

# Prefabricated Versus Customized Abutments: A Retrospective Analysis of Loosening of Cement-Retained Fixed Implant-Supported Reconstructions

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**Purpose:** The aim of this retrospective follow-up study was to determine whether implant-supported reconstructions on customized computer-milled abutments will loosen less frequently than those placed on prefabricated abutments. **Materials and Methods:** Suprastructures on prefabricated abutments (n = 312) were compared with those on customized computer-milled abutments (n = 96) over an observation period of 2 years. In all cases, the suprastructures had been cemented on the abutments with zinc oxide-eugenol cement (ZEC). Both groups were subdivided into single-crown restorations, fixed dental prostheses (FDPs) with two implants, and FDPs with more than two implants. The data were evaluated on the denture level. **Results:** Of the restorations on prefabricated abutments, 8% loosened, and of those on customized abutments, 3.1% loosened. The difference was not significant. Of the single crowns on prefabricated abutments, 7.7% loosened, and of those on customized abutments, 0% loosened. The difference was significant. For the FDPs with two implants (prefabricated abutments: 9.7%; customized abutments: 10.7%; not significant) and the FDPs with more than two implants (prefabricated abutments: 0%; customized abutments: 11.1%; significance not analyzed), statistical evaluation was difficult because of the small number of cases. **Conclusions:** Loosening of reconstructions placed on customized abutments can be reduced for single-crown restorations. When ZEC is used, customized abutments offer a valid alternative to prefabricated abutments. The small number of cases of FDPs with two implants and FDPs with more than two implants made statistical evaluation impossible. *Int J Prosthodont* 2015;28:522–526. doi: 10.11607/ijp.4307

Along with screw retention, cementation is a commonly used method of retaining fixed restorations on implants. Both methods pose the risk of reconstruction loosening after the dental restoration is incorporated.<sup>1–3</sup> Loosening may occur on either the implant or the abutment level. In the case of screw-retained reconstructions, screws may loosen on both levels. In the case of cement-retained dentures, however, screw loosening can only occur on the implant level, though decementation of the suprastructure is possible.

It can be assumed that the prevalence of decementation correlates with the retentive properties

of the cement used. Numerous in vitro studies have therefore compared the retentiveness of different cements.<sup>4–6</sup> Most of these studies, however, only applied uniaxial retention forces in the tests.<sup>7,8</sup> The clinical relevance of such test results to the prevalence of denture loosening has not been proven.

Cement-retained dentures can be placed on either prefabricated or customized abutments. Prefabricated abutments can only be partially adjusted to clinical requirements, whereas customized abutments can shape the marginal soft tissue more effectively and thus facilitate the optimal design of the crown contour and emergence profile. Fabrication is becoming possible of more and more individualized computer-milled abutments, which are a reasonably priced alternative to prefabricated abutments. Opinions vary on the influence of abutment design on retentiveness, which so far has been studied only in vitro.<sup>7,9,10</sup>

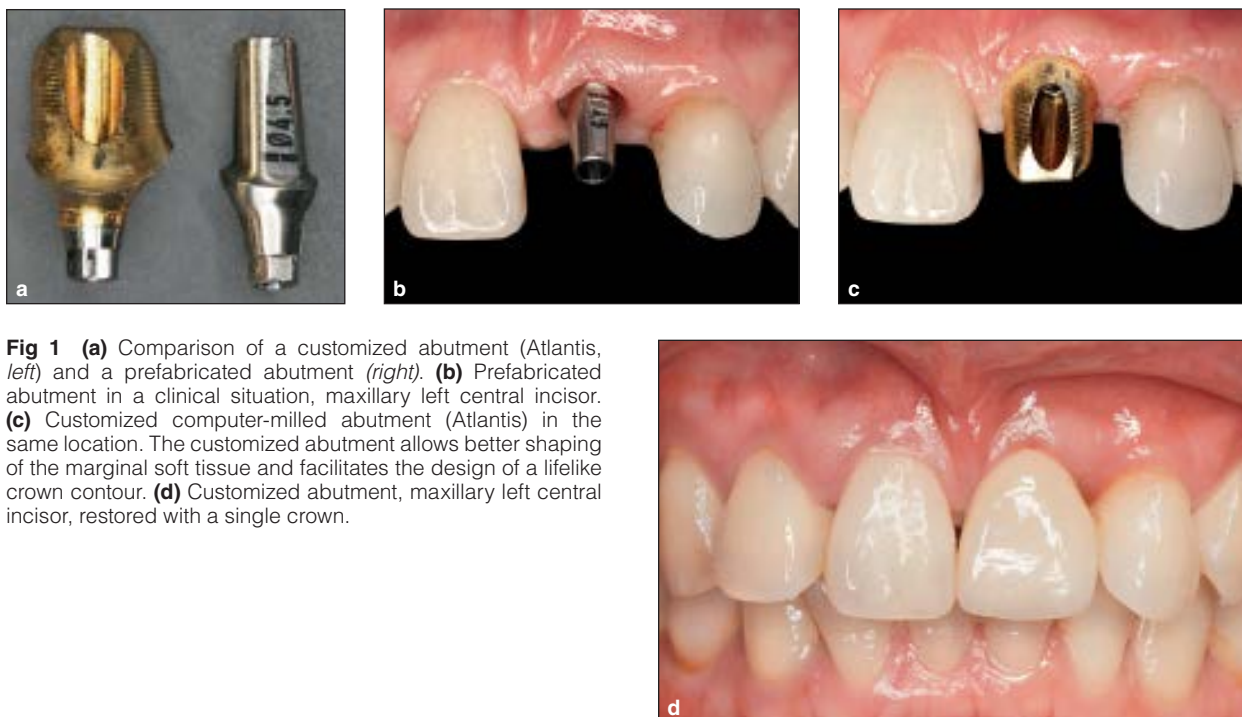
The aim of the present retrospective follow-up study was to find out whether the prevalence of suprastructure loosening of cement-retained dentures is influenced by the abutment design. Prefabricated abutments and customized computer-milled abutments were compared with one another.

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**Fig 1** (a) Comparison of a customized abutment (Atlantis, left) and a prefabricated abutment (right). (b) Prefabricated abutment in a clinical situation, maxillary left central incisor. (c) Customized computer-milled abutment (Atlantis) in the same location. The customized abutment allows better shaping of the marginal soft tissue and facilitates the design of a lifelike crown contour. (d) Customized abutment, maxillary left central incisor, restored with a single crown.

## Materials and Methods

Patients with fixed implant-supported prostheses whose implants and restorations were placed by the outpatient department of the Dental Academy for Continuing Professional Development, Karlsruhe, Germany, between July 2008 and March 2012 were followed up by the Academy. In this period, 266 patients with 569 implants were prosthetically restored. Between July 2008 and January 2011, the restorations were cemented onto prefabricated abutments (Figs 1a and 1b). From February 2011 to March 2012, all restorations were cemented on customized computer-milled abutments (Atlantis, Astra Tech Dental) (Figs 1a, 1c, and 1d). The reason for changing the type of abutment was the easier creation of the marginal contour in the peri-implant tissue with customized abutments. The loading protocol for all fixed dentures was delayed 3 to 4 months after implantation. The fixed cement-retained restorations had been placed by 14 different prosthodontists. The cementation protocol was standardized. All restorations in the study period had a metal framework veneered with ceramic material. The luting agent used for cementation was Temp-Bond (Kerr). All restorations were placed on Astra Tech implants (Astra Tech Dental). Within the framework of a

treatment data analysis, the patients were examined for loosening of the implant-supported restoration over a period of 2 years after insertion. The data were compiled from the medical records. The date of denture insertion, the type of abutment (prefabricated or customized), the implant region, and the time of onset of denture loosening were documented. In addition, all patients were asked by telephone whether any loosening had occurred after denture insertion that was treated not by the Academy but by an external dentist. Only cases of loosening that occurred within 2 years after denture insertion were documented. Loosening after that period was not evaluated.

## Inclusion and Exclusion Criteria

Patients of the Karlsruhe Dental Academy met the inclusion criteria if they had undergone fixed prosthodontic therapy on implants during the period from July 2008 to March 2012. Other requirements for inclusion were complete documentation of all technical implant characteristics (implant location and type of abutment) and continuous treatment by the Academy since placement of the restoration. Patients with incomplete documentation or patients who could not be contacted by telephone were excluded.

**Table 1** Patient Characteristics by Type of Abutment

	Patients with prefabricated abutments	Patients with customized abutments
Men	104	22
Women	102	23
Total	206	45
Age (y) at time of prosthetic restoration (mean [range])	59.1 (17–82)	59.2 (29–78)
Average number of implants per patient	2.6	2.7

**Table 2** Implant Type by Type of Abutment

	Prefabricated abutments	Customized abutments
Single crowns	233	59
FDPs with 2 implants	71	28
FDPs with more than 2 implants	8	9
Total	312	96

## Patients

In the period of evaluation, 266 patients were treated. Fifteen patients were excluded because of incomplete documentation. Thus, 251 patients (94% of the population originally treated) could be evaluated.

Between March and April 2014, the included patients were interviewed over the telephone and asked whether they had undergone other therapies in addition to the documented renewed denture fixation. The evaluation of the telephone interviews showed that 15 patients had undergone treatment outside the Academy in the observation period, for emergency measures only.

The 251 patients were divided into two groups depending on the type of abutment. The groups were further subdivided into single crowns, FDPs with two implants, and FDPs with more than two implants (Tables 1 and 2). For the analysis on denture level, every implant was weighted inversely to the total number of implants per reconstruction.

## Statistical Methods

Data were compiled with Excel (Microsoft) and analyzed with ISPPS Statistics 21 (IBM) on Windows XP (Microsoft). Statistical methods used were cross-tabulations with chi-square tests for categorical data. Means were compared using *t* tests.

## Dropout Analysis

Of the 266 patients treated during the evaluation period, 15 were excluded from the study (6%). Thus, 23 implants (4%) were lost to follow-up. Dropout analysis showed no significant differences in age and sex.

## Results

All 408 restorations were fixed on Astra Tech implants. Of these restorations, 312 (233 single crowns, 71 FDPs with two implants, and 8 FDPs with more than two implants) were cemented on prefabricated abutments and 96 (59 single crowns, 28 FDPs with two implants, and 9 FDPs with more than two implants) on customized abutments (Table 2).

## FDP Loosening on Denture Level

Within the first 2 years after prosthetic restoration, 8% of the restorations with prefabricated abutments loosened, compared with only 3.1% of the restorations with customized abutments. The difference was not significant. In the cases with prefabricated abutments, loosening occurred after 0.86 years on average, while in the cases with customized abutments it occurred after 0.62 years (Table 3).

Of the single crowns on prefabricated abutments, 18 (7.7%) loosened. Single crowns on customized abutments were not affected by this complication at all during the period of observation. The difference was significant (chi-square = 4.857; *P* < .028). For FDPs with two implants, the prevalence of loosening was not significant (prefabricated abutments: 7 [9.7%]; customized abutments: 2 [7.1%]). Among the FDPs with more than two implants, there was one case (11.1%) of loosening of a restoration on customized abutments. FDPs with more than two implants on prefabricated abutments were not affected. Due to the small number of cases, this subgroup was not statistically evaluated. The implant region (anterior vs posterior) and the prosthodontist had no influence on the prevalence of denture loosening.

Within the observation period of 2 years, four single crowns on prefabricated abutments loosened twice. All other subgroups were spared denture loosening. No denture loosened more than twice.

In all, four suprastructures on prefabricated abutments (three single crowns and one FDP with two implants) had to be renewed (Table 4). In one single crown the abutment broke; in the other cases the restorations were renewed as a result of chipping of the ceramic material. No dentures on customized abutments required renewal.

**Table 3** Loosening on Denture Level by Type of Abutment

	Prefabricated abutments	Customized abutments	Significance
Loosening within 2 y after prosthetic restoration	25 (8%)	3 (3.1%)	NS
Average time of onset of loosening after prosthetic restoration (y)	0.86	0.62	NS
Single crowns	18 (7.7%)	0 (0%)	chi-square = 4.857; <i>P</i> < .028
FDPs with 2 implants	7 (9.7%)	2 (7.1%)	NS
FDPs with more than 2 implants	0 (0%)	1 (11.1%)	NA

NS = not significant; NA = not analyzed.

**Table 4** Survival Rates of Dentures (On Denture Level)

	Prefabricated abutments	Customized abutments	Significance
Single crowns	230 (98.7%)	59 (100%)	NS
Survival rate of FDPs with 2 implants	70 (98.6%)	28 (100%)	NS
Survival rate of FDPs with more than 2 implants	8 (100%)	9 (100%)	NS

NS = not significant.

## Discussion

Retention is an important factor for the clinical success of fixed dental restorations. The type of cement used has an especially strong effect on retention.<sup>4–6</sup> In vitro studies that investigated the effect of abutment design on suprastructure loosening arrived at conflicting results. Some studies were able to prove that there was a relationship, while others could not.<sup>7,9,10</sup>

In the present study, suprastructures on prefabricated abutments and suprastructures on customized computer-milled abutments were compared in terms of frequency of decementation. Within the observation period of 2 years, loosening occurred more than twice as often in dentures on prefabricated abutments as it did in dentures on customized abutments (8% vs 3.1%), although the difference was not significant. Single crowns on prefabricated abutments loosened in 7.7% of the cases, but no single crown on a customized abutment loosened. The difference was significant. FDPs with two implants on prefabricated abutments were also affected more often by decementation than FDPs on customized abutments, although no significant difference was found. A statistical comparison of prefabricated vs customized abutments in the subgroup of FDPs with more than two implants was not made due to the low number of cases. Customized abutments, though, do not seem to have any effect on the abutment-to-implant connection.<sup>11</sup>

Customized computer-milled abutments can be adjusted far more effectively to the local clinical situation than prefabricated abutments. This allows for optimal design of the suprastructure and may lead to more

pleasing esthetic results. The optimized design of the abutment for single crowns also appears to have an effect on the prevalence of decementation. The survival rate of cement-retained dentures was not influenced by the abutment design.

The zinc oxide–eugenol cement (ZEC) used in the present study is a temporary cement that differs from permanent cements mainly by its retentive properties.<sup>6,12</sup> Cementation poses the risk of leaving excess cement in the peri-implant sulcus.<sup>13</sup> Undetected excess cement may favor the formation of a biofilm.<sup>14,15</sup> The consequence can be inflammation of the peri-implant tissue<sup>16</sup> causing bone and implant loss.<sup>17</sup> There are indications that ZEC dissolves at contact with liquid and thus excess cement will not permanently remain in the peri-implant sulcus.<sup>18</sup> Moreover, an antibacterial activity is ascribed to ZEC.<sup>19,20</sup> The material properties of ZEC seem to be ideally suited for the cementation of fixed dental restorations on implants. Its retentiveness, however, is low. When ZEC is used, customized computer-milled abutments for single crowns may improve the retentiveness enough to keep decementation at a reasonable level.

## Conclusions

Denture loosening occurred less frequently when customized computer-milled abutments were used as compared to prefabricated abutments. However, a significant difference was only found for single crowns. Further studies of cement-retained FDPs with larger case numbers and longer observation periods are needed.

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The authors reported no conflicts of interest related to this study.

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## Literature Abstract

### Diabetes as risk factor for medication-related osteonecrosis of the jaw

This critical review examines diabetes mellitus (DM) as a risk factor for the development of medication-related osteonecrosis of the jaw (MRONJ). The role of DM in the pathogenesis of MRONJ and the mechanism by which DM might increase the risk of developing MRONJ is discussed. It is postulated that poor bone quality as a result of the pathogenesis and treatment of DM may be due to altered bone turnover, increased osteoblast/osteocyte apoptosis, altered immune response and increased inflammation, angiogenesis/vascularization and endothelial damage, and genetic factors. A number of studies have been identified reporting an association between DM and MRONJ, although we are some way from suggesting a cause and effect relationship.

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