Clinical Monitoring of Tooth Wear Progression in Patients over a Period of One Year Using CAD/CAM

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Purpose: The aim of this study was to clinically monitor the progression of tooth wear over a period of 1 year in a cohort of referred tooth wear patients through the use of a computer-aided design/computer-assisted manufacture (CAD/CAM) scanner and a standardized scanning/assessment methodology. Materials and Methods: Polyether impressions were made of 11 participants (130 teeth) at baseline and at 1 year. Impressions were poured in type IV dental stone and the anterior teeth were 3D scanned. A surface-matching software was used to compare 1-year and baseline scans and identify any dimensional differences. Results: Parafunctional habits were reported by all patients. All participants exhibited tooth wear ≥140 µm in depth and extending to ≥280 µm in at least one tooth. Maxillary central incisors were the most commonly and severely affected teeth. Conclusion: The ability of the developed CAD/CAM scanning methodology in clinical monitoring of tooth wear was demonstrated. Further research is needed to assess its practicality in large-scale epidemiologic tooth wear studies. Int J Prosthodont 2017;30:153–155. doi: 10.11607/ijp.4990

Given the subjective nature of currently available tooth wear indices1 and the limited evidence supporting various tooth wear management approaches and their long-term outcomes,2,3 development of a method for objectively quantifying tooth wear in vivo is pertinent. Computer-aided design/computer-assisted manufacture (CAD/CAM) scanning can offer a more accurate and reliable alternative for monitoring tooth wear progression in patients.

The aim of this study was to clinically monitor the progression of tooth wear over a period of 1 year in a cohort of patients using a standardized three-dimensional (3D) scanning and assessment methodology.

Materials and Methods

Ethical approval was obtained from the West of Scotland Research and Ethics Committee (REC: 10/S0709/59, R&D Ref: GN10DN412). Participants were recruited between March 2011 and April 2012 through three restorative dentistry consultants’ clinics at Glasgow Dental Hospital and School. Participants completed a questionnaire addressing their medical and dental history, lifestyle factors, habits, and diet.

Study inclusion criteria were as follows:

• Consenting adults aged older than 16 years
• Patients referred solely for management of tooth wear
• Patients requiring management that only involved monitoring of tooth wear, dietary advice, oral hygiene instructions, and/or referral to hypnotherapy

The accuracy of the scanning system (3D scanner and dental stone casts) was previously assessed using a custom-made stainless steel model resembling the dimensions of the dental arch.4

Initial and 1-year recall visits involved making polyether impressions (Impregum Penta Soft, 3M ESPE) of participants’ dentition. Retrieved impressions were visually inspected, and if deemed satisfactory, disinfected for 10 minutes (Perform-ID 3%, Schülke & Mayr). After 24 hours, impressions were poured in ISO type 4 die stone (Suprastone, Kerr) mixed according to the manufacturer’s recommendations.

At 1 month postpouring, all anterior teeth were contact scanned on the cast replicas using a CAD/CAM system.
Monitoring Tooth Wear in Patients Using CAD/CAM

A surface-matching software, Geomagic Qualify (Geomagic), was used to superimpose the experimental T₁ scan onto the reference scan, T₀, using best-fit registration on an individual tooth basis. 3D deviation analysis was performed to calculate the mean step-height (square mean distance/Euclidean distance) difference between scans T₁ and T₀ in terms of x, y, and z coordinates (Fig 1b).

**Results**

A total of 30 patients were initially recruited. Of these, 11 were available at the 1-year recall: 6 males and 5 females (mean age: 47 ± 13 years).

The majority of the patients had been aware of their tooth wear condition within the past 5 years (n = 8) and reported mental health risk factors, such as depression (n = 7) (Table 1). All patients (n = 11) reported positive attrition risk factors in the form of parafunctional habits.

The majority of patients (n = 10) reported concurrent erosion and/or abrasion risk factors.

All participants (n = 11) demonstrated anterior tooth wear of ≥ 140 μm in one or more teeth. Maxillary central incisors were the most commonly and severely affected by wear, with 64% of these teeth presenting ≥ 260 μm of wear (Fig 3). They also exhibited the greatest surface area of wear, with a mean affected surface area of 7% (SD: ± 4%).

Due to the small sample size, further statistical analysis was not feasible.
Discussion

The findings of this pilot study demonstrate the feasibility and applicability of the developed 3D methodology in monitoring clinical wear. The pronounced 1-year wear of ≥ 140 μm exhibited by the patient cohort is in agreement with findings of other studies demonstrating wear of 113 to 656 μm over a period of 6 months to 1 year.5,6 Such high wear values 1 can be explained by the presence of active parafunctional habits potentially triggered by underlying mental health disorders such as stress and depression.

The study has limitations regarding operator training and complexity of scanning/analysis on an individual-tooth basis. However, the selection of specific teeth (central incisors, canines) as key indicators for monitoring tooth wear progression will simplify and expedite the process. Future employment of the methodology on a larger sample size with longer follow-up will offer a more population-representative description of tooth wear.

Conclusions

Over a period of 1 year, all patients presented anterior tooth wear ≥ 140 μm in depth. The most commonly and severely affected teeth were the maxillary central incisors. The clinical feasibility and applicability of the developed CAD/CAM methodology in monitoring tooth wear was demonstrated.

Acknowledgments

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References


Table 1 Positive Findings from Patient History Questionnaire Covering Medical, Dental, Dietary, and Lifestyle Risk Factors Related to Tooth Wear

<table>
<thead>
<tr>
<th>Patient</th>
<th>Gender</th>
<th>Age (y)</th>
<th>Duration of awareness of tooth wear condition (y)</th>
<th>Parafunctional habits</th>
<th>Intrinsic erosion</th>
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