# Relapse after orthodontic correction of maxillary median diastema: A follow-up evaluation of consecutive cases

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**Abstract:** An evaluation of 96 treated orthodontic patients with maxillary median diastema ranging from 0.50 mm to 5.62 mm (mean 1.22, SD 0.85) was performed 4.0 to 9.0 years after completion of active treatment. Pre- and posttreatment data were gathered from available records. Follow-up data were gathered from records and interviews of 37 patients, and from phone interviews of 59 patients. The incidence of diastema relapse was 49% when scored as either presence of a measurable space at follow-up, a history of orthodontic or prosthetic retreatment to close a reopened space, or continued use of a retainer to control relapse tendency. Logistic regression analysis revealed that pretreatment diastema size and presence of a family member with a similar condition were the only significant risk factors for relapse ($p<0.05$), while pretreatment spacing in the maxillary anterior dentition approached significance ($p=0.10$). No association was found between relapse and presence of an abnormal frenum or an osseous intermaxillary cleft, although patients with an abnormal frenum had a wider pretreatment diastema than those with a normal frenum ($p<0.05$). Fremitus of the maxillary incisors was the only parameter at follow-up associated with space reopening ($p<0.01$).

**Key words**: Diastema, Maxillary median diastema, Dental spacing, Space reopening, Relapse

Maxillary median diastema is common in the primary and mixed dentitions. It is termed "developmental,"[1-3] reflecting the spontaneous partial or complete closure that occurs with eruption of the permanent lateral incisors and canines.[4-9] In the adult dentition, the reported incidence ranges from 5% to 20%.[8,10,11] Suggested contributing conditions or etiologies include deficient tooth structure or displaced teeth in the maxillary anterior segment, oral habits, pathosis in the midline area, deep overbite, genetic predisposition, or tooth migration due to periodontal disease or posterior "bite-collapse."[1-3] However, these are observations based on clinical experience rather than systematic data analysis.

Abnormal frenum attachment and a patent intermaxillary suture are sometimes associated with a maxillary midline diastema.[12] There is disagreement as to whether these factors are causes or effects. In infants, the frenum appears thick and short and is typically attached to the incisive papilla.[4,7,13] With growth, the frenum does not usually follow the downward development of the alveolar process concomitant with tooth eruption,[14,15] and the suture tends to close. One theory is that a thick frenum and a patent suture disrupt the transeptal fiber attachment and prevent closure of the developmental diastema.[16,17] Another is that the abnormal frenum and suture appearance is the result of absence of mesially directed forces on the midline tissues by the erupting lateral incisors and canines.[4,14,15]

Reports on diastema relapse following orthodontic closure are chiefly anecdotal or based on an author's clinical experience,[18-20] and follow-up evaluations are few.[12,21] Edwards[12] found that relapse was twice as great in patients with an abnormal frenum compared with those having normal frenum attachment. Almost two-thirds of a group of patients presenting with an abnormal frenum and a mean diastema of 3.9 mm relapsed more than 1.5 mm after 8 to 10 months of retention. Following frenectomy and retreatment, fewer than one in ten showed similar reopening, strongly suggesting that an abnormal frenum is a significant relapse factor.[12] On the other hand, Sullivan et al.[21] found that only 34%

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of a group of patients presenting with a diastema of 1.4 mm had measurable space reopening 1 to 26 years postretention. The majority of the spaces were small, and reopening of more than 0.6 mm was rare. No predictors for relapse could be established, including presence of an abnormal frenum or an osseous cleft.[21]

One reason for differences between the findings of Edwards and those of Sullivan et al. may be the pretreatment difference in diastema size between the samples. Another may be that Edwards followed a cohort of patients over time, while Sullivan et al. examined only postretention patients. Because patients with permanent retention and restorative space closure were not included, and because patients with a favorable outcome may be more willing to participate in a follow-up examination,[22] the sample of Sullivan et al. may not be representative of the population of patients with median diastema.

The purpose of this study was to perform a follow-up evaluation of a large group of consecutively treated orthodontic patients with a pretreatment diastema of at least 0.5 mm. Specific aims were to test the hypothesis that relapse is a significant clinical problem following orthodontic closure of a maxillary median diastema, to identify risk factors for relapse, and to test for associations between relapse and other posttreatment variables.

**Table 1**
**Variables recorded from interviews of 96 consecutive patients presenting with maxillary median diastema, a mean period of 6.3 years after treatment**

| |
|---|
| Re-treatment (yes/no) |
| Reopening of maxillary median diastema (yes/no) |
| Fixed retention continued (yes/no) |
| Removable retention continued due to relapse tendency (yes/no) |
| Family members with maxillary median diastema (yes/no)* |

*Variables included in regression analysis to identify predictors for relapse

**Table 2**
**Variables recorded from charts and from study models, radiographs, and slides made before (T1), after (T2), and a mean period of 6.3 years after (T3) treatment of 96 consecutive patients presenting with maxillary median diastema**

| | |
|---|---|
| Diastema width (mm) | T1*,T2,T3 |
| Overbite (mm) | T1*,T2,T3 |
| Overjet (mm) | T1*,T2,T3 |
| Bolton Index 3-3 (%) | T1, T2* |
| Arch length availability (mm) | T1*,T2*,T3 |
| Additional spacing in maxillary anterior segment (yes/no) | T1*, T3 |
| Impacted or displaced maxillary anterior teeth (yes/no) | T1* |
| Maxillary incisor to SN (degrees) | T1*,T2,T3 |
| Root parallelism (parallel/convergent/divergent) | T1*,T2* |
| Intermaxillary osseous cleft (yes/no) | T1*+T2* |
| Severe periodontal bone loss (yes/no) | T1* |
| Frenum (normal/abnormal) | T1*,T2*,T3 |
| Age (years) | T1* |
| Gender (male/female) | T1* |
| Frenectomy (yes/no) | T2 |
| Treatment time (years) | T2 |
| Retention (fixed/removable/none) | T3 |
| Re-treatment (yes/no) | T3 |

* Variables included in regression analysis to identify predictors for relapse

## Materials and methods

### Sample

Records of 1275 patients from two orthodontic practices, consecutively finished 4 to 9 years previous to the study, were screened for the following inclusion criteria:

1. Pretreatment (T1) records taken after complete eruption of the maxillary permanent canines
2. Maxillary median diastema equal to or greater than 0.5 mm at T1
3. Complete closure of maxillary median diastema at the time of appliance removal (T2)

Patients with crowned central incisors were excluded, as were patients who had received a previous phase of orthodontic treatment in the permanent dentition (retreatment). All patients had been treated with an edgewise light-wire technique using bonded appliances with .022" x .028" slots.

Of the 134 patients identified, 10 were eliminated due to incomplete T1 or T2 records. Of the remaining 124 patients, 37 (group A) had a follow-up examination that included study models, radiographs, photographs, a clinical examination, and completion of a questionnaire (Table 1), while 59 (group B) answered the questionnaire over the telephone. Of the remaining 28 patients (group C), 24 could not be located and 4 refused to participate in the study. A two-sample *t*-test revealed no significant differences in sex distribution, age, duration of treatment, or diastema width at T1 between the patients in groups A and B and those in group C ($p>0.05$), suggesting that elimination of group C from the sample introduced no bias. The 96 patients in groups A and B had median diastemas ranging from 0.50 to 5.62 mm (mean 1.22, SD 0.85), were aged 10.9 to 53.5 years at T1 (median 13.9, mean 16.9, SD 8.9), were treated for 0.8 to 5.1 years (mean 2.2, SD 0.9), and were from 4.0 to 9.0 years (mean 6.3, SD 1.4) out of active treatment at

time of follow-up (T3). Quantitative measurements and chart examinations (Table 2) were made by the principal author. Independent subjective determinations were made initially by both authors. In case of conflicting scores, consensus was reached through joint reevaluation.

**Quantitative measurements**

The smallest width of the diastema was measured to the nearest 0.01 mm, the largest mesiodistal tooth dimension to the nearest 0.5 mm, and available space in the maxillary arch to the nearest 1.0 mm, using a Fowler Sylvac Ultracal III caliper (Fowler, Newton, Mass). The Bolton tooth-size index was calculated as the percent ratio of the sum of the widths of the mandibular incisors and canines to that of the maxillary teeth.[23] Overjet and overbite were measured for both maxillary central incisors with a transparent ruler to the nearest 0.5 mm and averaged. Maxillary incisor inclination was measured to the nearest degree in relation to the sella-nasion line. All measurements (Table 2) were made by the principal author.

**Clinical examination**

Fremitus of the maxillary incisors was recorded as present if mobility could be sensed when a forefinger was placed on the labial surface while the patient clenched his or her teeth.[24] Tongue indentations were scored as present if indentations were detected on the dorsum of the tongue. Both evaluations were made by the principal author.

**Chart examination**

Age, treatment time, retention design, performance of surgical procedures, and previous relapse or retreatment were determined from notes or correspondence in the charts by the principal author (Table 2).

**Subjective determinations**

Initially, each author made independent determinations. In case of conflicting scores, consensus was reached through joint reevaluation. Frenum type was scored subjectively as normal or abnormal from both intraoral slides and study models. An abnormal score was given if the frenum exhibited insertion close to the gingival margin and appeared continuous with the incisive papilla[12,14] (Figure 1A). Borderline cases were scored as normal. All abnormal frena scored at T1 were recorded. An abnormal frenum at T2 was recorded only if also scored at T1 and if there was no evidence of frenectomy.

An intermaxillary osseous cleft was recorded if a V-shaped radiolucency was observed in the crestal bone between the maxillary central incisors on the periapical radiographs[21] at both T1 and T2 (Figure 1B). Parallel radiolucency and borderline cases were not scored as clefts. Maxillary central incisor root parallelism was judged from both periapical and panoramic radiographs and scored as parallel, convergent, or divergent. Maxillary anterior spacing was scored if lack of interproximal contact was observed anywhere between maxillary left to maxillary right canines on study models. Evaluation of etiology[1-3] was based on all existing records at T1 (Table 3).

**Error of the method**

Reproducibility of the linear and angular measurements was assessed by statistically analyzing the difference between repeated measurements made 3 weeks apart on study models and cephalograms of 15 cases. The method error was calculated from the formula:

$$Sx=\sqrt{\Sigma D^2/2N}$$

where D is the difference between duplicated measurements and N is the number of double measurements.[25] The errors were 0.04 mm for diastema width, 0.43 mm for overbite, 0.28 mm for overjet, 0.21% for Bolton index, and 2.26 degrees for maxillary incisor inclination. Reproducibility of the subjective scorings was determined by re-evaluating 15 cases after at least 2 weeks. Scorings were identical in 100% of the cases for spacing, root parallelism, and deficient tooth structure in the maxillary posterior segment; in 93% of the cases for cleft, abnormal frenum, displaced teeth in maxillary anterior segment, loss of posterior support, periodontal bone loss, generalized spacing in the maxillary and mandibular dentition, and deficient tooth structure in the maxillary anterior segment; and in 80% of the cases for dysfunction. Midline physical impediments were not scored as present at either time.

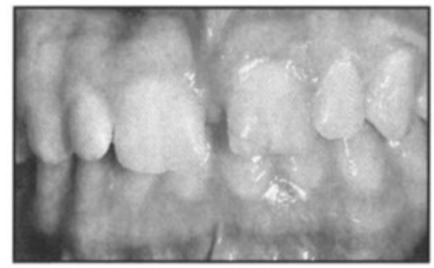

Figure 1A

Figure 1B

Figure 1A-B
Scoring of abnormal frenum and intermaxillary osseous cleft
A: Insertion of frenum near the gingival margin and apparent continuity with the incisive papilla
B: V-shaped radiolucency in crestal bone between maxillary central incisors

### Analysis of data

#### *Relapse*

Relapse was scored (groups A and B) if chart entries, T3 study models, or questionnaire answers indicated any of the following:

1. An open contact between the maxillary central incisors (Figure 2A)
2. Orthodontic retreatment or restoration of central incisors to close a reopened space (Figure 2B; restoration of small or missing lateral incisors devised as part of the treatment plan was not scored as relapse)
3. Presence of a fixed retainer bonded to maxillary incisors
4. Continued use of a removable retainer because diastema otherwise tends to reopen.

#### *Statistics*

Frequency of relapse was calculated for groups A and B according to the number of cases with presence of one or more of the different relapse criteria. Mean and standard deviation of diastema width at T3 were calculated for patients in group A. Student's *t*-tests were used to test for differences in diastema width at T1 between patients with and without abnormal frenum, those with and without osseous cleft, patients with and without both abnormal frenum and osseous cleft, and those with and without relapse. Chi square tests were used to test for differences in frequencies of relapse between patients with and without abnormal frenum, patients with and without osseous cleft, and patients with and without both abnormal frenum and osseous cleft. A univariate logistic regression analysis was used to establish possible predictors for relapse of maxillary median diastema (groups A and B). The dependent variable was relapse, and the covariates were data recorded from the charts, study models, intraoral slides, radiographs, questionnaires, and clinical examination (see Tables 1, 2, and 3). The independent variables found to be correlated most strongly with relapse ($p < 0.2$) were entered into a multiple logistic regression analysis. The resulting model was then used to calculate the probability of relapse (Table 5).

**Table 3**
**Scoring of etiology of maxillary median diastema in 96 consecutive patients presenting with diastema: Categories, scoring criteria and number of patients with each score. Note that for several patients more than one category applied.**

| Category | Criteria | Patients |
|---|---|---|
| Deficient tooth structure in the maxillary anterior segment* | Missing or peg shaped teeth | 16 |
| Displaced teeth in the maxillary anterior segment* | Impacted or labially/ lingually displaced teeth | 31 |
| Oral finger or tongue habit * | Arch form suggesting lip/ tongue/ finger habit | 14 |
| Midline physical impediment | Midline pathosis other than frenum or intermaxillary osseous cleft | 0 |
| Deep bite * | Overbite > 4 mm | 54 |
| General spacing tendency* | Spacing in both arches, no indication of habit | 28 |
| Periodontal disease* | Radiographic evidence of excessive bone loss | 4 |
| Loss of posterior support * | Missing posterior teeth, adults only | 2 |
| Deficient tooth structure in maxillary posterior segment* | Premolar extraction or agenesis | 16 |

* Variables included in regression analysis to identify predictors for relapse

Univariate linear regressions were used to test for associations between diastema width at T3 and changes from T2 to T3 as well as characteristics at T3. Data of patients in group A were used, excluding the 10 patients who reported use of fixed or removable retention to control relapse tendency, for a total of 27 patients (Table 4). The T3 diastema width was the dependent variable, and the covariates were changes in OJ, OB, maxillary incisor inclination, maxillary spacing (apart from diastema reopening), and presence of tongue indentations or fremitus.

## Results

### Relapse

Relapse was observed in 47 (49%) of the 96 patients in groups A and B, and in 17 (46%) of the 37 patients in group A. For 21 of the 96 patients, more than one relapse criteria applied (Table 4). An actual space was present in 24 cases. Of these, 3 were retreated orthodontically and 7 continued to use removable retainers to control the amount of reopening. Another 11 patients were retreated (8 orthodontically and 3 with composite restorations), and 8 patients were included in the relapse category solely because they reported a tendency for relapse unless they continued to use their removable retainer (Table 4). The mean width of the diastema at T3 was 0.10 mm (SD 0.20) for the 37 patients in group A, and ranged from 0.3 to 0.6 mm (mean 0.47, SD 0.10) for the 8 patients with actual space reopening.

The frenum was judged abnormal in 27 (28%) of the 96 patients in groups A and B at T1 and in 17 (18%) at T2. An osseous cleft was scored in 15 (16%) of the patients, and both an abnormal frenum and an osseous cleft were found in 5 patients (5%) at T1 and in 2 (2%) at T2. Relapse was scored in 15 of the 27 patients with an abnormal frenum at T1 (56%), in 10 of the 17 with an abnormal frenum

at T2 (59%), in 7 of the 15 with an osseous cleft (47%), in 2 of the 5 with both an osseous cleft and an abnormal frenum at T1 (40%), and in 1 of the 2 patients with both an osseous cleft and an abnormal frenum at T2. No significant association was found between the frequency of relapse and an abnormal frenum, an osseous cleft, or both. Frenectomy was performed on 9 patients, of which 3 were judged to have an abnormal frenum at T1. Reversal of an abnormal frenum from T1 to T2 without frenectomy was scored in 7 patients.

### Predictors for relapse

The variables most predictive of relapse according to the logistic regression analysis model were the width of the diastema at T1 (effect 2.52, 95% confidence interval 1.1 to 5.8, $p$=0.03) and report of a family member with a similar condition (effect 2.64, 95% confidence interval 1.1 to 6.4, $p$=0.03). Additional spacing in the maxillary anterior segment at T1 approached significance (effect 2.34, 95% confidence interval 0.9 to 6.6, $p$=0.10). No other associations were found. The probabilities of relapse according to this suggested model are delineated in Table 5. The diastema was significantly wider at T1 ($p$<0.01) in the patients with relapse (mean 1.44 mm, SD 1.02) than in those without (mean 1.11 mm, SD 0.43).

### Association between relapse and posttreatment changes

The only posttreatment variable that correlated with diastema width at T3, according to the univariate linear regression, was presence of fremitus (B=0.40, $p$<0.001). However, only 22 of the 27 group A patients out of retention were evaluated for fremitus. Fremitus was detected in 6 of the 7 patients with diastema reopening and in 1 of those without.

### Pretreatment status

The mean diastema width at T1 was 1.78 mm (SD 1.00) among the 27 patients with an abnormal frenum and 1.37 mm (SD 0.35) among the 69 with a normal frenum ($p$<0.001). No significant differences were found between patients with or without an osseous cleft and between those with or without both an osseous cleft and an abnormal frenum ($p$>0.05).

Subjective evaluation of the etiology revealed that more than one category applied to most cases (Table 3). The most frequently observed categories were overbite greater than 4 mm, displaced anterior teeth, and generalized spacing. None of the 96 patients exhibited midline pathosis other than osseous cleft or abnormal frenum.

## Discussion

Our results suggest that about 10% of orthodontic patients present with a maxillary median diastema of at least 0.5 mm, and that relapse is a significant clinical problem after orthodontic closure. A high tendency for diastema reopening was previously reported by Edwards[12] and also expressed in several case reports.[18,20] However, in our study actual space was evident in only 25% of the patients at the time of follow-up, and did not exceed 0.6 mm. The majority of patients who met our criteria for relapse controlled the space reopening tendency with retainers or had restorative dental care or orthodontic retreatment to close a reopened space (Table 4). These findings support Sullivan et al.,[21] who found very few patients with diastema reopening larger than 0.6 mm in a postretention follow-up examination. It may be speculated that most patients take action to control the relapse if the space exceeds 0.6 mm.

One may challenge the fact that the majority of the follow-up data for our study were obtained from telephone interviews (group B) rather than through a follow-up clinical examination (group A). However, the comparable incidence and distribution of characteristic variables that were demonstrated in the two subgroups

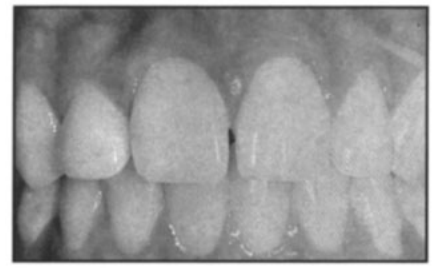

Figure 2A

Figure 2B

Figure 2A-B
Scoring of relapse.
A: Space between the central incisors at follow-up
B: Composite buildup of central incisors

(Table 4) corroborate the validity of this information. We also believe that the consecutive nature of our sample, allowing for good representation of the population of patients with a median diastema, by far outweighs this potential problem.

We confirmed our hypothesis that the risk of relapse increases with increasing initial width of the diastema. Supporting Edwards,[12] we found a high relapse incidence in patients with a diastema greater than 2 mm (Table 5). We realize that these findings may be biased if a correlation exists between initial diastema width and the orthodontist's decision to bond a fixed retainer. However, only 6 patients wore a bonded retainer at follow-up (Table 4), and two of them had been retreated due to diastema relapse.

The results also suggest that both a family tendency for diastema and the presence of anterior spacing are risk factors. The regression model indicates a strong predictive value of those three identifiable risk factors (Table 5). It should be stressed, how-

ever, that the risk factors predict occurrence of relapse only, according to the criteria identified in our study (Table 4), and do not suggest the size of space reopening. Equally important is the finding that relapse is a common problem in patients with a small initial diastema. Over 34% of the patients with a diastema of 1 mm or less were included in the relapse category, as indicated in the prediction model (Table 5).

It has been speculated that the tendency for relapse will be reduced if the etiology for the median diastema is eliminated with treatment, while the tendency will be enhanced if the causative factor cannot be removed.[1-3] The former may be demonstrated in patients with deficient tooth structure due to missing or peg-shaped maxillary incisors, or in patients lacking mesially directed forces due to impacted or displaced teeth.[1-3] In these situations, the etiology is removed either through the orthodontic treatment or through concomitant restorative procedures. If, on the other hand, the etiology is not eliminated, as may be the case with the presence of a habit, a genetic tendency, extensive loss of periodontal support, or posterior bite collapse, the diastema may reopen readily after appliance removal.[1-3] The present results do not support such speculations. It may be argued, however, that several of the etiologic categories were scored too infrequently to allow meaningful data analysis (Table 3).

Other than pretreatment width of the diastema and the presence of additional spacing of the maxillary anterior teeth, occlusal parameters of predictive value were not detected. The Bolton tooth-size analysis indicated that 31 patients had significant mandibular excess at the time of appliance removal. The fact that these patients were not at increased risk of relapse may suggest that orthodontic tooth movements performed to compensate for tooth-size discrepancies are a successful camouflage.

**Table 4**
**Number of cases in each relapse category among 47 cases with relapse in total sample of 96 consecutive cases presenting with median diastema. (Among 17 patients with relapse in subsample of 37 patients who met for a follow-up examination in parenthesis). Note that for several patients more than one category applied.**

| Relapse category | Presence of diastema | History of treatment | Presence of fixed retainer | Use of removable retainer | Total |
|---|---|---|---|---|---|
| Presence of diastema | 14 (3) | 3 (2) | 0 (0) | 7 (3) | 24 (8) |
| History of retreatment | | 3 (2) | 2 (1) | 6 (1) | 14 (6) |
| Presence of fixed retainer | | | 1 (0) | 3 (2) | 6 (3) |
| Use of removable retainer due to relapse tendency | | | | 8 (3) | 24 (9) |

**Table 5**
**Probability (%) of maxillary median diastema relapse according to suggested multivariate logistic regression model.**

| Width (mm) | Family members w/diastema Additional space | Family members w/diastema No additional space | No family members w/diastema Additional space | No family members w/diastema No additional space |
|---|---|---|---|---|
| 0.5 | 52 | 32 | 29 | 15 |
| 1.0 | 63 | 43 | 40 | 22 |
| 1.5 | 73 | 54 | 51 | 30 |
| 2.0 | 81 | 65 | 62 | 41 |
| 3.0 | 92 | 82 | 80 | 64 |
| 4.0 | 96 | 92 | 91 | 82 |
| 5.0 | 99 | 97 | 96 | 92 |
| 6.0 | 99 | 99 | 98 | 97 |

In keeping with a previous study,[21] we could not confirm the frequently suggested hypothesis of an association between the presence of maxillary midline alveolar bony cleft, or "notch," and diastema relapse.[12,26] Our results did confirm an association between pretreatment diastema width and the presence of an abnormal frenum, but not that an abnormal frenum is a risk factor for relapse.[12] We also observed that about 26% of the patients with abnormal frenum before treatment experienced spontaneous remodeling during orthodontic therapy. As experienced by others,[12,27] we did find it difficult to judge the condition of the frenum, particularly in borderline situations. However, our findings may allow the recommendation that a decision to perform frenectomy should be postponed until diastema closure is completed, that a conservative technique should be used, and that the procedure should be performed for reasons other than enhancement of stability. Edwards concluded a dramatic reduction in diastema relapse following retreatment and frenectomy.[12] However, he did not perform a long-term examination, nor did he control for any effect of the actual retreatment on the outcome. Miller's finding of only three subjects with postretention relapse following frenectomy and orthodontic diastema closure[28] is also difficult to interpret, since no control group was included. Bergström performed a longitudinal evaluation of a group of 9-year-olds with abnormal frenum and found no difference in spontaneous diastema closure between subgroups with and without frenectomy.[27]

The only posttreatment variable associated with relapse was the presence of fremitus of the maxillary incisors at the time of follow-up, suggesting that heavy or excessive function of the anterior teeth may cause a diastema to reopen. We could confirm neither a previous finding of an association between postretention incisor proclination and relapse,[21] nor the speculation that overbite increase might contribute to development of a median diastema.[1,2,29] However, only 27 patients in our sample could be included when testing for an association between posttreatment changes and diastema reopening, somewhat reducing the significance of this part of the results.

A study focusing on the decision to perform a frenectomy, as well as the esthetic outcome of the procedure, may be of interest in the future. It may also be interesting to analyze the tendency and contributing factors for posttreatment development of a median diastema in patients who did not present with such a space.

## Conclusions

1. About 10% of the population of orthodontic patients have a maxillary median diastema larger than 0.5 mm after eruption of the permanent canines.

2. About 50% of these patients experience relapse following orthodontic space closure. A significant proportion of these patients may need to wear retainers to avoid space reopening.

3. The initial width of the diastema, presence of a family member with diastema, and additional spaces between the maxillary anterior teeth are the most predictive factors of relapse.

4. An abnormal labial frenum is associated with the initial width of the diastema. However, an abnormal frenum may remodel spontaneously following orthodontic diastema closure. Neither an abnormal frenum nor an osseous cleft are risk factors for relapse.

5. Fremitus of the maxillary central incisors may be associated with diastema reopening.

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