Immediate- vs delayed- implant placement following tooth extraction: Survival analyses and factors associated with survival

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Abstract

Statement of the problem: Conventional implant practice dictates a delay between tooth extraction and implant placement. Some investigators advocate inserting implants immediately after the tooth is extracted. Advantages of immediate over delayed implant placement following extraction include shorter treatment time, fewer visits, and a diminished time period of functional and esthetic deficiency. Offsetting the advantages of immediate implant placement may be an increased risk for implant failure.

The **purpose** of this study was to answer the following clinical question: "Among implants inserted, do those placed immediately after tooth extraction, when compared to those placed at some time after tooth extraction, have a decreased 5-year survial rate?" A secondary purpose was to identify prognostic factors associated with five-year implant survival.

Materials and methods: Using a retrospective cohort design, the investigators enrolled a sample of subjects having at least one implant inserted between 7/1/01-8/31/05 at the Implant Dentistry Centre, Boston, MA. The primary predictor variable was the timing of implant placement following extraction (immediate vs delayed). An immediate implant was defined as an implant inserted immediately following the extraction. A delayed implant was defined as an implant inserted at any time after the day of tooth extraction. The outcome variable was implant survival at five-years after insertion. Secondary explanatory variables were categorized as demographic, health status (e.g. ASA status, tobacco use), implant-specific (diameter, length, coating), anatomic (location), and perioperative variables (e.g. staging, dentoalveolar reconstructive procedures, antibiotic use, implant stability at stage 2). Descriptive statistics, Kaplan-Meir survival analysis, as well as univariate and multivariate Cox proportional hazards regression analyses were completed using SAS (version 9, SAS Institute Inc, Cary, NC). Level of statistical significance was set a *priori* at $\alpha = 0.05$.

Results: The study sample was composed of 161 patients having 963 implants inserted (412 immediate-placed vs. 551 delayed-placed). The mean duration of clinical follow-up amongst the study sample was 26.2 months. The five-year unadjusted Kaplan-Meier survival rates for immediate- and delayed-placed implants were 87.5% and 92.8%, respectively (p=0.06). Multivariate analysis revealed no statistically significant difference in overall follow-up survival time between immediate- and delayed-placed implants (p=0.4) (Hazard Ratio = 0.7, 95%CI: 0.3, 1.6). After adjusting for potential confounders, factors significantly associated with implant survival (p<0.05) were implant length, bone quality at the implant site, coated implants, two-stage implant placement (insertion and subsequent uncovering at a future visit), and implant stability at the uncovering stage of treatment.

Conclusions: Implant survival at five years was not statistically different between implants placed immediately after tooth extraction and those placed in a delayed manner in the unadjusted or adjusted analyses. The data support the hypothesis that there is no significant difference in survival between implants immediately or delayed placed following tooth extraction. After adjusting for potential confounders, the investigators found implant staging, implant length, bone quality at the implant site, and coated implants to were associated with an increased likelihood of implant survival at five years post-insertion.

Clinical Question

How does the five-year survival rate of immediately-placed implants compare to delayed-placed implants?

Null Hypothesis

The adjusted five-year survival rate of immediately-placed implants equals that of delayed-placed implants

Specific Aims

1. To estimate and compare the 5-year survival of immediate- and delayed-placed implants
2. To identify risk factors associated with implant failure using a rigorous survival analyses adjusting for clustered (correlated) observations

Materials and Methods

Study design

- Retrospective cohort study

Sample enrollment criteria

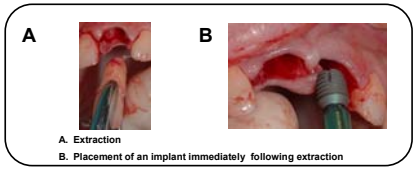
- Patients of the Implant Dentistry Centre, Boston MA, who had one immediate loaded or one delayed loaded implant between July, 2001 and August, 2005

Study Variables

A. Primary Predictor Variable

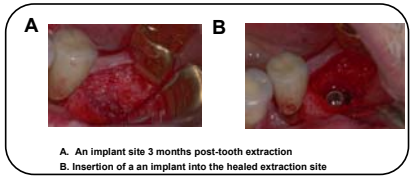
1. Placement Status

i. **Immediate placement:** Implant was inserted immediately following extraction



A. Extraction
B. Placement of an implant immediately following extraction

ii. **Delayed placement:** Implant was inserted at any time after the day of extraction



A. An implant site 3 months post-tooth extraction
B. Insertion of a an implant into the healed extraction site

B. Primary outcome variable

1. Implant survival at 12 months

C. Other Study Variables

1. Demographic variables:
   - i. Gender
   - ii. Race
   - iii. Age
2. Health specific variables:
   - i. ASA status
   - ii. Medical complication
   - iii. Tobacco use
3. Implant–specific variables:
   - i. Implant coating (TPS, HA)
   - ii. Size (mm)
     - Diameter
     - Length
4. Anatomic:
   - i. Implant position (maxilla/mandible, anterior/posterior)
   - ii. Bone quality (Type1-4)
   - III. Presence of radiolucency at or around implant site
5. Perioperative variables:
   - i. Implant mobility at integration check

Results

TABLE 1
Study variables grouped by treatment group

Study variable	Immediately-placed (k_0)	Delayed-placed (k_1)	Subjects (n)	P-value
Sample size	198 (42.3)	375 (57.7)	200	<0.001
Mean clinical Follow-up Time (mos) (k_0=591, k_1=674)	25.3	27.4		NA
Demographic variables				
Age at insertion (n=199; k_0=545, k_1=578)	59.8 ± 13.1 (15.2-91.8 y)	58.7 ± 12.0 (20.5-92.2)	59.1 ± 12.6 (16.1 -92.2)	0.15
Self-reported Sex (n=200, k_0=494, k_1=575)				
Male	260 (52.6)	406 (60.2)	103 (53.0)	0.08
Race (n=177, k_0=377, k_1=590)				
White	360 (95.5)	484 (92.8)	121 (95.3)	
Black	5 (1.3)	16 (3.2)	3 (2.4)	
Other (Asian, Pacific Islander, or Native American)	12 (3.2)	20 (4.0)	3 (2.4)	0.3
Health Status (n=192, k_0=479, k_1=649)				
ASA 1	284 (59.3)	388 (60.1)	111 (57.8)	
ASA 2	181 (37.8)	239 (36.1)	73 (38.0)	
ASA 3	14 (2.9)	25 (3.8)	8 (4.2)	0.96
Medically compromised (n=197, k_0=489, k_1=646)				
Yes	367 (75.6)	497 (76.9)	145 (76.0)	0.9
History of smoking (n=197, k_0=490, k_1=666)				
Never smoked	469 (95.7)	645 (96.8)	182 (97.3)	
Formally smoked	83 (17.9)	74 (11.1)	25 (13.2)	
Currently smoking	24 (4.9)	47 (7.1)	9 (4.1)	0.4
Anatomic and Radiologic variables				
Anterior/Posterior jaw position (k_0=493, k_1=674)				
Anterior	298 (45.6)	500 (74.2)		<0.001
Jaw arch (k_0=493, k_1=674)				
Maxilla	348 (60.6)	430 (63.8)		0.06
Bone Quality (k_0=342, k_1=485)				
Type 2	294 (76)	69 (14.5)		
Type 3	196 (57.3)	299 (54.4)		
Type 4	120 (35.1)	197 (33.8)		0.04
Presence of radiolucency (k_0=495, k_1=655)				
No	368 (74.4)	549 (82.4)		
At implant site	49 (9.9)	46 (7.2)		
Adjacent tooth	43 (8.9)	40 (6.9)		
Implant site and adjacent site	33 (6.8)	22 (3.4)		<0.001
Perioperative variables				
Immediate loading (k_0=494, k_1=675)				
Yes	347 (70.2)	199 (29.5)		<0.001
Mobility at integration check (k_0=453, k_1=568)				
Yes	54 (11.9)	32 (5.1)		<0.001
Size (mm)				
Implant diameter (mm) (k_0=107, k_1=966)				
3.5	34 (7.0)	33 (4.8)		
4.0	21 (4.3)	67 (10.0)		
4.5	200 (41.1)	325 (48.7)		
5.0	195 (40.0)	200 (30.2)		
6.0	37 (7.6)	10 (6.0)		0.99
Implant length (mm) (k_0=487, k_1=647)				
5.7	22 (4.5)	31 (4.8)		
6	48 (9.9)	56 (8.7)		
8	337 (69.5)	485 (74.9)		
11	85 (17.3)	104 (16.4)		0.7
Implant coating (k_0=491, k_1=661)				
HA	437 (90.9)	596 (90.2)		
Uncoated	24 (5.0)	32 (4.8)		
TPS	20 (4.2)	33 (5.0)		0.8
Implant well-size (mm) (k_0=492, k_1=647)				
2	54 (11.0)	100 (15.5)		
3	438 (89.0)	547 (84.5)		0.3

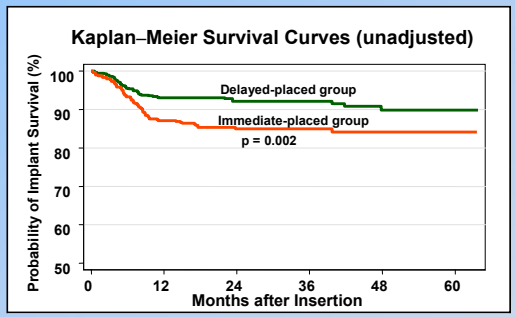


Table 3. Final Clustered Multivariate Marginal Cox Regression model (n=200 subjects, k_0=494, k_1=675)

Exposure	Hazard Ratio	p-value
Immediate placement	1.0 (0.4, 2.4)	0.95
Immediate loading	2.6 (1.1, 6.4)	0.03
Age at insertion	1.0 (0.99, 1.04)	0.06
Male gender	1.1 (0.6, 2.1)	0.7
Decreasing quality of bone	2.2 (1.3, 3.9)	0.004
Mobility Integration check	8.4 (3.7, 1.8)	<0.001
Peri-implant site radiolucency	1.2 (0.7, 2.3)	0.5
Coating		
No coating	6.2 (2.8, 14.0)	<0.001
TPS coating	2.3 (0.8, 6.6)	0.13

Conclusion

1. Implant survival 5-years after insertion was not significantly associated with time of placement status.
2. These data are consistent with the null hypothesis that the 5-year survival rate of immediate-placed implants equals the one-year survival rate of delayed-placed implants.

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