Long-Term Survival of Porcelain Laminate Veneers Using Two Preparation Designs: A Retrospective Study

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Purpose: This study evaluated the long-term survival of anterior porcelain laminate veneers placed with and without incisal porcelain coverage. ***Materials and Methods:*** Two prosthodontists in a private dental practice placed 110 labial feldspathic porcelain veneers in 50 patients; 46 veneers were provided with incisal porcelain coverage, and 64 were not. The veneers were evaluated retrospectively from case records for up to 7 years (mean 4 years). ***Results:*** At 5, 6, and 7 years, the cumulative survival estimates were 95.8% for veneers with incisal porcelain coverage and 85.5% for those without incisal coverage. The difference was not statistically significant. Six of the nine failures occurred from porcelain fracture in the veneers without incisal coverage. ***Conclusion:*** Although there was a trend for better long-term survival of the veneers with incisal porcelain coverage, this finding was not statistically significant. *Int J Prosthodont 2004;17:323–326.*

The porcelain laminate veneer is now a frequently prescribed restoration for anterior teeth.[1] Substantially less tooth preparation is required than for conventional esthetic complete crown preparations,[2] which accords with the practice philosophy of minimally invasive dentistry. The long-term clinical success of porcelain veneers depends on careful case selection, treatment planning, tooth preparation, laboratory veneer fabrication, and adhesive bonding procedures.[3] The apparent ease and speed of tooth preparation, combined with less-than-ideal laboratory and bonding procedures, may lead to unsatisfactory clinical performance of the veneers.[4] Most studies[5–25] on the clinical survival of porcelain veneers have been for less than 5 years, with survival rates from 48% to 100% reported. Few of these studies use life table methods to estimate restoration survival.[6,11,13,17]

Four types of incisal tooth preparations for porcelain veneers have been described[1,24]: window (intraenamel), leaving an intact incisal enamel edge; feathered, leaving an incisal edge in enamel and porcelain; beveled, with the incisal edge entirely in porcelain; and overlapped, with the porcelain extended further onto the palatal aspect of the preparation as a chamfer. The window and feathered incisal edge preparations cannot produce an increased tooth length or highly translucent incisal edge in worn teeth. Unsightly incisal margins and enamel and porcelain chipping have also been noted with these preparations.[16,21]

Using two-dimensional photoelastic stress analysis, one study reports that window preparations can withstand higher axial stresses than feathered and overlapped designs.[26] However, another study using three-dimensional photoelastic stress analysis reports that incisal overlapping reduces stress in the veneer most effectively.[27] Another in vitro study found that higher fracture loads are required for failure of beveled than overlapped and feathered veneer designs.[28] Using a finite element method, a beveled or overlapped design with a palatal minichamfer shows lower tensile stresses than an overlapped design with a long chamfer extending into the palatal concavity, where tensile stresses are concentrated.[29] Several clinical studies report either better results from incisal porcelain coverage or no significant differences when comparing

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Table 1 Distribution of Porcelain Veneers

Incisal porcelain coverage (n)	Age group (y)			Gender		Arch		Operator	
	16–30	31–50	⩾ 51	Male	Female	Maxilla	Mandible	A	B
Uncovered (64)	19	18	27	14	50	49	15	53	11
Covered (46)	16	23	7	17	29	34	12	22	24
Total (110)	35	41	34	31	79	83	27	75	35
	$\chi^2 = 9.953$, $df = 2$, $P = .007$*			Fisher, $P = .090$		Fisher, $P = .820$		Fisher, $P < .001$*	

*Statistically significant at the 1% probability level or less.

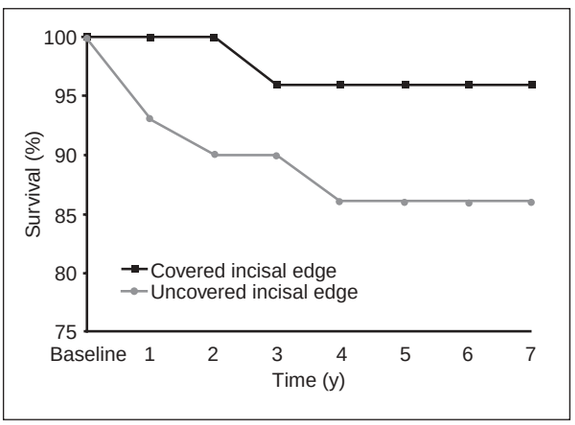

Fig 1 Cumulative survival estimates for porcelain veneers.

different preparation designs, with a lack of clinical consensus regarding the need to cover the incisal edge with porcelain.[6,11] Therefore, the null hypothesis in the present study was that there would be no significant difference in the long-term survival of anterior porcelain laminate veneers placed with and without incisal porcelain coverage of the tooth preparations.

Materials and Methods

This retrospective study involved the examination of the case records of 50 older adolescents and adult patients who had attended a specialist dental practice in Adelaide, South Australia, for the placement of anterior porcelain laminate veneers. The records were selected at random from among those of the longest attending patients. The University of Adelaide Committee on the Ethics of Human Experimentation approved the study.

The porcelain veneers were placed between 1989 and 1993 by two prosthodontists because of tooth defects and discolorations, fractures, wear, or minor malocclusions. Exclusion criteria included severe tooth discoloration, inadequate remaining sound enamel, and evidence of marked or severe bruxism. Where possible, all preparations were confined within enamel.[30] However, the exposure of some dentin often occurred, especially in the cervical tooth region. In other instances, incisal wear had led to the exposure of dentin. The incisal edge of the tooth was prepared minimally and covered by the porcelain veneer when an increased incisal length and/or improved incisal esthetics were required. There was no deliberate bias in selecting the preparation design, which was dictated by clinical and patient requirements. Conventional glass-ionomer cement bases were used to replace old cervical restorations beneath six (15%) veneers with incisal porcelain coverage and three (5%) veneers without incisal porcelain coverage. Provisional restorations were rarely provided.

Using a refractory die system, high-quality veneers were fabricated by one person in Mirage (Chameleon Dental) feldspathic porcelain. The veneers were adhesively bonded according to the manufacturer's instructions, using either of two dual-cured resin cements and their respective dentin adhesive systems, Mirage and Ultra-Bond (Den-Mat).

Data collected for the study included age and gender of each patient, principal reason for the veneer, tooth preparation site and type of preparation design, resin bonding cement used, principal reason for failure, and operator. All data were encoded for confidentiality and subjected to numerous error-checking procedures before analysis. The distribution of veneers was analyzed for several parameters using chi-square and Fisher's exact test statistics. Cumulative survival of the veneers was estimated using the life table method and BMDP program 1L (SPSS).[31] The probability level for statistical significance was set at $P = .050$.

Results

The placement of the porcelain veneers was uneventful, with only one instance of short-term sensitivity reported for a veneer placed without incisal porcelain coverage. There was a statistically significant difference between the two veneer designs for the different patient age groups, with relatively fewer veneers with incisal porcelain coverage in the ⩾ 51 age group (Table 1). There was also a statistically significant difference between the two operators, with relatively more veneers without incisal coverage placed by operator A ($P < .001$). As expected, most veneers were placed in maxillary anterior teeth (76%).

No failures occurred beyond 4 years with either preparation design. In this retrospective study, 32% of the uncovered and 28% of the incisal porcelain–covered veneers

Table 2 Distribution of Causes of Veneer Failures

Incisal porcelain coverage (n)	Fracture	Debonding	Color mismatch	Operator A	Operator B
Uncovered (8)	6	1	1	8	0
Covered (1)	0	1	0	0	1
Total (9)	6	2	1	8	1

could be followed for up to 6 years. At 5, 6, and 7 years, cumulative survivals were 95.8% (standard error 4.1%) for the veneers with incisal porcelain coverage and 85.5% (standard error 4.9%) for those without incisal porcelain coverage (Fig 1). The difference was not statistically significant (Mantel-Cox statistic = 2.294, $df = 1$, $P = .130$). Therefore, the null hypothesis was accepted.

Nine veneers failed (Table 2). All of the six bulk porcelain fractures occurred in veneers placed without incisal porcelain coverage. Following acute trauma, one apparent failure of a veneer without incisal porcelain coverage was censored in the cumulative survival analysis. More failures occurred for operator A than for operator B.

Discussion

Approximately 42% of the teeth were prepared for incisal porcelain veneer coverage. This compares with 47% reported in a UK survey of laboratory dies from 79 general dental practitioners, which also found that approximately 34% of the dies had feathered incisal edge preparations.[32] Another clinical study reported 50% incisal porcelain coverage preparations and 50% feathered preparations.[18]

The use of incisal porcelain coverage with labial veneers has been advocated by several authors to enhance restoration survival, incisal edge esthetics, and positive seating of the restorations.[3] Feathered preparations may lead to inadequate veneer seating, with increased marginal discrepancies and staining,[21] as well as incisal enamel and porcelain chipping.[16] In previous studies,[5–25] porcelain veneer failures usually occurred because of either fractures or debonding and were probably related to occlusal stress fatigue coupled with incorrect patient selection and unsatisfactory veneer fabrication and clinical procedures. The six fractures observed in the present study for operator A might be related to the larger number of veneers without incisal porcelain coverage placed by this clinician. Four of the six fractures occurred in twelve such veneers placed using Ultra-Bond resin cement in one 58-year-old patient. The incisal edges of her teeth were worn, and perhaps veneers were not the most suitable restorations. There were too few failures to allow analysis of any possible confounding factors.

Widely varying survival (48% to 100%) and methods for estimating it have been reported for porcelain veneers over approximately 2 to 10 years.[5–25] Relatively few studies use life table survival estimates, which allow for valid study comparisons, or distinguish clearly between the types of preparation designs used.[6,11,13,17,24] Many studies are also relatively short term or involve few veneers.[8,11,16,18–21,23,24] Although three different veneer designs were used in one large study, no survival analysis was undertaken for the designs.[17] Another 2.5-year study of 24 porcelain veneers fabricated with, and 32 fabricated without, incisal overlap found failures of 13% and 5%, respectively, but with no significant survival differences between the two designs.[11] A more recent study over periods of up to 10 years (mean 4.6 years) on 137 covered and 54 uncovered incisal edge veneers reports only 7 failures, which were unrelated to the veneer design.[6] Cumulative survival was 97% after 5 years, and veneer fractures were usually related to cervical dentin exposure during preparation. The importance of dentin exposure as a potential cause for veneer failure has been emphasized.[30,33] Enamel is thin in the cervical tooth region and can be readily exposed when trying to avoid overcontouring of the porcelain veneer. Additional mechanical retention might be required to prevent veneer failure if much dentin is exposed.[33]

Previous studies have failed to reach a consensus on the need for incisal porcelain coverage to optimize veneer survival.[6,11] In the present study, although not statistically significant, a trend for better long-term survival was found with incisal porcelain coverage veneers.

This retrospective case study examined the survival of 110 porcelain laminate veneers, 46 with and 64 without incisal porcelain coverage, placed by two prosthodontists in 50 patients in a private dental practice. Because the veneers were placed in a specialist practice, the findings might not be applicable to other dental practices. Nine veneers failed, usually because of bulk fracture. At 5, 6, and 7 years, cumulative survivals were 95.8% for veneers with incisal porcelain coverage and 85.5% for those without such coverage. The difference was not statistically significant. However, because of the few failures, which precluded analysis of any confounding factors, and the decreasing number of observations with time, the findings should be interpreted with caution.

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