Original Article

Malocclusion and Crowding in an Orthodontically Referred Turkish Population

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Abstract: This study was conducted to evaluate malocclusion and crowding in 1356 patients (793 girls, 563 boys) referred to the Department of Orthodontics, Suleyman Demirel University, Turkey. Class I was the most frequently seen malocclusion in this referred Turkish orthodontic population whereas Class II, division 2 was the least frequently seen. Comparison of mean ages of the malocclusion groups indicated statistically significant difference between Class I and Class II, division 1 groups ($P < .05$). The lowest mean age was present in the Class II, division 1 group. Mild mandibular crowding was the most common finding whereas severe mandibular crowding was seen least frequently in all malocclusion groups. Cross tabulation of maxillary and mandibular crowding indicated that mild maxillary and severe mandibular crowding in the same patient was rarely seen in all types of malocclusions. Moderate maxillary and severe mandibular crowding in the same patient was another rare finding for all malocclusion groups. (*Angle Orthod* 2004;74:635–639.)

Key Words: Crowding; Frequency; Malocclusion; Referred population

INTRODUCTION

For many years, studies have been conducted to determine the prevalence of malocclusion in different populations.[1–33] A comparison of these results is almost impossible, and the results of studies, even those studies conducted in a population of the same origin, may show great variability. Variables such as the differences in classification of occlusal relationships, the developmental period of the study sample, examiner differences in determining the bounds of normal, and differences in sample sizes can affect the results. Instead of differentiating normal and abnormal in a population, determining frequencies of different types of malocclusions in a referred population may also give valuable information.

Although, many studies of the prevalence of malocclusion in different populations have been reported, a review of the literature indicates that only a few studies evaluated malocclusion in a referred population.[34,35] Jones[34] investigated malocclusion and facial types in a group of Saudi Arabian patients referred for orthodontic treatment and reported that there were indications amongst Saudi Arabian patients of a tendency for bimaxillary proclination and a greater proportion of Class III malocclusion than in Western communities. Yang[35] evaluated patients who visited the Department of Orthodontics at Seoul National University Hospital from 1985 to 1989 and reported that the percentage of Class III malocclusion has been increasing but that of Class I has been decreasing.

The aims of this study were: (1) to determine frequencies of different types of malocclusions, (2) to compare mean ages of the patients in different malocclusion groups, and (3) to evaluate maxillary and mandibular crowding related to malocclusion groups in a sample of Turkish orthodontic referred population.

MATERIALS AND METHODS

A total of 1356 patients (793 girls, 563 boys) referred to the Department of Orthodontics, Suleyman Demirel University, were evaluated in this study. The mean age of the patients was 13.57 ± 3.16 years. These patients were from the southern regions of Turkey, and none of the subjects had undergone previous orthodontic treatment. Orthodontic examinations of the patients were carried out by the authors. Patients with systemic diseases were excluded from the study. Four malocclusion groups were formed according to the following criteria:

- Class I group: Class I soft tissue profile; positive overjet up to three mm; Angle Class I molar relationship in centric occlusion.
- Class II, division 1 group: Convex soft tissue profile; ex-

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TABLE 1. Statistical Comparison of Mean Ages Related to Malocclusion Groups

Class I (n = 875)		Class II, div 1 (n = 262)		Class II, div 2 (n = 63)		Class III (n = 156)		
Mean	SD	Mean	SD	Mean	SD	Mean	SD	*P*
13.77	3.16	13.11	2.92	13.33	2.74	13.34	3.63	0.017*

* $P < .05$ significance between Class I and Class II, div 1.

cessive overjet (more than three mm); protrusive maxillary incisors; Angle Class II molar relationship in centric occlusion.

- Class II, division 2 group: Decreased anterior facial height; excessive overbite (more than three mm); retroclination of two or more maxillary incisors; Angle Class II molar relationship in centric occlusion.
- Class III group: Concave soft tissue profile; negative overjet in all anterior teeth; Angle Class III molar relationship in centric occlusion.

The number of patients in each group and mean and standard deviations of the chronological ages of the groups are shown in Table 1. Analysis of variance was used to compare mean ages of the malocclusion groups.

Crowding was measured only in 1015 patients who were in the permanent dentition stage. Crowding was classified according to the following criteria: (1) mild: crowding up to three mm (spacing was also included), (2) moderate: crowding between four and six mm, and (3) severe: crowding more than six mm.

RESULTS

Malocclusion types

Class I malocclusion was found in 875 patients, which represented 64% of the sample. The frequency of Class II, division 1 and Class II, division 2 malocclusions were 19% and 5%, respectively. Class III malocclusion was present in 12% of the patients.

Mean ages

Comparison of the mean ages of the malocclusion groups (Table 1) indicated a statistically significant difference between Class I and Class II, division 1 groups ($P < .05$).

Dental arch crowding

Maxillary crowding. Distribution of maxillary crowding according to malocclusion groups is shown in Figure 1. Moderate maxillary crowding was the most common finding in all malocclusion groups. Mild maxillary crowding had the lowest frequency in Class I (21.7%) and Class II, division 2 (10.4%) malocclusion groups. Severe maxillary crowding had the lowest frequency in Class II, division 1 (15.0%) and in Class III (21.8%) malocclusions.

Mandibular crowding. The distribution of mandibular crowding according to malocclusion groups is shown in Figure 2. Mild mandibular crowding was the most common finding in all malocclusion groups. Severe mandibular crowding had the lowest frequency in all malocclusion groups.

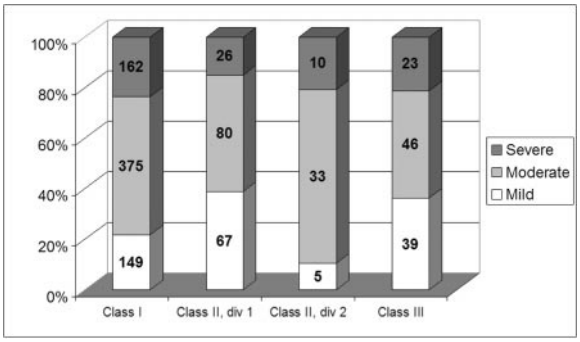

FIGURE 1. Bar graph of maxillary crowding related to malocclusion groups.

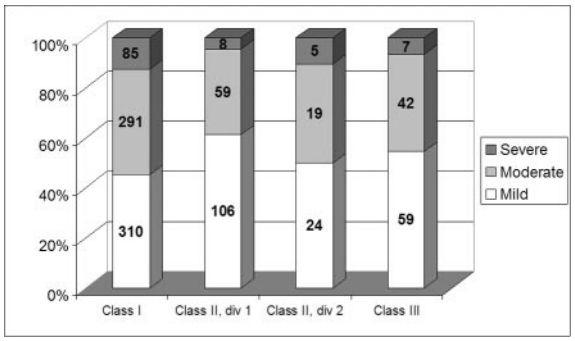

FIGURE 2. Bar graph of mandibular crowding related to malocclusion groups.

Cross tabulation of maxillary and mandibular crowding. Cross tabulation of maxillary and mandibular crowding (Tables 2 and 3) regardless of malocclusion groups (Table 3) indicated that mild maxillary and severe mandibular crowding in the same patient was rarely seen (0.30%). Moderate maxillary and severe mandibular crowding in the same patient was another rare finding for all malocclusion groups (0.89%).

DISCUSSION

The reported prevalence of malocclusion varies from 39% to 93%.[29] The prevalence of different types of malocclusions may show great variability even in a population of the same origin. Determining the criteria for normal changes from one examiner to the other and definitely af-

TABLE 2. Cross Tabulation of Maxillary and Mandibular Crowding Related to Malocclusion Groups

Maxillary Crowding	Mandibular Crowding		
	Mild	Moderate	Severe
Class I			
Mild	119	27	3
Moderate	167	201	7
Severe	24	63	75
Class II, div 1			
Mild	61	6	0
Moderate	36	43	1
Severe	9	10	7
Class II, div 2			
Mild	5	0	0
Moderate	19	14	0
Severe	0	5	5
Class III			
Mild	35	4	0
Moderate	16	29	1
Severe	8	9	6

TABLE 3. Cross Tabulation of Maxillary and Mandibular Crowding Regardless of Malocclusion Groups

	Mandibular crowding		
	Mild	Moderate	Severe
Maxillary Crowding			
Mild	220	37	3
Moderate	238	287	9
Severe	41	87	93

fects the results of studies. Clearly, the evaluation of referred patients and the distribution of malocclusion types may give valuable information for planning an orthodontic service.

According to our results, Class I malocclusion was found in 875 (64%) of the 1356 patients examined. The frequencies of Class II, division 1 and Class II, division 2 malocclusions were 19% and 5%, respectively. Class III malocclusion was observed in 12% of the patients. The prevalence of malocclusion in a Turkish population is not well documented in the literature. Sari et al[36] evaluated 1602 patients treated in the Department of Orthodontics, Selcuk University, Turkey. They reported that 61.7% of patients had Class I, 25.1% had Class II, division 1, 3.0% had Class II, division 2, and 10.2% had Class III malocclusion. Although their reported frequency of Class II, division 1 malocclusion was higher than in our study, the frequency of other malocclusion types was similar. The differences between the frequencies of Class II, division 1 can be related to the material differences. Their material consisted of patients accepted for treatment, but our material consisted a total referred population.

Jones[34] investigated malocclusion and facial types in 132 Saudi Arabian patients referred for orthodontic treatment and reported that 53.8% had Class I, 28.8% had Class II, division 1, 4.5% had Class II, division 2, and 12.9% had Class III malocclusions. However, these results do not represent the prevalence of malocclusion in a referred Saudi Arabian population because of the insufficient sample size. Yang[35] evaluated 3305 patients who had visited Department of Orthodontics, Seoul National University Hospital from 1985 to 1989. He reported that percentages of Class I, Class II, division 1, Class II, division 2, and Class III were 35.9%, 13.4%, 1.5%, and 49.1%, respectively. The higher reported frequency of Class III malocclusion is noticeable and may be because of the ethnic differences.

Numerous studies have been conducted to determine the prevalence of malocclusion in different populations.[1–33] Proffit et al[24] studied the data from the NHANES III survey and calculated the percentage of American children and youths present in Angle's four occlusion groups. They reported that 30% had Angle's normal occlusion, 50% to 55% had Class I malocclusion, approximately 15% had Class II malocclusions, and less than 1% had Class III malocclusions. A study of 1700 Danish children showed that about 14% had normal occlusion, 58% had Class I malocclusion, 24% had Class II malocclusion, and about 4% had Class III malocclusion.[2] Lew et al[12] evaluated 1050 ethnically Chinese children and reported that 7.1% had normal occlusion, 58.8% had Class I malocclusion, 18.8% had Class II, division 1 malocclusion, 2.7% had Class II, division 2 malocclusion, and 12.6% had Class III malocclusion. Because our study evaluated only subjects seeking orthodontic treatment, it is not surprising that Class II malocclusion was as frequent as in the Danish population and Class III malocclusion was as frequent as among the Chinese.

The type of malocclusion is an important factor that affects a patient's motivation to seek treatment. Wilmont et al[37] reported that patients with a severe sagittal Class II deformity had a higher motivation for orthodontic therapy than Class III patients. In our study, comparisons of the mean ages of the malocclusion groups indicated a statistically significant difference between Class I and Class II, division 1 groups ($P < .05$). The lowest mean age was in the Class II, division 1 group. In accordance with Wilmont et al,[37] this finding may indicate that patients with Class II, division 1 were aware of their problems earlier than those in any other malocclusion group.

Adolescence is often associated with increased self-consciousness, confusion about identity and acceptance by others, and concerns about recognition from adults and peers.[38] Therefore, it is obvious that motivation for and seeking of orthodontic treatment increases in adolescence. According to our results, the mean age of the referred population was 13.57 ± 3.16 years. Therefore, we can conclude that motivation for and seeking of orthodontic treatment occurs during adolescence in a Turkish population sample.

The frequency of maxillary and mandibular crowding in

different malocclusion groups may give valuable information about the characteristics of malocclusions and treatment strategies. In our study, crowding was measured only in patients with permanent dentitions to avoid the systematic errors of several mixed dentition analyses.

In the present study, moderate maxillary crowding was the most common finding in all malocclusion groups. Mild maxillary crowding had the lowest frequency in Class I (21.7%) and in Class II, division 2 (10.4%) malocclusion groups, but severe maxillary crowding had the lowest frequency in Class II, division 1 (15.0%) and in Class III (21.8%) malocclusions. Mild mandibular crowding was the most common finding whereas severe mandibular crowding was the least in all malocclusion groups. Therefore, one may think that severe crowding is not a common finding in the mandible for all malocclusion groups. This may reflect the frequency of extraction cases in a treated group. This is consistent with the findings of Sari et al[36] who reported that of 1602 patients, 34.5% were treated with extraction and 65.5% were treated without extractions. Although the frequency of extraction cases has changed through the years,[39] severe mandibular crowding is an important factor in the decision for orthodontic extractions.

In all types of malocclusions, cross tabulation of maxillary and mandibular crowding indicated that mild maxillary and severe mandibular crowding was rarely seen in the same patient (Table 3). Only three of 1015 patients (0.3%) showed this type of crowding, and all three had Class I malocclusions. Moderate maxillary and severe mandibular crowding in the same patient is another rare finding for all malocclusion groups. Only nine of 1015 patients (0.9%) showed this type of crowding. Therefore, our findings may be used to help predict crowding in the mixed dentition. For instance, if we know that a patient has mild crowding in the maxilla, we might not expect severe crowding in the mandible or vice versa. Similarly, if we know that a patient has moderate crowding in the maxilla, we might not expect severe crowding in the mandible or vice versa.

CONCLUSIONS

- In a sample of orthodontically referred Turkish population, Class I was the most frequently seen malocclusion, whereas Class II, division 2 was the least common.
- Comparison of the mean ages of a referred malocclusion group indicated statistically significant difference between Class I and Class II, division 1 groups. The lowest mean age was in the Class II, division 1 group.
- Mild mandibular crowding was the most common finding, whereas severe mandibular crowding was the least one in all malocclusion groups.
- Cross tabulation of maxillary and mandibular crowding indicated that in all types of malocclusions, mild maxillary and severe mandibular crowding was rarely seen in the same patient. Moderate maxillary and severe mandibular crowding in the same patient was another rare finding for all malocclusion groups.

REFERENCES

1. Erickson DM, Graziano FW. Prevalence of malocclusion in seventh grade children in two North Carolina cities. *J Am Dent Assoc.* 1966;73:124–127.
2. Helm S. Malocclusion in Danish children with adolescent dentition: an epidemiologic study. *Am J Orthod.* 1968;54:352–366.
3. Wood BF. Malocclusion in the modern Alaskan Eskimo. *Am J Orthod.* 1971;60:344–354.
4. Krzpow AB, Lieberman MA, Modan M. Prevalence of malocclusion in young adults of various ethnic backgrounds in Israel. *J Dent Res.* 1975;54:605–608.
5. Garner LD, Butt MH. Malocclusion in Black Americans and Nyeri Kenyans. An epidemiologic study. *Angle Orthod.* 1985;55: 139–146.
6. Al-Emran S, Wisth PJ, Boe OE. Prevalence of malocclusion and need for orthodontic treatment in Saudi Arabia. *Community Dent Oral Epidemiol.* 1990;18:253–255.
7. Van Vuuren C. A review of the literature on the prevalence of Class III malocclusion and the mandibular prognathic growth hypotheses. *Aust Orthod J.* 1991;12:23–28.
8. Burgersdijk RCW, Truin GJ, Frankenmolen F, Kalsbeek H, van't Hof M, Mulder J. Malocclusion and orthodontic treatment need of 15–74-year-old Dutch adults. *Community Dent Oral Epidemiol.* 1991;19:64–67.
9. Hill PA. The prevalence and severity of malocclusion and the need for orthodontic treatment in 9-, 12-, and 15-year-old Glasgow schoolchildren. *Br J Orthod.* 1992;19:87–96.
10. Diagne F, Ba I, Ba-Diop K, Yam AA, Ba-Tamba A. Prevalence of malocclusion in Senegal. *Community Dent Oral Epidemiol.* 1993;21:325–326.
11. Otuyemi OD, Abidoye RO. Malocclusion in 12-year-old suburban and rural Nigerian children. *Community Dent Health.* 1993;10: 375–380.
12. Lew KK, Foong WC, Loh E. Malocclusion prevalence in an ethnic Chinese population. *Aust Dent J.* 1993;38:442–449.
13. Tang EL. The prevalence of malocclusion amongst Hong Kong male dental students. *Br J Orthod.* 1994;21:57–63.
14. Harrison RL, Davis DW. Dental malocclusion in native children of British Columbia, Canada. *Community Dent Oral Epidemiol.* 1996;24:217–221.
15. Ng'ang'a PM, Ohito F, Ogaard B, Valderhaug J. The prevalence of malocclusion in 13- to 15-year-old children in Nairobi, Kenya. *Acta Odontol Scand.* 1996;54:126–130.
16. Jacobson S, Lennartsson B. Prevalence of malocclusion and awareness of dental appearance in young adults. *Swed Dent J.* 1996;20:113–120.
17. Ben-Bassat Y, Harari D, Brin I. Occlusal traits in a group of school children in an isolated society in Jerusalem. *Br J Orthod.* 1997;24:229–235.
18. Tschill P, Bacon W, Sonko A. Malocclusion in the deciduous dentition of Caucasian children. *Eur J Orthod.* 1997;19:361–367.
19. Tod MA, Taverne AA. Prevalence of malocclusion traits in an Australian adult population. *Aust Orthod J.* 1997;15:16–22.
20. Johannsdottir B, Wisth PJ, Magnusson TE. Prevalence of malocclusion in 6-year-old Icelandic children. *Acta Odontol Scand.* 1997;55:398–402.
21. Sonnesen L, Bakke M, Solow B. Malocclusion traits and symptoms and signs of temporomandibular disorders in children with severe malocclusion. *Eur J Orthod.* 1998;20:543–559.
22. Bassler-Zeltmann S, Kretschmer I, Goz G. Malocclusion and the need for orthodontic treatment in 9-year-old children. Survey

based on the Swedish National Board of Health and Welfare Scale. *J Orofac Orthop.* 1998;59:193–201.
23. Carvalho JC, Vinker F, Declerck D. Malocclusion, dental injuries and dental anomalies in the primary dentition of Belgian children. *Int J Paediatr Dent.* 1998;8:137–141.
24. Proffit WR, Fields HW Jr, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the NHANES III survey. *Int J Adult Orthodon Orthognath Surg.* 1998;13:97–106.
25. Otuyemi OD, Ogunyinka A, Dosumu O, Cons NC, Jenny J. Malocclusion and orthodontic treatment need of secondary school students in Nigeria according to the dental aesthetic index (DAI). *Int Dent J.* 1999;49:203–210.
26. Alamoudi N. The prevalence of crowding, attrition, midline discrepancies and premature tooth loss in the primary dentition of children in Jeddah, Saudi Arabia. *J Clin Pediatr Dent.* 1999;24: 53–58.
27. Johnson M, Harkness M. Prevalence of malocclusion and orthodontic treatment need in 10-year-old New Zealand children. *Aust Orthod J.* 2000;16:1–8.
28. Silva RG, Kang DS. Prevalence of malocclusion among Latino adolescents. *Am J Orthod Dentofacial Orthop.* 2001;119:313–315.
29. Thilander B, Pena L, Infante C, Parada SS, de Mayorga C. Prevalence of malocclusion and orthodontic treatment need in children and adolescents in Bogota, Colombia. An epidemiological study related to different stages of dental development. *Eur J Orthod.* 2001;23:153–167.
30. Willems G, De Bruyne I, Verdonck A, Fieuws S, Carels C. Prevalence of dentofacial characteristics in a Belgian orthodontic population. *Clin Oral Investig.* 2001;5:220–226.
31. Chevitarese AB, Della Valle D, Moreira TC. Prevalence of malocclusion in 4–6 year old Brazilian children. *J Clin Pediatr Dent.* 2002;27:81–85.
32. Hensel E, Born G, Korber V, Altvater T, Gesch D. Prevalence of defined symptoms of malocclusion among probands enrolled in the Study of Health in Pomerania (SHIP) in the age group from 20 to 49 years. *J Orofac Orthop.* 2003;64:157–166.
33. Lauc T. Orofacial analysis on the Adriatic islands: an epidemiological study of malocclusions on Hvar Island. *Eur J Orthod.* 2003;25:273–278.
34. Jones WB. Malocclusion and facial types in a group of Saudi Arabian patients referred for orthodontic treatment: a preliminary study. *Br J Orthod.* 1987;14:143–146.
35. Yang WS. The study on the orthodontic patients who visited department of orthodontics, Seoul National University Hospital [abstract]. *Taehan Chikkwa Uisa Hyophoe Chi.* 1990;28:811–821.
36. Sari Z, Uysal T, Karaman AI, Basciftci FA, Usumez S, Demir A. Orthodontic malocclusions and evaluation of treatment alternatives: an epidemiologic study. *Turkish J Orthod.* 2003;16:119–126.
37. Wilmont JJ, Barber HD, Chou DG, Vig KW. Associations between severity of dentofacial deformity and motivation for orthodontic-orthognatic surgery treatment. *Angle Orthod.* 1993;63: 283–288.
38. Tung AW, Kiyak HA. Psychological influences on the timing of orthodontic treatment. *Am J Orthod Dentofacial Orthop.* 1998; 113:29–39.
39. Proffit WR. Forty year review of extraction frequencies at a university orthodontic clinic. *Angle Orthod.* 1994;6:407–414.