Immediate Functional Loading of Posterior Delayed Placement Nano-Hydroxyapatite-Coated Implants: Early Clinical and Radiographic Outcomes From a Prospective Trial

Joseph Montesano, DMD[1]; Chia-Yu Chen, DMD, DMSc[1]; Sang Lee, DMD, MMSc[2]; Jae-Hyun Lee, DMD, PhD[2]; David Kim, DDS, DMSc[1]

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Introduction

- Dental implant success depends on achieving early mechanical stability and subsequent integration
- Surface modifications (e.g., SLA, HA coatings) enhance osseointegration and early stability
- **This study aims to evaluate early implant stability and marginal bone level (MBL) changes in posterior, immediately loaded, delayed-placement of a novel nanohydroxyapatite(NH)-coated implant**

Methods: Study Design

- Prospective clinical and radiographic cohort study
- 31 participants requiring single-tooth posterior implants
- 20-85 y/o with no significant medical history
- Flapless, fully guided placement with immediate provisional
- Outcome measures:
  - Insertion torque (ITV)
  - Implant stability (percussion and resonance frequency analysis)
  - Marginal bone level
- Key exclusion criteria: need for bone/soft tissue grafting, active periodontal disease/infection, uncontrolled systemic disease, or medications affecting bone metabolism

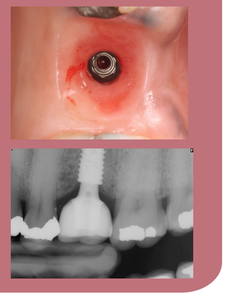
Methods: Visits

Visit #0/1
Consent
Baseline clinical measurements
(Perio-Prosth Plan)

Visit #2
Implant + provisional
Standardized radiograph
Implant stability

Visit #3
4-week PO
Standardized radiograph
Occlusal analysis

Visit #4
12-week PO & final impression
Digital impression
Implant stability



Visit #5
Final restoration
Standardized radiograph
Occlusal analysis

Visit #6/7
1-year & 2-year PO
Standardized radiograph
Occlusal analysis

Preliminary Results

- Mean MBL change at crown delivery (14–16 weeks): –0.67 ± 0.45 mm (N=9)
  - 100% of implants showed <1.5 mm ΔMBL
  - 78% of implants showed ≤1.0 mm ΔMBL
- Average implant stability (IST/ISV) increased over 3 months (N=12)
- All implants included in this analysis remained stable and functional during early healing

Conclusions

- Immediately loaded, posterior, NH-coated implants demonstrated successful osseointegration, minimal marginal bone remodeling, and improvements in stability
- NH-coated implants show promise for predictable immediate loading protocols
- Follow-up will determine whether these favorable trends persist over the two-year study period

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Results: *Marginal Bone Level*

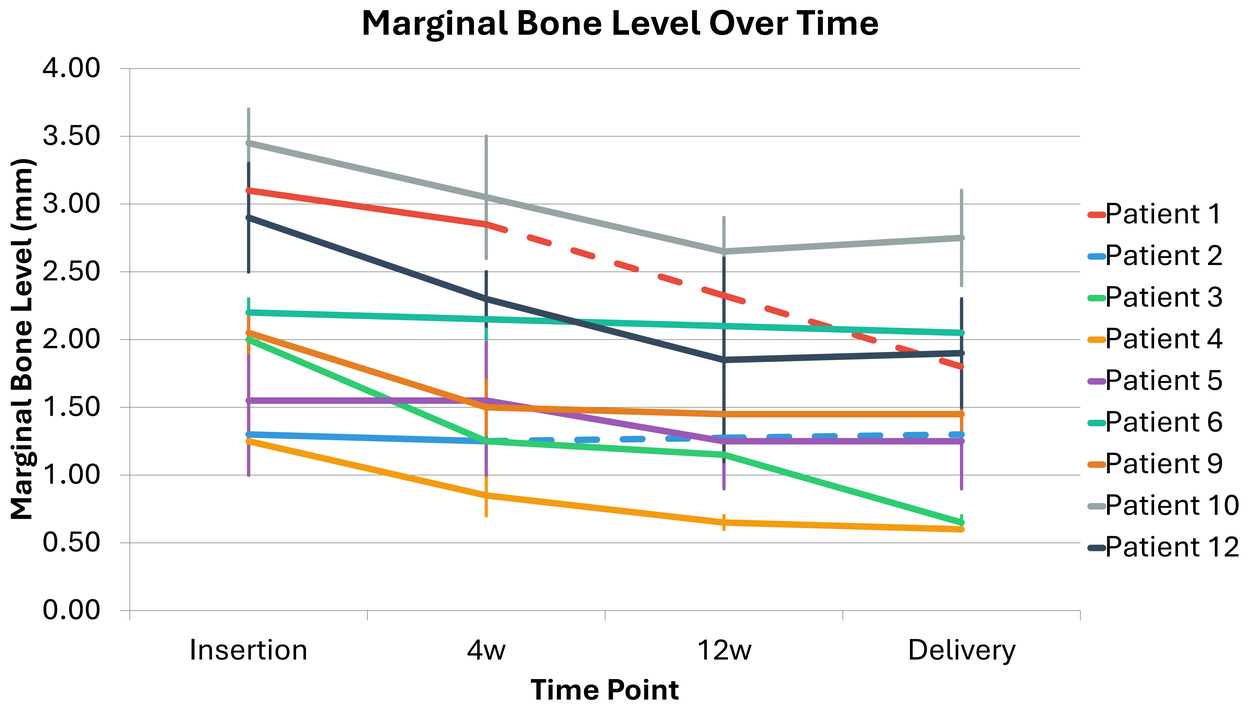

Figure 1. Marginal bone level trajectories from implant placement to prosthetic delivery. Dotted lines indicate extrapolated 12-week values for patients 1 and 2.

Marginal bone levels demonstrated clinically acceptable remodeling from implant placement to definitive prosthetic delivery, consistent with established success criteria for dental implants[1].

-0.67 ± 0.45 mm ΔMBL on average (N=9)

Benchmark (mm)	Avg	Difference	T-stat*	P-value	Interpretation
1.5 mm	0.67 mm	-0.83 mm	-5.51	< 0.05	Significantly below upper limit
1.0 mm	0.67 mm	-0.33 mm	-2.18	> 0.05	NSD
0.5 mm	0.67 mm	+0.17 mm	1.15	> 0.05	NSD

*one-sample t-test

[1]Albrektsson, T., and Isidor, F. (1993). "Consensus report of session IV," in *Proceedings of the 1st European Workshop on Periodontology*, eds N. P. Lang and T. Karring (London: Quintessence), 365–369.

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Results: *Implant Stability*

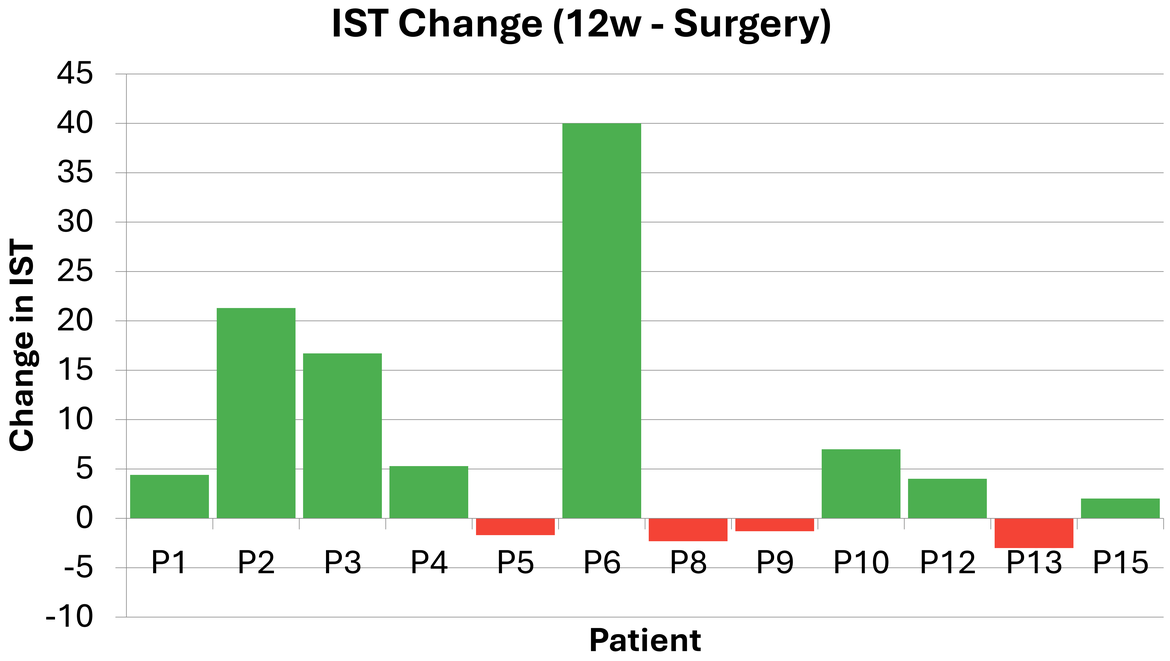

Figure 2. Change in IST values (ΔIST) from surgery to 12 weeks (N=12). Green bars indicate increased stability; red bars indicate decreased stability. **Mean ΔIST = +7.7 ± 12.1** (range: -3.0 to +40.0).

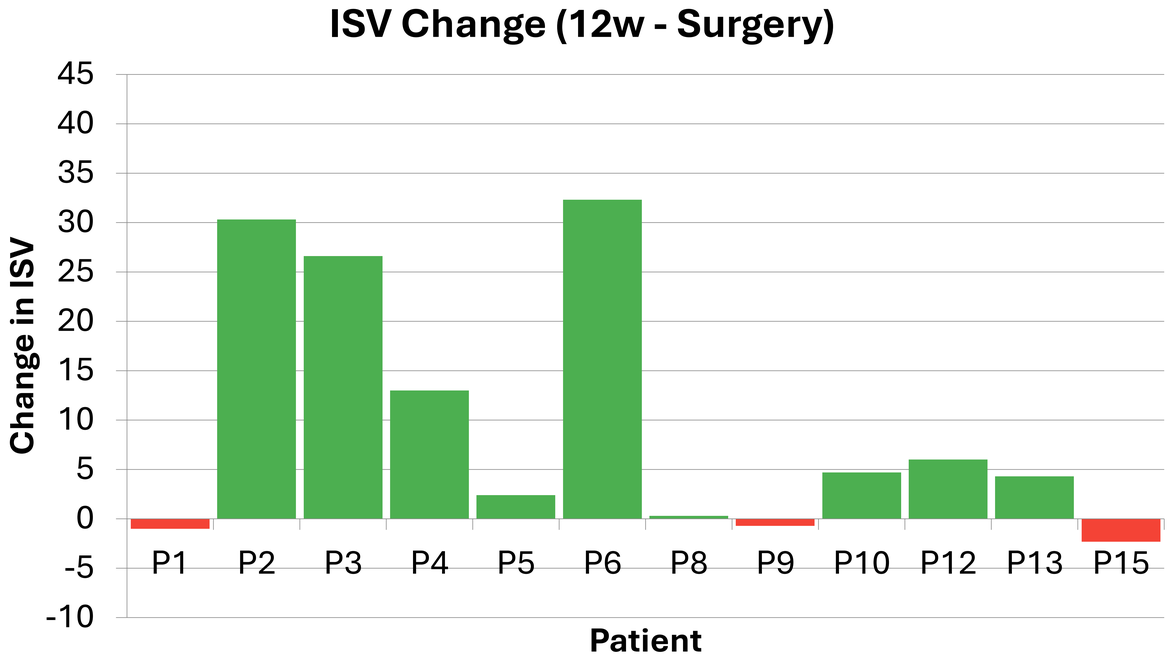

Figure 3. Change in ISV values (ΔISV) from surgery to 12 weeks (N=12). Green bars indicate increased stability; red bars indicate decreased stability. **Mean ΔISV = +9.7 ± 12.3** (range: -2.3 to +32.3).

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Results: *Implant Stability*

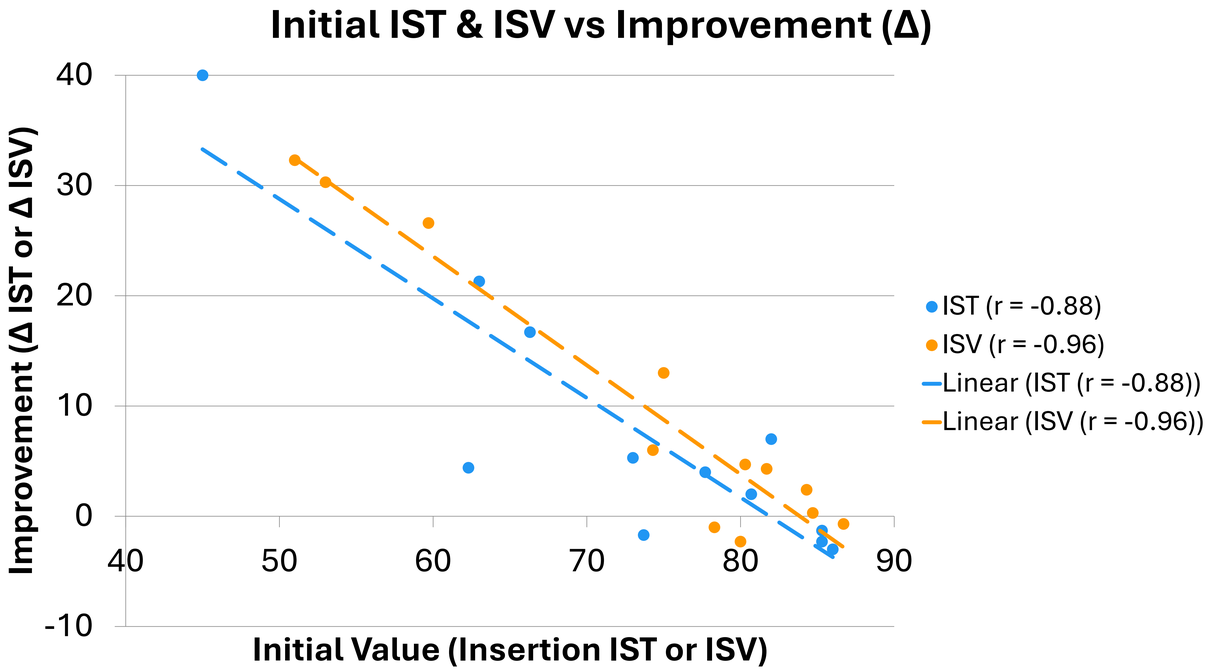

Figure 2. Scatter plot showing the relationship between initial stability values at surgery and improvement (Δ) at 12 weeks (N=12). Strong negative correlations were observed for both IST ($r = -0.88$, $p < 0.001$) and ISV ($r = -0.96$, $p < 0.001$)

Implant stability progressively improved over 12 weeks, indicating successful osseointegration.

Patient #	Tooth #	ITV (Ncm)	Insertion ISQ Avg.
1	5	>65	77.0
2	30	>50	81.7
3	30	>45	75.7
4	14	>45	80.3
5	14	>45	76.7
6	4	>35	73.0
8	5	>40	60.3
9	14	>40	63.0
10	30	~30	58.7
12	13	>40	64.7
13	12	>40	67.0
15	5	45	70.7

- "Ceiling effect"
  - Lower initial stability → greatest improvement
  - High baseline stability → minimal change or slight decline
- No clear tooth-position pattern: location does not determine stability trajectory
- Higher insertion torque did not guarantee higher IST/ISV, and vice versa

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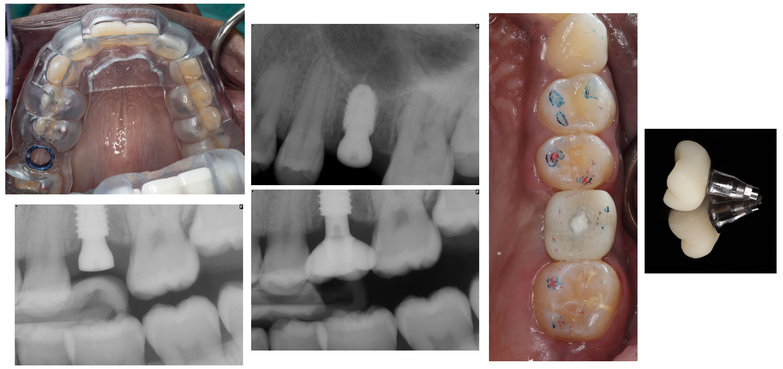
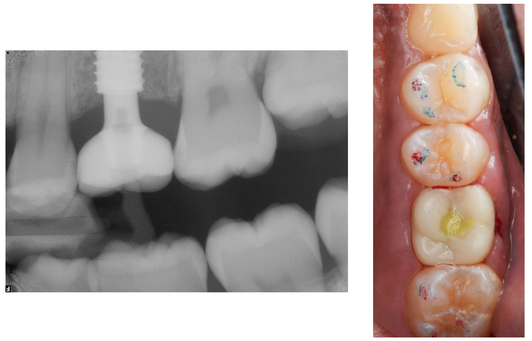
Example Patient

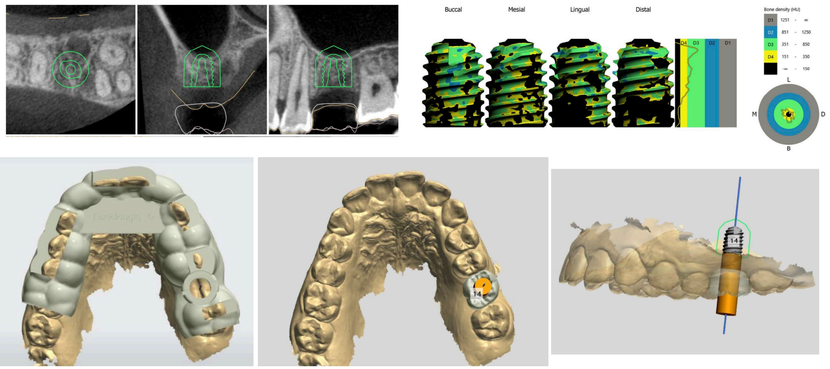
Initial Situation



Surgery + Provisionalization

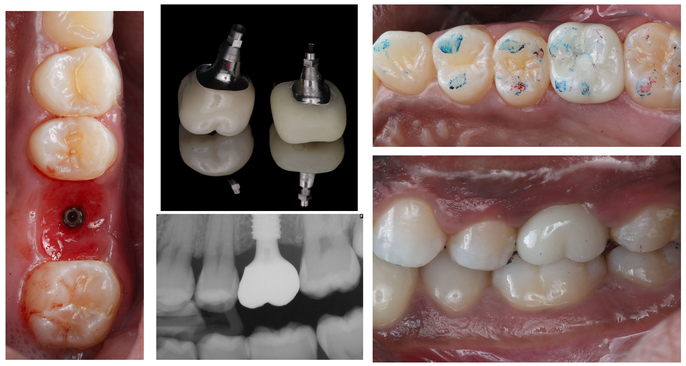


12-week Post-Op and Impression



Implant Planning

4-week Post-Op
(provisional de-bonded)



Definitive Crown Delivery