Retrospective Study of the Survival and Patient Satisfaction with Composite Dahl Restorations in the Management of Localised Anterior Tooth Wear

Keywords

Tooth Wear
sTooth Surface Loss
Dahl Technique
Resin Composite

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ABSTRACT

Objective: This retrospective study was undertaken to evaluate the clinical performance of direct composite restorations placed at an increased vertical dimension to manage localised anterior tooth wear using the Dahl approach.Subjects and Methods: Two hundred and ninety six restorations were placed at an increased OVD in 41 subjects with localized anterior Tooth Surface Loss (TSL) were included. Survival analysis was carried out at three levels, major failure only, minor failure only and all types of failure. Clinical follow up showed that the posterior occlusion was reformed after a mean duration of 25.4 months (range 6 to 60 months). Mean clinical follow up of 25.4 months showed a success rate of 88.8% and survival rate of 95.6% of the restorations. The major failure rate was 4.4 % while the minor failure rate was 8.7%. Patients' reported a significant improvement in appearance, and self-confidence and reduction in sensitivity. Self-reported patient satisfaction with the procedure was high. Clinical relevance: Placement of resin-based composite restorations at an increased occlusal vertical dimension to manage localised anterior tooth wear has a good short to medium term survival.

INTRODUCTION

One of the major topics in dentistry and a subject of increasing interest in dental research is tooth surface loss (TSL) which can be defined as non-carious loss of hard tooth structure resulting from attrition, abrasion, erosion or abfraction.[1-6] TSL is considered to be a normal physiological process that occurs throughout life or a pathologic process when seen in younger people or when affecting dental health and appearance.[1] The features of pathological TSL tooth surface loss are that the surface loss may result in changes in the appearance or the integrity of the teeth and may be considered to be excessive with respect to the age of the patient. With the increased understanding and control of dental caries and periodontal disease, more teeth are being retained into old age, which may contribute to an increased prevalence of TSL.[7]

Once enamel is lost and the dentine becomes exposed, TSL may cause dentine hypersensitivity, aesthetic problem and discomfort. In addition, progressive TSL may cause loss in occlusal vertical height, a history of frequent fracture of teeth or restorations, hypermobility or difficulty in eating and speaking.[7] Based on the aetiology, the severity of wear and the patient's concerns, the clinical management varies from regular observation and monitoring, diet analysis and counselling, application of bonding agents, direct and indirect composite restorations or an extensive full mouth rehabilitation.[8-12]

The Dahl approach was first described by Dahl *et al* in 1975[13] to manage localised anterior tooth wear at an increased OVD and initially used a removable metal based appliance to gain space between the upper and lower anterior teeth followed by definitive restorations. The technique has evolved over the last 20 years or so and clinicians now commonly place direct composite palatal restorations at an increased OVD.[14-19]

Only a few publications to date have assessed the clinical performance of the direct composite Dahl approach.[15-19] The aim of the present study was to investigate the success, survival rates and the types of failure of the composite Dahl approach. In addition to this, patient satisfaction with treatment outcomes was also explored.

MATERIALS AND METHODS

The study was granted approval by the Cardiff & Vale University Health Board Audit committee. (Ref: 1798) The sample involved 41 patients, 22 males and 19 females, treated for localised anterior tooth wear with composite resin 'Dahl' restorations placed at an increased occlusal vertical dimension. The youngest patient was 21 years old and the oldest was 70 years old, giving a mean age for the sample of 39.6 years. The age distribution of the sample is shown in Table 1. The patients were treated between March 2006 and February 2011 at the Cardiff University Dental hospital by one operator (JR).

Table 1. Age distribution of the sample

Age Range	Number of patients
21-25	5
26-30	11
31-35	5
36-40	4
41-45	3
46-50	3
56-60	4
61- 65	3
66-70	3

Patients were selected from the new patient consultant clinics at Cardiff University Dental Hospital. The aetiology of the tooth surface loss was established as far as possible by taking a careful history and examination and a diagnosis and treatment plan was established. Depending on the aetiology of the tooth surface loss, preventive care including dietary analysis, diet advice and the use of high concentration fluoride tooth pastes and mouth washes was instituted according to the regimen suggested by Chander & Rees.[12]

The following inclusion criteria were used in this study;

1. Tooth wear was localised to the maxillary or mandibular anterior teeth (incisors and canines), or combination of both.
2. At least 4 teeth required restoration.
3. Tooth wear extended into dentine (Smith and Knight tooth wear score[20] of 3 or 4).
4. Patients had intact dentitions with no fixed or removable partial dentures or implants.
5. The periodontal condition was stable with periodontal probing depths of 3mm or less

Prior to restorative treatment, each patient had a set of articulated study models constructed and a diagnostic wax up was carried out. A silicone putty matrix was produced from this and direct composite restorations were placed by a single operator (JR) on the worn teeth and shaped to restore their original contour. All teeth were restored at the same visit using direct composite (CeramX Duo) using the following clinical technique.

Minimal tooth preparation was carried out to reduce sharp enamel edges or undermined enamel. Moisture control was obtained by using labial cotton wool rolls and high volume suction. Enamel and dentine bonding (Prime & Bond) was carried out according to the manufacturers' instructions. An incremental build-up of the composite restoration was performed using a silicone putty matrix formed on the diagnostic wax-up model to aid development of the palatal increments (Aquasil). Some patients required restoration of the incisal and/or labial surfaces and following restoration of the palatal surfaces, a clear matrix strip was used to separate contact points. Alternate teeth were built up to facilitate the procedure. Teeth were restored to a normal contour and finishing of composite restorations was carried out conventionally with Soflex discs and polishing points (Enhance system). Occlusal contacts were arranged to provide even contacts on the RCP on the restored teeth which was commonly the six maxillary anterior teeth. Canine guidance was established in lateral excursions where possible.

Postoperative follow-up was at 1 week, 1 month and then every three months until the posterior occlusion re-established. Thereafter, they were reviewed on an annual basis. Posterior tooth contacts were assessed by use of articulating paper and Shimstock occlusal foil.

At the review visit, a full history and clinical examination was performed and the following data recorded;

- Angle's incisal relationship
- Time the restorations had been in function since placement (months).
- Assessment of restorations, noting any failures.
- Patients' were asked to complete an anonymous form rating their the effect of their treatment on self-confidence using three 10cm visual-analogue scales.
- Details of any previous repairs or replacements were assessed from the clinical notes.
- The reformed occlusal contacts between the opposing premolar and molar teeth were assessed using shimstock occlusal foil (Hanel, Langenau, Germany) and by marking with articulating paper (Dentsply UK, Addelstone, Surrey) to confirm the re-establishment of posterior occlusal contacts. Photographs of each 'marked' arch were taken for detailed analysis once the patient had been dismissed.

RESTORATION ASSESSMENT

Restorations were clinically assessed by one operator (AA) using the modified United States Public Health Service (USPHS) criteria.[21] Failure of the composite restorations was therefore assessed as:

Major failure; restorations in this group were those that required replacement due to total restoration loss or bulk fracture.

Minor failure; restorations in this group included those that had required refinishing or repair for any reason. These included margin fracture, surface roughness, and marginal discolouration. Wear were not included once it became apparent that this was an almost universal finding and would have given an inaccurate impression of overall performance.

Patient satisfaction was also assessed before the commencement of treatment and at the last review visit. Patients self-completed an anonymous form using a 10cm visual-analogue to assess their response to each of the following questions;

- How happy are you with your appearance?
- How sensitive are your teeth at the moment?
- What effect is the appearance of your teeth having on your 'self confidence'?
- Overall, how satisfied are you with the treatment you have received?

RESULTS

The commonest cause of tooth surface loss in this cohort was erosion (44%), followed by a combination of erosion and abrasion *(Table 2)*. A total of 296 restorations were assessed and the distribution of these restorations within the different incisal relationships are shown in Table 3.

Table 2. Aetiology of tooth surface loss

Suspected aetiology	Number of patients	Percentage
Primarily erosion	18	44%
Primarily attrition	5	12%
Primarily abrasion	0	0%
Combined erosion/ attrition	7	17%
Combined erosion/abrasion	11	27%
Total	41	10s0%

Table 3. Number of restorations placed classified by incisal relationship

Incisal Relationship	Number of restorations	Number of patients
Class I	242	32
Class II Div.1	0	0
Class II Div.2	30	5
Class III	24	4
Total	296	41

The patients were reviewed at various time periods following placement of the composite restorations and ranged from 6 to 60 months. The mean follow up period was 25.4 months.

SUCCESS AND SURVIVAL RATE

The result of this retrospective study showed that the success rate (number of restorations found with no complications) was 88.8% while the survival rate was 95.6% (number of restorations with no complications plus the restorations with minor failures, such as chipping, that were easily repairable).

MINOR FAILURE

There were minor failures in the form of chipping of the incisal edges of 6 restorations (2% of the total) which were easily repaired. This type of failure occurred between 18 and 32 months following placement of the restorations, with a mean of time to minor failure of 24.4 months *(Figure 1)*. An overview of the minor failures in relation to tooth type is given in Table 4. The results showed that chipping of composite restorations happened more frequently on upper central and lateral incisors, compared to canines, although the overall numbers of restorations is small.

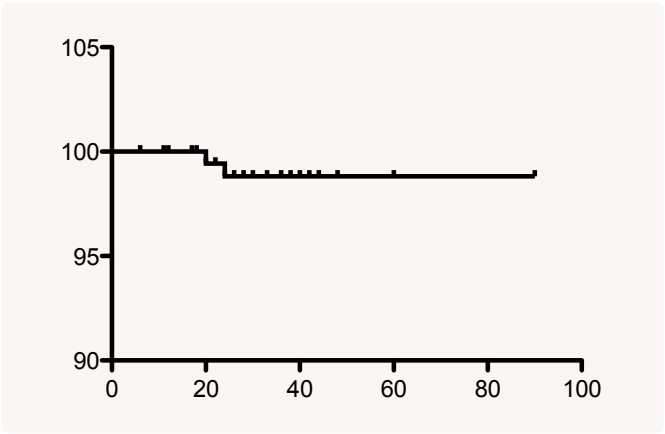

Figure 1: Timings of minor failure caused by chipping

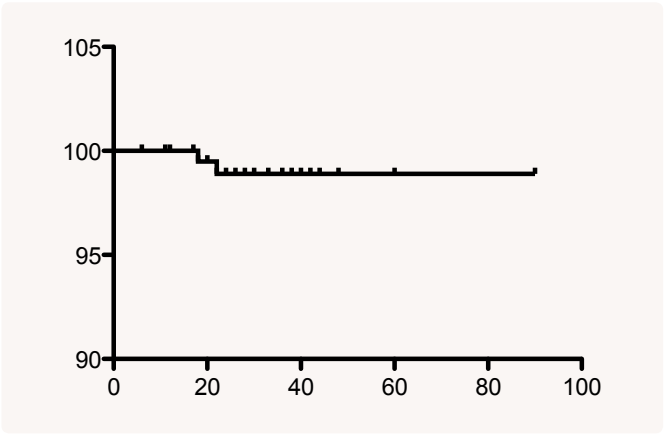

Figure 2: Timing of minor failure caused by discolouration

Table 4. Number of chipped restorations in relation to the time of failure, patient age, aetiology of TSL, incisal relation, gender of patient and tooth type

No. of chipped restorations	Time to fail	Age of pt. in years	Aetiology of TSL	Incisal relation	Gender	Tooth type
2	32 m	42	Erosion	Class I	M	2 central incisors
1	26 m	29	Erosion	Class I	M	1 central incisor
1	24 m	56	Erosion/ abrasion	Class I	F	1 lateral incisor
1	18 m	26	Erosion	Class I	M	1 lateral incisor
1	22 m	38	Abrasion/erosion	Class I	F	1 central incisor

Table 5. Number of discoloured restorations in relation to the time of failure, patient age, aetiology of TSL, incisal relation, gender of patient and tooth type

No. of discoloured restorations	Time to fail	Age of pt. in years	Aetiology of TSL	Incisal relation	Gender	Tooth type
1	24 m	57	Erosion / abrasion	Class I	F	1 canine
2	20 m	26	Erosion	Class I	M	2 central incisors
4	50 m	62	Attrition	Class I	F	2 canines,1 central incisor and 1 lateral incisor
4	32 m	44	Erosion	Class I	M	2 central incisors, 1 canine and 1 lateral incisor
3	40 m	30	Erosion	Class I	M	2 canines and 1 lateral incisor

Table 6. Number of restorations with major failure in relation to the time of failure, patient age, aetiology of TSL, incisal relation, gender of patient and tooth type

No. of restorations with major failure	Time to fail	Age of pt. in years	Aetiology of TSL	Incisal relation	Gender	Tooth type
3	12 m	56	Attrition/ erosion	Class I	M	2 canines and 1 central incisor
2	13m	50	Erosion/ abrasion	Class I	M	2 canines
1	18 m	36	Erosion	Class I	F	1 central incisor
2	15 m	44	Erosion /abrasion	Class I	M	1 central and 1 lateral incisor
3	12m	63	Attrition	class II div 2	M	2 canines and 1 lateral incisor
1	22m	28	Erosion	Class I	F	1 canine
1	13m	48	Abrasion/ erosion	Class I	M	1 central incisor

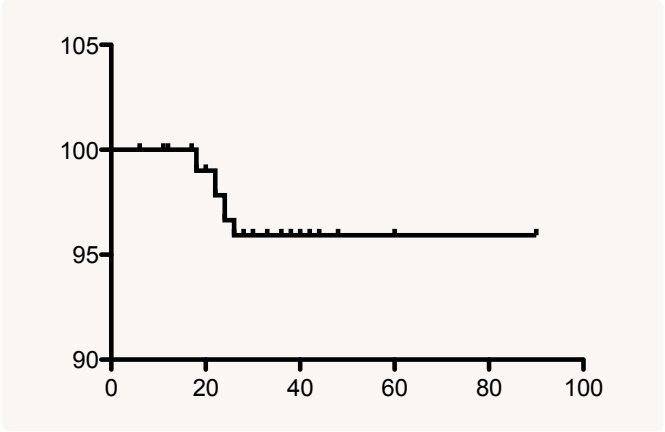

Figure 3: Kaplan-Meier survival function for restorations with minor failure (chipping and discolouration)

In addition there were 14 restorations (6.7% of the total number of restorations) with marginal discolouration that were managed by simple re-polishing. This type of failure occurred between 20 months to 50 months following placement (mean 22.3 months) (*Figure 2*). An overview of the minor failures in the form of discolouration is given in Table 5.

In the restorations which survived, no obvious wear was observed. The median survival time (MST) for all restorations when considering only minor failure was 5.0 years and the Kaplan-Meier survival curve for minor failure is given in Figure 3.

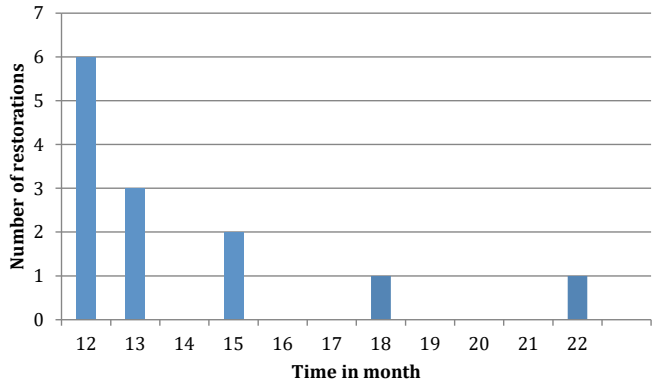

Figure 4: Timing of major failure (bulk-fracture)

MAJOR FAILURE

Thirteen out of 296 restorations exhibited major failure in the form of bulk fracture giving an overall major failure rate of 4.4%. The major failures occurred relatively early following placement between 12 to 22 months post-placement (mean time to failure of 15 months). Specific details of these failed restorations including the age of the patient, aetiology of TSL and tooth types are given in Table 6.

Furthermore, the data showed that the number of restorations failing with major failures declined with the time after placement (*Figure 4*). Moreover, two restorations had an unusual mode of failure, as they failed at 24 months post-placement during intubation in an operating theatre. The median survival time (MST) of all restorations when considering major failure only was 4.2 years and the Kaplan-Meier survival curve for major failure is given in Figure 5.

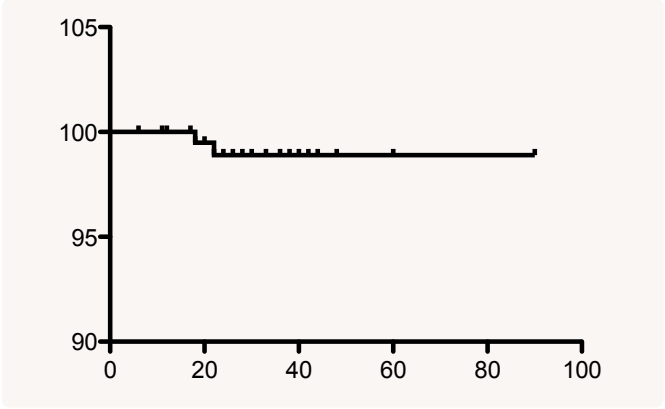

Figure 5: Kaplan-Meier survival function for all restorations with major failure

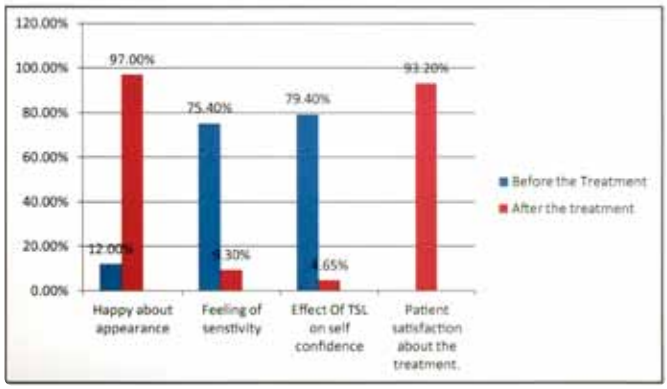

Figure 7: Change in patients' perception of appearance, sensitivity, self-confidence and overall satisfaction

COMBINED MAJOR AND MINOR FAILURES

The median survival time (MST) of all restorations when both minor and major failure considered was 4.0 years. The Kaplan-Meier survival curve for combined major and minor failures is given in Figure 6.

POSTERIOR OCCLUSION

In this study there were 3 cases with premolars teeth failed to re-establish occlusal contacts, giving an overall rate of 4.8%. One of the cases was a 28 years old patient with class III incisal relationship where the premolars failed to erupt back into contact bilaterally. The other two cases were a 57 and 60 years old patients with class I incisal relationship with the premolars failed to erupt unilaterally in each case. In each case occlusal stability was regained by the placement of composite onlays.

PATIENT FEEDBACK

Changes in patients self-reported perceptions about appearance, tooth sensitivity, self-confidence are given in Figure 7. Patients' self-confidence and contentment with their appearance increased dramatically following appearance and self-reported symptoms of sensitivity reduced from 75% pre-operatively to 9% post-opertively. Patient reported satisfaction with the treatment ('would you have treatment carried out again?') was high at 93% but the small number of patients who were not satisfied with treatment did not give any reasons for this response.

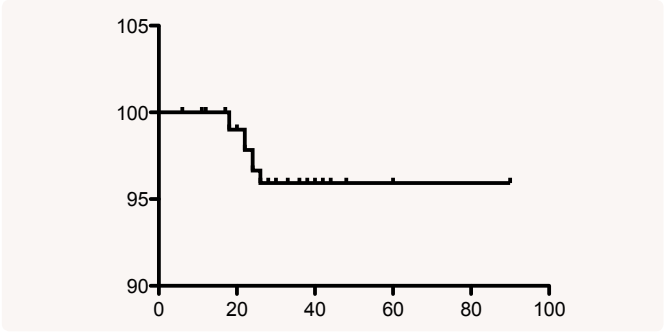

Figure 6: Kaplan-Meier survival function for all restorations at major and minor failure combined

DISCUSSION

The present study was undertaken to assess patients treated for localised anterior tooth surface loss that had been treated with a direct composite Dahl approach by one operator (JR) in a single centre. Forty-one patients were followed up for between 6 and 60 months with a mean follow up time of 25.4 months. Additionally, a survey was completed by all patients to evaluate changes in their appearance, sensitivity, self-confidence and their overall satisfaction with the clinical care received.

Overall, this study found that the use of direct composite restorations used to restore a worn anterior dentition at an increased OVD was a useful and viable medium term option, which confirms the findings of previous studies.[15-19]

AETIOLOGY

Accepting the well-known difficulties of establishing precisely the aetiological factors causing TSL[22] the commonest cause of TSL was erosion comprising 44% of the cases treated. This was not too surprising, as it is well established that extrinsic acids in the diet are a common cause of erosion in addition to gastric reflux and eating disorders.[8] These findings were broadly similar to the results reported by Redman *et al.*[15] and Gow and Hemmings[16] where 51% and 66% of the their TSL cases were attributed to erosion.

RESTORATION SURVIVAL RATES

The survival rate of composite restorations placed at an increased OVD was 89% with 263 of restoration remaining in function without any type of complication. This result is similar to the findings of Hemmings *et al.*[17] who reported a success rate of 89.4% and to Gow and Hemmings[16] who reported a survival rate of 87%.

This general agreement might be explained by the studies using similar criteria (Ryge criteria[20]) for assessing success and failure and using direct composite restorations. However, there may well have been differences between the studies in terms of the patterns of tooth wear between these studies and there were also differences in the commercial brands of composite resins used, although all the composite resins placed in all three studies were heavily filled materials.

As far as restoration failure was concerned, the present study showed no clinically significant wear of the surviving restorations occurring after the mean follow up time of 25 months. This may be a reflection of the low number of attritional cases included in the study sample, together with the use of a heavily filled composite resin. Of course, it may also reflect the relatively short mean follow up period of just over 2 years, but the data provided suggests that there may be a trend of restoration failure clustering within the first 12-18 months following placement. This result is again comparable to those reported result by Hemmings *et al*.[17] who showed no significant wear of restorations after a mean review period of 30 months.

There was major failure of just 13 restorations which was considered to be a rare complication during the follow up period of from 6 to 60 months. This result was in agreement with the study by Gulamali *et al*.[18] and Redman *et al*.[15] ; they also found that the major failure was a rare complication in the first five years of placement of composite restorations at increase OVD. Furthermore, we found also that the chipping and discoloration of composite restorations placed at increased OVD comprised was 2% and 7% of restorations, respectively.

In the study of Hemmings *et al*,[17] the number of restorations which fractured within the mean review time of 30 months and required replacement and lost restorations were 18 restorations, which were comparable to the result of the present study which there 13 restorations with bulk - fracture and needed replacement. In addition, the discoloured or stained restorations in the same mean follow up time were 12 restorations which again comparable to the result of this study which reported 14 restorations with discolouration at mean follow up of 25.4 months. The minor failure reported by Gow and Hemmings[16] after a minimum of 2 years follow up was 13.3% of the cases which was comparable to the reported percentage of minor failure by the present study which was 8.7%. A possible explanation for this agreement may be because in both studies they consider the restoration to be having minor failure if it is possible to be repaired successfully without replacing the whole restoration.

The result of this study showed that the occurrence of major failure decreased with time. The possible reason behind that might be the load on the restoration placed at increased OVD on the anterior teeth might be high before the posterior teeth re-established the occlusal contacts.

POSTERIOR OCCLUSION

In the present study, the posterior teeth re-established posterior contacts to an adequate level after the mean follow up of 25.4 months. The time taken for the posterior occlusion to re-establish in this study was longer than the result reported by Hemmings *et al*.[17] and Gow and Hemmings[16] of 5 months and 9 months respectively.

The design of the present study was a retrospective audit to analyse the re-establishment of posterior contact at mean follow up time of 25.4 months without having any reference of the time required for the teeth to re-establish the contact. The study of Hemmings *et al*.[17] and Gow and Hemmings,[16] on the other hand, were prospective studies which assessed the required time of the posterior teeth to restore the contact in each case. In this retrospective study it was only possible to examine patients that attended for their recall appointments. It is therefore likely that some patients who did not attend had suffered restoration failure which was impossible to assess. This may provide one explanation for the higher success rates of the Dahl technique reported in this study compared to previous studies.[16,17]

In the present study, there were 3 cases with premolars teeth failed to re-establish occlusal contacts. One of the cases was a 28 years old with class III incisal relationship where the premolars failed to erupt back into contact bilaterally. The other two cases were a 57 and 60 years old patients with class I incisal relationship with the premolars failed to erupt unilaterally in each case. In each case occlusal stability was regained by the placement of composite onlays. The reason for the failure of a small number of teeth to re-establish contact has been reported previously[15,16] but the reasons for this are not fully understood and may possibly be due to lateral tongue spread or by the lower eruptive potential exhibited by some teeth.

In this audit, 4.8% of the premolars failed to re-establish posterior contacts. This result was comparable to the reported percentage by Gow and Hemmings[16] which was in two of the cases. Additionally, Gough and Setchell[19] reported that 4% of the patient expected to have failure in the re-establishment of occlusal contact after follow up time up to 14.1 years.

PATIENT SATISFACTION

Almost all the patients were satisfied with the treatment carried out and expressed their willingness to receive the same treatment again if needed. The patient satisfaction rate in this audit was 93.2% which is slightly higher than that reported by Gulamali *et al*.[18] and Gow and Hemmings.[16] However the studies of Gulamali[18] and Gow and Hemmings[16] had longer follow up periods so lower patient satisfaction values are not too surprising as the patients in these longer studies will have experienced more failures.

CONCLUSIONS AND CLINICAL IMPLICATIONS

This study has provided further confirmatory evidence that the minimally invasive composite Dahl approach is a conservative and predictable approach in managing localized anterior TSL, at least in the medium term. It also provides a clinical approach that is less destructive, has a lower cost and failure can be more easily managed compared to more conventional techniques such as multiple conventional crowns. The majority of the posterior teeth also re-established their occlusal contacts predictably following restoration of the upper anterior teeth.

The results also show that from a patient perspective this approach is a successful treatment method and makes significant improvements in the appearance and self confidence of the majority of patients. Overall, there was a very high patient satisfaction level with this treatment.

MANUFACTURERS' DETAILS

- CeramX Duo, Dentsply UK Ltd., Building 3, The Heights, Weybridge, Surrey KT13 ONY
- Prime & Bond, Dentsply UK Ltd., Building 3, The Heights, Weybridge, Surrey KT13 ONY
- Aquasil Impression material, Dentsply UK Ltd., Building 3, The Heights, Weybridge, Surrey KT13 ONY
- Soflex discs, 3M Healthcare, Loughborough, UK.
- Enhance polishing points, Dentsply UK Ltd., Building 3, The Heights, Weybridge, Surrey KT13 ONY
- Shimstock occlusal foil, Hanel, Langenau, Germany.
- Articulating paper, Dentsply UK Ltd., Building 3, The Heights, Weybridge, Surrey KT13 ONY

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