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Article original

Epidemiology of Class III malocclusion in school children in Constantine

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Summary:

The aim of our study is to determine the prevalence of class III malocclusion in 1500 children aged 5 to 15 years (729 boys and 771 girls) enrolled in public schools of the primary and middle cycle of the wilaya of Constantine, ALGERIA and a characterization of the occlusal features of this malocclusion. It took place from January to May 2010.

Materials and Method: The partial descriptive type survey. The direct clinical observation (without radiographic examination) using as an index the classification of Angle during made it possible to identify the presence or not of class III malocclusion. The relationships of canines, incisors and molar as well as inter-arch relationships in the static and dynamic transverse direction were also studied. Bivariate analysis was used to supplement our descriptive survey to identify subgroups of the study population.

Results: Of the 1,500 children examined, 90 presented with class III malocclusion, i.e. a prevalence of 6% including 2.4% of functional class III (36/1500). Bivariate analysis has shown that this malocclusion is visible in young children with temporary dentition with twice the risk for men. The occlusal examination revealed a molar class III, a canine class III, an inverted or zero incisal overjet and was complicated in 31% of the cases by a lateral cross bite.

Keywords: Class III malocclusion, Prevalence, School children, Occlusal characteristics,Wilaya of Constantine

Introduction

Our orthodontic practice in the Dental Medicine Department of the Regional University Hospital of Constantine revealed a massive demand for orthodontic care for patients with class III malocclusion. It is a dysmorphia that is often accompanied by an inversion of anterior occlusion, and may be due to a skeletal, dento-alveolar or functional problem, or a combination of these various anomalies [1] **(Figure 01)**. It is an anomaly that has always been considered by orthodontists as a case of failure and recurrence [2]. Constantine, the capital of eastern Algeria, has always experienced a large migratory flow of people from the various regions of eastern Algeria in particular [3,4]. Despite its regional representativeness and its social and administrative weight ,our bibliographical research on this malocclusion revealed the absence of any epidemiological data concerning orthodontic problems in this wilaya.

Figure 01: Class III malocclusion

Materials and method

In 2009, Constantine had a population of almost one million inhabitants with a source school population of 172118 pupils divided into 89577 pupils in the primary cycle and 82541 pupils in the middle cycle. The survey is a partial descriptive epidemiological study of school children in the wilaya of Constantine [5].

The calculated sample of our study consisted of 1500 children of both sexes aged between 5 and 15 years.

Thus, the use of Angle's classification during direct clinical observation (without radiographic examination) made it possible to identify the presence or absence of class III malocclusion. Sex, stage of dentition, molar, canine and incisor bite examination were assessed as well as the examination of the closure path (DE NEVREZE procedure). Data collection took place from January to May 2010. Children in secondary grades as well as children with general illness or facial deformities were not included in the study.

Our survey design is stratified into three-stage clusters:

The first level: schools; the second level: classes and the third level: pupils. We have two (02) strata corresponding to the primary and middle levels and in each stratum we have drawn classes according to the calculated sample size (1500 pupils). The choice of schools was made using the systematic survey technique which gives us the "sample size". The choice of classes and pupils was made by random selection.

The survey team consisted of a single practitioner examiner, a qualified academic specialist in orthodontics who was the author of this research. Intra-examiner calibration was done to assess the relevance of the different parameters used in the questionnaire.

The systematic examination of the oral cavity was carried out in an equipped classroom with a disposable examination tray. The child was seated facing the examiner under a good light source. Knowing that the phenomenon of dentition is inseparable from the general facial growth of the child, during the endobuccal examination, the subjects were classified into four stages of dental development according to the classification of BJORK et al [6]. The arches were examined in maximum intercuspidation occlusion. The molar tooth relationships were recorded according to the Angle classification [7, 8].

Figure 02: Angle Classification

The reference is the position of the lower first molar which is mesial by half a cuspid to the upper first molar **(Figure 02)**. We will have three classes: Angle Class I or normoclusion, Angle Class II or distoclusion and Angle Class III or mesioclusion. If one of the first molars is absent due to extraction, we will note "undetermined class". In patients with temporary dentition, the ratio of the distal faces of the upper and lower temporary second molars, or terminal plane, will be used as a reference. Thus we note: terminal plane with mesial, straight and distal steps.

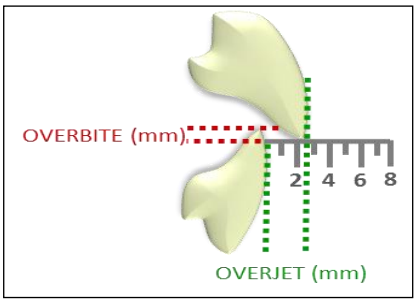

Figure 03: Overjet and overbite measurement

This classification is however completed by the description of the position of the canines and permanent incisors [8]. Class I corresponds to normality; the cuspid point of the maxillary canine is in the embrasure between the canine and the lower first premolar. Class II is characterized by a distocclusion of the cuspidian tip of the mandibular canine. Class III is defined by the mesiocclusion of the cuspid point of the mandibular canine. The incisal overjet **(Figure 03)** is measured with a millimetre scale from the free edge of the upper incisor to the vestibular surface of its lower counterpart [9]. The normal value is 1 to 3 mm. If the overjet is >3mm, it is referred to as a procline, if the overjet is =0mm, and if the overjet is <0mm, it is referred to as an inverted bite. If the incisors are absent we will note Indeterminate.

The vertical ratio assesses the recovery **(Figure 03)** of the mandibular central incisors by the maxillary central incisors (measured with a millimetre ruler). Normal vertical overbite =1 to 3mm, overbite if over is >3mm and underbite if overrecovry is ≤0mm. If the incisors are absent we will score Indeterminate.

In the frontal plane, we will note the deviation or not of the inter-incisal middles. The deviated point (upper or lower) and the direction of the deviation (right or left).

At the premolar and molar level, we note whether the transverse relationship is normal, inverted (cross-bite) or exaggerated (exoclusia), unilateral (left or right) or bilateral. The DE NEVREZE procedure [1] gives us information on the presence or absence of mandibular sliding (functional anomaly). It consists in guiding the mandible to recenter the condyles in their glenoid cavities. The DE NEVREZE procedure is considered positive if a shift of at least 2mm is obtained between the

maximum intercuspidation occlusion and the centred relation.
The clinical examination will give us either a class I, class II or class III Angle malocclusion. The diagnosis of class III is evoked in front of a class III molar of Angle even unilateral, a mesial terminal plane or an inverted articulation of at least evoked in front of a class III molar of Angle even unilateral, a mesial terminal plane or an inverted articulation of at least two incisors.
The data collected on the form are entered into the computer and the statistical analyses are carried out using Epi info 6.0; Microsoft Excel 2013 and Spss 20.0

Results

3.1 Distribution of the sample by gender:
The sex ratio (Male 729/Female771) = 0.95.

The study that we conducted allowed us to record: A prevalence of 6%, i.e. 90 children with class III malocclusion out of the 1,500 children consulted within the various primary and middle school structures of the wilaya of Constantine.

3.2. Gender Distribution of ANGLE class III malocclusion:
The prevalence of class III malocclusion was higher in boys (64.4%) than in girls (36%). Bivariate analysis shows that this malocclusion is related to gender with a statistically significant relationship. p=0.002. The risk is twice as high in boys as in girls

3.3. Age distribution of ANGLE class III malocclusion:
Bivariate analysis revealed a statistically significant association, p=0.008, between Class III malocclusion and the age group 5-7 years, the young child.

3.4. Distribution of ANGLE class III malocclusion by dentition stage :
Class III malocclusion occurs in the temporary dentition (14.44%). The highest percentages of class III malocclusion occur in the early and late mixed dentition with 47.8% and 23.3% respectively. Class III malocclusion in permanent dentition accounts for only 14% of cases. Class III malocclusions with an early orthopaedic dentition are in the majority (85.5%). The bivariate analysis shows a statistically significant relationship between class III malocclusion and BJORK dentition type with p=0.006.

3.5. Distribution of class III malocclusion by degree of incisal overjet :
63% of class III malocclusion cases have a negative overjet. The incisor tip to tip accounts for 32% of the cases, while only 1% has a positive overjet. The overjet could not be recorded in 3% of the cases due to the absence of the (erupted) incisors. Bivariate analysis shows a highly significant statistical relationship between class III malocclusion and negative incisal overjet or anterior reverse bite with $p<10^{-6}$.

3.6. Distribution of class III malocclusion by degree of incisal overbite :
The overbite was normal in 53% of cases (48/90). Underbite was found in 41% (37/90) of the cases of class III malocclusion, probably related to a functional anomaly (drive and lingual interposition), while overbite was found in only 2% (2/90) of cases. Overbite could not be recorded in 3% of cases due to the absence of the (erupting) incisors. The bivariate analysis shows a highly significant statistical relationship between class III malocclusion and incisal infraclusion or zero or negative overlap with $p<10^{-6}$.

3.7. Distribution of incisal point coincidence in the ANGLE Class III malocclusion sample:
The prevalence of incisal point deviation is significant 46% (41/90). The highest percentage was for deviation of the lower incisal point to the right side.

3.8. Distribution of ANGLE Class III malocclusion by type of canine relationship on the right and left side: Canine class was not recorded for temporary canines. On the right side the canine class III predominates followed by class I. There is one case of class II canine related to the deviation of the incisal point or linguogression of a lateral incisor (12). On the left side, the same observation was made, with a predominance of class III followed by class I and one (01) case of class II. Bivariate analysis showed a highly significant statistical relationship between class III malocclusion and class III canine on the right and left with $p<10^{-6}$.

3.9. Distribution of ANGLE class III malocclusion by type of molar relationship on the right and left sides: On the right side molar class III predominates followed by class I. There are no cases of molar class II. On the left side, Class III predominates followed by Class I and one case of Class II in relation to an upper molar mesioposition. Bivariate analysis revealed a highly significant statistical relationship between class III malocclusion and class III molar on the right and left sides with $p<10^{-6}$.

3.10. Distribution of ANGLE class III malocclusion by type of relationship of the distal surfaces of the right and left temporary second molars:
The mesially running terminal plane predominates on both sides of the dental arches followed by the straight terminal plane. It should be noted that the mesially running terminal plane can evolve into either an ANGLE class III or class I. There is no distal terminal plane. Bivariate analysis revealed a highly significant statistical

relationship between class III malocclusion and the mesial terminal plane on the right and left sides. $p<10^{-6}$.

3.11. Prevalence of a forward mandibular displacement:

In 60% (54/90) of the cases, the De Névrezé procedure does not succeed which may be in favour of a true class III. 40% of the cases have a positifthe maneuver; with a highly significant statistical relationship $p<10^{-6}$. Children with class III malocclusion have a very high risk of developing a forward mandibular displacement CI=95%. OddsRatio=49.29 [24.67<OR<99.5]

3.12. Distribution of ANGLE class III malocclusion by type of relationship in the transverse dimension:

In 31% of cases, the class III malocclusion is complicated by a lateral crossbite. The percentage of unilateral crossbite was higher (64.3%) with a predominance of the left side (36%) compared to the right side (29%). Bivariate analysis shows a highly significant statistical relationship between class III malocclusion and posterior crossbite with $p<10^{-6}$. Bilateral inverted bite accounts for 36% of the cases and may be the cause of latero-deviations. The analysis also shows a highly significant statistical relationship between class III malocclusion and lateral deviation of the closure path with $p<10^{-6}$. Children with class III malocclusion are 7 times more likely to have a closure path deviation.

Discussion

In 2009, Constantine had almost one million inhabitants[5]. The school population of the two cycles represents 18.3% of the population spread across twelve communes, six of which were urban, four mixed and two rural. This survey thus revealed the proportion of subjects with malocclusion and more particularly those with class III malocclusion throughout the wilaya. The figures collected in this research will provide health planners in the wilaya with credible data that they do not have.

The index used is the classification of Angle (1899)[7]. It is a classification based on the anteroposterior relationship of the lower first molar and does not take into account transverse and vertical differences. Despite early criticism by Crayer[10], Helmann[11], Simon[12], Ackerman and Proffit [13], Angle's classification remains widely used and accepted in most dental schools and clinics. Moyers [14] has found this method of studying occlusion to be the most practical and popular. Graber and Vanarsdall [15] confirmed the simplicity and practicality of this system. Many surveys around the world use this classification to this day [16]. In our survey, in addition to this classification, other variables were studied, measured and recorded in order to refine the study of class III malocclusion in our sample of school children while following the WHO-IDF recommendations [17].

Although the assessment of occlusion in periods of stable permanent dentition is more reliable, this age group (5-15 years) was chosen because it represents the majority of candidates for orthodontic treatment. Bouge quoted by Otuyemi [18] , stated that the same occlusal problems found in the rimary dentition would be expected to recur in the permanent dentition. Thus, the study of occlusion in the temporary or even mixed dentition could change our approach to more early detection and more interceptive treatment as long as there is a potential for growth.

For Turpin [19] , and Ngan [20] , a class III detected and treated early during early or late mixed dentition will avoid additional future damage (psychological, articular, occlusal...) as well as heavy therapeutics (orthognatic surgery) for the child and for the public funds (financial consequences).

Our prevalence of class III malocclusion of around 6% (90/1500) is in line with national and international averages [21]. It is similar to that found in the various surveys carried out in Algeria by Chaker [22] et al in 2013 (6.2% national survey on oral health) and very close to that of Boulemkhali [23] (7%) in school children in the wilaya of Blida in 2013.

This interesting fact has been reported by Chamla and Ferembach [24,25,26] when studying the anthropological position of Algerians in relation to other Arab-Berber populations of North Africa including the Sahara, using the metric mean method. Indeed, these authors argue that although they are geographically distant, there is less divergence between the sedentary groups in the north.

Our prevalence of Class III malocclusion at 6% would be lower than the Chinese [27,28] and Malaysian [29,30,31] groups who have the highest prevalence. This is consistent with the various studies reporting the highest rates of Class III malocclusion in Asian populations (share of genetics). It is also lower than those reported by Al-Mangoury and Mostapha [32] in Egyptians (11.4%) and Behbehani [33] in Kuwaiti children (9.5%) and Bourzgui [34] (10%) in 1000 Moroccan schoolchildren in the city of Casablanca aged 8 to 12 years.

However, our prevalence of class III malocclusion would be similar to that found by Perillo [35] et al (6%) in southern Italian schoolchildren, Bittencourt [36] (6.2%) in Brazilian children aged 6-10 years; Saleh [37] (5.1%) in Lebanese children and Bougaighis [38] (4%) in Libyan school children.

On the anthropological level, Chamla [25,26] reports in the same metric study, cited above, that there are certain affinities between Algerians and Libyans, that Algerians are closer to Moroccans than to Tunisians and Egyptians. In the Mediterranean basin, Algerians are much closer to the western Mediterranean (Corsicans; Spaniards; Italians and Sardinians).

Another interesting fact to be highlighted in the work of Chamla and Ferembach [24], is that the Algerians of the north are different from the Saharan nomads, which shows that the Sahara plays the role of an anthropological barrier isolating the populations that inhabit it from each other, a factor that favours the appearance of specific biological characteristics.

Staudt and Kiliaridis [39] reported that 75% of Class III malocclusions are caused by skeletal imbalance due to either deficient growth of the maxilla (19-37% of adults) or excessive growth of the mandible (19-40%) or a combination of both (1.5%-34.5%) (Dietrich 1970; Jacobson, Evans et al 1974; Ellis and Mc Namara, 1984; Guyer, Ellis et al 1986).

In our survey, we found that boys had twice as much class III malocclusion (64.4% or 58/90 children) as girls (35.6% or 32/90 children). This result is similar to that reported by Al Mangoury and Mostapha [32] in Egyptians with a prevalence three times higher in boys than in girls and a high level of significance p=0.005. Oshagh [40] , on the other hand, found in school-aged children (6-14 years) in Iran that the prevalence of class III malocclusions in girls (44.2%) was significantly lower than in boys with $p<0.05$. Jarabak [41], finds that the gender difference is highly significant in class III malocclusions. Boys have a greater tendency towards mandibular prognathism than girls who tend towards orthognathism or even retrognathism. Baccetti and Reyes [41] also find that there is a very significant difference in craniofacial growth between the two sexes with class III malocclusions, especially after the age of 13 years. Female subjects show smaller linear measurements compared to male subjects especially in the maxilla, mandible and facial height in the pubertal and post-pubertal periods.

Other authors do not find this gender-related predisposition such as Goose [42] et al, Solow and Helm[43] who report the same incidence for both sexes.

The highest percentages of class III malocclusion are found in the 5-7 year age group (54.4% p=0.008). Guyer [44] and coworkers report that malocclusion is present at an early age and although the anomaly may worsen with age, class III malocclusion does not appear at a later age.

Our results show that negative overjet predominates in our sample of children with class III malocclusion at 64% (56/90). These results are similar to those of Sanborn[45], Kayukawa[46], Susami [47] and Jacobson[48] who note that Class III malocclusion is generally accompanied by a negative incisal overjet. They agree with Al Mangoury and Mostapha and Grewe et al (female subjects) regarding the three types of incisal overhang found [32].

Raymond [49] reports that the absence of an anterior guide will maintain a pathological mastication that causes masticatory forces unfavourable in intensity and direction to the stability of the maxillary advance. These forces [50] cause exaggerated stimulation of the condyles and sphenomandibular ligaments which can lead to further growth of the latter.

Mohlin and Thilander [51] found a positive correlation between Angle Class III malocclusions and temporomandibular joint disorders in men. Similarly, Wisth [52] found that a group of patients with a treated Angle Class III malocclusion had fewer symptoms than an untreated group.

The canine relationship is an excellent predictor of the sagittal relationship in the permanent dentition, as the canine Class III associated with a negative overjet is often found in Class III malocclusions [53]. According to Vesse [54], Class III form a vast "syndrome", grouping a very large number of different anatomical and etiopathogenic varieties, the common feature of which is Class III ANGLE Molar. Proffit [55] reports that a child who has a molar relationship with a mesially advancing terminal plane at an early age is more likely to develop a Class III malocclusion over time.

Our survey found that 31% (28/90) of cases of class III malocclusion were complicated by a lateral crossbite with a highly significant statistical relationship of 10^{-6}. The results reported by Borzabadi-Farahani [56] in a population of urban Iranian children are similar to ours, with a prevalence of lateral crossbite of 35.9% of class III malocclusions. For Baik [57], Ulgen and Firatli [58], sagittal anomalies of the class III type are frequently associated with transverse dimension disorders resulting, for Baik [57], in a uni or bilateral posterior cross bite. Pangrazio-Kulbresh [59] and al show that skeletal class III patterns often present a transverse insufficiency of the maxilla which is grouped into two categories depending on the intensity of the area of involvement, basal (endognathy) or alveolar (deficit without sutural pathology).

Thilander [60] has shown that lateral and anterior inverted occlusions are responsible for asymmetric muscle activity with muscle hyperactivity on the side of

the pathological occlusion. This unilateral muscle hyperactivity affects TMJ development and is significantly related to the presence of joint noises in older children with inverted occlusions.

Timms [61], shows that children with a posterior occlusion inversion present three times more breathing difficulties. This transverse deficit can also have an unsightly effect on the smile by the presence of "negative zones" in the upper arch according to Vanarsdall quoted by Salama [62] or black zones in the corners of the mouth.

In our study, unilateral reverse occlusion was predominant (64%) (18/28 cases of reverse occlusion), an anomaly which, according to Daniel [21], increases the frequency of TMJ disorders. This transverse disorder associated with class III malocclusion further complicates the masticatory deficit of subjects with this malocclusion. Indeed, Ahlgren [63] notes that the presence of a molar crossbite is associated with a disturbance of the masticatory cycle, with an increased proportion of vertical and epsilateral cycles.

Buschang [64] reported that the greatest masticatory deficits were found in subjects with Class III malocclusion. Similarly, Zhou and Fu [65] showed that the masticatory efficiency of subjects with Class III malocclusion was about 60% of that of a sample with normal occlusion.

According to English [66] et al, patients with a class III malocclusion are well aware of their chewing disability. In their study, about 50% of these patients report that they have difficulty chewing and biting steaks, chops, or firm meats, compared to less than 25% of those with normocclusion. More importantly, the inability to eat meals and chew food effectively may affect the subjects' quality of life.

Togawa [67] et al and Takada [68] report that patients with masticatory dysfunction have a higher incidence of gastrointestinal disorders, including gastroesophageal reflux disease (GERD).

Togawa [67] et al, studying GERD symptoms in nineteen adult patients with severe class III malocclusion compared to 20 adults with normal occlusion (control group), concluded that GERD symptoms were observed more often in patients with class III malocclusion than in normal subjects as determined by questionnaires. This transverse jaw deficit is most often the cause of a lateral deviation of the closure pathway present in our study sample at 13% (12/90). Ahlgren [69] shows that in the presence of a lateral deviation, mastication will be unilateral on the side of the deviation and during maximal contraction; muscle activity will be more intense on the side of the deviation.

White[70], Myers [71] et al recall Myers' findings that latero-deviation may be responsible for a pathological transverse growth vector that may alter facial symmetry and cause the occlusal plane to tilt in the same direction. This functional anomaly present in temporary dentition will evolve into a mandibular asymmetry creating temporo-mandibular disorders and anomalies of body posture. For Ngan and Wei [72] and Myers [71], early treatment of latero-deviation is a priority to avoid the development of joint pathology. Slavicek [73] emphasises the importance of the timing of treatment of functional latero-deviation. According to this author, the time of choice is the phase of dentition change, as the TMJs have maximum potential for adaptation. Any late treatment in the adolescent dentition can lead to craniomandibular dysfunction.

The bivariate analysis shows that the percentage of latero-deviation is higher in class III malocclusion cases in our sample, compared to class I cases with a highly significant statistical relationship $p<10^{-6}$. Children with this malocclusion are 7 times more likely to have a latero-deviation OR=7.14. These results show the interest of static and dynamic examination of the occlusion in the transverse direction in order to detect early an anomaly that can further complicate the class III malocclusion.

Conclusion

The prevalence of class III malocclusion is around 6% among Constantinian schoolchildren aged between 5 and 15 years, and is in line with national [22,23] and international [21] averages.
This observation leads us to ask the following question: can the prevalence that we found among schoolchildren in the wilaya of Constantine be representative of the North Algerian child?
Malocclusion is present at an early age and can be detected as early as the temporary dentition stage. It is therefore essential to examine children even before the age of 5 years and at stages of mixed or even temporary dentition in order to detect the presence of this malocclusion at an early stage and to re-establish the best mechanical conditions at an early stage so that the maxillary anvil can receive the shocks of the mandibular hammer, in other words the "mandibular strike" described by Delaire [74,75] which is necessary for a balanced facial growth.

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