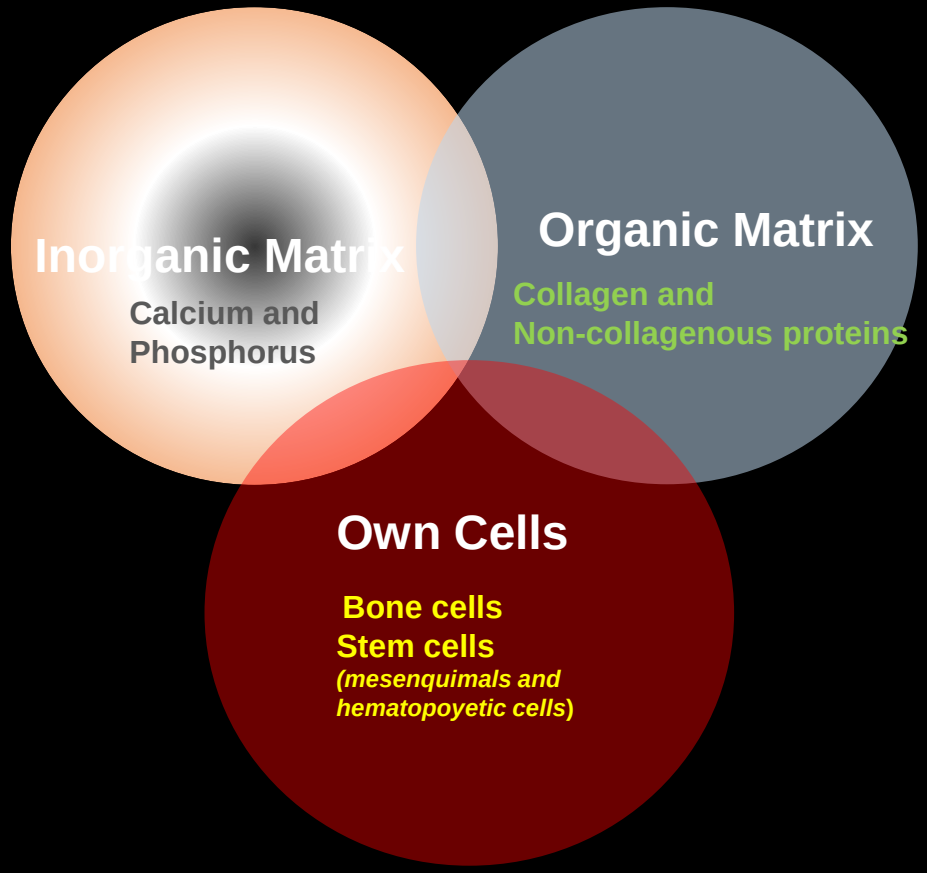
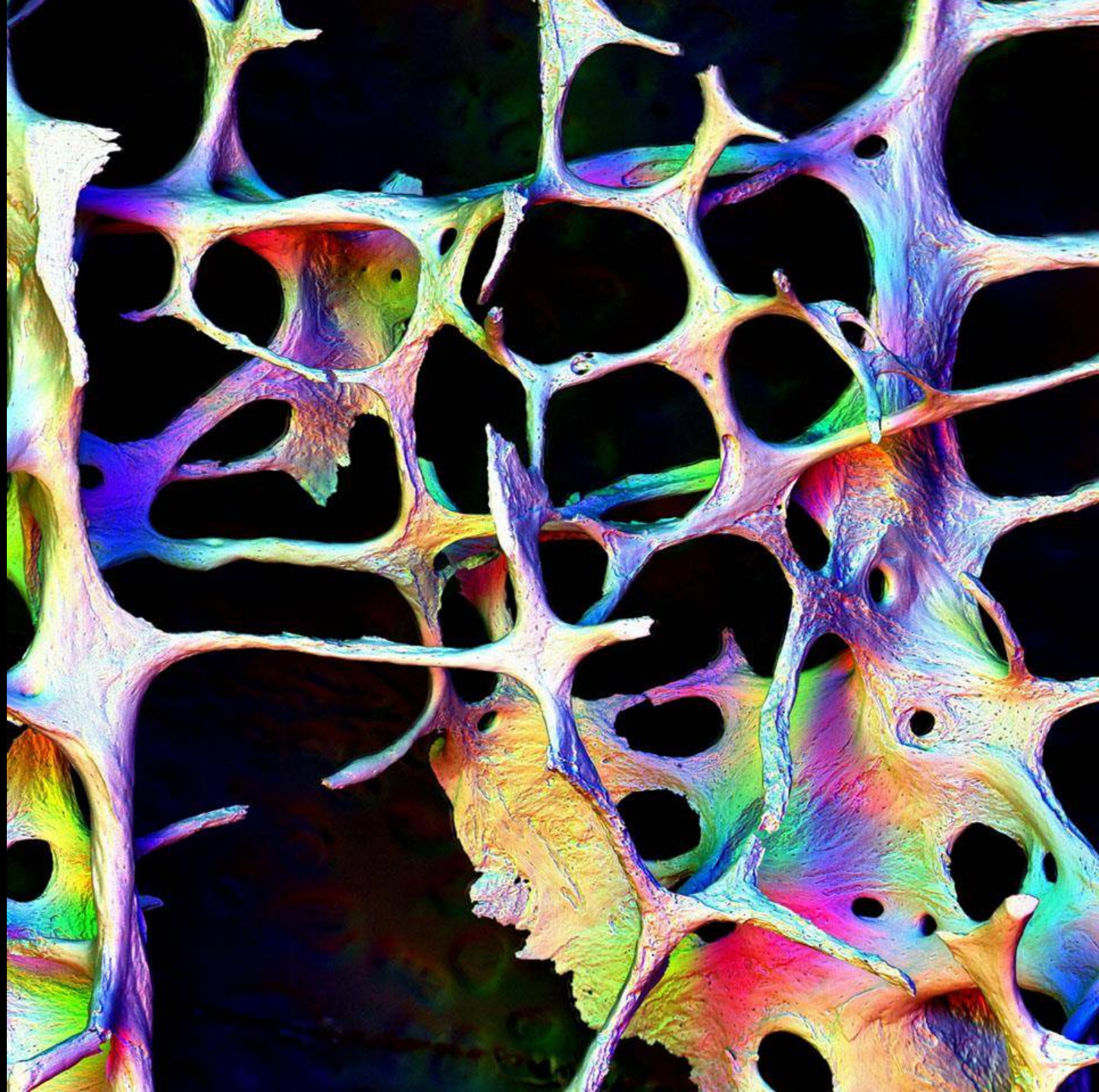
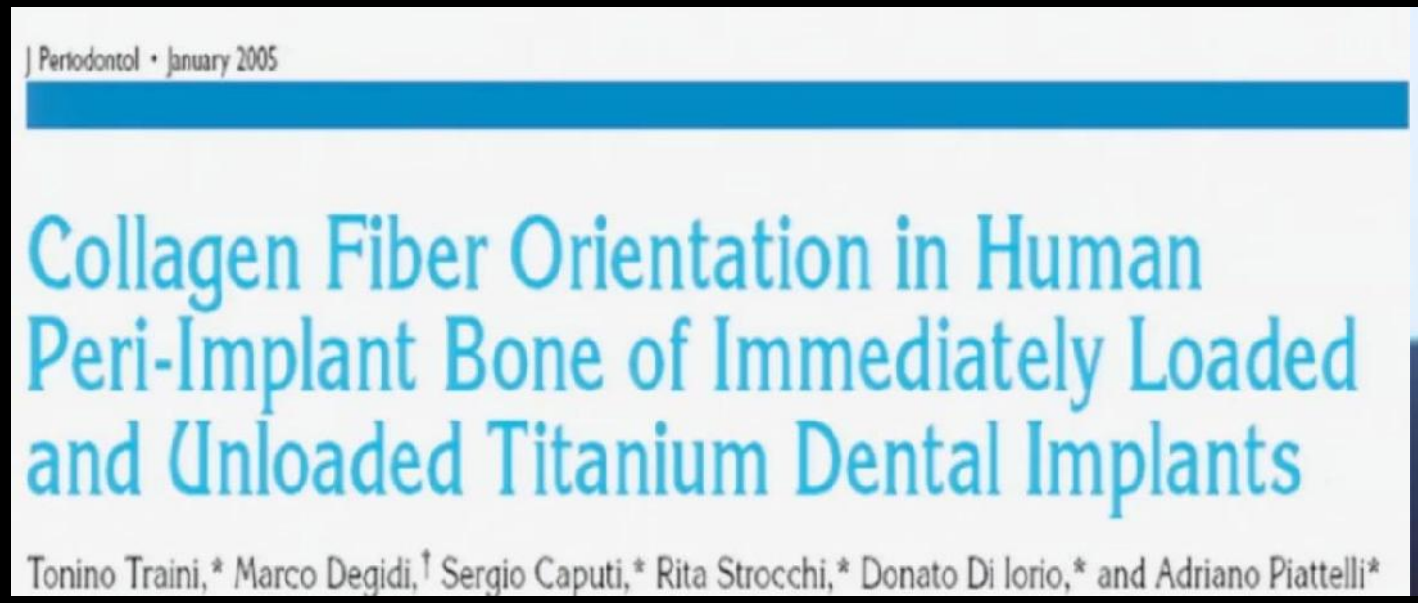
Architecture of the bone matrix





Architecture of
the bone matrix

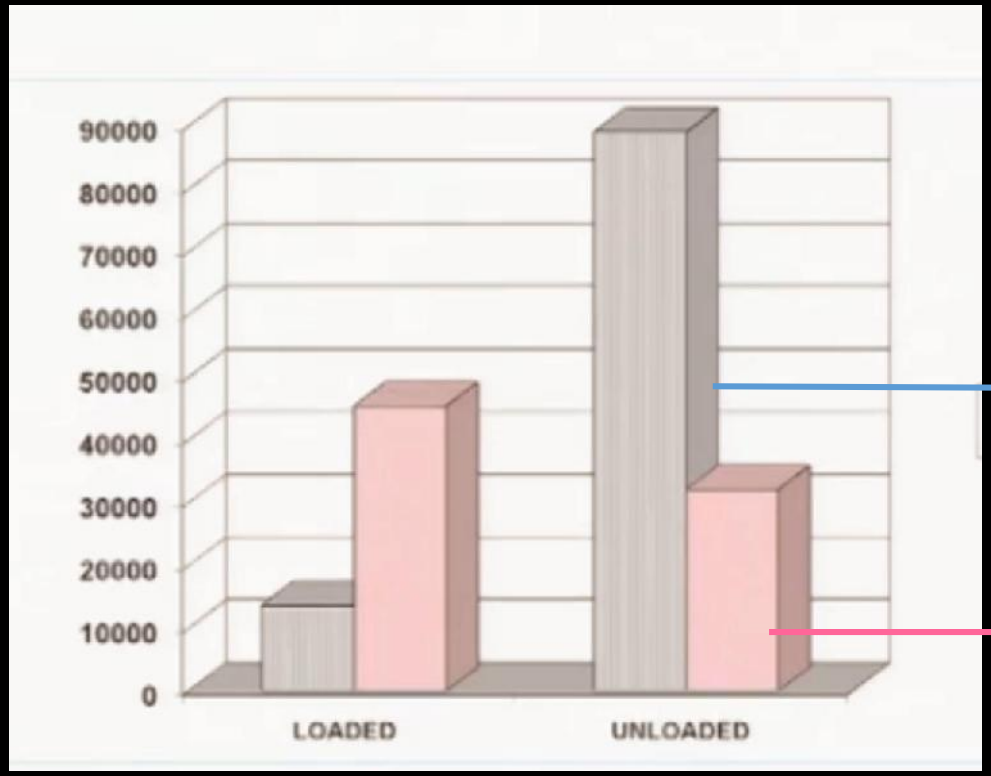
IS PERI-IMPLANT BONE MATRIX ORGANIZATION IMPORTANT IN THE *SURVIVAL AND STABILITY* OF THE DENTAL IMPLANT ?

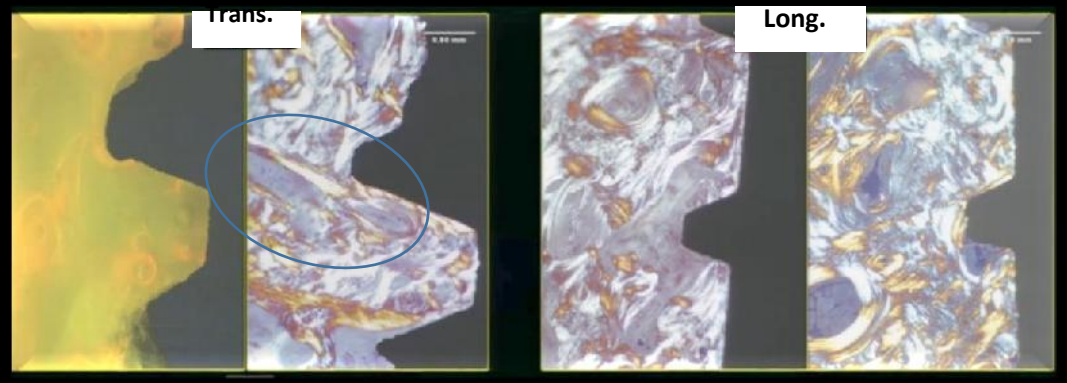

J Periodontol • January 2005

Collagen Fiber Orientation in Human Peri-Implant Bone of Immediately Loaded and Unloaded Titanium Dental Implants

Tonino Traini,* Marco Degidi,† Sergio Caputi,* Rita Strocchi,* Donato Di Iorio,* and Adriano Piattelli*

YES!



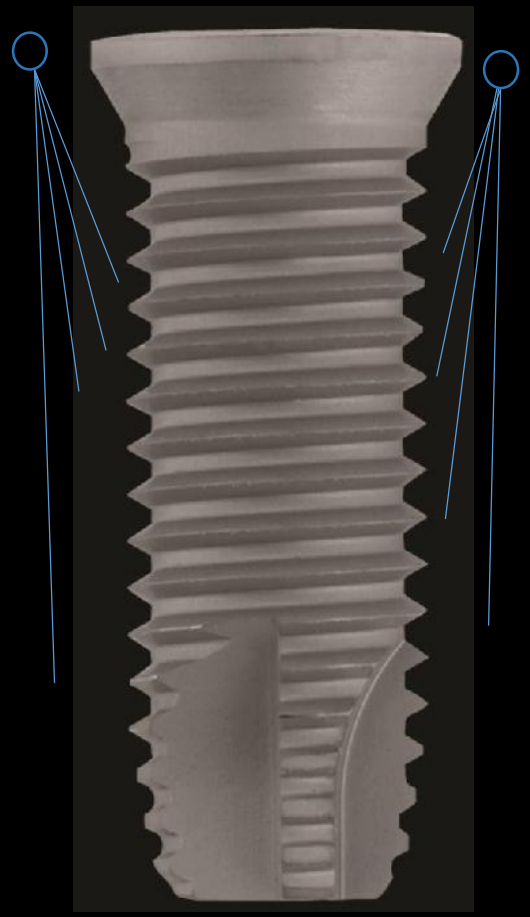


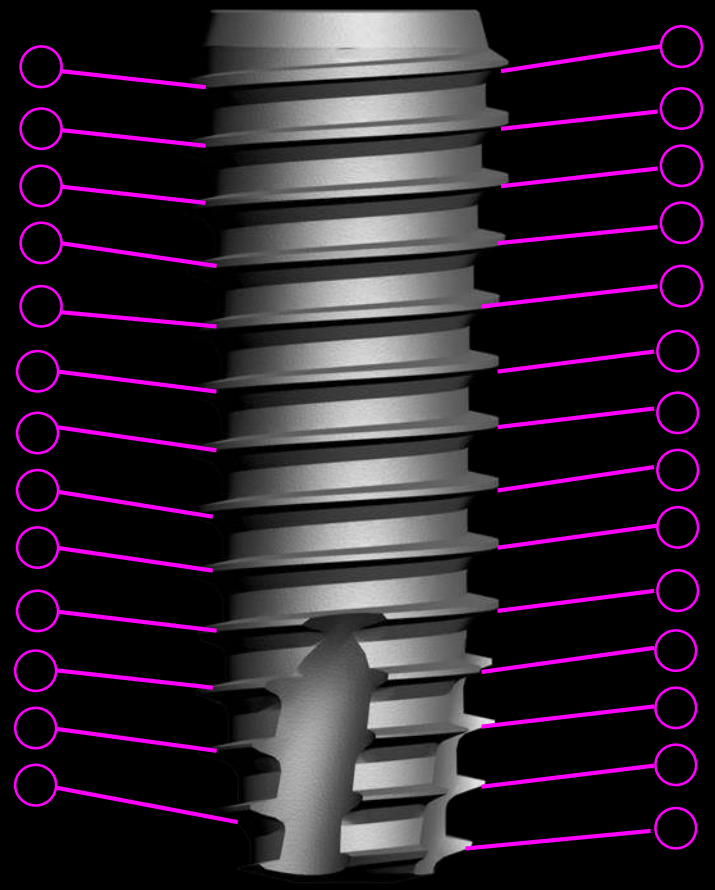
Longitudinal
collagen fibres

Transverse
collagen fibres

Prof. Adriano Piatelli
Universita "G. Dannunzio"
Chiei-Pescara

Physical and mechanical effect of the orientation of the fibers

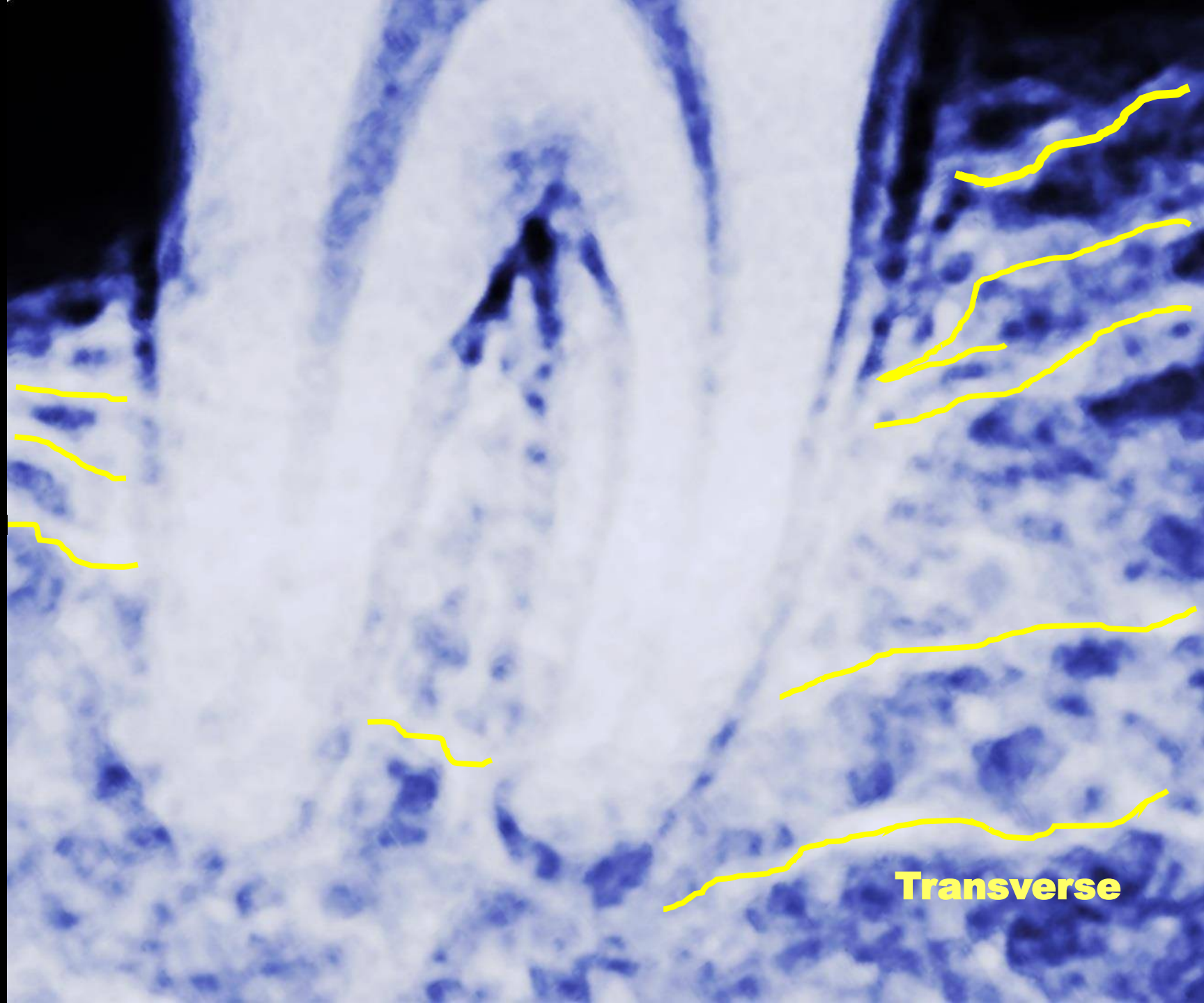




Alejandro Aguilar, DDS,CD
2015

Architecture of
the bone matrix

5,000,000 years of nature's wisdom



Dr. Alejandro Aguilar
Comparative study of the osseointegration of six Brands of dental implants during the first four weeks 2013-2014 Research and Education Center Mexico City

Osseointegration

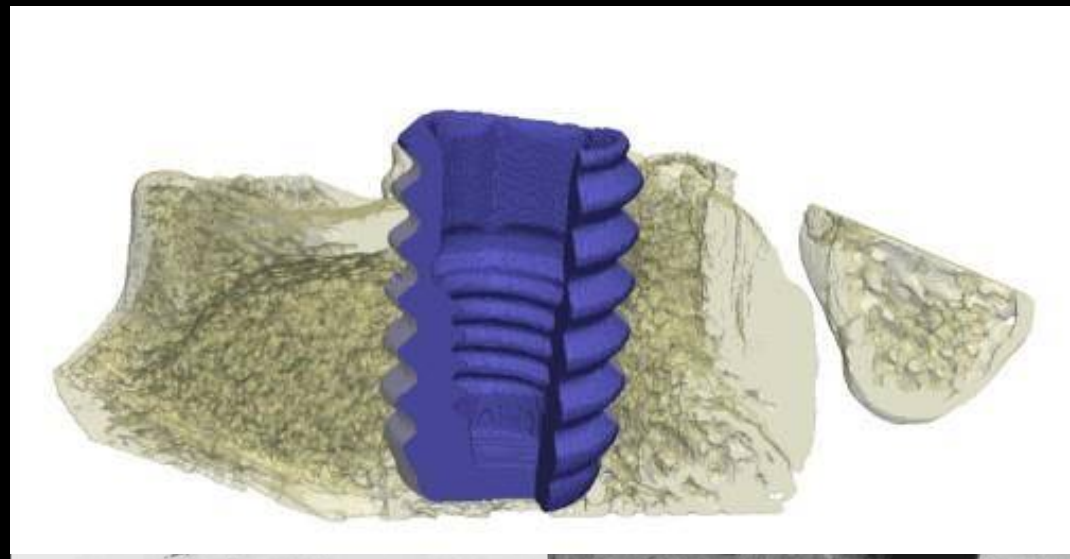
Focus on the understanding of this process allows us a quick and in some cases immediate rehabilitation.

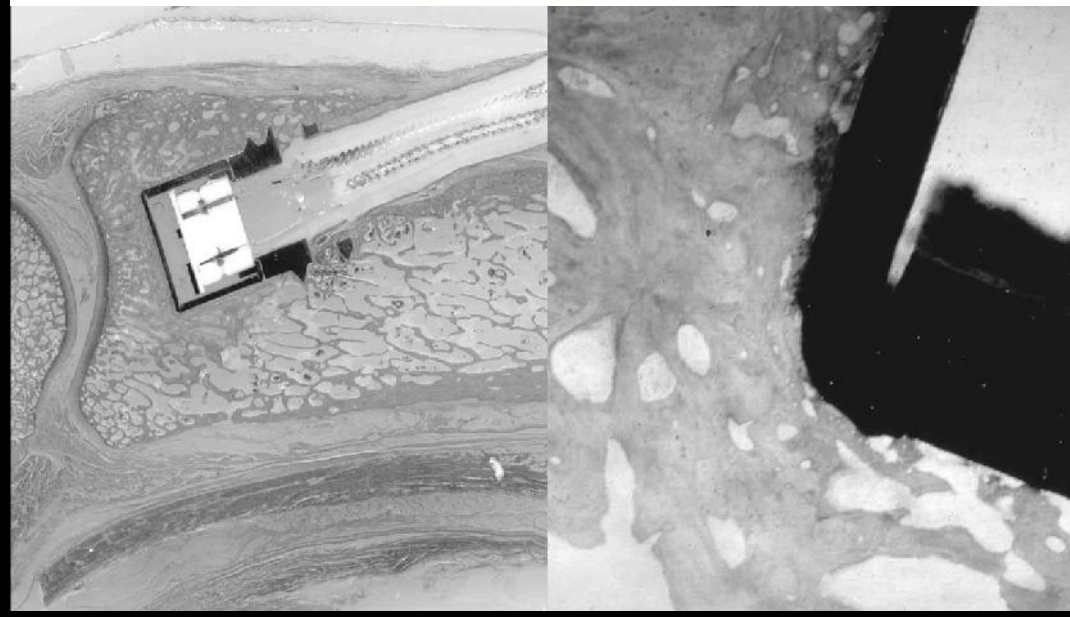
Venegas Acosta JC; Garzon Alvarado D.; Casale Martin
Osteoblastos y superficies de titanio
Revista Cubana de investigaciones Biomedicas
2010; 29(1)51-68

Osseointegration

The term ***osseointegration*** is often defined as an internal and stable relation between the anchoring of the implant and formation of bone tissue ***without the growth of fibrous tissue on the bone-implant surface.***

This implies that the osteoblast and the mineralized matrix are in contact with the surface, even when oclussal loads are applied.





Osseointegration

How does this phenomenon come about?

common in the bone repair process

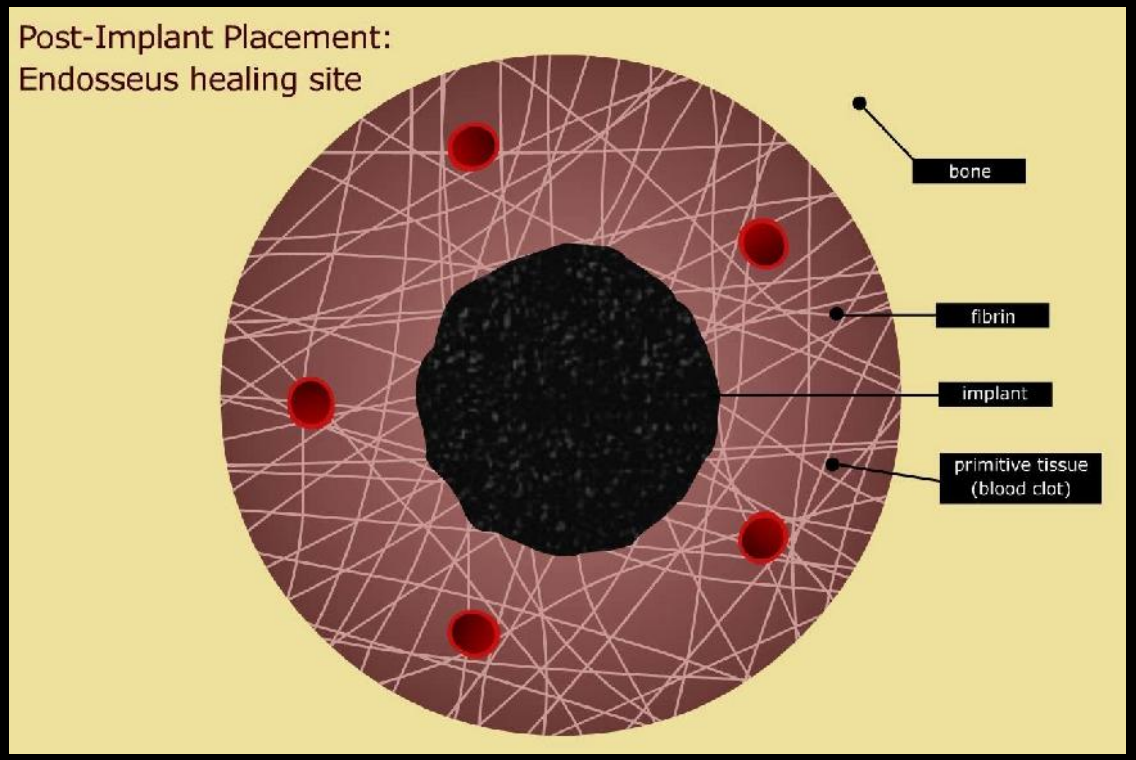
Osteoconduction: refers to the growth of the bone on a surface ***(bone implants).***

A titanium oxide surface promotes the deposition of bilogical molecules that enable the existence of bone near the implant surface.

Davis JE, Understending peri-implant endosseous healing
Journal of Dental Education
2003; 67(8): 932-949

Osseointegration

- **Distance Osteogenesis**

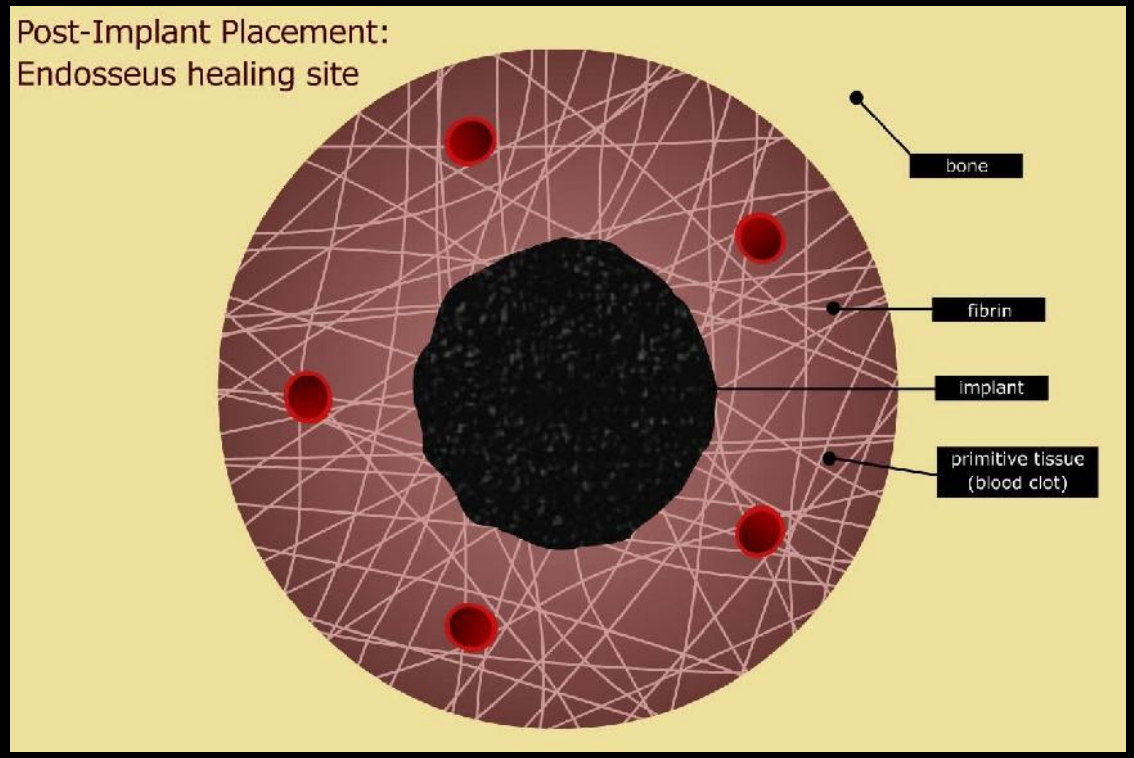


Davis JE, Understending peri-implant endosseous healing
Journal of Dental Education
2003; 67(8): 932-949

Mechanisms in Medicine INC. 2005

Osseointegration

- **Contact Osteogenesis**

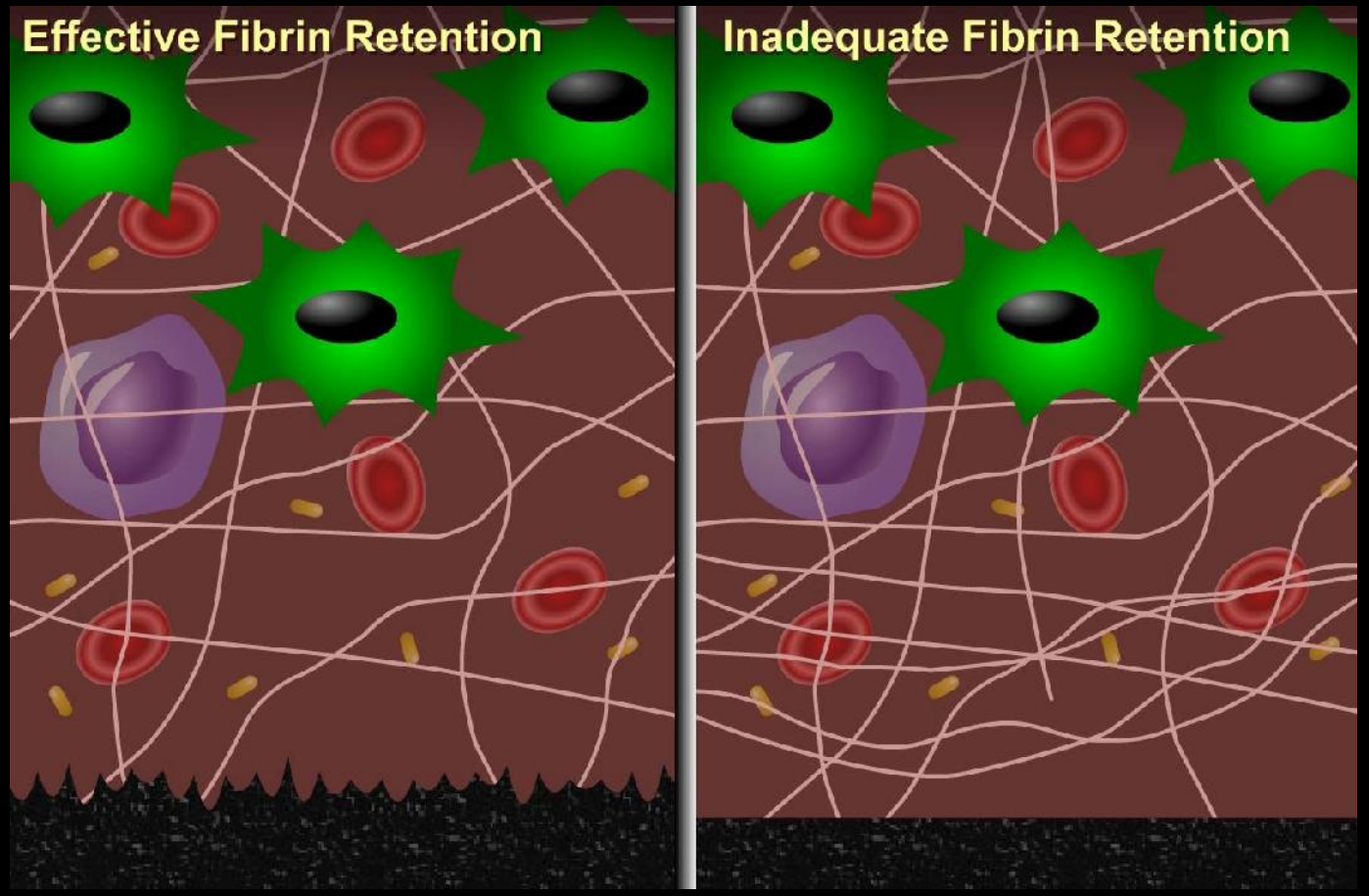


Davis JE, Understending peri-implant endosseous healing Journal of Dental Education 2003; 67(8): 932-949

Mechanisms in Medicine INC. 2005

Osseointegration

- **Fibrin Retention**

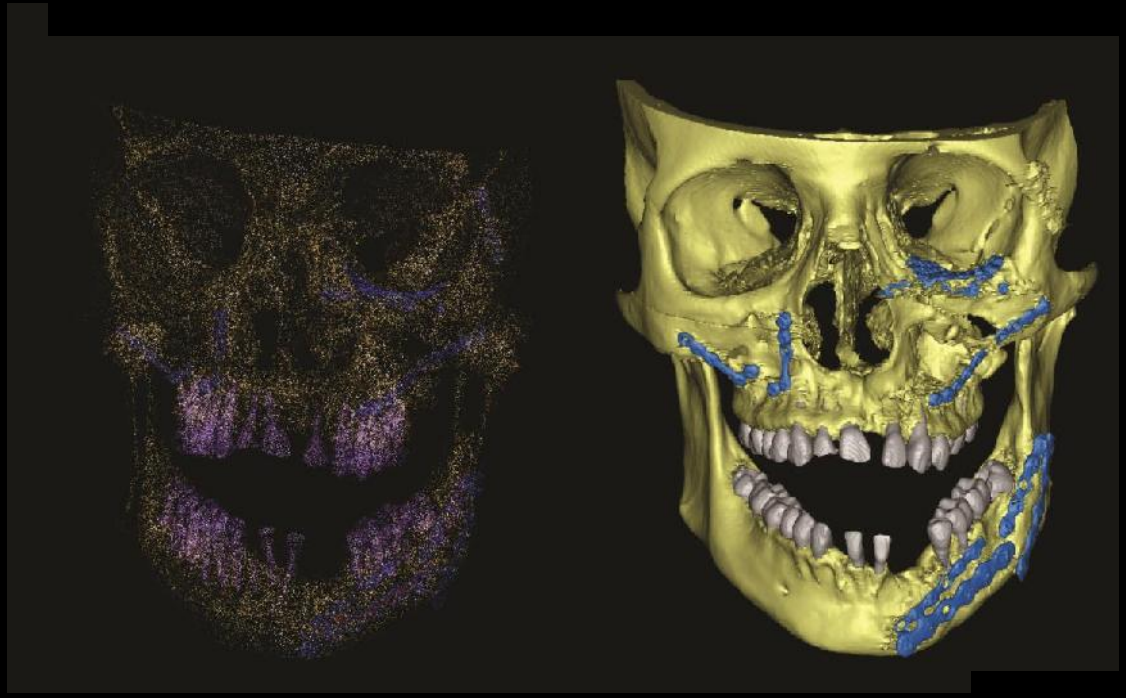


Davis JE, Understending peri-implant endosseous healing Journal of Dental Education 2003; 67(8): 932-949

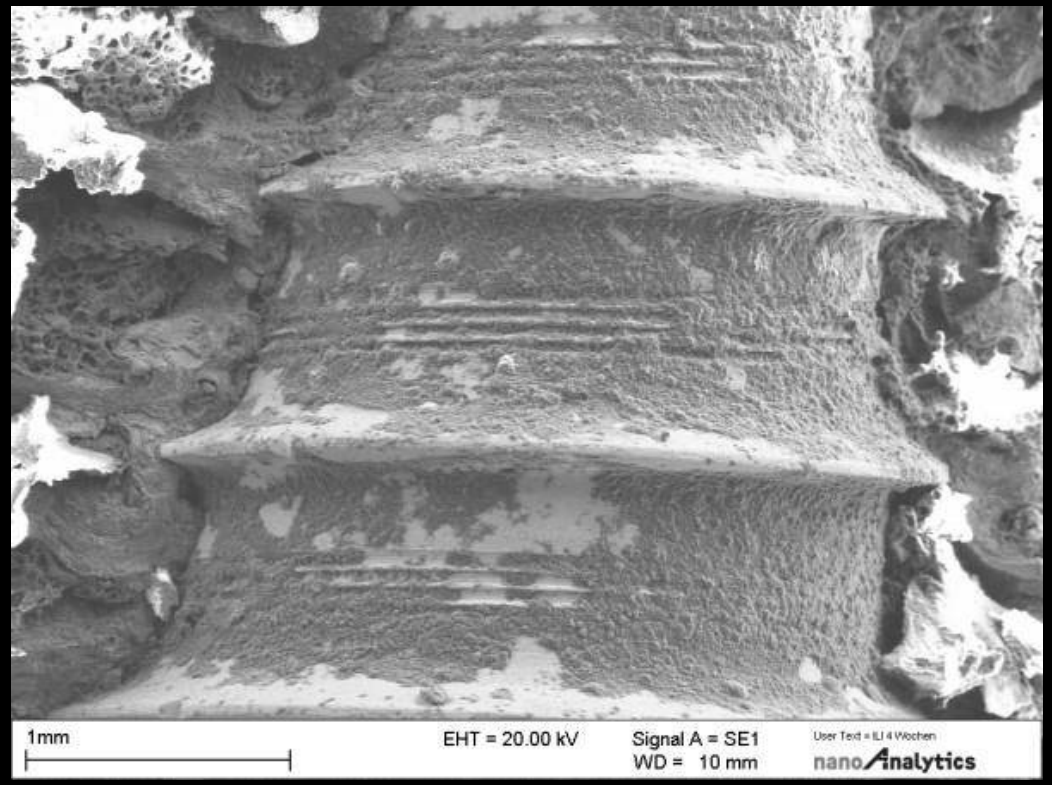
Mechanisms in Medicine INC. 2005

Osseointegration

And the process is completed.



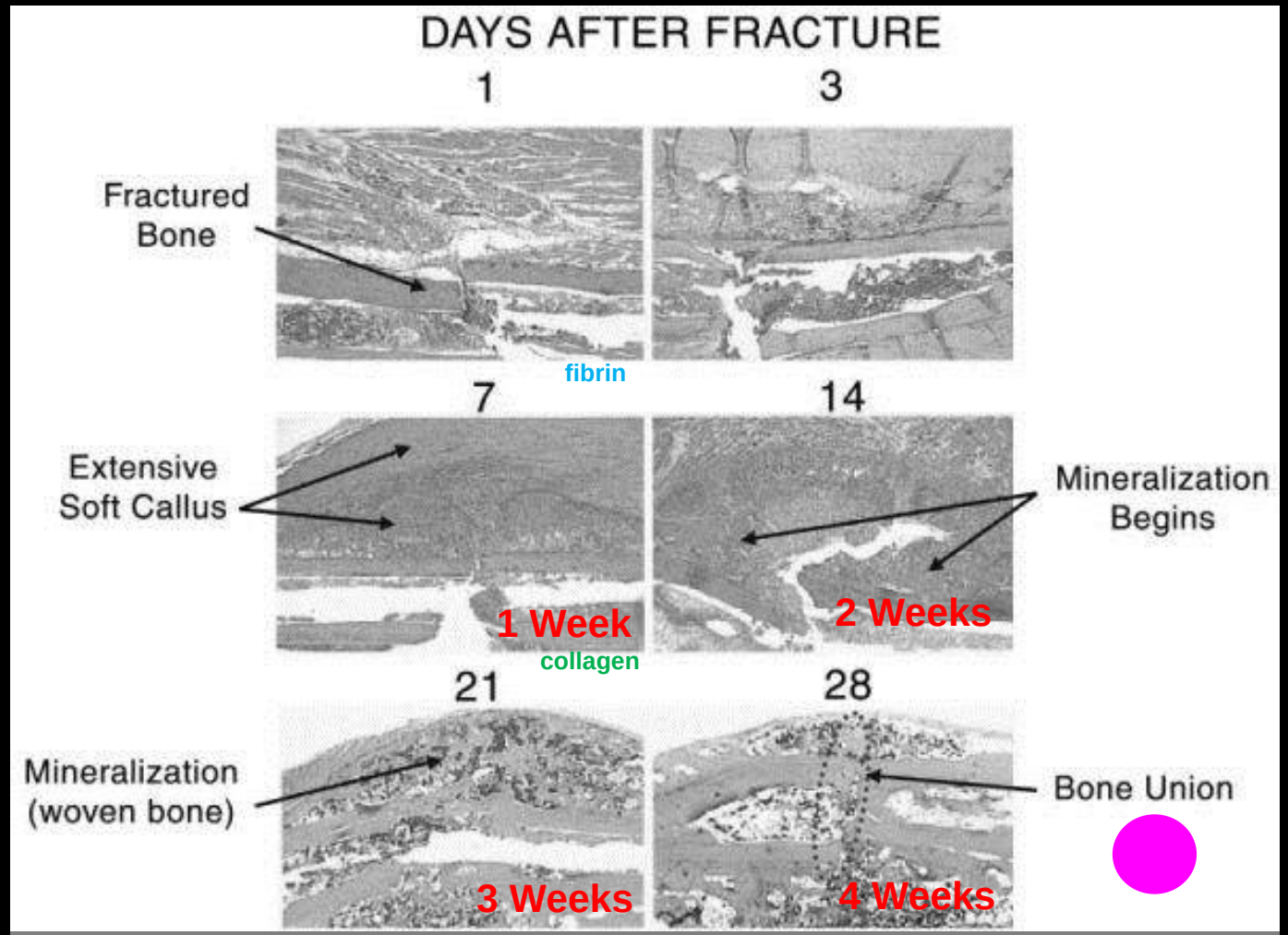
Alejandro Aguilar DDS,CD

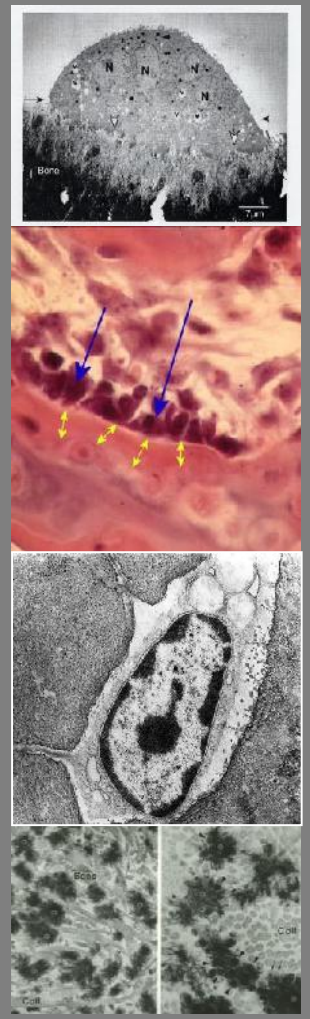


How long does this process take?

We can extrapolate from the bone healing process to osseointegration with the implant.

We are dealing with a biological timeframe which cannot be altered by a doctor's decision.





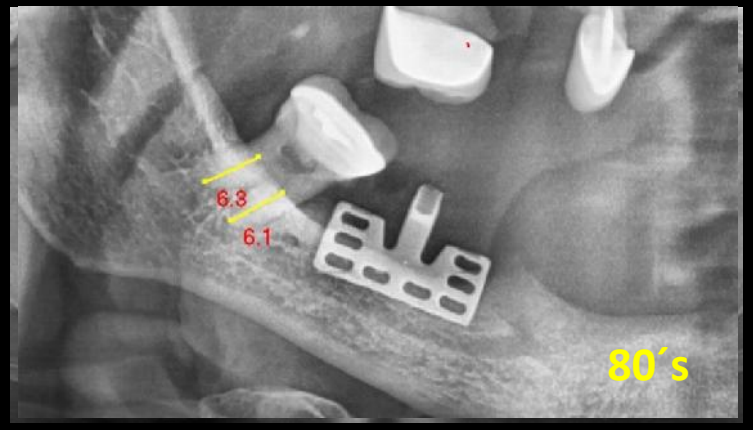
Osseointegration

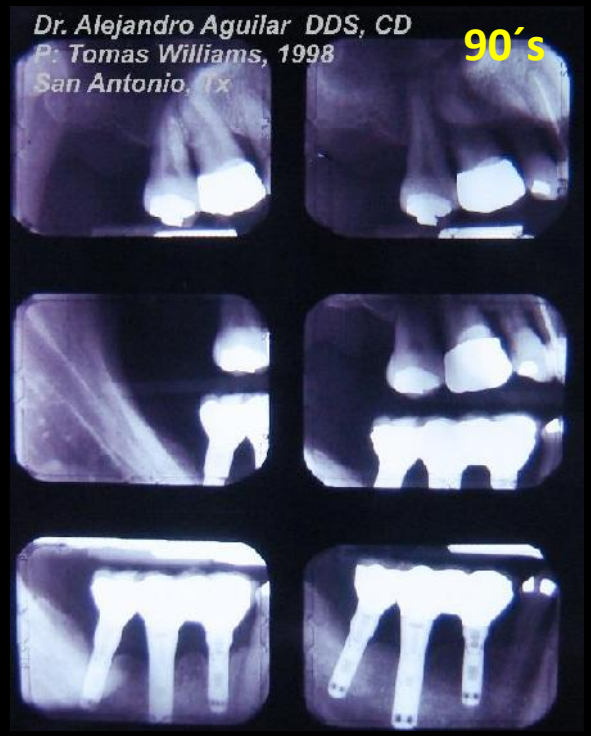
BONE and IMPLANT

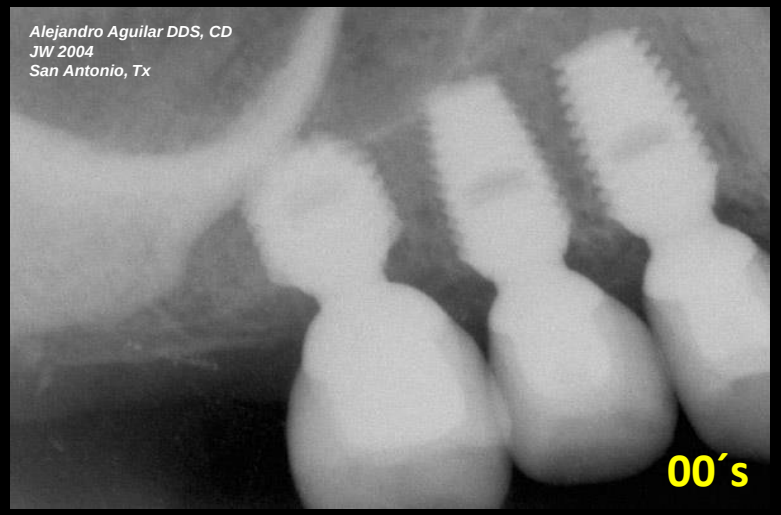
Two strange elements that have to learn to live and work together harmoniously.

(Biocompatibilty)

Over the last 30 years of my clinical experience







My success rate between dental implants and failures

Evaluated at 12 and 24 months after placement, where the following was considered as a failure:

A) Crestal bone loss greater than 25%
B) Total loss

Percentage (%)	Success	Failure
80´s Steel nails. Stainless steel in bar and plate. Titanium bar and plate. Smooth and grated cylindrical titanium.	38	62
90´s Titanium CP4. Cylindrical implants; solid and perforated with an early cord. Surfaces: solid, grated, with etching and sand-blasting. Improvements in prosthetic attachments.	64.8	35.20 < Crestal bone loss greater than 25%
00´s Titanium CP 4 Implants with natural root anatomy. Surfaces with controlled acid etching and sand-blasting. Surfaces added with bio-compatible materials. Inverted platform.	92	8 = Crestal bone loss Total loss
13 → Titanium CP 4 Implants with natural root anatomy and sharp blade. Surfaces HSA Inverted conection. DIO* FII	99	1 400 implants placed 5 total loss

2013

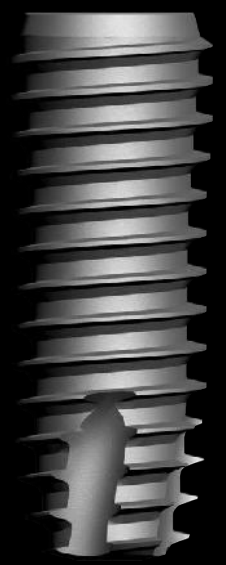
Initial findings on the use of dental implant **UF(II) of the DIO**

Corp. Company, Pusan, Korea

By Dr. Alejandro Aguilar, DDS

Graduated from Universidad Intercontinental in Mexico City
Conducted multiple research and submitted his fieldwork for international publications
Certificated in Dental Implants by the University of Pennsylvania in Philadelphia
Awarded in 2012 with the International Excelsis Award*,
General Director at the Research Center in Biomaterials and Bio-Technology VIOTECHNO
International figure in the Buccal Aesthetic as well as Cosmetic Dentistry.

KEMMClinic*, which I am currently directing, has the experience of having successfully placed more than 5,000 dental implants degree of Initial Titanium-Bone Contact (ITBC*) that can be achieved during placement, as well as good primary stability.

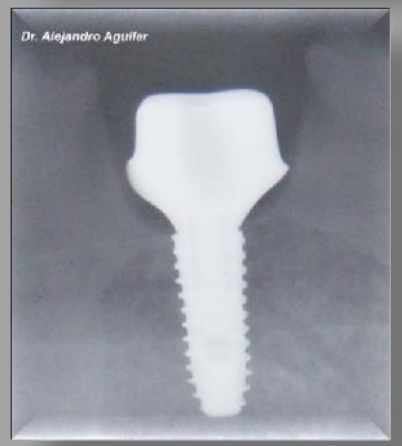


DIO* UF//

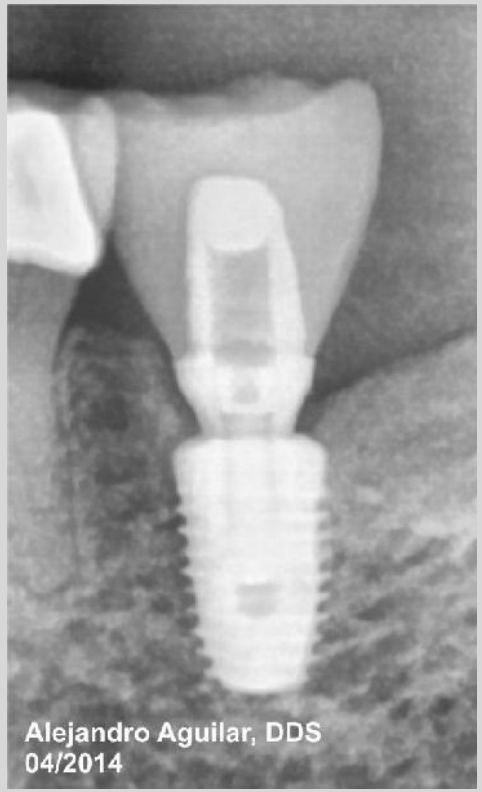
HSA Surface

Hybrid Sand blasted & Acid Etched

2013



2015

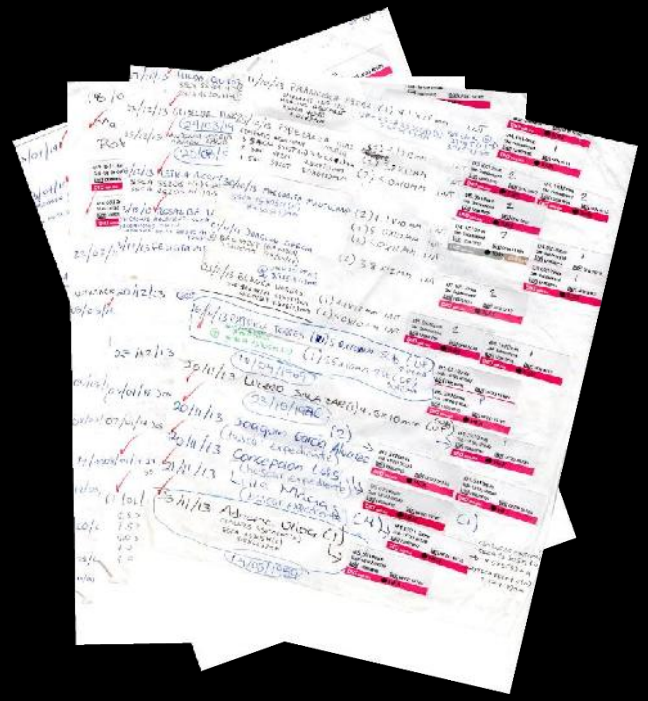


What is going on here?

With this implant the bone behaves differently in the first four weeks after placement from what I've seen in the last 30 years of my practice in dental implantology!

To try to discover the mystery,

I decided to rigorously monitor 350 **DIO*** UF*II implants that I placed in the most similar parameters possible over a period of 12 - 18 months.*



N DE IMPLANTES DIO*UF II

FECHA	CANTIDAD		DESCRIPCION	LOTE
16/11/2013	2	1	UF (II) 50105 5.0 X 10 mm	130316P42
		1	UF (II) 55105 5.5 X 10 mm	130620P45
20/11/2013	1	1	UF (II) 45105 4.5 X 10 mm	130702P34
20/11/2013	2	2	UF (II) 55105 5.5 X 10 mm	130620P45
20/11/2013	1	1	UF (II) 50105 5.0 X 10 mm	130316P42
21/11/2013	4	4	UF (II) 40115 4.0 X 11.5 mm	130924P47
23/11/2013	1	1	UF (II) 55105 5.5 X 10 mm	130620P45
27/11/2013	2	2	UF (II) 50105 5.0 X 10mm	130316P42
03/12/2013	2	2	UF (II) 40105 4.0 X 10 mm	130925P31
05/12/2013	2	1	UF (II) 50105 5.0 X 10 mm	130316P42
		1	UF (II) 45105 4.5 X 10 mm	130702P34
06/12/2013	2	1	UF (II) 55105 5.5 X 10 mm	130620P45
		1	UF (II) 45105 4.5 X 10 mm	130702P34
13/12/2013	4	4	UF (II) 40135 4.0 X 13 mm	130415P68
08/01/2014	1	1	UF 4011 4.0 X 11.5 mm	111227P17
11/01/2014	1	1	UF (II) 45105 4.5 X 10 mm	130702P34
14/12/2014	1	1	UF (II) 45105 4.5 X 10 mm	130702P34
21/06/2014	2	2	UF (II) 38115 3.8 X 11.5 mm	140311P43
17/07/2014	1	1	UF (II) 45135 4.5 X 13 mm	130620P37
24/07/2014	2	1	UF (II) 40085 4.0 X 8.5 mm	140120P45
		1	UF (II) 50075 5.0 X 7 mm	140117P32
07/08/2014	6	1	UF (II) 38115 3.8 X 11.5 mm	131129P46
		1	UF (II) 38115 3.8 X 11.5 mm	140503P42
		1	UF (II) 45105 4.5 X 10 mm	140417P48
		1	UF (II) 45105 4.5 X 10 mm	130924P46
		2	UF (II) 50085 5.0 X 8.5 mm	131028P34
08/08/2014	1	1	UF (II) 38105 3.8 X 10 mm	140221P33
13/08/2014	2	2	UF (II) 45115 4.5 X 11.5 mm	130924P44
21/08/2014	1	1	UF (II) 50105 5.0 X 10 mm	140121P39
27/08/2014	1	1	UF (II) 50105 5.0 X 10 mm	140121P39
04/09/2014	5	5	UF (II) 38105 3.8 X 10mm	140425P46
05/09/2014	1	1	UF (II) 45115 4.5 X 11.5mm	130924P44
10/09/2014	1	1	UF (II) 50105 5.0 X 10 mm	140121P39
17/09/2014	4	2	UF (II) 38085 3.8 x 8.5mm	140529P55
		2	UF (II) 40105 4.0 X 10 mm	140408P40
18/09/2014	1	1	UF (II) 40115 4.0 X 11.5 mm	140416P51
18/09/2014	1	1	UF (II) 50105 5.0 X 10 mm	140121P39
25/09/2014	2	2	UF (II) 38115 3.8 X 11.5 mm	140120P45
27/09/2014	4	4	UF (II) 40085 4.0 X 8.5 mm	140120P45
01/10/2014	1	1	UF (II) 40115 4.0 X 11.5 mm	140416P51

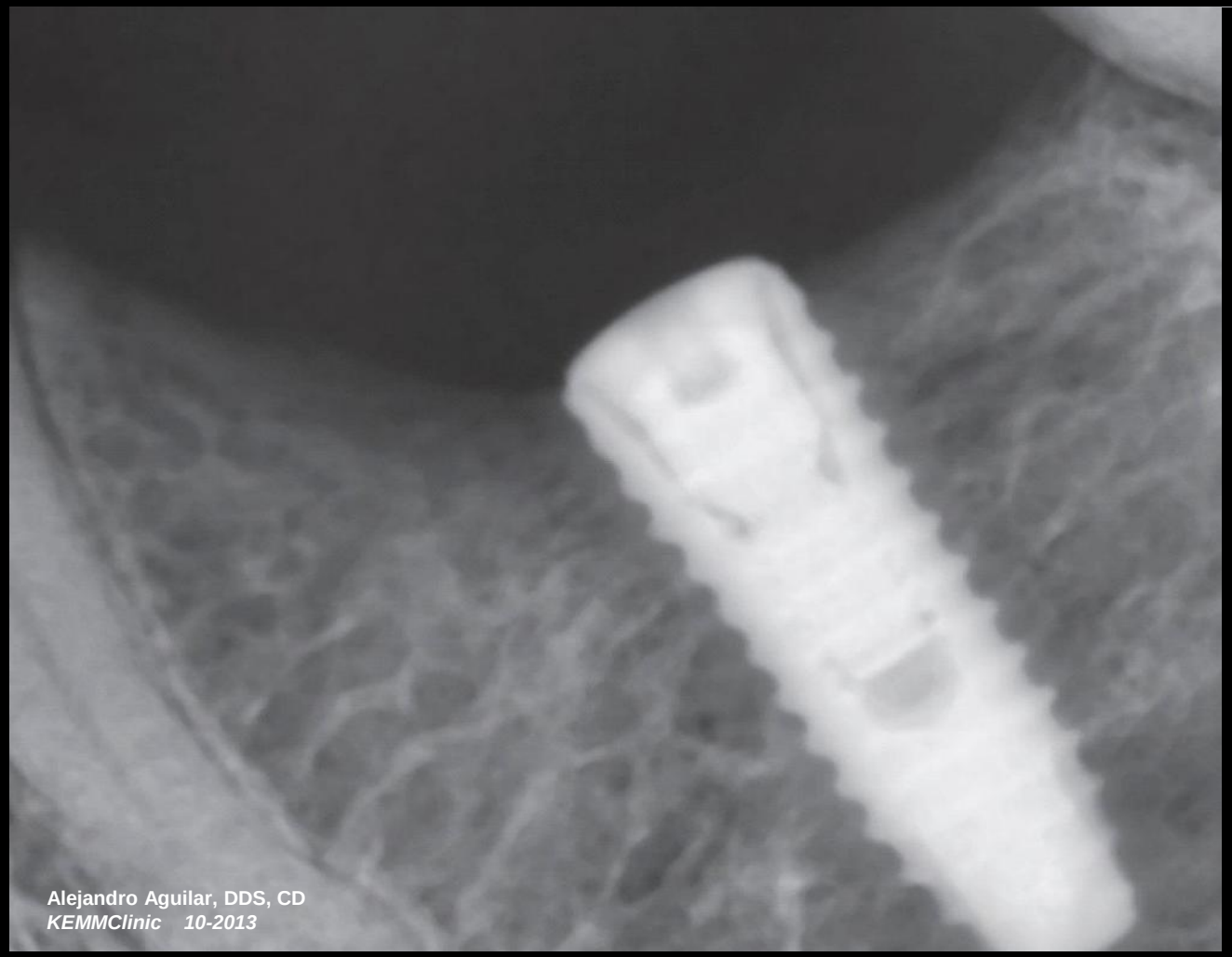
1	1	UF (II) 40105 4.0 X 10 mm	130925P31	
5	1	UF (II) 38115 3.8 X 11.5 mm	131129P46	11 4.5 x 11.5 mm 130924P44
	1	UF (II) 50115 5.0 X 11.5 mm	130723P37	
	2	UF (II) 40105 4.0 X 10 mm	130625P45	11 4.5 x 11.5 mm 130924P44
	1	UF (II)40115 4.0 X 11.5 mm	130410P36	
1	1	UF (II)40115 4.0 X 11.5 mm	130410P36	10S 5.0 X 10mm 130910P36
1	1	UF (II) 50115 5.0 X 11.5 mm	130723P37	11 4.5 x 11.5 mm NO HAY STICKER
3	1	UF (II) 38115 3.8 X 11.5 mm	131129P46	
	2	UF (II) 40105 4.0 X 10 mm	130625P45	10S 5.0 X 10mm 130910P36
1	1	UF (II) 50105 5.0 X 10mm	130910P36	
				11S 4.0 X 11.5 mm 130410P36
1	1	UF (II)40115 4.0 X 11.5 mm	130410P36	10S 4.0 X 10 mm 130925P31
3	1	UF (II) 38115 3.8 X 11.5 mm	131129P46	11S 5.0 X 11.5 mm 130723P37
	2	UF (II) 50115 5.0 X 11.5 mm	130723P37	08S 3.8 X 8.5 mm 131129P44
1	1	UF (II) 40105 4.0 X 10 mm	130625P45	
				10S 4.0 X 10 mm 130625P45
8	3	UF (II) 40105 4.0 X 10 mm	130625P45	
	5	UF (II) 50105 5.0 X 10mm	130910P36	
				11S 4.0 X 11.5 mm 130410P36
1	1	UF (II) 4511 4.5 x 11.5 mm	130924P44	11S 3.8 X 8.5 mm 131129P44
3	2	UF (II) 45135 4.5 X 13 mm	130401P39	
	1	UF (II) 50115 5.0 X 11.5 mm	140210P32	11S 5.0 X 11.5 mm 130723P37
				11S 5.0 X 11.5 mm 140210P32
1	1	UF (II) 50115 5.0 X 11.5 mm	130723P37	
1	1	UF (II) 4511 4.5 x 11.5 mm	130924P44	11 4.5 x 11.5 mm 140228P49
				11S 5.0 X 11.5 mm 140210P32
4	4	UF (II) 38115 3.8 X 11.5 mm	131129P46	
	1	UF (II) 45135 4.5 X 13 mm	130401P39	11 4.5 x 11.5 mm 140228P49
1	1	UF (II) 50115 5.0 X 11.5 mm	130723P37	

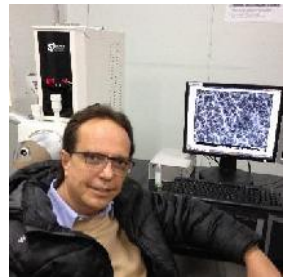
/2014	1	1	UF (II) 50115 5.0 X 11.5 mm	130723P37
/2014	3	1	UF (II) 40105 4.0 X 10 mm	140418P44
		1	UF (II) 40105 4.0 X 11.5 mm	130410P36
		1	UF (II) 50115 5.0 X 11.5 mm	130723P37
/2014	4	1	UF (II) 40115 4.0 x 11.5 mm	130410P36
		1	UF (II) 40115 4.0 x 11.5 mm	140416P51
		2	UF (II) 40115 4.0 x 11.5 mm	130410P36
/2014	2	1	UF (II) 40115 4.5 x 10 mm	130924P46
		1	UF (II) 38155 3.8 X 15 mm	140314P47
		1	UF (II) 45105 4.5 X 10 mm	130924P46
		1	UF (II) 40115 4.0 X 11.5 mm	140416P51
		1	UF (II) 50115 5.0 X 11.5 mm	140423P44
15/12/2014	3	2	UF (II) 40105 4.5 X 10 mm	140418P44
		1	UF (II) 38105 3.8 X 10mm	140425P46
16/12/2014	1	1	UF (II) 45105 4.5 X 10 mm	140527P49
16/12/2014	1	1	UF (II) 38105 3.8 X 10mm	140527P49
19/12/2014	2	1	UF (II) 55105 5.5 X 10 mm	131125P51
		1	UF (II) 45105 4.5 X 10 mm	140618P47
1/12/2014	6	2	UF (II) 38105 3.8 X 10mm	140425P46
		4	UF (II) 40105 4.0 X 10 mm	130925P31
16/12/2014	2	2	UF (II) 38105 3.8 X 10mm	140425P46
7/12/2014	3	1	UF (II) 38105 3.8 X 10 mm	140425P46
		2	UF (II) 45085 4.5 X 8.5 mm	131128P44
16/01/2015	4	1	UF (II) 38105 3.8 X 10 mm	140425P46
		1	UF (II) 40105 4.0 X 10 mm	130925P31
		1	UF (II) 45105 4.5 X 10 mm	140618P47
		1	UF (II) 45105 4.5 X 10 mm	130924P46
07/01/2015	2	2	UF (II) 40115 4.0 X 11.5 mm	140217P31

1	1	UF (II) 40115 4.0 X 11.5 mm	140416P51
2	1	UF (II) 40115 4.0 X 11.5 mm	140416P51
	1	UF (II) 40115 4.0 X 11.5 mm	130726P32
3	2	UF (II) 40115 4.0 X 11.5 mm	140416P51
	1	UF (II) 50115 5.0 X 11.5 mm	140423P44
8	4	UF (II) 40115 4.0 X 11.5 mm	140416P51
	1	UF (II) 40115 4.0 X 11.5 mm	140416P53
	3	UF (II) 40105 4.0 X 10 mm	140809P44
1	1	UF (II) 40115 4.0 X 11.2 mm	140416P51
1	1	UF (II)55115 5.5 X 11.5 mm	140210P32
1	1	UF (II) 40105 4.0 X 10 mm	140809P44
2	1	UF (II) 40115 4.0 X 11.2 mm	140416P51
	1	UF (II) 40105 4.0 X 11.2 mm	140809P44
4	1	UF (II) 40105 4.0 X 10 mm	140809P44
	2	UF (II) 55085 5.5 X 5 mm	140426P55
	1	UF (II) 60085 6.0 X 8 mm	140528P43
1	1	UF (II) 50115 5.0 X 11.5 mm	14012P35
1	1	UF (II)55085 5.5 X 8.5 mm	140426P55
1	1	UF (II)40105 4.0 X 10 mm	140418P44
1	1	UF (II) 40105 4.0 X 10 mm	140418P44
7	1	UF (II) 45085 4.5 X 8.5 mm	130814P38
	5	UF (II) 40105 4.0 X 10 mm	140418P44
	1	UF (II) 45085 4.5 X 8.5 mm	130814P38
4	4	UF (II) 40135 4.0 X 13 mm	140502P42
2	1	UF (II) 50115 5.0 X 11.5 mm	140423P44
2	1	UF (II) 38085 3.8 X 8.5 mm	140523P46
	1	UF (II) 40115 4.0 X 11.5 mm	140416P51
1	1	UF(II) 38105 3.8 X 10mm	140425P46
3	1	UF (II) 38085 3.8 X 8.5 mm	140529P55
	1	UF (II) 38085 3.8 X 8.5 mm	140523P46
	1	UF (II) 45085 4.5 X 8.5 mm	130814P38
3	1	UF (II) 38105 3.8 X 10 mm	140425P46
	1	UF (II) 38115 3.8 X 11.5 mm	140503P42
	1	UF (II) 40115 4.0 X 11.5 mm	140217P31
4	1	UF (II) 40115 4.0 X 11.5 mm	140325P31
	1	UF (II) 40135 4.0 X 13 mm	140325P51
	2	UF (II) 38135 3.8 X 13 mm	140325P41
1	1	UF (II) 45135 4.5 X 13 mm	130620P37
3	3	UF (II) 38135 3.8 X 13 mm	140325P41
1	1	UF (II) 45115 4.5 X 11.5 mm	130924P44
8	1	UF (II) 50105 5.0 X 10 mm	140404P43
	1	UF (II) 50105 5.0 X 10 mm	140121P39
	2	UF (II) 55085 5.5 X 8.5 mm	131224P36
	4	UF (II) 40115 4.0 X 11.5 mm	120217P31
2	1	UF (II) 40105 4.0 X 10 mm	140408P40
	1	UF (II) 45115 4.5 X 11.5 mm	140228P49

(Tomograph)

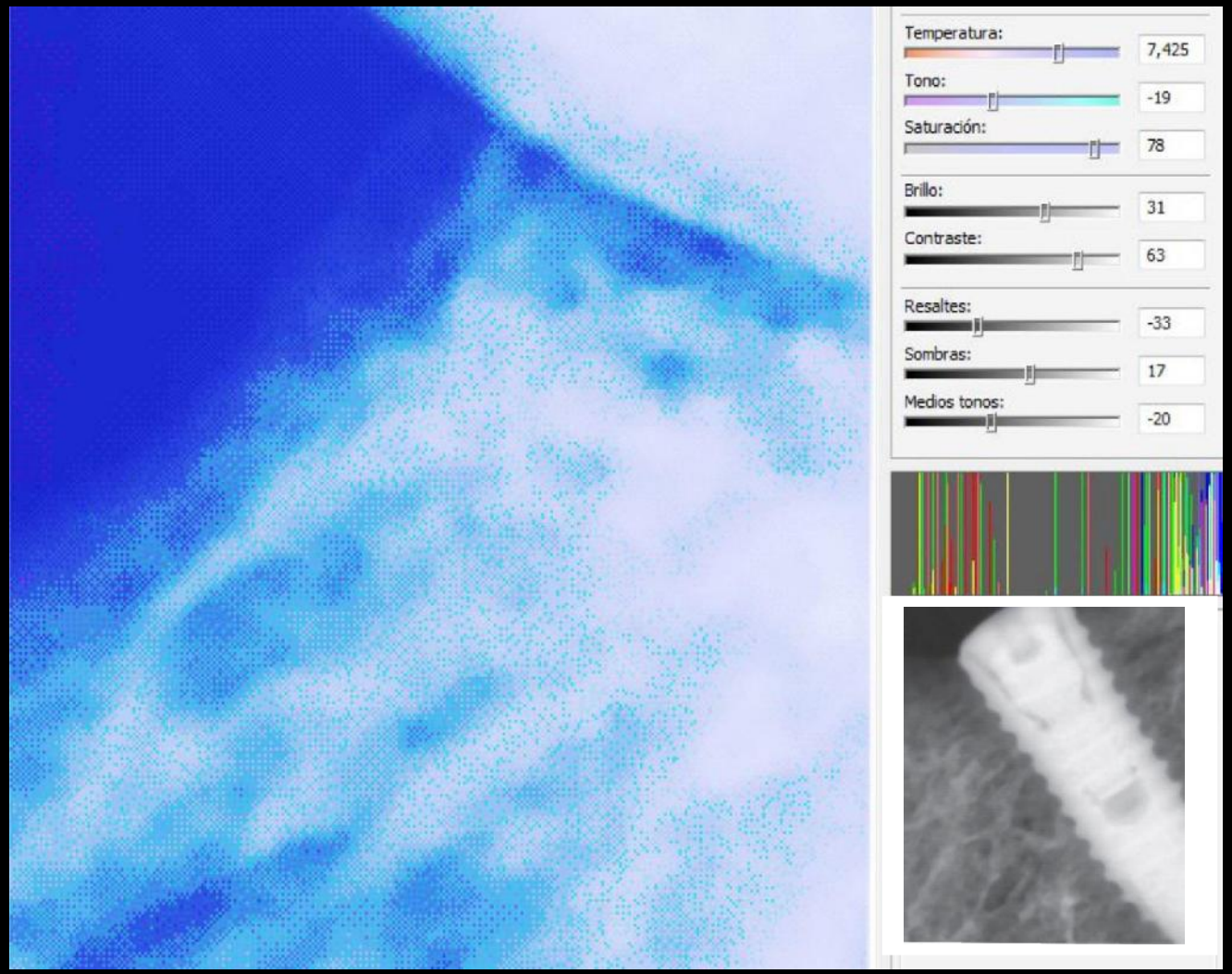
IPAX-i3D
UHD Head
600 cuts/sec
Vatech





Chromatic spectrum

normally used in electron microscopy

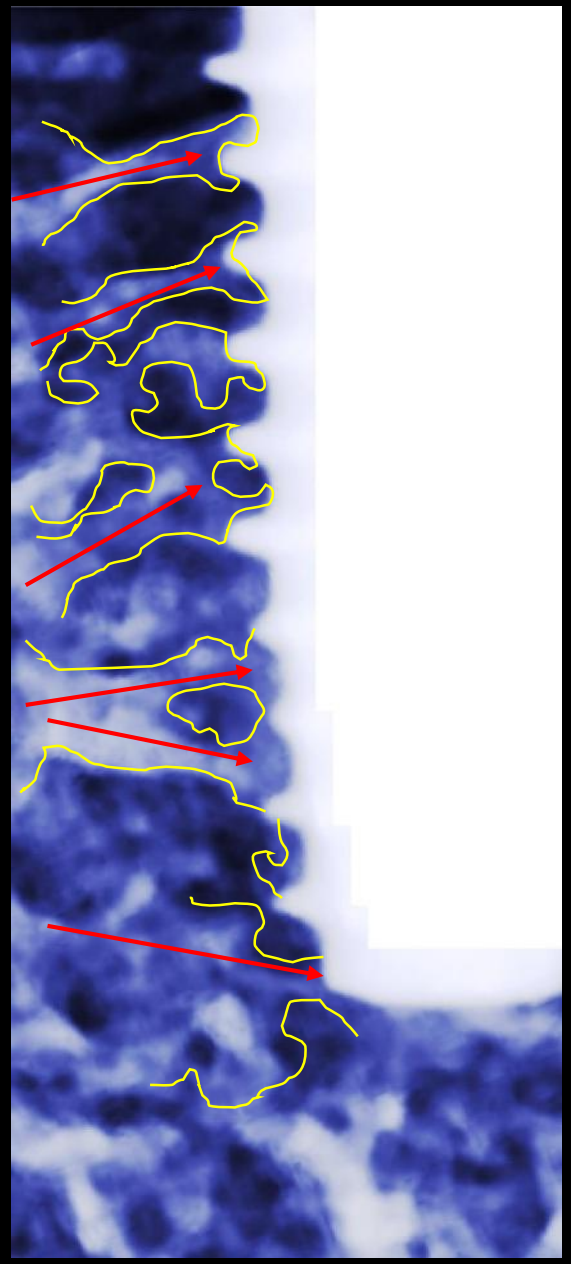


Parameter	Level
Temperature	7425
Tone	-19
Saturation	78
Brightness	31
Contrast	63
Highlights	-33
Shadows	17
Halftoning	-20

Densities filtration software:
2010 Corel Corporation PP X15

Transverse

Bone Matrix



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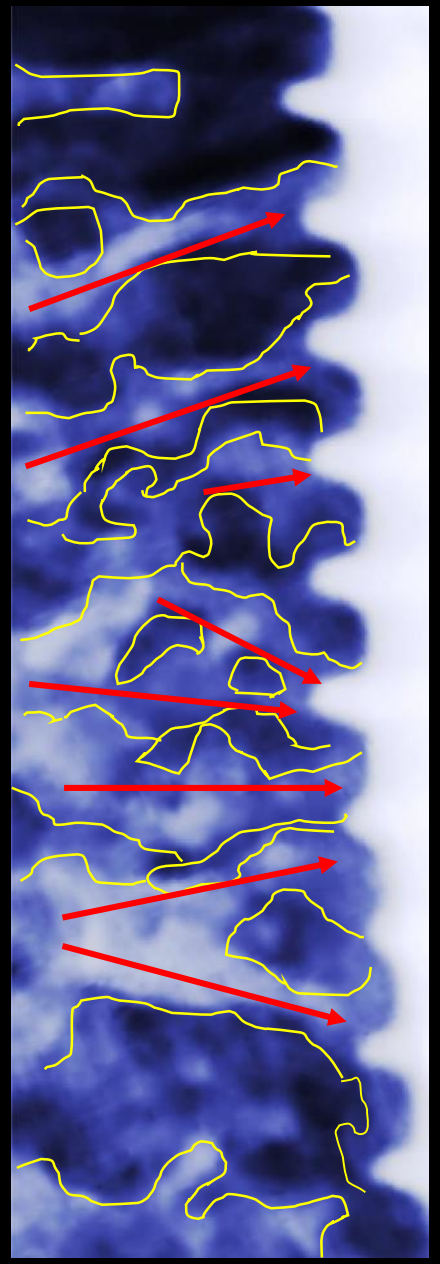

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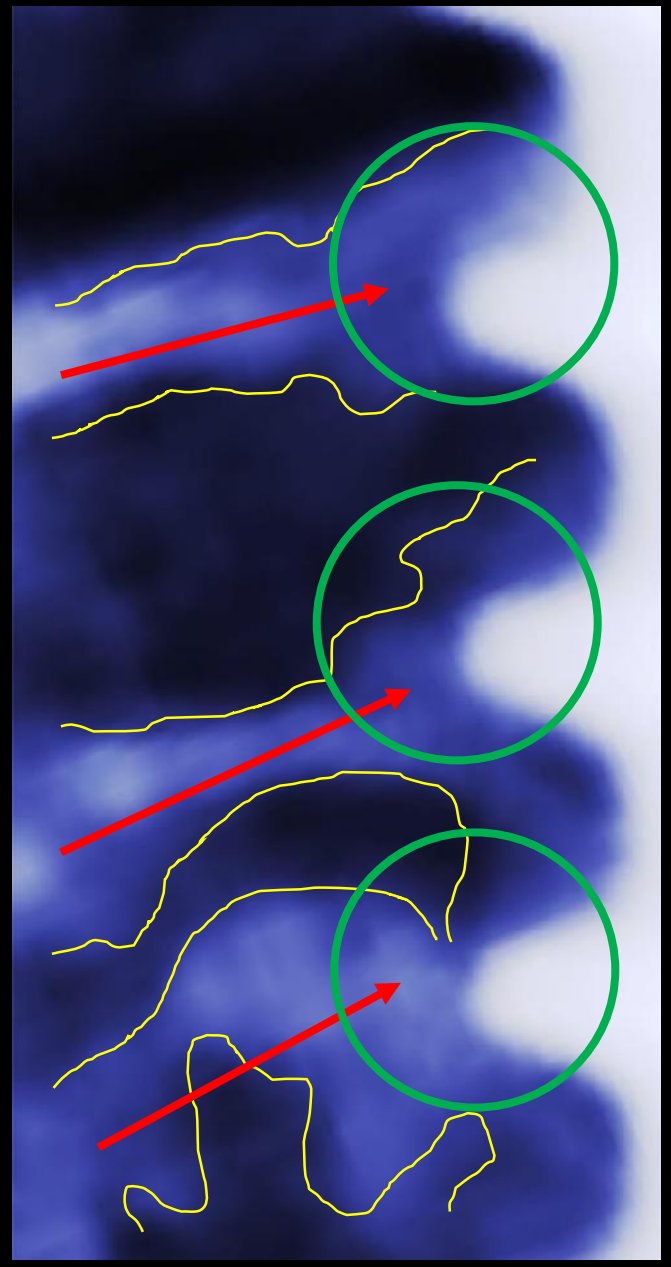
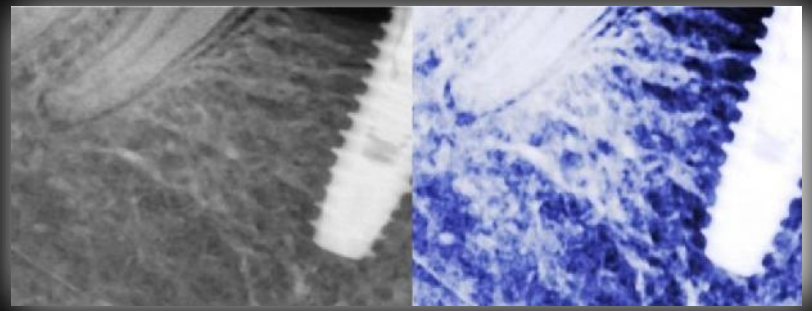
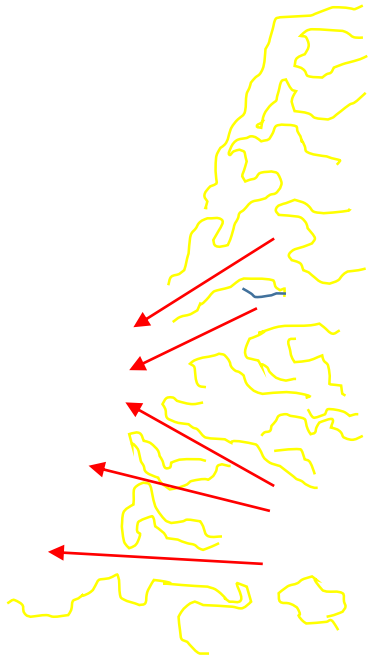
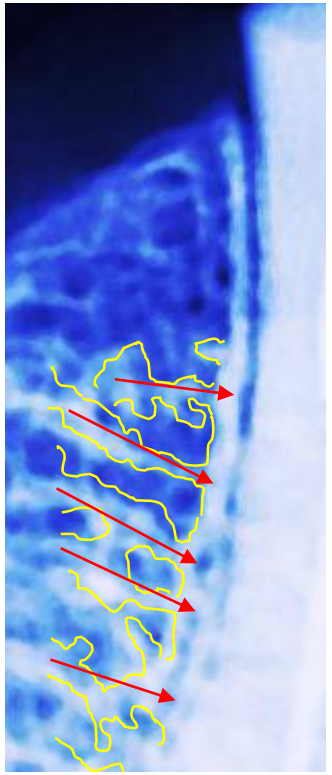


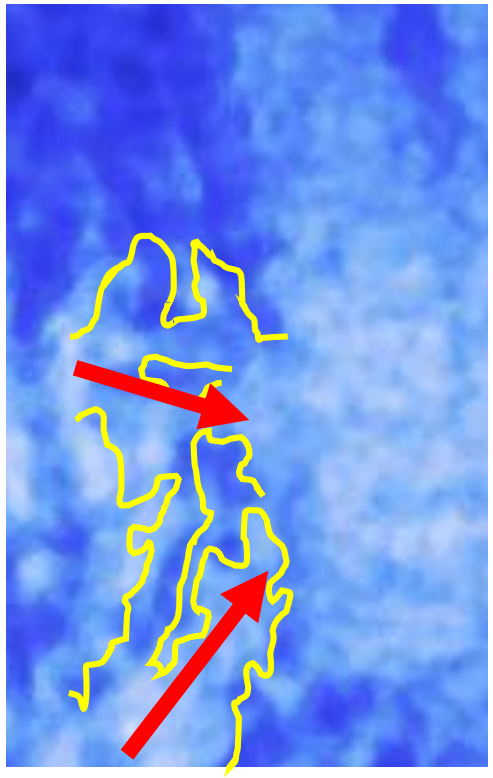
1:20

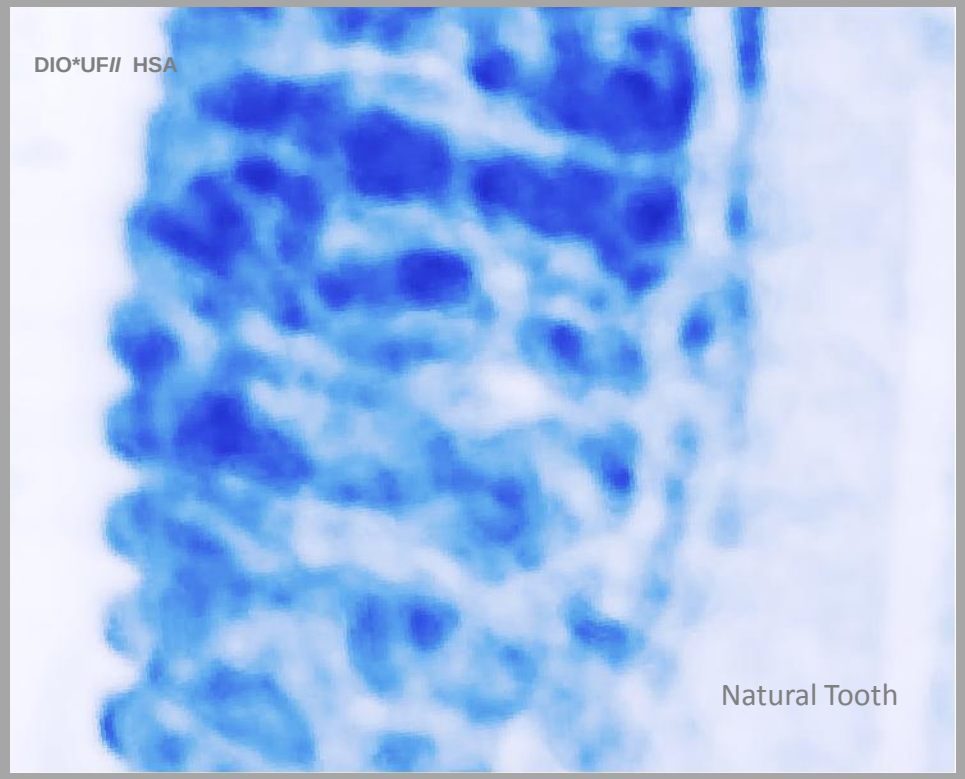
Natural tooth vs Dental Implant







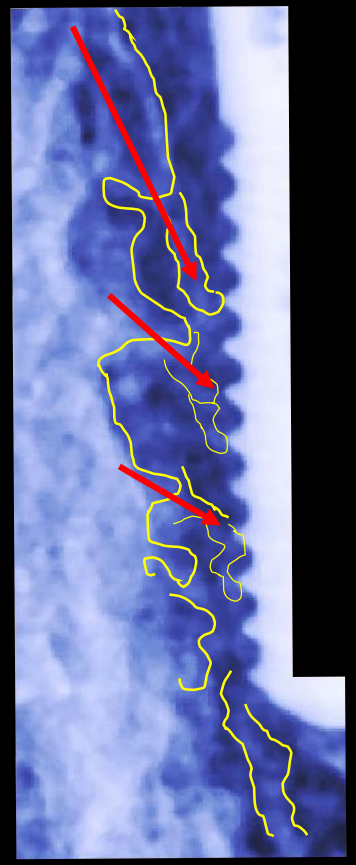


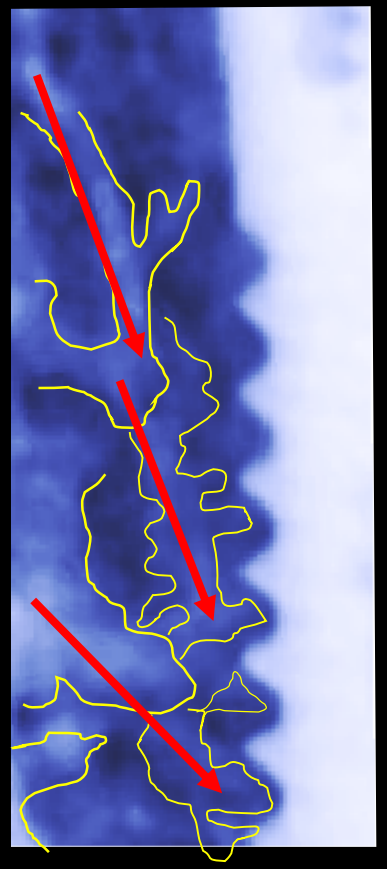


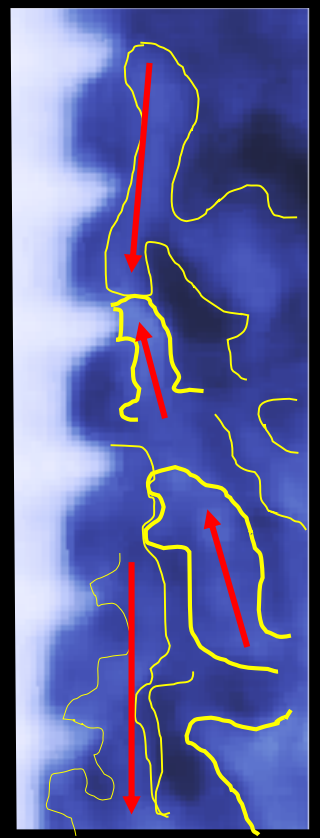
Initial (2013) comparison of osseointegration with the surface of other brands of dental implants

Intrsoskip

"Rough surface" (MaCo Surface)

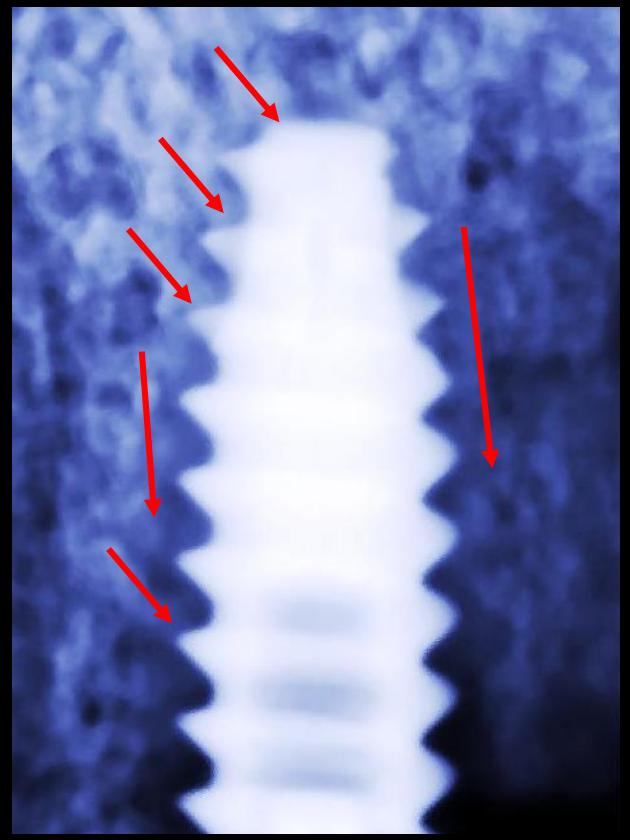




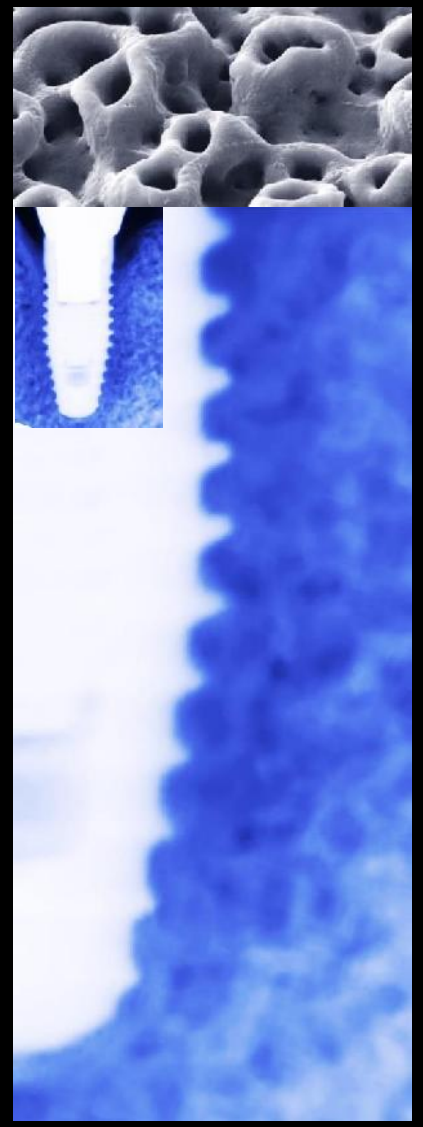


SEVEN

Sand blasted and acid etched surface



NobelReplace*
TiUnite* ***surface***



Under such circumstances we decided:

Comparative study of the osseointegration of six brands of dental implants during the first four weeks following implantation

NOBEL Replace, TS System OSSTEM*, NEO Biotech*, FX Dentium*, Seven I*, DIO* UFII.*

Dr. Alejandro Aguilar W.

MC Roberto B Palma C.

Introduction

Osseointegration is the key to success for the new implant systems, the most important phenomenon in implantology. Studies focus on the understanding of this process since it enables quick and in some cases immediate rehabilitation.[1]

Studies are currently being carried out on titanium oral implants, as well as on alloys and their effect on osseointegration, osteoconduction and osteoinduction, using different methods to modify the structure of both the bone and the implant, adding biological and chemical substances in hopes of improving their properties.

Comparative study of the osseintegration
Of six brands of dental implants during the first
Four weeks following implantation
2015- p 01-16
Pressent for publication 2015 Unliverr publishing

This study was carried out in more than 100 patients who received:

NobelReplace*
TS System *OSSTEM**
NeoBiotech *IS-II**
Fx Dentium*
SEVEN*
DIO* UF II

The intention was to observe how the bone structure was formed around the implant, to learn how osseointegration came about in the first 4 weeks of implantation, as well as to observe how cancelllous bone tissue is organaized architecturally *(bone matrix)* around the implants and compare this with bone matrix around a natural tooth.

Criteria for selection:

- Surface
- External design *(root desing)*
- Blades
- Representation on the Market

NobelReplace*

TiUnite* *surface*

TS III OSSTEM*

Acid-etching and
sand-blasting with
alumina

IS-II Neo Biotech*

SLA
Sand-blasting with
Large grit and acid etching

FX Dentium*

SLA
Sand-blasting with
Large grit and acid etching

SEVEN* Mis*

Acid-etching and
sand-blasting

DIO* UF *II*

HSA
Hybrid Sand-blasting
and acid etching

Methodology

1) The study was carried out with more than 100 patients in the 2nd and 3rd stages of life (40 to 60 years) with good health.

2) The indications for each manufacturer were followed.

3) The specific surgical kit for each implant was used.

4) Flap technique was used in the implantation of all implants.

5) Surgery was performed in a sterile surgical environment, in an operating room.

6) All patients were monitored during the first four weeks of implantation.

7) Ultra High Definition X-Ray *(Vatech iPax)* equipment and densities software *(Corel Corporation 2010 – PPX15)* was used for this study.

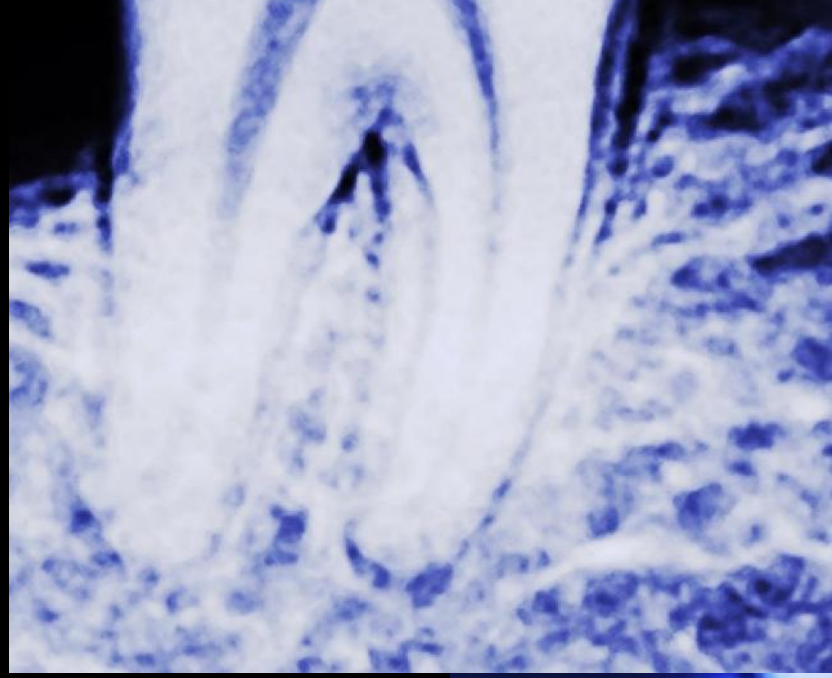
8) The resolution and chromatic filtration for the study were constant throughout the study, as shown in the table.

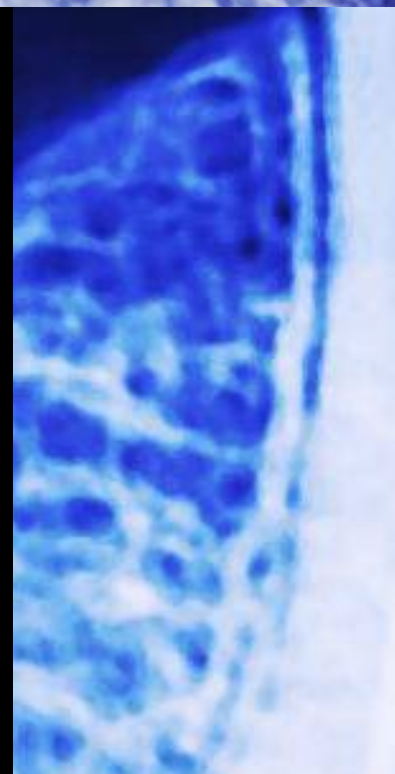
9) The results were plotted according to qualitative observation.

Resolution and chromatic filtration parameters

Parameter	Level
Temperature	7425
Tone	-19
Saturation	78
Brightness	31
Contrast	63
Highlights	-33
Shadows	17
Halftoning	-20

Densities filtration software:
2010 Corel Corporation PP X15

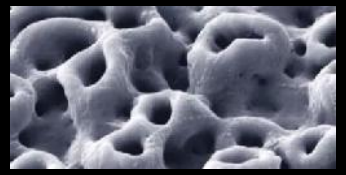


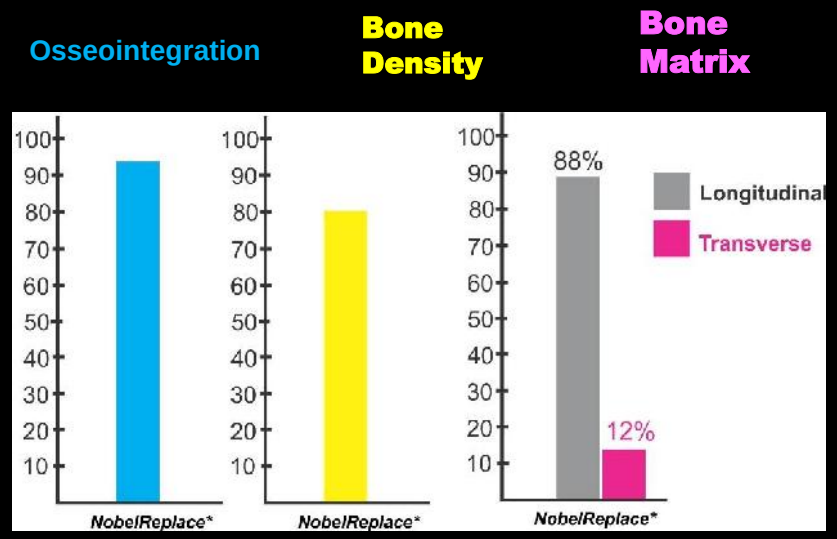


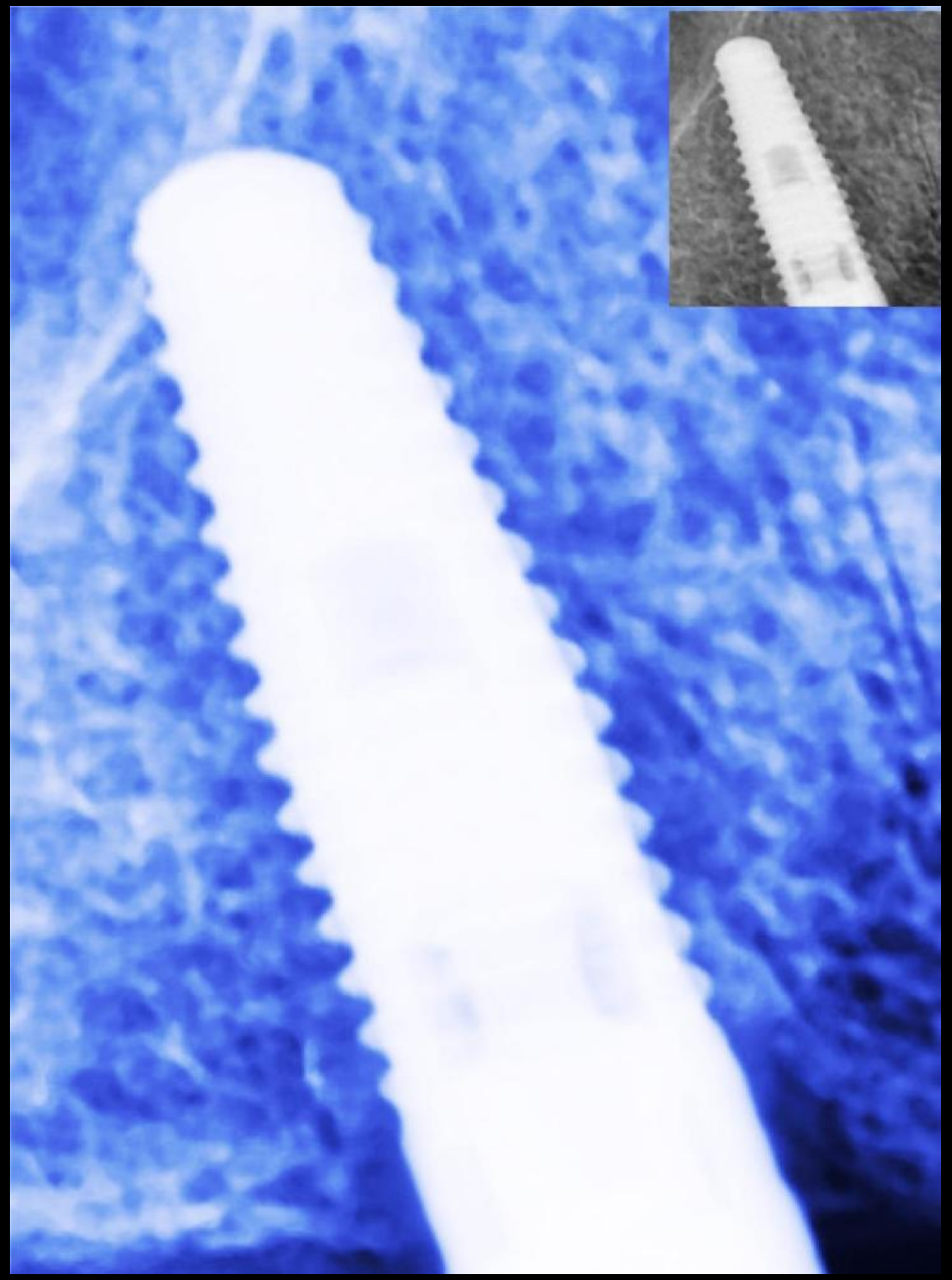
Images taken and filtered of the six implants in the fourth week

*NobelReplace**

TiUnite* *surface*

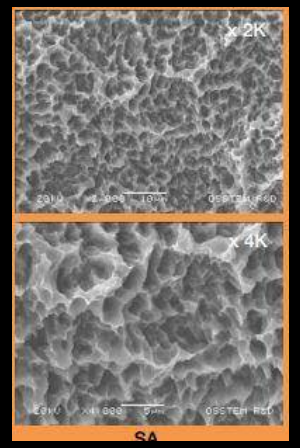


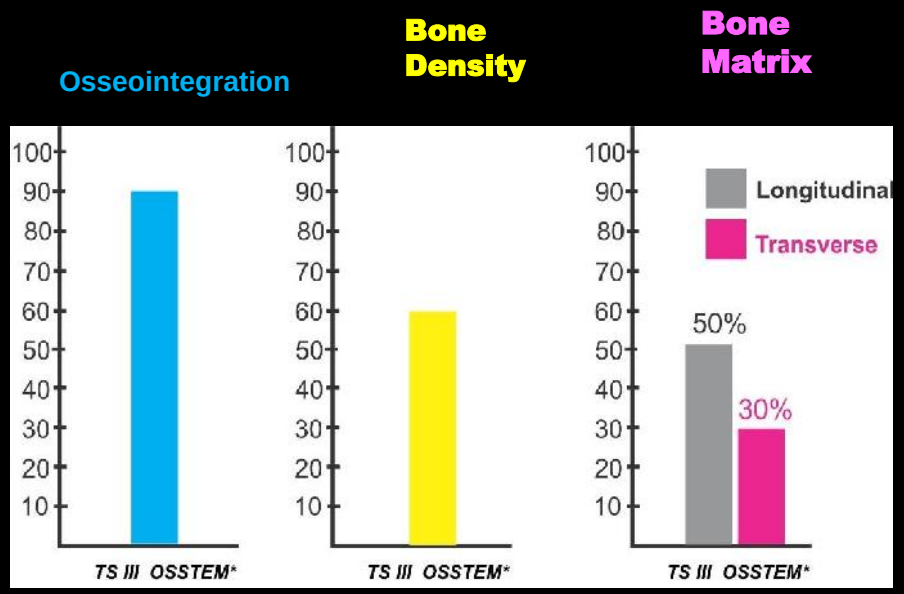


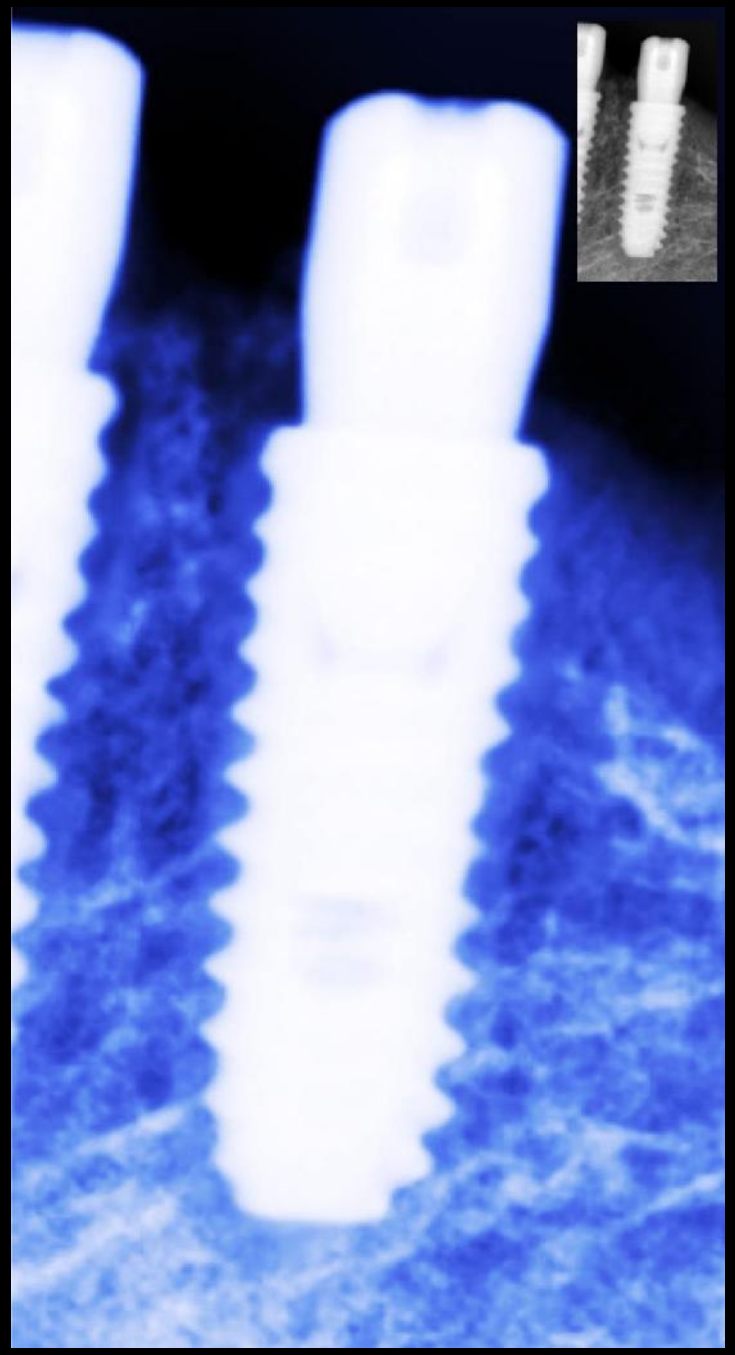


*TS III OSSTEM**

Acid-etching and sand-blasting with alumina

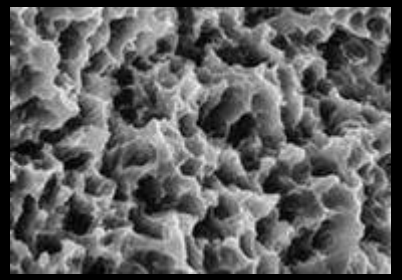


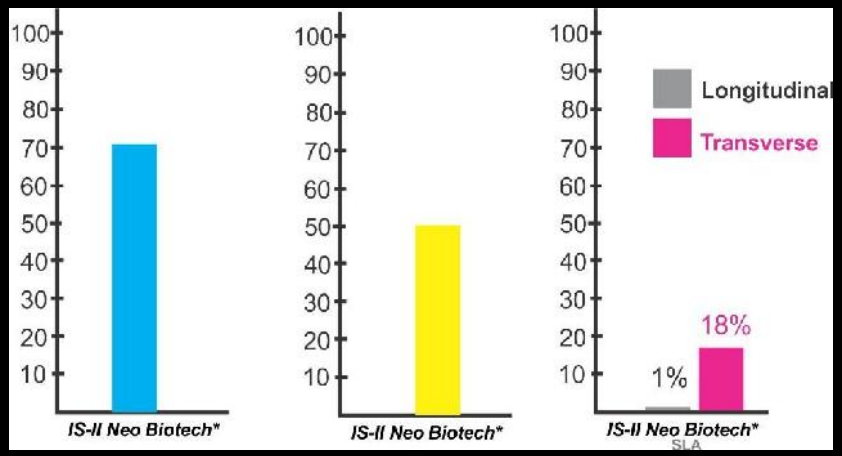


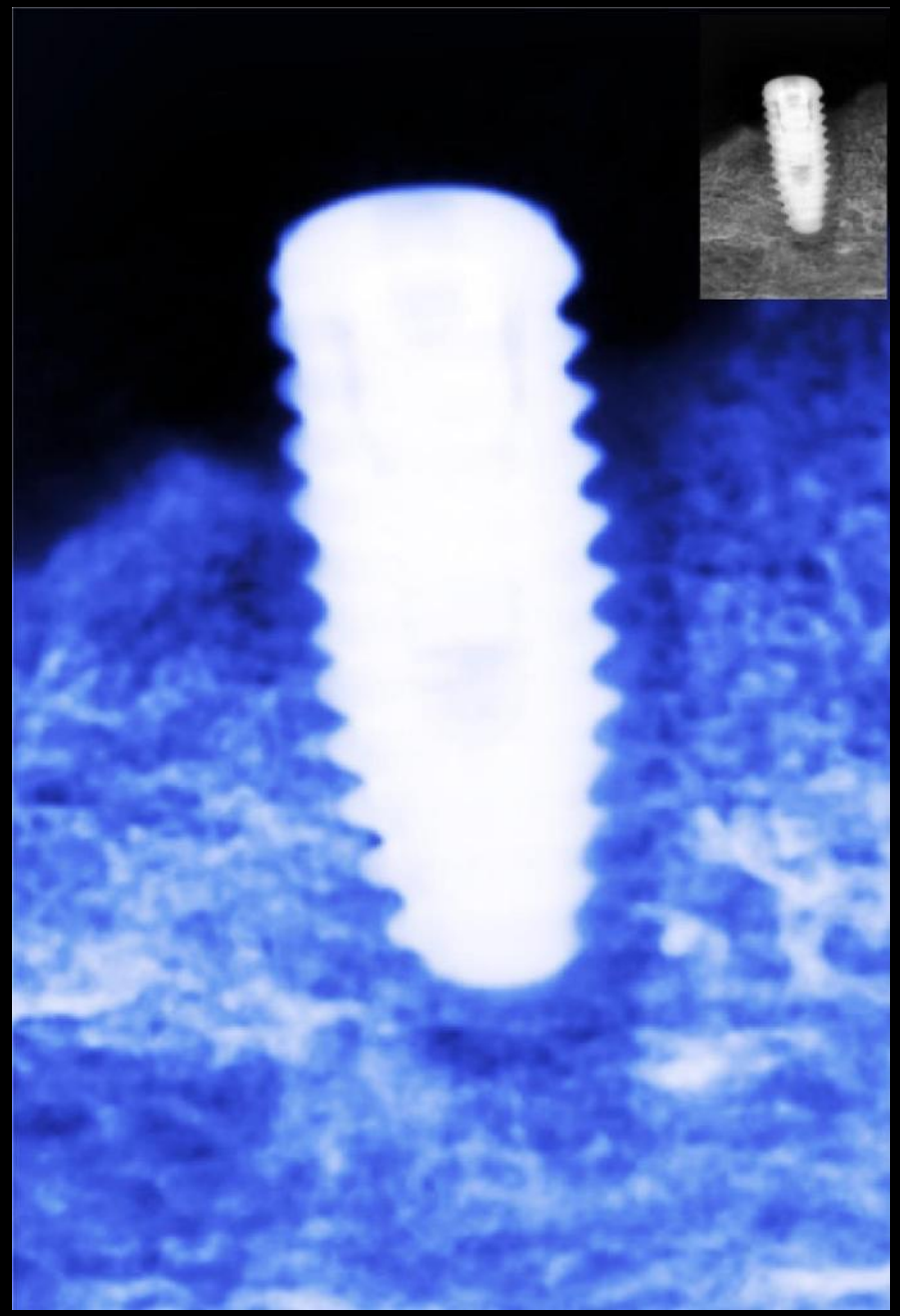


*IS II NEO Biotech**

SLA
Sand-blasting with Large grit and acid etching

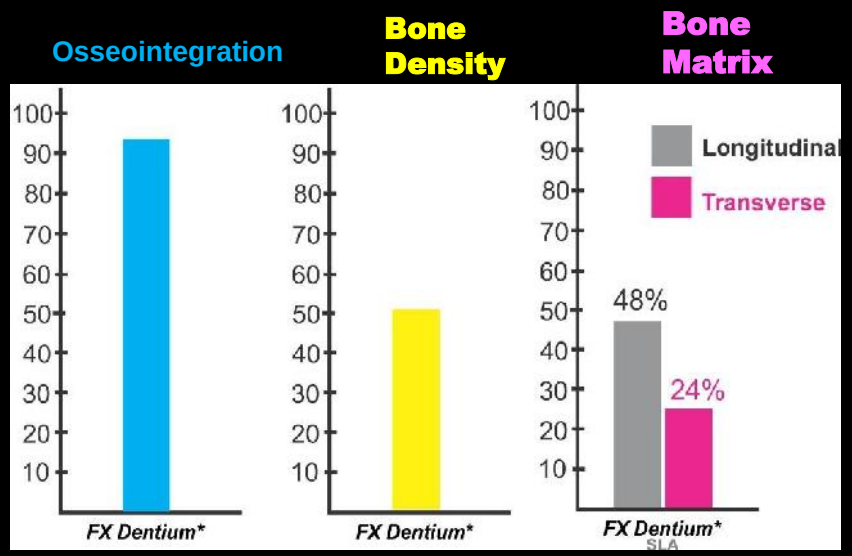


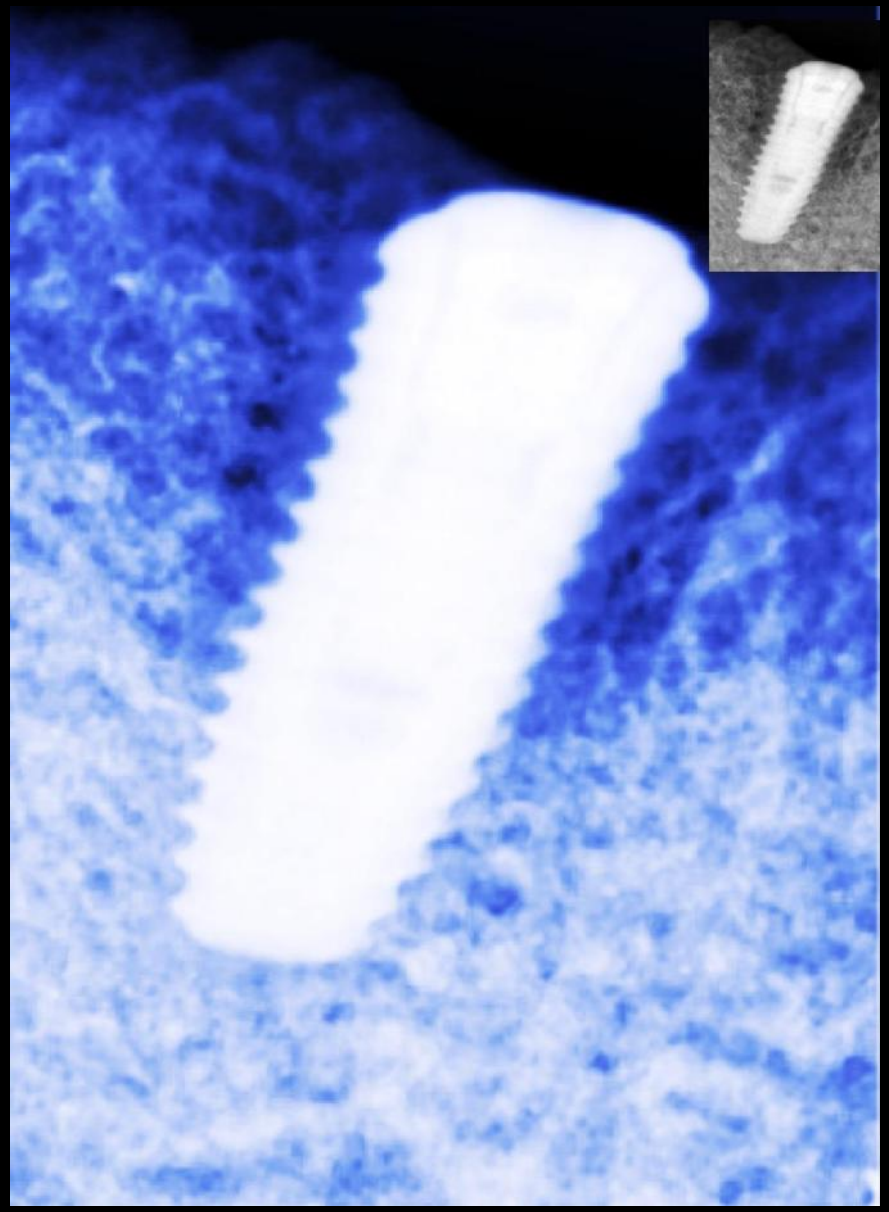




*FX Dentium**

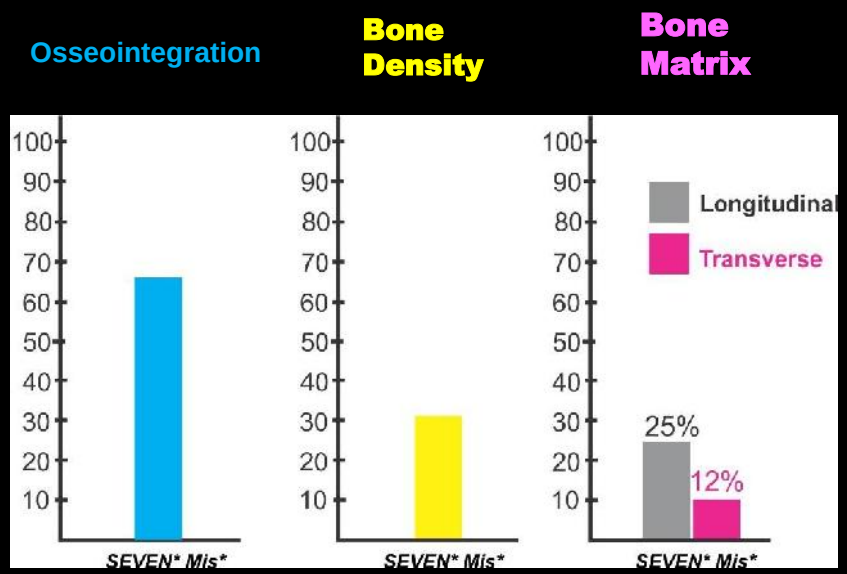
SLA
Sand-blasting with Large grit and acid etching

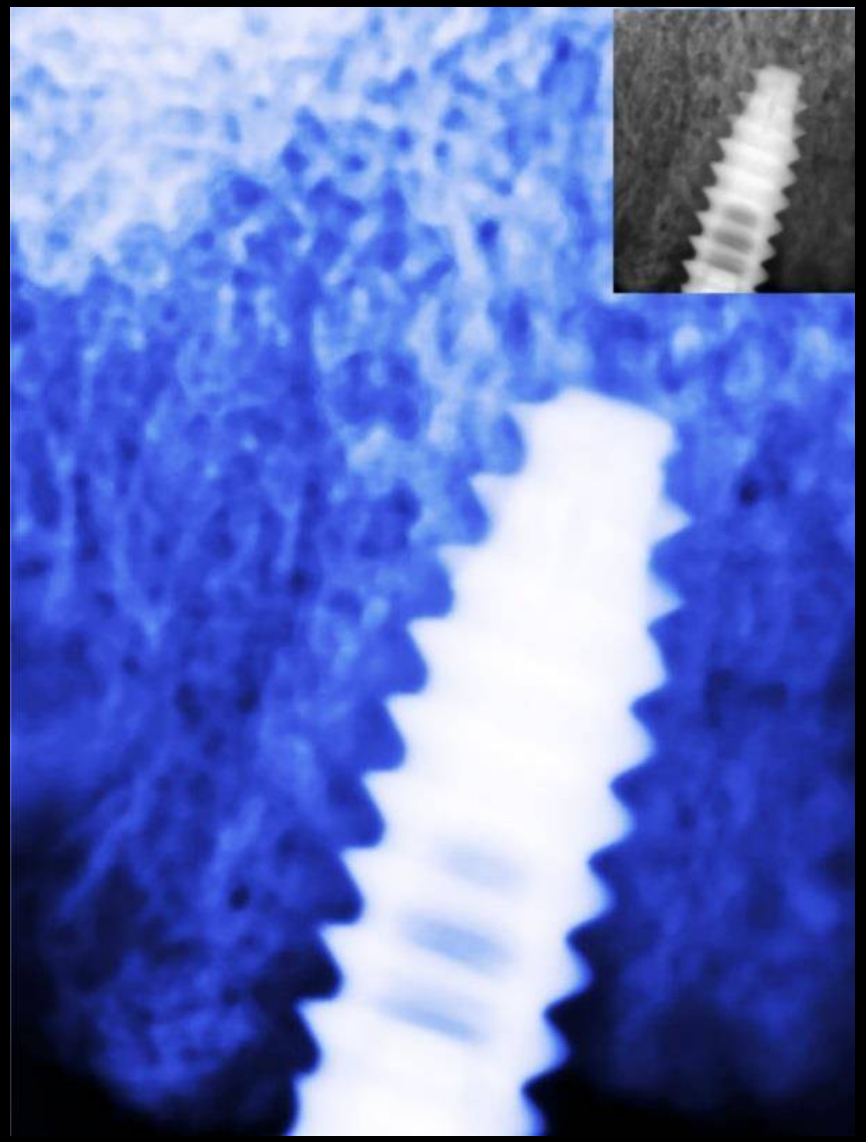




SEVEN*

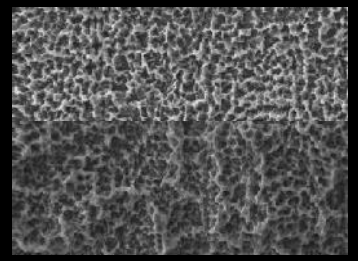
Acid-etching and sand-blasting

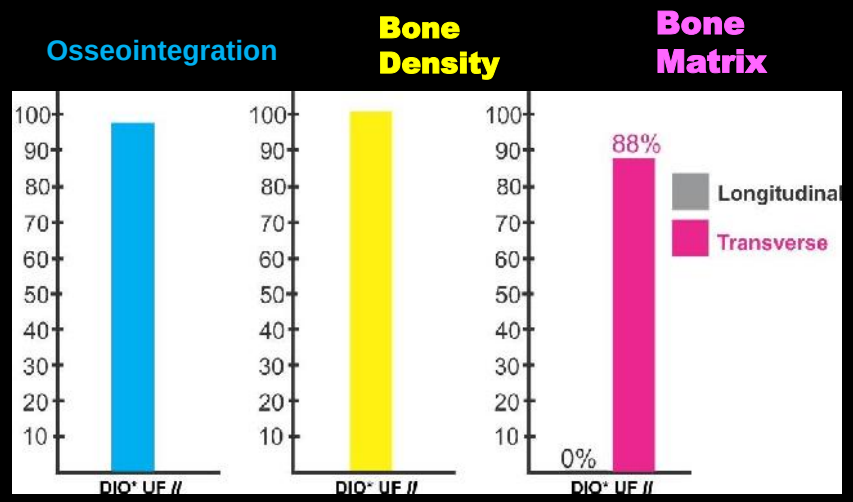


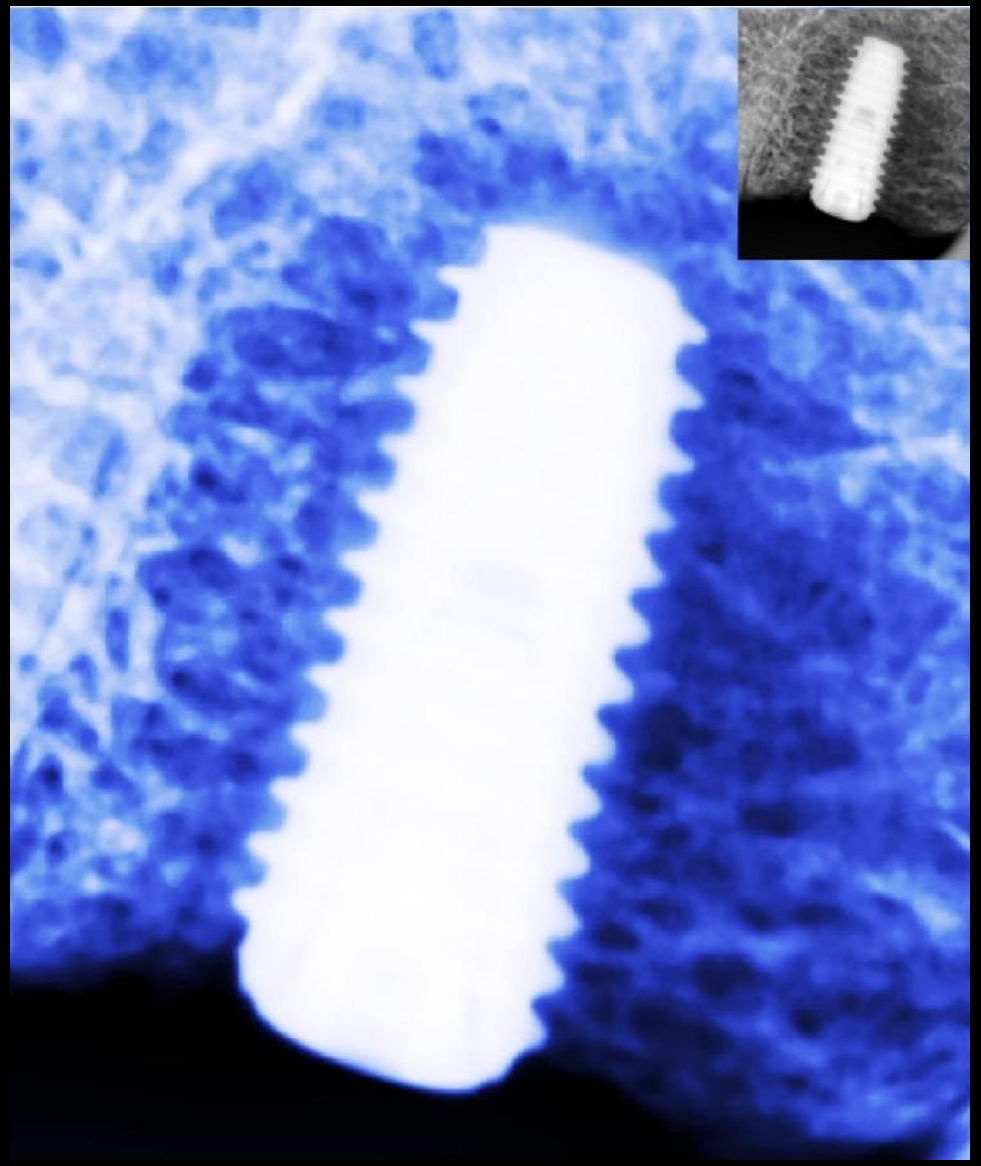


DIO* UF //

HSA
Hybrid Sand-blasting with acid etching







Discussion


Despite the success in current implantology there are still several problems to be solved:

1. Understanding regeneration around the implant surface.

2. How the different surfaces of the implant help to accelerate union with the bone.

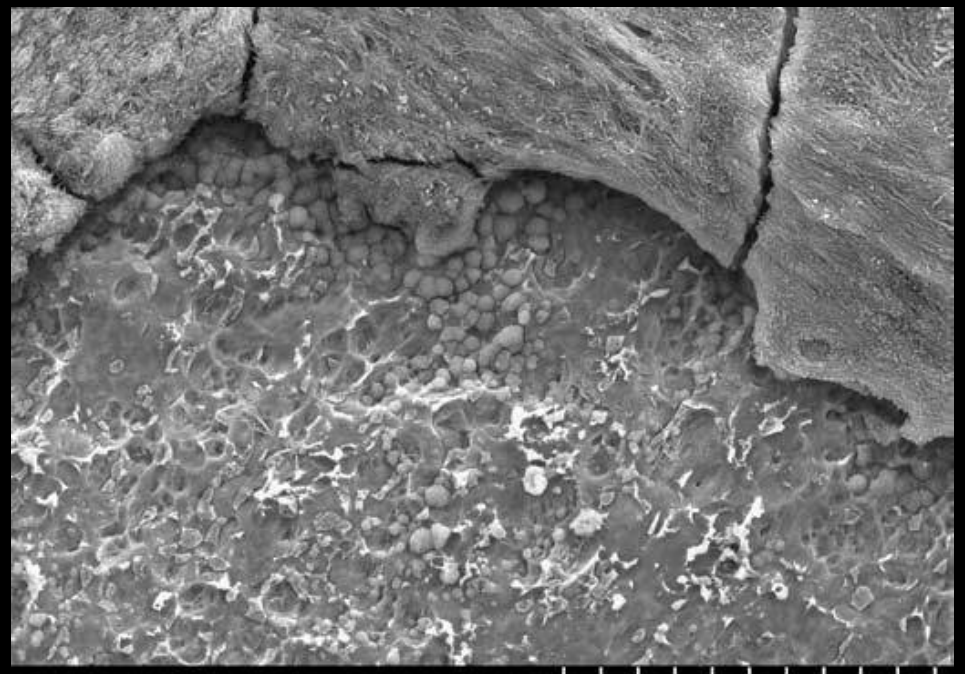
3. The formation of the bone matrix must correctly duplicate what is present in natural teeth, thus ensuring proper support of the masticatory forces by the implant.

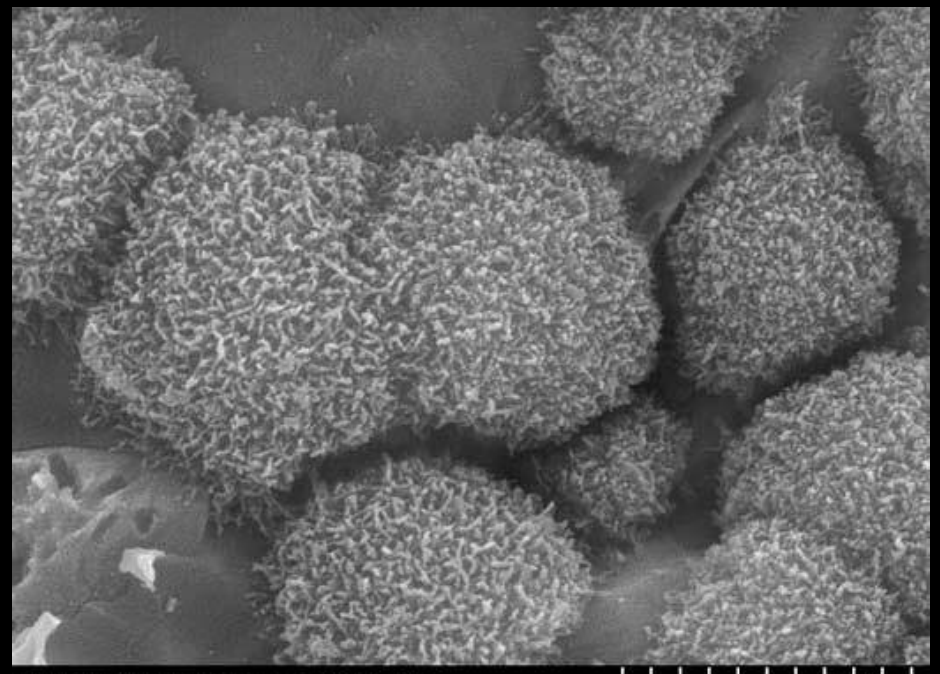
The first and the most important phase: ***osteoconduction***; this is carried out thanks to the first scaffold, **The Blood Clot**.

The second phase of regeneration is the formation of new bone: ***Osteogenesis*** develops the second and third regeneration scaffold.

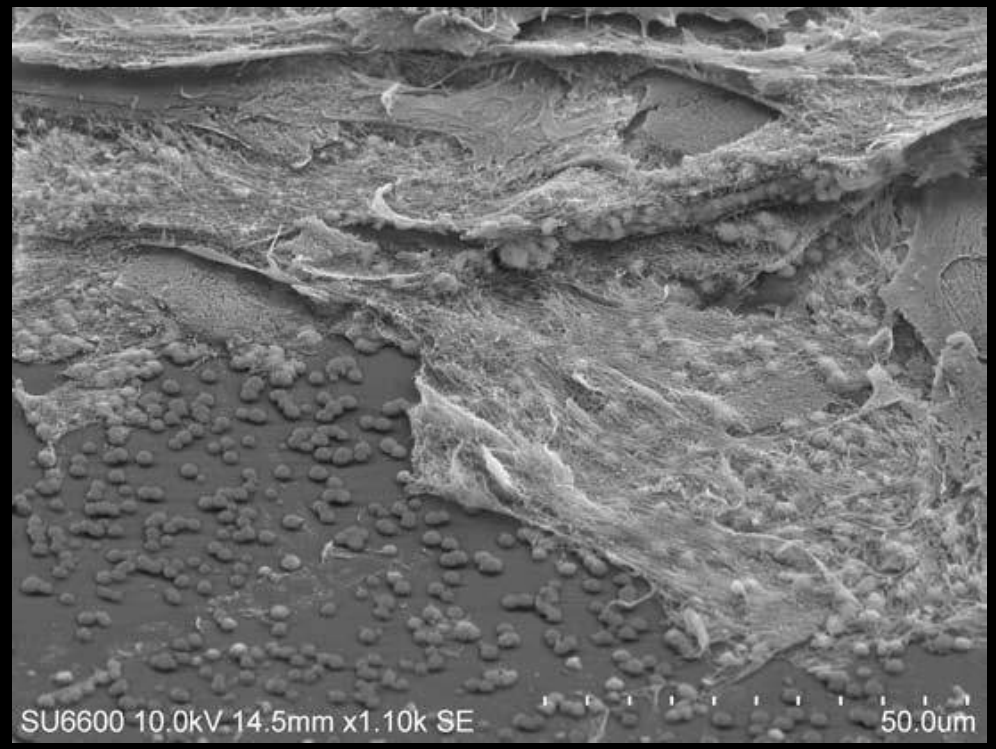
The third phase is ***Bone Maturation.***

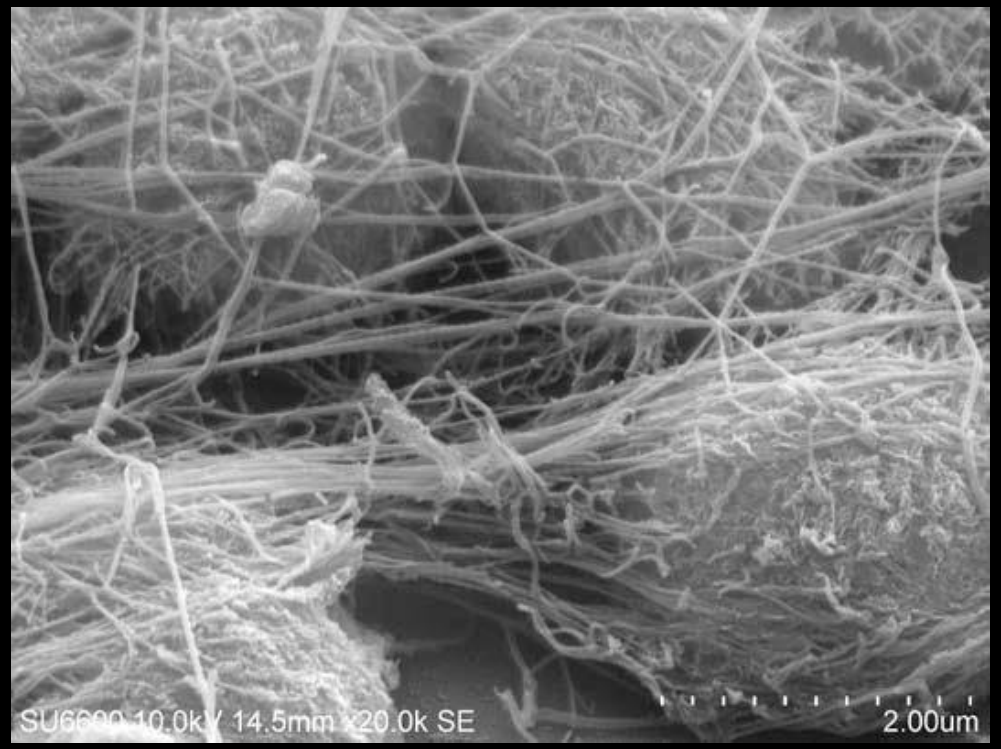
Dr. Alejandro Aguilar MC Roberto B Palma.
Comparative study of the osseointegration of six
Brands of dental implants during the first four weeks - pp10
2013-2014 Research and Education Center Mexico City





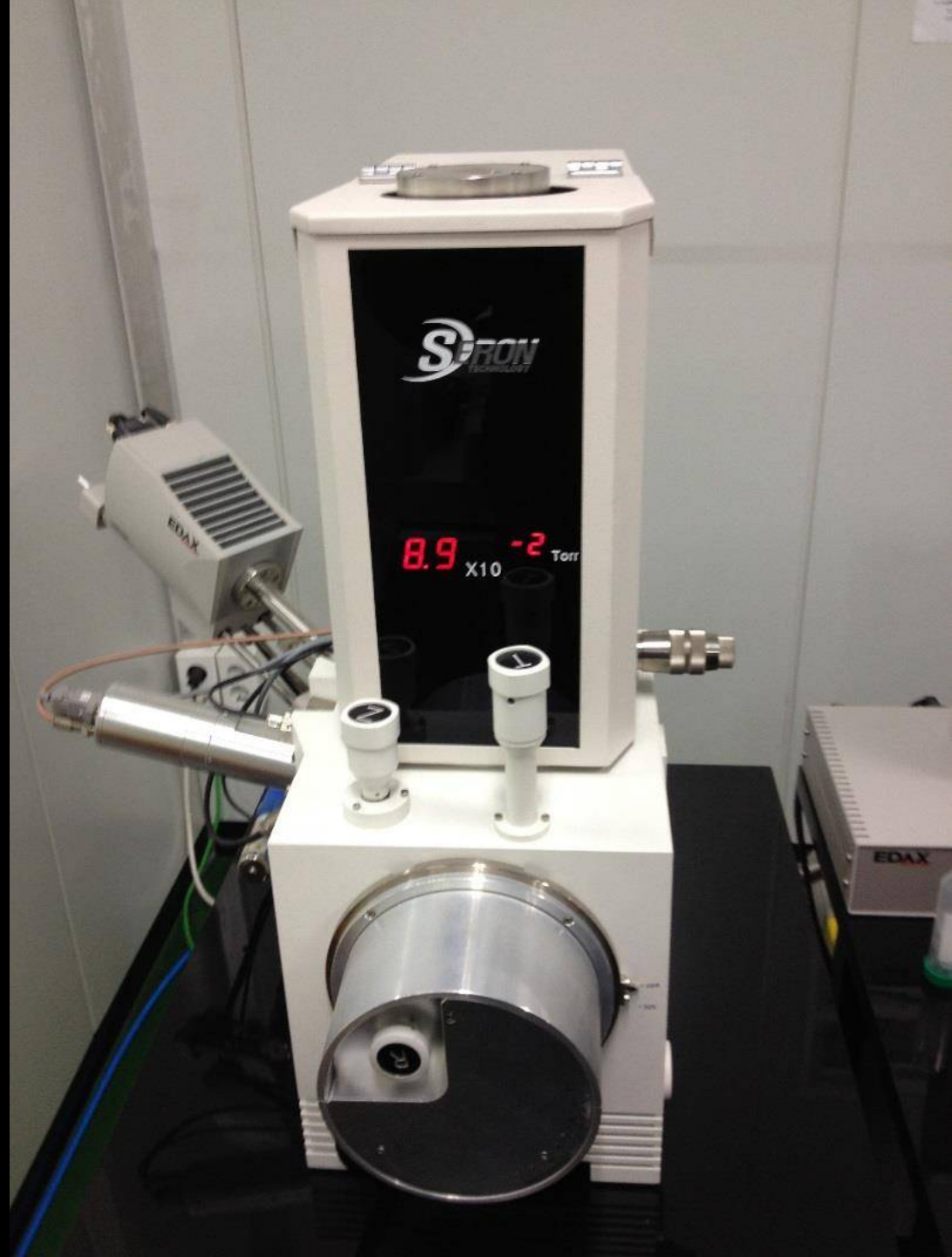
Chih Hesien Ko
University of Toronto *(Canada),*2010
Investigeiting the Process of Cement Line, pp218

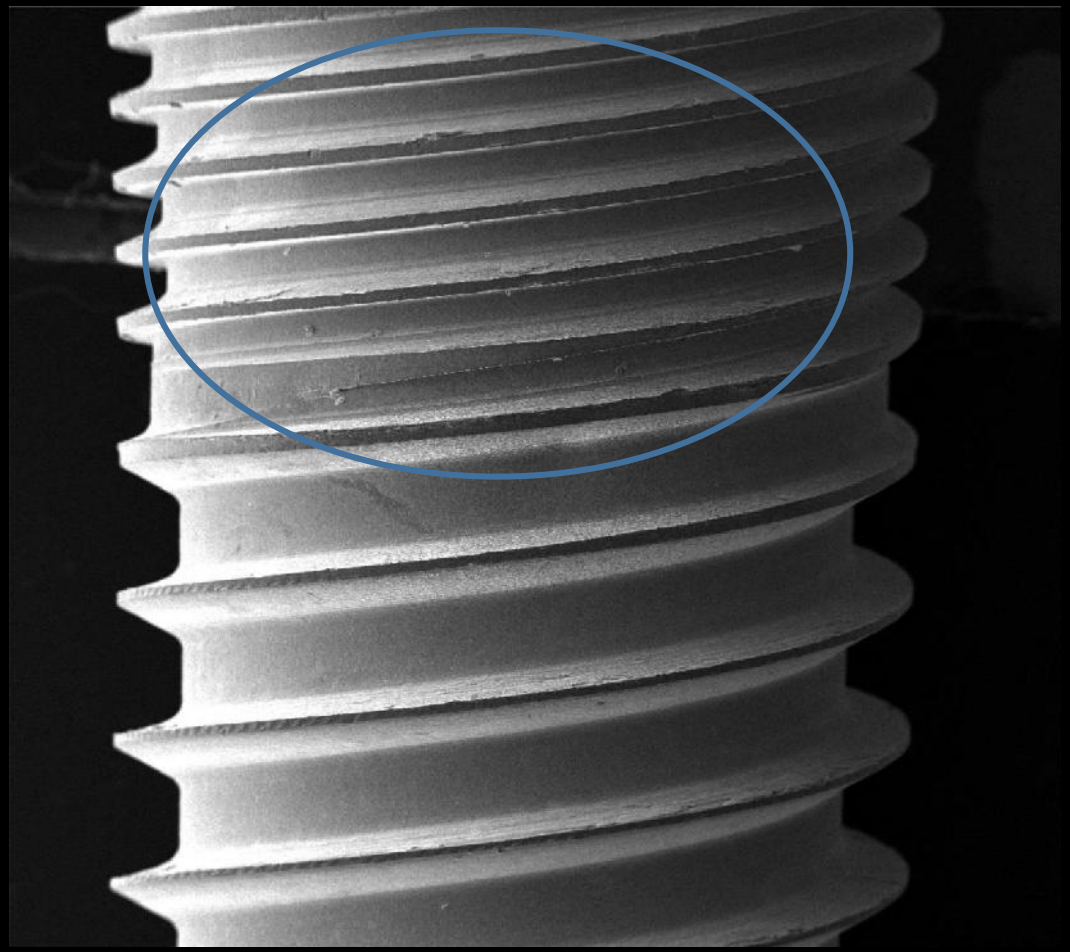




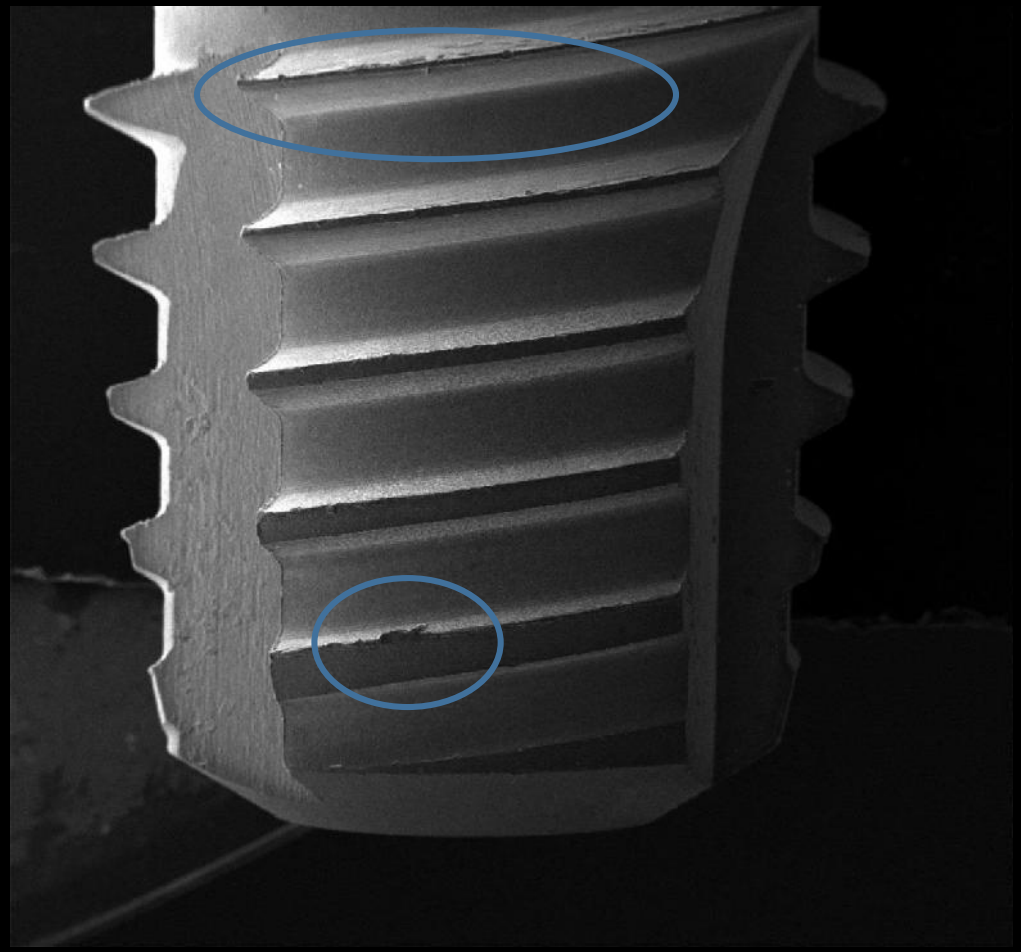
Chih Hesien Ko
University of Toronto *(Canada),*2010
Investigeiting the Process of Cement Line, pp218

Microscopically we observe the surface of a sample of each of the implants selected for study, to find a correlation with the observations in the *Radio-Color* study.





Sample –D0079



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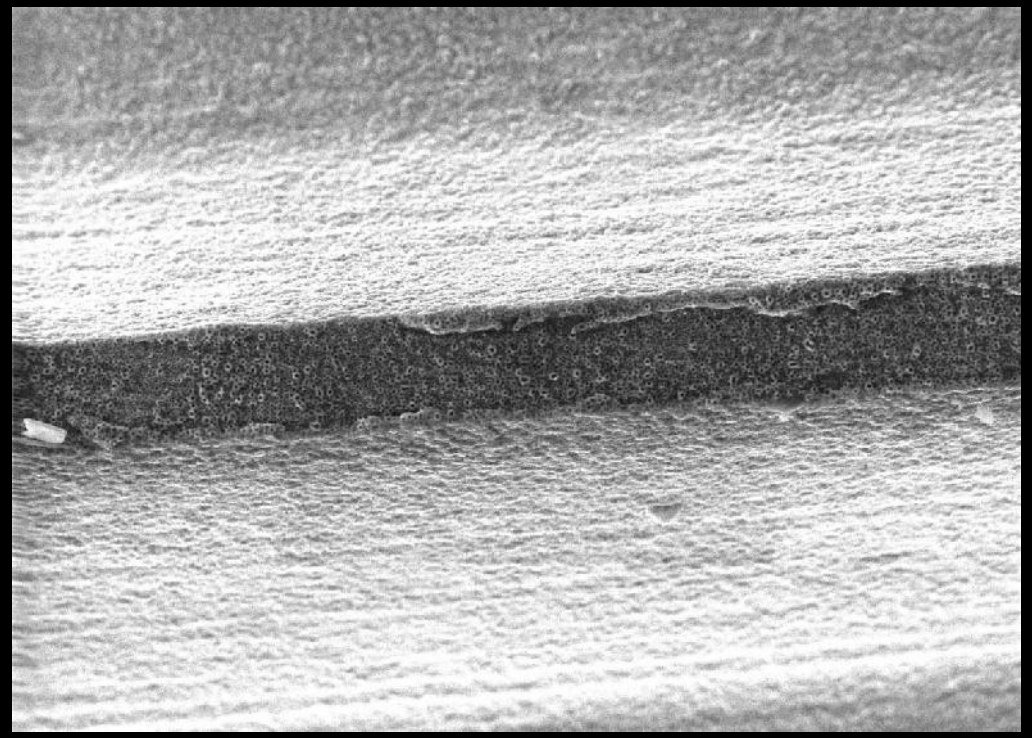

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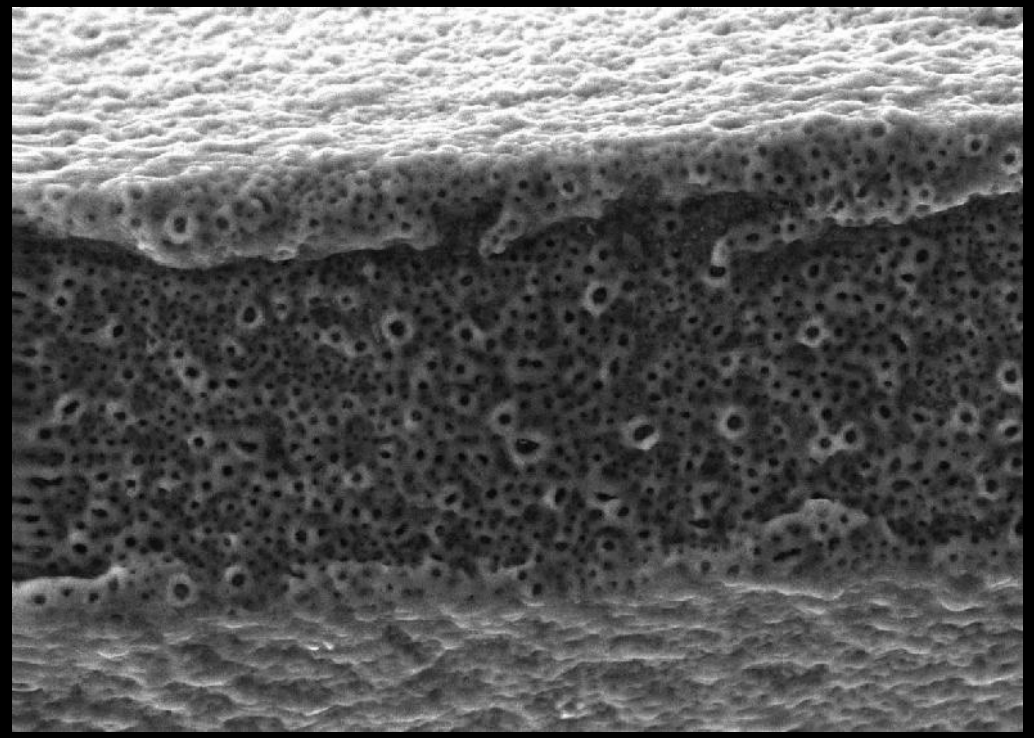
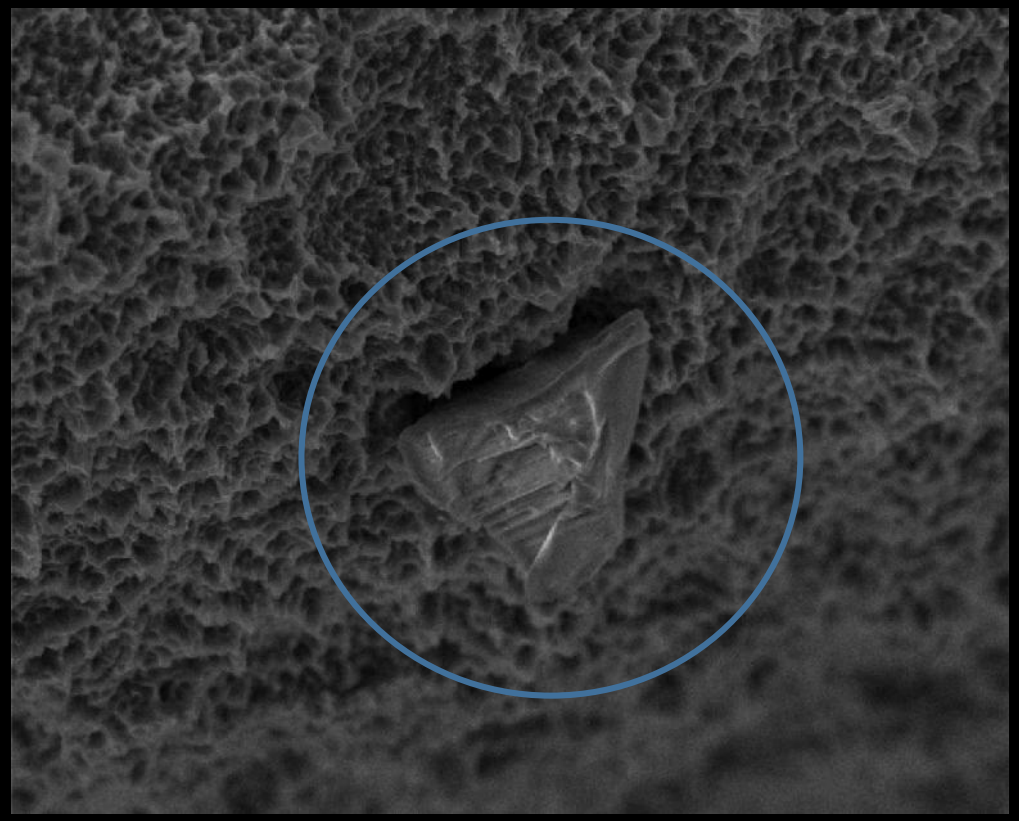


Sample –ND00470



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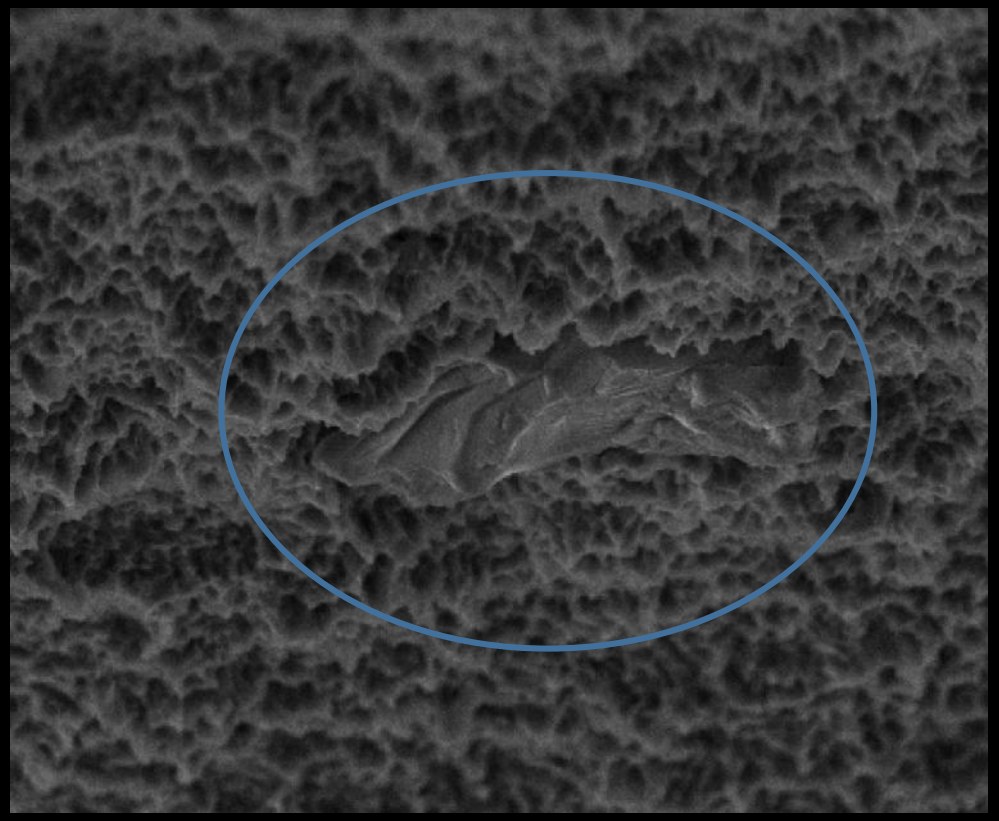

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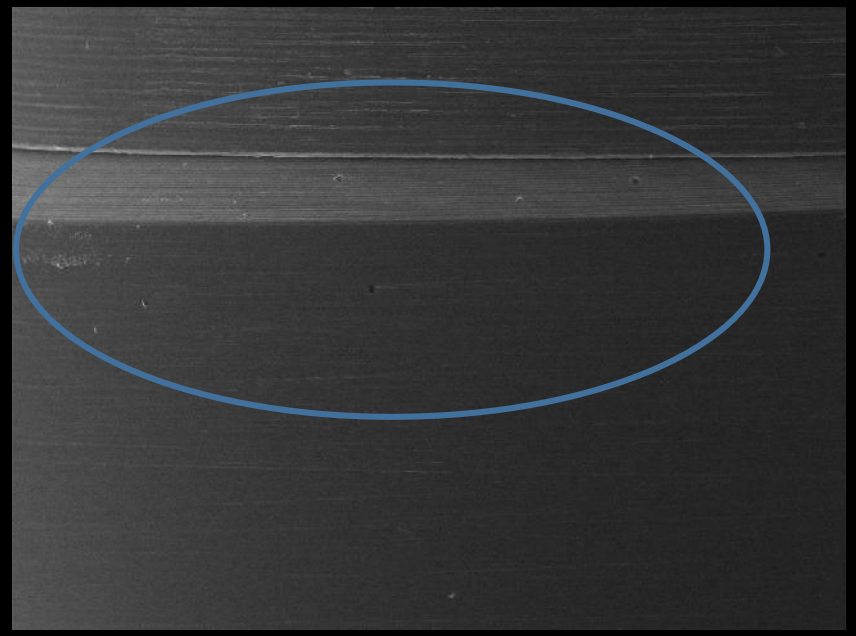
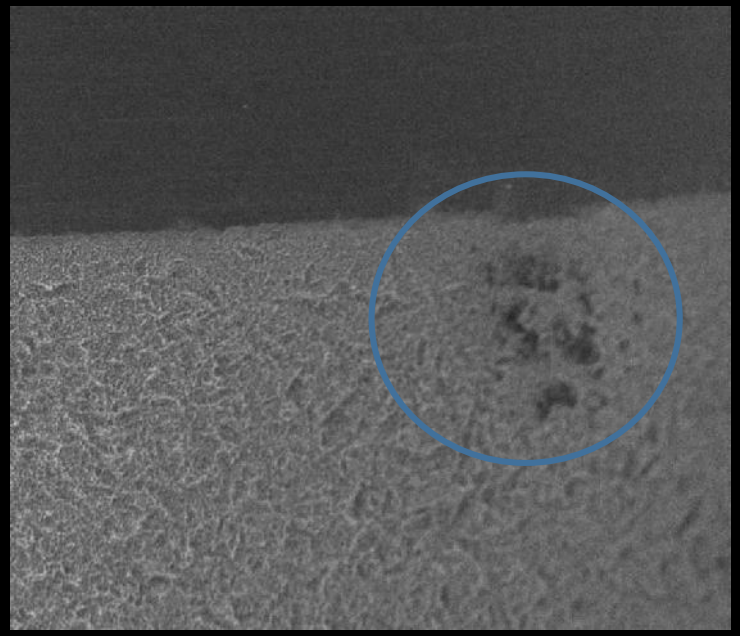


Sample –SD0018



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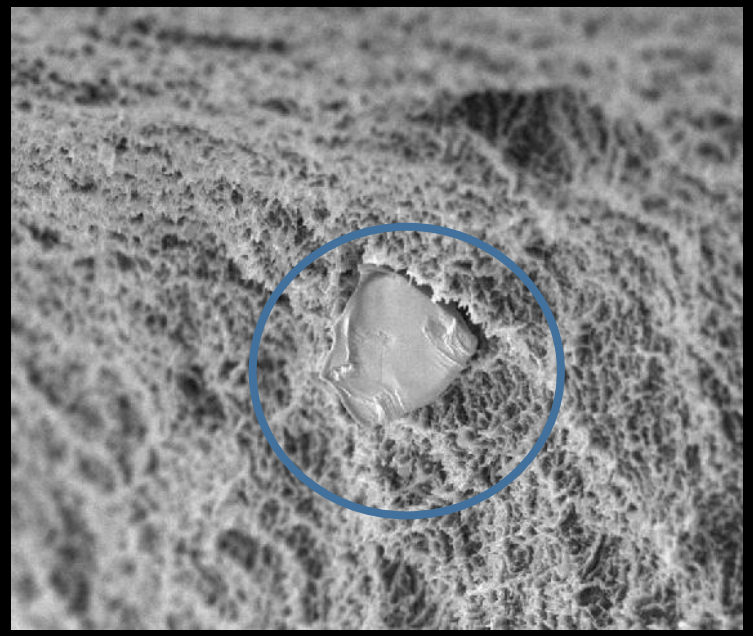
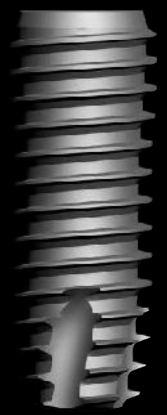
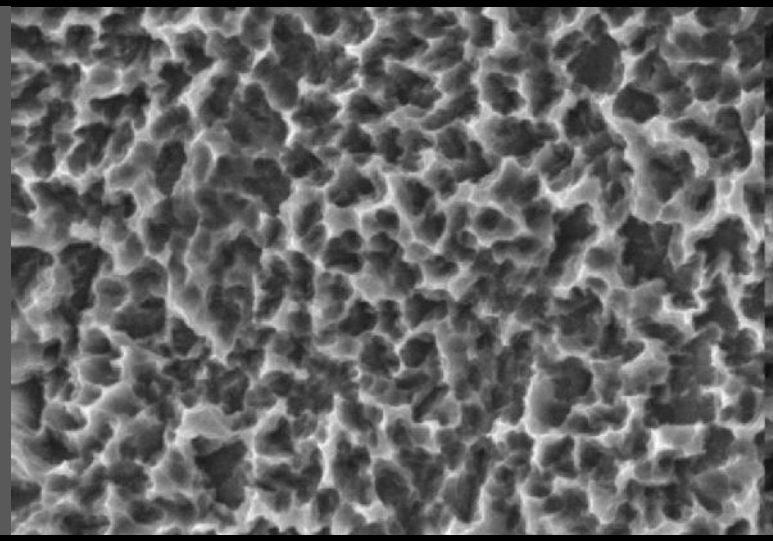


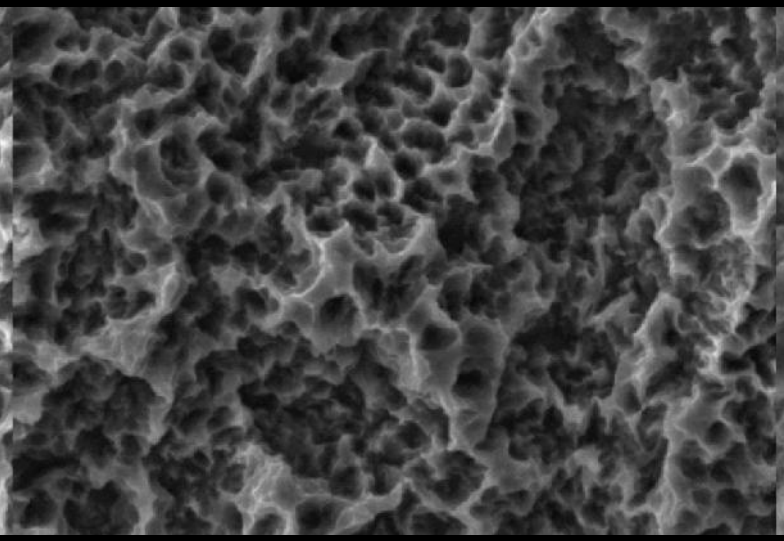
Sample –SD00179

DIO* UF//

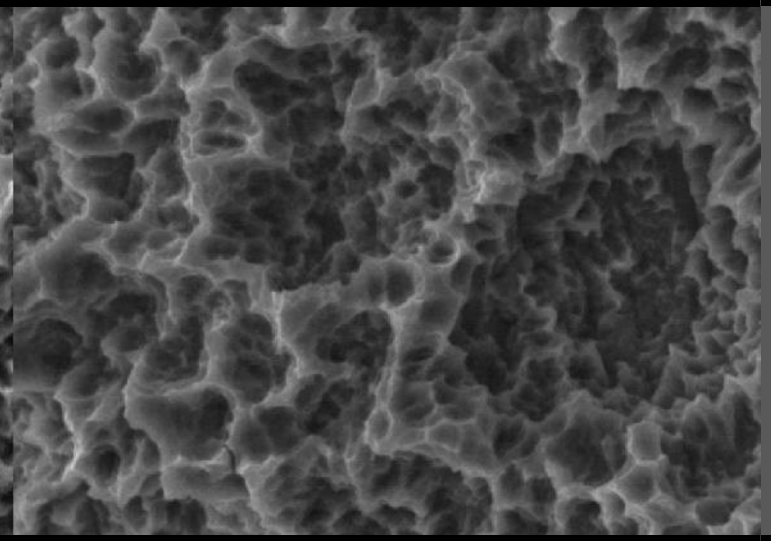




Sample –D00290



Sample –D00392



Sample –D00577

Our preliminary conclusions **are that for the bone to form correctly and evenly all surfaces of the implant and the formation of the bone matrix must be created with a horizontal trabecular similar to a natural tooth:**

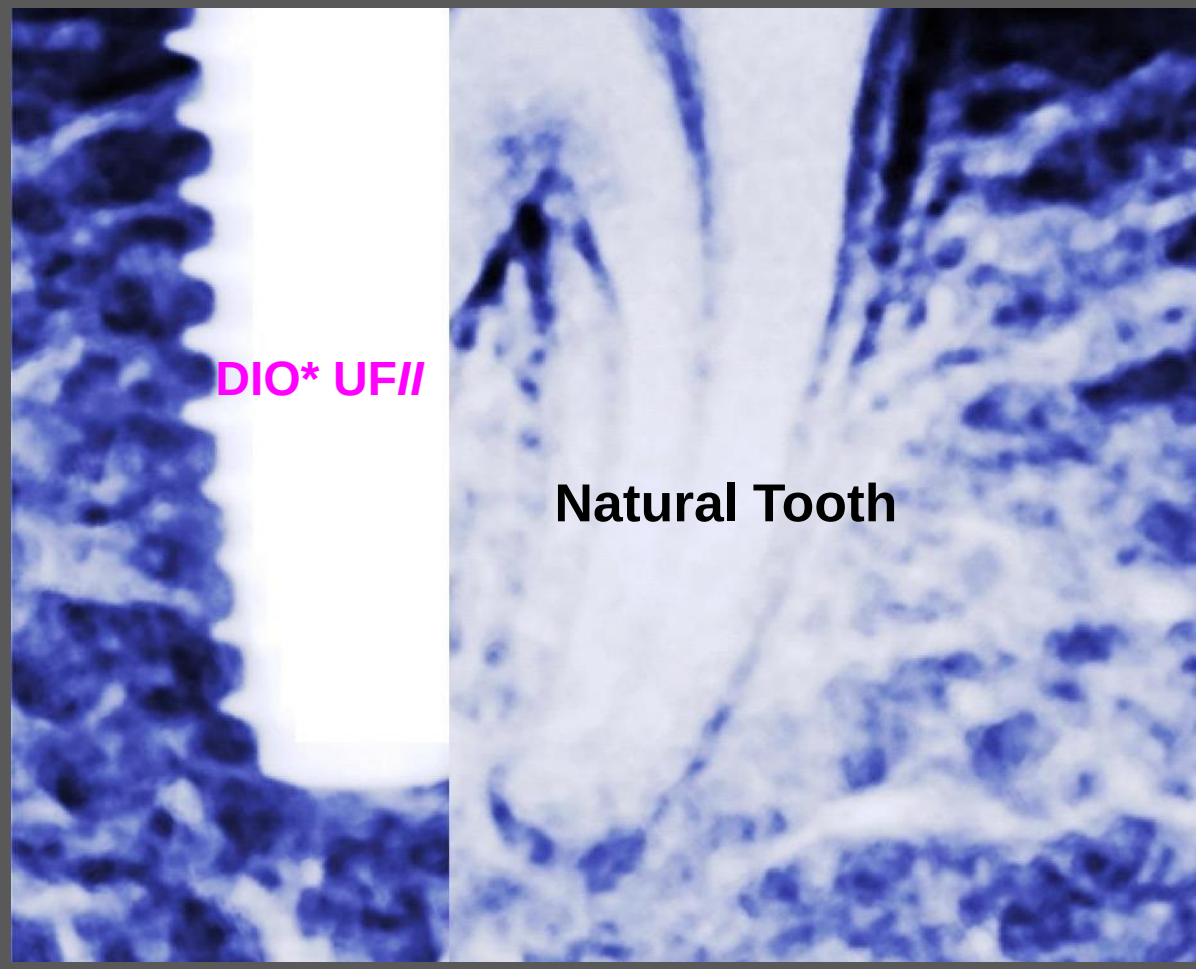
1. **Contact osteogenesis** is the most important phase in the initiation of osseointegration on the implant surface.

2. The implant surface must be homogeneous, free of any impurities or scratches in the manufacturing process. Its architectural design must enable and facilitate the collagen-free hydroxyapatite deposition (cementum) which is the first contact of bone with the implant surface.

3.- **During the clinical procedure the physician must work in an environment that is free from dust and micro organisms that can contaminate the implant surface.**

4. **The cleanliness, purity and homogeneity of the implant surface is critical.**

5. The surface roughness (rugosity) has a definitive influence on the bone matrix formation.



Dr. Alejandro Aguilar MC Roberto B Palma.

There is still a 1% failure rate to resolve.

Success	Failure
99%	1%
450 Placed	5 total loss

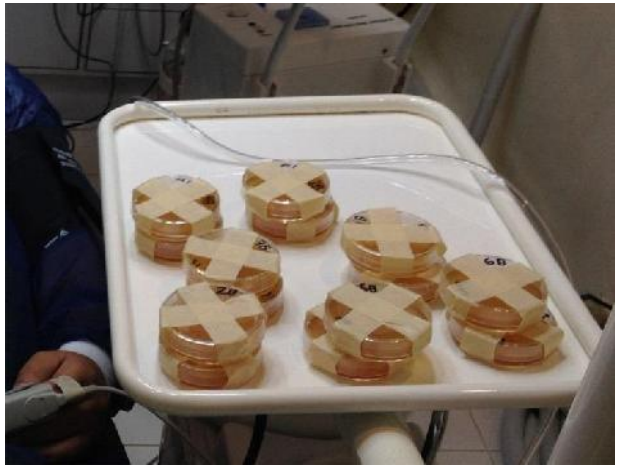
NO loss *was attributable to the dental implant.*

4 *Infection in the first 8 weeks.*

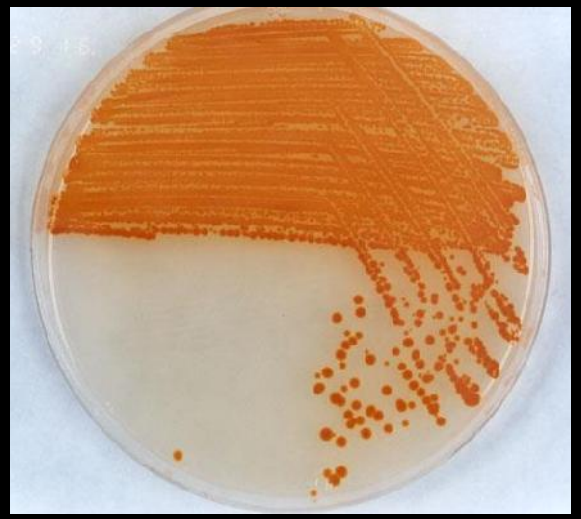
1 *Poor location and clinician error (placement).*

It is critical to place dental implants in a *surgical environment*, or as *clean as possible*.

Detection and infection control in a dental clinic



The most common bacteria in a dental clinic:



Streptococcus

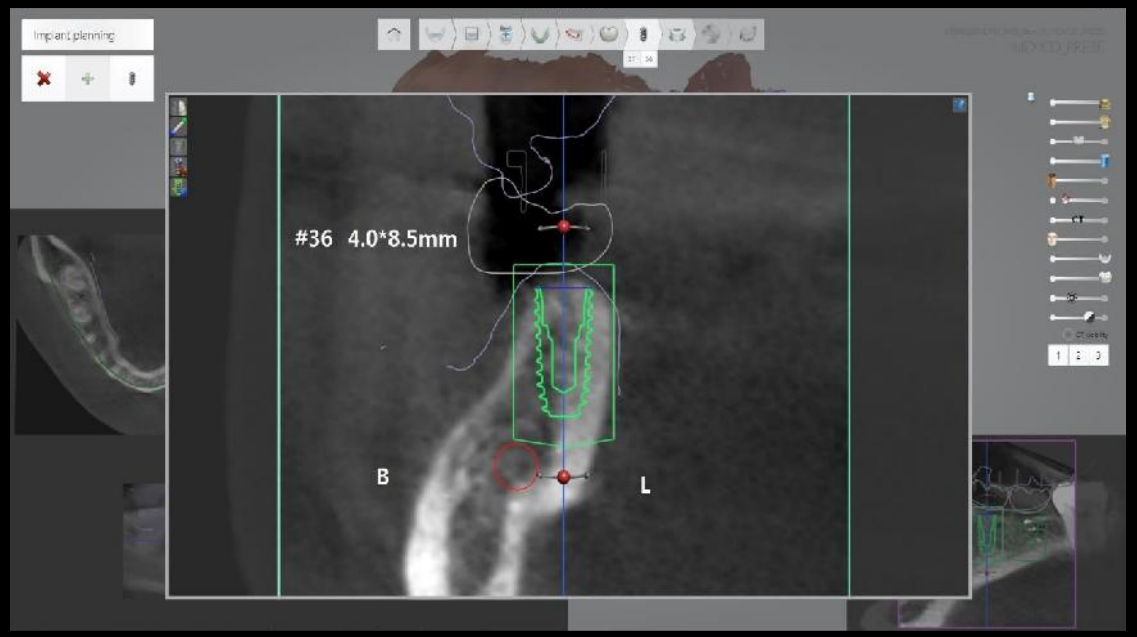
The control of infections in the area where dental implants will be placed is the *responsibility* of the implantologist.

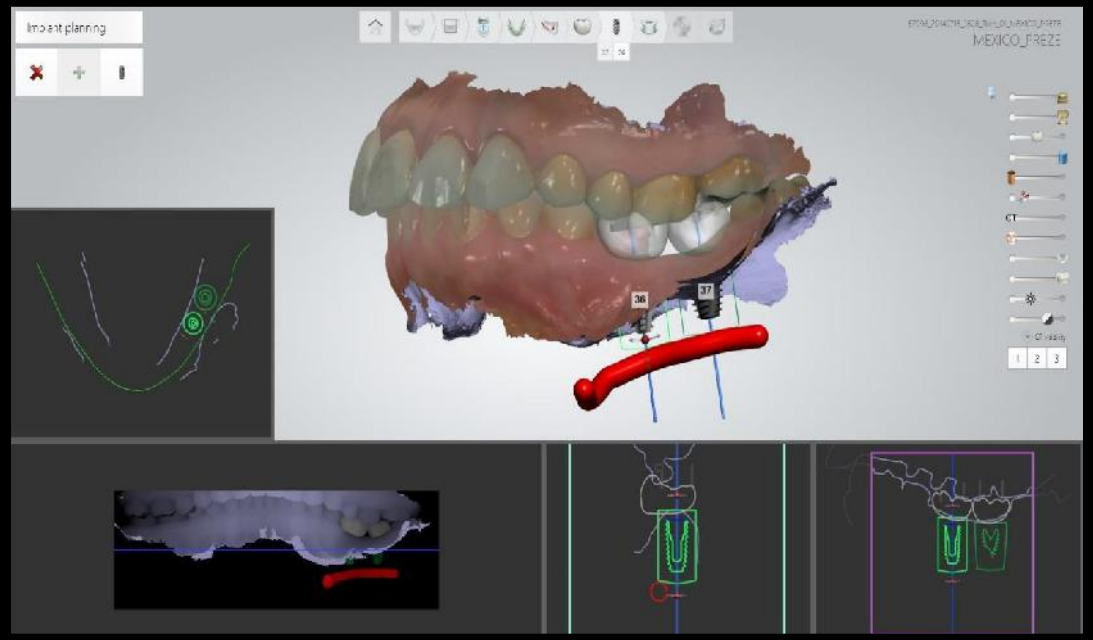

Alejandro Aguilar DDS, CD
KEMMClinic 2014


Alejandro Aguilar DDS, CD
KEMMClinic 2014

Placement

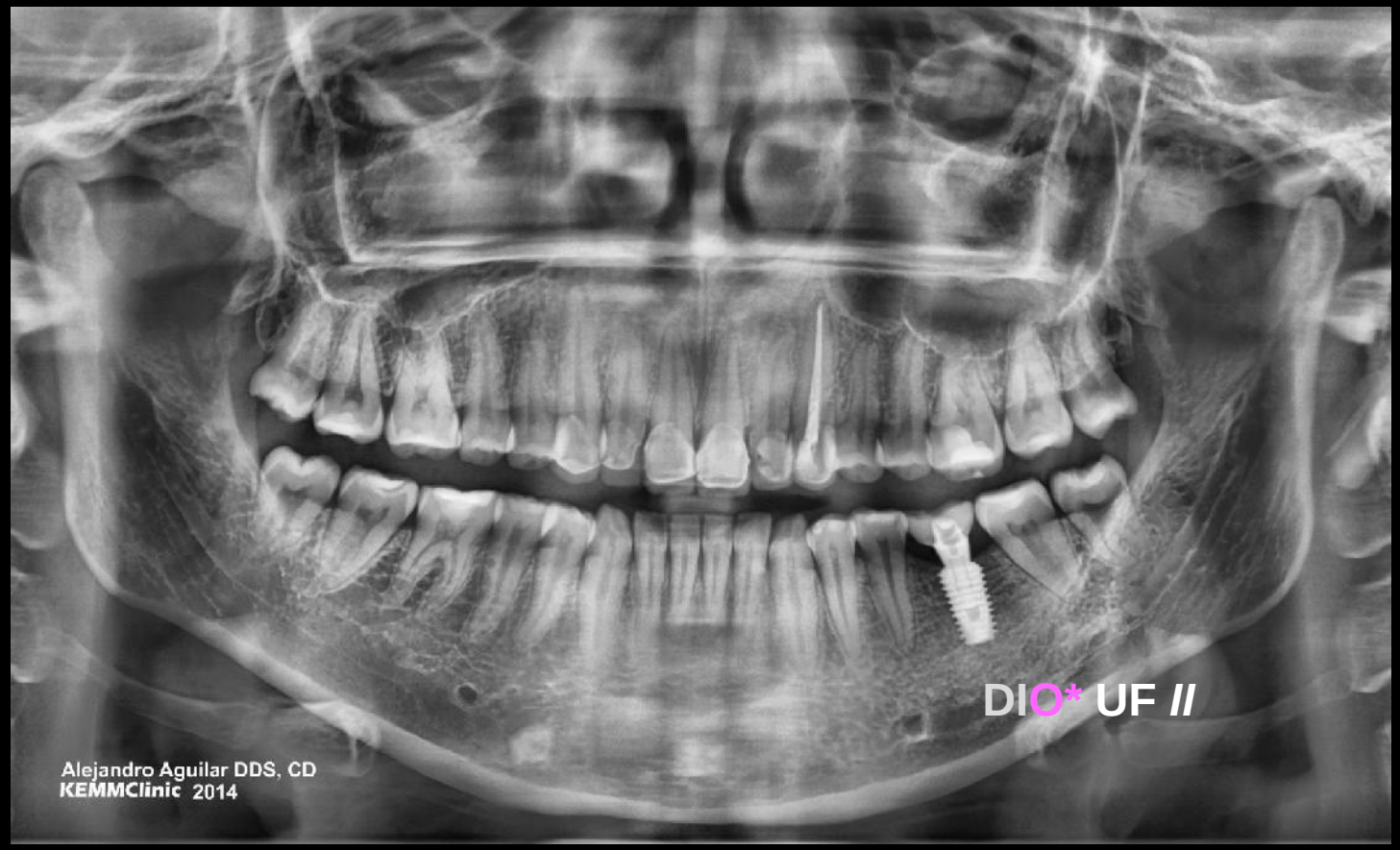
Digital planning and digital placement

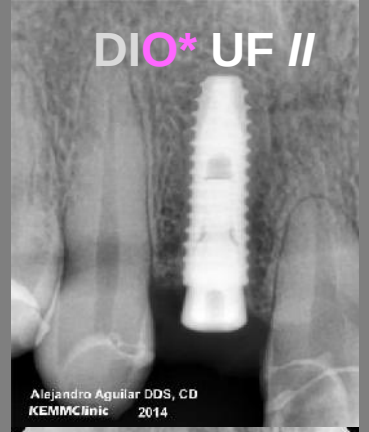




DIO navi.

The dental implant is one of the most reliable treatments at our disposal today.





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