Effects of Ultrasonic Debridement on Oral Hygiene Status

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Abstract

The aim of this randomized-controlled, single-blinded study was to compare the effects of mechanical tooth cleaning (MTC) and ultrasonic debridement (UD) on oral hygiene status in healthy young adults. Thirty-seven participants (mean age: 20.3 ± 0.62 years) were divided into 3 groups after pre-examination: group A, receiving MTC; B, receiving MTC + UD using a universal insert (UDUI); and C, receiving MTC + UD using a probe-shaped insert (UDPI). All participants were required to abstain from oral hygiene for 24 hours after the allocated intervention, after which they were examined. A masked examiner determined the Quigley-Hein plaque index (PlI) and Silness and Löe gingival index (GI) scores before the interventions and after 24 hours of non-brushing. A significant increase in the PlI score was observed in group A (p < 0.001) in comparison with that in group B (A: 0.311 ± 0.26; B: −0.01 ± 0.33; C: 0.13 ± 0.27; p < 0.05). A significant decrease in the GI score was observed in groups B and C (p < 0.05), and the change in this score in group C significantly differed from that in group A or B (A: −0.04 ± 0.25; B: −0.13 ± 0.17; C: −0.33 ± 0.2; p < 0.05). Only MTC was insufficient to prevent plaque formation over a 24-hour period of non-brushing and decrease the GI score. Ultrasonic debridement was more effective in preventing plaque formation and decreasing the GI score, regardless of the type of insert used. The present results suggest that UD should be included as an important procedure in the provision of professional oral prophylaxis and that UDPI is as efficient for cleaning as UDUI.

Key words: Professional oral prophylaxis — Ultrasonic debridement — Ultrasonic insert

Introduction

Ultrasonic debridement (UD) has been extensively reported in the literature and is a primary procedure in the provision of professional oral prophylaxis. Professional oral prophylaxis should be as nonaggressive as possible, however, so there are a number of
procedures available to suit the oral health of the individual concerned\(^5\). A number of studies have investigated the effects of mechanical tooth cleaning (MTC) on tooth mortality, caries, and periodontal disease in adults\(^3,7\). Nevertheless, little research has compared the clinical effects of MTC and UD, particularly with regard to the question of whether professional oral prophylaxis including MTC but without UD is sufficient to achieve the goals of such treatment. Therefore, this remains to be clarified. In addition, UD is performed using a variety of inserts with different operational methods\(^15\). Little research has evaluated differences in clinical outcomes among different types of insert, however. Moreover, previous research has focused on unhealthy individuals, even though professional oral prophylaxis is intended for preventive treatment in those who are healthy\(^6\).

The objectives of the present study were to 1) compare the effects of MTC and UD on oral hygiene status in healthy young people; and 2) compare the effects of UD using a universal insert (UDUI) with that using a probe-shaped insert (UDPI) on oral hygiene status in healthy individuals.

### Methods

#### 1. Participants

Forty healthy female dental hygiene students (mean age: 20.3 ± 0.62 years) participated in the study after a pre-examination in which a dentist diagnosed each participant’s oral status and dental hygienist determined their Quigley-Hein plaque index (PII) and Silness and Löe gingival index (GI) scores\(^10,12\). The exclusion criteria were as follows: active dental caries; severe gingivitis; a gingival index score of higher than 2.0; a history of orthodontic treatment; and regular use of antibiotics. The participants were divided into 3 groups systematically and randomly as follows: (1) in descending order based on the results of the PII and GI scores obtained during the pre-examination; and (2) each of 3 participants from the top were systematically and randomly allocated into group A, B, or C to make the average PII and GI scores in each group equal. No significant difference was found in the average PII or GI score at baseline among the groups (Table 1). Each group received a different kind of professional oral prophylaxis procedure: group A received MTC; group B received MTC + UDUI; group C received MTC + UDPI and were required to abstain from any form of oral hygiene for 24 hours after receiving the allocated interven-

|          | Baseline | First | Second | p values (First to second) |
|----------|----------|-------|--------|---------------------------|
| PII      |          |       |        |                           |
| A (n: 14)| 0.9 ± 0.43 | 0.9 ± 0.42 | 1.22 ± 0.38 | 0.0006                  |
| B (n: 11)| 0.95 ± 0.37 | 1.0 ± 0.39 | 0.98 ± 0.35 | NS                      |
| C (n: 12)| 0.97 ± 0.4  | 1.02 ± 0.37 | 1.14 ± 0.26 | NS                      |
| GI       |          |       |        |                           |
| A (n: 14)| 0.88 ± 0.3  | 0.96 ± 0.34 | 0.91 ± 0.41 | NS                      |
| B (n: 11)| 0.83 ± 0.32 | 0.86 ± 0.38 | 0.73 ± 0.26 | 0.0302                  |
| C (n: 12)| 1.05 ± 0.29 | 1.01 ± 0.23 | 0.68 ± 0.2  | 0.0001                  |

A: received MTC; B: received MTC + UDUI; C: received MTC + UDPI. First: before receiving the allocated intervention; Second: after 24 hours of non-brushing; Wilcoxon signed rank test; NS: no significance.
tion (Fig. 1). Approval for the study protocol was obtained from the Ethical Committee of the Japan Dental Hygienists’ Association (number: 3). Written informed consent was obtained from all participants prior to commencement of the study.

2. Professional oral prophylaxis

The operators, who were all dental hygienists, conducted a series of trials for each participant. The operators were all required to practise using the ultrasonic instruments provided and all the scheduled procedures prior to commencement of the trials to ensure a sufficiently high standard of professional skill. Professional oral prophylaxis and collection of data were implemented at the Taiyo School of Dental Hygiene. The procedures used for professional oral prophylaxis were as follows:

1) UDUI

The P-MAX 2 (ACTEON, France) was used. The power level was set to 3 in accordance with the manufacturer’s recommendations. A universal insert (URM perio-hard chip, H3) was used with a 70-degree angle and light-pressure.

2) UDPI

The P-MAX 2 was used. The power level was set to 3 and a probe-shaped insert (URM perio-hard chip, HY1) used with a walking stroke and light-pressure.

3) MTC

A contra-angle handpiece and rotating rubber cup were used in combination with application of fluoride prophylaxis paste. Flossing was performed on all interproximal surfaces at the end of MTC.

3. Measurements

The first set of PII and GI scores were obtained by a masked examiner, also a dental hygienist, at pre-examination; they were then collected a second time at after 24 hours of non-brushing (second set). Intra- and inter-group differences in mean change in PII and
GI scores between the first and second assessments were compared.

4. Statistical analysis

Non-parametric tests were used as the frequency of the GI scores did not show a normal distribution (Shapiro-Wilk test: p < 0.01). A Wilcoxon-signed rank test was used to compare intra-group differences. Inter-group differences were compared using the Kruskal-Wallis test. If the Kruskal-Wallis test showed significant inter-group differences, the Wilcoxon rank-sum test was used to compare individual groups. JMP version 11 for Windows (Statistical Discovery. From SAS., SAS Institute Inc., Cary, NC, USA) was used for statistical analysis, and a p-value of < 0.05 was considered to be statistically significant.

Results (Tables 1 and 2)

A total of 37 participants completed the clinical trials, with 3 being excluded (1 for receiving professional cleaning at a private dental clinic before undergoing the intervention; 2 for not undergoing the second assessment).

1. PlI

The average PlI score between the first and second assessment showed an increase in groups A and C, but a decrease in group B. A significant increase in the PlI score was observed in group A (p<0.001) in comparison with that in group B (p<0.05).

2. GI

The average GI score showed a decrease in all groups between the first and second assessment. A significant decrease in the GI score was observed in groups B and C (p<0.05); also, the change in the GI score in group C showed a significant difference in comparison with that in groups A and B (p<0.05).

Discussion

The results of the present study revealed that MTC alone was insufficient to prevent plaque formation and decrease the GI score. Although MTC alone was sufficient to remove disclosed plaque on smooth surfaces and cervical areas, it was insufficient to remove supragingival biofilms completely, which would have been possible, however, with UD, regardless of the type of insert used. One of aims of professional oral prophylaxis is the removal of biofilms which the patient would be unable to remove by themselves. Therefore, it should be performed with ultrasonic instruments, utilising the effects of cavitation\textsuperscript{[13]}. This has been shown to be effective in removing biofilms and improving oral hygiene status\textsuperscript{[8]}.

|       | Change (First to second) | p values of A | p values of B | p values of C |
|-------|--------------------------|--------------|--------------|--------------|
| PlI   |                          |              |              |              |
| A (n: 14) | 0.311 ± 0.26          | —            | 0.0148       | NS           |
| B (n: 11) | −0.01 ± 0.33           | 0.0148       | —            | NS           |
| C (n: 12) | 0.13 ± 0.27            | NS           | NS           | —            |
| GI    |                          |              |              |              |
| A (n: 14) | −0.04 ± 0.25           | —            | NS           | 0.0068       |
| B (n: 11) | −0.13 ± 0.17           | NS           | —            | 0.0261       |
| C (n: 12) | −0.33 ± 0.2            | 0.0068       | 0.0261       | —            |

Wilcoxon rank-sum test; NS: no significance.
The present results also demonstrated that UDPI was as effective as UDUI in preventing plaque formation during 24 hours of non-brushing and decreasing the GI score. The results also revealed that UDUI removed plaque more efficiently than UDPI. Nevertheless, no significant increase in the PII score was observed between the first and second assessments in groups B or C, which received UDUI and UDPI, respectively. This showed that both these procedures were capable of removing enough plaque and biofilm to prevent plaque formation during a 24-hour period of non-brushing. A significant difference was found between the GI scores in groups B and C, which received UDUI and UDPI, respectively. A significant decrease in the GI score was observed in both groups, however, between the two assessments. A large amount of water spray can penetrate sub-gingival biofilm during UDPI, which may explain the greater decrease observed here in the GI score in group C than in group B. Indeed, the effects of irrigation on improving gingival status have been clarified in previous research. In the present study, a probe-shaped insert was sufficient to remove supra-gingival plaque and supra- and sub-gingival biofilms in healthy participants. This suggests that whether or not an insert has an edge is not important. Although tooth roughness was not compared after each treatment here, UDUI was probably more invasive of the teeth than UDPI. Previous research found that differently shaped inserts had different effects on the surfaces of the tooth. This suggests that dental professionals should use a PI when providing professional oral prophylaxis in healthy patients to minimize the invasive effects of such treatment.

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