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RESEARCH ARTICLE

ASSOCIATION OF POSITIONAL VARIATIONS OF PREMOLARS WITH INTERARCH FEATURES AMONG MALAYSIANS

***[1]Syiral Abdullah, [2]Alizae Marny Mohamed, [3]Tuti Ningseh Mohd Dom**

[1]Faculty of Dentistry, Universiti Sains Islam Malaysia
[2,3]Faculty of Dentistry, Jalan Raja Muda Abd Aziz, Universiti Kebangsaan Malaysia, Kuala Lumpur

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ABSTRACT

Objectives: This study aims to determine the prevalence of various premolar positions and to identify the interach features that are associated with these variations.
Materials and Methods: Using a cross-sectional epidemiological study design, individuals meeting the selection criteria were randomly selected from the 15-35 years old Malaysian population. Dental impressions of 1000 subjects were obtained using alginate and poured into dental casts. Clinical data of the premolar positions and interarch features were made using these dental casts. Chi-square tests were performed to compare the prevalence rates among the positional variations of premolars.
Results: A total of 4000 maxillary and 4000 mandibular premolar (N=8000) positions were observed in 1000 patients. Normal position accounted for majority of the premolars (59%), followed by those that were rotated (32.4%), displaced (6.9%), impacted (1.2%), unerupted (0.3%) and congenitally missing (0.2%). The left mandibular first premolars positions were mostly significantly associated ($P<0.05$) with all of the interarch features variables measured. Associations were noted with incisor relationships (p=0.004, Table 4), canine relationships (p=0.011, Table 5), molar relationships (P=0.043, Table 6), overjet (p=0.016, Table 7) and overbite (p=0.046, Table 8).
Conclusion: The variations of premolar position shows significant association with interarch features; incisor, canine and molar classifications, as well as overjet and overbite.

INTRODUCTION

Eruption of premolar teeth normally takes place between the ages of 10 to 12 years. In the mandible, the canine erupts before the first premolar followed by the second premolar, whereas in the maxilla, the first premolar erupts ahead of the second premolar and subsequently the canine. The consequences of these eruption patterns include malposition of teeth which will be reflected in dental arch crowding. Premolars are preceded by deciduous molar teeth, whereby the special feature of leeway space usually provides premolars with adequate space to erupt into the arch without any problem of crowding. Despite this feature, premolars may still fail to erupt, be missing from the arch, partially impacted or erupt in ectopic positions, either lingual or buccal to the arch (Burch *et al*., 1994 and Stemm, 1971). Furthermore, premolars can also present with variable degrees of rotation or inclination. Interarch features are important clinical parameters to facilitate epidemiological registration and are appropriately considered when categorizing orthodontic treatment needs. Incisor, canine and molar relationships, overjet and overbite influence decisions about the pattern of extraction to be performed and anchorage demands in orthodontic treatment. The role of extraction in orthodontic treatment in malocclusion correction has been a controversial and been debated over century (Profit, 1994 and McCaul *et al*., 2001). In addition, premolars have always been the preferred tooth to extract to relieve crowding in the dental arches, especially the first premolars (Travess *et al*., 2004; Kim *et al*., 2005 and Janson *et al*., 2006). Premolars are often ideal to relieve both anterior and posterior crowding. Both first and second premolars have similar crowns forms which means the contact point of remaining premolars can be achieved with molar and canine once the space are closed. Literature and scientific research reported on the prevalence of premolars position and the association of positional variations of premolars with specific interach features is lacking. There was deficiency of this information among the Malaysian population despite the contributions of premolars to the development of malocclusion and their relevance to treatment decisions in orthodontics. Furthermore, the contribution of premolars position in decision making during the orthodontic treatment planned was not really understood. Therefore, this study aims to determine the prevalence of various premolar tooth positions among 15-35 year old Malaysians and to explore associations between these premolar positions and interach features; incisors, canine, molar, overbite and overjet.

**Corresponding author: Syiral Abdullah*
Faculty of Dentistry, Universiti Sains Islam Malaysia

MATERIALS AND METHODS

This study was approved by the Universiti Kebangsaan Malaysia (UKM) Research and Ethics Committee [UKM1.5.3.5/244/DD/032 (1)/2009]. The sample size calculation was done using Statcalc. Of EpiInfo Version 6. A total of 1000 patients were estimated necessary to obtain expected frequency of 2.5% based on congenitally missing premolars with confidence level was determined at 80% and α=5% (Locht, 1980). The material for this study consisted of dental casts which were obtained from the subjects. The inclusion criteria for the individuals in this study were: aged between 15-35 years old (this is to ensure the completion of permanent teeth presence in the mouth), no history of extraction, orthodontic treatment and trauma.

Interach parameters were measured from the dental models as described in Tables 1 and 2. Following the dental cast evaluations, radiographic examination was performed if any premolars were observed to be missing on the casts. Percentages of premolars within each of the position categories were calculated, and chi-squared tests were used to identify any statistical associations with interarch parameters using SPSS software (version 17.0; SPSS, Chicago, IL, USA). The significance level for statistical testing was set at $\alpha<0.05$. Intra-examiner reliability measurements were performed by repeating measurements by the same examiner (SA) on 100 randomly selected dental casts after one month's interval. The measurement error was calculated according to the formula; $ME=\sqrt{d^2/2n}$, where d is the difference between the duplicated measurements and n is the number of replications (Dahlberg, 1940). Analysis was performed giving Kappa value of 0.79 which showed good reliability and reproducibility.

RESULTS

A total of 7960 premolars were observed in 1000 subjects. There were 618 (61.8%) males and 382(38.2%) females subjects involved with their mean age were 17.8 $\pm$ 3.5 years old. Majority of the subjects were among the Malays 677(67.7%), followed by Chinese 151(15.1%), Indian 161(16.1%) and other ethnicity (Sabahan, Kadazan, Iban) 11(1.1%). However, this study was not intended to determine the differences in the prevalence of premolars position among the ethnic groups. As shown in Table 3, the majority of the premolars were observed to be in a normal position (59%), followed by those that were rotated (32.4%), displaced (6.9%), impacted (1.2%), unerupted (0.3%) and congenitally missing (0.2%). The premolars that were rotated, displaced, impacted, unerupted or congenitally missing were than grouped as 'others' for further analysis. Despite variations in position, a few significant associations were observed between premolar positions with incisor, canine and molar relationship (Tables 4-6). For premolars position in relation to incisor relationship, only mandibular first premolars in both quadrants were significantly associated with incisor relationship. A significantly higher proportions of normally positioned premolars were found among subjects with Class I and Class III as compared to other positions, whereas among those with Class II div 1 and 2, a significantly higher proportions of premolars with other positions was observed (p=0.04, 0.005; Table 4). For canine relationships, only the left first premolars in both maxilla and mandible had shown significant associations where regardless category of canine relationship. Two-third of the left maxillary first premolars were normally positioned (p=0.016; Table 5). However, for left mandibular first premolars, higher premolar with other positions was found among those with Class III. However, almost equal proportion of normal and other positions was found in Class I and II canine relationship (p=0.011; Table 5). It was observed among the subjects that the proportions of normally positioned right maxillary first premolar and left mandibular first premolar were highest in those with Class I molar relationships (P=0.021 and P=0.043; Table 6). All mandibular premolars, however, showed higher proportions of normal positions in subjects with Class I molar relationships ($P<0.05$, Table 6). The left and the right mandibular first premolar showed a significant association with overjet (p=0.016, 0.0034; Table 7). Normally positioned mandibular first premolars appeared more frequently in individuals with overjets between 0-6mm. However, as the overjet increase to more than 6mm, more proportion of other positioned premolars was observed. As for the overbite, it was noted there are a significant association of both premolars position in all categories of overbite. Generally, the normally positioned left maxillary and mandibular first premolars appeared more frequently with overbite less than 30%, including the anterior open bite. Once the overbite increased more than 30%, the prevalence of more of other premolars positioned were affected (p=0.025, 0.046; Table 8).

DISCUSSION

Although the individuals involved in this study were among the Malaysian population, this study was not intended to determine the differences in the prevalence of premolars position among the ethnic groups. Therefore no analysis was made to compare variables among these ethnic groups. As part of the routine examination process to ensure diagnostic validity in the assessment of premolar position, 40 subjects that have been justified as having clinically missing premolars on the cast were referred for dental panoramic tomography (DPT). The radiographs analysed confirmed that 24 premolars (5 first premolars and 19 second premolars) were unerupted and 16 second premolars were congenitally missing (Table 3). These subjects were than given advices and an explanation of their dental conditions. Further management and options for treatment were discussed.

Dental clinicians and orthodontist are faced with the need to explain and justify their treatment plan particularly that involves premolars. However, it is well known that differences in decision making among dental clinician are in part to the differing knowledge, training, experience and perceptions. The scientific evidence of relationship between premolars position to the interarch features are hard to locate, although interarch features can be varies because of differences in the tooth positions. This study demonstrated a higher percentage of mandibular second premolars that are varying in their positions compared to the maxillary second premolars (Table 3). These results are consistent with previous study by Stemm, 1971 which were limited to the assessment of lower premolars. This higher percentage may be due to local factors such as mesial

Table 1. Dental Cast Assessment

Assessment	Definition
The incisor relationship (British Standard Institute, 1972)	
Class I	The lower incisor edges occlude with or lie immediately below the cingulum plateau of the upper central incisors
Class II division 1	The lower incisor edges occlude posterior to the cingulum plateau of the upper central incisors with the upper central incisors proclined
Class II division 2	The lower incisor edges occlude posterior to the cingulum plateau of the upper central incisors with the upper central incisors retroclined
Class III	The lower incisor edges occlude anterior to the cingulum plateau of the upper central incisors.
The molar relationship (Angle)[a]	
Class I	The mesiobuccal cusp of the upper first molar occlude with or lie immediately on the buccal groove of the lower first permanent molar
Class II	The mesiobuccal cusp of the upper first molar occlude anterior to the buccal groove of the lower first permanent molar
Class III	The mesiobuccal cusp of the upper first molar occlude anterior to the buccal groove of the lower first permanent molar
The canine relationship [a]	
Class I	The permanent canine lie immediately between the embrasure of lower permanent canine and first premolar
Class II	The permanent canine lie anterior the embrasure of lower permanent canine and first premolar
Class III	The permanent canine lie posterior the embrasure of lower permanent canine and first premolar
Premolar positions	
Normal	Premolar is in alignment or minor deviation from the line of the arch.
Missing[b]	Clinically missing or with retained deciduous molar.
Impacted	Premolar teeth that are partially erupted and obstructed against other teeth to erupt completely.
Rotated	Premolar with its centre fossa rotated from the line of the arch
Displaced[c]	Premolar that are excluded from the line of the arch either buccally or lingually.

[a] A quarter or half unit or three quarter unit class II or III is considered as class II or III respectively.
[b] Radiograph were taken to confirm the presence either unerupted or congenitally missing
[c]Preference for displaced were given priority for scoring when rotation was also observed

Table 2. Dental Cast measurements

Measurement(mm)	Definition
Overjet [e]	Horizontal distance from the most labial point of the incisal edge of maxillary right central incisor to the most labial surface of the corresponding mandibular incisor measured to the nearest half millimeter using metal ruler parallel to the occlusal plane.
Overbite [f]	Vertical overlap of incisors measured from the incisal edge of the maxillary right central incisor to the incisal edge of the corresponding mandibular incisor to the nearest half millimeter

[e]A positive value was recorded if the upper incisor was ahead of the lower incisor and a negative value when the upper incisor was behind the lower incisor
[f]An openbite was recorded when there was no vertical overlap of the incisors

Table 3. Distribution of premolars positional variation

Tooth		Clinical Features						Total
		Normal	Rotated	Displaced	Impacted	Unerupted	Missing	
First premolar	14	731(73.1)	241(24.1)	24(2.4)	2(0.2)	2(0.2)	0(0)	1000
	24	743(74.3)	221(22.1)	32(3.2)	3(0.3)	1(0.1)	0(0)	1000
	34	512(51.2)	386(38.6)	89(8.9)	11(1.1)	2(0.2)	0(0)	1000
	44	526(52.6)	392(39.2)	76(7.6)	6(0.6)	0(0)	0(0)	1000
	Total	2512(62.8)	1240(31.0)	221(5.5)	22(0.6)	5(0.1)	0(0)	4000
Second premolar	15	664(66.4)	248(24.8)	69(6.9)	10(1.0)	4(0.4)	5(0.5)	1000
	25	657(65.7)	247(24.7)	80(8.0)	6(0.6)	6(0.6)	4(0.4)	1000
	35	424(42.4)	446(44.6)	91(9.1)	30(3.0)	5(0.5)	4(0.4)	1000
	45	462(46.2)	411(41.1)	92(9.2)	28(2.8)	4(0.4)	3(0.3)	1000
	Total	2207(55.2)	1352(33.8)	332(8.3)	74(1.8)	19(0.5)	16(0.4)	4000
TOTAL		4719(59.0)	2592(32.4)	553(6.9)	96(1.2)	24(0.3)	16(0.2)	8000

Table 4. Distribution of premolar position in relation to incisor relationship

Tooth		Positions	Incisor Relationship				Total	p value
			Class I	Class II div 1	Class II div 2	Class III		
			N=423	N=301	N=71	N=205		
			n (%)	n (%)	n (%)	n (%)		
First premolar	14	Normal	312(73.8)	219(72.8)	50(70.4)	150(73.2)	731	0.946
		Others	111(26.2)	82(27.2)	21(29.6)	55(26.8)	269	
	24	Normal	320(75.7)	227(75.4)	43(60.6)	153(74.6)	743	0.054
		Others	103(24.3)	74(24.6)	28(39.4)	52(25.4)	257	
	34	Normal	236(55.8)	134(44.5)	29(40.8)	113(55.1)	512	0.004*
		Others	187(44.2)	167(55.5)	42(59.2)	92(44.9)	488	
	44	Normal	247(58.4)	143(47.5)	29(40.8)	107(52.2)	526	0.005*
		Others	176(41.6)	158(52.5)	42(59.2)	98(47.8)	474	
	Total		1692	1204	284	820	4000	
Second premolar	15	Normal	299(70.7)	195(64.8)	42(59.2)	128(62.4)	664	0.074
		Others	124(29.3)	106(35.2)	29(40.8)	77(37.6)	336	
	25	Normal	289(68.3)	194(64.5)	45(63.4)	129(62.9)	657	0.500
		Others	134(31.7)	107(35.5)	26(36.6)	76(37.1)	343	
	35	Normal	187(44.2)	123(40.9)	33(46.5)	81(39.5)	424	0.564
		Others	236(55.8)	178(59.1)	38(53.5)	124(60.5)	576	
	45	Normal	207(48.9)	122(40.5)	39(54.9)	94(45.9)	462	0.061
		Others	216(51.1)	179(59.5)	32(45.1)	111(54.1)	538	
	Total		1692	1204	284	820	4000	
TOTAL			3384	2408	568	1640	8000	

*p<0.05 statistically significant; n= number of subjects

Table 5. Distribution of premolar position in relation to canine relationship

Tooth		Positions	Canine Relationship			Total	p value
			Class I	Class II	Class III		
			n (%)	n (%)	n (%)		
First premolar	14	Normal	324(76.6)	362(71.4)	44(65.7)	730	0.072
		Others	99(23.4)	145(28.6)	23(34.3)	267	
	24	Normal	345(78.1)	347(72.6)	50(64.1)	742	0.016*
		Others	97(21.9)	131(27.4)	28(35.9)	256	
	34	Normal	245(55.4)	235(49.2)	30(38.5)	510	0.011*
		Others	197(44.6)	243(50.8)	48(61.5)	488	
	44	Normal	230(54.4)	266(52.5)	29(43.3)	525	0.238
		Others	193(45.6)	241(47.5)	38(56.7)	472	
	Total		1730	1970	290	3990	
Second premolar	15	Normal	297(70.2)	328(64.7)	37(55.2)	662	0.067
		Others	126(29.8)	179(35.3)	30(44.8)	335	
	25	Normal	299(67.6)	312(65.3)	45(57.7)	656	0.223
		Others	143(32.4)	166(34.7)	33(42.3)	342	
	35	Normal	194(43.9)	197(41.2)	33(42.3)	424	0.714
		Others	248(56.1)	281(58.8)	45(57.7)	574	
	45	Normal	199(47.0)	234(46.2)	29(43.3)	462	0.842
		Others	224(53.0)	273(53.8)	38(56.7)	535	
	Total		1750	1970	290	3990	
TOTAL			3460	3940	580	7980	

*p<0.05 statistically significant

Table 6. Distribution of premolar position in relation to molar relationship

Tooth		Positions	Molar Relationship			Total	p value
			Class I	Class II	Class III		
			n (%)	n (%)	n (%)		
First premolar	14	Normal	459 (75.7)	137(65.9)	135(72.6)	731	0.021*
		Others	147(24.3)	71(34.1)	51(27.4)	269	
	24	Normal	436(76.2)	109(67.3)	198(74.4)	743	0.071
		Others	136(23.8)	53(32.7)	68(25.6)	257	
	34	Normal	309(54.0)	84(51.9)	119(44.7)	512	0.043*
		Others	263(46.0)	78(48.1)	147(37.2)	488	
	44	Normal	326(53.8)	113(54.3)	87(46.8)	526	0.209
		Others	280(46.2)	95(45.7)	99(53.2)	474	
	Total		2356	740	904	4000	
Second premolar	15	Normal	433(71.5)	119(57.2)	112(60.2)	664	0.000*
		Others	173(28.5)	89(42.8)	74(39.8)	336	
	25	Normal	398(69.6)	95(58.6)	164(61.7)	657	0.009*
		Others	174(30.4)	67(41.4)	102(38.3)	343	
	35	Normal	262(45.8)	63(38.9)	99(37.2)	424	0.040*
		Others	310(54.2)	99(61.1)	167(62.8)	576	
	45	Normal	301(49.7)	90(43.3)	71(38.2)	462	0.014*
		Others	305(50.3)	118(56.7)	115(61.8)	538	
		Total	2356	740	904	4000	
		TOTAL	4712	1480	1808	8000	

*p<0.05 statistically significant

Table 7. Distribution of premolar positional variation in relation to overjet

Tooth		Positions	Overjet				Total	p value
			0 to 3 mm	3 to 6 mm	>6mm	<0 mm		
			N= 503	N=342	N=16	N=39		
			n (%)	n (%)	n (%)	n (%)		
First premolar	14	Normal	369(73.4)	252(73.7)	82(70.7)	28(71.8)	731	0.929
		Others	134(26.6)	90(26.3)	34(29.3)	11(28.2)	269	
	24	Normal	372(74.0)	252(73.7)	90(77.6)	29(74.4)	743	0.860
		Others	131(26.0)	90(26.3)	26(22.4)	10(25.6)	257	
	34	Normal	274(54.5)	174(50.9)	44(37.9)	20(51.3)	512	0.016*
		Others	229(45.5)	168(49.1)	72(62.1)	19(48.7)	488	
	44	Normal	271(53.9)	190(55.6)	48(41.4)	17(43.6)	526	0.034*
		Others	232(46.1)	152(44.4)	68(58.6)	22(56.4)	474	
	Total		2012	1368	464	156	4000	
Second premolar	15	Normal	347(69.0)	221(64.6)	77(66.4)	19(48.7)	664	0.059
		Others	156(31.0)	121(35.4)	39(33.6)	20(51.3)	336	
	25	Normal	342(68.0)	222(64.9)	73(62.9)	20(51.3)	657	0.154
		Others	161(32.0)	120(35.1)	43(37.1)	19(48.7)	343	
	35	Normal	211(41.9)	145(42.4)	49(42.2)	19(48.7)	424	0.878
		Others	292(58.9)	197(57.6)	67(57.8)	20(51.3)	576	
	45	Normal	248(49.3)	146(42.7)	53(45.7)	15(38.5)	462	0.204
		Others	255(50.7)	196(57.3)	63(54.3)	24(61.5)	538	
	Total		2012	1368	464	156	4000	
TOTAL			4024	2736	928	312	8000	

*p<0.05 statistically significant; N= no of subjects

Table 8. Distribution of premolar positional variation in relation to overbite

Tooth		Positions	Overbite					Total	p value
			0-10%	11-30%	31-60%	>60%	AOB		
			N= 169	N=361	N=306	N=106	N=58		
			n (%)	n (%)	n (%)	n (%)	n (%)		
First premolar	14	Normal	135(79.9)	267(74.0)	221(72.2)	69(65.1)	39(67.2)	731	0.070
		Others	34(20.1)	94(26.0)	85(27.8)	37(34.9)	19(32.8)	269	
	24	Normal	129(76.3)	287(79.5)	211(69.0)	75(70.8)	41(70.7)	743	0.025*
		Others	40(23.7)	74(20.5)	95(31.0)	31(29.2)	17(29.3)	257	
	34	Normal	93(55.0)	201(55.7)	136(44.4)	52(49.1)	30(51.7)	512	0.046*
		Others	76(45.0)	160(44.3)	170(55.6)	54(50.1)	28(48.3)	488	
	44	Normal	89(52.7)	203(56.2)	154(50.3)	52(49.1)	28(48.3)	526	0.476
		Others	80(47.3)	158(43.8)	152(49.7)	54(50.9)	30(51.7)	474	
	Total		676	1444	1224	905	232	4000	
Second premolar	15	Normal	118(69.8)	245(67.9)	204(66.7)	70(66.0)	27(46.6)	664	0.022
		Others	51(30.2)	116(32.1)	102(33.3)	36(34.0)	31(53.4)	336	
	25	Normal	113(66.9)	245(67.9)	199(65.0)	67(63.2)	33(56.9)	657	0.525
		Others	56(33.1)	116(32.1)	107(35.0)	39(36.8)	25(43.1)	343	
	35	Normal	75(44.4)	161(44.6)	116(37.9)	52(50.1)	20(34.5)	424	0.140
		Others	94(55.6)	200(55.4)	190(62.1)	54(50.1)	38*65.5)	576	
	45	Normal	73(43.2)	185(51.2)	129(42.2)	48(45.3)	27(46.6)	462	0.174
		Others	96(56.8)	176(48.8)	177(57.8)	58(54.7)	31(53.4)	538	
	Total		676	1444	1224	905	232	4000	
TOTAL			1352	2888	2448	1810	464	8000	

*p<0.05 statistically significant

drift of teeth arising from premature loss of primary molars, ectopic positioning of the developing premolars tooth buds, and over-retained or infraocclusal ankylosed primary molars. In sequence of tooth eruption, mandibular premolars erupt after the mandibular first molar and mandibular canine. Consequently, if the space for eruption is inadequate, it would usually be the second premolars that are affected on their position into the arch (Burch *et al*., 1994). Therefore, it may predict that the mandibular premolars especially the second premolars will show great variation in its position in the arch. Tooth rotation is defined as mesiolingual or distolingual intra-alveolar displacement of a tooth around its longitudinal axis.[10] It could be influenced by irregular order of eruption, an extended period of the replacement dentition, early loss of deciduous teeth or mesial movement of permanent teeth which also may occur as a result of crowding in the arch (Shigenobu et a., 2007). It has been reported that rotation of first premolars in both the upper and lower arches has a lesser tendency to improve over time compared with second premolars.

There seem to be cases where premolar rotation deteriorates over the period, especially involving the first premolars (McMullan and Richardson, 1991). Previous studies have also shown that rotation of premolars was significantly associated with congenitally missing lateral incisors, and associations have also been noted between unilateral aplasia of premolars and rotation of premolars on the other side of the arch (Baccetti, 1998). In this study, most of the rotated premolars were among the mandibular second premolars. This percentage is lower than reported previously by Stemm, 1971. There were 4 subjects with rotated premolars who exhibited clinically missing lateral incisors. Also 5 subjects exhibited rotated premolars on one side of the arch, accompanied by unilateral congenitally missing premolars. An earlier study has suggested an autosomal additive effect of this premolars feature within the dental arch (Hu *et al*., 1992). An impacted tooth is one that is embedded in the alveolus and its eruption is prevented or locked in position by bone or an adjacent tooth (Kalia and Aneja, 2009). Previous studies reported that premolar impaction is rare, with corresponding frequencies ranging from 2.1-2.7% according to population studied (Dachi and Howell, 1961; Kramer and Williams, 1970 and Thilander and Myrberg, 1973). This study categorised the impacted with premolars that were partially erupted and obstructed against other teeth - that is, they were present on the dental cast. Therefore, any reference with other studies needs to be made with caution as there may be differences in methodology and differences in assessment of the impacted condition. Furthermore the inclusion criteria for this study did not specify other factors, such as skeletal factors and malocclusion type. Premolar impaction ranks third after third molars and canines, and studies also report that the mandibular second premolar is most frequently impacted among premolars (Alling, 1993; Collett, 2000; Chu *et al*., 2003; Lee, 2005; Fardi *et al*., 2011 and Şimşek-Kaya *et al*., 2011). This study found that the impaction was observed more frequently in the mandible compare to maxilla. Hence, mandibular second premolar was the most frequently impacted among the impacted premolars.

Impaction of teeth, not particularly focused on premolars, among orthodontic patients has been reported to be significantly lower in Class II (Class II molar) and Class II division 2 (Class II molar, deep bite) groups (Uslu *et al*., 2009). This may result from lack of space in the arch by several factors such as mesial drift, early loss of deciduous tooth or any carious tooth. Studies have also shown relationships between unerupted mandibular second premolar with a group of dental development abnormalities of possible common genetic origin**.** For example, distoangular malposition has been reported to be associated with agenesis of its antimere (Shalish *et al*., 2001), clefting (Shalish *et al*., 2007) and delayed tooth formation[27]. There were only 4 occasions in this study where unerupted premolars were associated with presence of the second primary molar and this was among patients aged 15-16 years. Age is important as interceptive procedures, such as extraction of the corresponding deciduous molar, has been suggested to

facilitate the normal eruption of the succeeding premolar (Burch et al., 1994 and Collett, 2000). However, premolars can show self-correction and become upright during their development (Shalish *et al*., 2009). Even early loss of the deciduous molars may not affect the inclination of the premolar (Wassertein and Shalish, 2002). The congenitally missing premolars in this study involved 9 maxillary second premolars and 7 mandibular second premolars. Bilaterally missing teeth were observed in 4 patients and unilateral missing teeth in 8 patients. In contrast, other studies have reported that the mandibular second premolar was the most frequently missing tooth, followed by the maxillary second premolar (Valinoti, 1958 and Clayton, 1956). Commonly, congenitally missing premolars are accidentally discovered. In occasion, where the deciduous molars are retained beyond their exfoliation dates, a radiograph should be prescribed to confirm the presence and position of premolars. This may influence the treatment decision, as in uncrowded arches deciduous molars with good root are often retained, as space closure can be difficult. The variability in premolars positions affects the interarch features in some degree of anterior-posterior dimension. The first premolars as located at the junction of the anterior and posterior segment of the arch, therefore it affects the incisor, canine and molar relationship; overjet and overbite. Whereas, the second premolar located anterior to molars, easily can affects the molar relationship. These were demonstrated by the statistical analysis of this study. This provides some indications and information on clinical decision or judgments in choice of extraction especially in determining the treatment plan for orthodontics.

Conclusion

Premolars examined in this study were commonly found to be in a normal position. The mandibular first premolar positions were observed to be significantly associated with incisor, canine and molar relationships; overjet and overbite. All second premolars showed significant associations between positioning and the molar relationship. This finding suggests an association between premolar position and malocclusion. Clinician should include tooth position when undertaking treatment planning.

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