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<b>Citation</b>	<b>Hong Kong Medical Journal, 2003, v. 9 n. 3, p. 158-163</b>
<b>Issued Date</b>	<b>2003</b>
<b>URL</b>	<b><a href="http://hdl.handle.net/10722/44552">http://hdl.handle.net/10722/44552</a></b>
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# Prevalence of impacted teeth and associated pathologies — a radiographic study of the Hong Kong Chinese population

## 透過香港華人的放射照片研究阻生齒的患病情況與相關病理學

**Objectives.** To investigate the prevalence and pattern of impacted teeth and associated pathologies in the Hong Kong Chinese population.

**Setting.** The Reception and Primary Care Clinic, Prince Philip Dental Hospital, Hong Kong.

**Design.** Retrospective study.

**Subjects and methods.** The records of 7486 patients were examined to determine whether the chief complaints were related to impacted teeth and associated pathologies, which were investigated using panoramic radiographs.

**Results.** A total of 2115 (28.3%) patients presented with at least one impacted tooth. Among the 3853 impacted teeth, mandibular third molars were the most common (82.5%), followed by maxillary third molars (15.6%), and maxillary canines (0.8%). Approximately 8% of mandibular second molars associated with impacted third molars had periodontal bone loss of more than 5 mm on their distal surfaces. Caries were also found on the same surfaces in approximately 7% of the second molars. Approximately 30% of patients with dental impaction had symptoms, and 75% had complaints limited to one side of the mouth.

**Conclusions.** The prevalence of impacted teeth was high, and there was a predilection for impacted third molars in the mandible. More than 50% of maxillary third molars had erupted, creating potential trauma of the pericoronal tissues of the partially erupted mandibular third molars. Caries and periodontal diseases were commonly seen in relation to the impacted third molars, whereas cystic pathology and root resorption were rarely observed.

**目的：**研究香港華人阻生齒的患病情況、模式及相關病理學。

**安排：**初診及收症處，香港菲臘牙科醫院。

**設計：**回顧性研究。

**患者與方法：**檢查了7486名患者的放射照片紀錄，確定與阻生齒有關的主要疾病及相關病理學。

**結果：**2115(28.3%)名患者最少有一顆阻生齒。在3853顆阻生齒中，下顎第三白齒最常見(82.5%)，其次是上頷第三白齒(15.6%)，及上頷犬齒(0.8%)。與阻生第三白齒有關的下顎第二白齒中，約8%在牙齒表面有超過5毫米的牙骨質缺損。在同一表面上，約7%還出現齲。約30%的阻生齒患者出現徵狀，而75%患者的徵狀只出現在口腔的一邊。

**結論：**阻生齒的情況相當普遍，尤其出現在下顎第三白齒。一半以上的上頷第三白齒已長出，引起部份長出的下顎第三白齒牙周組織的潛在損傷。涉及阻生第三白齒時，齲和牙周病會較常出現，而胞囊病理學和牙根再吸收的情況則較為罕見。

### Key words:

Chinese;  
Prevalence;  
Tooth, impacted

### 關鍵詞：

華人；  
流行；  
阻生齒

*Hong Kong Med J* 2003;9:158-63

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## Introduction

The literature shows that tooth impaction is a frequent phenomenon.<sup>1-19</sup> However, there is considerable variation in the prevalence and distribution of impacted teeth in different regions of the jaw (Table 1).<sup>2-19</sup> Factors affecting the prevalence include the selected age-group, timing of dental eruption, and the radiographic criteria for dental development and eruption. Although removal of impacted third molars is the most common oral surgical procedure, many investigators have questioned the necessity of removal for patients who are free of symptoms or

**Table 1. Prevalence and number of impacted teeth reported in the dental literature<sup>2-19</sup>**

Authors, year	No. of patients with impacted teeth/total no. of patients (prevalence)	No. of impacted teeth	Upper third molar	Lower third molar	Upper canine	Lower canine	Others
Ahlqwist and Grondahl, <sup>4</sup> 1991	117/1418 (8.3%)	166	141		17		8
Aitasalo et al., <sup>2</sup> 1972	571/4063 (14.1%)	823	304	323	147	19	30
Alattar et al., <sup>3</sup> 1980	1512/6780 (22.3%)	1834	791	927	69		47
Brown et al., <sup>6</sup> 1982	583/1895 (30.8%)	1259	372	606	150	44	87
Dachi and Howell, <sup>7</sup> 1961	281/1685 (16.7%)	482	213	209	28	13	19
Eliasson et al., <sup>8</sup> 1989	644/2128 (30.3%)	1211 <sup>‡</sup>	477	734			Not studied
Haider and Shalhoub, <sup>9</sup> 1986	323/1000 (32.3%)	1173 <sup>‡</sup>			Not studied		
Hattab et al., <sup>10</sup> 1995	78/232 (33.6%)	194 <sup>‡</sup>	102	92	Not studied		
Hugoson and Kugelberg, <sup>11</sup> 1988	262/693 (37.8%)	699	317	382	Not studied		
Kramer and Williams, <sup>12</sup> 1970	684/3745 (18.3%)	1218	717	429	48		24
Mead, <sup>13</sup> 1930	276/1462 (18.9%)	518	213	248	23	2	32
Peltola, <sup>14</sup> 1993*	787/1027 (76.6%)	1807	Not reported				
Sandhu and Kapila, <sup>15</sup> 1982	264/1015 (26.0%)	321	78	243	Not reported		
Schersten et al., <sup>5</sup> 1989	86/257 (33.5%)	177	61	116	Not reported		
Shah et al., <sup>16</sup> 1978	546/7886 (6.9%)	918	286	505	61	8	58
Stanley et al., <sup>17</sup> 1988	1756/11598 (15.1%)	3702	1468	2068	166		
Stermer Beyer-Olsen et al., <sup>18</sup> 1989	22/141 (15.6%)	31	18	12	1	0	0
Yamaoka et al., <sup>19</sup> 1995 <sup>†</sup>	155/1834 (8.5%)	181 <sup>‡</sup>	Not reported				

\* Did not differentiate between impacted and unerupted third molars

† Completely impacted third molars were studied

‡ Only impacted third molars were studied

associated pathologies. Such comments are based on the view that long-term retention of impacted teeth has little risk of pathological change in the tooth itself, or of adverse effects on adjacent structures. There are currently no data on the prevalence of impacted teeth and associated pathologies in the ethnic Chinese population.

The aims of this study were to investigate the prevalence and pattern of impacted teeth in the Hong Kong Chinese population, and to report the features of associated pathologies.

## Subjects and methods

Consecutive panoramic radiographs and clinical records of 7486 Chinese patients who attended the Reception and Primary Care Clinic at the Prince Philip Dental Hospital between September 1997 and August 1998 were retrieved for this study. The minimum age for inclusion was 17 years because the accepted view is that third molars normally start to erupt by that age. Patients referred to Oral and Maxillo-facial Surgery from external sources for major pathologies associated with third molars were excluded from this study.

All panoramic radiographs were taken with the Dentsply Gendex Model 9200 Plus Panoramic Machine (Dentsply Asia, Milford, US), and the magnification factor was 1.23. All reported measurements were adjusted according to this factor. One group of researchers examined the radiographs at the same time on standard light boxes to determine the number and types of impacted teeth, and the presence of associated pathologies. A tooth was defined as impacted when the tooth was obstructed on its path of eruption by an adjacent tooth, bone, or soft tissue. A tooth was defined as embedded if it was covered by bone but no adjacent tooth was obstructing its eruption path. When an impacted third molar was identified, the presence/absence and development/

eruption of the patient's other third molars were also assessed. The depth of impaction was measured using Winter's lines,<sup>2</sup> while the angulation of impaction was measured using long axes of the impacted and adjacent teeth, as described by Schersten et al.<sup>5</sup> Pathologies associated with impacted teeth included:

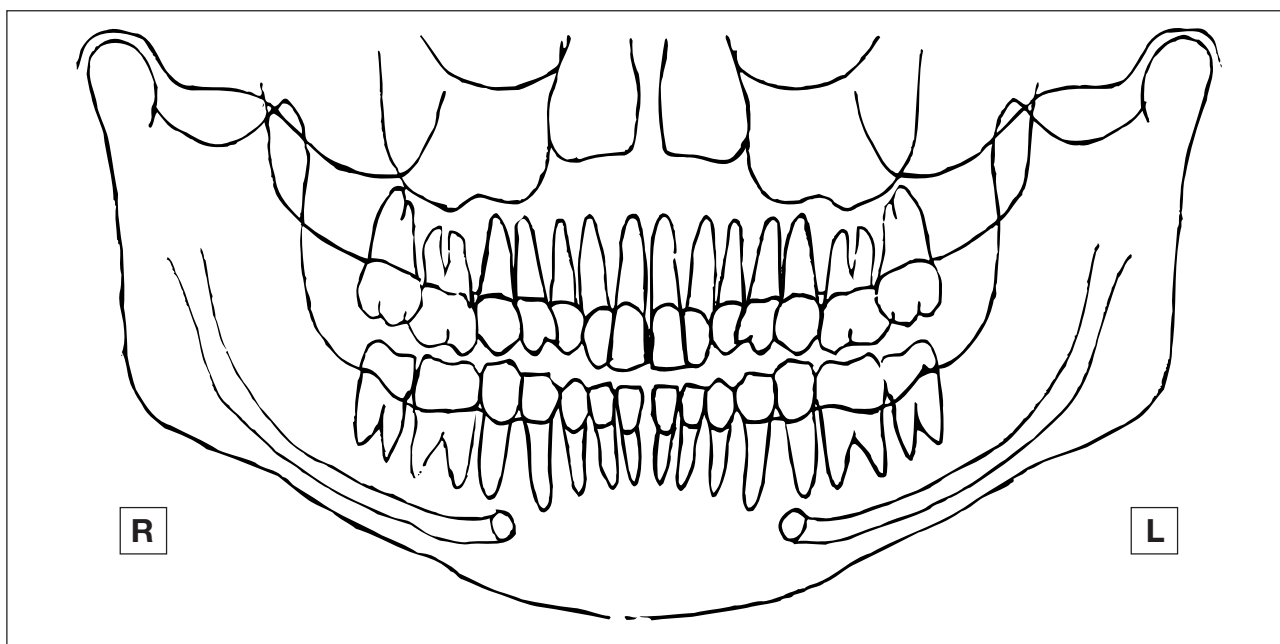
- (1) caries of the impacted and/or adjacent teeth;
- (2) periodontal bone loss of the adjacent tooth of more than 5 mm below the cemento-enamel junction;
- (3) root resorption of the adjacent tooth; and
- (4) an increase in the pericoronal space of the dental follicle of more than 4 mm around the impacted tooth.

Although it is possible to observe the profile of soft tissue in relation to third molars, there are currently no standardised clinical criteria for the assessment of soft tissue associated with impacted teeth. These difficulties in the accurate recording of the clinical condition of soft tissue should be recognised and addressed to aid future studies.

Following the radiographic evaluations, patient records were studied to determine whether they had attended the hospital because of the impacted teeth. The signs and symptoms related to the impacted tooth or teeth were recorded. All patients were examined using a standard chart established for teaching purposes, which included the eruption status of all existing teeth, and the presence of caries, and periodontal disease (Fig). Data collected were entered into a spreadsheet (Excel 2000; Microsoft, US) and analysed subsequently using the Statistical Package for Social Sciences (Windows version 9.0; SPSS Inc., Chicago, US).

## Results

Panoramic radiographs of 7486 Chinese patients aged 17 to 89 years (mean, 39.6 years) were examined. A total of 2115 (28.3%) patients (mean age, 27.9 years) presented with at least one impacted tooth, and impacted third molars were



**Fig. Chart for dental and radiographic examination**

found in 2081 (27.8%) patients. The 20 to 29 years age-group had the highest prevalence of tooth impaction (55.1%), but this decreased with increasing age (Table 2). The male to female ratio of the study group was 1:1.6 (2856:4630), and the ratio for patients with impacted teeth was 1:1.2 (959:1156).

Of the 3853 impacted teeth, mandibular third molars were most commonly encountered (82.5%), followed by maxillary third molars (15.6%), and maxillary canines (0.8%) [Table 3]. Analysis of the developmental stages and eruptive status of third molars in patients with impacted tooth/teeth showed that the distribution of impacted teeth was similar between the left and right sides ( $P>0.05$ ). For this selected cohort with approximately 75% of the mandibular third molars impacted, 14% of the associated maxillary third molars were also impacted (Table 4). There were 780 patients with one impacted third molar, 1005 patients with two, 196 with three, and 100 patients with four. More than 80% of impacted mandibular third molars were either horizontally or mesially angulated against the second molars, and the pattern was bilaterally symmetrical. The Kappa values related to the repeated assessments by the three assessors were calculated using the SPSS program.

**Table 2. Prevalence of impacted teeth in different age-groups of patients**

Age-group (years)	Total no. of patients	Patients with impacted teeth No. (%)
17-19	573	192 (33.5)
20-29	2311	1274 (55.1)
30-39	1389	404 (29.1)
40-49	1072	156 (14.6)
50-59	774	46 (5.9)
60-69	867	33 (3.8)
70-79	429	8 (1.9)
80-89	71	2 (2.8)
Total	7486	2115 (28.3)

**Table 3. Distribution of impacted teeth (n=2115)**

Tooth type	FDI* tooth numbering	Quantity
Mandibular third molars	38, 48	3178
Maxillary third molars	18, 28	600
Maxillary canines	13, 23	31
Mandibular premolars	34, 35, 44, 45	15
Maxillary premolars	14, 15, 24, 25	9
Mandibular canines	33, 43	5
Mandibular first and second molars	36, 37, 46, 47	5
Maxillary central and lateral incisors	11, 12, 21, 22	5
Mandibular central and lateral incisors	31, 32, 41, 42	3
Maxillary first and second molars	16, 17, 26, 27	2
Total		3853

\* FDI International Federation of Dentists

The Kappa value for assessment of orientation of mandibular third molars was 0.973. Assessment using Winter's lines showed that approximately 80% of impacted third molars were no more than 9 mm deep (Table 5). The Kappa value for depth measurement was 0.95.

Approximately 9% of mandibular second molars adjacent to impacted third molars had periodontal bone loss on the distal surface of more than 5 mm, and this was found to be the most commonly associated pathology. Caries were also found in approximately 7% of the distal surfaces of adjacent mandibular second molars (Table 6). For the maxillary second molars adjacent to impacted third molars, only 13 of 600 teeth had distal caries or periodontal bone loss of more than 5 mm. Root resorption of the second molars, cystic changes in the third molars, and major pathologies such as tumours were rare (Table 7).

Twenty-nine percent of patients (610/2081) presented with clinical symptoms in their third molars—three quarters (457/610) had complaints relating to one tooth

**Table 4. Developmental and eruptive stages of third molars for patients with impacted third molars (n=2081)**

	Maxillary third molars		Mandibular third molars	
	FDI* 18† No. of patients (%)	FDI 28‡ No. of patients (%)	FDI 38§ No. of patients (%)	FDI 48   No. of patients (%)
Absent	502 (23.7)	451 (21.3)	229 (10.8)	217 (10.3)
Developing	70 (3.3)	74 (3.5)	8 (0.4)	8 (0.4)
Embedded	103 (4.9)	96 (4.5)	3 (0.1)	6 (0.3)
Impacted	313 (14.8)	287 (13.6)	1582 (74.8)	1596 (75.5)
Erupted	1058 (50.0)	1134 (53.6)	288 (13.6)	277 (13.1)
Unclear	69 (3.3)	73 (3.5)	5 (0.2)	11 (0.5)

\* FDI International Federation of Dentists

† Left maxillary third molar

‡ Right maxillary third molar

§ Left mandibular third molar

|| Right mandibular third molar

**Table 5. Orientation and depth of impaction for mandibular third molars**

	FDI* 38† No. of patients (%)	FDI 48‡ No. of patients (%)
<i>Orientation</i>		
Horizontal	755 (47.7)	753 (47.2)
Mesio-angular	579 (36.6)	592 (37.1)
Vertical	71 (4.5)	63 (3.9)
Disto-angular	152 (9.6)	161 (10.1)
Other	25 (1.6)	27 (1.7)
<i>Depth of impaction</i>		
Soft tissue impaction	94 (5.9)	100 (6.3)
Mild (<5 mm)	543 (34.3)	556 (34.8)
Moderate (5-9 mm)	579 (36.6)	603 (37.8)
Deep (>9 mm)	366 (23.1)	337 (21.1)

\* FDI International Federation of Dentists

† Left mandibular third molar

‡ Right mandibular third molar

only, and the remainder had symptoms on both sides. The most frequent complaints were pain and swelling, which were found in 457 and 151 patients, respectively. Only 28 patients complained of food trapping, while bleeding was reported by 14 patients.

**Discussion**

The use of dental panoramic tomography (DPT) for the study of impacted teeth is limited to hospital dental patients and large dental practices because of associated costs and ethical considerations.<sup>1-19</sup> A further shortcoming associated with the use of DPT for the study of impacted teeth and associated pathologies is the validity of the assessment when

the radiograph is used as the only diagnostic tool. To ensure diagnostic validity in this study, radiographic findings were verified with clinical records, which were collected on standard forms as part of the routine examination process.

Although this study may not represent the Hong Kong population as a whole, the results are useful for primary health workers because the patients studied represent the range of dental patients presenting to a dental hospital. The prevalence of impacted teeth in the study population was 28.4%, a relatively high figure compared with studies involving a wider age range of patients, including patients younger than 17 years.<sup>2,4</sup> In this study, clinical data were collected from the only dental teaching hospital in Hong Kong, which has a policy of using DPT for all new patients. Unlike some previous studies that have investigated specific age-groups only,<sup>4,5,10,11,14,18</sup> this study sampled patients across a range of ages, and the age distribution of the study group was in keeping with that of the Hong Kong population overall.<sup>20</sup>

More than 30% of patients in this study were aged between 21 and 30 years. This may reflect increased dental awareness in this group of patients, who were provided with free dental care services by the Hong Kong government during their primary school years. However, the relatively high proportion of patients in their third decade may also have increased the overall prevalence of impacted teeth in this study. The pattern of impacted tooth types seen

**Table 6. Periodontal disease and caries associated with impacted mandibular third molars in different age-groups**

Age-group (years)	FDI* 38†			FDI 48‡		
	No. of pathology/no. of impacted mandibular third molars			No. of pathology/ no. of impacted mandibular third molars		
	Periodontal disease of FDI 37	Caries of FDI 37	Caries of FDI 38	Periodontal disease of FDI 47	Caries of FDI 47	Caries of FDI 48
17-19	1/162	5/162	1/162	8/169	5/169	1/169
20-29	59/1006	50/1006	24/1006	60/999	50/999	19/999
30-39	45/283	31/283	11/283	50/269	31/269	15/269
40-49	19/88	21/88	1/88	24/108	25/108	8/108
50-59	6/26	5/26	0/26	7/29	5/29	0/29
60-69	2/16	4/16	0/16	0/15	1/15	0/15
70-79	0/1	1/1	0/1	0/5	0/5	0/5
80-89	-	-	-	1/2	0/2	0/2
Total no. (%)	132/1582 (8.3)	117/1582 (7.4)	37/1582 (2.3)	150/1596 (9.4)	117/1596 (7.3)	43/1596 (2.7)

\* FDI International Federation of Dentists

† Left mandibular third molar

‡ Right mandibular third molar

**Table 7. Major pathologies associated with impacted mandibular third molars by age-group**

Age-group (years)	Major pathologies identified (No.)
17-19	Ameloblastoma (1)
20-29	Dentigerous cyst (1)
30-39	Odontogenic keratocyst (3)
	Ameloblastoma (3)
	Dentigerous cyst (3)
	Odontogenic keratocyst (1)
40-49	Radicular cyst (2)
	Dentigerous cyst (2)
	Radicular cyst (1)
	Residual cyst (1)
50-59	Radicular cyst (1)
60-69	Dentigerous cyst (3)
	Radicular cyst (1)
	Squamous cell carcinoma (1)
70-79	No major pathologies
80-89	Radicular cyst (1)
Total no. (%)	25 (0.8%)

was similar to previous reports,<sup>2-4,6,7,12,13,16-18</sup> with the most common being third molars, then upper canines, and others. The number of impacted mandibular third molars accounted for 84% of all impacted third molars. This predilection for impaction in third molars of the lower jaw has not been reported in studies of other ethnic groups. Analysis of the developmental stages and eruption status of all third molars showed that the number of erupted and absent maxillary third molars was significantly higher than mandibular third molars ( $P < 0.05$ ). Clinically, a combination of erupted upper and impacted lower third molars require special attention because of the risk of over-eruption of ‘unopposed’ upper third molars. Additional or pre-existing pericoronitis associated with the lower third molars may exacerbate the discomfort experienced by patients, unless extraction or occlusal adjustment is attempted for the upper third molars.

The distribution of angulation and depth of impaction in the impacted lower third molars seen in this study is similar to that noted by Kramer and Williams.<sup>12</sup> They reported that 75% of impacted lower third molars were in mesio-angular and horizontal angulation. The angulation of an impacted tooth against the second molar has potential clinical implications, as outlined by Yamaoka et al.<sup>19</sup> For mesio-angular and horizontal impacted lower third molars partially exposed in the oral cavity, their occlusal surfaces form plaque accumulative crevices against the distal surfaces of the second molars. This may be clinically relevant to the present group, as more than 40% of impacted lower third molars were less than 5 mm deep in bone. In fact, the prevalence of periodontal disease and caries in lower second molars (8.8% and 7.4%, respectively) seen in the present study is higher than the corresponding figures of 4.5% and 3%, respectively, reported by Stanley et al.<sup>17</sup>

It is controversial whether impacted teeth can cause root resorption of the adjacent teeth. Nitzan et al<sup>21</sup> reported that 8% of second molars adjacent to impacted teeth showed root resorption. Kahl et al<sup>22</sup> examined the effect of

impacted third molars in orthodontically treated patients and found that 8% of upper second molars, and 9.5% of lower second molars, had signs of root resorption. Conversely, Sewerin and von Wowern<sup>23</sup> did not find any resorption caused by impacted third molars, and Ahlqwist and Grondahl<sup>4</sup> reported only one instance of second molar resorption in a study of 141 impacted third molars. Stanley et al<sup>17</sup> have commented that it is difficult to determine radiologically whether coronal radiolucency adjacent to an impacted third molar is due to caries or root resorption. These researchers grouped the findings together and reported the total figure to be 3.1% for 3702 impacted teeth. In the study reported here, there were only 13 (0.4%) cases of root resorption among more than 3000 impacted third molars. It is believed that intact tooth cementum should normally be able to withstand ‘pressure’ from neighbouring impacted teeth, but differentiating radiolucency as resorption or caries is difficult, even on periapical radiographs.

Follicular enlargement of impacted third molars is another major concern in the literature because if such cystic changes develop, the management of the pathological lesion becomes more complicated. These results confirm that the prevalence of increased pericoronal space of more than 4 mm in impacted third molars is no more than 1%.<sup>4,17</sup> For patients older than 50 years, however, this figure was 6.7% (6/89). Thus, the risk of cystic changes associated with long-term impacted third molars should be considered as an indication for elective removal of asymptomatic impacted teeth.

In this study, it was noted that approximately 30% of patients with impacted teeth were symptomatic, whereas Stanley et al<sup>17</sup> found only 8.4% of their patients had symptoms. Three quarters of patients in this study had problems on one side only, and the two most common complaints were pain and swelling, which were related to pericoronitis. Consultation should be sought from dental specialists if there are symptoms in the third molar region.

**Conclusions**

Impacted teeth were found in 28.3% of the 7486 patients in this study. The order of impacted tooth types found was identical to previous reports,<sup>2-4,6,12,13,17-19</sup> but there was a predilection for impacted mandibular third molars in this study population. In the cohort with impacted third molars, three quarters had impacted mandibular third molars, while more than 50% of their upper counterparts had erupted. Such a combination may lead to trauma of the pericoronal tissues by the upper third molars. Periodontal diseases and caries of the lower second molars adjacent to impacted third molars were found in approximately 8% of cases. The prevalence of root resorption and follicular enlargement was low overall (<1%). Only 30% of patients with dental impaction had symptoms, and 75% had problems limited to one side. Pain and swelling were the most frequent complaints.

## References

1. Morris CR, Jerman AC. Panoramic radiographic survey: a study of embedded third molars. *J Oral Surg* 1971;29:122-5.
2. Aitasalo K, Lehtinen R, Oksala E. An orthopantomographic study of prevalence of impacted teeth. *Int J Oral Surg* 1972;1:117-20.
3. Alattar MM, Baughman RA, Collett WK. A survey of panoramic radiographs for evaluation of normal and pathologic findings. *Oral Surg Oral Med Oral Pathol* 1980;50:472-8.
4. Ahlqwist M, Grondahl HG. Prevalence of impacted teeth and associated pathology in middle-aged and older Swedish women. *Community Dent Oral Epidemiol* 1991;19:116-9.
5. Schersten E, Lysell L, Rohlin M. Prevalence of impacted third molars in dental students. *Swed Dent J* 1989;13:7-13.
6. Brown LH, Berkman S, Cohen D, Kaplan AL, Rosenberg M. A radiological study of the frequency and distribution of impacted teeth. *J Dent Assoc S Afr* 1982;37:627-30.
7. Dachi SF, Howell FV. A survey of 3874 routine full-mouth radiographs: II. A study of impacted teeth. *J Oral Maxillofac Surg* 1961;14:1165-9.
8. Eliasson S, Heimdahl A, Nordenram A. Pathological changes related to long-term impaction of third molars. A radiographic study. *Int J Oral Maxillofac Surg* 1989;18:210-2.
9. Haidar Z, Shalhoub SY. The incidence of impacted wisdom teeth in a Saudi community. *Int J Oral Maxillofac Surg* 1986;15:569-71.
10. Hattab FN, Rawashdeh MA, Fahmy MS. Impaction status of third molars in Jordanian students. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1995;79:24-9.
11. Hugoson A, Kugelberg CF. The prevalence of third molars in a Swedish population. An epidemiological study. *Community Dent Health* 1988;5:121-38.
12. Kramer RM, Williams AC. The incidence of impacted teeth. A survey at Harlem Hospital. *Oral Surg Oral Med Oral Pathol* 1970;29:237-41.
13. Mead SV. Incidence of impacted teeth. *Int J Orthod* 1930;16:885-90.
14. Peltola JS. A panoramatomographic study of the teeth and jaws of Finnish university students. *Community Dent Oral Epidemiol* 1993;21:36-9.
15. Sandhu SS, Kapila BK. Incidence of impacted third molars. *J Indian Dent Assoc* 1982;54:441-4.
16. Shah RM, Boyd MA, Vakil TF. Studies of permanent tooth anomalies in 7,886 Canadian individuals. I: impacted teeth. *Dent J* 1978;44:262-4.
17. Stanley HR, Alattar M, Collett WK, Stringfellow HR Jr, Spiegel EH. Pathological sequelae of "neglected" impacted third molars. *J Oral Pathol* 1988;17:113-7.
18. Stermer Beyer-Olsen EM, Bjertness E, Eriksen HM, Hansen BF. Comparison of oral radiographic findings among 35-year-old Oslo citizens in 1973 and 1984. *Community Dent Oral Epidemiol* 1989;17:68-70.
19. Yamaoka M, Furusawa K, Yamamoto M. Influence of adjacent teeth on impacted third molars in the upper and lower jaws. *Aust Dent J* 1995;40:233-5.
20. Hong Kong Annual Digest of Statistics. 1998. Hong Kong: Census and Statistics Dept; 1998.
21. Nitzan D, Keren T, Marmary T. Does an impacted tooth cause root resorption of the adjacent one? *Oral Surg Oral Med Oral Pathol* 1981;51:221-4.
22. Kahl B, Gerlach KL, Hilgers RD. A long-term, follow-up, radiographic evaluation of asymptomatic impacted third molars in orthodontically treated patients. *Int J Oral Maxillofac Surg* 1994;23:279-85.
23. Sewerin I, von Wowern N. A radiographic four-year follow-up study of asymptomatic mandibular third molars in young adults. *Int Dent J* 1990;40:24-30.