Prevalence of Malocclusion and Orthodontic Treatment Needs in Mixed Dentition of School Going Children of Dharan, Nepal

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ABSTRACT

Introduction: Malocclusion can be defined as a mal-relation between the dental arches in any planes beyond the normal limits. With the rise in concern about good dental appearance, people compare it with success in different fields of life and are always willing to pursue the orthodontic treatment.

Objectives: To determine the prevalence of malocclusion and orthodontic treatment needs according to gender, race and age in mixed dentition of school going children of Dharan, Nepal.

Methods: A cross sectional study was conducted among 830 school children from 10 randomly selected schools from January 2017 to December 2017. The type of malocclusion was determined using a structured questionnaire and the orthodontic treatment need was calculated based on Dental Aesthetic Index (DAI). Chi-square test was used to test the associations.

Results: The prevalence of Class I, Class II division 1, Class II division 2 and Class III malocclusion was 49.11%, 11.43%, 4.03%, and 12.24%, respectively. Normal occlusion was found in 5.79% and 17.39% had asymmetry. The prevalence of orthodontic treatment needs was: 70.06% for slight or no need, 18.67% for elective need, 7.76% for highly desirable need, and 3.52% for mandatory need. Class I malocclusion was statistically significant for both Caucasians and Mongolians and among 8-year-old children ($P \leq 0.001$) whereas, 6-and-7-year-old children had no need for orthodontic treatment which was significant ($P<0.05$).

Conclusion: The study highlights the prevalence of malocclusion to be high with Class I being the most common and nearly one third in need for treatment as assessed by the DAI.

Key words: *Malocclusion, mixed dentition, orthodontic treatment needs, prevalence.*

INTRODUCTION

Malocclusion can be defined as an occlusion with a mal-relationship between the arches in any planes or with anomalies in tooth position, number, form and developmental position.[1] It affects periodontal health, increases the prevalence of dental caries and can cause temporomandibular joint problems.[2,3] Usually not a common finding requiring treatment, but if left untreated, can cause a negative and significant impact on the quality of life due to the associated psychological and social changes.[4] It is considered as a public health problem, occupying third place after dental caries and periodontal disease.

Whether to pursue any orthodontic treatment is usually influenced by the individual's desire to look attractive, gender, age and peer group norms. World Health Organization (WHO) recommends the Dental Aesthetic Index (DAI) as a rapid, relatively simple, internationally accepted index for assessing the dentofacial anomalies in epidemiological studies and also as a screening tool in

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dental public health programs.[5] Identifying the prevalence of a problem in mixed dentition helps to effectively implement its action earlier. This study was conducted to determine the prevalence of malocclusion and orthodontic treatment needs in mixed dentition of school going children of Dharan, Nepal and compare the prevalence between gender, race and age.

METHODS

A descriptive cross-sectional study was conducted among 830 school going children of Dharan from a period of January 2017 to December 2017 after obtaining the ethical approval from the Institutional Review Committee (IRC) of B.P. Koirala Institute of Health Sciences, Dharan (Ref. No. 303/073/074-IRC). Ten schools were randomly selected by lottery method including two government and eight private schools (nearly 10% of the total school population) and students from each school were selected using a systematic random sampling. A written informed consent was obtained from the Principals of each school and individual parents/ guardian along with assent from the participating children. Children with mixed dentition and with no history of orthodontic treatment were included and those with the presence of developmental disturbances of oral/dental tissues (congenitally missing teeth, retained deciduous teeth, or clefts of lip/palate) and syndromes and/or special health care needs (i.e. differently abled) and whose parents refused to give consent were excluded from the study.

A total 830 children were examined (inclusive of 15 percent non-response) and the sample size was calculated using the formula

$$\frac{Z_{\alpha}^{2}pq}{l^{2}}$$

considering 27.1 percent prevalence of asymmetries from the study conducted by Lagana et al.[6] (95 percent confidence interval=1.96; power = 88 percent).

Dental examination was carried out by the principal investigator (PI) under natural day light using a standard protocol. A proforma was used for recording the demographic profile, facial form (profile, antero-posterior jaw relation, vertical facial form, lip competency), dentition (stage, molar/incisor and canine relation, overjet, overbite, open bite, crossbite), tooth/arch size discrepancy[7] and orthodontic treatment need (as per DAI). The racial categorization into Caucasian and Mongolian was done according to Gurung et al.[8] After completing the oral examinations, health education regarding proper brushing technique, importance of primary teeth and diet counseling were given by the PI using tooth models, food guide pyramid model, audiovisual methods, booklets and pamphlets.

The findings were classified into normal occlusion, Class I malocclusion, Class II malocclusion (divisions 1 and 2), Class III malocclusion and asymmetry.

a. Normal occlusion: The mesio-buccal cusp of the upper first molar is present in the sulcus between the mesial and distal buccal cusps of the lower first molar. The mesial and distal inclines of the mesio-buccal cusp of the upper first molar are received between the mesial and distal buccal cusps of the lower first molar. The inclines of the disto-buccal cusp of the upper first molar are received between the disto-buccal cusp of the first lower molar and the mesio-buccal cusp of the second lower molar. The mesial incline of the upper canine occludes with the distal incline of the lower canine; the distal incline of the upper canine occludes with the mesial incline of the buccal cusp of the lower first premolar. Each of the teeth in both jaws has two antagonists or supports in the opposite jaw, except the lower centrals and the upper third molars.[7]

b. Angle's classification was used to classify the malocclusion into Class I, Class II and Class III malocclusion. Class I malocclusion included bilateral class I relationship of molar and canine along with crowding, spacing and rotations. Class II malocclusion included bilateral class II molar and canine relation (division 1 proclined incisors and division 2 retroclined and overlapped incisors). Class III malocclusion included bilateral class III molar and canine relationship.[6]

c. Asymmetry included bilaterally different molar and canine relationship.[6]

The data were entered into Microsoft Excel and transferred into Statistical Package of Social Sciences (SPSS) version 20 for statistical analysis. For descriptive statistics, frequency and percentage were calculated. Chi-square test

was used to determine the association of malocclusion and orthodontic treatment needs with different variables like gender, race, and age. The level of significance was set at P≤0.05.

RESULTS

Out of the total of 830 sample, 386 (46.50%) were males and 444 (53.50%) were females. The mean age of the participants was 9.27±2.00 (Mean [SD]). Among them, 320 (38.6%) were Caucasians and 510 (61.4%) were Mongolians.

Prevalence of Malocclusion

The prevalence of different types of malocclusion was determined according to the Angle's Classification based upon the relationship of the maxillary and mandibular first permanent molars which also included normal occlusion and asymmetry, where asymmetry means bilaterally different molar relation. Out of 830 school children, 36 (5.79%) were with normal occlusion, 305 (49.11%) with Class I malocclusion, 71 (11.43%) with Class II division 1 malocclusion, 25 (4.03%) with Class II division 2 malocclusion, 76 (12.24%) with Class III malocclusion, and 108 (17.39%) with asymmetry. However, in 209 children, the type of malocclusion was not recorded as the first permanent molars could not be assessed either due to partial eruption or extensive dental caries (Figure 1).

Frequency and Distribution of Malocclusion

The frequency and distribution of malocclusion was evaluated on the basis of gender, race, and age. A Chi-square test was used to see the difference.

- The most prevalent type of malocclusion among both males and females was Class I malocclusion (49.1%) whereas, Class II division 2 was the least (3.8%; 4.2%, respectively) and normal occlusion was more common among females (7.2% vs 4.2%). This difference was statistically non-significant (P = 0.212) (Table 1).

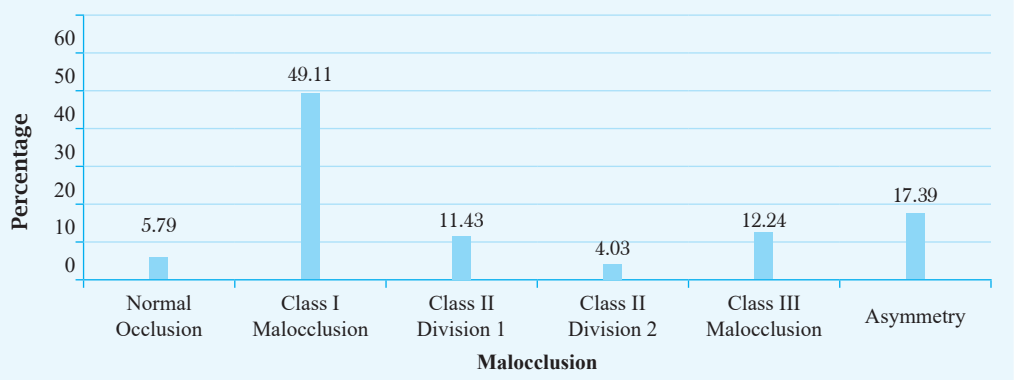

Figure 1. Prevalence of Malocclusion (n=621).

Table 1. Gender-wise Distribution of Malocclusion (n=621).

Malocclusions	Males n (%)	Females n (%)	Chi-square Value	P Value
Normal Occlusion	12 (4.2)	24 (7.2)	7.124	0.212
Class I Malocclusion	141 (49.1)	164 (49.1)		
Class II Division 1	40 (13.9)	31 (9.3)		
Class II Division 2	11 (3.8)	14 (4.2)		
Class III	30 (10.5)	46 (13.8)		
Asymmetry	53 (18.5)	55 (16.5)		

Remarks: Not Recorded 99 males and 110 females

Table 2. Race-wise Distribution of Malocclusion (n=621).

Malocclusions	Caucasians n (%)	Mongolians n (%)	Chi-square Value	P Value
Normal Occlusion	11 (4.8)	25 (6.4)	21.009	0.001
Class I Malocclusion	102 (44.2)	203 (52.1)		
Class II Division 1	43 (18.6)	28 (7.2)		
Class II Division 2	6 (2.6)	19 (4.9)		
Class III	28 (12.1)	48 (12.3)		
Asymmetry	41 (17.7)	67 (17.2)		

**Remarks: 89 Caucasians and 120 Mongolians not recorded*

Table 3. Age-wise Distribution of Malocclusion (n=621).

Malocclusion by Age (years)	Normal Occlusion n (%)	Class I n (%)	Class II Div. 1 n (%)	Class II Div. 2 n (%)	Class III n (%)	Asymmetry n (%)
6	0 (0.0)	4 (50.0)	3 (37.5)	0 (0.0)	1 (12.5)	0 (0.0)
7	0 (0.0)	12 (54.5)	1 (4.5)	1 (4.5)	4 (18.2)	4 (18.2)
8	0 (0.0)	72 (66.1)	12 (11.0)	4 (3.7)	9 (8.3)	12 (11.0)
9	3 (2.3)	71 (53.4)	26 (19.5)	6 (4.5)	6 (4.5)	21 (15.8)
10	6 (5.2)	61 (52.6)	9 (7.8)	6 (5.2)	15 (12.9)	19 (16.4)
11	9 (8.2)	41 (37.3)	11 (10.0)	4 (3.6)	19 (17.3)	26 (23.6)
12	11 (13.8)	26 (32.5)	1 (1.3)	3 (3.8)	15 (18.8)	24 (30.0)
13	7 (16.3)	18 (41.9)	8 (18.6)	1 (2.3)	7 (16.3)	2 (4.7)

**Remarks: Not Recorded 209*

Table 4. Relationship between Malocclusion and Age Group (n=621).

		Normal Occlusion	Malocclusion	Total	Chi-square Value	P Value
Age group	≤ 10	9 (2.3)	379 (97.7)	388 (100.0)	22.900	<0.001
	> 10	27 (11.6)	206 (88.4)	233 (100.0)		
Total		36 (5.8)	585 (94.2)	621 (100.0)		

**Remarks: Not Recorded 209*

- Class I malocclusion was more common among both Caucasians and Mongolians (44.2%; 52.1%, respectively) and Class II division 2 malocclusion was the least (2.6%; 4.9%, respectively). Normal occlusion was more common among Mongolians than Caucasians (6.4% vs 4.8%). The racial difference was statistically significant (P=0.001) (Table 2).
- The age-wise distribution of malocclusion was highest for Class I malocclusion among 8-year-old children (66.1%) which was significant statistically (P<0.05) (Table 3, 4).

Prevalence of Orthodontic Treatment Needs

The orthodontic treatment need was calculated based upon the Dental Aesthetic Index (DAI) given by WHO. Out of 830 children, 29 (3.52%) had mandatory need indicating very severe or handicapping malocclusion, 64 (7.76%) had highly desirable need indicating severe malocclusion, 154 (18.67%) had elective need indicating definite malocclusion and 578 (70.06%) had no or slight need indicating no abnormality or minor malocclusion. However, five children could not be assessed due to the absence of molars as well as the canines either due to partial eruption or extensive decay (Figure 2).

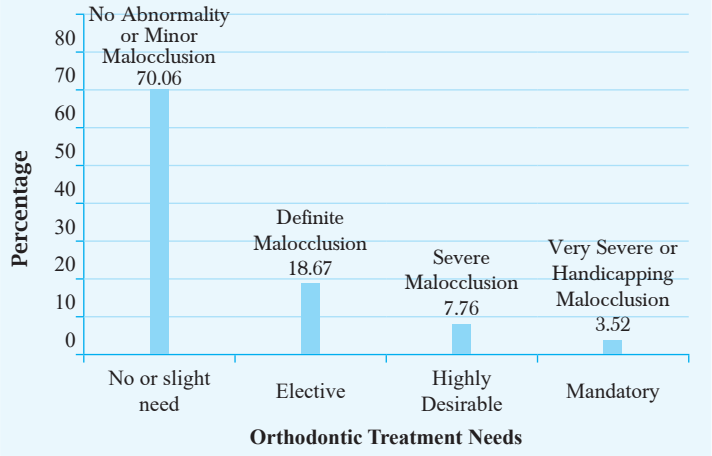

Figure 2. Prevalence of Orthodontic Treatment Need.

Frequency and Distribution of Orthodontic Treatment Needs

The frequency and distribution of orthodontic treatment needs was evaluated on the basis of gender, race, and age. A Chi-square test was used to see the difference.

- Gender-wise distribution showed 71.4% of females with no need for orthodontic treatment, whereas 20.3% of males showed elective need; the difference among males and females being non-significant (P>0.05) (Table 5).
- Race-wise distribution among Caucasians and Mongolians showed 4.1% of Mongolians with mandatory need for treatment, whereas 71.2% of them had no need. However, the difference was non-significant (P>0.05) (Table 6).
- Age-wise, 80-90% of 6-and-7-year-old children had no need for orthodontic treatment whereas, mandatory need was present only among 6% of 8-year-old children. The difference in treatment need among age groups was statistically significant (P=0.002) (Table 7, 8).

Table 5. Gender-wise Distribution of Orthodontic Treatment Needs (DAI).

Treatment Indication	Gender		Total	Chi-Square	P value
	Males n (%)	Females n (%)			
No need	263 (68.5)	315 (71.4)	578 (70.1)	1.370	0.713
Elective	78 (20.3)	76 (17.2)	154 (18.7)		
Highly Desirable	29 (7.6)	35 (7.9)	64 (7.8)		
Mandatory	14 (3.6)	15 (3.4)	29 (3.5)		
Total	384 (100)	441 (100)	825 (100)		

**Remarks: Not Recorded 5*

Table 6. Race-wise Distribution of Orthodontic Treatment Needs (DAI).

Treatment Indication	Race		Total	Chi-Square	P value
	Caucasians n (%)	Mongolians n (%)			
No need	217 (68.2)	361 (71.2)	578 (70.1)	3.282	0.350
Elective	66 (20.8)	88 (17.4)	154 (18.7)		
Highly Desirable	27 (8.5)	37 (7.3)	64 (7.8)		
Mandatory	8 (2.5)	21 (4.1)	29 (3.5)		
Total	318 (100.0)	507 (100.0)	825 (100.0)		

**Remarks: Not Recorded 5*

Table 7. Age-wise Distribution of Orthodontic Treatment Needs (DAI).

Age	Treatment Indication			
	No need	Elective	Highly Desirable	Mandatory
6	80 (90.9)	6 (6.8)	2 (2.3)	0 (0.0)
7	66 (80.5)	7 (8.5)	7 (8.5)	2 (2.4)
8	107 (71.8)	24 (16.1)	9 (6.0)	9 (6.0)
9	84 (59.6)	29 (20.6)	21 (14.9)	7 (5.0)
10	84 (71.2)	22 (18.6)	9 (7.6)	3 (2.5)
11	75 (65.8)	24 (21.1)	11 (9.6)	4 (3.5)
12	52 (59.1)	29 (33.0)	4 (4.5)	3 (3.4)
13	30 (66.7)	13 (28.9)	1 (2.2)	1 (2.2)

**Remarks: Not Recorded 5*

Table 8. Relationship between Orthodontic Treatment Needs (DAI) and Age Group.

Age Group	Treatment Indication				Chi-square	P value
	No need	Elective	Highly Desirable	Mandatory		
≤ 10 years	421 (72.80%)	88 (15.20%)	48 (8.30%)	21 (3.60%)	15.197	0.002
< 10 years	157 (63.60%)	66 (26.70%)	16 (6.50%)	8 (3.20%)		

**Remarks: Not Recorded 5*

DISCUSSION

Early diagnosis of malocclusion and the need for treatment helps to prevent and/or intercept it at an earlier stage. These kinds of epidemiological studies help in determining the target population that is being affected in order to plan the treatment accordingly. According to the American Academy of Pediatric Dentistry, the factors that should be kept in mind while choosing for the need of orthodontic treatment in mixed dentition period depends upon: chronological/ mental/ emotional age of the patient, patient's ability to understand and co-operate with the treatment, parental support for treatment, compliance with instructions and accuracy of diagnosis regarding the appropriateness of treatment.[9] This cross-sectional study presents the first one of its kind to be conducted in the mixed dentition of school going children of Dharan, Nepal with the primary objective to find out the prevalence of malocclusion and orthodontic treatment needs.

The prevalence of malocclusion has been found to vary according to age, gender, race and types of population studied in different parts of the world including Nepal. In the present study, normal occlusion was recorded for 5.79%, Class I malocclusion in 49.11%, followed by asymmetry in 17.39%. Similarly, Class III malocclusion was seen in 12.24%, Class II division 1 malocclusion in 11.43%, and Class II division 2 malocclusion in 4.03% which was statistically significant age-wise (P<0.05); whereas, in a similar study in Albanese population Class I malocclusion, Class II malocclusion, Class III malocclusion and asymmetries were found in 40.4%, 29.2%, 3.2% and 27.1%, respectively with no significant differences according to the age.[6] Class I malocclusion was the most common finding in our study (49.11%), similar to other studies conducted in Eastern Nepalese population that showed Class I malocclusion in 62.28% of 8-36-year-old[10] and 48.50% of 12-15-year-old.[11] The racial comparison in present study shows a lower prevalence rate for Class I malocclusion among Mongolians (52.1%) as compared to the findings of Baral[12] (64%). This difference may be attributed to the different age groups and dentition status of the study population. The age-wise distribution of malocclusion in our study was more in children ≤ 10 years as compared to the normal occlusion, where only 2.3% had normal occlusion and 97.7% had malocclusion. Whereas, above 10 years showed a slight change which was evident with 11.6% having normal occlusion, compared to malocclusion in 88.4%. Here, a significant difference was seen between malocclusion and age of the children (P≤0.001).

The role of dental and facial appearance has been ever changing since the past years with a notable increase in

orthodontic treatment demand. The perception towards malocclusion and a greater desire for better esthetics show an improvement in awareness of the parents as well as patients.[13] Several indices have been used in different studies to evaluate the need for treatment and in the present study, orthodontic treatment needs was calculated based upon the Dental Aesthetic Index (DAI) which was introduced for implementation in oral health research and epidemiological studies by World Health Organization. DAI is considered as a simple and less time-consuming tool for screening the treatment priority in public health programs.

It was found that 70.06% of total children had DAI score <25 indicating no or slight treatment need with minor malocclusion similar to the findings of Khanehmasjedi, Bassir and Haghighizade[13] (70.8%), more in comparison to Poonacha, Deshpande and Shigli[14] (3%) and Garcia et al.[15] (58.6%), and less compared to Otuyemi[16] (77.4%) and Shivakumar et al.[17] (80.1%). The DAI score of 26-30 indicating definite malocclusion with an elective treatment need was present in 18.67% of children which was less as compared to Khanehmasjedi, Bassir and Haghighizade[13] (19.2%), and Garcia et al.[15] (20.3%) whereas, it was more in comparison to Poonacha, Deshpande and Shigli[14] (15%), Otuyemi[16] (13.4%), and Shivakumar et al.[17] (15.7%). Likewise, 7.76% of children were in the category of DAI score of 31-35 with highly desirable treatment need and severe malocclusion similar to Khanehmasjedi, Bassir and Haghighizade[13] (7.8%) but low compared to Poonacha, Deshpande and Shigli[14] (27%) and Garcia et al.[15] (11.2%) and high compared to Otuyemi[16] (5.5%) and Shivakumar et al.[17] (3.7%). Nearly four percent (3.52%) had DAI score ≥36 with handicapping or very severe malocclusion, and mandatory treatment need which was quite low and in contrast to Poonacha, Deshpande and Shigli[14] (55%). Other studies also showed a lower prevalence for DAI score ≥36 indicating handicapping malocclusion. The gender- and race-wise comparison was statistically non-significant for the treatment need, whereas the age-wise comparison showed the distribution of treatment need to be greater for children less than 10 years of age except for the elective need which was found to be more in children >10 years and was statistically significant (P=0.002). This may be attributed to the racial variation, age, and dentition status of the selected population.

Mixed dentition is a phase with continuous change. There is an alteration in incisor and molar relation that occurs due to various factors like eruption of teeth, utilization of leeway spaces and mandibular growth. As Angle's classification requires first permanent molars to be in occlusion, their evaluation may be limited either due to partial eruption, extensive dental caries, or even absence. There may be an overestimation of malocclusion and treatment need due to the developing transient malocclusions like ugly duckling stage, end-on molar relation, deep-bite and anterior mandibular crowding. Genetic and environmental factors always play their role in growth and development of dentition and occlusion especially Class III malocclusion.

CONCLUSION

The present study highlights the prevalence of malocclusion to be high with Class I being the most common, and among those who had malocclusion; nearly two thirds had slight or no need for treatment as assessed by the DAI. The higher prevalence of Class I malocclusion was followed by asymmetry, Class III malocclusion, Class II division 1 malocclusion, Class II division 2 malocclusion and normal occlusion and this distribution was significant for race and age. The prevalence of orthodontic treatment needs was highest for slight or no need followed by elective need, highly desirable need, and mandatory need with the comparison being significant for age. The findings form a baseline that would be helpful in reforming the treatment policies and provide preventive and interceptive orthodontics. Timely detection of malocclusion with its associated risk factors along with treatment needs highlights the importance of periodic screenings and referral focused at both community as well as individual dentists' level.

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Conflict of interest: None.

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REFERENCES

1. Chauhan D, Sachdev V, Chauhan T, Gupta KK. A study of malocclusion and orthodontic treatment needs according to dental aesthetic index among school children of a hilly state of India. J Int Soc Prev Community Dent. 2013 Jan;3(1):32-7. [PubMed| DOI]
2. 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 Apr;23(2):153-67. [PubMed | DOI]
3. Kumar P, Londhe SM, Kotwal A, Mitra R. Prevalence of malocclusion and orthodontic treatment need in schoolchildren - An epidemiological study. Med J Armed Forces India. 2013 Oct;69(4):369-74. [PubMed | DOI]
4. Santos RR, Nayme JG, Garbin AJ, Saliba N, Garbin CA, Moimaz SA. Prevalence of malocclusion and related oral habits in 5- to 6-year-old children. Oral Health Prev Dent. 2012;10(4):311-8. [PubMed]
5. Chen MS, Andersen RM, Barmes DE, Leclerq MH, Lyttle CS, World Health Organization. Comparing oral health care systems: a second international collaborative study. World Health Organization; 1997. Retrieved 22 July 2020. Available from: https://apps.who.int/iris/handle/10665/41976. [Link]
6. Lagana G, Masucci C, Fabi F, Bollero P, Cozza P. Prevalence of malocclusions, oral habits and orthodontic treatment need in a 7- to 15-year-old schoolchildren population in Tirana. Prog Orthod. 2013 Jun 14;14(1):12. [PubMed |DOI]
7. Bishara SE, Saunders WB. Textbook of orthodontics. Saunders Book Company; 2001 Mar 21. Retrieved 22 July 2020. Available from: scribd.com/doc/121958829/Textbook-of-Orthodontics-Samir-Bishara-599-52MB. [Full Text]
8. Gurung H, Gurung Y, Chidi C. Nepal atlas of ethnic and caste groups. Kathmandu, Nepal: Nepal Foundation for Development of Indigeneous Nationalities (NFDIN); 2005:iv(fig1). Retrieved 22 December 2020. Available from: https://www.worldcat.org/title/nepal-atlas-of-ethnic-caste-groups/oclc/81150038 [Link]
9. American Academy of Pediatric Dentistry. Management of the developing dentition and occlusion in pediatric dentistry. The Reference Manual of Pediatric Dentistry. Chicago, Ill: American Academy of Pediatric Dentistry; 2021:408-25. [Full Text]
10. Sharma J. Pattern of Distribution of Malocclusions in Patients Seeking Orthodontic Treatment at BPKIHS from Sunsari District of Nepal. Health renaissance. 2010;8(2):93-6. [Full Text | DOI]
11. Singh VP, Sharma A, Roy DK. Assessment of the Self-Perception of Dental Appearance, Its Comparison with Orthodontist's Assessment and Demand for Treatment in Eastern Nepalese Patients. Adv Med. 2014;2014:547625. [PubMed | DOI]
12. Baral P. Prevalence of malocclusion in permanent dentition in Aryan and Mongoloid races of Nepal-A Comparative study. Pakistan Orthodontic Journal. 2013 Dec 1;5(2):57-9. [Full Text]
13. Khanehmasjedi M, Bassir L, Haghighizade MH. Evaluation of orthodontic treatment needs using the dental aesthetic index in Iranian students. Iran Red Crescent Med J. 2013 Oct;15(10):e10536. [PubMed | DOI]
14. Poonacha KS, Deshpande SD, Shigli AL. Dental aesthetic index: applicability in Indian population: a retrospective study. J Indian Soc Pedod Prev Dent. 2010 Jan-Mar;28(1):13-7. [PubMed | DOI]
15. Garcia AB, Bravo M, Baca P, Baca A, Junco P. Malocclusions and orthodontic treatment needs in a group of Spanish adolescents using the Dental Aesthetic Index. Int Dent J. 2004 Jun;54(3):138-42. [PubMed | DOI]
16. 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 Aug;49(4):203-10. [PubMed| DOI]
17. Shivakumar KM, Chandu GN, Subba Reddy VV, Shafiulla MD. Prevalence of malocclusion and orthodontic treatment needs among middle and high school children of Davangere city, India by using Dental Aesthetic Index. J Indian Soc Pedod Prev Dent. 2009 Oct-Dec;27(4):211-8. [PubMed| DOI]