



Retention Force of Custom-Made Abutments before and after Fatigue Load - An In Vitro Study

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Objective

The aim of the study was to evaluate the retentive force value for custom-made locators attached to implants at zero, 15, and 30-degrees angle.

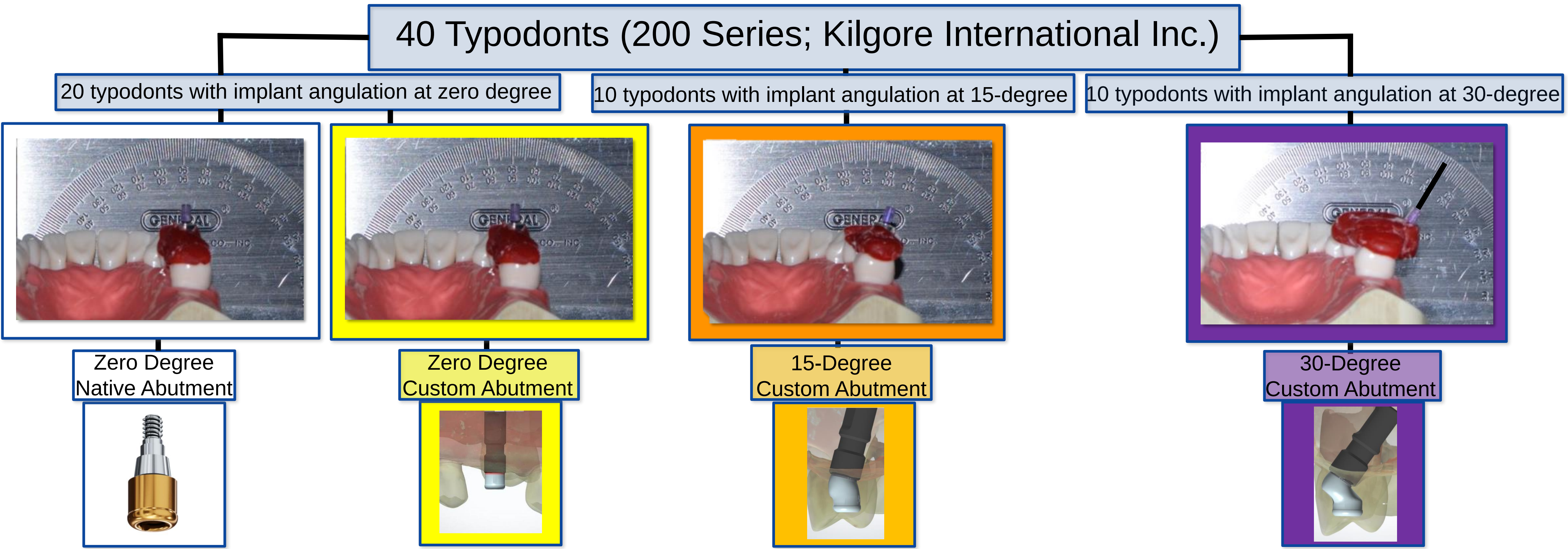
Introduction

Edentulous patients with severely resorbed ridges lack supporting tissue and may suffer from denture instability and lack of retention. An implant-supported overdenture can offer these patients especially, those with an edentulous mandibular arch—improved denture stability, retention, chewing ability, and improved quality of life.¹ Maxillary implant overdentures are growing in popularity, as they provide prosthesis stability and a palateless overdenture, creating a natural feeling for the patient.² However, implant placement may be challenging in the edentulous maxilla due to anatomic restrictions and the pattern of bone resorption.² A custom-fabricated locator can be designed and milled to a specific height, angulation, and emergence profile to correct for challenging implant position and angulation. Its design is compatible with the use of matrix component attachments of native locator abutments and acts as an adapter to provide a parallel path of insertion for the denture attachment. This improves the retention load and reduces the deformation of the attachment.³ The retentive load and attachment wear resistance of custom-made locator abutments have not yet been assessed and reported in the literature. The purpose of this study was to evaluate the retentive force value for custom-made locators attached to implants at zero, 15, and 30-degrees angle.

Materials and Methods

Material	Manufacture
Implant Analog, RC	Straumann USA LLC
Locator Abutment, AH=3mm	Zest Dental Solution Corp
Angulated Abutment	TruAbutment Inc.
Ivotion Base billets	Ivoclar Vivadent Inc.
ProBase, Cold Cure	Ivoclar Vivadent Inc.
Gingifast Elastic	Zhermack

Table 1. List of Materials



Fabrication of Denture Base

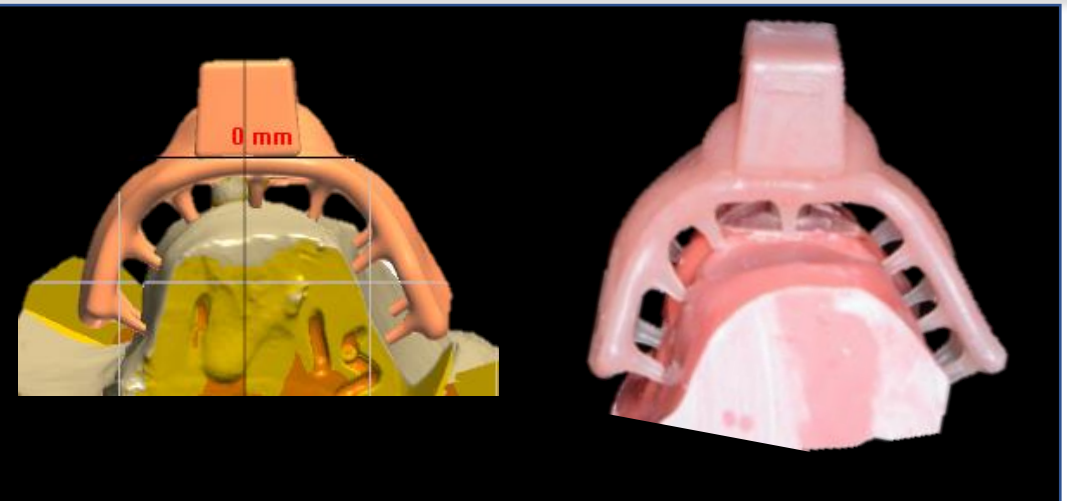


Fig. 1: Denture base designed using a Dental System; 3Shape A/S. Then, they were milled from PMMA billets (Ivotion Base, Ivoclar Vivadent) using a 5-axis milling machine (PM7, Ivoclar Vivadent).

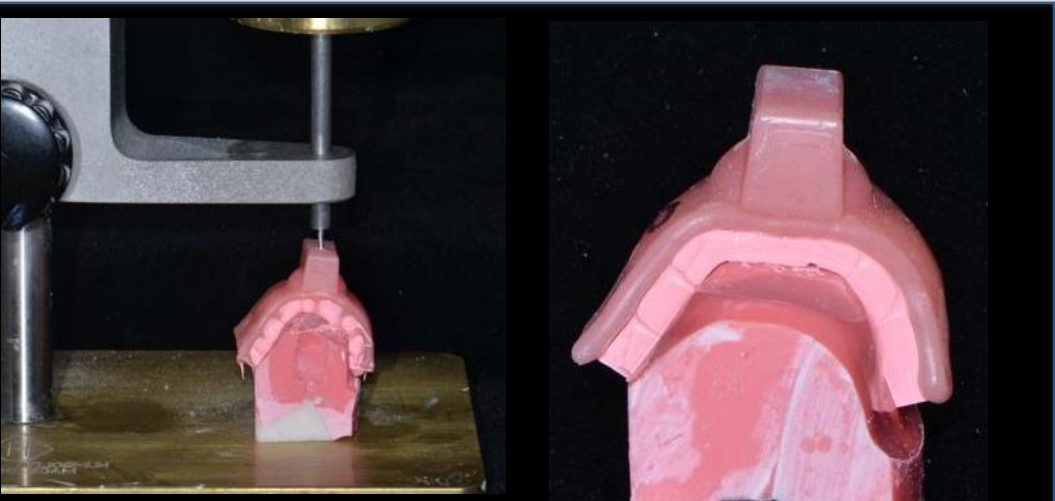


Fig. 2: The gap between the denture base and edentulous arch was filled with Gingival mask under a constant pressure; then, denture base positives were cut.

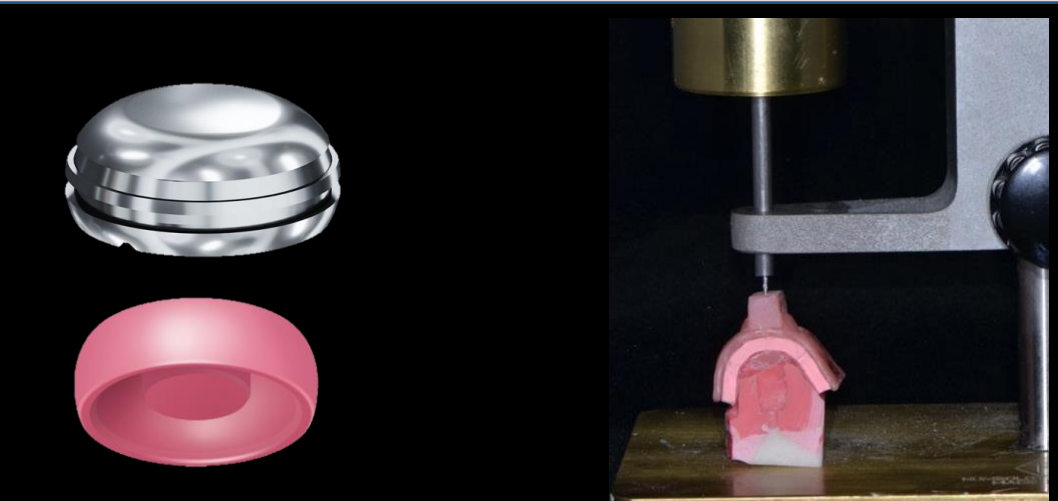


Fig. 3: The metal housing-processing nylon was picked-up using ProBase,Cold Cure and under a constant pressure. Then, the pink retentive nylon was inserted in the housing.



Fig. 4: Denture base was perforated to insert wire rope for the retention test.

Retention Test Before and After Fatigue Load

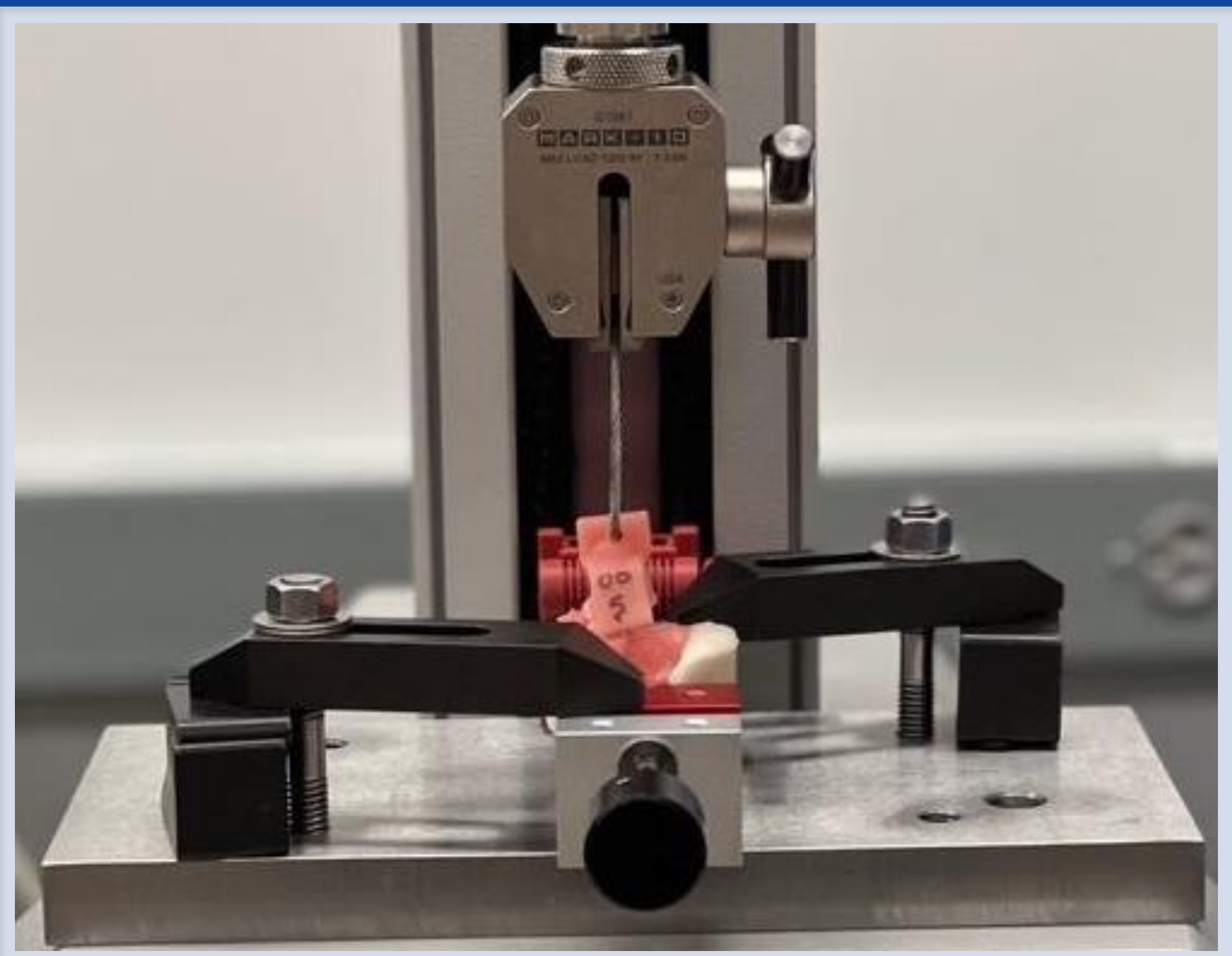


Fig. 5: Retention of denture bases were assessed using a universal testing machine (Dillon Quantrol TC2i, Mecmesin) with a cross-head speed of 5 mm/min before and after two rounds of 120,000 cycles fatigue load.



Fig. 6: Specimen were mounted in a chewing simulator machine (Chewing Simulator CS-4; SD-Mechatronik, Westerham, Germany) for two rounds of 120,000 cycles (equivalent to 6 month of chewing) under a loading force of 49 N at a frequency of 1.3 Hz immersed in 37°C running deionized water. The retention of the denture base was assessed after each 120,000 cycles. A digital stereo microscope at 30x magnification (Dinolite) was used to assess the nylon inserts after fatigue loading.



Results

Two-way ANOVA with repeated measure, followed by Tukey Post Hoc test showed a significant ($p < 0.05$) increase in retention after the first round of the fatigue load and a significant ($p < 0.05$) decrease in retention after the second round. There were no significant ($p > 0.05$) difference between different abutment, before or after fatigue load. Four nylon inserts were damaged after the fatigue load for 15-degree and 30-degree custom abutments.

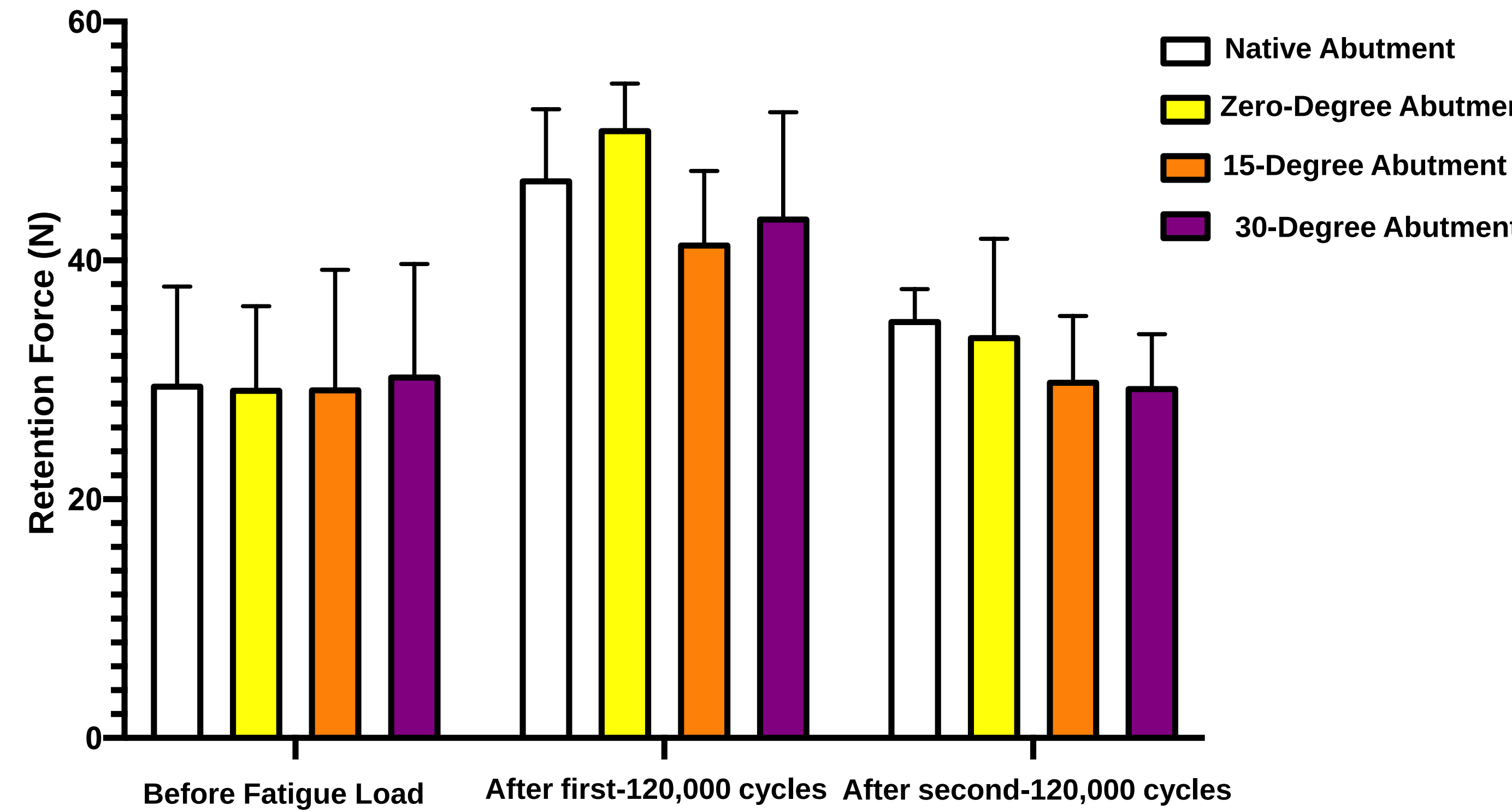


Fig. 7: Retention force (N) of denture base before and after fatigue load

Fig. 7: Nylon insert at 30x magnification before and after fatigue load



Nylon Insert Before Fatigue Load



Nylon Insert After Fatigue Load

Conclusions

A custom-made locator is a valid treatment option when implants are placed with significant angulation due to bone loss. Statistical analysis revealed no significant ($p > 0.05$) differences in retention between Custom locator abutments at 0, 15, and 30 and native locator abutments before and after fatigue testing. Customized angled abutments may lead to nylon insert damage, requiring frequent replacement.

References

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