

Residual periodontal defects distal to the mandibular second molar 6-36 months after impacted third molar extraction. A retrospective cross-sectional study of young adults.

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Running head: Impacted third molar periodontal effects

Abstract

Aim: This retrospective study investigated the periodontal conditions distal to mandibular second molars 6 – 36 months after routine surgical extraction of adjacent impacted third molars.

Method: Subjects were randomly selected by systematic sampling from computer records of 3211 surgical mandibular third molar extractions in the Hong Kong dental teaching hospital. Records and pre-extraction radiographs of the selected cases were retrieved. Selected subjects (n=283) were invited for an interview followed by a clinical examination. Community Periodontal Index (CPI) protocol was used for the assessment of the general periodontal status (excluding the mandibular second molar of interest i.e. the subject tooth) followed by a detailed periodontal examination of the subject tooth.

Results: 158 subjects, aged 29 ± 7 years, were examined with only 6% (9 subjects) having a highest CPI score of 4 (excluding the subject tooth), but local periodontal defects were prevalent at the distal surface of subject mandibular second molars: mean probing pocket depth (PPD) was 5.4 ± 1.9 mm with 67% (106 subjects) exhibiting $PPD \geq 5$ mm and 23% (36 subjects) exhibiting $PPD \geq 7$ mm; mean recession was 0.8 ± 1.0 mm; bleeding on probing 96% and suppuration on probing 5%. Multiple linear regression analysis was used to analyze the effects of 12 independent variables on the PPD at the distal surface of the involved mandibular second molar. Three possible risk indicators ($p < 0.001$, $R^2 = 0.27$) associated with localized increased PPD at the distal surface of the mandibular second molars were identified and they were: (1) third molar “mesio-angular” impaction; (2) pre-extraction crestal radiolucency and (3) inadequate post-extraction local plaque control.

Conclusion: The results suggest that periodontal breakdown initiated and established on the distal surface of a mandibular second molar in the vicinity of a “mesio-angular” impacted third molar evidence by pre-extraction crestal radiolucency in association with inadequate plaque control after extraction can predispose to a persistent localized periodontal problem.

Keywords: Impacted tooth, extraction, periodontal pocket, periodontitis, third molar

Third molars, the last teeth to erupt into the human dental arch, have been shown to be the most frequently impacted teeth of all human races (Andreasen et al. 1997). Possible contributing factors to the impaction include inadequate dental arch space (Bjork et al. 1956, Hattab & Abu Alhaija 1999) and erratic eruption paths (Garcia & Channcey 1989, Hattab 1997). From published reports, the prevalence of third molar impaction was observed to be as high as 66% (Morris et al. 1971). Many studies have reported similar prevalence of third molar impaction in the maxilla and the mandible in Caucasian populations (Dachi & Howell 1961, Murtomaa et al. 1985, Hugoson & Kugelberg 1988; Table 1), while a few studies have reported more frequent occurrence of mandibular third molar impaction in Asian and African population (Nanda & Chawla 1959, Odusanya 1984). There is no published report on the prevalence of impacted third molars in the population of Hong Kong. However, a recent investigation of the incidence of impacted third molars among a Hong Kong dental hospital population showed that 228 of 652 subjects (35%) examined over a 4-month period had one or more impacted third molars observable radiographically (Chu 2001). From this group of subjects, 379 of the 404 impacted third molars were mandibular teeth indicating that mandibular third molar impaction is prevalent in Hong Kong Chinese and may constitute a common dental problem.

Impacted third molars, like other impacted teeth, can predispose the remaining dentition to an array of problems. Some examples of the problems include pericoronitis and/or oro-facial infection, caries and/or periodontitis of the adjacent tooth, root resorption of the adjacent tooth, cystic or neoplastic changes, orthodontic or prosthetic problems or even Temporomandibular Joint symptoms (National Institute of Health 1980, Knutsson et al. 1996, Nemcovsky et al. 1996, Worrall et al. 1998). Management of many of these third molar associated problems includes treatment of the acute symptoms, if any, followed by surgical

extraction of the impacted tooth (Howe 1985). However, not all impacted third molars cause problems and it has been recommended that asymptomatic impacted third molars should not be removed prophylactically (National Institute of Health 1980, Morant 2000). Studies on Caucasian populations have reported that around 60% of impacted third molars were removed subsequent to development of pathology, the most prevalent problem being pericoronitis (Goldberg et al. 1983, Nordenram et al. 1987, Lysell & Rohlin 1988, Worrall et al. 1998). However, sometimes, lesions associated with an impacted mandibular third molar may be asymptomatic. An example is a localized periodontal problem on the adjacent second molar that is associated with an impacted partially erupted mandibular third molar (Kugelberg et al. 1985).

The present investigation aimed at i) describing the periodontal conditions and other associated features of mandibular second molars after surgical extraction of the adjacent impacted mandibular third molars, and ii) identifying characteristics of patients and impaction patterns which were associated with persistent post-extraction periodontal problems of these second molars.

MATERIAL AND METHODS

Patients

A list of all patients who had undergone surgical extraction of mandibular third molars in the Prince Philip Dental Hospital, the Faculty of Dentistry, the University of Hong Kong, within a continuous 30 month period starting 36 months before the commencement date of this study in July 1997 was generated from the hospital's computerized records (n = 3211). All patient cases were listed in chronological order by the date of the surgical extraction of the third molar. A systematic sampling of one out-of-every ten cases was carried out and cases with

the following conditions were excluded: i) incomplete treatment records, such as a missed entry, ii) relevant pre-extraction radiographs not taken within 6 months before third molar surgery, iii) surgical extraction of a non-impacted erupted mandibular third molar, iv) the related second molar (subject tooth) was missing before or was extracted during the extraction, v) cystic or neoplastic changes associated with the impacted third molar and/or the subject tooth, vi) subjects undergoing orthodontic treatment, vii) subjects with systemic diseases such as diabetes mellitus, valvular heart disease etc. For each selected individual with more than one surgical extraction of an impacted mandibular third molar, only one of the two second molars was chosen to be the subject tooth by tossing a coin.

Extraction record and patient interview

The clinical records of the sampled subjects were reviewed. The eruption status of the involved impacted third molar as assessed by the oral and maxillofacial surgeon-in-charge was recorded in a dichotomous fashion, i.e. unerupted or partially erupted. The subject's gender, age at third molar extraction and the time in months since third molar extraction were also noted. All sampled subjects were then invited for a dental examination and a structured questionnaire survey. Included in the questionnaire were questions on the subject's smoking habits, and history of dental scaling since the third molar extraction.

Radiographic assessment

The pre-extraction panoramic oral radiograph of each subject was studied. The impaction pattern of the third molar and the presence of a crestal radiolucency, indicating loss of crestal bone between the mandibular second and third molar were recorded. The impaction pattern of the third molar was classified as "mesio-angular" if the convergence angle, towards the coronal aspect, between the long axes of the third and second molars was $\geq 30^\circ$, thus a

horizontal impaction was also included under the category of mesio-angular impaction. A crestal radiolucency with an ill-defined crestal margin at a distance from the third molar crown greater than the space created radiographically by the third molar follicular space was the operational definition of a “crestal radiolucency” (Fig. 1).

Clinical examination

The general periodontal condition of the whole mouth excluding the subject mandibular second molar and the specific clinical condition of the subject mandibular second molar were assessed by two calibrated examiners (KWK, JKSL) using a manual constant pressure periodontal probe (TPS probe, flexible plastic universal explorer, Vivacare). The general periodontal status was recorded using the Community Periodontal Index (CPI). CPI scores for sextants of the dentition were assigned according to the World Health Organization (1997) protocol, but excluding the subject tooth as an index tooth for the sextant in which this tooth was present. The following local periodontal parameters of the subject tooth were recorded at mesio-buccal, buccal, lingual and distal surfaces: probing pocket depth (PPD), recession (Rec), bleeding on probing (BOP), suppuration on probing (SOP), tooth mobility and grade of furcation involvement (Nyman & Lindhe 1997). Local plaque control on the subject tooth was recorded in a dichotomous fashion: i) plaque detectable by visual inspection and/or by probe, ii) no plaque detected. The presence of a caries lesion or a restoration at distal surface of the subject tooth was detected with the aid of a sickle probe. If the subject tooth had been lost some time after the third molar surgery, this was noted.

Ten per cent of the patients were randomly selected for a duplicate examination by the other examiner to assess inter-examiner reproducibility. Reproducibility of the clinical examination

was assessed by calculating the percentage agreement or percentage agreement \pm 1 mm (for periodontal parameters) between the two sets of data recorded by the two examiners.

Data analysis

Computer data analysis was carried out using the statistics software SPSS (SPSS Inc, Chicago, IL). Standard descriptive statistics were used to summarize all variables studied. Linear multiple regression analysis was performed to determine if there was any co-relation between PPD at the distal surface of the studied mandibular second molars and 12 independent variables of the patients. These variables were: gender; smoking habit; highest CPI score; age at third molar extraction; time since third molar extraction; impaction pattern; eruption status; the presence of a crestal radiolucency; local plaque control; caries on the distal surface of the second molar; the presence of a restoration on the distal surface of the second molar; history of scaling since the third molar extraction. The analysis method recommended by Beck (1994) was followed.

RESULTS

321 cases were sampled from the computer list generated. Eight patients appeared on the selected list twice because they had both mandibular third molars surgically removed on separate occasions. For these 8 subjects, only one mandibular third molar was selected for the study, leaving potentially 313 cases available for the study. Ten cases were excluded because clinical records were not retrievable. Out of the remaining 303 subjects, 20 (7%) were not included for failing to meet the pre-set exclusion criteria, 76 (27% of the remaining) could not be contacted and 49 (24% of the remaining subjects) were unable, or refused, to attend for examination. Thus 158 subjects were examined in this study.

All 158 subjects recruited were Chinese and 61 (39%) were men. The age of the subjects ranged from 18 to 55 years. Their mean age at the time of third molar extraction was 27 ± 7 years; the modal age at extraction was 23 years. 121 (77%) of the subjects had never smoked while 29 (18%) were current smokers and 8 (5%) were former smokers. 106 (67%) of the subjects reported a history of routine dental scaling as part of dental treatment received since the third molar extraction. Among the 158 impacted mandibular third molars studied, 77 (49%) were mandibular left third molars and 102 (65%) were partially erupted. 120 (76%) of the third molars were classified as mesio-angular impactions and 28 (18%) were found to exhibit crestal radiolucency on the pre-extraction radiograph distal to the second molar.

The general periodontal conditions of the subjects, excluding the subject tooth, recorded by the CPI is summarized as follows. None of the subjects had code 0 or 1 as their highest CPI score. The percentage of subjects who had a highest CPI score of 2, 3 and 4 were 53%, 41% and 6% respectively. Only a mean of 0.5 sextant per mouth had a zero CPI score while the corresponding values for CPI scores 1, 2, 3 and 4 were 0.4, 4.3, 0.8 and 0.1 sextants respectively.

The periodontal conditions of the subject mandibular second molar tooth are shown in Table 2 and Figure 2. Two (1%) of the mandibular second molars were missing at the examination. Plaque was detectable on distal surface of 135 subject teeth (87%), only one subject tooth (1%) showed class I furcation involvement while four (3%), and two (1%) of the subject tooth showed mobility of Grade I and II respectively. Caries was found on the distal surface of nine (6%) and a restoration on seven (4%) subject teeth.

The percentage agreement of the duplicate examinations on mobility, furcation involvement, bleeding on probing, restoration and caries at the subject tooth were 94%, 100%, 84%, 100%, and 100% respectively. The percentage agreement \pm 1 mm for PPD and recession measurement of the second molar were 97% and 94% respectively while the agreement for CPI sextants scores was 71%.

The 12 independent variables were put into linear multiple regression analysis with the residual PPD recorded at the distal surface of the subject tooth as the dependent variable. Plaque detectable at distal surface of the subject tooth, third molar impaction pattern (mesio-angular impaction) and presence of crestal radiolucency were found to be related to the PPD measurement in the final regression model (Table 3).

There was no correlation between the length of time since surgical extraction of the third molar and the PPD at the distal aspect of the second molar (Fig. 3).

DISCUSSION

The present study investigated the specific periodontal conditions at the distal aspects of mandibular second molars 6-36 months after routine surgical extraction of adjacent impacted third molars. One of the aims was to study the prevalence and severity of the residual periodontal problems after routine surgical management of impacted mandibular third molars in the local Hong Kong Chinese population. To avoid a clustering effect, only one tooth was chosen randomly from each selected subject. Such a protocol, it should be noted, was not practiced in previously reported studies (Ash et al. 1962, Gröndahl & Lekholm 1973, Kugelberg 1990). Since this is a cross-sectional study, it is not possible, due to the

limitations of the research design, to prove a cause-effect relationship between the residual periodontal defect and the various independent variables studied.

It is likely that mainstream surgical attention has remained around the prevention of surgical complications or delayed wound healing after third molar extraction (Howe 1985, de Boer et al. 1995). As localized periodontal lesions might remain symptomless until the periodontal attachment loss is very advanced, these may easily escape detection by the patient and an attending dentist. This potentially creates a threat to the second molar involved. So far, only a few groups of researchers have studied the periodontal consequences (Gröndahl & Lekholm 1973, Kugelberg 1990, Kugelberg et al. 1985, 1991a & b), or tried to control the periodontal disease (Ferreira et al. 1997) and to improve the periodontal healing (Karapataki et al. 2000) after the surgical removal of impacted lower third molars.

In this study, the general periodontal condition of the subjects was recorded in order to assess whether the periodontal problem at the subject tooth was a local problem or part of a generalized problem. The general periodontal condition of subjects in a study such as this should be recorded because it is possible that for subjects affected by chronic periodontitis, and hence heavily colonized by periodontopathogens, a mandibular second molar would be at an increased risk for periodontal breakdown (Marmory et al. 1986, Ong 1998) irrespective of whether or not the second molar is affected by an adjacent impacted third molar. However, it was in only one other study that the periodontal conditions of any other tooth, which in that study was the mandibular first molar, was noted (Kugelberg 1990). In order to simplify the general clinical periodontal investigation of the 158 subjects in the present study, the CPI protocol was used (World Health Organization 1997). This methodology has been shown to

be reliable in assessing the severity of periodontal conditions in young subjects (Ainamo & Ainamo 1985).

A period of at least 6 months following surgical extraction of the mandibular third molar had elapsed prior to clinical examination in this study so as to enable sufficient time for hard and soft tissue post-extraction healing to have occurred. Special emphasis was given to investigate the correlation of i) the age of the subjects at extraction (Kugelberg 1990); ii) the time elapsed since extraction; (iii) the eruption status; and iv) the impaction pattern, with the residual PPD on the distal aspect of the adjacent the mandibular second molar. Other factors that might relate to the periodontal disease experience of the subject tooth, such as local plaque control and tobacco smoking, were also investigated. Crestal radiolucency or radiographic evidence of pre-operative bone loss or defect between the second molar and the third molar was chosen as one of the factors to be studied because this had been previously shown to be a significant predictor of persistent post-operative intrabony defects 2 years after impacted lower third molar surgery (Kugelberg et al. 1991b). There was no difficulty in discriminating between a crestal radiolucency due to bone loss around the distal surface of a second molar and a normal follicular space around the crown of an adjacent impacted third molar on the panoramic oral radiograph.

A relatively high prevalence of deep residual periodontal defects at the distal surface of the mandibular second molar after the surgical extraction of the adjacent impacted third molar was found in the study subjects, which is in accordance with previous studies (Gröndahl & Lekholm 1973, Kugelberg et al. 1985). Given the high reported prevalences of impacted mandibular third molars, as shown in Table 1, this could indicate a potentially common periodontal condition. The study subjects mostly exhibited gingivitis, calculus or shallow

periodontal pockets. It is reasonable to surmise that a localized more severe periodontal problem could be easily overlooked in such patients. Not enough attention is generally given by the dentists to the local plaque control and periodontal treatment needs at the distal surface of mandibular second molars after removal of adjacent impacted third molars. The earlier report by Osborne and co-workers (1982) that no additional benefits for the mandibular second molars were found when the teeth were root planed right after the surgical removal of the adjacent third molar might have engendered false security among dental practitioners regarding the prevention of residual periodontal problems persisting on mandibular second molars following mandibular third molar extraction. It may be that many of the teeth in that study (Osborne et al. 1982) did not require and thus would not benefit from the root planing. It was not until almost 10 years later that gradually more attention was given to this post extraction residual periodontal problem (Kugelberg et al. 1991a, Knutsson et al. 1996). The present study also suggests that persistent local periodontal problems constitute a potentially sizable problem or post-operative complication and identifies a few possible risk indicators for these residual periodontal pockets.

Kugelberg and co-workers (1991a) carried out a prospective 2-year study on the periodontal healing distal to the ipsilateral second molar after surgical removal of impacted lower third molars. That study reported that a greater reduction of the number of deep intrabony defects persisting post-extraction was observed in the ≤ 20 year-old age group versus the ≥ 30 -year-old age group. Essentially the same observation had been reported earlier (Marmary et al. 1986). However, in the current study, no correlation could be found between increased PPD at the distal aspect of the subject second molar and the age at the time of third molar extraction, accepting that the study population was primarily composed of young adults, but with an age range of 18 – 55-years and a mean age of 27 ± 7 years. This discrepancy in

results might be explained by the fact that a larger percentage of the older age group than the young age group could be expected to have a pre-operation intrabony defect. By arbitrarily segregating patients into two different age groups, the earlier studies might have inadvertently introduced a bias.

As this was a cross-sectional study, it was not possible to investigate the behaviour in terms of progression or healing over time of periodontal pockets remaining on the distal aspects of second molars after extraction of adjacent third molars. However there was no correlation between the time elapsed since extraction and the PPD at the distal aspect of the second molar (Fig. 3) which is not suggestive of any particular behaviour over time.

Knowing that the oral health status of patients attending a dental teaching hospital for third molar extraction may not reflect the oral health status of the local population, the general periodontal conditions of the study subjects were compared to the corresponding results of the Hong Kong Adult Oral Health Survey (Holmgren et al. 1994). While the mean age at extraction of the subjects was only 27 ± 7 years it was found that the subjects in this study aged 35-years and above did not have more severe periodontal disease (data not shown) than the Hong Kong population age 35-44 years. However, despite the relatively infrequent finding of advanced periodontal disease around CPI index teeth, excluding the subject second molar, in any sextant of the subjects of the present study there was a significant level of periodontal disease at the distal surface of the subject second mandibular molars. These two findings highlight the significance of the localized deep lesions observed on the subject teeth.

Possible risk indicators that might be associated with local periodontal defects on the mandibular second molars adjacent to surgically extracted mandibular third molars were

explored in this study. Three factors, i.e. crestal radiolucency, impaction pattern, and post-operative local plaque were identified as being associated with persistent residual periodontal pockets. Pre-operative crestal radiolucency as a predictor of a persistent post-operative bone defect after two years has been reported by Kugelberg et al. (1991b) and the present study confirms its risk indicator role.

The reasons for a correlation of these three risk indicators to persistent post-extraction periodontal defects at the distal surface of mandibular second molars could easily be explained. It is postulated that the “mesio-angular” impaction pattern of the third molar induce a defect or cleft between the second and third molars which favours colonization of a subgingival microbiota including periodontopathogens (Leung et al. 1993). The presence of crestal radiolucency most likely indicates that there has been crestal bone loss due to plaque infection, suggestive of an already pre-existing established periodontal lesion on the distal aspect of the second molar. If subsequent proper oral hygiene around the second molar after the impacted third molar is extracted and in the absence of local periodontal therapy (i.e. root surface debridement to remove plaque and calculus from the infected root surface), a residual periodontal pocket and perhaps gingival recession, as signs of a persisting periodontal defect, may be apparent. While 67% of subjects reported having received a dental scaling at varying times, performed mostly by general dental practitioners, since the third molar extraction, this scaling was performed as a component of routine dental care and may not have been focussed on the any residual periodontal problems on the distal aspect of mandibular second molars. In none of the subjects’ records was it recorded that the second molar received scaling at the time of the third molar surgical extraction. If scaling of the second molar were to be performed at the time of surgical extraction of the third molar, then presumably care should

be taken not to disrupt viable periodontal fibres on the second molar root surface so as to avoid hindering periodontal healing.

Given an the estimation that approximately 30% of the Hong Kong local young adult population might have an impacted mandibular third molar, of which about 75% are “mesio-angularly” impacted, as many as one-fifth of the Hong Kong young adult population might be at risk of developing localized deep residual periodontal pockets at the distal surface of mandibular second molars after the ipsilateral impacted third molar extraction, in the absence of periodontal therapy. As the data in Table 1 suggest, these potential problems may be also encountered in other countries.

Based on the findings of this retrospective study, it is recommended that oral health care workers should pay attention to the detection of signs of established periodontal breakdown on the distal aspects of mandibular second molars when assessing the clinical state of the adjacent mesio-angular impacted lower third molars. More attention should also be given to enhance plaque control at mandibular second molars following third molar extraction in subjects at greater high risk of persistent residual periodontal defects.

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LEGEND

Fig. 1. Pre-extraction panoramic oral radiograph of a subject showing bilateral “mesio-angular impacted” mandibular third molars. The lower right second molar shows a crestal radiolucency (arrow head) at its distal surface while the lower left second molar shows evidence of caries but with no crestal radiolucency.

Fig. 2. Distribution of probing pocket depth values on the buccal, lingual, mesial (mesio-buccal) and distal surfaces of the subject teeth. The proportion of sites ≥ 4 mm is significantly higher on the distal than the other surfaces (Fisher’s Exact test, $p < 0.0001$).

Fig. 3. Distribution of probing pocket depth (PPD) at the distal aspect of the mandibular second molars 3-36 months following surgical extraction of the adjacent impacted third molar (n=156).

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Table 1 Prevalence of impacted lower third molars in different countries.

Investigator	Country	Number of subjects	Prevalence of mandibular third molar impaction	
			female	male
Nanda & Chawla 1959	India	1300	33%	32%
Dachi & Howell 1961	USA	3874	18%	17%
Odusanya 1984	Nigeria	700		19%
Murtomaa et al. 1985	Finland	248	21%	28%
Hugoson & Kugelberg 1988	Sweden	693	32%	51%
Amaratunga & Chandrasekera 1988	Sri Lanka	2208		2%
Rajusuo et al. 1993	Finland	876	10%	
Chu 2001	Hong Kong SAR, China	652		33%

Table 2. Periodontal conditions of the mandibular second molars 6-36 months following surgical extraction of the adjacent impacted third molar (n = 156)

Surface	PPD ^{a)} (mean ±SD)	Rec ^{b)} (mean ±SD)	BOP ^{c)} (%)	SOP ^{d)} (%)
Buccal	1.8±1.0	1.3±0.7	89 (57)	1 (1)
Lingual	2.2±0.8	1.3±0.8	119 (76)	0
Mesial ^{e)}	2.6±0.8	0.9±0.6	100 (64)	0
Distal	5.4 ±0.8	0.8±1.0	150 (96)	7 (5)

^{a)} significant difference between individual tooth surfaces, Bonferroni multiple comparison, $p < 0.05$

^{b)} buccal and lingual surfaces significantly different from mesial and distal surfaces, Bonferroni multiple comparison, $p < 0.05$

^{c)} BOP score different between individual tooth surfaces, Chi-square test, $p < 0.0005$

^{d)} SOP score different between distal vs combination of other surfaces, Fisher's Exact test $p = 0.0003$

^{e)} mesio-buccal surface

Table 3. Linear multiple regression model of probing pocket depth (PPD) distal of mandibular second molars 6-36 months following surgical extraction of the adjacent impacted third molar^{a)}

Variable	B	SE B	P value
Crestal radiolucency	1.66	0.36	< 0.001
Local plaque	1.35	0.39	<0.001
Impaction pattern	1.03	0.32	0.001
(Constant)	3.20	0.41	<0.001

^{a)} Adjusted $R^2 = 0.27$, $F = 19.65$, $P < 0.001$. Analysis performed as per recommendations by Beck (1994).

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Kan et al.
Residual periodontal defects
Mandibular second molar after
impacted third molar removal.
Fig. 1



