



Marginal bone loss of platform switching implants with or without microthreads

: A retrospective multi-center study upto 15 years



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Introduction

Since Albrektsson and colleagues proposed the success criteria for dental implants, the marginal bone level has been used to assess the success of dental implant treatments. Marginal bone loss is associated with many factors, such as implant-abutment connection, implant surface microtexture, the type of prosthesis, soft tissue thickness, etc. Among the influencing factors, the implant neck's micro and macro geometric configurations are considered significant. The implant neck's micro or macro geometric configurations included surface microtexture, implant-abutment connection type, and the platform switching design.

A recent study compared the marginal bone loss of Astratech, Straumann, and Branemark implant systems. It concluded that the type of surface preparation did influence the change in marginal bone level. However, those implant systems have different macro-geometric configurations as well as different surface preparations. Platform switching is an effective feature to prevent marginal bone loss, and many new implant products adopted platform switching design. Microthreads have been paid attention to as an excellent feature to prevent marginal bone resorption since it was first introduced in Astra implant systems. However, Astra implants have a platform switching design as well as microthreads. Most implant systems with microthreads included platform switching; therefore, the sole effect of microthreads on marginal bone loss is hardly assessed. The purpose of the current study was to compare the amount of marginal bone loss in platform switching implants with or without microthreads.

Materials and Methods

This retrospective study included all partially edentulous patients who had received implant-supported fixed dental prostheses at the Department of Prosthodontics, Gangnam Severance Dental Hospital, and the Hayan Dental Clinic between 2003 and 2019. One clinician at each institute performed implant surgeries and restorative procedures. Two different implant systems from the same manufacturer were used in the entire study. Both implant had 0.9mm Macrothreads, but One had a platform switching with microthreads, which has 0.4mm intervals, at the implant neck and 7 degree internal taper (IT implant, Warantec, Seoul, Korea), and the other only had a platform switching design and 11 degree internal taper(IU implant, Warantec, Seoul, Korea). (Figure 1)

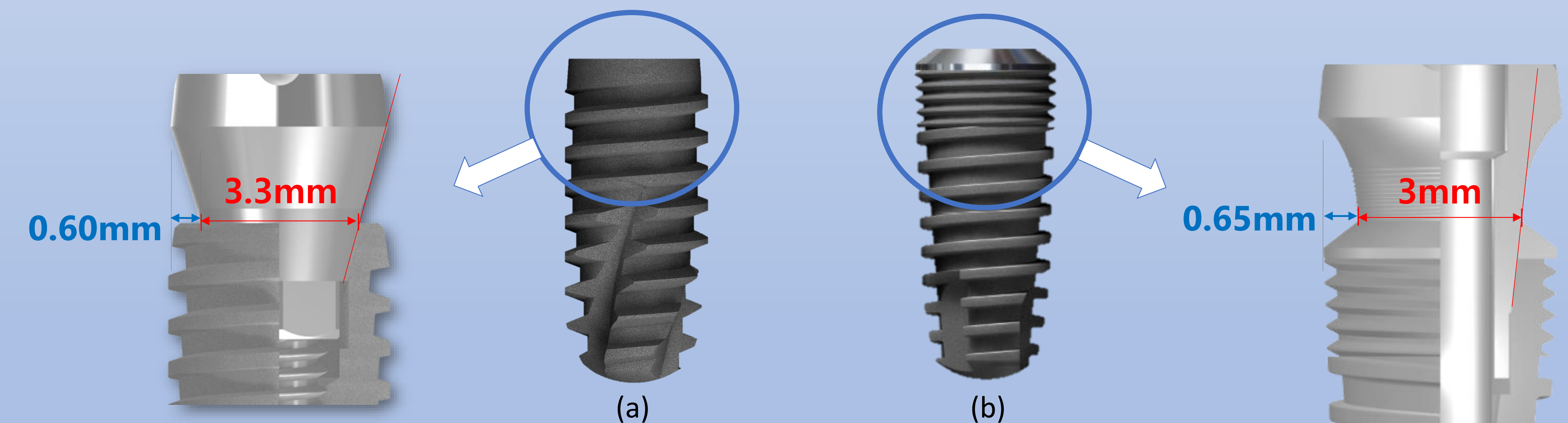


Figure 1. (a) IU implant, (b) IT implant

Both systems had the same sandblasted and acid-etched surface. Handwritten and electronic charts during periodic visits were reviewed to assess any specific events. Periapical radiographs were used to analyze the amount of marginal bone changes. Implant survival is defined as follows; the implant remained

in the patient's mouth, and the restoration functioned normally at the time of the last periodic visit. The bone level in the periapical radiographs was measured using an image software to evaluate the marginal bone changes. (Figure 2)

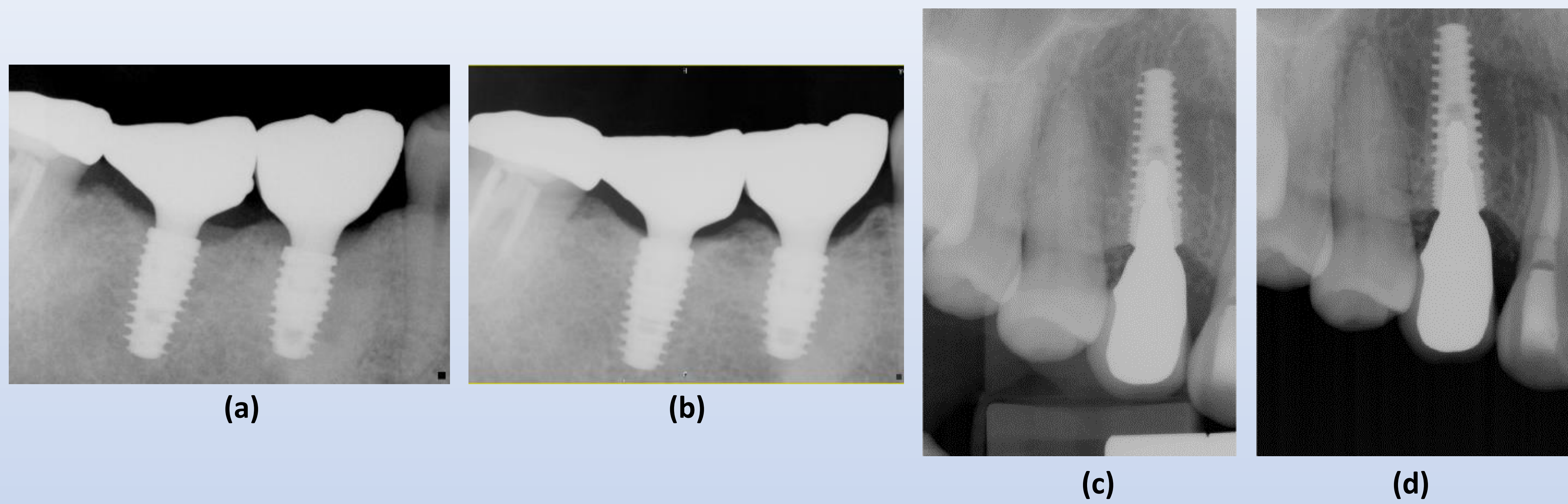


Figure 2. Periapical radiographs of IU, IT implant. (a) IU implant at delivery, (b) IU implant at 6 years of function. (c) IT implant at delivery. (d) 11 years after definitive prosthesis delivery.

Result

A total of 1769 implants, including 1,368 IT implants and 401 IU implants, were placed in a total of 804 patients, and treatment was performed with implant-supported fixed prostheses. The longest follow-up was 15 years after prosthesis was installed for 11 IT implants and 6 years for 6 IU implants. Demographic date is recorded in Table 1. The survival rate of each implant was 98.8% for IT and 99.0% for IU. There were 6 early implant failures, and the cause was infection at the bone graft site or poor initial fixation. Failures after delivery of the prosthesis were found in 14 cases; implant removal due to abutment fracture in 1, abutment screw fracture in 1, fixture neck area tearing in 3, and others in 9 cases(Table 2). Examples of abutment and screw fracture are shown on Figure 3. Two abutment screw fractures were happened in a 3-unit FPD with a distal cantilever after 4 years of function. One of the screw fragments could not be removed, therefore, the implant was buried and regarded as a failure (Figure 4).

Table 1. Demographic data at implant and patient levels

Variables		N	N	
Fixture			Position	
	IT	1368	Maxilla	
	IU	401	Anterior	193
Age		58.5	Premolar	287
Sex			Molar	459
	Male	789	Mandible	
	Female	980	Anterior	38
Diameter			Premolar	165
	< 4mm	103	Molar	627
	4~5mm	1429		
	> 5mm	237		
Length				
	Short(<8.5mm)	63		
	Regular(8.5~10mm)	1177		
	Long(>10mm)	529		
Prosthetic type				
	Fixed partial denture	468		
	Single	547		
	Splint	754		

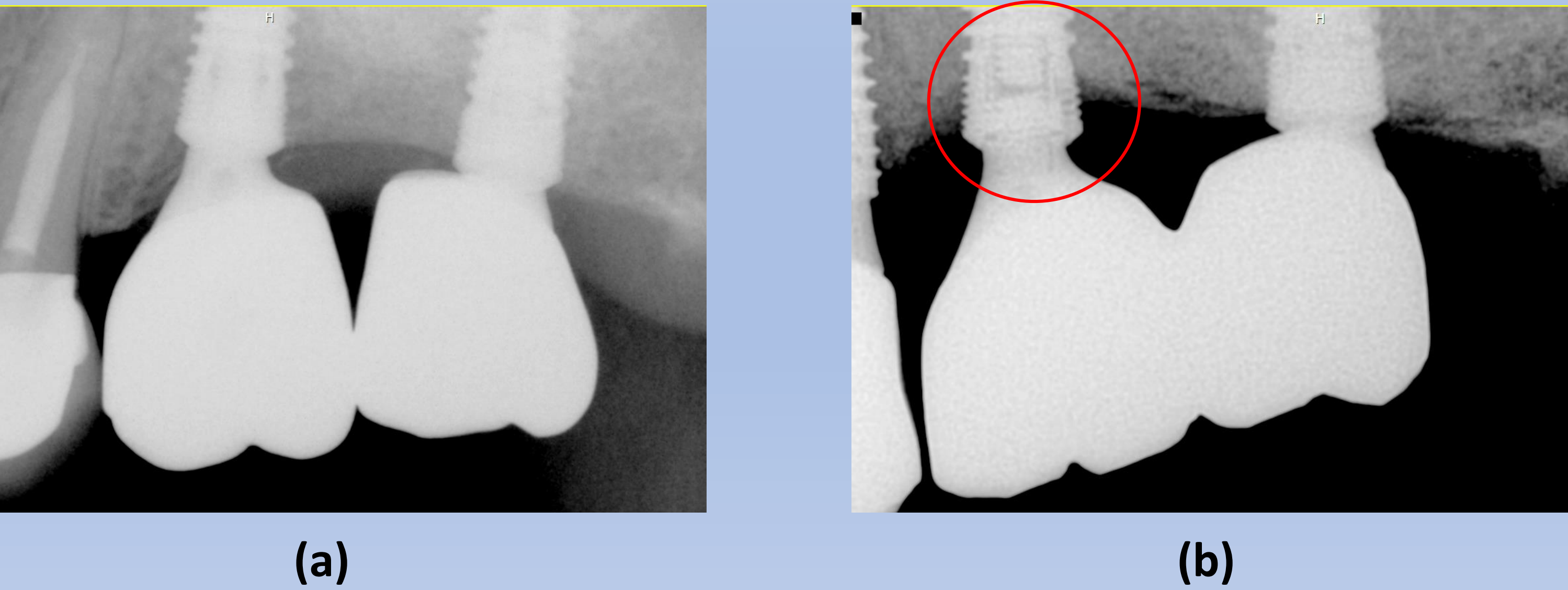


Figure 3. Abutment and abutment screw fracture. (a) prosthesis delivery, (b) screw and abutment fracture after 5 years of function

Table 2. Demographic data of failed implant

Time of failure	Age	Gender	Position	implant	Diameter	Length	Prosthetic type2	Prosthetic material	opposing structure	Cause of failure
14 year	52	F	I14	IT	4.3	10	Splint	PFM	Tooth	Peri-implantitis
11 year	60	F	I16	IT	4.3	11.5	Bridge	-	-	Peri-implantitis
10 year	61	F	I45	IT	4.3	10	Splint	PFM	Denture	Fixutre neck tearing
9 year	60	F	I16	IT	4.3	10	Bridge	-	-	Peri-implantitis
8 year	79	M	I16	IT	4.3	8.5	Single	PFG	Tooth	Fixutre neck tearing
8 year	61	F	I35	IT	4.3	10	Splint	PFM	Denture	Fixutre neck tearing
6 year	59	M	I46	IT	4.3	10	Single	PFM	Tooth	Fixutre neck tearing
5 year	66	M	I36	IT	4.3	10	Cantilever	PFM	Denture	Abutment screw fracture
5 year	62	M	I26	IT	4.3	10	Splint	Zirconia	Tooth	Abutment fracture
2 year	66	M	I26	IU	4.5	10	Single	PFM	Tooth	Failure of osseointegration
1 year	50	F	I47	IU	4.5	10	Single	Zirconia	Tooth	Failure of osseointegration
Within 1 year	75	M	I26	IT	4.3	11.5	Cantilever	PFM	Implant	Failure of osseointegration
Within 1 year	72	F	I46	IT	4.3	8.5	Single	PFM	Implant	Failure of osseointegration
Within 1 year	54	F	I27	IT	4.3	10	Splint	PFM	Tooth	Failure of osseointegration
Early failure	56	M	I14	IT	4.3	13	-	-	-	Infection
Early failure	55	F	I22	IT	4.3	11.5	-	-	-	Graft failure
Early failure	71	M	I37	IU	5	8.5	-	-	-	Failure of osseointegration
Early failure	42	F	I21	IU	4	10	-	-	-	Graft failure
Early failure	59	F	I36	IT	4.3	10	-	-	-	Infection
Early failure	52	F	I17	IU	4.5	10	-	-	-	Infection

The average marginal bone change was -0.26mm at mesial area, -0.35mm at distal area for IT at 3~5 years of follow-up, and -0.22mm at mesial area, -0.21mm at distal area for IU at 3~5 years of follow-up. The mean marginal bone loss of each fixture collectively for each interval, are suggested in Table 3, 4. in some case, Increased marginal bone level was observed with IU implants , which had shorter follow-up period, after more than 5 years. It is considered that small size of sample could have led to untypical results. Examples of increased bone level is shown in Figure 5.

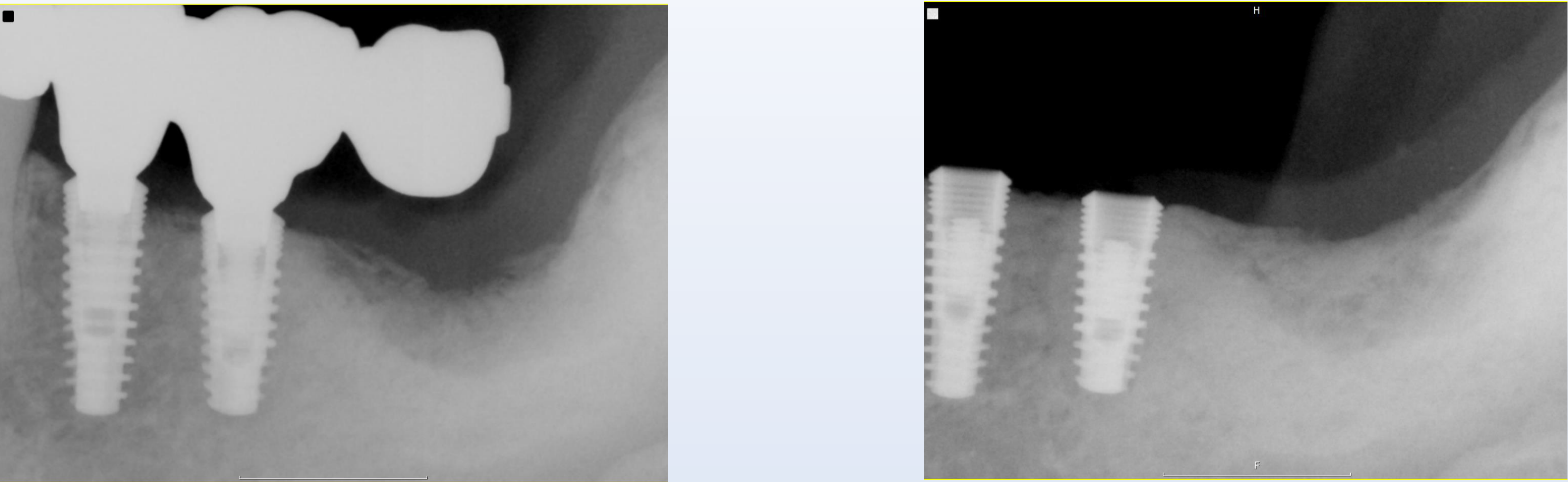


Figure 4. Periapical view of abutment screw fracture after 5 years of loading. Screw fragment of the distal implant could not be removed. The distal implant was regarded as a failure

Table 3. Average bone loss at the selected time interval in IU implant

Mean(mm)	1 year	1~3 year	3~5 year	> 5 year
Mesial	-0.16	-0.14	-0.22	0.00
Distal	-0.19	-0.17	-0.21	0.00
N	401	296	193	56

Table 4. Average bone loss at the selected time interval in IT implant

Mean(mm)	1 year	1~3 year	3~5 year	> 5 year
Mesial	-0.20	-0.24	-0.26	-0.41
Distal	-0.30	-0.33	-0.35	-0.12
N	1368	1009	908	471

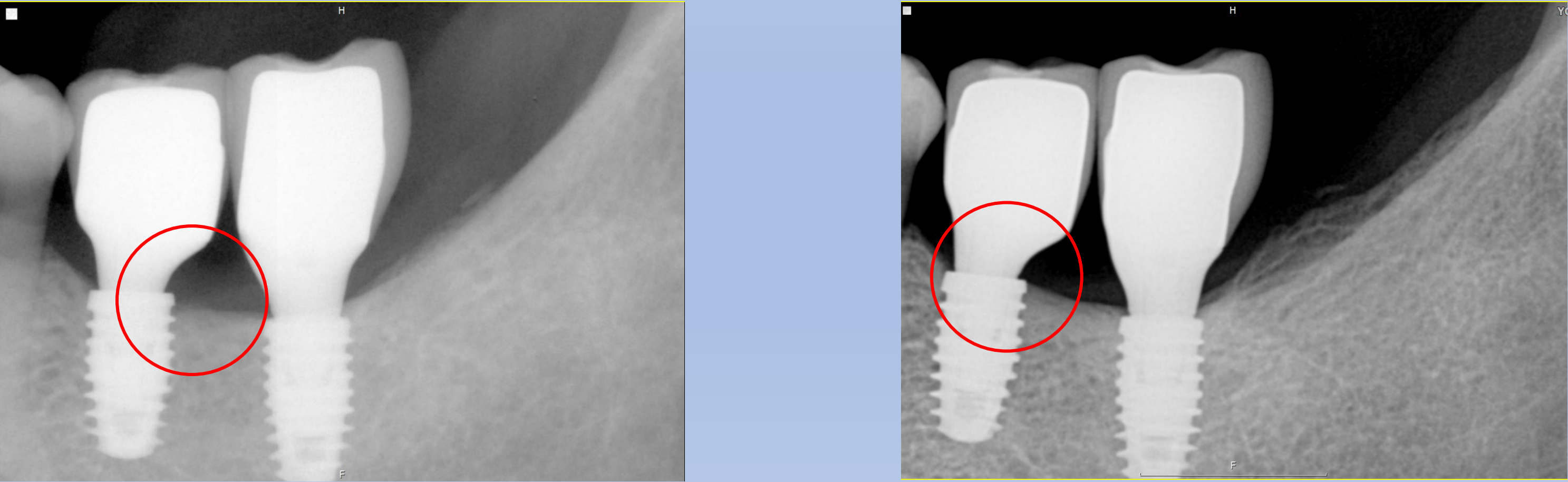


Figure 5. Example of Increased marginal bone level in IU implant. (a) periapical view at delivery, (b) periapical view at 5 years of follow up

For IT implants, less than 1mm of marginal bone loss was observed after 3~5 years of follow up in 96.4% and 95.76% of mesial and distal areas, respectively. After over 5 years of follow-up, the same was found in 93.47% and 93.94% of mesial and distal areas. For IU implants, of which follow-up period of relatively short, less than 1mm of marginal bone loss was observed after 3~5 years of follow up in 100% and 98% of mesial and distal areas, respectively. Percentage of implant in bone loss section for each implant fixture is suggested in Table 5, 6.

Table 5. Percentage of Implant in bone loss section (IT implant)

Fixture	Bone loss Section			
IT implant	< 1 mm	1 mm ~ 2mm	2mm ~ 3mm	> 3 mm
1 year mesial	98.91%	0.99%	0.10%	0.00%
1 year distal	98.22%	1.49%	0.20%	0.10%
1~3 year mesial	97.91%	1.87%	0.11%	0.11%
1~3 year distal	97.58%	1.98%	0.33%	0.11%
3~5 year mesial	96.40%	2.12%	1.27%	0.21%
3~5 year distal	95.76%	2.54%	1.48%	0.21%
5~ year mesial	93.47%	3.96%	1.63%	0.93%
5~ year distal	93.94%	3.50%	1.63%	0.93%

Table 6. Percentage of Implant in bone loss section (IU implant)

Fixture	Bone loss Section			
IU implant	< 1 mm	1 mm ~ 2mm	2mm ~ 3mm	> 3 mm
1 year mesial	100.00%	0.00%	0.00%	0.00%
1 year distal	98.65%	1.35%	0.00%	0.00%
1~3 year mesial	98.45%	1.55%	0.00%	0.00%
1~3 year distal	99.48%	0.52%	0.00%	0.00%
3~5 year mesial	100.00%	0.00%	0.00%	0.00%
3~5 year distal	98.25%	1.75%	0.00%	0.00%
5~ year mesial	100.00%	0.00%	0.00%	0.00%
5~ year distal	100.00%	0.00%	0.00%	0.00%

Discussion

The survival rates of both implant were 98.8% for IT and 99.0% for IU, showing excellent survival rates. This was found to be higher than 97.6% as survival rate in systematic review, which was suggested by Jung. In comparison from 3 to 5 years, the IU implant showed excellent results with mesial marginal bone loss -0.22 mm and -0.21 mm for distal, and IT implant with mesial -0.26 mm and distal -0.35 mm as shown in Table 3,4. This showed better results than previous systematic review and meta analysis presented by Norton which show -0.35mm, -0.74mm, -1.19mm of marginal bone loss for Astra Tech Osseospeed, Straumann SLA/SLActive, Nobel Biocare TiUnite, respectively. When comparing the IU implant and the IT implant which has microthread structure, the IU implant showed better results than IT implant in 3 to 5 years of follow up period. And when comparing bone loss by intervals, the proportion of implants with bone loss of 1 mm or less, up to 5 years or longer, was higher in IU. The difference in microstructure of these two implants seems to have shown these results.

Conclusion

The overall survival rate of platform switching implants with or without microthreads was 98.8% for 15 years and 99.0% for 6 years, respectively. At 5 years, the amount of marginal bone loss was significantly smaller in platform switching implants without microthreads

Reference

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