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# Investigation of Clinical and Laboratory Wear in Locator-Supported, Implant-Retained Overdentures

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**Purpose:** To investigate the mechanical properties and wear of nylon inserts and abutments in Locator-retained, implant-supported overdentures (L-IODs). **Materials and Methods:** Clinical wear of inserts and abutments was qualitatively rated in a group of 16 patients with L-IODs. The inserts were also subjected to microscopic analysis, differential scanning calorimetry (DSC), and thermal gravimetric analysis (TGA). **Results:** Wear was identified in almost all inserts and abutments. These results were corroborated by DSC and TGA analyses, which showed significant mechanical deterioration of the inserts. **Conclusion:** Nylon inserts and Locator abutments show relevant signs of deterioration in clinical use, indicating that regular maintenance is an issue that should be addressed with the patients prior to treatment. *Int J Prosthodont* 2018;31:334–337. doi: 10.11607/ijp.5706

Locator-retained implant overdentures (L-IODs) have been introduced as a minimum standard of care concept for rehabilitation of the edentulous jaw. Previous clinical studies have highlighted that the retention of L-IODs decreases significantly with time and that regular replacement of the nylon inserts is necessary.<sup>1–4</sup> However, apart from these clinical observations, wear of the Locator abutments—as well as the mechanical properties and deterioration of the nylon inserts—has not yet been adequately addressed. Thus, the purpose of the present study was to evaluate the wear and deterioration of the various components of the Locator attachment system. It was hypothesized that (1) Locator abutments are subject to wear, which might affect retention of the IODs, and (2) nylon inserts are subject to degradation and subsequent impairment of their mechanical properties.

## Materials and Methods

The local ethics committee approved this cross-sectional clinical study. A total of 42 patients who had been supplied with L-IODs between 2008 and 2016 were invited to participate. Of these 42 patients, 16 could be scheduled for a clinical examination: 8 females and 8 males with a mean age of 69 years (range: 39 to 89 years) with an overall total of 15 mandibular L-IODs and 1 maxillary L-IOD. Nylon inserts and abutments were photographed (Figs 1 and 2), and wear of the inserts and abutments was qualitatively assessed and independently rated by two calibrated dentists (C.A. and M.S.) using a Likert-type rating scale that allowed the ratings no, moderate, and heavy wear. The nylon inserts were carefully removed from the L-IODs, grouped according to retention strength (pink, green, clear), microscopically analyzed (VHX5000), and subsequently cut into pieces and mechanically characterized using differential scanning calorimetry (DSC; 204 F1; 25°C to 300°C, 20 K/minute, n = 2) and thermal gravimetric analysis (TGA; 209 F3; 20°C to 600°C, 20 K/minute, N<sub>2</sub>-atmosphere [20 mL/minute, n = 2]; DSC and TGA by NETZSCH). TGA curves were analyzed in two steps (room temperature: 200°C, 300°C to 550°C), and decomposition temperatures were determined. DSC curves were analyzed and endothermal heat flow was calculated in three areas (room temperature: 80°C, 80°C to 220°C, 280°C to 300°C). New and unworn nylon inserts were used for reference. Statistical analyses were performed using SPSS 24.0 (IBM SPSS Statistics for Windows, Version 24.0, IBM). Null hypotheses were analyzed with the (1) Mann-Whitney U test and (2) one-way analysis of variance

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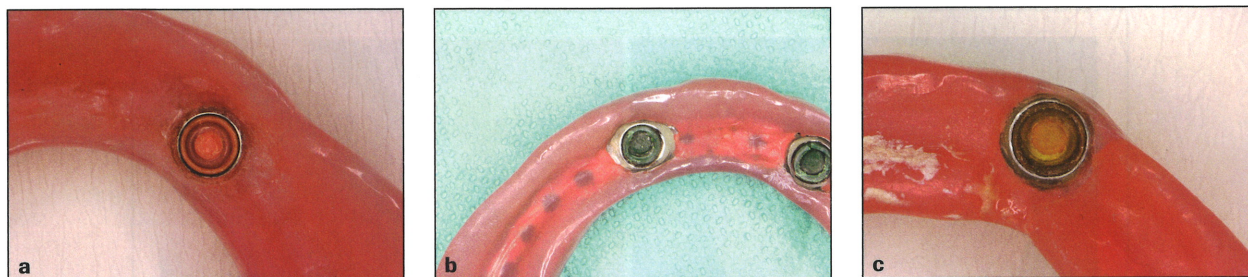
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**Fig 1** Nylon inserts in clinical service. **(a)** Pink retention insert (dual retention mode) showing minor signs of wear limited to the core of the insert. **(b)** Green retention insert showing extensive wear. The periphery of the insert is deformed and its surface is severely damaged. In this situation, the material around the metal housing is a self-curing composite luting material that can be used to incorporate the housing into the denture base in a chairside approach. **(c)** Clear retention insert with moderate wear.



**Fig 2** Locator abutments in clinical service. **(a)** Locator abutment in the mandible with no clinical signs of wear. **(b)** Locator abutment with moderate wear. Food impaction and plaque accumulation in the screw canal of the abutment are visible in both **(a)** and **(b)**. **(c)** Locator abutment with extensive wear, particularly in the cuff (collar) of the abutment.

(ANOVA). The level of significance ( $\alpha$ ) was set to .05 with 95% confidence intervals (CI).

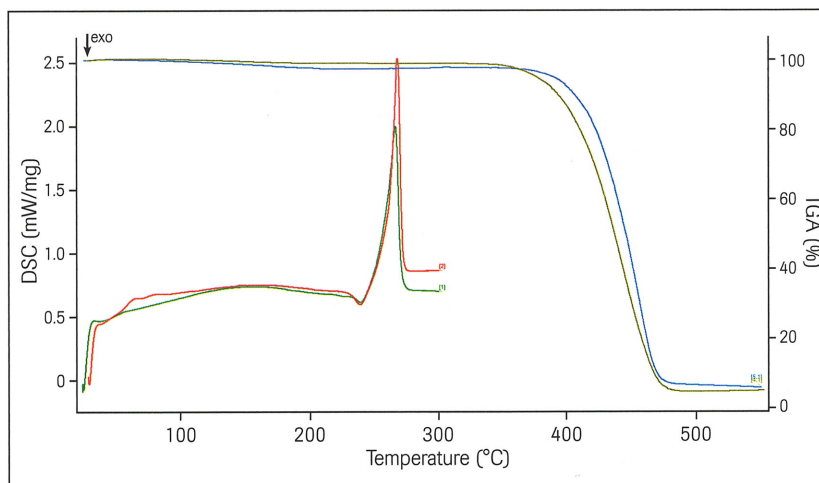
## Results

### Laboratory Analyses

TGA and DSC analyses (Fig 3) indicated statistically significant differences in heat flow and weight loss between worn and unworn nylon inserts ( $P < .05$ ). Microscopic analysis of worn inserts showed relevant signs of deterioration (Fig 4).

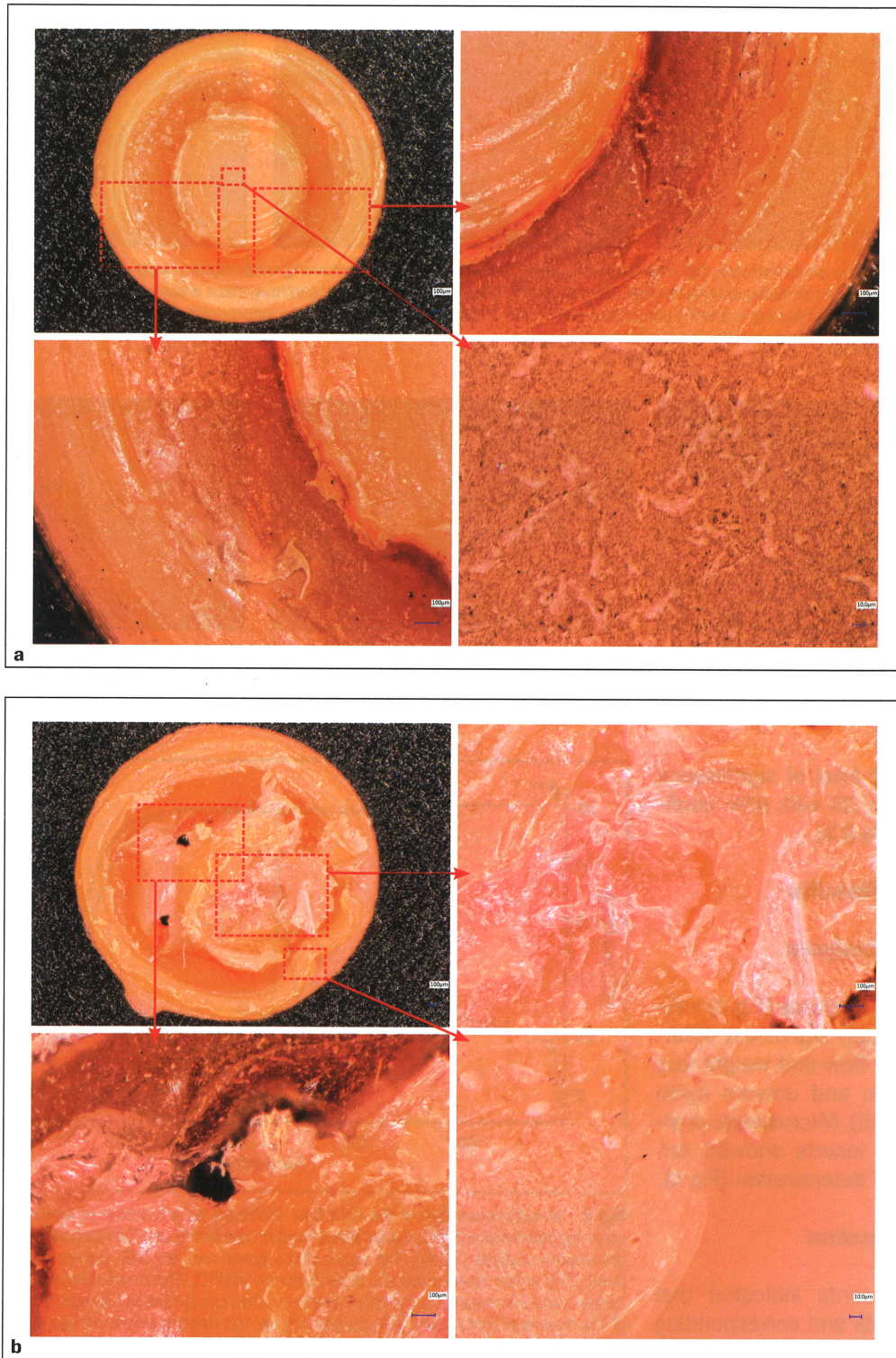
### Clinical Evaluation

Treatment records indicated that the pink inserts and corresponding abutments were in clinical service for a mean period of 10 months (range: 7 to 70;  $n = 5$ ), the green inserts for 43 months (range: 33 to 52;  $n = 5$ ), and the clear inserts for 60 months (range: 5 to 100;  $n = 5$ ). Of the removed nylon inserts, 37.9% showed moderate wear and 62.1% showed heavy wear (Fig 1). Of the



**Fig 3** Simultaneous plot of the heat flow (mW/mg) as a function of temperature (differential scanning calorimetry [DSC] analysis) and weight loss (wt%) as a function of temperature (thermal gravimetric analysis [TGA]). The peaks of the green and red DSC curves represent the melting point ( $T_m$ ) of the insert materials (approximately 260°C). The downward shift of the worn insert (green curve) compared to the reference insert (red curve) was not statistically significant. Slopes of the blue and light green TGA curves display the decomposition of the material. The shift to higher temperatures of the blue thermal curve (worn insert) compared to the reference insert (light green) was statistically significant for green inserts, indicating that degradation is initiated at higher temperatures, presumably due to material aging. exo = exothermic peak.

abutments, 14.7% showed no signs of wear, 20.6% moderate wear, and 61.8% heavy wear (Fig 2). More than 80% (81.2%) of the oral surfaces and approximately 70% (69.7%) of the vestibular surfaces of the Locator abutments showed signs of wear; in contrast, wear was identified in 50% of the mesial and distal surfaces (48.5% for both).



**Fig 4** Microscopic images of nylon inserts after removal from the Locator-retained implant overdentures (L-IODs). **(a)** Pink retention insert with signs of moderate wear. **(b)** Pink retention insert with signs of heavy wear; the core of the retention insert is entirely distorted.

### Discussion

The results of this investigation suggest acceptance of both hypotheses, as wear was identified in the

majority of the abutments and in all nylon inserts. Moreover, relevant signs of degradation and impairment of the mechanical properties of the nylon inserts were observed in the TGA and DSC analyses.

A minimum of two implants is required to support IODs with Locator attachments; however, these clinical settings allow movement of the dentures in all directions and planes, which fosters wear of the attachments. Moreover, the design of mandibular IODs supported on two interforaminal implants triggers posterior bone loss due to the hinge movement over the rotation axis of the two implants.<sup>5</sup> The results of the current study suggest that these phenomena might contribute to wear of the Locator attachments, as clinical assessment of the abutments indicated that the vestibular and oral sites were particularly subject to wear.

Previous studies have concluded that current laboratory approaches cannot adequately simulate wear in stud attachments and that loss of retention cannot be sufficiently explained by dimensional changes and surface alterations.<sup>2</sup> In L-IODs, the nylon inserts are fabricated from polyamide, which is well known to absorb ambient moisture that impairs its mechanical properties. In the present study, impairment of the mechanical properties of the nylon inserts was assessed with TGA and DSC, which can be employed to identify the amount of volatiles in polymers. Data from the TGA and DSC analyses indicated a significant uptake of water of the nylon inserts in comparison to the unworn systems.

## Conclusions

Locator abutments and nylon inserts are subject to wear and deterioration during clinical service, which

underlines the relevance of regular maintenance and control/exchange of the various components of the Locator system. Wear of abutments was most frequently identified on the buccal and oral areas, which could be in response to gingival loading of the prosthesis in the posterior areas and the resulting rotational axis.

## Acknowledgments

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### Literature Abstract

#### Factors affecting the occurrence of complications in the early stages after dental implant placement: A retrospective cohort study

This study aimed to evaluate the background factors related to the occurrence of complications in the early stages after dental implant placement. A total of 289 outpatients who received dental implants were retrospectively evaluated for the presence or absence of complications. Background factors, including age, sex, implant width, implant length, implant site, number of implants placed, Periotest values at the time of implant placement, presence/absence of systemic disease (particularly diabetes), and the use of anticoagulation therapy, were compared between patients with and without complications. Logistic regression analysis was performed to identify significant risk factors for the occurrence of complications after dental implant placement. Complications in the early stages after dental implant placement occurred in 25 patients (8.65%). The patients with complications were older than those without complications ( $P = .003$ ). In addition, the incidence of complications was significantly higher in patients with systemic diseases ( $P = .004$ ) and in those receiving anticoagulation therapy ( $P = .005$ ). Logistic regression analysis revealed that age was a significant risk factor ( $P = .025$ ) for early-stage complications, whereas the number of implants, presence of diabetes, and the use of anticoagulation therapy were not significant risk factors. These results show that age is a significant factor influencing the occurrence of complications in the early stages after dental implant placement. Therefore, clinicians should consider this factor when developing treatment plans.

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