Tissue Tolerance to Orthodontic Banding

A Study in Carbohydrate Metabolism

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An evaluation of gingival state one month after banding, showing a sensitivity to blood glucose levels.

One of the most perplexing questions in orthodontics is why seemingly similar patients, subjected to seemingly similar orthodontic treatment by the same orthodontist, often respond so differently. This paradox is an old one that has been expressed in many ways, such as the following from an orthodontic text.

The characteristic of living tissue to function under handicap within limited conditions may be termed tissue tolerance. Without tissue tolerance our orthodontic practice would not be possible. Of course, this attribute is a variant and differs with every individual. It is this variation of tissue tolerance that renders some of the hazards of orthodontic practice unpredictable. Thus, the incidence of root resorption, periodontal disturbance, and disturbances of the pulps of the teeth during treatment depends a great deal upon tissue tolerance. The reason for this difference in tissue tolerance cannot be explained. We simply do not know.[1]

The purpose of this study is to investigate one biochemical factor, blood glucose, which may either contribute to or help to predict differences in tissue tolerance. This has been accom-

plished through an analysis of the statistical relationship between periodontal repercussions of orthodontic banding and nonfasting blood glucose level.

Previous Study

An earlier investigation[2] evaluated the effect of multivitamin-trace mineral supplementation and orthodontic banding on clinical gingival state, clinical tooth mobility and labial debris. There appeared to be substantial differences between placebo and multivitamin-trace mineral groups under banded conditions, suggesting that those children receiving an orthodontic band and multivitamin-trace mineral supplementation fared better periodontally than those receiving a band and placebo supplement.

Method of Investigation

The patients selected for this program presented a variety of malocclusion types. All were selected from a waiting list in the Department of Orthodontics at the University of Alabama School of Dentistry. With only four exceptions, all were Caucasian. Full particulars regarding age and sex distribution have been reported earlier.[3,4]

State of gingival inflammation, clinical tooth mobility and labial debris were evaluated on a double-blind basis.

Inflammation of the gingivae surrounding the mandibular right and left lateral incisors was graded on a four-point scale in which 0 = no gingival inflammation, 1 = slight hyperemia, swelling and loss of stippling with no awareness on the part of the patient, 2 = moderate hyperemia, swelling and loss of gingival stippling with possible bleeding, tenderness or pain with pressure, and 3 = marked hyperemia, swelling, "spontaneous" bleeding and possible tenderness or ulceration. This scoring system is one of a number of available techniques, all of which possess some advantages and limitations. It was chosen because it is simple, lends itself to application by the private practitioner, and has been employed successfully by others in similar studies.

Mobility was graded on a four-point scale with 0 = none, 1 = slight, 2 = approximately one millimeter, and 3 = more than one millimeter of movement.

The method selected for scoring labial debris is a modification of the Greene-Vermillion index in which 0 = no debris or stain, 1 = soft debris covering not more than one third of the tooth surface, or extrinsic stains without other debris regardless of surface area covered, 2 = soft debris covering more than one third but not more than two thirds of the exposed tooth surface, and 3 = soft debris covering more than two thirds of the exposed surfaces.

The distribution of the scores for gingival condition, tooth mobility, and labial debris has been described previously.[3,4]

Of about twenty biochemical tests performed on these subjects at the initial and final visits, only the nonfasting blood glucose values will be reported here.

Table 1 shows the nonfasting blood glucose distribution. A range from 60 to 100 milligrams percent is usually regarded as normal. On that basis, 0.7% of the subjects would be considered hypoglycemic and 7.2% hyperglycemic. If one adopts the somewhat narrower range of 70 to 90 milligrams percent as normal, then 2.1% of the subjects would be classified as hypoglycemic and 30.9% hyperglycemic.

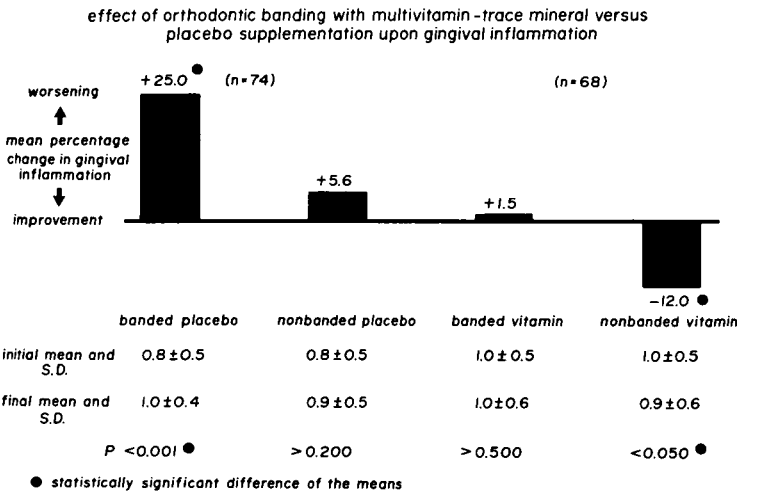

Fig. 1 The effect on gingival state of orthodontic banding with and without multivitamin-trace mineral supplementation. Particular attention is directed to the banded placebo group, which shows a mean worsening of 0.2, or 25% of the initial 0.8 score.

TABLE 1
Nonfasting Blood Glucose Distribution

blood glucose groups (mg%)	*percentage of subjects*
<60	0.7
60-69	1.4
70-79	20.9
80-89	46.0
90-99	23.7
100+	7.2

On a random basis, either the mandibular right or left lateral incisor was banded. This eliminated the possibility of superimposing the effects of banding the adjacent tooth on the tooth used as a control.

At the initial visit, the teeth were scored as described, and a band of .003″ × .125″ (.08 × 3.2 mm) stainless steel constructed for the selected mandibular lateral incisor to fit approximately one millimeter subgingivally on the mesial and distal sides. A twin-tie bracket was welded to the labial surface of the band, which was then cemented to the tooth with zinc phosphate cement.

At the conclusion of the initial visit, each subject was given a supply of outwardly identical capsules of either a multivitamin-trace mineral or a placebo, to be taken daily through the course of the experiment.

At the second visit one month later, the clinical assessment was repeated, the band removed, the tooth cleaned, and the subject and parent instructed in oral hygiene.

Results

Earlier reports[2,4] showed the changes in gingival state, clinical tooth mobility, and labial debris which followed banding versus non-banding with and without multivitamin-trace mineral supplementation (Fig. 1). Particular attention is di-

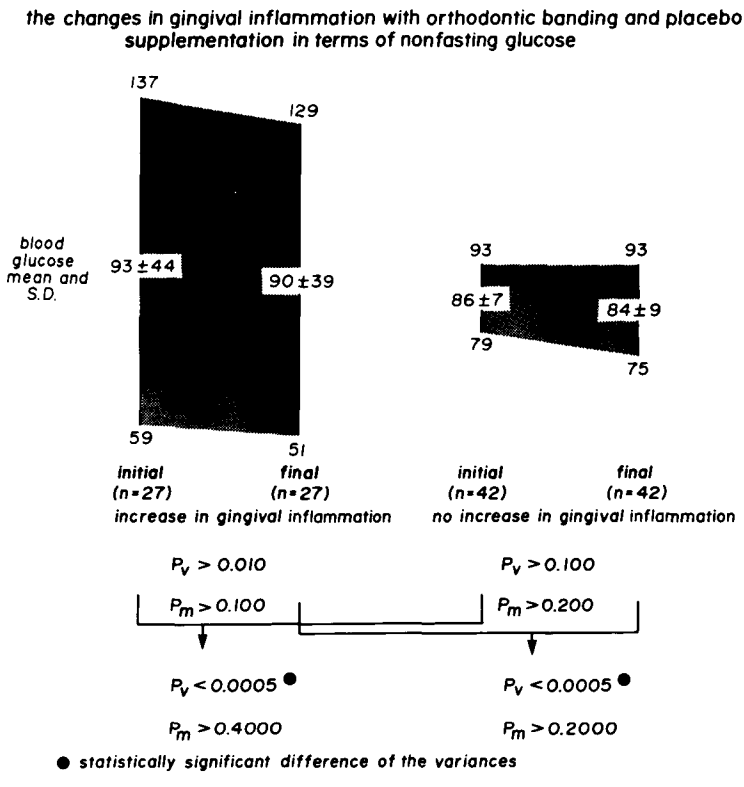

Fig. 2 The changes in gingival state with orthodontic banding and placebo supplementation related to nonfasting blood glucose. Note that the initial and final values for each group are very similar. There is a statistically significant variance difference between the group which worsened versus the group which did not, suggesting greater dysglycemia in those subjects showing an unfavorable gingival response to orthodontic banding.

rected to the banded placebo group, which showed a mean worsening of 0.25 (25%, uncorrected) in their score.

All percentage changes (mean worsening) are calculated on the mean score, without correction for the full range of the scale of scores. This yields a higher percentage of change with low mean scores.

In the group of 74 subjects shown in Fig. 1, 29 (39%) worsened, 36 (49%) demonstrated no change and 9 (12%) improved. The range of blood glucose levels in these two groups at the initial and final visit in relation to the gingival response is outlined in Fig. 2. Initial and final mean blood glucose values showed little change within the two groups. The range of blood glucose values was broader in the group with gingival worsening than in the nonworsening group, suggesting that those subjects responding unfavorably to orthodontic banding are more dysglycemic, either hyper- or hypoglycemic.

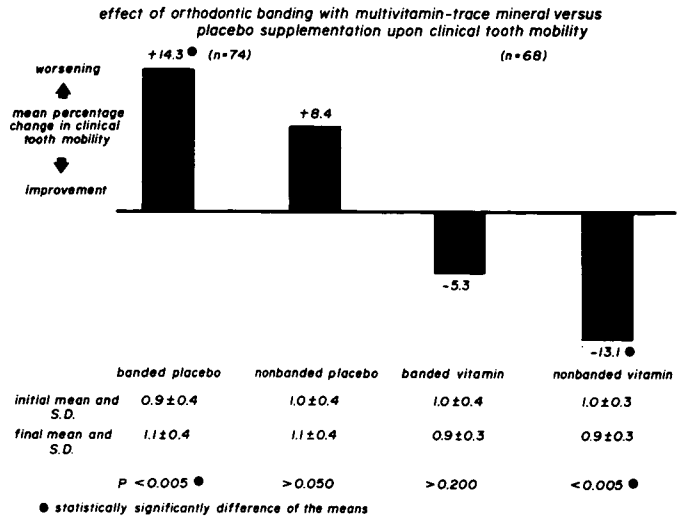

Fig. 3 The effect of orthodontic banding with and without multivitamin-trace mineral supplementation on clinical tooth mobility. Note the banded placebo group, which shows a mean worsening of 0.2.

The same earlier reports[2-4] showed changes in clinical tooth mobility following banding versus nonbanding, with and without multivitamin-trace mineral supplementation (Fig. 3). Here the banded placebo group showed a mean worsening of approximately 14% (increase in score from 0.9 to 1.1). In that group of 70 subjects, 18 (26%) worsened, 47 (67%) were unchanged, and 5 (7%) improved.

Blood glucose levels are related to clinical tooth mobility in Fig. 4. Initial and final blood glucose levels within groups are again very similar, while they cover a broader range in the group with increased clinical tooth mobility. This also suggests that those subjects responding unfavorably to orthodontic banding tend to be more dysglycemic.

Labial debris findings from the same study are summarized in Fig. 5. The banded placebo group showed a mean worsening of 0.6, which is a 28% increase over the original score of 2.1. In this group, 40% worsened, 26% were unchanged, and 34% improved.

Blood glucose levels in relation to labial debris are shown in Fig. 6. Mean blood glucose values increased slightly but significantly in the group showing an increase in labial debris with orthodontic banding, while they remained similar in the group with no increase in debris. It should be noted that this is at variance with the findings for gingival inflammation and clinical tooth mobility.

Initial and final blood glucose values are much broader in the group with increased labial debris, which is consistent with the findings for the other two clinical parameters. This again suggests that those subjects responding unfavorably to orthodontic banding in terms of labial debris tend to be more dysglycemic.

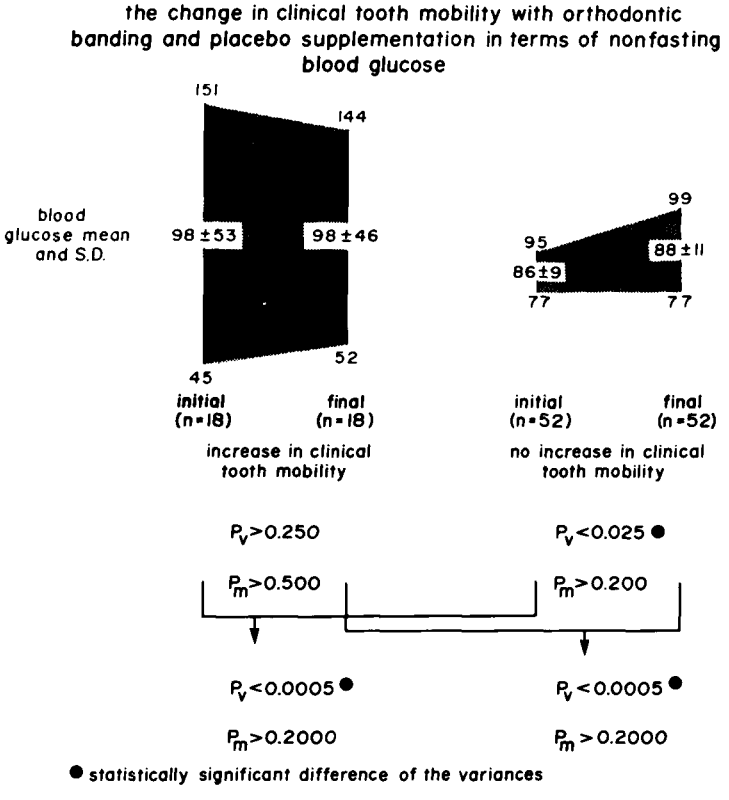

Fig. 4 The changes in clinical tooth mobility with orthodontic banding and placebo supplementation, in terms of nonfasting blood glucose. The initial and final values for each group are very similar, with a statistically significant variance between the group which worsened versus the group which did not. This suggests greater dysglycemia in those showing an increase in mobility following orthodontic banding.

Discussion

These data demonstrate that the variability of therapeutic response by patients, sometimes referred to as tissue tolerance,[1] may be related to blood glucose levels. The subjects who showed no worsening following orthodontic banding, demonstrating good tissue tolerance, showed glucose values closely grouped about the mean, which showed no significant change during therapy.

On the other hand, those who worsened following band placement showed blood glucose levels widely dispersed around the mean both before and after the period with the band in place.

The question is whether it is possible to predict which subjects will worsen, which will remain the same, and which will improve after banding. These data suggest that blood glucose level may serve as a predictor of patient response.

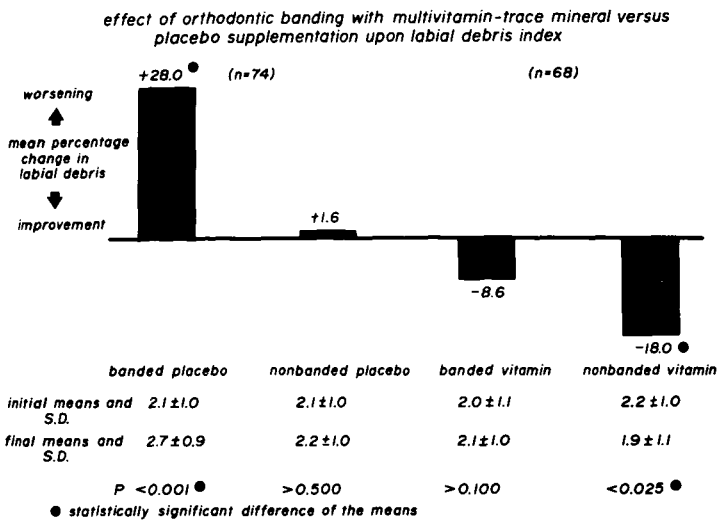

Fig. 5 The effect of orthodontic banding with and without multivitamin-trace mineral supplementation on labial debris. The banded placebo group shows a mean worsening of 0.6, or 28% of the initial score of 2.1.

The concept of predicting clinical response by the assessment of blood glucose variability or glucose homeostasis has been repeatedly documented in the medical and dental literature by the authors. In each instance the health of the oral or extraoral parameter being assessed varied in a direct manner with an estimate of blood glucose homeostasis. High or low glucose values were always associated with a worsening of the parameter being assessed, while values near the mean were repeatedly associated with improvement.[5-54] Parameters considered in that series of papers included gingival pathosis, tooth mobility, alveolar bone loss, dry mouth, burning mouth, gingival tenderness, tooth loss, dry socket, painful teeth, physical activity, psychologic state, electrocardiographic components, blood pressure, furunculosis, and carcinomatosis.

The consistency of those results should come as no surprise, since a reduced glucose tolerance involves every system in the body. A partial listing in alphabetical order includes addictions, aging, atherosclerosis and arteriosclerosis, cancer, congenital malformations or anomalies, coronary heart disease, delayed wound healing, drug suppression of ovulation, eye disorders, gout, hyperlipemias, hypertension, hyperthyroidism, infectious disorders, liver disease, mental retardation, multiple sclerosis, obesity, osteoporosis, peptic ulcer, pregnancy, psychologic disorders, pulmonary emphysema, renal failure, skin disorders, sterility, and tic douloureux.[46,55]

All of this evidence points toward a prognostic role for blood glucose variability or homeostasis in the assessment of the tolerance of cells, tissues, organs and body systems.

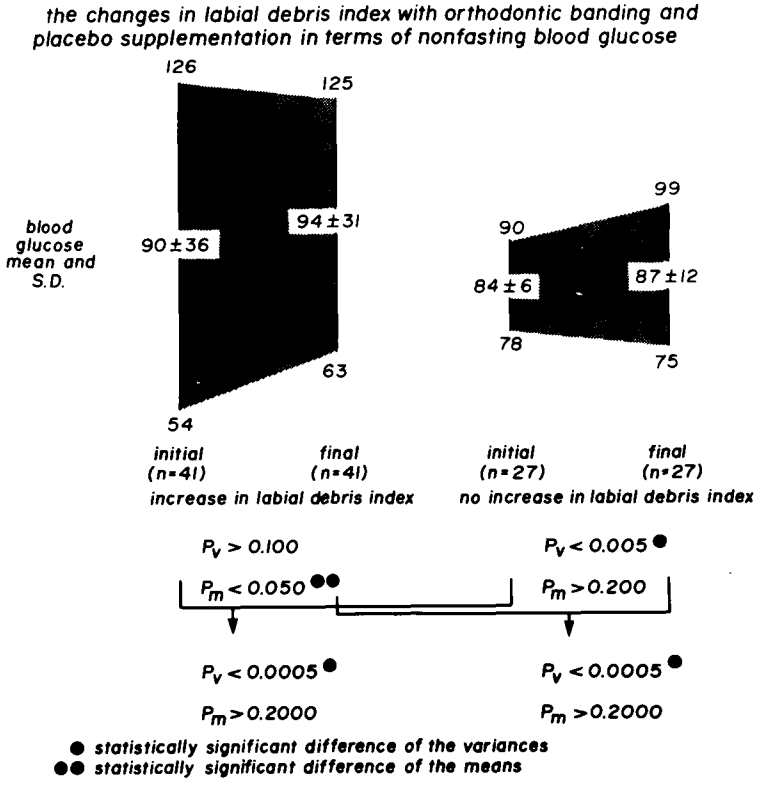

Fig. 6 The change in labial debris with orthodontic banding and placebo supplementation related to nonfasting blood glucose. There is a statistically significant variance between the group which worsened versus the group which did not, suggesting greater dysglycemia in those showing an increase in labial debris following orthodontic banding.

Summary

Tissue tolerance to orthodontic banding was determined in a group of children in the Department of Orthodontics at the University of Alabama School of Dentistry.

Nonfasting blood glucose and three oral parameters—gingival state, clinical tooth mobility and labial debris—were determined before banding a mandibular lateral incisor and again one month later. Each subject received a multivitamin-trace mineral supplement or an indistinguishable placebo during that month.

In the placebo group, statistically significant blood glucose variability (variance) was found in those whose periodontal state was made worse by the orthodontic band. However, a very homeostatic pattern of blood glucose values was displayed by those whose gingival state, tooth mobility, and labial debris improved or remained the same in the presence of the band.

Thus, blood glucose variability or homeostasis is one possible way to predict or measure the elusive factor that has been called tissue tolerance.

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