Critical Factors in Implant Aesthetics, Immediate Loading and Sinus Lifts

Lecturer : Dennis P. Tarnow

Immediate loading

- Definition
- Stabilization vs. Osseointegration
- Histological Outcomes
- Clinical Outcomes
- Implant Design
- Transitional Implants
- Technique
- Conclusions

2002년 Spain의 Barcelona에서 열렸던 Immediate Loading 에 관한 Consensus Meeting 에서 Definition 이 확정되기 전까진 미국과 유럽의 Immediate loading 과 immediate function에 관한 정의는 서로 완전히 상반된 것이었다.

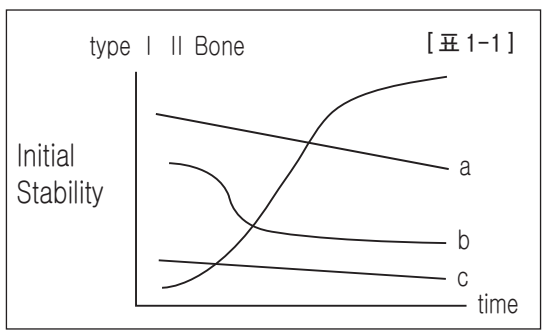
"Consensus 이전"	Immediate Loading	Immediate Function
U.S.	In occlusion	Out of occlusion
Europe	Out of occlusion	In occlusion

Today's Definition of immediate loading after the 2002 consensus :
A procedure in which dental implants are subjected to Functional Occlusal Forces / loads coincident with the date on which the surgery to place them was performed.

Immediate loading 에 관해 다음 네 가지 상황을 고려해 볼 수 있다.

1. immediate temporization without occlusion
2. immediate temporization in occlusion
3. immediate socket placement without occlusion
4. immediate socket placement with occlusal loading

표 1-1 은 immediate loading 을 위해 반드시 이해해야만 하는 도표다. a, b, c 선이 % of osseointegration line 과 만나는 곳은 initial stabilization이 osseointegration의 힘으로 넘어가는 지점이다. 여기서 type III bone에 주의해야 한다. 왜냐하면 초기의 biologic width 형성 후 첫 번째 thread 까지 bone 이 흡수되면 약한 marrow 쪽의 bone 만 남기 때문이다. 그러므로 type III bone 에서는 supracrestal 로 implant 를 위치시키도록 해야 한다.



Initial stabilization을 높이는 3가지 방법은
1) dense bone에 심는다,
2) wedging force를 위해 tapered implant를 심는다.
3) "go around the turn"

즉 straight line splint가 아니라 U-shaped splint를 한다.
Straight line splints는 mesiodistal force엔 강하나 buccolingual force엔 약하다. 약 150 ㎛ 이상의 lateral force 가 있을 시 osseointegration이 일어나지 않는다. 그러므로 M/D, B/L force에 저항할 수 있는 U-shaped splint를 해준다.

Immediate loading 에 관한 몇 가지 literature review 를 해보도록 한다.
1. The effects of early occlusal loading on One-stage Ti-Alloy implants in beagle dogs: A pilot study
Sagara M, JPD 1993; 69:281-288

	BIC (Bone to Implant Contact)
Healing abutment, No loading	40.1
Occlusally loaded	35.5
Submerged	57.4

Submerged case에서 더 나은 BIC를 보여주었다

2. Immediate loading of Ti-plasma-sprayed implants: An Histological Analysis in Monkeys
Piattelli A, Scarano M, Paolantonia M J. Periodontol 69; 329-327:1998
-monkey study
-48 TPS (24 Maxilla, 24 Mandible)
-24 test (loaded), 24 control (unloaded)
-9 months
-Histomorphometric analysis
-BIC (bone to implant contact)

	Test	Control
Maxilla	67.3 ± 7.6	54.5 ± 3.3
Mandible	73.2 ± 5.9	55.8 ± 6.5
Overall	70.2 ± 7.3	55.1 ± 5.1

-1번 연구와는 달리 loading을 가한 test group 에서 더 나은 BIC를 보여주고 있다.

3. Histological and Histomorphometrical implant bone subjected to immediate loading : An experi mental study with Macasa fascilularis
• Romanos GE, Toh CG, Siar C
• IJOMI 17; 44-51, 2002

BIC 는 immediately loaded case와 delayed case 에서 별다른 차이를 보이지 않았으나, BA(bone around implant within the threads)에서는 immediately loaded case에서 더 많은 % bone 을 보여주었다.

4. Immediate fixed interim prosthesis supported by two-stage threaded implants: Methodology and Results
• Schnitman P, Wohlre B, Rubenstein J
• J Oral Implantol 1990; 16; 96-105

• N=7 patients
• 47 Nobelpharma Implants
• 26 implants submerged in anterior mandible
• 4 months submerged period
• 21 implants loaded to support interim prosthesis
• 1 immediately loaded molar region fixture failed at 3 months
• 1 immediately loaded molar region fixture failed at 6 months
• 1 immediately loaded molar region fixture failed at 21 months

• Potential cause for immediate implant failure
  -inadequate implant length
  -poor bone quality (as per Schnitman)
• 18 still integrated
위에 열거된 서로 상반된 연구결과로 본인은 자체적

으로 Immediate loading 에 관한 다음과 같은 새로운 실험을 하게 되었다.

1) Immediate loading of threaded implants at stage 1 surgery in edentulous arches: Ten consecutive case reports with 1 to 5 year date

- Tarnow DP, Emtiaz S, Classi A
- IJOMI 12; 319-324, 1997

- 10 patients
- 6 mandibular cases (64)
- 4 maxillary cases (43)
- Total loaded: 69
- Total submerged: 38
- Total # placed: 107
- Failed

  2 immediate loaded

  (이 두 case 모두 interim prosthesis 를 한 경우임)

  1 submerged

Case #	Total placed	Immediate loaded	Submerged	Arch	Type
1	10	5	5	Mandible	Noble
2	10	5	5	Mandible	Noble
3	10	4	6	Mandible	Noble
4	11	6	5	Mandible	ITI
5	11	6	5	Maxilla	Noble
6	13	6	7	Mandible	Noble
7	11	8	3	Maxilla	Noble
8	11	9	2	Maxilla	Astra
9	10	10	0	Mandible	Astra
10	10	10	0	Maxilla	3I

본인은 case 가 진행됨에 따라 좀더 자신 있게 immediate loading의 수를 늘리게 되었다. 또한 Maxilla의 경우도 예외가 아니며 implant type 에 따른 차이도 없는 것을 볼 수 있다.

2) Implant-retained mandibular overdentures with immediate loading:

A Retrospective multicenter study on 226 consecutive cases

- Chiapasco M, Markwalder TH
- COIR; 8:48-57, 1997

- 226 patients, 904 Implants (4/implant)
- 4 systems (TPS, ITI, HA-Ti, NLS)
- Impression immediately after surgery
- U-shaped gold bar inserted next day
- Clips mounted and denture inserted same day
- Average follow up 6.4 years
- Implant success 96.9%, Bar success 98.5%

여기서 Dr. Tarnow 는 bar는 class III malocclusion 에서 maxillary case 를 제외하고는 이제 잘 쓰지 않는다고 함.

3) The use of transitional implants for immediate fixed temporary prostheses in cases of implant restorations

- Froum S, Emtiaz S, Tarnow D
- Pract Perio Aesthet Dent ; 1998; 10(6) 737-746

- 78 transitional implants in 15 patients
- 6 failed (3 in one patient)
- 3 were mobile but remained in function
- no prostheses were lost
- failure due to early prosthesis removal

정확한 Surgical Template를 만들고 2mm twist drill 로 깊이 5mm까지 drilling 한 후 drilling 한 위치에 attached gigiva 가 있을 경우 flapless surgery를 한다. punch를 사용하는 경우는 일종의 flap이므로 flapless surgery 라 할 수 없다.

다음과 같은 경우에 out of occlusion 시켜준다
immediate temporization without occlusion
1) One stage surgery with a healing abutment
2) Single crown
3) Straight line splints

Immediate socket placement without occlusion
1) when the socket is filled by the implant
(1.5mm rule)
2) full arch case only or 4 on floor splinted

Conclusion

1) Full arch cases only for occlusally loaded cases
2) Or 4 on the floor splinted with a bar
3) Non-occlusally loaded with immediate temporization for cases with good initial stabilization (type I & II bone)
4) Immediate socket implants should be utilized with caution for immediate occlusally loaded cases
5) Success will depend on
length of implant in bone
density of bone
width of the implants
distribution of the implants
(turn in the arch and AP spread)

Tips for immediate occlusal loading

1) For Full arch case only
2) Use minimum 10mm implants
3) Use diagnostic wax-up for template and provisional
4) Use rigid metal casting in lingual of provisional (if there are long spans)
5) Use screw retained provisional
6) If cemented, do not remove provisional for 8 + weeks
7) All implants must have high initial stability (tongue, ISQ, periotest)
8) Utilize widest A-P distribution of implants

Sinus lift

▶NYU sinus study database
▶Evidence-based decision making
Effect of time
Effect of graft materials
Effect of membranes
Effect of implant surface
Interactions

NYU Sinus Study (1993~July 2003)
797 Sinus lifts (517 patients)
1461implants placed
395 histological cores

Effect of time on sinus graft healing
1) Histological evaluation of the sinus elevation procedure : A clinical report
• Wallace et al
• Int J Rest Dent 1996; 16; 46-51
• 4 sinus cores from the same subject
80% Osteograf/N, 20% Autogenous
Cores at 4, 8, 12 20 months
Histomorphometric analysis done inde - pendently by different university & not supported by any company

# months	4	8	12	20
% vital bone	15%	33%	38%	65%

2) Effect of time on graft maturation
• Froum et al

• Int J periodont Rest Dent 1998; 18:529-543

Time	# cores	Range %	Average %
6 ~ 9 months	9	9 - 34	24
12 ~ 15 months	9	10 - 65	33

*cores from the same patient

*여기서 25-30% 의 calcification에 주목해야 한다. 예를 들어 같은 시기에 발치한 하악 소구치와 상악 소구치는 1년 후 분명히 다른 calcification 상태를 보인다.

Genetically coded된 발치외벽으로부터 새 골조직이 형성되기 때문이다. 그래서 만약 sinus가 anterior mandible 에 있다면 sinus augmentation 후 약 70% 의 calcification 과 약 30%의 marrow를 갖게 될 것이나, posterior maxilla 에 있으므로 약 25-30%의 calcification 과 70% 정도의 marrow 를 갖게 되는 것이다.

Rate of calcification 은 약 1mm/month from the bony wall

예) remaining bone 이 약 4mm 인 경우 sinus augmentation 후 6개월이 지난 시점에서 약 10mm 정도의 solid bone이 형성된다.

Effect of graft material

1) Human histologic evidence of integration functionally loaded hydroxyapatite-coated implants placed simultaneously with sinus augmen tation: A case report 2.5 years post placement

Rosenlicht J, Tarnow D

J Oral Implantol 1999; 25:7-10

2.5년 후 일부 graft material (bovine bone) 은 bone 과 완전히 integration된 상태로 남아 있으며 implant 주변엔 bone 과 marrow 만이 접해있다

(bovine bone graft material 은 주변에 접해 남아있지 않는다)

2) Histologic evaluation of Bio-Oss in a 2 stage sinus floor elevation and implantation procedure: A human case report

Valentini P, Abensur D, Densari D

COIR 1998; 9:59-64

Area densities of the mineralized bone at 6 month

	Area density of bone	Area density Bio-Oss	Area density Bone marrow
Non-grafted area	27		73
Grafted area	28	28	44

Area density of bone은 어떤 research paper든, 어떤 material 을 쓰는가에 상관없이 일정하게 25-30% 정도로 나온다. Grafted area 에서 Bio-Oss 가 bone marrow space를 차지하고 있는 것은 좋은 점이다.

결론적으로 반드시 Mineralized boned을 사용해야만 한다. (human bone 이나 bovine bone 어느 쪽이나 무방하다)

3) Sinus Grafting with porous bone mineral (Bio-Oss) for implant

placement:

A 5 year study on 15 patients

Valentini P, Abensur D, Schenk R et al

Int J Rest Dent 2000; 20:245-253

20 sinuses, 15 patients

100% Bio-Oss

57 implants placed at 6 months

stage 2 surgery in 6 months

cores at 6 & 12 months in 3 patients

cores taken through crest

N=3	% new bone	% Bio-Oss	% marrow
Grafted area 6 months	21	39	40
Non-Grafted area 6 months	24		76
Grafted area 12 months	28	27	45
Non-Grafted area 12 months	31		69

시간이 지남에 따라 분명 new bone 은 증가하나 non-grafted area의 %를 넘어서지 못한다.

Results achieved with different grafting materials

1) Sinus floor elevation using anorganic bovine bone matrix (Osteograf/N) with and without autogenous bone
Froum S et al
Int J Rest Dent 1998; 18:528-543
Graft combinations in study

Graft material	With membrane	Without membrane
Osteograft alone	11	4
Osteograft + Autogenous bone	30	6
Osteograft + DFDBA	13	9
Osteograft + DFDBA + Autogenous bone	24	14
Total	79	34

• % vital bone content at 6 month

Graft material	N	Range %	Average
Osteograft alone	10	5-33	17
Osteograft + Autogenous bone	31	16-45	29
Osteograft + DFDBA	14	13-32	23
Osteograft + DFDBA + Autogenous bone	24	21-35	33

Xenograft + DFDBA 가 Xenograft 단독사용 시 보다 더 많은 vital bone 형성이 이루어짐을 볼 수 있다

• Implant Survival

Graft material	Placed	Failed	% Survival
Osteograft alone	25	0	100
Osteograft + Autogenous bone	64	1	98.4
Osteograft + DFDBA	48	3 (Cluster)	93.8
Osteograft + DFDBA + Autogenous bone	78	0	100

Osteograft 단독 사용시 5% vital bone range 에서도 성공을 보여주고 있는 점은 주목할만하다.

2) Clinical and histological evaluation of implant integration after sinus floor augmentation with autogenous bone, bovine HA, or a 20:80 mixture

Hallman M, Sennerby L, Lundgren S
IJOMI 2002; 17:635-643
36 sinuses, vital bone contents

100% autogenous	37.7 ± 31.3%
20/80 composite	39.9 ± 8%
100% Bio-Oss	41.7 ± 26.6%

No statistical difference
Then, How about implant survival?
36 sinuses, 111 implants, 1 year loading

Overall survival	91.0 %
100% autogenous	82.4 %
100% Bio-Oss	96.0 %
20/80 composite	94.4 %

Autogenous bone이 Gold Standard 가 아님을 보여준다.

Evidence shows mineralized bone replacement grafts can be used alone
with highly predictable results
100% Bio-Oss
Hising 2001, Hallman 2002, Valentini 2003
100% Osteograf/N
Froum 1998
Evidence-based literature reviews
Wallace, Froum 2003, Del Fabbro, Testori 2004

Effect of autogenous bone, PRP

1) Effect of PRP on bone formation in Xenografts (Bio-Oss) placed in the human Maxillary sinus: A pilot study of 3 bilateral cases Froum S et al
Int J Periodontal Rest Dent 2002; 22:45-53

Case #	Graft	Time months	Platelet gel	No platelet gel
1	100% Bio-Oss, Bioguide	7	15	13
2	95% Bio-Oss, 5% Autogenous, Bioguide	7.5	21	19
3	100% Bio-Oss, test implants	7.5	34	32
Mean			23.3	21.3

PRP를 사용한 경우와 그렇지 않은 경우에 통계적으로 유의 있는 차이가 없음을 알 수 있다.

2) Implant survival by graft material
Del Fabbro, Testori et al, IJPRD accepted

Graft material	# Studies	# Implants	# Failures	% Survival
100% Autogenous bone	20	3398	418	87.7
Composite	13	2011	103	94.9
100% Bovine replacement	12	1197	45	96.2

여기서 자가골에서의 survival rate이 더 낮은 이유가, 초창기엔 주로 hip marrow 와 machined Ti-implants 를 조로 사용하였기 때문일 수도 있다. (Rough surface implant 는 더 나중에 사용되기 시작)

3) Particulate vs. autogenous block graft
Wallace et al, Annals Periodontol 2003; 7

Graft type	Mean	Standard error	Least square mean
Iliac block	80.4	2.96	83.3
particulate	94.8	1.72	92.3

*least square mean include adjustments for other variables

Sinus Graft 시의 Membrane 사용

장점: -excludes non-osteogenic connective tissue from the flap
-enhances graft containment
단점: -removes periosteum from the healing site
-inhibits vascularity

Patient	Maturation time (months)	% Vital bone without memb.	% Vital bone with memb
1	7	3.8	14.5
2	7	20	25
3	8	8	54
4	8	22	32.4
5	8	9	11
6	8	7	30
7	8	30.8	31
8	8	9.8	42.2
9	8	9	11
10	12	10	13
11	12	4	25
12	12	10	7.4
Average		11.9	25.5

1) Effect of membrane on vital bone formation

- Tarnow et al
- Int J Rest Dent 2000; 20:117-125
- Same graft material, same maturation time, membrane on one side only

결과를 보면 평균적으로 membrane을 쓰는 쪽이 분명히 도움이 되고 개별적으로 보더라도 월등히 좋거나 차이가 없다. 그러므로 Sinus lift 시 membrane 사용은 이제 routine practice가 되어야 한다.

2) Intrastudy comparison of 3 randomly controlled trials

Wallace et al, Annals Periodontol 2003; 7

Study	With membrane	Without membrane
Tarnow (2000)	28 implants, 100%	27 implants, 92.6%
Tawil (2001)	29 implants, 93.1%	32 implants, 78.1%
Froum	133 implants, 99.2%	82 implants, 96.3%

3) Sinus augmentation using Bio-Oss with various membranes

Froum et al, manuscript in preparation

Membrane type	# Sinuses	Range vital bone	Average
e-PTFE	26	3-53	19.5 %
Collagen	43	3-51	19.0 %
No membrane	9	1-29	11.9 %

e-PTFE와 Collagen membrane 사이에 차이가 없음을 보여준다.

Survival Rate for implants

Membrane type	# Placed	# Failed	% Survival
e-PTFE	56	1	98.2 %
Collagen	98	3	96.9 %
Total	154	4	97.4 %

Effect of implant surfaces

1) Survival rates of implants with different surface morphologies in grafted sinuses - 6 months post loading data

Tarnow et al, manuscript in preparation 517 patient

1461 implants loaded for a minimum of 6 months

Surface	Acid-etched	HA	SLA	TiOBlast	TPS	Machined
# of implants	962	22	169	28	160	105
Survival rates	95.4 918/962	90.9 20/22	95.8 162/169	96.4 27/28	95.0 152/160	70.4 74/105

Average survival rates: 93.7 % (1368/1461)

Survival rate of rough surface: 95.4 %

Survival rate of smooth surface: 70.4 %

2) Implant survival by surface

Del Fabbro, Testori et al IJPRD, Accepted for publication

Surface	# studies	# implants	# failures	% survival
Turned	19	2827	406	85.6
Rough	18	2939	115	96.1

3) Wallace et al, Annals Periodontol 2003:7

surface	Mean
Machined	82.4
Rough	95.2

In conclusion, Don't place machined surface in sinus

Interaction

Graft material and Implant surfaces

	Mean	Standard	Least square
Machined-iliac block	78.8	2.5	78.8
Machined-particulate	89.5	3.3	90.0
Rough-iliac block	90.9	6.1	89.5
Rough-particulate	94.5	1.2	94.6

Vital bone formation is
−time dependent
−graft material dependent
−enhanced with a barrier membrane
Implant survival is
−graft material dependent
−enhanced with a barrier membrane
−enhanced by a rough surface (가장 중요!!)
Biology Rules!!!

Aesthetics

- ▶ 3-dimensional placement
- ▶ Occlusal-gigival
- ▶ Facial-lingual
- ▶ Mesial-distal
- ▶ 3-dimensional integration

Occlusal-gingival level의 고려

1998 년의 concept 은 3mm from the height of soft tissue (apical to adjacent CEJ) 였다. 그러나 만약 이처럼 implant platform이 crest 에 위치하게 되면 interdental area 에서는 3mm + 4.5mm (between labial tissue and papilla) 가 되어 약 7.5 ~ 10mm 의 차이가 생기며 첫 번째 thread 까지 흡수되는 biologic width 까지 고려 시 약 9mm정도의 차이가 생긴다

Facial-lingual의 고려

Gingival recession around wide vs. standard diameter implants: A
5−year longitudinal prospective study
Small P, Cho S, Tarnow D
PPAD 2001; 15:527−532
Buccal Recession
전 기간에 걸쳐 standard diameter의 recession 정도가 wide diameter implant 를 사용한 경우보다 작았다.

	Standard diameter	Wide diameter
Prosthesis insertion	0.43 mm (138)	1.15 mm (58)
3 month	0.56 mm (138)	1.41 mm (58)
6 month	0.61 mm (138)	1.45 mm (58)
1 year	0.69 mm (128)	1.48 mm (54)
18 month	0.82 mm (110)	1.55 mm (45)

Mesial-distal 의 고려

1) Radiological evaluation of marginal bone loss at tooth surfaces facing single Brånemark implants
Esposito M et al

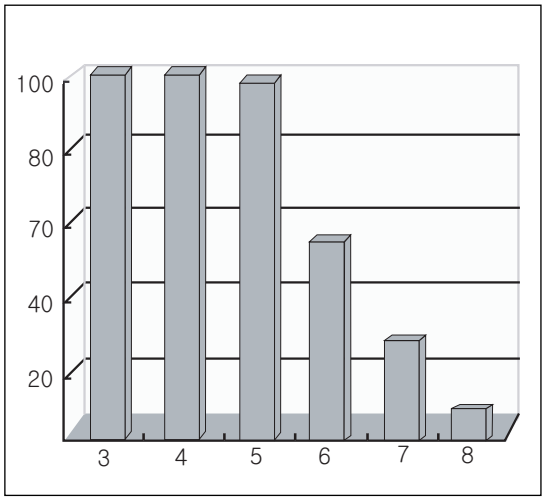
COIR 4(3); 151−157, 1993
The mean bone loss at adjacent tooth surfaces increased with increasing distance fixture−tooth for the time interval between preoperative evaluation and crown installation

2) Influence of flap design on peri−implant interproximal crestal bone loss around single tooth implants

Gomez−Roman G
IJOMI 16; 61−67, 2001
Adjacent tooth 에 약간의 tissue를 남겨두는 limited flap design이 0.5mm, wide flap 이 2mm 정도의 bone loss 를 보여주었다

3) The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla

Tarnow et al
J Periodontol 63; 995−996, 1992
Presence of papillae (n=288)



X-axis: % presence of papillae
Y-axis: distance from contact point to crest of bone
결론: contact point에서 crest of bone 까지의 거리가 5mm 또는 그 이하인 경우에 papillae 형성이 거의 100% 가 된다

4) Regeneration of gingival papilla after single-implant treatment
Jemt T
Int J perio Resto Dent 17; 327-333, 1997
Papillae index
0 - bad, 1- slight growth of papilla
2 - good, 3- perfect, 4 - overgrowth

	Papilla index score				
	0	1	2	3	4
Mesial papilla					
Placement	5	7	10	3	0
Follow up	0	3	5	17	0
Distal papilla					
Placement	1	12	10	2	0
Follow up	1	1	10	12	1

1 year F/U 에서 17 papilla 가 거의 완벽하게 자라났음을 볼 수 있으며, implant crown insertion 시 환자에게 (contact 이 제대로 있는 한) papilla growth 는 시간이 걸림을 주지시킨다!

5) Restoring the gingival contour by means of provisional resin crowns
after single-implant treatment
Jemt T
Int J Perio Resto Dent 19; 21-29, 1999
2차 수술 시 Healing abutment를 채우든지, 바로 temporary crown을 제작해주든 지는 papilla growth 에는 큰 영향을 주지 않는다.
술 후 2년 follow up 에서 soft tissue volume에 차이가 없었음

Is the 5mm rule also true for papillae between teeth and implants? Yes

6) Stability of the mucosa: Topography around single-tooth implants and adjacent tooth: 1 year result
Grunder U, IJPRD 20; 11-17, 2000
자연치와 implant 사이의 papilla존재 여부는 implant 쪽이 아니라 치아 쪽 bone level이 결정적인 요소다.
Contact point 에서 bone level 까지의 거리가 거의 9mm (max 10.5)인 경우에도 자연치 쪽이 5mm 이하인경우 문제가 없었음.

7) clinical and radiographic evaluation of the papilla level adjacent to single-tooth dental implants: A retrospective study in the Maxillary anterior region
Choquet V, Hermans M, Tarnow D, Malevez C
J Periodontol 72; 1364-1371, 2001
26 patient, 27 Brånemark Implant
17 implant: uncovered with a standard technique
10 implants: generate papilla-like formation

52 papillae were evaluated clinically and radiographically

Immediate implant placement and Immediate provisionalization

Immediate vs. delayed placement variables

- –height of soft tissue
- –thickness of soft tissue
- –amount of keratinized tissue
- –degree of inflammation of buccal tissue
- –thickness of buccal plate of bone (가장 중요)
- –are adjacent crowns being placed
- –histologic vs. clinical success
- –placement of graft or not?
- –was flap elevated?
- –was membrane placed?
- –was primary closure achieved?
- –was implant placed facially or palatally
- –provisionalization
- –fixed or removable?

1) Single tooth replacement in the aesthetic zone with immediate provisionlization; 14 consecutive case reports
Wohrle PS
PPAD 10; 1107–1114, 1998
Immediate provisionalization은 papilla를 위해서는 좋지만 midfacial tissue height 에도 도움이 되는가 하는 문제는 questionable 하다.

2) Evaluation of Ti–implants placed into simulated extraction sockets: A
study in dogs
Akimoto K, Becker W
IJOMI 14; 351–360, 1999
Clinically, all control and test sites healed with complete bone fill in the defect. But, histologically there's space. As the gap widened, the amount of bone–to–implant contact decreased, and the point of the highest bone–to–implant contact shifted apically.

3) Dimensions of peri–implant mucosa: An evaluation of maxillary anterior single implants in humans
Kan JYK, Rungcharussaeng K, Kois JC
J Periodontol 74; 557–562, 2003
Bone–sounding measurements of anterior implant single crowns comparing thick and thin biotype

Site	Bone sounding depth	
	Thick biotype (n=28)	Thin biotype (n=17)
MI (mesial of implant)	6.54 ± 1.05	5.56 ± 1.40
F (mid facial)	3.79 ± 0.89	3.38 ± 0.91
DI (distal of implant)	6.14 ± 1.11	5.59 ± 1.31
DT (distal of tooth)	4.45 ± 0.57	3.79 ± 0.56

<<Ice cream Technique>>
Handle – socket
아이스크림 – over the top
extraction socket 에 bone material 삽입 후 collagen membrane사용 buccal plate missing area에 handle 모양 삽입, 아이스크림 쪽은 bone material 을 덥고 palatal 쪽에서 2~3 suture, buccal 쪽은 suture 안 함

Between adjacent implants

Is the 5 mm rule also true for papillae between implants? NO

1) The effect of inter-implant distance on the height of the inter-implant
bone crest
Tarnow DP, Cho SC, Wallace S
J Periodontol 71; 1546-549, 2000

Inter-implant distance less than 3mm show increased crestal bone resorption
1) D (distance between the adjacent implant) >3mm (n=11)
X (implant shoulder to inter-implant crest peak) = 0.45mm
2) D ≤ 3 mm (n=25)
X = 1.04mm
2) The vertical distance from the crest of bone to the height of the interproximal papilla between adjacent implants
Tarnow et al, J Periodontol 74; 1785-1788, 2003

Height of papilla (mm)	1	2	3	4	5	6	7	Total
%	1.5	16.9	35.3	37.5	5.9	0.9	2.2	100%

반 이상의 case 가 3mm 이하이므로 문제

2 Maxillary incisor missing case
-broad contact point를 만들어 준다
Central and lateral incisor missing case
-central 에 implant, lateral에 distal cantilever ovate pontic
Lateral and Cuspid missing case
-canine에 implant, lateral 에 mesial cantilever ovate pontic

4 Maxillary incisor missing case
-2 laterals 에 implant
3-dimensional positioning
1) platform switching
: placing a "smaller" diameter abutment on a larger diameter implant seating surface
3) Scalloped implant의 사용
: Nobelbiocare의 Scalloped implant는 정확한 개념에서 출발하였으나 screw type이어서 정확히 식립하는 것이 힘들어서 성공적이지 못했다. Dr.Tarnow's version of Scalloped implant는 Endopore와 같은 mallet을 이용한 식립을 하므로 식립 용이.

Golden Rule

Do all site development before implant placement into the aesthetic zone
Do one miracle at a time
Use the "KISS" principle (Keep It Simple, Stupid!!)

Treatment Planning guidelines in the aesthetic zone

Do all significant site development before placing implants
Place implants 2 to 3 mm apical to desired height of facial tissue
Place implants at least 1 to 1.5 mm away from adjacent teeth
Position implants palatal to the incisal edge or at the cingulum
Use ovate pontic
Use papillae saving incisions where possible
Avoid adjacent implants if possible
Overbuild the inter-implant bone before placing implants adjacent to each other

Place adjacent implants 3mm apart to preserve the crestal bone
Place a scalloped top implant (??) or platform switching

Transcriber's note

Dr.Tarnow의 강의는 언제나 그러했듯 근거중심(evidence-based) 이었으며 훌륭했습니다. 다만 약간 아쉬웠던 점은 이전의 그의 강의와 중복되고, 이미 많이 알려진 내용도 있었고 대부분의 evidence가 자신과 그의 동료들의 연구에 바탕을 두었으므로 (물론, 그와 그의 동료들의 연구 업적은 존경 받아 마땅합니다), 좀더 제3자의 연구에 근거한 강의였으면 더욱 좋았을 거라는 생각은 해봅니다. 좋은 강의를 해 주신 Dr.Tarnow께 이 자리를 빌어 다시 한번 감사 드리며 이 Transcription이 이식학회 회원 분들께 조금이나마 도움이 되기를 바랍니다.

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▶Transcriber : 강 민 석