



# The Effect of Tightening Torque on Vertical Position of SRA Implant Scan Bodies

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## Introduction

Inconsistent tightening torque of implant scan bodies (ISBs) may cause vertical displacement and errors in implant restorations, a problem especially critical in full-arch cases where small discrepancies accumulate. Hand torquing is the most common protocol for securing ISBs and the torque achieved can vary significantly between clinicians [1, 2]. While different scan body materials and designs exist, their response to torque variation remains insufficiently studied.

**Aim:** To evaluate the effect of tightening torque on the vertical displacement of various screw-retained abutment (SRA) scan bodies, including titanium, PEEK, and Optisplint ISBs.

## Methods

- Sample: 30 SRA scan bodies: 10 Straumann titanium ISBs (Fig. 1a), 10 Optisplint ISB (Fig. 1b), 10 PEEK IBBs (Fig. 1c).
- Each scan body was attached to an SRA analog and sequentially tightened to **5Ncm, 10Ncm, 15Ncm, and 20Ncm**.
- Scanning was performed at each torque level using a 3Shape E4 lab scanner.
- Vertical displacement deviation analysis was obtained using Geomagic Control X software. Each scan body scan was superimposed to its group reference scan at 15 Ncm (Figs. 4a-c).
- Statistical analysis was conducted using Two-Way ANOVA followed by Tukey's HSD for pairwise comparisons.



Fig 1a. Titanium SRA ISB

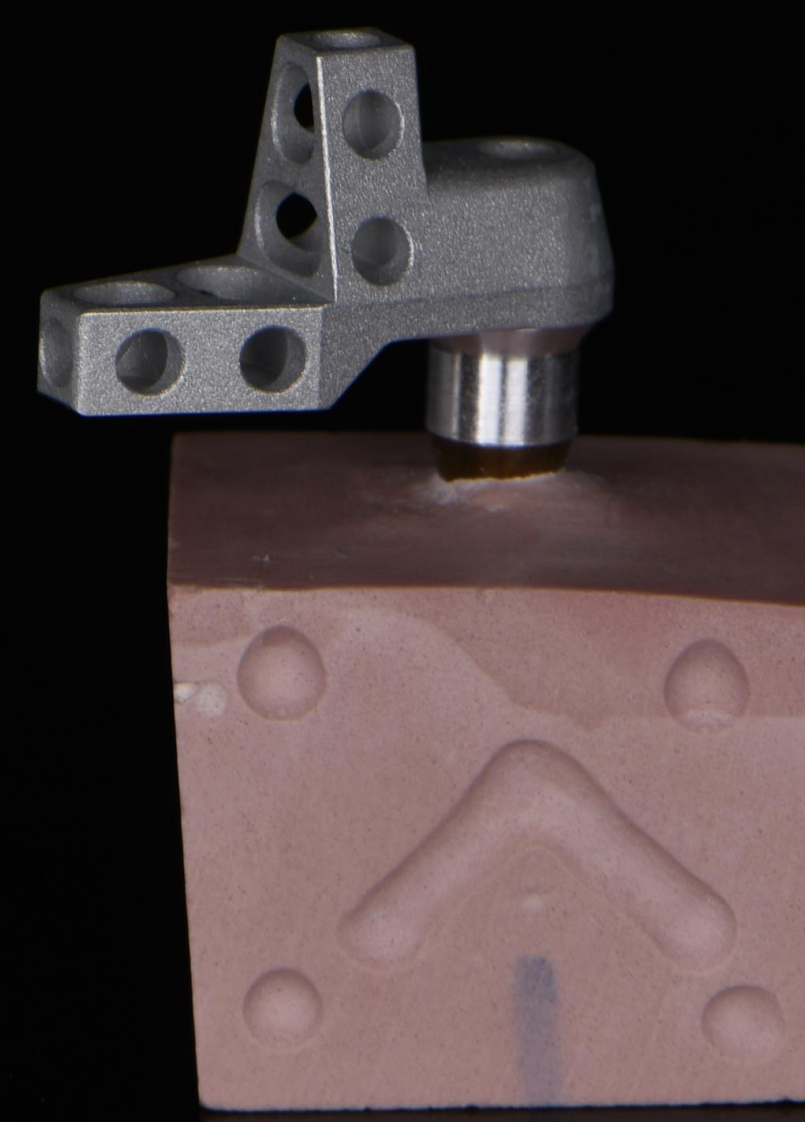


Fig 1b. Optisplint ISB

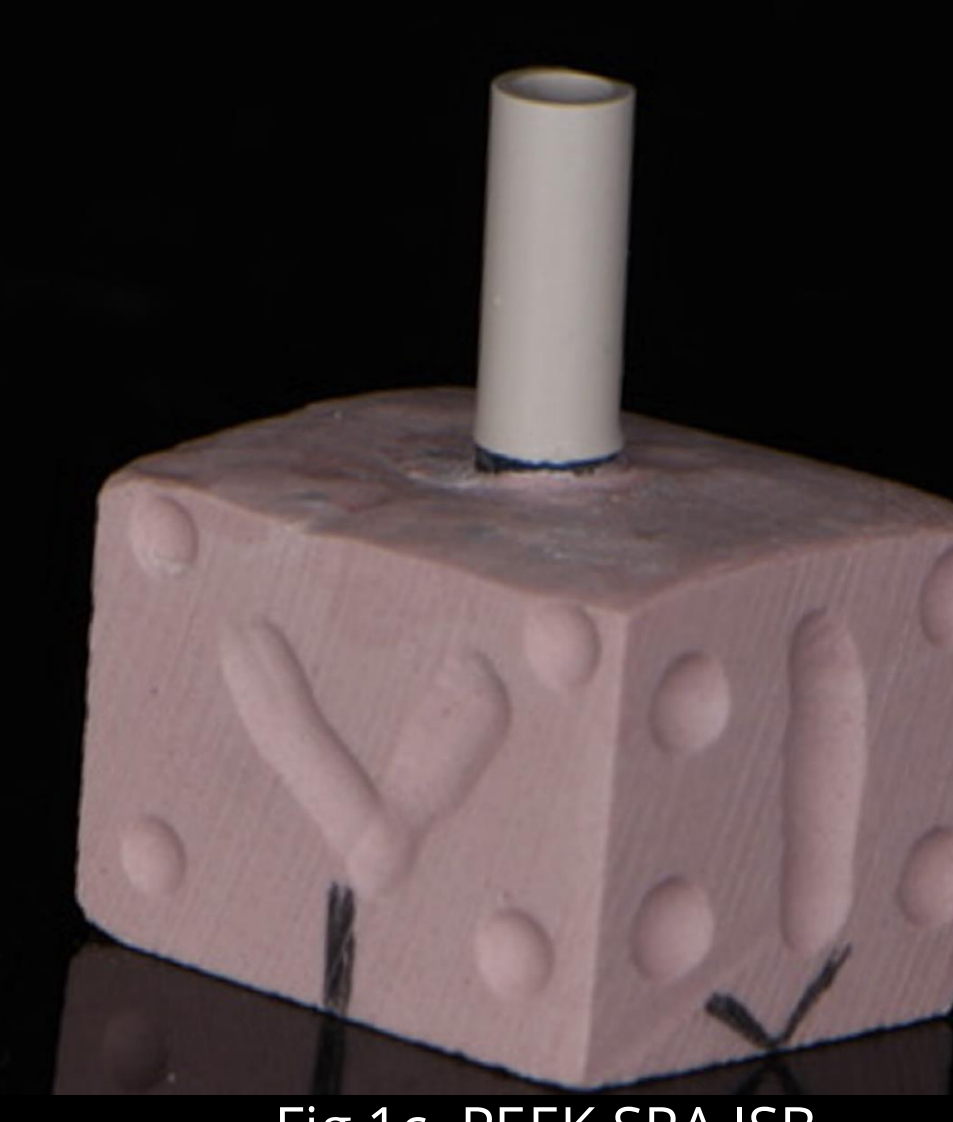


Fig 1c. PEEK SRA ISB

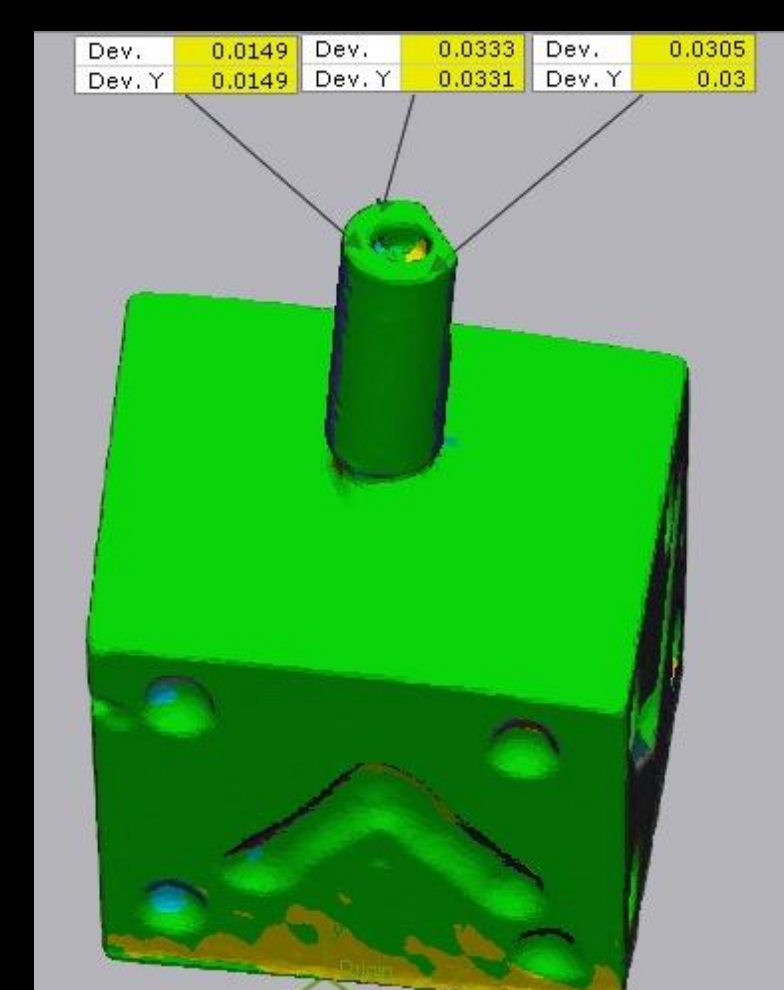


Fig 4a.

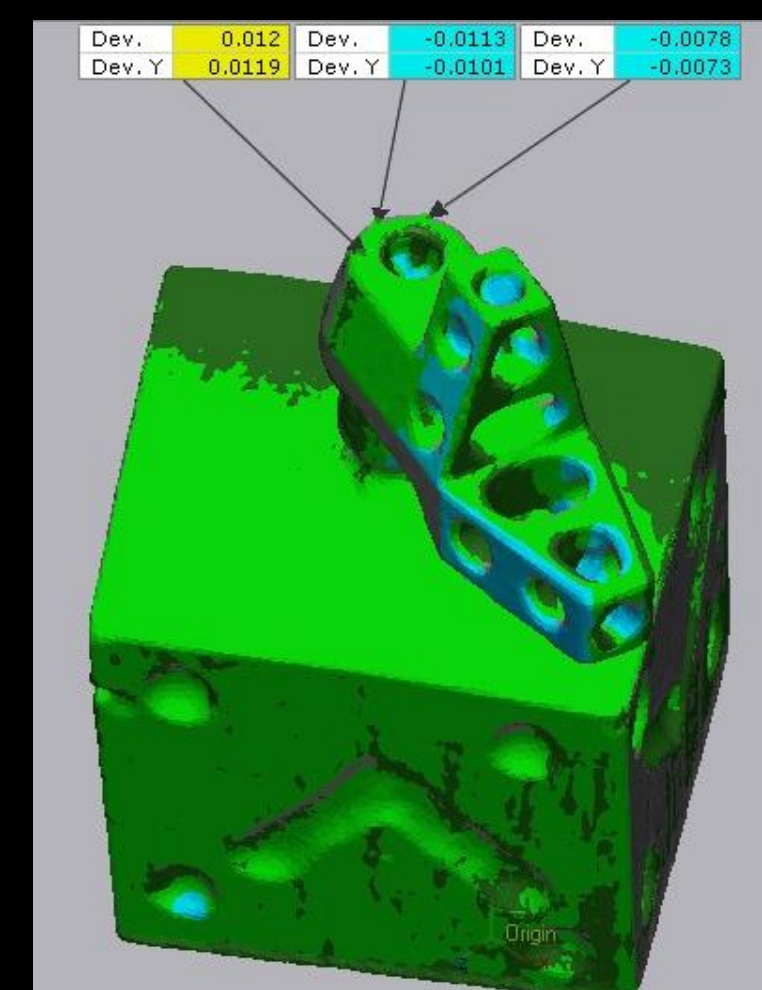


Fig 4b.

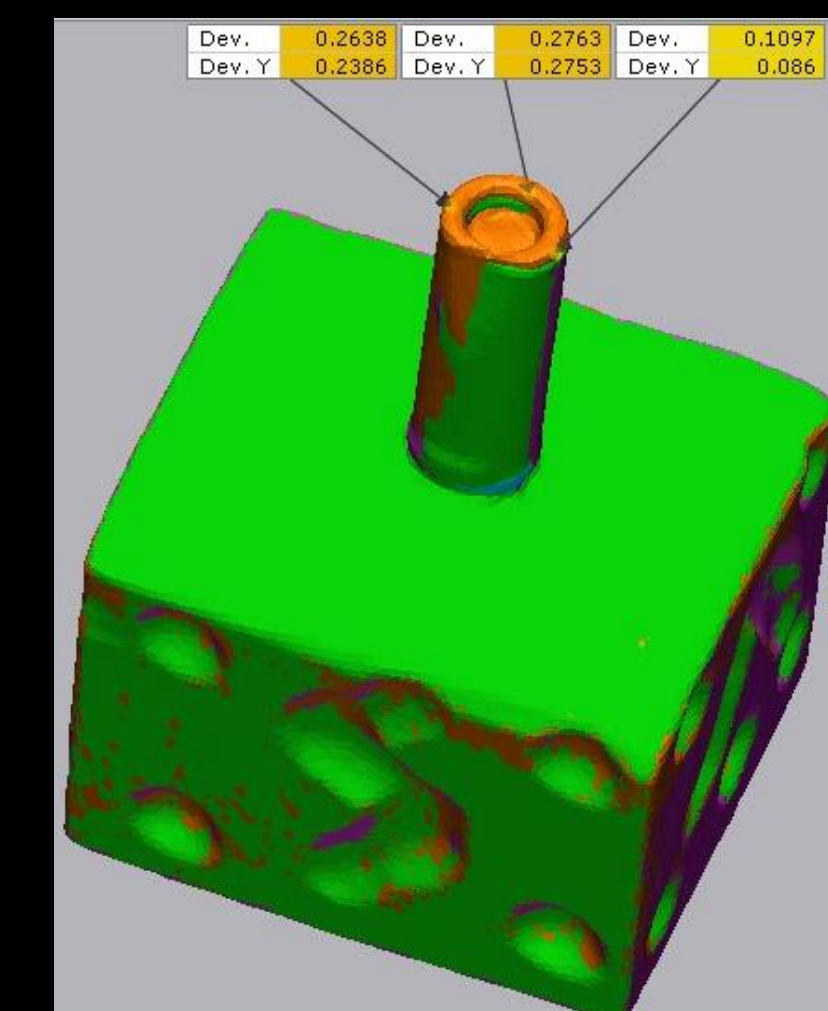


Fig 4c.

Fig 4. Geomagic Control X superimpositions of titanium SRA ISB (a), Optisplint ISB (b), and PEEK SRA ISB (c) at 5 Ncm vs 15 Ncm torque.

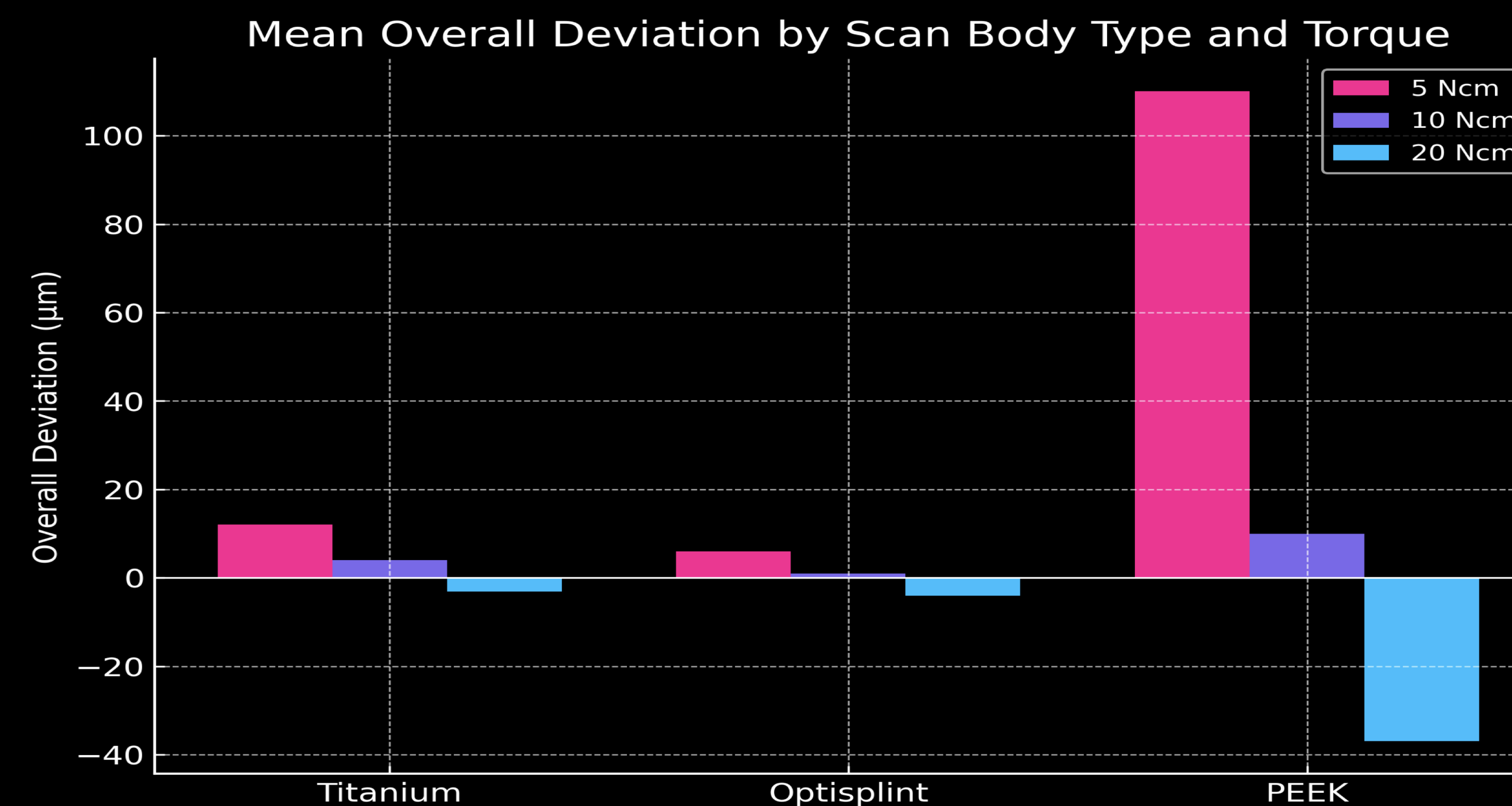


Fig 5. Mean Overall Deviation by Scan Body Type and Torque

## Results

Significant differences in vertical displacement were observed among the different scan body types ( $p < 0.001$ ) (Fig. 5).

- PEEK:** At 5Ncm torque, PEEK scan bodies had significantly higher deviation than both Optisplint ( $p < 0.001$ ) and titanium scan bodies ( $p < 0.001$ ).
- Titanium:** Significant displacement between 5 Ncm and higher torque levels ( $p < 0.005$ )
- Optisplint:** Least affected by torque; no significant differences across torque values.

Overall, titanium & Optisplint SRA scan bodies consistently showed lower mean deviations than PEEK.

## Conclusions

Tightening torque affected vertical position of SRA ISBs. PEEK SRA ISBs showed the highest deviations, which suggests they may need to be reconsidered as a suitable material. In contrast, titanium and Optisplint ISBs demonstrated lower and more consistent displacement, with Optisplint being the least torque-sensitive. These results highlight the importance of both ISB type and consistent torque application to ensure accuracy in implant restorations.

## References

- [1] E. Diker, H. Terzioğlu, D. N. M. Gouveia, M. B. Donmez, J. Seidt, and B. Yilmaz, "Effect of material type, torque value, and sterilization on linear displacements of a scan body: An in vitro study," *Clin Implant Dent Relat Res*, vol. 25, no. 2, pp. 419–425, 2023. doi:10.1111/cid.13187
- [2] M. Gómez-Polo, M. B. Donmez, G. Çakmak, B. Yilmaz, and M. Revilla-León, "Influence of implant scan body design (height, diameter, geometry, material, and retention system) on intraoral scanning accuracy: A systematic review," *J Prosthodont*, vol. 32, no. S2, pp. 165–180, 2023. doi:10.1111/jopr.13774