Introduction

Cleft lip and/or palate is the most common congenital anomaly affecting the craniofacial region. Its etiology is complex and likely to have both genetic and environmental underpinnings [Jugessur and Murray, 2005]. Embryologically, the formation of tooth germs and the occurrence of cleft lip and/or palate have a close relationship both in terms of timing and anatomical position [Tonge, 1967]. Dental anomalies such as variations in shape, number, size, and position of developing teeth are found to occur in a markedly increased frequency in children affected with cleft lip and/or palate when compared with that of unaffected healthy subjects [Ranta, 1982; Ranta, 1988; Peterka et al., 1993; Shapira et al., 2000; Rawashdeh and Bakir, 2007]. The comprehension of such dental abnormalities is important in understanding the development of the premaxilla, the maxilla, and the dental lamina, as well as in planning treatment in oral rehabilitation [Bishara, 2002; Velemínská et al., 2005].

A child's rate of growth may be advanced, normal, or delayed compared to age and sex-specific population norms. The pace at which the formation of teeth proceeds is under fairly rigorous genetic control. An adverse environment can slow the speed of teeth development toward maturity [Merwin and Harris, 1998; Harris, 2002]. Delayed dental development was reported in children with various types of clefts with a considerable concordance between the maxillary and mandibular teeth [Prahl-Andersen, 1976; Ranta, 1982; Nyström and Ranta, 1988; Harris and Hullings, 1990; Heidbüchel et al., 2002; Huyskens et al., 2006]. Although some investigators found no gender difference in the dental development of cleft subjects [Ranta, 1982; Harris and Hullings, 1990], others found that the delay of dental development is more pronounced in boys than in girls [Prahl-Andersen, 1976; Huyskens et al., 2006]. The influence of the severity of the cleft on dental development has been scarcely investigated and controversial. The majority of investigations focused on dental development in

**ABSTRACT.** Aim The aims of this study were to assess and compare the dental development in patients with unilateral (UCLP) and bilateral (BCLP) cleft lip and palate. Study design Dental developmental delay was compared between 40 UCLP patients (20 boys and 20 girls, average age 9.6 ± 2.7 years) and 40 BCLP patients matched by sex and age (to the nearest 6 months). For the purpose of comparison, a total of 80 panoramic radiographs of unaffected group matching in age and sex were selected randomly. Methods Using panoramic radiographs, the seven left mandibular permanent teeth, second molar to central incisor, were rated on eight stage scales using the methods described by Demirjian et al. [1973]. The stage of each tooth was converted to the corresponding numeric value, and then all values were added to obtain a dental maturity score, which corresponded to a dental age. Statistics The differences in developmental delay between the two cleft groups were determined using independent t-test. Results There was statistically significant difference (P<0.0001) between chronologic and dental age in cleft patients. The mean dental development delay in UCLP was 0.34 years and for BCLP was 0.61 years. BCLP patients were found to have a greater delay than UCLP patients (P<0.05). Girls showed an advanced dental development in both types of clefts. Comparison between the two cleft groups showed only significant difference in the amount of delay in female subjects. Conclusions Dental development in UCLP and BCLP patients was significantly delayed compared to non cleft reference. Dental development in boys was significantly behind that of girls. A significant difference in the amount of delay between both cleft types was found only in female subjects.

**Key words:** Radiography; Panoramic; Cleft lip and palate; Tooth development.
specific type of cleft such as unilateral cleft lip and palate [Huyskens et al., 2006], bilateral cleft lip and palate [Heidbüchel et al., 2002], and cleft palate [Ranta, 1982]. For instance, Harris and Hullings [1990], in a study consisting of 54 cleft patients of which 35 cases were unilateral and 19 were bilateral, reported no difference in dental development between unilateral and bilateral cases. Whereas, Ranta [1982] and Nyström et al. [1989] reported a progression of delay in dental development corresponding to the severity of the cleft in a heterogeneous sample. However, reports investigating the relationship between cleft severity and delay in dental development in a homogeneous sample are not available. Thus, the question remains unsettled and requires further studies.

Therefore, the present study was designed to: (a) compare the dental development of a group of Jordanian patients with unilateral cleft lip and palate (UCLP) and bilateral cleft lip and palate (BCLP) with age and sex matched healthy controls, (b) analyze sexual dimorphism of dental age in the study groups, and (c) test the hypothesis that the dental development in BCLP would be more delayed than that in UCLP because of the severity of the aberration.

Materials and Methods

The materials for the this investigation were collected from the records of cleft patients treated at the Cleft Centre at King Abdullah University Hospital and the Oral and Maxillofacial outpatient’s clinics at the Faculty of Dentistry, Jordan University of Science and Technology. Patients under the age of 5 and/or more than 16 years and those whose radiographs were of poor quality were excluded from this study. In addition, patients in whom the cleft was part of a more complex syndrome were excluded also.

The current investigation included 40 panoramic radiographs for UCLP patients (20 boys and 20 girls, average age 9.6 years + 2.7). Each of these subjects was matched according to sex and age (to the nearest 6 months) by a case with BCLP. For the purpose of comparison and to attempt to determine the validity of the findings obtained from examining the panoramic radiographs of the cleft lip and palate patients, a total of 80 panoramic radiographs of an unaffected group matching in sex and age were selected randomly from the patient records of the Department of Orthodontics.

The cleft and control individuals were born of Jordanian parents and grew up in Jordan. The principles outlined in the Declaration of Helsinki were strictly followed throughout the study.

Under standard conditions, including the use of subdued lights, film masking and a conventional viewing box (Exal-Type F.I.D-1, Basingstone, England) with a variable light intensity and a 2X magnifying lens (X-viewer, Malmö, Sweden) the panoramic radiographs were used to assess patient’s dental ages by employing the method of Demirjian et al. [1973]. The radiographical appearances of the seven permanent teeth on the left side of the mandible for each patient were evaluated according to developmental criteria. Thus, the effects of local disturbing factors of the oral cleft or surgical trauma are limited. Each tooth was categorized into one of the eight calcification stages (A-H). Stage A is defined as the start of calcification at the most occlusal part of the crypt in the form of a small inverted cone. Stage H is defined as the stage in which the apical end of the root is complete and the periodontal ligament space has a uniform width around the root and its apex. The intermediate stages establish a continuum. A numerical score for each tooth was then obtained using standard references for each stage, and the summed scores on all seven teeth give a dental maturity score which is converted directly into a dental age.

Before the actual research, subject's radiographs were evaluated, two investigators (Radiologist) were calibrated through daily exercises on random panoramic radiographs using Demirjian's protocol, and then all radiographs were scored by the investigators independently. Of the 546 teeth scored, the level of agreement was 90.3% and never exceeded one stage.

Statistical analysis

The data obtained was analysed using the Statistical Package for the Social Sciences (SPSS, Chicago, Ill). Means and standard deviations were calculated for each group. The significance of the developmental delay in the control and cleft groups was tested by one-sample t-test. The differences between the UCLP and BCLP groups were determined using independent t-test. The differences were considered statistically significant when P values less than 0.05 were considered statistically significant.

Results

There was no significant difference between the chronologic and dental age for the control group (P=0.19). In contrast, both cleft lip and palate groups showed delay in the development of their dentition. In the UCLP group the delay was 0.34 year (P<0.001) whereas in the BCLP group it was 0.61 year (P<0.001). In both cleft groups boys were found to be delayed more than girls subjects (P=0.001 for the UCLP group and P=0.012 for the BCLP group) (Table 1).

Comparing the amount of delay between both cleft groups revealed that the BCLP group had significantly more delay than the UCLP group (P=0.023). Nevertheless, when the comparison between the two cleft groups was made according to gender, there was only significant difference in the amount of delay in girls subjects (0.42 year in the BCLP and 0.05 year in
UCLP, P=0.014). While the difference in the delay between boys subjects was not statistically significant (0.80 year in the BCLP and 0.61 year in UCLP, P=0.21). Moreover, only 35% of the female subjects in the UCLP group showed delay in the dental development compared to 75% in the BCLP group. In male subjects 80% of the UCLP group and 90% of the BCLP showed dental developmental delay (Table 2).

### Discussion

Determination of the dental age is important to those involved in the treatment of cleft lip and palate patients. It is particularly useful to the orthodontist in the treatment plan of different types of malocclusion related to maxillofacial growth. It is also of great importance to paediatric dentists who may be concerned about the stage of development and time of eruption.

Two methods were described to determine the dental age, by using tooth eruption [Hägg and Taranger, 1982] or by judging the root formation on panoramic radiographs [Demirjian et al., 1973]. However, dental eruption and dental development are two separate processes. Several local factors affect tooth eruption such as extraction of deciduous tooth, ankylosis, and impaction or crowding of the permanent teeth [Demirjian et al., 1973; Fanning, 1961; McDonald, 1969]. Contrary, development of the permanent teeth is not affected by the status of the primary dentition [Fanning, 1961; Sapoka and Demirjian, 1971]. Therefore, tooth formation is a more reliable indicator to evaluate dental maturity than tooth eruption [Hägg and Taranger, 1982]. Furthermore, several authors concluded that the use of dental development as an index of chronologic age is better than any other developing organs or structures [Moorrees et al., 1963; Lewis and Garn, 1960; Anderson et al., 1976]. However, some criticism may arise regarding the conversion to dental age for the sample in this study, since it was developed for a different population. Nevertheless, the normal control group in our study showed close correlation between their dental and chronologic ages, indicating that they have tooth development similar to the normal values established by Demirjian et al. [1973].

It has been reported that the degree of dental development is affected by age. Moreover, the degree of dental developmental delay was found to be greater in boys compared to girls. Therefore, the aim of this study was to compare the magnitude of dental developmental delay between UCLP and BCLP subjects with similar age and sex.

In the present study, a significant delay in dental development was observed in the cleft group (UCLP and BCLP jointly) of 0.75±0.36 years compared to children without cleft. This is in close agreement with the mean delay of 0.7 years and 0.9 years reported by Ranta [1986] and Harris and Hullings [1990] respectively.

In the UCLP patients group there was a significant delay in dental development (0.34 year; P< 0.001) compared to non cleft peers. This finding confirms the results of Huyskens et al. [2006], who found significant delay in dental age in UCLP children as compared with their non cleft peers.

Similarly, in our BCLP sample there was a significant difference between the chronological and dental age (0.61 year; P< 0.001) and this in accordance with Pöyry et al. [1989], who reported a delay in dental development in children with BCLP of about 7 months before 9 years of age and 2 months thereafter compared to non cleft children.

The etiology behind the delay in dental maturation in cleft subjects is likely to be multifactorial in nature. Local environmental and systemic postnatal developmental factors such as: feeding problems,
recurrent respiratory infections, sequential surgical interventions, and the psychological impact of the cleft may contribute to the observed delay in dental development [Harris and Hillings, 1990; Merwin and Harris, 1998; Harris, 2002]. Furthermore, over 300 genes have been associated with the regulation of tooth development and the majority of these genes have functions in cellular communications [Thesleff, 2006]. Moreover, experimental studies demonstrated that an increasing number of these genes have an important role in the development of the craniofacial structures and mutations in the genes cause a variety of craniofacial defects [Thesleff, 1998; De Coster et al., 2007]. Thus, since orofacial clefts and dental development seem to have a similar genetic background, defects in the regulatory genes that lead to orofacial clefts also may result in a delay in tooth development.

Ranta [1982] and Nyström and Ranta [1982] were the only studies to investigate the influence of the severity of the cleft on the amount of dental developmental delay. Ranta’s [1982] sample consisted of 841 Finnish children with: cleft lip (CL), UCLP, BCLP, and cleft palate (CP) ranging in age from 7 to 12 years; Nyström and Ranta [1982] sample comprised of 22 pairs of twins concordant or discordant for: CL, UCLP, BCLP, and CP. Both studies concluded that the delay in dental development increased with the severity of the cleft. These results are in accordance with our findings which have shown that dental age in BCLP patients was significantly delayed more than in UCLP. However, when the comparison between the two cleft groups was made according to gender, there was only significant difference in the amount of delay in female subjects.

Reports in the literature about sexual dimorphism and dental age in cleft patients are contradictory. Huyskens et al. [2006] found in sample of 70 children with UCLP a significant delay in dental development in boys. Similarly, Prahl-Andersen [1976] found in a mixed sample of 91 children with various types of clefts a significant delay in dental development in boys. In a group of BCLP patients, Heidbüchel et al. [2002] reported a significant delay in tooth development only in boys at 5 years of age. Lovey and Aduss [1988] reported an advanced dental development in males. However, the number of female patients with BCLP in Lovey and Aduss [1988] study was nine and that in Heidbüchel et al., [2002] was twenty scattered over three age groups. Therefore, the limited numbers of female BCLP patients in both studies may influence the results and preclude comparison. Nevertheless, our results have shown that the dental development in boys was significantly more delayed than in girls in both UCLP and BCLP groups. This advanced dental development in females may be explained by the fact that the female sex presents a tendency toward precocity with regard to the chronology of both mineralisation and eruption.

**Conclusion**

In conclusion, this study has shown that dental development in UCLP and BCLP patients compared to non-cleft reference was significantly delayed. Dental development in boys was significantly behind that of girls and there was only a significant difference in the amount of delay between UCLP and BCLP groups in female subjects.

**References**


