

Stress effect of occlusal rest and implant support for removable partial dentures

Victor Velasquez, DDS, Sotillo Amanda DDS, Al-Rashdan Rama, DDS, Berna Saglik, DDS, MS, Won-Suk Oh, DDS, MS
University of Michigan School of Dentistry, Ann Arbor, Michigan

INTRODUCTION

The implant customarily locates at the most posterior tooth or one occlusal unit anterior to support the base of mandibular free-end partial overdenture prostheses (IPODs). However, the biomechanically optimum location of implant has not been investigated scientifically to reduce the stress and bending moment developed in IPODs.

OBJECTIVE

This study investigated stress effect of occlusal rest and dental implant supporting a mandibular removable partial denture (RPD).

MATERIALS and METHODS

Four theoretical test models of unilateral mandibular RPDs were constructed to represent the base for second premolar (P2), first molar (M1), and second molar (M2). The test models were designed to resist occlusal loading against the first premolar (P1) by means of mesial (Me) or distal (Di) rest, and implant located either at M1 or M2 site, as follows; Model 1: Me rest and implant at M1, Model 2: Me rest and implant at M2, Model 3: Di rest and implant at M1, Model 4: Di rest and implant at M2. The occlusal loading was concentrated at P2 (50N), M1 (100N), and M2 (100N) to calculate the stress resultants of forces and moments developed in the RPD.

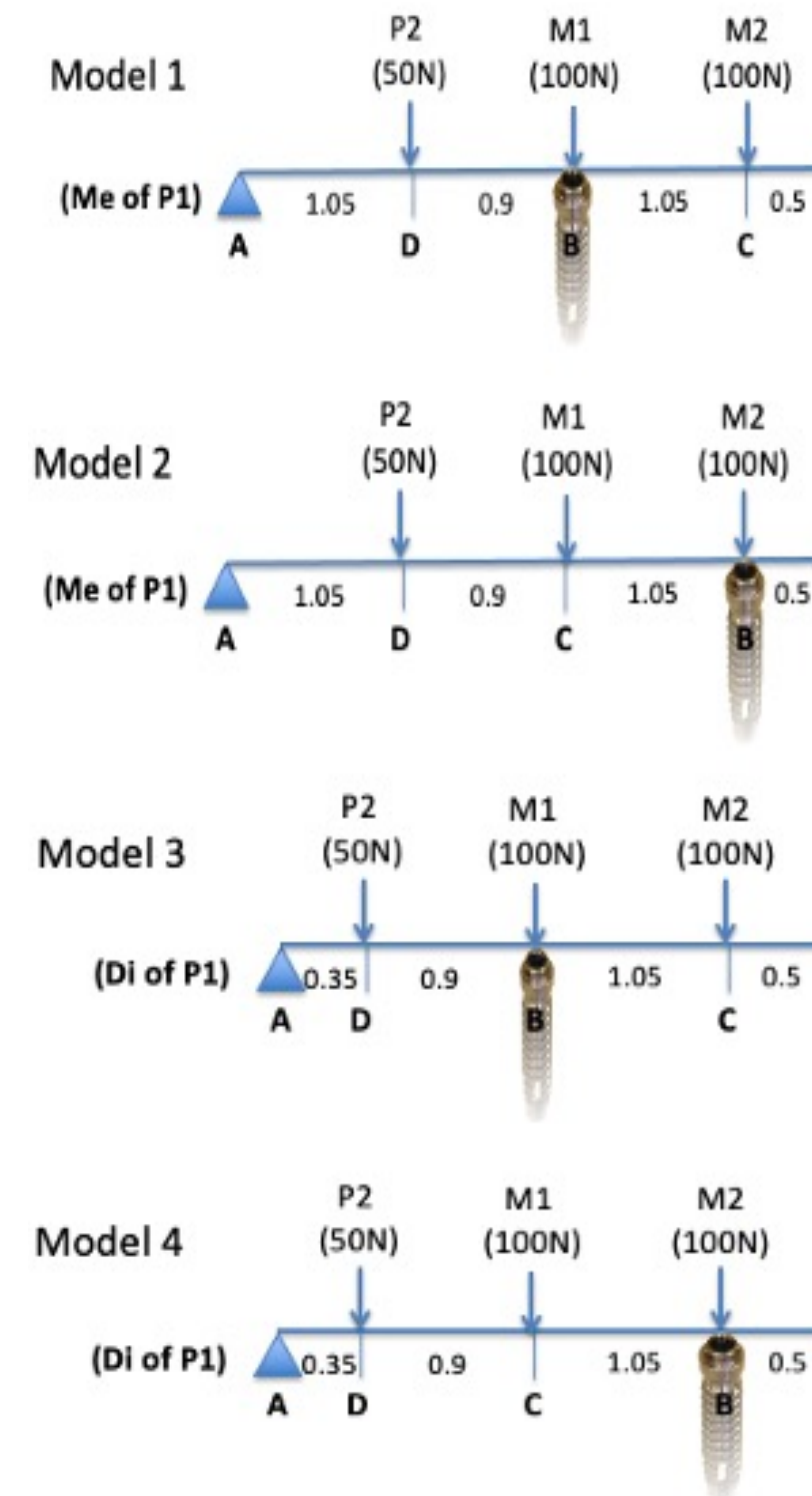


Fig 1. Tooth size: 0.7 cm for P1; 0.7 cm for P2; 1.2 cm for M1; 1.0 cm for M2 and the location of implant and loadings: 50 N for P1; 50 N for P2; 100 N for M1; 150 N for M2.

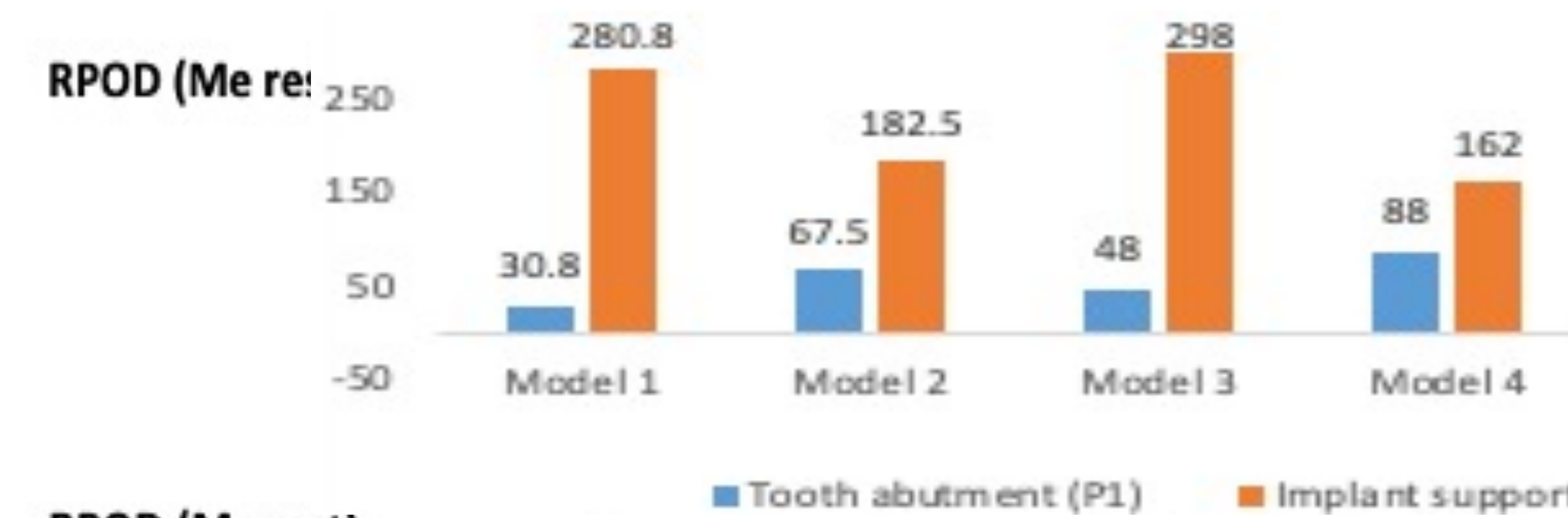


Fig 2. Vertical force (N) subjected to implant.

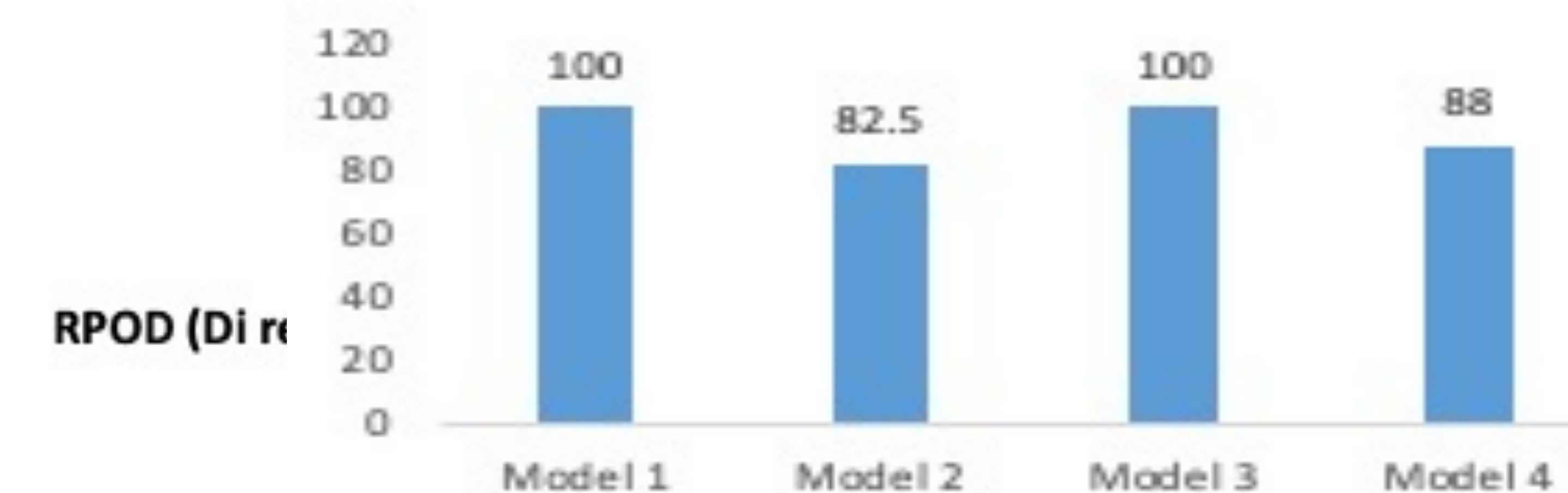


Fig 3. Peak shear force (N) developed in base.

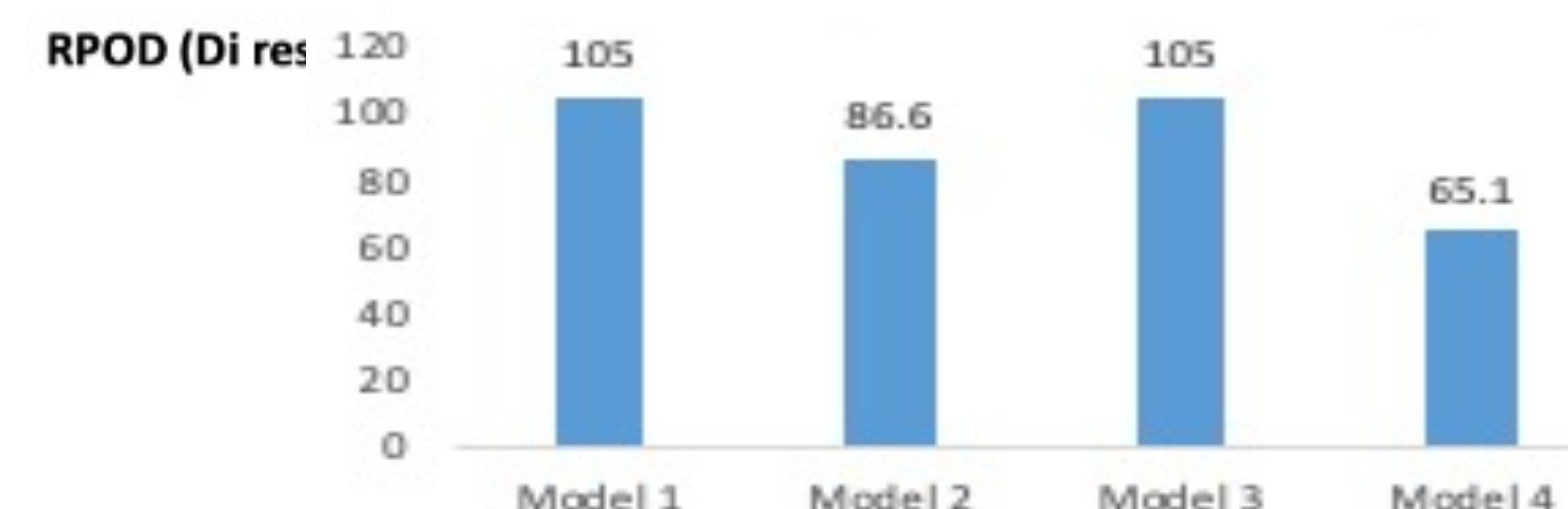


Fig 4. Peak bending moment (Ncm) in base.

RESULTS

The vertical force driven against P1 was the greatest in Model 4 and was the lowest in Model 3. However, the force driven against implant support was the greatest in Model 3 and was the lowest in Model 4. The shear forces and bending moments developed in the RPD varied among the test models. The peak shear force was the greatest in Models 1 and 3, and bending moment was the greatest in Model 4. The force and moment were the lowest in Model 2.

DISCUSSION

The rest seat position can influence the stress directed toward the anterior abutment tooth in IPODs. The rest seat at the premolar sites can be subjected to higher level of stresses resulting from heavier forces and increased bending moments depending on location of rest seat in correlation of the position and the posterior implant. The conventional wisdom may hold in locating the implant anterior to one occlusal unit as demonstrated in Model 3; however, this location was found to develop higher bending moments in Models 1 and 2. Thus, optimal location of implant can vary depending on loading condition of occlusal force and number of teeth replaced.

CONCLUSION

Within the limits of this study, the stress resultants of forces and moments developed in the RPD varied with different location of occlusal rest and implant support.