Complication and Survival of Mark II Restorations: 4-Year Clinical Follow-up

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A total of 163 monolithic restorations made from Vitablocs Mark II and luted adhesively or with resin cement were followed up for 3 to 70 months. Recall consisted of an evaluation of complete dental and hygiene status as well as quality assessment. Seven of 35 patients were lost to follow-up. Ninety-one percent of the 37 crowns, 23 partial crowns, and 89 inlays evaluated were in the posterior region. Combined survival estimate was 0.92 at the 48-month median observation time. Inlays and partial crowns performed well. Prevalence of complication and failure was highest for crowns (C_P = 37.8%, F_P = 21.6%). The results demonstrate that success relates to patient factors and restoration type, not luting protocol. *Int J Prosthodont 2013;26:272–276. doi: 10.11607/ijp3287*

The demand for all-ceramic restorations has recently increased. Today, patients are frequently treated with different kinds of ceramic materials in everyday practice. Clinicians usually decide on one system to cover most indications. Vitablocs Mark II (VITA Zahnfabrik) are fine-structured feldspar ceramic blocks provided for different computer-aided design/computer-assisted manufacture (CAD/CAM) systems, allowing for all kinds of single-tooth restorations. Introduced to the market in 1998, there is little clinical data available for this system, especially when used for crowns.[1–3] Thus, this study evaluated a cohort treated with Mark II restorations that was also enrolled in a prospective recall program for all-ceramics.

Materials and Methods

Treatment

Patients asking for all-ceramic treatments instead of metal-based restorations were treated with silicate restorations if the remaining tooth was not discolored and the tooth arrangements allowed for all-ceramic standards to be met. Impressions were taken with polyether materials using a double mixing technique. CAD/CAM was performed after a scan of the casts via a milling machine (Cerec inLab, Sirona) at the dental lab of the Tübingen University Hospital by three trained technicians. All restorations were inserted according to the most suitable clinical protocol: 84 were bonded adhesively (95% with Variolink, Ivoclar Vivadent) and 65 were resin luted with RelyX Unicem (3M ESPE). The patients were enrolled in a recall system for annual follow-up including quality assessment.

Statistical Analysis

Besides quality evaluation according to modified California Dental Association (CDA) criteria,[4] all observed events were classified as: minor complication (flaw), adverse event, severe adverse event, or loss (Table 1). For calculation of survival and complication rates, Kaplan-Meier estimation was performed regarding restoration type and luting protocol as applied by Malament and Socransky.[5] Date of any first event censors "complication rate" and date of removal "survival rate." The rates are determined from analysis at median observation time, including their 95% confidence interval borders. Differences between luting and restoration types were calculated using the log-rank test.

Results

During a median observation time of 48 months (mean, 49 months; standard deviation [SD], 12.5), 7 of 35 patients failed to show up for dental examination after insertion. With regard to these patients, 9% of all restorations were lost to follow-up, namely 8 of 97 inlays, 4 of 41 crowns, and 2 of 25 partial crowns.

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Table 1 Classification of Observations and Events*

Classification	Definition	Usage for calculation
Minor complication (MC) = CDA rating Sierra	Not detectable by the patient or in a routine dental check-up → calls for intervention, ie, polishing	Failure function as Kaplan-Meier estimation censored by MC, AE, and SAE; prevalence of complications [C_p] = N(affected)/N(all)*100
Adverse event (AE) = CDA rating Tango	Reported by the patient or visible during check-up → calls for intervention, ie, polishing, reattachment, hygiene instruction	
Severe adverse event (SAE) = CDA rating Victor	Severely affecting the restoration or tooth → calls for biologic therapy or technical renewal	Prevalence of failure [F_p] calculated as shown for C_p
Loss/removal = CDA rating Victor	Removal or destruction of restoration, ie, trepanation through an inlay (not loss of retention)	Survivor function as Kaplan-Meier estimation censored by removal

*Observed events were rated toward this three-step scheme. These ratings are marked in Fig 1 on the life lines of restorations. Their relevance for further calculations is explained.

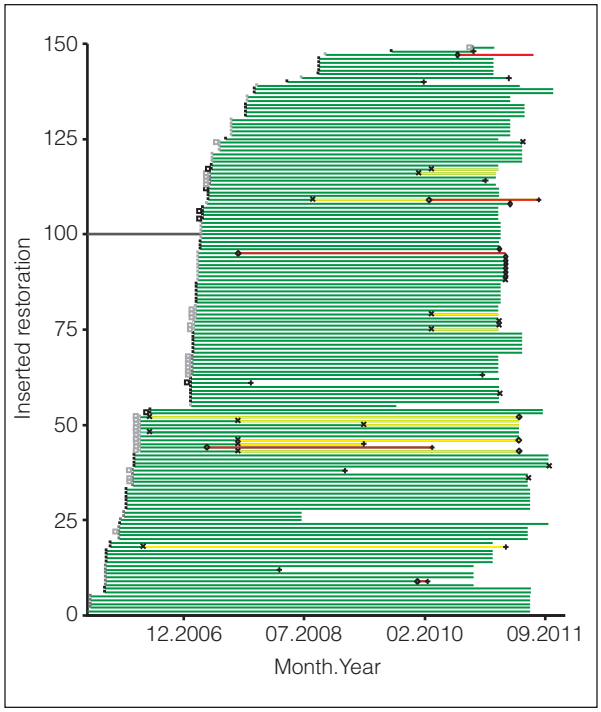


Fig 1 Modified Lexis diagram of the Mark II cohort showing all evaluated restorations and observed events. The life line starts with the date of insertion and ends with the date of removal (+) or the last observation date. Minor complications (MCs) and adverse events (AEs) are marked (X), serious adverse events (SAEs) are marked (◇). The life line changes to yellow if a restoration was affected by an MC or AE and changes to red if it was rated as SAE demanding removal. As demarcation of different patients, the start point of the life line is marked alternating with a gray or black point. Crowns are highlighted (□).

The other 149 Mark II single-tooth restorations were examined at least once after insertion (Fig 1). One hundred thirty-six reconstructions were inserted in the posterior region (61 in the mandible, 75 in the maxilla), and 12 were maxillary anteriors; thereby, 46 complications were observed (Table 2) on 40 restorations in 16 patients. The CDA ratings of all assessments are shown in Fig 2.

Overall survival was estimated as 92% (95% confidence interval [CI] = 87.4–96.6). Overall failure rate was estimated as 22.1% (95% CI = 14.8–29.4). A difference in survival rate was found for complication rate of crowns but not for restoration type (Fig 3).

Discussion

The present data contain a variety of indications. Three patients from this cohort reported 59% of the events found, which may bias the results; however, excluding these three patients would not significantly change the complication (23%) or survival (93%) rates. This is because all affected patients experienced adverse events within 3 years and restorations mostly failed at 4 years or later (see Fig 1).

Nonetheless, 11 restorations that experienced serious adverse events were fixed and needed replacement in the future. For survival and failure of

Table 2 Summary of Classified Events and No. of Losses Within Cohort and Time*

[N] type	37 crowns (24A + 13R)	23 partial crowns (13A + 10R)	89 inlays (47A + 42R)	Total
Cohort prevalence and survival at 48 mo	C_P = 37.8%; F_P = 21.6%; combined = 0.82; 95% CI = 0.7–0.95	C_P = 8.7%; F_P = 4.3%; combined = 1.0	C_P =4.5%; F_P= 19.1%; combined=0.94; 95% CI = 0.89–0.99	See Fig 3
Minor complications	6 chip-offs (15 mo); 3 cracks (48 mo)	1 crack (48 mo)	2 chip-off (57 mo)	12 = 9A + 3R
Adverse events	3 chip-offs (15 mo); 2 marginal gap (48 mo)	1 chip-off (16 mo)	1 chip-off (49 mo); 1 loss of retention (5 mo)	8 = 3A + 5R
Serious adverse events	3 chip-offs (60 mo); 5 fractures of framework (35 mo)	1 chip-off (35 mo)	1 fracture of enamel (20 mo); 3 losses of retention (27 mo); 1 endo problem (22 mo); 10 caries/marginal gap (49 mo); 2 fracture of inlay (23 mo)	26 = 9A + 17R
Failed or lost	6 (44 mo) = 4A + 2R	1 (52 mo) = 1R	7 (49 mo) = 5R + 2A	

A = adhesive; R = RelyX; CI = confidence interval.
*The number of restorations is listed according to luting type, as well as the quality of observed events, and the prevalence of complication and failure. Furthermore, the median time of occurrence is noted in parentheses. The multiple events of six restorations are included.

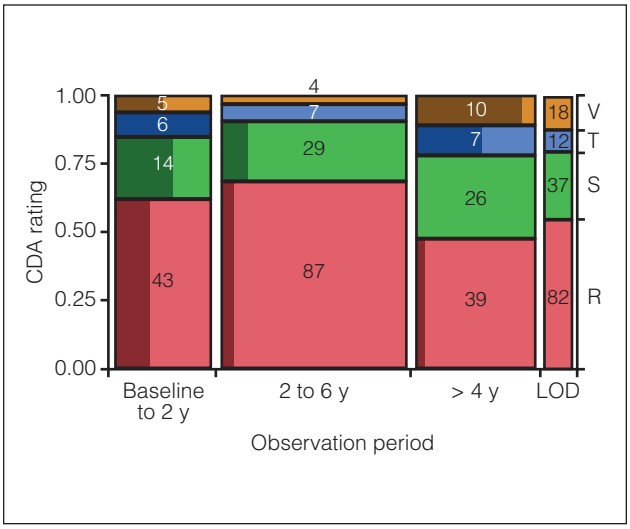
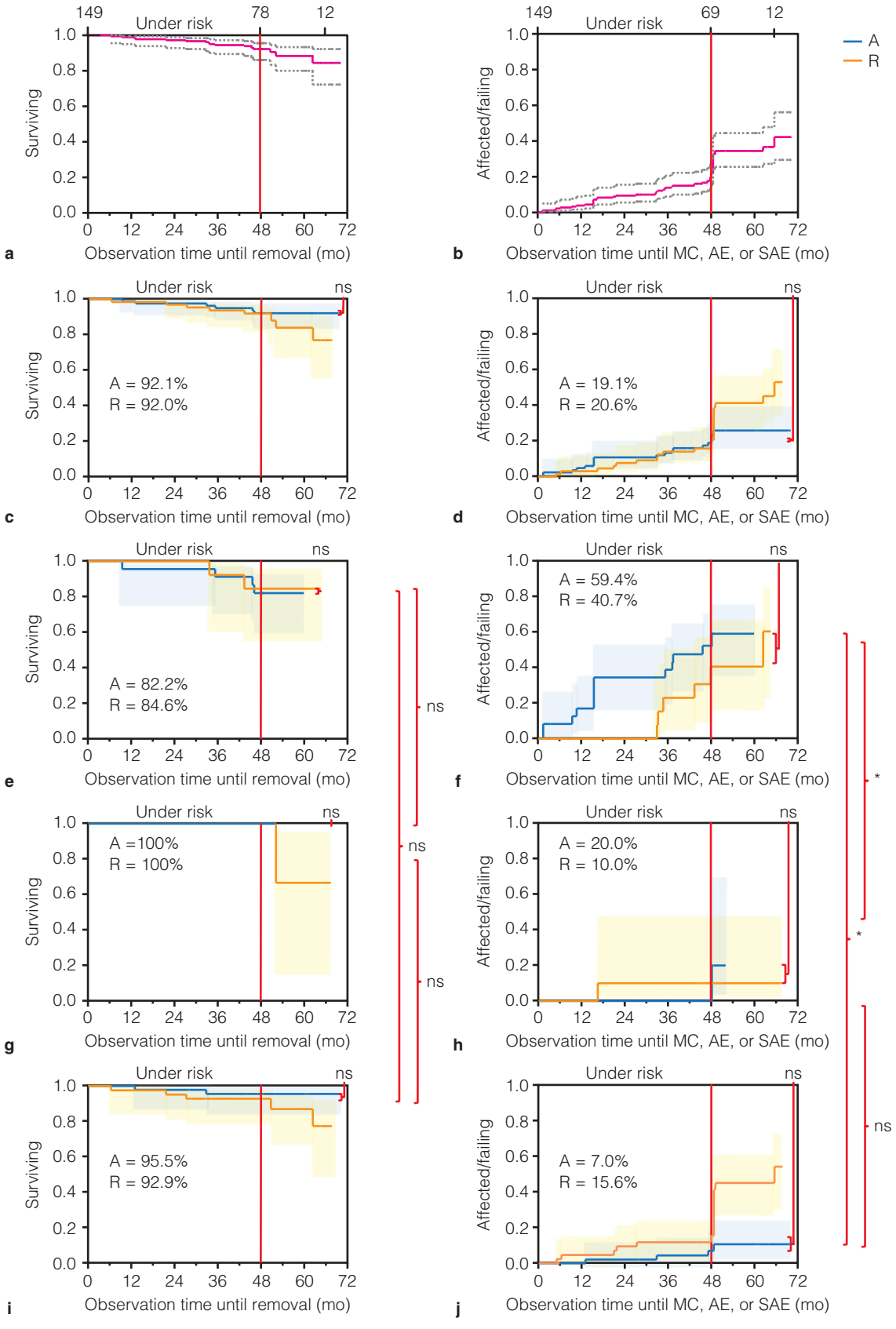


Fig 2 Distribution of CDA ratings in the course of observation. The shares of the three most affected patients are represented by a darker shade. Observation time grouping was decided on common timespans. The number of reconstructions observed within one timespan can be summed up by the centered numbers of each rating. CDA ratings of all reconstructions at their very last observation date (LOD) are presented on the right bars. V = failed (replace statim); T = questionable (in need of correction); S = acceptable; R = satisfactory (flawless).

Fig 3 *(facing page)* Estimations of survival and complication. Comparison of Kaplan-Meier survivor *(left)* and failing *(right)* functions with 95% CIs for the two different luting protocols (A = adhesively bonded; R = resin luted) grouped by type of restoration. **(a and b)** Combined all; **(c and d)** combined all types of restoration; **(e and f)** crowns; **(g and h)** partial crowns; **(i and j)** inlays. The remaining "units under risk" are noted for each luting protocol on top of the diagram. Spaces between CIs indicate a time period when the survivor functions were likely to have differed significantly. Differences between restoration types were tested using the log-rank test and indicated as nonsignificant (ns; $P \geq .05$) or significant (*$P < .05$).

inlays, an adhesive protocol appears to be superior to resin luting. On this aspect, there was no difference for full crowns performing statistically and clinically significantly worse. The absence of statistical significance between studied groups is due to few units under risk at the time of comparison; however, this may be established in future analyses of this cohort. Restorations in the posterior region (91%) accounted for 85% of both complications and failures, but the six anterior restorations contributed three complete fractures. One of these patients, who had a tongue piercing, experienced one chip-off, which was rated as a complication, followed by veneer fracture later. Taking patient-related factors into account, the present findings are in line with other authors reporting on Mark II restorations.[1–3] Moreover, the mechanical strength of feldspathic ceramic is inferior to today's glass-ceramics based on lithium disilicate. That is why lithium discilicate may be superior in clinical long-term survival, especially for crowns.



Conclusion

Success of Mark II full crowns is compromised by and heavily dependent on patient factors. Inlays and partial crowns perform best in the posterior region and when bonded adhesively.

Acknowledgments

According to German law, this study was counselled by the Ethics Committee of Tuebingen University Hospital. The authors thank Dr Detlef Axmann for biometric support. The authors reported no conflicts of interest related to this study.

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Literature Abstract

Volume changes of iliac crest autogeneous bone grafts after vertical and horizontal alveolar ridge augmentation of atrophic maxillas and mandibles: A 6-year computerized tomographic follow-up

The aim of this study was to look at the long-term remodelling of autogenous corticocancelleous grafted bone taken from the ilium and used in alveolar augmentation for subsequent implant placement. Pre- and postsurgical computed tomography (CT) scans were used to compare bone graft volumes over time. Eleven maxillary grafts (8 positioned horizontally) and 13 mandibular grafts (10 positioned vertically) were placed in 16 patients. Using CT scans before bone grafting, 3 to 5 months after grafting, just before implant insertion, and after implant insertion up to 6 years, the annual percentage of remaining bone and the overall percentage of bone resorption that could be expected was calculated. Yearly measurements of volumes and the percentages of remaining bone were then compared statistically. At the 6-year examination, a resorption rate of 87% was seen in the mandibular grafts and complete resorption (resorption rate of 105.5%) of the maxillary grafts was seen. Bone resorption appeared to be slow with most of the resorption occurring in the first 2 years. No implant failure was recorded and implant success was 100% in the maxilla and mandible. This study demonstrates the progressive and unavoidable bone resorption of almost the entire graft in both the maxilla and mandible. Clinicians should take this into consideration when performing alveolar bone augmentation with an autogenous iliac graft and aim to place the implants not only in the augmented bone but also in the native bone below the graft.

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