Success and Failure of Banding and Bonding

A Clinical Study

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A clinical comparison of the frequency of cementation failure with orthodontic attachments secured to teeth by banding or bonding. Lowest failure rates were found with banding on buccal teeth and bonding on anterior teeth.

The orthodontic band has been in use for about a hundred years, but in spite of its widespread clinical acceptance, few studies have reported on the success or failure rate of band cementation during orthodontic treatment. Studies by Clark *et al.* in 1977[1] recorded a failure rate of 4%-5%, while the author subsequently reported failure rates ranging from 7% to 21% in 1977[2,3] and 1979.[4]

Since the first reported attempt by Sadler in 1958[6] to cement orthodontic brackets directly to the enamel surface, the direct bonding technique has developed to the extent that it is now a generally accepted means for attaching brackets to teeth for orthodontic treatment.

In contrast to banding, numerous studies have been published on direct bonding, demonstrating a wide range of success and failure rates. Comprehensive clinical studies have reported failure rates ranging from 11%[8] to 4%-30%.[5]

The failure rates that have been quoted in the literature for bands and directly bonded brackets generally represent the overall failure rates, which is the total number of bands or brackets that required recementation over a specific period of time. From the data available it is apparent that the overall failure rates for bands (4%-5%[1] to 21%[4]) and directly bonded brackets (4%-30%[5]) are similar.

The few studies that have reported on the failure rates occurring on individual teeth reveal interesting differences. Mizrahi[4] reported that with bands the highest failure rates occurred on maxillary incisors (13%-50%), while the lowest failure rates were recorded on maxillary and mandibular bicuspids and molars, and on mandibular incisors (1%-11%).

The studies of Zachrisson[8,9] and Newman[5] showed the highest failure rates for direct bonding on maxillary and mandibular molars and bicuspids (10%-30%), with the lowest failure rates on maxillary incisors and cuspids 4%-11%).

On the basis of this data, it would be reasonable to assume that the lowest overall incidence of failure could be achieved by selectively combining these two techniques.

In order to test the validity of this assumption, a study was undertaken to determine the overall failure rate and the failure rate on individual teeth when bands were cemented to bicuspids and molars and brackets bonded directly to cuspids and incisors.

Methods and Materials

The sample consisted of 100 consecutively completed cases treated with full fixed appliances using the Begg light wire technique. Stainless steel preformed seamless bands were cemented to all first permanent molars and first and second bicuspids. The cementing material and technique were the same as described for a prospective study reported previously by Mizrahi (Group 2).[4]

Begg light wire mesh-backed brackets were bonded directly to the maxillary and mandibular cuspids and incisors with a composite resin.*

Following cleaning and etching of the enamel surface with phosphoric acid solution, the resin was mixed according to the manufacturer's instructions and applied to the base of the bracket. An electrothermic tweezer as described by Vorster[7] was used to place the bracket and accelerate the setting of the resin. The heat generated within the bracket decreased the setting time of the resin so that as the bracket was released by the tweezer (3 seconds for mandibular incisor brackets and 5 seconds for the others), the resin had set hard.

All failures of either bands or brackets were recorded and repaired using the original technique. The data was processed and analyzed as described previously.[4]

Results

Overall Analysis

Details of sample size, mean age, sex distribution, the use of extraoral traction and the mean case duration are shown in Table 1.

The overall failure rate for the sample, which was the percentage of bands and brackets that required recementation, was 4.7%. This was significantly lower than 7% recorded in the prospective study by Mizrahi[4] using only bands ($x^2 = 12.71$ $p < 0.01$). The frequency of recementation is shown in Table 2.

* Commercial names of materials used may be obtained from the author.

Sex

As in previous studies, the failure rate was higher for males (5.5%) than for females (4.3%), but the difference was not statistically significant.

Extraoral Traction

Patients treated with extraoral traction showed a significantly higher failure rate (7.2%) than those without (4.0%), with $\chi^2 = 7.68$ and $p < 0.01$.

Individual Teeth

The Chi-square test indicated a significant relationship between individual teeth and band or bracket failure rate.

When the teeth were grouped by quadrants, there was no significant difference in the failure rate of bands or brackets cemented to teeth on the left or right side of the mouth. However, the failure rate was significantly higher on mandibular teeth than on maxillary teeth. The failure rate on each tooth in both the maxilla and mandible is shown in Fig. 1.

Comparison between the previously reported[4] failure rate of bands and that recorded in the present study showed no significant difference for molars and bicuspids taken together (3.7% 1979, 4.7% present study).

On the incisors and cuspids, the failure rate of the 4.6% recorded for directly bonded brackets in the present study was significantly lower than the 9.9% reported earlier[4] for bands on those teeth ($\chi^2 = 24.6$ $p < 0.001$).

TABLE 1

Details of Sample

No. of patients	100
No. of bands	882
No. of brackets	1194
Percentage of males	38%
Percentage of females	62%
Mean age (years) (S.D. 1.5 years)	12.6
Mean duration of treatment (months) (S.D. 5.4 months)	20.1
Percentage with EOT	21%

Discussion

Failure Rate

The significant drop that was found in the overall failure rate for bonded brackets and bands in the present study (4.7%) compared to 7% for bands alone in the prospective study[4] may be attributed to the use of directly bonded brackets, particularly on the maxillary cuspids and incisors.

When the teeth were grouped by quadrants, the present study showed a higher failure on the mandibular teeth than on the maxillary teeth, which was a reversal of the findings reported earlier (Group 2)[4] for bands alone. This reversal was also due largely to the marked reduction in the failure rate on the maxillary cuspids and incisors (Fig. 1).

When the incisors and cuspids were considered as a group, the failure rate

TABLE 2

Frequency of Recementation

	X1	*X2*	*X3*	*Total No. of Recementations*
No.	83	12	3	98
% of total	4.0	0.6	0.1	4.7
% of Recemented bands and brackets	84.7	12.2	3.1	100

for the directly bonded brackets (4.6%) was significantly lower ($\chi^2 = 24.6$ $p < 0.001$) than the failure rate for the bands reported in the earlier study[4] (9.9%).

The failure rate of the directly bonded brackets on maxillary cuspids and incisors (4.4%) is a great improvement over the 16% recorded for bands on a similar group of teeth[4] ($\chi^2 - 42.9$ $p < 0.001$). Mandibular cuspids and incisors showed no significant difference between the failure rates of bands and directly bonded brackets in the two studies (Fig. 1).

In view of the absence of a significant difference in failure rates between directly bonded brackets and bands on the mandibular cuspids and incisors, the effects of band thickness between teeth and the preference of the individual clinician would be the major considerations in the choice of technique.

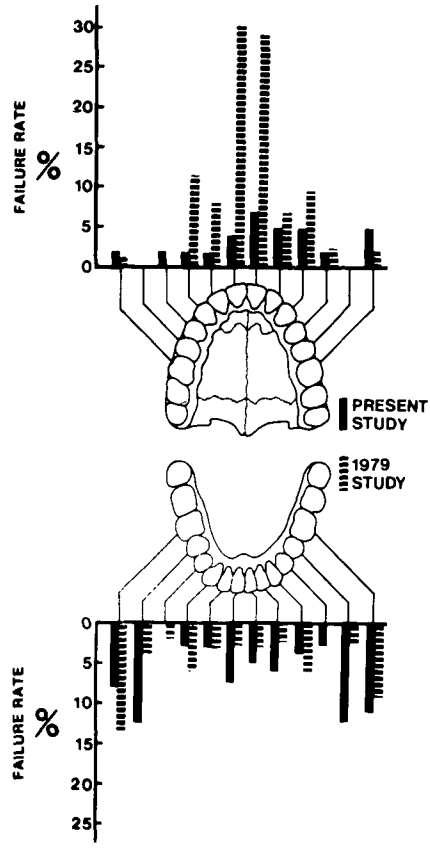

Fig. 1 Percentage failure rate on individual teeth, a comparison between the results of the present study and an earlier study using only bands.[4]

Frequency of Recementation

The frequency of recementation (Table 2) shows that of all bands and brackets recemented, the majority (84.7%) were recemented only once. This indicates that repeated failures on the same teeth were not common.

Sex

Male patients showed a statistically insignificant higher failure rate (5.5%, compared to 4.3% for females). The same patterns of sex differential, all of marginal or negligible statistical significance, were observed in earlier studies. In 1977 Mizrahi[3] recorded higher band failure rates for males than for females (23.1% vs. 20.1%). In 1979[4] it was reported that males showed higher band failure rates than females in 3 out of 4 groups studied.

Extraoral Traction

The failure rate on patients using extraoral traction was nearly double (7.2%) that recorded for patients without (4.0%). This ratio is similar to that reported in 1977[3] (34.4% vs. 18.1%).

Summary

A clinical study on the failure rate of 882 bands and 1194 directly bonded brackets placed on the teeth of 100 consecutively completed orthodontic

patients treated with the Begg light wire technique showed an overall adhesion failure rate of 4.7%. This was significantly lower than the 7% recorded in a comparable study by Mizrahi in 1979[4] using only bands.

The reduction was due primarily to a much lower failure rate of directly bonded brackets compared to bands on the maxillary cuspids and incisors.

These results indicate that the lowest attachment failure rate during orthodontic treatment can be achieved by using bands on molars and bicuspids, directly bonded brackets on maxillary cuspids and incisors, and either on lower anterior teeth.

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