Scoring Patient Hygiene Performance by Observation of Selected Tooth Surfaces

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AS THE EMPHASIS in dental treatment moves from restoration to prevention, procedures for assessing oral hygiene levels become increasingly important. Ramfjord (*1*), Greene and Vermillion (*2, 3*), and O'Leary and associates (*4*) have developed methods for measuring periodontal disease and oral hygiene. Podshadley and Haley originated the patient hygiene performance (PHP) method; they reported that it is reliable, sensitive, and simple to administer (*5*). This method is intended not only for the dental practitioner, but also for use in public health surveys and research.

Two problems are encountered, however, in determining any oral hygiene index for a large number of adults. First, since examining the surfaces of all teeth requires too much time, the index must be calculated from only a sample of surfaces. Procedures for drawing a statistically reliable sample have not been outlined in the literature. Second, the teeth included in the sample, and on which the index is based, are missing in many patients. A method to overcome these problems has not been devised.

To help future investigators draw better samples, we determined statistically the groups of tooth surfaces of adults that had similar degrees of cleanliness as measured by the PHP method. The surfaces selected from these groups will contribute a substantial amount of information to the assessment of total oral hygiene. We also identified statistically equivalent substitutes for these surfaces in each group.

Measurement of Oral Hygiene

The amount of oral debris present on tooth surfaces determines the patient hygiene performance (PHP) score (*5*). The patient is given an erythrosine disclosing wafer, which stains the oral debris. The debris on each surface is assessed by dividing the tooth into five sections. The clinical crown is divided longitudinally into mesial, middle, and distal thirds. The middle third is further subdivided into thirds, which are described as gingival, middle, and occlusal.

Each division is examined for oral debris. If none is present, 0 is assigned to that section; if debris is present, 1 is assigned. The value of 1 is assigned only to those areas showing definite debris. The score used in our study was the sum of all five divisions for each tooth surface. It could range from 0 to 5 for any single surface.

Eighty adult patients were examined by one person, and their oral hygiene was scored according to the PHP method. The oral hygiene examinations were conducted before the patients were instructed in oral hygiene. Observations were made of the facial and lingual surfaces of 14 upper and 14 lower teeth. All third molars were excluded.

Statistical Analysis

The PHP scores for the 56 surfaces were correlated for the 80 patients. Each correlation indicated how well a patient's PHP score on one surface could be predicted from his PHP score on another. Since many patients had missing teeth, a program that determined a correlation table from incomplete data was used. From 60 to 79 patients were available for determining a particular correlation coefficient.

A cluster analysis (*6*) was performed on the correlations of the 56 surfaces. The goal of this

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analysis was to form, statistically, groups of clusters of at least three surfaces. Surfaces which correlated at a level of 0.50 or more with each other were grouped together to form a cluster. Thus, in our study, correlations between tooth surfaces within a cluster all exceeded 0.50. As many surfaces as possible were included in each cluster. We hoped that each of the 56 surfaces would belong to only one cluster.

A high PHP score for a patient on one surface of a cluster means that if the other cluster surfaces were examined, they would probably also yield a high score. Conversely, a low PHP score for a patient on one surface of a cluster would lead us to predict that the other surfaces in the cluster would also have a low score.

Some surfaces did not qualify for full membership in any cluster. We related these surfaces to the cluster with which they had the greatest number of surface correlations exceeding 0.50; all related surfaces had at least two such correlations.

Results

The eight clusters shown in figures 1–8 were determined by the cluster analysis. Shaded areas indicate the member surfaces; striped areas, the related surfaces. Of the 56 surfaces represented, 42 (75 percent) were members of one of the eight clusters. The remaining 14 surfaces were related to one of the eight clusters.

Cluster 1. Maxillary and mandibular facial surfaces. Cluster 1 is the largest cluster (fig. 1). It has

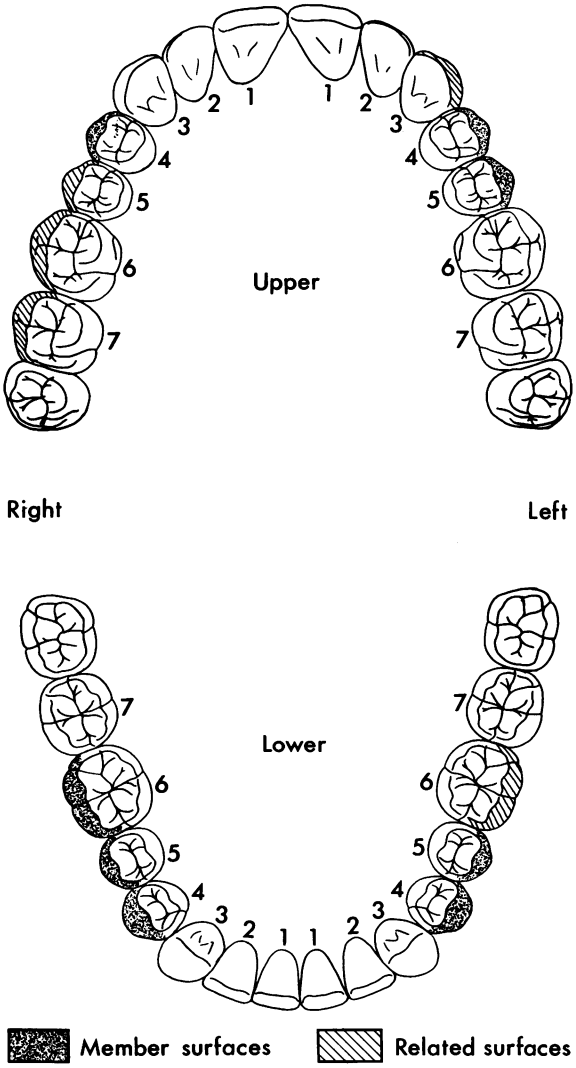

Figure 1. Maxillary and mandibular facial surfaces (cluster 1)

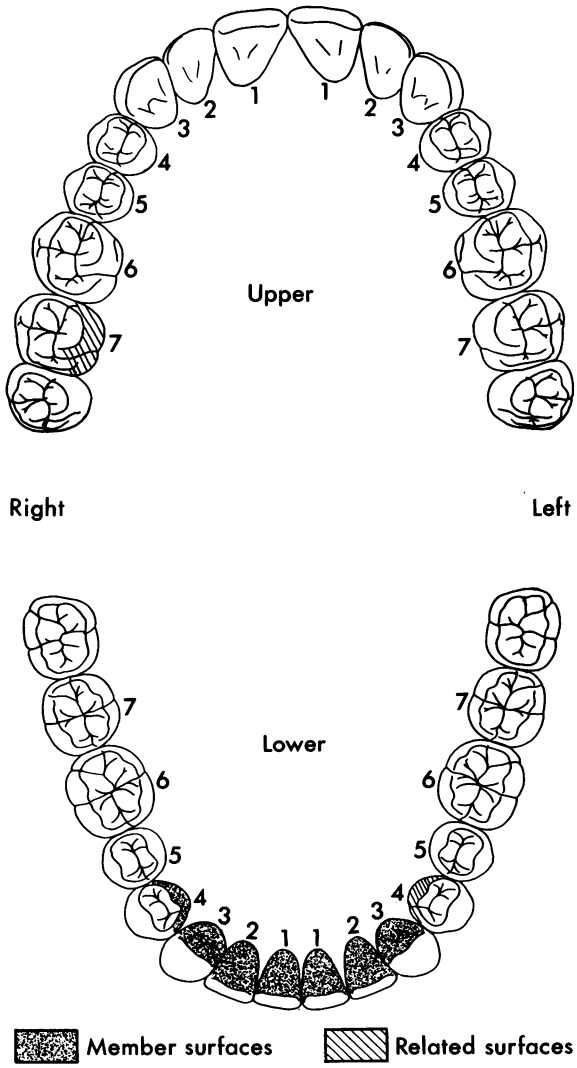

Figure 2. Anterior mandibular lingual surfaces (cluster 2)

eight member surfaces and five related ones. Only facial surfaces belong to this cluster, but both upper and lower surfaces are represented. Seven of the eight members of the cluster are surfaces of premolars. The median correlation between all cluster members is 0.57.

Cluster 2. Anterior mandibular lingual surfaces. Cluster 2 is the second largest cluster (fig. 2), with seven member surfaces and two related surfaces. Members of the cluster are anterior lower lingual surfaces. Their median correlation is 0.80. Two other lingual surfaces are related to the cluster.

Cluster 3. Maxillary lingual surfaces. Cluster 3 has five member surfaces and two related ones (fig. 3). The median correlation between cluster members is 0.69. Four of the five member surfaces are on the left side of the dental arch, as is one of the related surfaces. All member surfaces and related surfaces are upper lingual.

Cluster 4. Posterior mandibular lingual surfaces. The five members of the fourth cluster are lingual surfaces of posterior mandibular teeth from both sides of the dental arch (fig. 4). Their median correlation is 0.61. The one related surface is also posterior lower lingual.

Cluster 5. Anterior maxillary lingual surfaces. The five members of cluster 5 are lingual surfaces of anterior maxillary teeth (fig. 5), which have a median correlation of 0.69. The one related surface is also an upper lingual surface.

Cluster 6. Anterior mandibular facial surfaces. All five members of cluster 6 and the one related

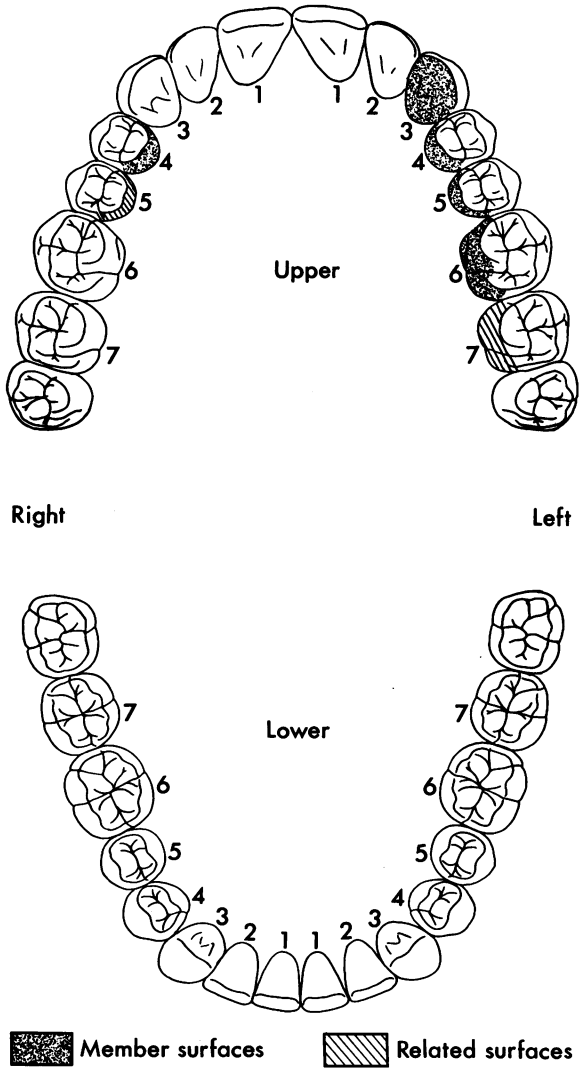

Figure 3. Maxillary lingual surfaces (cluster 3)

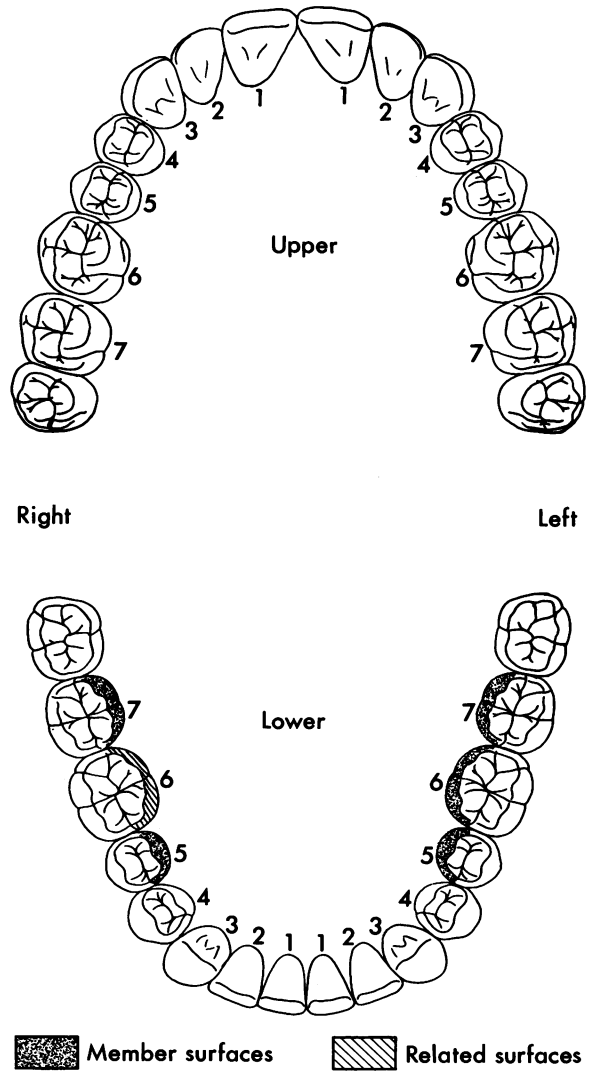

Figure 4. Posterior mandibular lingual surfaces (cluster 4)

surface are facial surfaces of lower incisors and cuspids (fig. 6). The median correlation between cluster members is 0.72.

Cluster 7. Anterior maxillary facial surfaces. There are four member surfaces in cluster 7 and one related surface (fig. 7). They are facial surfaces of maxillary incisors and a cuspid. The median correlation between cluster members is 0.72.

Cluster 8. Posterior maxillary and mandibular facial surfaces. The eighth cluster is the smallest (fig. 8). The three member surfaces and the one related surface are facial surfaces of upper and lower molars. The median correlation between cluster members is 0.59.

These eight clusters range over the entire mouth and are relatively independent of one another. Only two of the 42 member surfaces qualified for membership in more than one cluster; each of these two surfaces, however, is depicted only in the figure that illustrates the cluster in which it forms the simplest and most symmetric pattern. The facial surface of the mandibular right cuspid could be placed in clusters 1 and 2 as well as in the one in which it is included, cluster 6. Also, the lingual surface of the first mandibular right bicuspid could be a member of cluster 4 as well as of cluster 2.

For the group of patients studied, the lingual and facial surfaces of the teeth were independent of one another in regard to oral hygiene. Upper and lower surfaces also belonged to different clusters with the exception of the posterior facial surfaces that comprised clusters 1 and 8. There was also a trend for

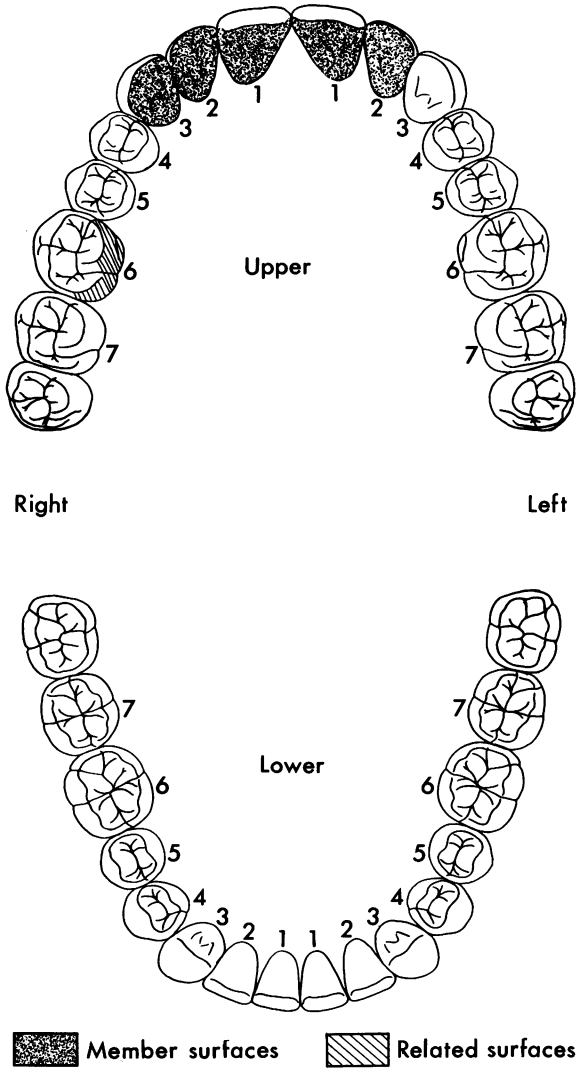

Figure 5. Anterior maxillary lingual surfaces (cluster 5)

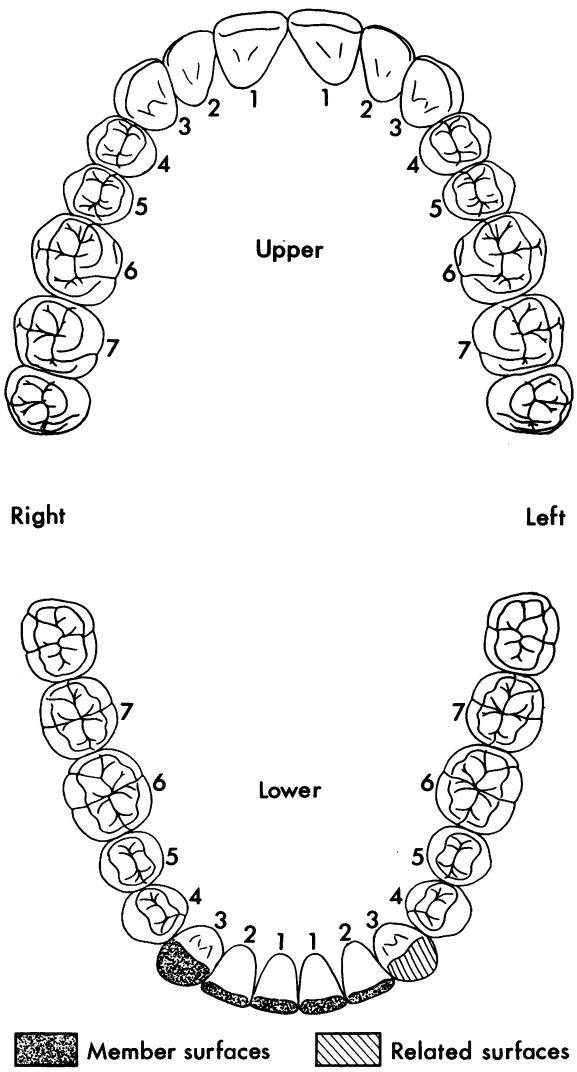

Figure 6. Anterior mandibular facial surfaces (cluster 6)

anterior and posterior surfaces to cluster, although this trend was broken somewhat by clusters 1 and 3.

The median correlations between cluster members range from 0.57 to 0.80. The median of these median correlations is 0.69, which is substantial. The predictability from one member of a cluster to another is sufficient to make an examination of more than one surface in each cluster redundant in any large study or survey.

Implications of the Cluster Analysis

In 1959, Ramfjord (*1*) developed a quantitative method for scoring periodontal disease and related conditions. As indicators of the periodontal condition of the whole mouth, he chose six teeth which were located in six logical divisions of the dentition; he based his selection on previously published data and on his own clinical experience. Ramfjord examined the lingual and facial surfaces of each of these teeth, a total of 12 observations. Our cluster selections were made by an entirely different method, and yet, except for cluster 8, the smallest one, each cluster is represented by one or more of the 12 surfaces selected by Ramfjord.

Greene and Vermillion (*2*) based their oral hygiene index on numerical determinations from six areas of the mouth. The upper and lower dental arches were divided into three segments each: one segment posterior to the right cuspid, another posterior to the left cuspid, and an anterior segment including both the right and left cuspids. Both lingual and facial surfaces of all teeth were examined, but

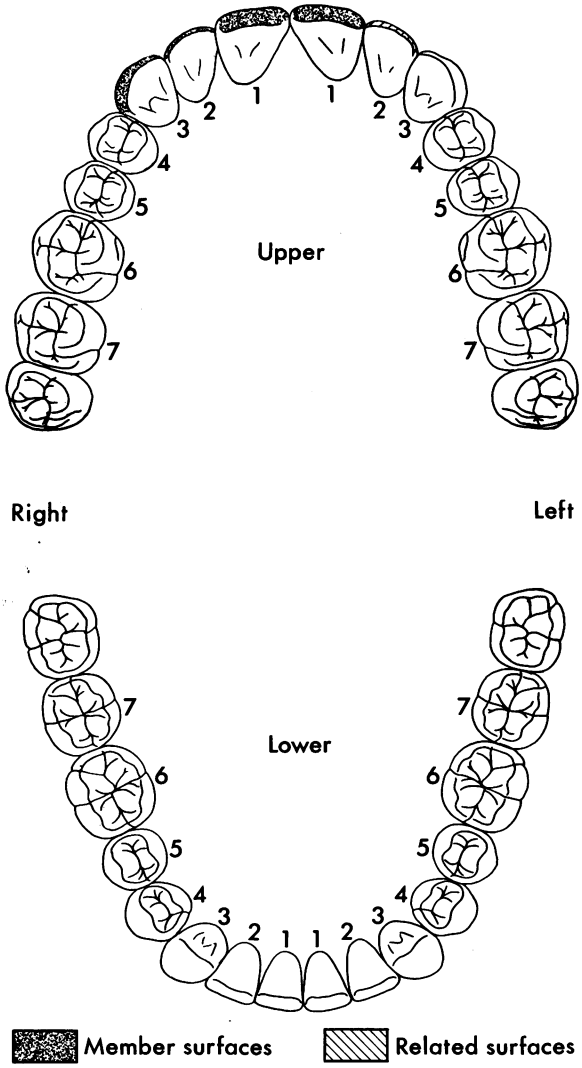

Figure 7. Anterior maxillary facial surfaces (cluster 7)

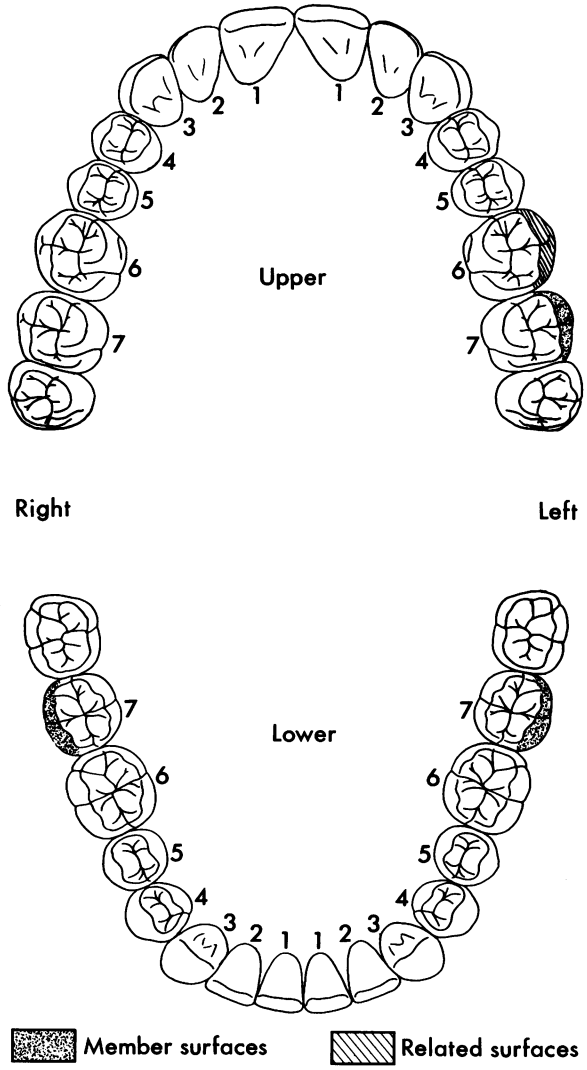

Figure 8. Posterior maxillary and mandibular facial surfaces (cluster 8)

only the highest lingual and facial scores in each segment were recorded, thus giving 12 measurements. Our study indicates that a balanced examination of lingual and facial surfaces of upper and lower teeth is justified, but the statistical analysis in our study shows that only eight observations are necessary for a reliable evaluation of total oral hygiene.

In their simplified oral hygiene index, Greene and Vermillion (*3*) scored six tooth surfaces—two surfaces from our cluster 4 and one surface each from clusters 1, 6, 7, and 8. Podshadley and Haley (*5*) examined the same six surfaces. In both studies, substitute surfaces were suggested in case surfaces were missing or in poor condition; the substitutes were from the same clusters as the surface selected first. One-third of the sample chosen in each study consists of lower lingual surfaces; no observations were made from the areas of the mouth represented by our clusters 2, 3, and 5. In light of the statistical findings of the study reported here, such a surface selection seems to be too limited.

The clusters we have presented should be more reliable and helpful to any researcher or practitioner who wants to assess the oral hygiene of a group by less than a full-mouth examination. Examination of one member surface from each of the eight clusters should yield a sufficiently representative picture of an adult's oral hygiene for public health surveys. Each surface examined according to this system would contribute a substantial amount of unique information to the total assessment. In addition, if the tooth surface usually examined is missing in a particular subject, any other member surface from the same cluster could be substituted. Thus, persons with many missing teeth would not necessarily be excluded from a research project or a public health survey.

If less than eight surfaces are to be examined, surfaces from the largest clusters should be included in the sample. This strategy would provide the most information, per surface examined, about the patient's oral hygiene. Of course, if the investigation is focused on a particular area of the mouth to the exclusion of other regions, several surfaces from the same cluster, or clusters, should be examined. This sampling would give a more reliable picture of that area than examination of one surface from several clusters but, of course, the picture would not show the total oral hygiene status of the patient.

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Two problems are encountered in calculating an oral hygiene index for adults. First, since examination of the surfaces of all teeth requires too much time, the index must be calculated from only a sample of surfaces. Second, the teeth included in the sample on which the index is based are missing in many patients. In this investigation, the best surfaces to include in a sample, as well as statistically equivalent surfaces which could substitute, were determined statistically.

The oral hygiene of 80 adult patients was examined by the PHP (patient hygiene performance) method of Podshadley and Haley. Measurements were made of the facial and lingual surfaces of 14 upper and 14 lower teeth. These 56 measurements were then correlated and a cluster analysis performed on the correlations.

Eight clusters were thereby identified. In decreasing order of size, they are:

1. Maxillary and mandibular facial surfaces
2. Anterior mandibular lingual surfaces
3. Maxillary lingual surfaces
4. Posterior mandibular lingual surfaces
5. Anterior maxillary lingual surfaces
6. Anterior mandibular facial surfaces
7. Anterior maxillary facial surfaces
8. Posterior maxillary and mandibular facial surfaces.

To obtain a complete picture of a person's oral hygiene, one surface from each cluster should be examined.