Aim. The aim of this study is to analyze the etiological factors underlying the presence of maxillary midline diastema in a sample of orthodontic patients. Materials and Methods. One hundred patients who fulfill the inclusion criteria were selected from 1355 patients seeking orthodontic treatment. The pretreatment orthodontic records were analyzed. The width of the maxillary midline diastema was measured clinically with a digital caliper at two levels: the mesioincisal angles of the central incisors and five millimeters from the incisal edge. The two measurements were averaged, and patients with diastema of more than 0.5 millimeter in width were enrolled. Results. Diastema is a multifactorial clinical finding with more than one underlying etiological cause. The interrelationship between the familial pattern of midline diastema and the microdontia, macroglossia, labial frenum, and alveolar cleft conforms was clear. The effect of a mesiodens and the upper lateral incisor whether bilaterally missing, unerupted, or peg shaped was minimal. Conclusion. Etiological factors underlying maxillary midline diastema are interconnected. Using a checklist as a guide during handling maxillary midline diastema is important in the different stages of treatment.
Sex Facial profile Facial type Dentition Axial inclination Proclination
Male Straight Brachycephalic Late mixed Convergence Proclined
Female Convex Mesocephalic E. permanent Normal Normal
Concave Dolichocephalic L. permanent Divergence Retroclined

Figure 2: Bar chart showing the distribution of the criteria of the sample.

width were enrolled (Figure 1). The examination was made by the principle observer and repeated by the second observer. Because of the physiological diastema, patients younger than 13 years were excluded, while patients above 30 years were excluded because of the possibility of diastema formation due to periodontal involvement and migration of teeth.

The distribution of the criteria of the sample was analyzed (Figure 2). The criteria represent the commonsensical orthodontic categories that segregate the sample into comparable subclasses. The etiological factors underlying the maxillary midline diastema were extracted from the records and clinical examination of the patients (Table 1). These etiological foundations were separated into major etiological factors and etiological factors of lesser influence. These factors represent all the etiological factors underlying the presence of the maxillary midline diastema that were extracted from the research sample. The prevalence of each factor in percentage of the 100 cases enrolled was calculated.

Additionally, the association between diastema with overjet and overbite is depicted through dividing the sample into 10 groups each representing 1 mm regarding diastema, overjet, and overbite (Figure 3).

3. Results

The prevalence of the diastema was found to be 13.6% among the screened sample. The occurrence of the six criteria (Figure 2) demonstrated that the maxillary midline diastema is more observed in females, mesocephalic faces, convex facial profiles, and the early permanent dentition. Maxillary midline diastema is more prevalent with upright maxillary central incisors than convergent or divergent central incisors. The least prevalence of diastema occurs with retroclined maxillary incisors.

The relationship between the maxillary midline diastema, overjet, and overbite depicted in Figure 3 shows that a diastema width of 1-2 mm is more prevalent (44 patients) than other extents of diastema, and this prevalence decreases as the amount of overbite and overjet increases.

Etiological factors were segregated into major contributing factors and factors of lesser contribution taking 5% prevalence as the limit (Table 1). The interrelation (overlap) between the major contributing factors is denoted by intersecting circles charts (Figures 4–6). Factors that might be of strong developmental interrelation were linked together in
Figure 3: Chart showing the relation of common prevalence between diastema, overjet, and overbite.

| Major etiological factors                      | % of prevalence | Etiological factors of lesser prevalence       | % of prevalence |
|-----------------------------------------------|-----------------|-----------------------------------------------|-----------------|
| Generalized spacing                           | 42              | Missing bilateral maxillary central incisors   | 5               |
| Familial incidence                            | 39              | Bilateral missing maxillary lateral incisors   | 5               |
| Abnormal frenal attachment                    | 22              | Peg shaped maxillary lateral incisors         | 5               |
| Alveolar intraosseous cleft                    | 21              | Missing unilateral maxillary central incisors  | 4               |
| Tongue-thrusting                               | 16              | Ankylosed maxillary central incisors          | 1               |
| Macroglossia                                  | 15              | Excess bony defect                            | 1               |
| Unerupted canine bilateral                    | 14              | Thumb sucking                                 | 1               |
| Unerupted canine (unilateral)                 | 12              | Mesiodens                                     | 1               |
| Microdontia                                   | 10              | Malformed maxillary central incisors          | 0               |
| Unilateral missing maxillary lateral incisors  | 8               | Genetics                                      | 0               |
| Palatally erupted maxillary lateral incisors   | 6               | Midline pathosis                              | 0               |
| Mouth breathing                                | 6               | Unerupted maxillary lateral incisors          | 0               |
| Tooth migration                                | 6               |                                               |                 |

4. Discussion

Treatment of maxillary midline diastema should be directed towards management of the underlying cause before seeking closure of the diastema; thus, identifying the etiology is of chief importance. The aim of this survey is to highlight the factors underlying maxillary midline diastema and the interrelation between them. This might influence the timing for closure of the diastema during treatment and/or retention protocols.

Our results conformed to the consensus that diastema is a multifactorial clinical finding with more than one underlying etiological cause. Based on a prevalence of 5%, the etiological factors were segregated into major and minor factors. Surprisingly, the effect of the upper lateral incisor whether bilaterally missing, unerupted, or peg shaped was minimal. The same outcome was found with a mesiodens. The interrelationship between the familial pattern of midline diastema and the microdontia, macroglossia, labial frenum, and alveolar cleft conforms was clear. On the other hand, no cases showed a familial tendency of missing unilateral maxillary lateral incisor. However, as regards the enlarged labial frenum as an etiological cause, results of this study revealed that it represents only a minor etiological cause,
Table 2: Checklist showing the impact of each etiological factor of the maxillary midline diastema upon the diagnosis, treatment, or retention protocol.

| Factor                              | Extra diagnostic tool         | Treatment modification | Retention modification |
|-------------------------------------|-------------------------------|------------------------|------------------------|
| Generalized spacing                 |                               |                        |                        |
| Familial incidence                  | (Family screening)            |                        | (Permanent)            |
| Abnormal frenal attachment          | (Periapical radiograph)       | (Frenotomy)            | (Permanent)            |
| Alveolar intraosseous cleft         | (Periapical radiograph)       | (Nonidentified)        |                        |
| Tongue-thrusting                    |                               | (Habit breaking appliance) | (Habit breaking)        |
| Macrognlosia                        |                               | (No encroaching on tongue) | (Permanet)            |
| Unerupted canine bilaterally        |                               |                        |                        |
| Unerupted canine unilaterally       |                               |                        |                        |
| Microdontia                         |                               | (Build-up)             |                        |
| Unilateral missing maxillary lateral incisors |                     | (Prosthesis) (Canine substitution) |                        |
| Palatally erupted maxillary lateral incisors |                     | (Root torquing)        |                        |
| Mouth breathing                      | (ENT consultation)            |                        | (Habit breaking)        |
| Tooth migration                      |                               |                        |                        |
| Missing bilateral maxillary central incisors |                     | (Prosthesis)           |                        |
| Bilateral missing maxillary lateral incisors |                     | (Prosthesis) (Canine substitution) | army             |
| Peg shape maxillary lateral incisors |                               | (Build-up)             |                        |
| Missing unilateral maxillary central incisors |                     | (Prosthesis)           |                        |
| Ankylosed maxillary central incisors |                               | (Luxation, crowning, extraction) | (Surgical) |
| Excess bony defect                  |                               | (Surgical)             |                        |
| Thumb sucking                        |                               | (Habit breaking appliance) | (Habit breaking) |
| Mesiodens                           |                               | (Surgical extraction)  |                        |
| Malformed maxillary central incisors |                               | (Build-up)             |                        |
| Midline pathosis                    | (Periapical radiograph)       | (Surgical excision)    |                        |
| Unerupted maxillary lateral incisors | (Periapical radiograph)       |                        |                        |

Figure 4: Intersecting circles chart depicting the common occurrence between the major contributing factors.

an observation that conforms to the findings of Huang and Creath [2]. In addition, the interrelation between the alveolar cleft and abnormal labial frenum was an important finding.

Figure 5: Intersecting circles chart depicting the common occurrence between spacing, microdontia, macrognlosia, and tongue thrust.

Implementation of the findings of this survey is important from the clinical sense. The impact of each etiological factor of the maxillary midline diastema upon the diagnosis, treatment, or retention protocol is summarized into a checklist. This checklist was designed to highlight the intervention at
5. Conclusion

Etiological factors underlying maxillary midline diastema are interconnected.

Using a checklist as a guide during handling maxillary midline diastema is important in the different stages of treatment.

Competing Interests

The authors declare that they have no competing interests.

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