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Assessing the Primary Stability of Dental Implants via Different Osteotomy Preparation Techniques: An Ex Vivo Comparative Study Utilizing Two Distinct Non-invasive Methods

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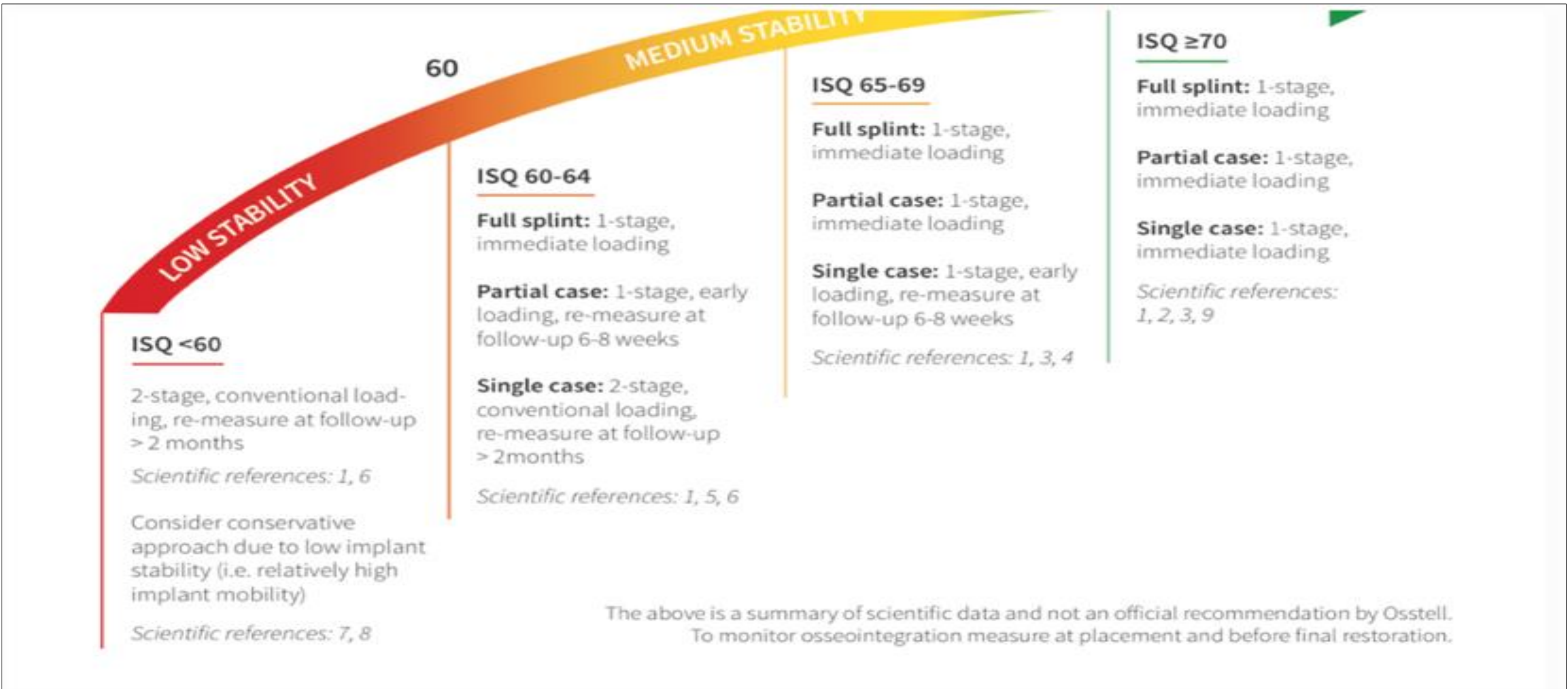
Stable connection between dental implants and bone is crucial in implant dentistry₍₁₎. Osteotomy preparation methods, such as **Conventional drilling (C)**, **Piezoelectric Bone Surgery (P)**, and **Osseodensification (O)**, play a major role in this process₍₂₎. The primary stability of implants, which influences prognosis and loading protocols, is affected by several factors, including cortical bone thickness. . Two innovative noninvasive devices like **Periotest®** and **resonance frequency analysis (RFA)** have been introduced to measure implant primary stability ₍₃₎ .

The aim of this study is:

- 1- To assess and compare the **primary stability** of dental implants inserted through
- **Conventional drilling (C)**

- **Piezoelectric Bone Surgery (P)**

- **Osseodensification (O)** , utilizing Resonance Frequency Analysis and Periotest.
- 2- To explore the effect of cortical bone thickness on the primary stability.



(<https://www.osstell.com/>)

Periotest value range	Interpretation
-8 to 0	Good osseointegration; the implant is well integrated and can be loaded
+1 to +9	Clinical examination is required; in most cases implant loading is not (yet) possible
+10 to +50	Osseointegration is insufficient; the implant must not be loaded

(<http://www.med-gulden.com/>)

Ten porcine ribs were utilized, with three osteotomies per rib employing (Fig. 1,2):

- 1- Conventional drilling (C)
- 2- Piezoelectric Bone Surgery (P)
- 3- Osseodensification (O)

Each technique involved ten implant preparation sites for 4.1 x 10 mm implants (Fig.3).

Primary stability was assessed using Periotest and RFA (Fig 4,5).

Bone thickness was measured using a calibrated dental ruler after bone sectioning at osteotomy sites (Fig.6).

Statistical analysis involved one-way repeated measures ANOVA and multiple comparison tests, with significance set at $p < 0.05$ for the first objective.

The second objective utilized the Pearson Correlation Coefficient (r) test.

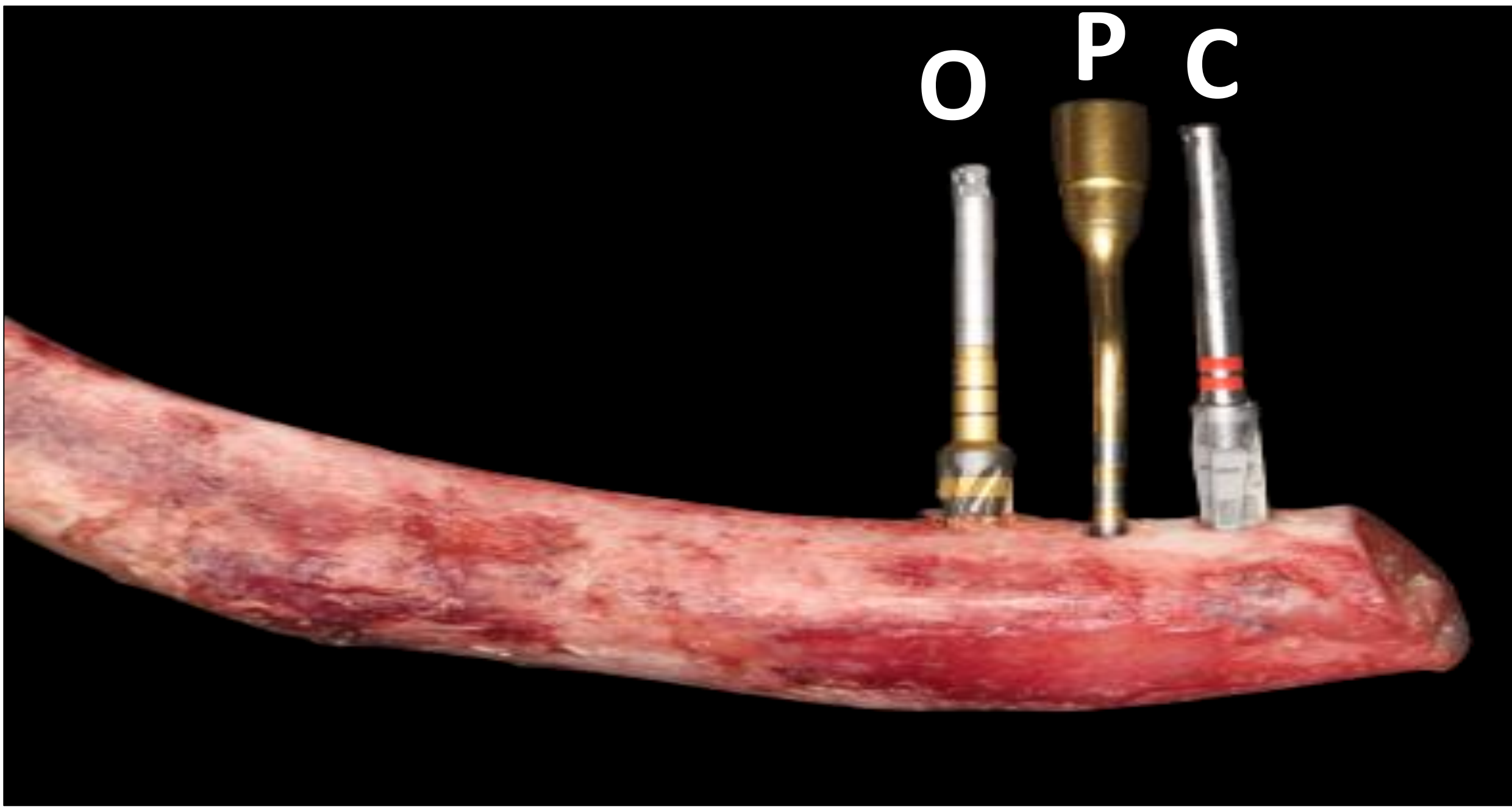


Fig.1: The final drill of the three distinct implant site preparation techniques, arranged from right to left: C: conventional drilling procedure, P: piezoelectric bone surgery, and D: Densah® bur method.



Fig.2: Osteotomy site preparation for C: conventional drilling procedure, P: piezoelectric bone surgery, and D: Densah® bur method.



Fig.3: BLT 4.1mm implant placement with the Ratchet Adapter into the implant bed.

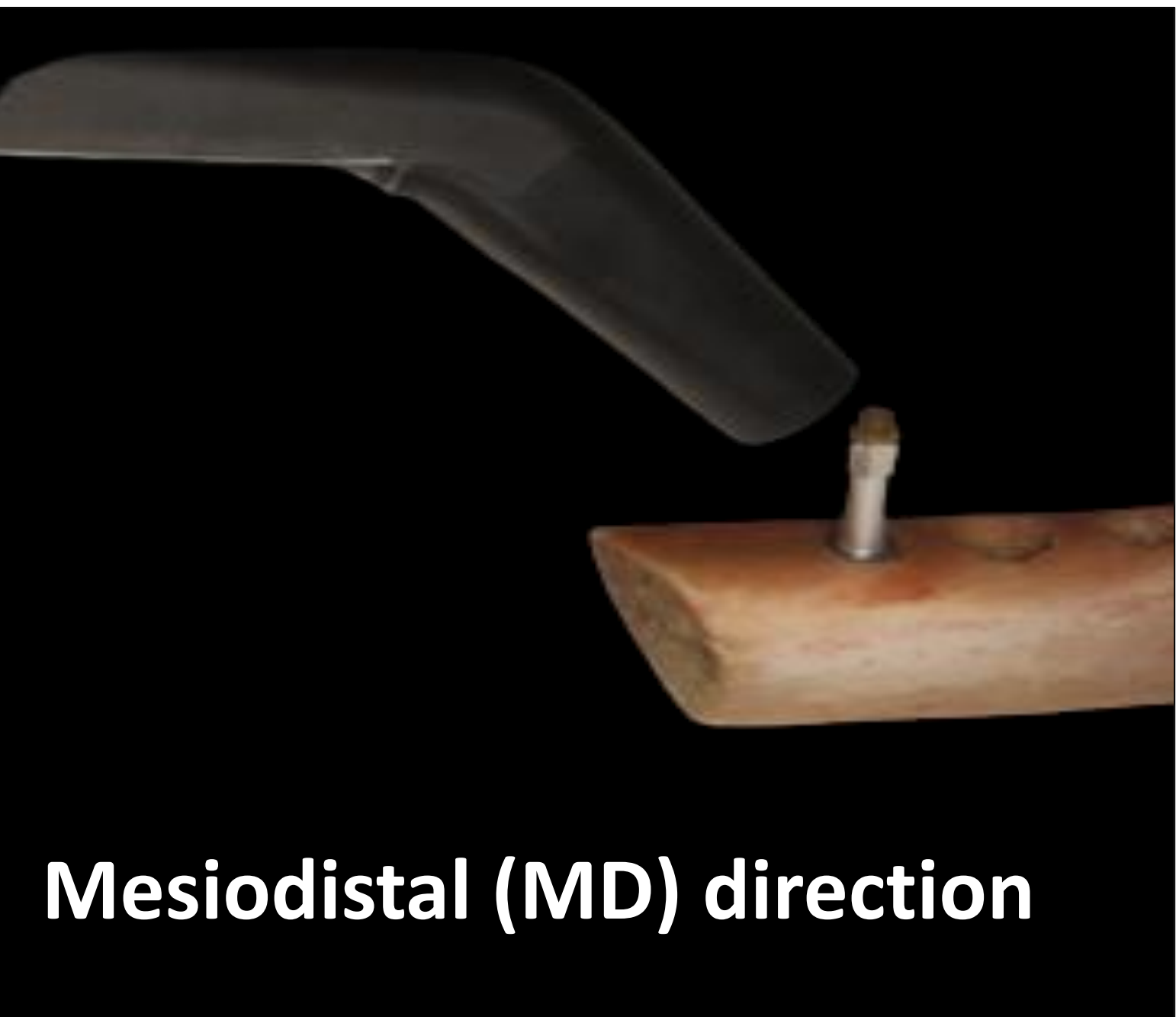


Fig.4: ISQ measurements were taken in both the mesiodistal (MD) and buccolingual (BL) directions for each implanted implant.



Fig.5: Periotest measurements were taken in both the mesiodistal (MD) and buccolingual (BL) directions for each implanted implant.

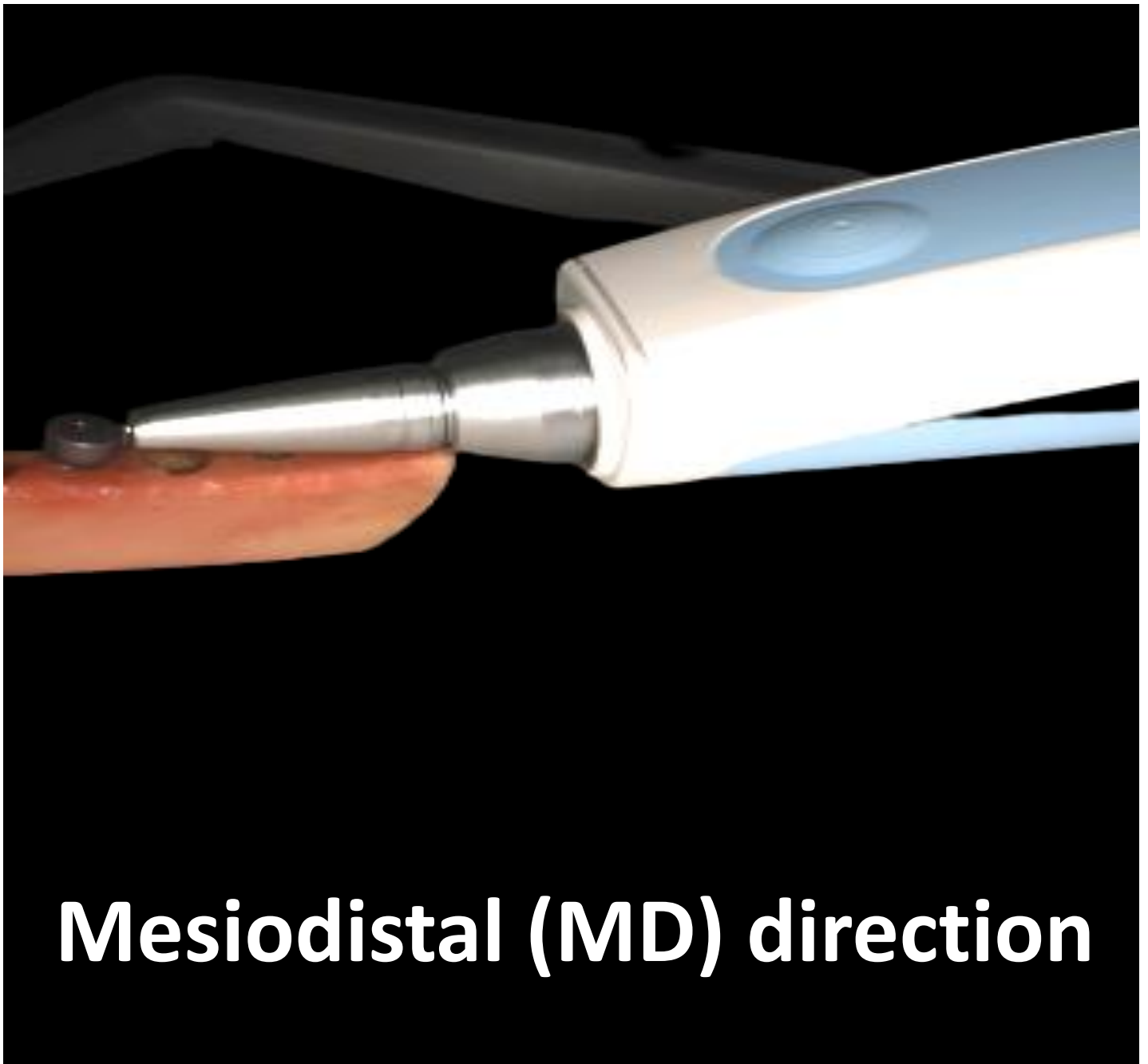


Fig.6: Caliber Dental Ruler was used to the measure the cortical bone thickness after sectioning the osteotomy site.

The mean ISQ for RFA was reported as 69.85, 68.25, and 73.05 for (C), (P), and (D), respectively (Table 1). The PTV (Periotest Value) was recorded as -5.2300, -3.2250, and -3.5000 for (C), (P), and (D), respectively (Table 1).

The (O) technique exhibited a **higher mean RFA** score compared to **(C) and (P) techniques**, while **Periotest scores** were **lower for (C)** than **(P) and (O)**. Interestingly, there was no consistent ranking between the RFA and Periotest results. Furthermore, **no significant correlation** was found between **cortical bone thickness** and either **RFA or Periotest scores** (fig.6,8).

Technique	RFA			Periotest		
	N	Mean	SD	N	Mean	SD
Conventional	10	69.85	2.89	10	-5.2300	1.22
Piezo	10	68.25	4.60	10	-3.2250	0.98
Densah	10	73.05	2.75	10	-3.5000	1.27
RFA = Resonance Frequency Analysis						

Table 1: Descriptive analysis of both methods RFA and Periotest

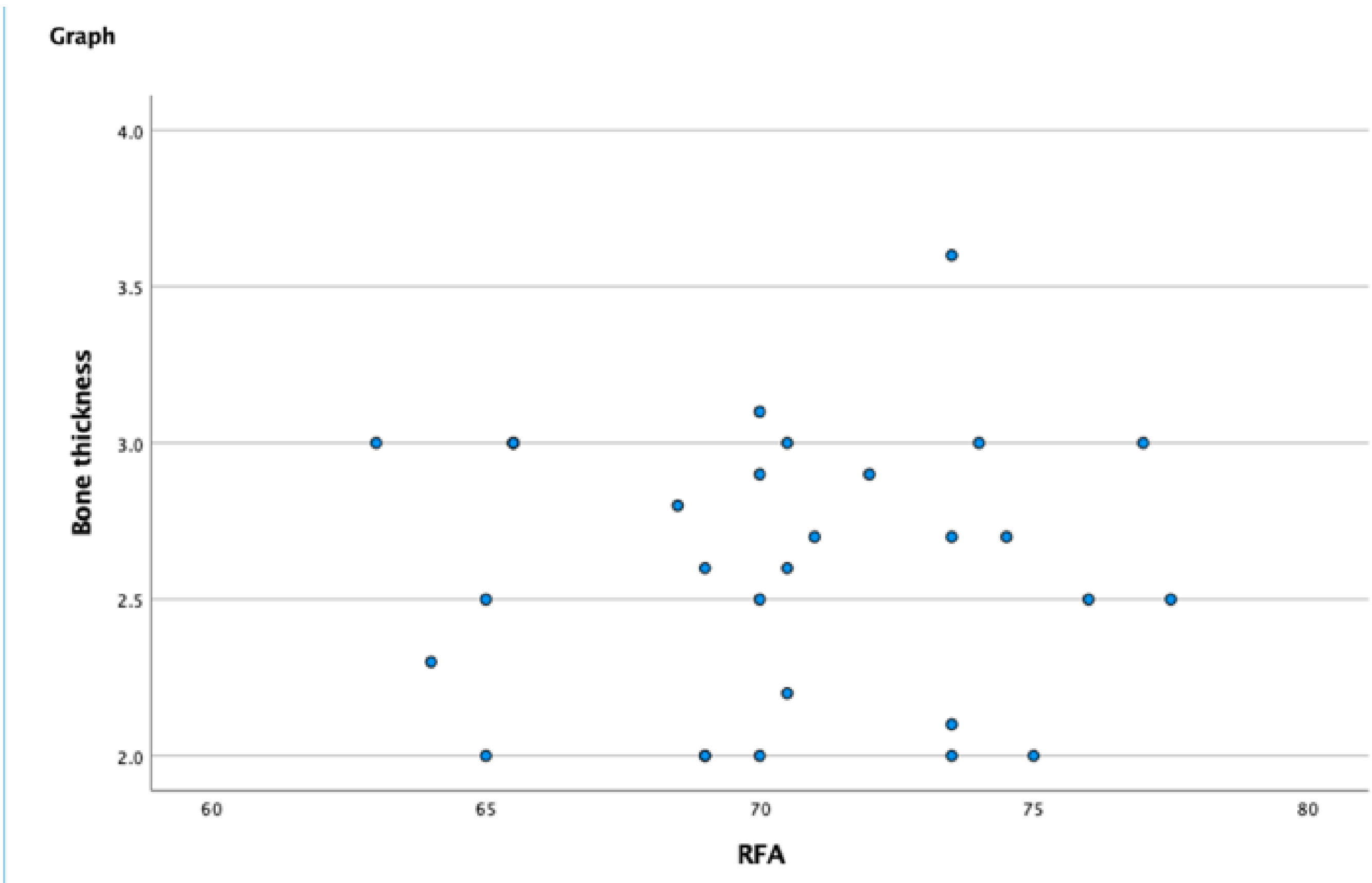


Fig. 6: Pearson correlation coefficient (r) indicated no significant association between bone thickness and Periotest (r = .26)

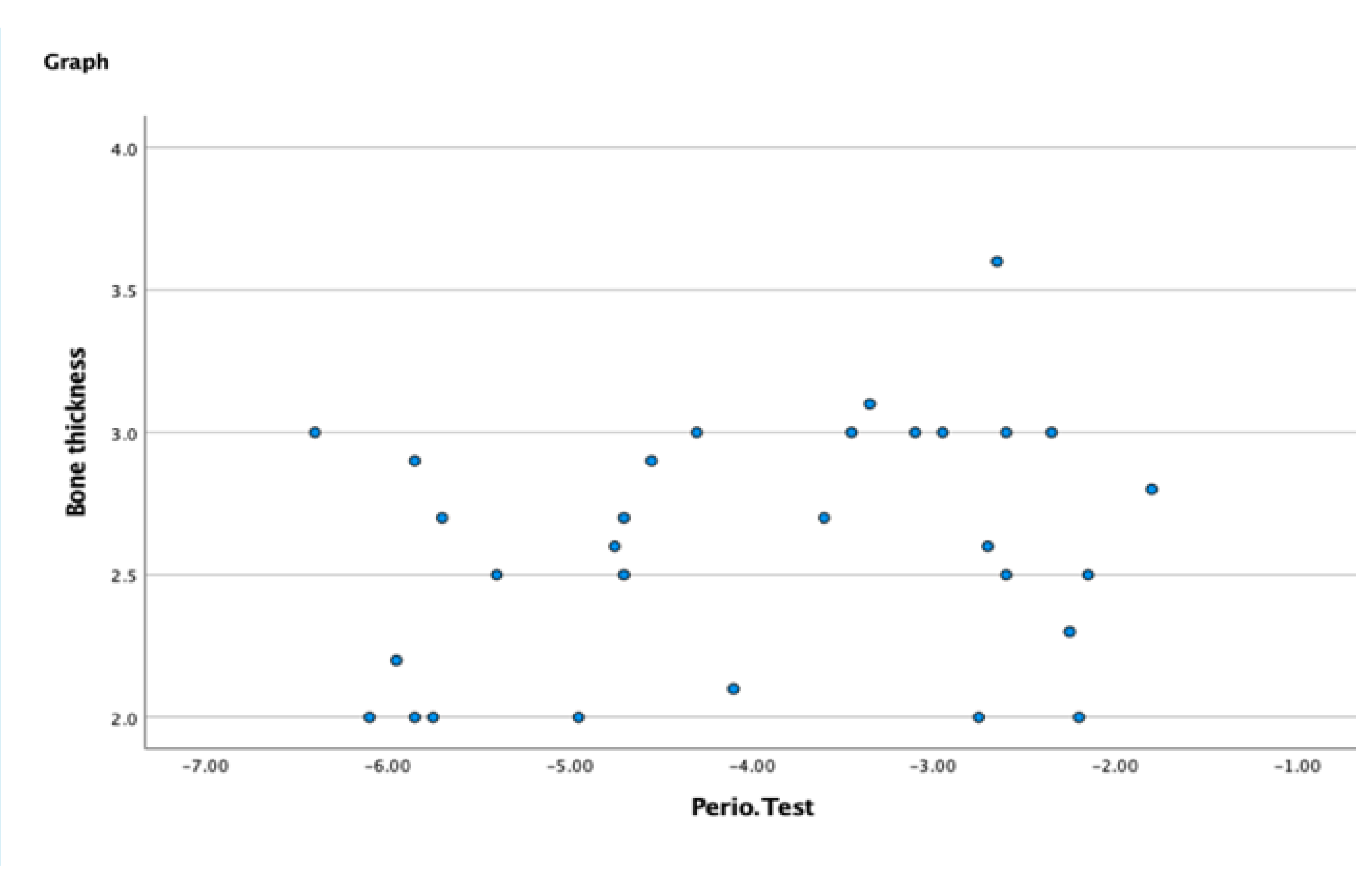


Fig. 7: Pearson correlation coefficient (r) indicated no significant association between cortical bone thickness and RFA (r = -.08)

- While **statistically significant differences were observed**, all three techniques demonstrated results falling within the range of good clinical primary stability.
- The study suggests **that there is no significant clinical distinction between (RFA) and Periotest**.
- Additionally, **cortical bone thickness did not show** a significant correlation with either **RFA or Periotest** readings .

Acknowledgment:

I acknowledge the support of the **Buhite-DiMino** Corridor for Oral and Maxillofacial Health Foundation in the form of a grant which enabled me to attend this meeting.

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