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A Collaborative Research Study To Investigate The Relationship Between Size Of Interlabial Gap And Long Term Dental Status In An Anterior Open Bite Population

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INTRODUCTION

The following pilot study was the initial attempt of the International Association of Orofacial Myology to gather research data in a systematic manner from member clinicians across the United States. It is published here because of its pioneering nature and because the lessons learned and barriers encountered in conducting it should be helpful to investigators pursuing similar ventures in the future.

INVESTIGATORS

The prinicpal investigators for this study were Diana Nelson and Allen Nelson. Coinvestigators who collected data for the study were Sandra Coulson, Marv Hanson, Anita Weinfield, Sylvia Zante, and Christine Zovnic.

STUDY BACKGROUND

This project was designed as a short term project which would allow for a collaborative research effort to be undertaken by members of the I.A.O.M. Research Committee. Orientation and training for the project took place during the June 1990 I.A.O.M. meeting. Reliability testing and training also took place at that time.

HYPOTHESIS

The project was designed to test the following hypothesis:

There is no significant relationship between the size of interlabial gap and long term dental status in an anterior open bite population.

CONCEPTUAL FRAMEWORK

The theoretical basis for this study rested largely in the experience of several professionals in the field of Orofacial Myology who questioned how the spacing of an individual's lips might influence that individual's long term dental stability following orthodontic treatment. A general feeling existed that if the lips are kept abnormally apart, that the success of long term dental status might be compromised. The conceptual framework was not specifically literature based, but based on widespread clinical observations.

SAMPLING

The original study design called for a total of 150 subjects between the ages of 15 and 21 years of age. Of this total, 75 were to be male and 75 female. Subjects were to have begun orthodontic treatment with an interdental gap of at least 2mm.

Numerous changes were made during the course of data collection due to a combination of investigator dropout, difficulty in finding cooperating orthodontists, and problems in locating appropriate subjects. These adjustments included expansion of the age range for subjects and the dropping of the 2mm criteria. The final sample consisted of a total of 23 subjects, of which 6 were male and 17 were female. Subject age ranged from 8 years to 43 years. It became clear that this study would be classified as an exploratory pilot study rather than the type of project it was intended to be.

PROCEDURES

The study was designed as a collaborative endeavor. Participants were to contact one or more orthodontists with whom they had a working relationship in order to identify subjects and collect data from dental models as well as from the individual subjects themselves. Three measurements of interdental gap were taken of dental models prior to treatment, following treatment, and a followup two to five years post-treatment. Measurements of the interlabial gap were also taken corresponding to the followup time.

DEFINITIONS AND MEASUREMENT

Long term dental status is defined as the difference between the measurements of post-treatment and post retention interdental gap taken from dental models.

Interdental gap is defined as the vertical distance in mm between the maxillary incisors and the mandibular incisors.

Measurement of interdental gap with openbite (pre-treatment model)

The measurement of interdental gap when openbite is present was taken as the distance from the midpoint of the maxillary incisal edge to the mandibular incisal edge at a point directly below in a vertical plane. NOTE: Distance is generally reported as a positive measurement. The measurement was taken at between four upper and lower incisors and averaged. Measurements in millimeters were taken using a clear ruler.

Measurement of interdental gap with overbite in post-treatment models

The measurement of interdental gap when overbite is present was taken as the vertical distance in mm from the mandibular incisal edge to the point where the maxillary incisor midpoint extended over the mandibular teeth while in posterior occlusion.

Interlabial gap is defined as the vertical distance between the most inferior portion of the upper lip and the most superior portion of the lower lip when the posterior teeth are brought into gentle (light) contact. The lips and other orofacial muscles should be as relaxed as possible.

The measurement of the interlabal gap was taken as the distance in mm from the point where the midline of the philtrum intersects the inferior portion of the upper lip to where a vertical line intersects the most superior portion of the lower lip.

Relaxed vermillion distance is defined as the vertical distance between the most superior portion of the upper lip vermillion and most inferior portion of the lower lip vermillion.

The measurement of resting vermillion distance is taken as the distance in millimeters between the most superior upper lip vermillion and most inferior portion of the lower lip vermillion.

DATA ANALYSIS

For each subject a value was computed for each of the three interdental gap measurement times. For each time, the value was the average of the distance measured at between the right lateral, right central, left central, and left lateral incisors. The measure of long term dental status was then taken as representative of the difference between the average interdental gap at time T2, following orthodontic treatment, and time T3, two to five years post-treatment. The specific outcome measures were as follows.

Outcome 1 - a direct numerical value computed as the average distance between the T3 and T2 measures. (CHANGE 23 = AVGD3-AVGD2).

Table 1 — Description of Sample Characteristics

Sex —	Male	26.1%
	Female	73.9%
Class of Occlusion —	Class I	44.4%
	Class II	44.4%
	Class III	11.1%
Mean Age —		19.9 years
Type of Treatment —	Elastic	33.3%
	Archwire	38.9%
	Both	27.8%
Palatal Expansion Used —	Yes	22.2%
	No	75.2%
	With Surgery	5.6%
Tongue Resting Location —	Between Teeth	22.2%
	Inbetween Teeth	5.6%
	Against Upper	44.4%
	Against Lower	16.7%
	None of above	11.1%
Breathing with Lips Closed —	Yes	52.9%
	No	47.1%
History of Digit Sucking —	No	40.0%
	Yes	60.0%

Outcome 2 - a categorical definition of change in dental status based on a criteria of .5 mm change (CHNGCAT1 = 0 if less than .5 mm or 1 if .5 mm or greater).

Outcome 3 - a categorical definition of change in dental status based on a criteria of 1.0 mm change (CHNGCAT2 = 0 if less than 1.0 mm or 1 if 1 mm or greater).

An additional measure of "relaxed vermillion distance" was taken as the distance between the most superior portion of the upper lip vermillion and the most inferior portion of the lower lip vermillion.

Tests of association were used to test the relation between the change in dental status and interlabial gap.

RESULTS

DEMOGRAPHIC SUMMARY

The characteristics of the study sample are described in Table 1.

DESCRIPTIVE STATISTICS ON STUDY VARIABLES

The descriptive statistics for the study variables are reported in Table 2.

Table 2 — Descriptive Statistics

Resting Vermillion Distance	19.3	3.9
Interlabial Gap	4.2	2.7
Avg Interdental Gap at T1	2.6	1.2
Avg Interdental Gap at T2	−1.4	1.2
Avg Interdental Gap at T3	0.1	1.6
Long Term Dental Status		
Avg Change from T2 to T3	1.5	2.1

MEASURES OF RELATION

The Pearson Correlation Coefficient was computed between the direct measure of long term dental status (CHANGE23) and the measure of interlabial gap (ILG). A non-significant correlation of .28 was found.

The statistical relation between the categorized measures of long term dental status (CHNGCAT1 and CHNGCAT2) was tested through the use of a one way analysis of variance. In the analysis, CHNGCAT1 and CHNGCAT2 were treated as the independent variables and ILG treated as the dependent variable. In both tests, higher average values for ILG were found to be associated with the group which met the criteria for change in dental status. However, the differences were not statistically significant at or below the .05 level of probability.

An analysis of variance was also used to test differences in change in dental status by investigator. The average change broken down by investigator ranged from a low of -.08 mm to a high of 4.8 mm. The differences were statistically significant below the .001 level of probability. A comparison of these means is shown in Table 3.

Table 3 — Comparison of Mean IDG Change by Investigator

	Mean Change in Interdental Gap
Investigator 1	4.83 mm
Investigator 2	- .24 mm
Investigator 3	1.40 mm
Investigator 4	- .08 mm
Investigator 5	.69 mm

* Differences in means significant below .001 probability level

SUPPLEMENTAL ANALYSIS

Supplemental analysis of variance was run to test any differences in long term dental status which might appear to be related to the variables of tongue resting location and to airway obstruction. The results are summarized below in Tables 4 and 5.

Table 4
Comparison of Mean IDG Change by Tongue Resting Location

	Mean Change in Interdental Gap
Between Teeth	5.28 mm
Inbetween Teeth	1.50 mm
Against Uppers	1.36 mm
Against Lowers	.52 mm
None of Above	.00 mm

* Differences in means significant below .001 probability level

Table 5
Comparison of Mean IDG Change by Airway Obstruction

	Mean Change in Interdental Gap
Breathe with lips closed	.93 mm
Cannot breathe with lips closed	3.36 mm

* Differences in means significant at .01 probability level

INTERPRETATION

In terms of the direct and expected findings, the data fail to reject the null hypothesis of no relation between change in long term dental status and the size of interlabial gap. The numbers actually point in a direction that might suggest such a relationship; however, the tests of statistical significance are not significant. Were the sample size closer to originally anticipated, one might have seen different results. Based on an inspection of data from different sources, the investigators suspect a possibility that some cooperating orthodontists may have selectively chosen models of their more successful cases, therefore leading to a biased sampling procedure.

Some significant findings of interest are found in the supplemental analyses. The data indicate some support for describing a significant relationship between measures of tongue resting position, as defined and categorized in this study, and changes in long term dental status. A similar finding exists between measures of airway obstruction and changes in long term dental Status. These findings could provide for future hypotheses.

The biggest lessons to be learned from this research have to do with the kinds of problems which surround collaborative research of this type. The word "collaborative," as used here, applies both to collaboration between the investigators as well as with the orthodontic professionals.

A major problem which surfaced in this study was the high attrition rate amongst investigators. While some of the dropout was due to personal situations which did not allow time for participation, another problem was trying to find cooperating orthodontists and subjects that matched the study criteria. The investigators found that it was nearly impossible to find orthodontists who were willing to share in this research. Is it fair to ask "what does the orthodontists have to gain - or perhaps lose?" Even when cooperation was possible, it was very difficult to find patient records and/or patients who met the study criteria. All of these limitations led to an extremely small sample size and seriously limited any conclusions which can be drawn from the collected data.

Ironically, the strongest statistical finding in this study leads one to directly question the sampling and measurement procedures of the study itself. The greatest statistical predictor of change in long term dental status was found to be related to where data were collected and by whom. Average change in long term dental status scores varied by investigator from near 0.0 up to 5.0. The statistical analysis was also supported by a visual review of the data collection forms. What is important here is the great consistency of scores within any one investigator's data as compared to the great variability between investigators. These findings suggest major concerns that could be related to any of the following:

1. Differences in how each orthodontist treats patients or takes models (e.g. many orthodontists do not take models at the end of treatment).
2. Differences in the selection process of subjects and dental models by orthodontists (e.g. some orthodontists may have been more likely to preselect the more successful cases).
3. Differences in the population of patients seen by different orthodontists.
4. Differences in how each investigator may have taken measurements.
5. Differences in the use or interpretation of data collection by different investigators.

Another major concern in this study is the amount of time which had elapsed between reliability training and testing and the actual collection of data. The long delays in trying to locate orthodontists and proper subjects can only lead to a degradation of interrater reliability.

SUMMARY AND RECOMMENDATIONS

The findings of this study were not able to reject the null hypothesis. However, there was a trend toward a

positive relation between the variables of long term dental status and the size of interlabial gap. Supplemental findings indicate that other variables such as tongue resting posture as defined here, and airway obstructions may have a relationship with the outcome variable.

This study, which needs to be classified as exploratory in nature, had several limitations, specifically the following:

1. High attrition rate of volunteer investigators.
2. Difficulty in finding cooperating orthodontists.
3. Difficulty in finding subjects that met study criteria.
4. Major differences between subjects selected by different orthodontists.
5. Possible lack of reliability associated with collaborative research.

No doubt a great deal was learned during this study, albeit more about the process than the outcomes. Hopefully the experience of the investigators will be helpful in gaining support for further research. Some of the recommendations for future research of this type include.

1. Design studies that allow for greater control over data access and collection, rather than a dependency on the willingness of other professionals.
2. When working with other professionals, choose a study subject that is non-threatening and provides some reward for their cooperation.
3. Provide reasonable financial compensation for subjects and data collectors.
4. Involve other professionals during the early stages of designing the study to insure participation.
5. Involve dental schools and/or professional orthodontic associations in future research projects.
6. Pay greater attention to potential differences in populations. This is especially a problem with several researchers collecting data from independent sources.
7. If using different locations for data collection, incorporate greater controls for ensuring interrater reliability. Incorporate a cross rater measurement system whenever possible. (e.g. reliability checks can be incorporated into the midyear conferences).
8. Begin a fund raising effort to support further research. This process can be enhanced by working with the Center for Research in Orofacial Myology (CROM), which has been established as a not for profit research organization with tax exempt status. Contributions to CROM for the support of research projects are tax deductible. Fund raising should include targeting manufacturers of dental supplies and equipment.
9. Whenever possible, conduct a pilot study prior to a more extensive project.

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