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# Gingival health and relapse tendency: a prospective study of two types of lower fixed retainers

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*Background:* Different types and diameters of wire are used in bonded lingual retainers. Some clinicians bond a small diameter multistrand wire to each tooth, while other clinicians bond a large diameter wire to the lingual surfaces of the lower canines.
*Aim:* To compare the gingival health, plaque accumulation, tooth stability and integrity of multistrand wire and round wire bonded lingual retainers.
*Methods:* Sixty-two subjects, who had completed treatment and who required fixed retention for the lower anterior segment, were assigned to either the Round wire retainer group or the Multistrand wire retainer group. In the Round wire retainer group, a 0.036 inch round, stainless steel wire was bonded to the lingual surfaces of both lower canines. The Multistrand retainer group had a 0.015 inch multistrand wire bonded to the lingual surfaces of all lower anterior teeth. At least 12 months after debonding, the subjects were recalled and the following variables were recorded: Oral Hygiene Index (OHI), Plaque Index (PI) of the lower anterior teeth, Gingival Index (GI) of the lower anterior teeth, Irregularity Index (IRI) of the lower anterior teeth, and the number of broken retainers.
*Results:* There were no significant differences between the PI ($p = 0.165$) and GI ($p = 0.150$) of the two groups. More plaque was found on the distal surfaces of the lower anterior teeth in the group with multistrand wire retainers ($p = 0.02$). The lower anterior teeth were significantly more irregular in the group with round wire retainers compared to the group with multistrand wire retainers ($p = 0.002$). Although the multistrand wire retainers fractured more frequently than the round wire retainers the difference was not statistically significant ($p = 0.325$).
*Conclusion:* More plaque accumulated on the distal surfaces of the lower anterior teeth in subjects with multistrand wire retainers than in subjects with round wire retainers. Multistrand wire retainers were better at maintaining incisor alignment than single span, round wire retainers.
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## Introduction

Malocclusions with rotated and/or imbricated incisors require long-term retention after treatment to prevent relapse.[1] Although banded canine-to-canine lingual retainers were generally removed after 1 to 2 years, bonded lingual retainers can be left in place for many years and are often referred to as 'permanent' retainers.[2,3] Early bonded lingual retainers, which copied the design of the banded retainers, had a large diameter wire bonded to the lingual surfaces of either the lower canines or premolars.[4] The next development was the use of small diameter spiral or multistrand wires bonded to all lower anterior teeth.[5,6] It was felt that a multistrand wire would be flexible enough to allow physiological movement of the teeth and, at the same time, retain previously rotated or imbricated teeth.[7] However, the roughness of a multistrand wire can be uncomfortable to some patients and encourage the retention of plaque. The latter can lead to gingivitis and/or periodontal breakdown. At least one author felt that the flexibility of multistrand wire retainers would result in distortion of the wire during chewing and bond failure.[8]


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Studies of patients with bonded retainers indicate that multistrand wire retainers are better at maintaining alignment of the lower incisors than single span, canine-to-canine retainers and do not promote the accumulation of plaque.[9–12] However, round wire canine-to-canine retainers appear to be more durable than multistrand retainers.[10,12]

The aims of this prospective study were to compare the gingival health, plaque accumulation, tooth stability and integrity of lingual retainers made of multistrand wire bonded to all lower anterior teeth with lingual retainers made of thick, round wire bonded to the lower canines.

## Materials and methods

The subjects in this prospective study were 62 patients who completed orthodontic treatment at the Dental Teaching Center, Jordan University of Science and Technology, between 2003 and 2005, and who required fixed retention for the lower anterior segment. Alternate subjects were assigned to the Round wire retainer group (Mean age: 20.23 ± 3.8 years) and the Multistrand wire retainer group (Mean age: 19.97 ± 4.2 years). There were 22 women and 9 men in both groups.

At the completion of treatment, the teeth in all subjects were thoroughly scaled and the roots planed by the same clinician. The appliances were then debonded and impressions taken for study casts and fabrication of the retainers. The round wire retainers were made of 0.036 inch stainless steel wire, sandblasted at both ends, and bonded to the lingual surfaces of the lower canines only (Round wire retainer group).[8] The multistrand retainers were made of 0.015 inch multistrand wire, bonded to the lingual surfaces of all lower anterior teeth (Multistrand wire retainer group). All retainers were bonded by the same clinician using a localising template and Filtek P60 composite resin (3M Espe, St. Paul, MN, USA). At debonding, the mean Irregularity Index for the subjects in the Multistrand retainer group was 0.38 and for the subjects in the Round wire retainer group it was 0.32 ($p$ = 0.637). Oral hygiene instructions were given to all participants.

At least 12 months after debonding all subjects were recalled and the following variables were recorded: Oral Hygiene Index (OHI); Plaque Index (PI) of the lower anterior teeth; Gingival Index (GI) of the lower anterior teeth; Irregularity Index (IRI) of the lower anterior teeth; number of breakages of the retainers.

The OHI records the amount of debris or calculus on the buccal and lingual surfaces of the teeth in each dental arch i.e. both buccal segments and the anterior segment.[13] In each segment the tooth with the greatest area covered by either debris or calculus was used to determine the index for that particular segment. The debris scores for the segments were summed and divided by the number of segments recorded. In the present study, the lower anterior segments were excluded as the amount of debris and calculus may have been affected by the presence of the fixed retainer. The same method was used to obtain the Calculus Index scores. Then the debris and calculus scores were combined to obtain the OHI score.

To determine the PI, the buccal, lingual, mesial and distal surfaces of the lower anterior teeth were scored from 0 to 3, according to the amount of plaque on each surface.[14] The scores for each tooth were summed and divided by 4 to give the PI for the tooth. The scores for the lower anterior teeth were averaged to give the PI score for the lower anterior segment.

To obtain the GI, the labial and lingual surfaces of the lower anterior teeth were given a score from 0 to 3; these scores were averaged to give the GI for each tooth.[15] The GI scores of the lower anterior teeth were summed and averaged to give a GI score for the lower anterior segment.

The IRI was used to measure the irregularity of the lower anterior teeth.[16] Contact point displacements were measured directly with calipers to 0.1 mm. The calipers were held parallel to the occlusal plane, and the IRI for each subject was the sum of the measurements of the five contact points.

To determine the measurement error, 10 subjects (5 subjects from each group) were re-examined at least 7 days after the initial examination and the measurement error determined using Dahlberg's method. The errors varied between 0.018 for the total PI to 0.073 for the GI on the lingual surfaces.

### *Statistical analysis*

Means and standard deviations were calculated for all the variables using SPSS (Version 11, Chicago, Illinois, USA). Statistically significant group differences in PI, GI and IRI were determined using the

Table I. Differences between the Round wire and Multistrand wire retainer groups.

| Variable | Round wire group Mean (SD) | Multistrand wire group Mean (SD) | Mean difference | *p* |
|---|---|---|---|---|
| Retention period (Months) | 21.31 (8.97) | 19.35 (6.67) | 2.96 | 0.473 |
| Oral Hygiene Index | 2.11 (0.98) | 2.18 (0.67) | 0.07 | 0.747 |
| Plaque Index | 1.02 (0.52) | 1.21 (0.48) | 0.19 | 0.165 |
| Gingival Index | 1.19 (0.44) | 1.34 (0.39) | 0.15 | 0.150 |
| Irregularity Index (mm) | 3.08 (1.52) | 1.92 (1.21) | 1.16 | **0.002** |
| Fractured retainers (N) | 4 | 9 | 5 | 0.325 |

Significant value in bold

Table II. Plaque Index (PI) and Gingival Index (GI) of the lower anterior segments.

| Surface | Round wire group Mean (SD) | Multistrand wire group Mean (SD) | Mean difference | *p* |
|---|---|---|---|---|
| PI buccal surfaces | 0.66 (0.57) | 0.83 (0.66) | 0.17 | 0.290 |
| PI lingual surfaces | (0.85) 1.35 | 1.50 (0.45) | 0.15 | 0.419 |
| PI mesial surfaces | 1.04 (0.64) | 1.30 (0.72) | 0.27 | 0.127 |
| PI distal surfaces | 0.96 (0.59) | 1.33 (0.61) | 0.36 | **0.020** |
| GI buccal surfaces | 1.12 (0.60) | 1.20 (0.50) | 0.08 | 0.560 |
| GI lingual surfaces | 1.25 (0.51) | 1.50 (0.48) | 0.25 | 0.053 |

Significant value in bold

Table III. Irregularity of the lower incisors at recall.

| Irregularity Index | Round wire group (N) | Multistrand wire group (N) | Total |
|---|---|---|---|
| Ideal (0-1 mm) | 2 | 9 | 11 |
| Mild (2-3 mm) | 15 | 16 | 31 |
| Moderate (4-6 mm) | 13 | 6 | 19 |
| Severe (7-10 mm) | 1 | 0 | 1 |

* $p = 0.045$, chi-squared analysis

Student's *t*-test. Chi-squared was used to examine the differences in the fracture rates and the IRI scores in the two groups. Probability values less than 0.05 were considered significant.

## Results

The mean retention period for the group with round wire retainers was 21.31 months, and for the group with multistrand wire retainers it was 19.35 months. The difference was not statistically significant ($p = 0.473$).

The mean OHI, PI, GI and IRI scores and the number of fractured retainers in each group are given in Table I. Only the IRI was significantly different: the lower anterior teeth in the Round wire group were significantly more irregular at recall than the lower anterior teeth in the Multistrand wire group ($p = 0.002$). Although more multistrand wire retainers fractured than round wire retainers, the difference was not statistically significant. When, however, the mean PI and mean GI were broken down into tooth surfaces, the distal surfaces of the lower anterior teeth in the Multistrand wire group had significantly more plaque than the distal surfaces of the anterior teeth in the Round wire group (Table II, $p = 0.020$). The mean difference in the GI scores for the lingual surfaces of the anterior teeth also approached statistical significance ($p = 0.053$).

More subjects in the Multistrand wire group had ideal alignment of the anterior teeth compared with the subjects in the Round wire group, and more subjects in the latter group had moderate crowding at recall than the subjects in the Multistrand wire group

**Table IV.** Gingival health and relapse tendency in the present study and previous studies.

| Study | Observation period | Retainer type | Number of subjects | Plaque Index | Gingival Index | Irregularity Index | Fracture rate |
|---|---|---|---|---|---|---|---|
| Årtun et al.[10] | 3 years | Thick plain wire | 11 | 0.06 | 0.66 | 1.19 | 9.1 |
| | | Thick spiral wire | 13 | 0.10 | 0.49 | 0.36 | 30.8 |
| | | Thin spiral wire | 11 | 0.13 | 0.39 | 0.66 | 27.3 |
| Störmann and Ehmer[9] | 2 years | Thick wire | 34 | NA | NA | 80% | 53.0 |
| | | 0.0195 inch spiral wire | 38 | NA | NA | 0% | 29.0 |
| | | 0.0215 inch spiral wire | 31 | NA | NA | 20% | 18.0 |
| Booth et al.[11] | 20 years | Thick plain wire | 60 | NA | 0.58 | 2% >2mm | 25.0 |
| Present study | 1–3 years | 0.036 inch round wire | 31 | 1.02 | 1.19 | 3.08 | 13.0 |
| | | 0.015 inch spiral wire | 31 | 1.21 | 1.34 | 1.92 | 29.0 |

NA, Not available

(Table III). The distributions were significantly different ($p$ = 0.045)

## Discussion

Bonded lingual retainers are frequently used to retain the lower anterior teeth. These retainers are often fabricated from different types and gauges of wire and may be attached to all anterior teeth or only to the canines. The aims of this study were to compare the gingival health, plaque accumulation, tooth alignment and fracture rate of two designs of fixed retainers after both had been in use for at least a year. The underlying intentions were to determine if both retainers achieved what they were designed to do, i.e. retain alignment, determine if the gingival health was acceptable at recall or if early signs of periodontal breakdown were present. There were no statistically significant differences in oral hygiene, plaque retention or gingivitis. Multistrand wire retainers were more effective at retaining alignment of the lower incisors and were more likely to be lost than round wire, single span retainers. There was also significantly more plaque on the distal surfaces of the anterior teeth in the group with multistrand wire retainers, which suggests that long-term studies are needed.

Our findings that there were no differences between the PI and GI scores for both types of retainer agrees with Årtun and coworkers.[7,10] They reported that plaque was no more likely to accumulate on teeth adjacent to retainers made of multistrand wire than on the teeth adjacent to retainers made from a large diameter, round wire. However, the distribution of the plaque we found differs slightly from that reported by Årtun.[7] We found there was significantly more plaque on the distal surfaces, which suggest that interproximal cleaning was difficult because of the short spans of multistrand wire.[17] Årtun[7] reported that the PI scores for teeth bonded with round wire and multistrand wire retainers were generally higher in the inter-proximal areas than on the lingual surfaces, indicating that interproximal cleaning was difficult with both types of retainer. We found the GI of lingual surfaces was higher in the Multistrand wire group ($p$ = 0.053), which suggests that this surface also needs attention during tooth cleaning.

In agreement with Artun et al.,[10] we found that round wire retainers were less likely to maintain alignment of the anterior teeth than multistrand retainers bonded to all anterior teeth. The difference in irregularity was quite marked: fewer subjects in the Round wire group had an ideal alignment and 14 subjects (45 per cent) in the Round wire group had an unacceptable return of irregularity (IRI > 4 mm). This indicates that when the lower incisors are likely to relapse a multistrand wire retainer should be used.

Because only the ends of a large diameter, round wire retainer are bonded to the canines the incisors are free to move away from the wire.

The failure rate of retainers made of multistrand wire was 30 per cent compared with a failure rate of 13 per cent for the round wire retainers. Although this difference was not statistically significant, a debonded wire may be time-consuming to repair and if a tooth has moved out of position time-consuming retreatment will be required.[17] This finding agrees with Årtun et al.,[10] who reported failure rates of 27.3 per cent for multistrand wire retainers and 9.1 per cent for round wire retainers. Our finding of a higher failure rate for multistrand retainers may have occurred because the short spans in multistrand retainers are not flexible enough to allow the incisors to move independently under biting loads, whereas a round wire retainer, which attached at its ends, may be flexible enough to allow the canines to move under load.

Our failure rate for lower round wire retainers (13 per cent) is slightly higher than the 11.6 per cent reported by Zachrisson[4] and the 9.1 per cent reported by Årtun et al.[10] Our failure rate for the multistrand retainers (30 per cent) is also higher than the failure rates reported by Dahl and Zachrisson (20.6 per cent),[12] Årtun et al. (27.3 per cent)[10] and by Lumbesdun (23.2 per cent).[18] Comparisons between our results and previous studies are summarised in Table IV.[9–11] The differences in the failure rates between the various studies may be due to differences in the bonding materials and techniques used, the sizes and types of the wires, number of teeth bonded, the observation period and the patients' behaviours and habits.

## Conclusions

There was no difference between the gingival conditions of the lower anterior teeth retained with either a multistrand wire retainer or a single round wire retainer.

More plaque accumulated on the distal surfaces of the lower anterior teeth when a multistrand wire retainer was used as compared with a retainer made of round wire bonded to the canines only.

Multistrand wire retainers bonded to all lower anterior teeth were better at maintaining tooth alignment than single span, canine-to-canine retainers.

Although more multistrand wire retainers failed than round wire, single span retainers, the difference was not statistically significant.

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