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Prevalence of occlusal traits and orthodontic treatment need in 14 year-old adolescents in Northeast Italy

ABSTRACT

Aim *Studies on prevalence of malocclusion support the planning and provision of public dental services. The aim of the study was to assess the prevalence of malocclusion and occlusal traits in adolescents aged 14 years from public secondary schools in the area of Health District n.15 - Veneto region, Italy.*
Materials and methods *Study design: Cross-sectional survey. Methods: Out of a randomly selected sample of 1187 subjects, 444 adolescents (55% males, 45% females) were evaluated in the school settings according to the criteria adopted by Brunelle et al. [1996]. Alginate impressions were then taken for 380 students together with a wax bite. The occlusal traits of the cast were analysed and IOTN was established.*
Results *The most common occlusal traits measured on casts were overjet >3 mm (48%), overbite >3 mm (39%), midline misalignment (32%), crowding (30%), 99% of the sample showed at least one occlusal trait. Class I molar relationship prevailed (75.5%) and the prevalence of molar asymmetries was 21.9%. The prevalence of anterior and posterior crossbite and open bite was significantly higher in females, while the mean values of overjet and overbite were higher in males. The distribution of IOTN in the study population showed that only 49.5% had no or little need of treatment, and more than one third (35.8%) were assigned a 4 or 5 score. Statistics: Descriptive statistics are expressed as a percentage (± confidence interval) or mean ± standard deviation, according to the nature of the variable.*
Conclusions *These outcomes indicate a high prevalence of the aforementioned occlusal traits and also a high need for orthodontic treatment among adolescents in Northeast Italy*

Keywords *Adolescents; Malocclusion; IOTN; Occlusal traits.*

Introduction

The prevalence of malocclusions in modern populations is about 40% to 80% and several reports found increases in the frequency of malocclusion since medieval times [Evensen and Ogaard, 2007]. The demand for orthodontic treatment is increasing in many countries. Malocclusions prevalence is second only to tooth decay and periodontal disease, and therefore rank third among all worldwide public health dental disease priorities [World Health Organization, 1997]. Therefore rational planning of an orthodontic treatment service on a population basis is essential and requires baseline data on the prevalence of different types of malocclusion. The considerable variations in malocclusion prevalence and treatment need is related to the age, dental age, genetics and methods of assessment. Methods that describe, evaluate and classify occlusion can basically be divided into qualitative and quantitative methods and are designed either for study cast measurements, clinical use or both [Thilander et al., 2001; Ovsenik et al., 2004]. In clinical orthodontics, malocclusion assessment remains problematic because there are no generally accepted criteria to define normal or abnormal occlusal status to date. Moreover, the widespread orthodontic treatments in industrialised countries has created methodological problems for aepidemiological studies of malocclusion [Bezroukov et al., 1979; Hassan and Rahimah, 2007; Harris and Corruccini, 2008; Brunelle et al., 1996]. Several prevalence studies have been conducted on children in mixed or permanent dentition stages [Mtaya et al., 2009; Elham et al., 2005; Joseffsson et al, 2007; Mugonzibwa et al., 2004; Mohan Das et al., 2008; Komazaki et al., 2012; Behbehani et al., 2005; Poeung et al., 2011; Bozarbadi-Farahani et al., 2009; Gelgor et al., 2007; Kerosuo et al., 1991; N'gang'a et al., 1996; Shivakumar et al., 2010; Laganà et al., 2013; Sidlauskas and Lopatiene, 2009] showing that the majority of children have irregular teeth and an occlusal relationship that differs from the ideal. This divergence in prevalence figures may depend on differences for specific ethnic groups, but also on the wide ranges in number, as well as in age, among the subjects examined. However, the differences

in terminology used to define the traits of malocclusion and in methodological criteria adopted in the studies, are probably the most important factors explaining these differences, emphasising the need to standardise the rules for assessing malocclusion. The methods differ also in the mode of evaluation, which can be performed on study casts, clinically or both [Ovsenik et al., 2004]. Angle's parameters, that have been traditionally used for years to define the "ideal occlusion", represent only one dimension of the complex concept of occlusion [Angle, 1899]. At present it is generally accepted that malocclusions are more frequent than ideal occlusions and the goal of orthodontic treatment is to provide at least an "acceptable occlusion".

In Italy there are only a few studies on the prevalence of malocclusions. Many of them are dated [Bertelli et al., 1990; Anelli and Montaruli, 1998] and use a classification method based only on reciprocal first molars position in dental arches. Only in three most recent studies on different aspects of malocclusion, diagnosis and orthodontic need in adolescents are analysed, in line with the international literature, adopting international validated indexes [Ciuffolo et al., 2005] or evaluating the prevalence of malocclusion related to the orthodontic treatment need [Nobile et al., 2007; Perillo et al., 2010].

The aim of the present survey was to document the prevalence of individual traits of malocclusion in Italian eighth graders aged 14 years in the area of the Health District n. 15 "Alta Padovana" (Northeast Italy). Furthermore, the association between gender and occlusal traits was evaluated. These baseline data will be useful to forecast the need for orthodontic treatment for a rational planning of public orthodontic and dental services.

Materials and methods

The present study was carried out as a random cluster cross-sectional survey from October 2007 to May 2008 within the Observational Research on Teeth Health and Occlusion (ORTHO) project, aiming to evaluate the occurrence of malocclusion in permanent dentition in a sample of Italian 14 year-olds. The study design was approved by the Local Ethics Committee of Padua. The adolescents born in 1994 were considered eligible for the study. The area comprises 28 municipal areas (Health District n. 15 – 240,000 inhabitants) in the centre of Veneto region. The study population was the cohort of students attending 8th grade (14 years old). Inclusion criteria were the year of birth (1994) and parents' signed consent. Authorisation was sought and obtained from the schools' administrations and, together with the consent, a questionnaire regarding the socio-economic status (SES) and oral health behaviours was self-administered to the adolescents' parents or legal representatives. Before undergoing a dental examination, a validated Italian version of the CPQ11-14 oral health-related quality of life (OHRQoL) questionnaire was utilised to carry out our survey and all of the adolescents recruited were administered the questionnaire [Olivieri et Al., 2013].

Exclusion criterion was any current or present history of orthodontic treatment. This question was explicitly asked and then recorded in a chart.

In the assumption that the prevalence of malocclusion in adolescents is about 50%, using an interclass coefficient of 0.5, the estimated number of children/adolescents was set at 1100. The mean number of children/adolescents in each class was approximately 22; each class was identified as a cluster. In the considered geographical area there were 107 eighth grade classes, and 51 of these were randomly chosen. The drawn sample of adolescents in this study was therefore 1187. Out of these, 295 (24.86%) did not return the consent forms and were thus excluded from the study. Another 110 subjects were excluded because they were not born in 1994. Overall 782 children were enrolled in the study. Of the eligible students, 115 subjects had a history of orthodontic treatment or were currently wearing an orthodontic appliance, and 223 were absent on the day the dental examination or declined to participate. Hence, were investigated 444 subjects: 205 girls and 239 boys. Eventually the final group included the 380 subjects (209 males, 55 %, and 171 females, 45%) who agreed to have impressions taken. Two trained professionals (AB, DM) with experience in epidemiological surveys, after a calibration phase for all clinical variables performed by a gold standard examiner (RF), examined each elegible student inside the school building using artificial light, latex gloves, dental mouth mirrors and millimeter rulers, without the use of radiographs. All occlusal relationships were evaluated in the centric occlusion position, which was achieved by asking the subject to swallow and then to bite on his or her teeth together. Alginate impressions were then taken for the 380 consenting students together with a wax bite. The impressions were poured the same day by an orthodontic technician and the respective casts were examined by the gold standard examiner (RF), who assessed the molar relationship [Angle, 1899] and the presence of the following occlusal characteristics.

1. Sagittal dimension: Angle's classification to define the molar relationship, overjet, anterior cross-bite.
2. Vertical dimension: overbite, openbite.
3. Transverse dimension: posterior cross-bite, midline misalignment.
4. Space discrepancies: crowding, midline diastema (>2 mm).

These data were measured on casts and then recorded according to the criteria established for the US National Health and Nutrition Examination Survey- NHANES III [Brunelle et al., 1996]. Recording the molar relationships as Class I, II or III, in the case of less than a half-cusp displacement, this was considered as Class I. Overjet and overbite values between 2 and 3 mm were considered

normal. Anterior crossbite was recorded when any maxillary incisors occluded lingually or in an edge-to-edge position with the opposed mandibular teeth. Posterior crossbite was recorded when the buccal cusp of any of the maxillary molars, premolars or canines totally occluded lingually or in an edge-to-edge position to the buccal cusps of the opposed mandibular teeth. Dental crowding was scored using the Irregularity index [Little, 1975]. A lack of space ≤ 3 mm was not considered as crowding. Descriptive statistics are expressed as a percentage (± confidence interval) or mean ± standard deviation, according to the nature of the variable. Furthermore we calculated the Dental Health Component (DHC) of the Index of Orthodontic Treatment Need (IOTN) [Brook and Shaw, 1989] which grades patients' treatment needs in five categories with progressively increasing severity of malocclusion. Comparisons between the groups were made by means of the Pearson chi-squared test and Student's t-test. Data were analysed with Stata rel. 11.0 [Stata Corporation, College Station, TX, USA].

Results

The distribution of the study sample by gender and according to the molar class is shown in Table 1. About the assessment of the molar class the study shows that Class I is more frequent (86.3%) than Class II (19.5%) and Class III (3.9%) molar relationship. Class II molar relationship is bilateral in 3.2% of subjects, Class II in 9.2% of the cases, however Class I molar relationship exhibits a much higher

			males	females	p *
Class I	Freq.	%	%	%	>0.05
no	52	13.7	13.4	14.0	
right	22	5.8	5.7	5.8	
left	19	5.0	2.4	8.2	
bilateral	287	75.5	78.5	71.9	
asymmetrical	41	10.8	8.1	14.0	
total	328	86.3	86.6	85.9	
Class II					>0.05
no	306	80.5	81.3	79.5	
right	17	4.5	2.4	7.0	
left	22	5.8	5.7	5.8	
bilateral	35	9.2	10.5	7.6	
asymmetrical	39	10.3	8.1	12.8	
total	74	19.5	18.6	20.4	
Class III					>0.05
no	365	96.1	9.1	93.6	
right	2	0.5	0.0	1.2	
left	1	0.3	0.5	0.0	
bilateral	12	3.2	1.4	5.3	
asymmetrical	3	0.8	0.5	1.2	
total	15	4.0	1.9	6.5	
Total	380	100			
* Pearson X^2					

TABLE 1 Distribution of the sample by molar class.

Variable	overall proportion	[95% CI]		males %	females %	p *
overjet>3mm	0.48	0.43	0.54	55.0	40.4	>0.05
overjet>5mm	0.15	0.12	0.19	16.3	14.0	>0.05
overjet_all	0.97	0.94	.98	97.6	95.3	>0.05
overbite>3mm	0.39	0.34	0.44	44.0	32.8	>0.05
overbite>5mm	0.09	0.06	0.13	10.5	7.6	>0.05
overbite_all	0.94	0.91	0.96	95.7	91.2	>0.05
crossbite	0.10	0.07	0.13	5.7	14.6	0.004
ant. crossbite	0.04	0.03	0.07	2.4	.0	0.003
post.crossbite	0.05	0.03	0.07	2.4	7.6	0.017
bil. crossbite	0.03	0.01	0.05	1.9	3.5	>0.05
openbite	0.01	0.00	0.03	0.0	2.9	0.013
crowding	0.30	0.26	0.35	29.2	31.6	>0.05
upper crowding	0.17	0.14	0.22	15.3	19.9	>0.05
lower crowding	0.19	0.15	0.23	19.6	17.6	>0.05
midline_misalignement	0.32	0.27	0.37	32.5	31.6	>0.05
median diastema > 2mm	0.01	0.00	0.03	1.9	0.6	>0.05
at least one maloccl. trait	0.99	0.98	1.00	98.6	100.0	>0.05
only one maloccl. trait	0.01	0.00	0.02	0.5	1.2	>0.05
one or two maloccl. trait	0.32	0.27	0.37	34.0	28.7	>0.05
Variable	Mean	[95% Conf. Interval]		boys	girls	p **
overbite	3.1	2.9	3.3	3.3	2.9	0.017
overjet	3.6	3.4	3.9	3.9	3.3	0.007
num. trait	2.9	2.8	3.0	2.9	3.0	>0.05
* Pearson X^2, ** t-test						

TABLE 2 Prevalence of occlusal traits.

occlusal trait	Class I n=328	Class II n=74	Class III n=15
overjet>3mm	0.46	0.82	0.07
overjet>5mm	0.11	0.39	0.00
overjet_all	0.98	0.99	0.53
overbite>3mm	0.38	0.69	0.00
overbite>5mm	0.07	0.24	0.00
overbite_all	0.95	0.97	0.40
crossbite	0.09	0.07	0.53
ant. crossbite	0.03	0.03	0.47
post.crossbite	0.05	0.05	0.13
bil. crossbite	0.02	0.00	0.27
openbite	0.01	0.00	0.07
crowding	0.29	0.34	0.47
midline_misalignement	0.32	0.57	0.33
median diastema > 2mm	0.01	0.01	0.00
at least one maloccl. trait	0.99	1.00	0.93
only one maloccl. trait	0.00	0.00	0.13
one or two maloccl. trait	0.33	0.15	0.47

TABLE 3 Distribution of occlusal traits by molar class. The distribution of occlusal traits by molar class is showed in Table 5: overjet >3/>5mm and midline misalignment were most frequent in Class II subjects, while crossbite (anterior, posterior and bilateral) was most frequent in Class III subjects.

percentage: 75.5%. An asymmetric molar relationship was found in 21.9% of the subjects.

The distribution of occlusal traits is showed in Tables 2 and 3. In 99% of the sample was detected at least one type of malocclusion; one or two malocclusion traits were found in 32% of the sample, only one malocclusion trait in 1.0%. Overjet >3 mm was the most frequent anomaly (48%), followed by overbite >3 mm (39%), midline misalignment (32%), crowding (30%), upper crowding (17%) and lower crowding (19%). All other traits have a smaller prevalence: overbite >5 mm (9%), crossbite (10%), overjet >5 mm (15%), diastema (1%), openbite (1.4%). The mean values (mm) of overjet and overbite were respectively 3.1 and 3.6. The mean number of occlusal traits present in one subject was 2.9. Some features showed statistically significant differences between males and females: crossbite, anterior and posterior crossbite, openbite (higher in females), mean values of overjet and overbite (higher in males). The distribution of occlusal traits by molar class is showed in Table 3: overjet >3/>5 mm and midline misalignment were most frequent in Class II subjects, while crossbite (anterior, posterior and bilateral) were in most frequent in Class III subjects.

Table 4 presents the distribution of IOTN in the study population. Only 49.5% of the subjects had no or little need of treatment, and more than one third of the sample (35.8%) was assigned a IOTN DHC score of 4-5.

The differences between boys and girls were not statistically significant.

Discussion

A selection bias could be a concern given the number of subjects examined related to the number of subjects attending the schools selected for the study (n=1187). With the aim of obtaining reliable

IOTN categories	boys	girls	Total
1 - none	17.4%	22.4%	19.5%
2 - little	34.3%	25.3%	30.0%
3 - moderate	15.5%	13.5%	14.7%
4 - great	25.6%	33.5%	29.5%
5 - very great	7.2%	5.3%	6.3%
* Pearson X^2= 6.63 ; p > 0.05			

TABLE 4 IOTN categories accounting for gender.

Authors	Ferro et al.	Perillo et al. (29)	Ciuffolo et al. (27)
age (n. of subjects)	14 (380)	12 (703)	11-14 (810)
overjet>3mm	48	16.2 (>4mm)	19.1
overjet>5mm	15	nr	9.6
overbite>3mm	39	79.2 (0-4mm)	41
overbite>5mm	9	20.2 (>4mm)	6.5
ant. crossbite	4	nr	5.4
post.crossbite	5	14.2	12.2
bilateral crossbite	3	2.9	nr
anterior openbite	1	0.7	1.7
crowding	30	45.9	20.2
upper crowding	17	17.2	nr
lower crowding	19	47.3	nr
midline_misalignement	32	nr	53.8
median diastema > 2mm	1	nr	5.6
at least one maloccl. trait	99	nr	93
bilateral molar class I	75.5	59.5	nr
bilateral molar class II	9.2	36.3	nr
bilateral molar class III	3.2	4.3	nr
asymmetrical forms	21.9	nr	nr
mean overjet (mm)	3.6	nr	2.6
mean overbite (mm)	3.1	nr	3.2
mean n. of traits	2.9	nr	2.0

TABLE 5 Italian data (percentages and mean values).

Authors	Ferro et al.	Gelgor at al.	Josefsson et al.	Josefsson et al	Kerosuo et al.	Laganà et al.	Sidlauskas and Lopatiene
Country	Italy	Turkey	Sweden (natives)	Sweden (East Europe)	Finland	Albany	Lithuania
age (n. of subjects)	14 (380)	12-17 (2329)	12-13 (263)	12-13 (64)	12-18 (458)	14 (346)	13-15 (597)
overjet >3mm	48	25.1	nr	nr	79 (0-4)	nr	15.3
overjet >5mm	15	nr	nr	nr	16.5 (5-8)	nr	nr
overbite >3mm	39	20.2	nr	nr	35.5	nr	12.6
overbite >5mm	9	nr	nr	nr	nr	nr	nr
ant. crossbite	4	nr	11.4	7.8	8.0	nr	nr
post. crossbite	5	9.5	11.8	14.1	12.0	nr	7.7
bilateral crossbite	3	nr	nr	nr	nr	nr	2.2
anterior openbite	1	8.5	nr	nr	1	nr	4.1
crowding >3mm	30	65.2	nr	nr	63.0	nr	nr
upper crowding >3mm	17	17.9	nr	nr	nr	nr	47.6 (>2mm)
lower crowding >3mm	19	9.1					41.2 (>2mm)
midline_misalignement	32	nr	nr	nr	nr	nr	nr
median diastema >2mm	1	7 (>1mm)	nr	nr	6.0	nr	nr
at least one maloccl. trait	99	89.9	nr	nr	88.0	nr	nr
bilateral molar class I	75.5	45.0	nr	nr	80.5	36.1	70.2
bilateral molar class II	9.2	44.7	nr	nr	18.5	32.3	22.6
bilateral molar class III	3.2	10.3	nr	nr	1.0	2.9	5.5
asymmetrical forms	21.9	nr	nr	nr	nr	28.6	nr
mean overjet (mm)	3.6	nr	4.1	3.9	nr	nr	2.1
mean overbite (mm)	3.1	nr	3.7	3.8	nr	nr	2.1
mean n. of traits	2.9	nr	nr	nr	nr	nr	nr

TABLE 6 European data (percentages and mean values).

Authors	Ferro et al.	Ajayi	Behbehani et al.	Elham et al.	Kerosuo et al	Mtaya et al	Mugonzibwa et al.	Ng'ang'a et al
Country	Italy	Nigeria	Kuwait	Jordan	Tanzania	Tanzania	Tanzania	Kenia
age (n. of subjects)	14 (380)	13 (441)	13-14 (1299)	13-15 (1003)	11-18 (642)	12-14 (1601)	15-16 (212)	13-15 (919)
overjet >3mm	48	24.7	53.2 (0-3.5mm)	24.7	86 (0-4mm)	73.3 (1-4.9mm)	nr	10
overjet >5mm	15	nr	42.8 (4->9mm)	21.7 (4-6mm)	11.5 (5-8mm)	11.1	19.3	nr
overbite >3mm	39	9.8	nr	16.9	nr	17.9	nr	nr
overbite >5mm	9	nr	nr	1.0 (>6mm)	nr	0.9	0.5	nr
ant. crossbite	4	7.0	20.8	1.9	4	8.4	1.4	nr
post. crossbite	5	4.5	18.9	5.5	6	19.4	nr	10
bilateral crossbite	3	nr	6.3	1.6	nr	nr		
anterior openbite	1	4.1	3.4	2.9	8	15	12.7	8
crowding > 3mm	30	nr	nr	20.6	15	14.1	nr	19
upper crowding > 3mm	17	11.1	69.5 (3.5->6.5mm)	nr	nr	nr	2.3	nr
lower crowding > 3mm	19	12.0	73.2 (3.5->6.5mm)	nr	nr	nr	4.0	nr
midline_misalignement	32	nr	nr	31.7	nr	22.5	nr	nr
median diastema > 2mm	1	19.5	6.9	6.9	6	nr	nr	nr
at least one maloccl. trait	99	nr	86.3	92	nr	63.8	47.2	72
bilateral molar class I	75.5	80.7	57.8	55.3	95.5	93.6	83.0	93
bilateral molar class II	9.2	1.6	31.2	17.5	3.0	4.4	11.8	nr
bilateral molar class III	3.2	1.8	11.0	1.4	1.5	2.0	5.2	nr
asymmetrical forms	21.9	nr	nr	17.7	nr	nr	nr	nr
mean overjet (mm)	3.6	nr	3.5	nr	nr	nr	3.2	nr
mean overbite (mm)	3.1	nr	nr	nr	nr	nr	1.0	nr
mean n. of traits	2.9	nr	nr	nr	nr	nr	nr	nr

TABLE 7 African data (percentages and mean values).

TABLE 8
Asian data (percentages).

Authors	Ferro et al.	Borzabadi-Farahani et al.	Komazaki et al.	Poeung et al.
Country	Italy	Iran	Japan	Cambodia
age (n. of subjects)	14 (380)	11-14 (502)	12-15 (821)	12-15 (1800)
overjet >3mm	48	67.7 (0-3.5mm)	nr	nr
overjet >5mm	15	28.1	9.8 (>6mm)	6.5 (>6)
overbite >3mm	39	nr	nr	21.3
overbite >5mm	9	nr	8.9 (>6mm)	nr
ant. crossbite	4	8.4	18.6	14.7
post. crossbite	5	8.4	7.1	30.0
bilateral crossbite	3	2	nr	nr
anterior openbite	1	1.6	nr	16.4
crowding > 3mm	30	nr	nr	nr
upper crowding > 3mm	17	37.2 (=2mm)	55.6 (=4=10mm)	41
lower crowding > 3mm	19	32.7 (=2mm)	61.0 (=4=10mm)	41
midline_misalignement	32	nr	nr	70.5
median diastema > 2mm	1	nr	2.9	nr
at least one maloccl. trait	99	nr	nr	nr
bilateral molar class I	75.5	64.7	51.3	nr
bilateral molar class II	9.2	27.5	38.3	nr
bilateral molar class III	3.2	7.8	10.5	nr
asymmetrical forms	21.9	30.5	nr	nr
mean overjet (mm)	3.6	nr	nr	nr
mean overbite (mm)	3.1	nr	nr	nr
mean n. of traits	2.9	nr	nr	nr

data, we chose measurements on casts as method of screening. Taking impressions can be unpleasant for children and this could be the main reason for refused consents. Another explanation could be related to the chance that the 14-year-old children, in our area, may be already seen in a private dental office, thus parents might consider a further examination unnecessary. The examined sample of our study was randomly selected and could be regarded as representative.

Comparisons of the present findings with those of other studies must be cautiously undertaken because different methods and indices have been applied in varying age ranges of populations. The probability of having under- or overestimated some prevalence traits such as agenesis and supernumerary teeth cannot be overlooked. The high prevalence of crowding may be partly explained by the frequent occurrence of caries and deciduous molar extractions, which favours the migration, inclination and rotation of first permanent molars.

Malocclusion is a normal biological variability from an ideal pattern. The studies on the prevalence of malocclusion usually show great variability for different ethnic groups, and, even in the same population, for different age groups, as well as variable criteria for determining the boundaries of normal occlusion.

The distribution of the comparable Italian (Table 5) and European data (Table 6) differs from those recorded in our investigation, confirming however the high prevalence of malocclusion traits and, for the European data, the distribution of molar classes. This type of distribution is showed also in African data (Table 7), while the prevalence of malocclusion is lower. The different distributions of the Asian data reflect the racial component (Table 8), and a prevalence of malocclusion close to 70%. Western industrialised populations show a higher prevalence of malocclusal traits, suggesting that environmental factors have important roles in determining malocclusion [Corruccini, 1984]. Looking at these tables, providing conflicting data related to malocclusions, the need of esatblishing an internationally shared common approach for the study of this topic is plain and cannot be postponed, especially to define the prevalence of malocclusion requiring treatment based on internationally comparable diagnostic criteria.

Conclusions

In Italy, the National Health System (Servizio Sanitario Nazionale, SSN) does not provide effective assistance

to malocclusion patients. Since a significant portion of the population depends exclusively on the public system, many patients with malocclusions are likely not to receive proper assistance. It should be emphasised that epidemiological surveys like this are extremely important. By highlighting the patients' occlusal and functional changes, the provision of interceptive and corrective treatment to this underserved portion of the population has to be encouraged.

The high prevalence (35.8%) of IOTN grade 4-5 represents a challenge for the local Community Orthodontic Service that, given the disparity between needs and available resources, devised a supportive care model to grant benefits to people suffering from severe malocclusions belonging to a disadvantaged socioeconomic class (Ferro et al., 2013).

Authors' contributions

RF and AB conceived the study, and participated in its design and coordination and helped to draft the manuscript. AO participated in the design of the study and performed the statistical analysis. All authors read and approved the final manuscript.

References

› Anelli G, Montaruli G. Caries and malocclusion. A statistical-epidemiological study performed on 5399 children between 3 and 10 years old in the schools of Bari. Minerva Stomatol 1998;47: 489-497.
› Angle EH. Classification of malocclusion. Dental Cosmos 1899;41:248-64.
› Behbehani F, Artun J, Al-Jame B, Kerosuo H. Prevalence and severity of malocclusion in adolescent Kuwaitis. Medical Principles and Practice 2005; 14: 390-395.
› Bertelli E, Gasperini R, Valerio P, Nocchi L, Mazzini M, Martelli S. Indagine epidemiologica su una popolazione scolastica della provincia di Siena. Nota I: prevalenza delle malocclusioni. Rivista Italiana di Odontoiatria Infantile 1990;1:7-11.
› Bezroukov V, Freer TJ, Helm S, Kalamkarov H. Sardo Infirri J, Solow B. Basic method for recording occlusal traits. Bulletin World Health Organization 1979; 57(6): 955-961.
› Bozarbadi-Farahani A, Bozarbadi-Farahani A, Eslamipour F. Malocclusion and occlusal traits in an urban Iranian population. An epidemiological study of 11- to 14-year-old children. Eur J Orthod 2009; 31: 477-484.
› Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod 1989;11:309-320.
› Brunelle JA, Bhat M, Lipton JA. Prevalence and distribution of selected occlusal characteristics in the US population, 1988-1991. J Dental Res 1996; 75: 706-13.
› Ciuffolo F, Manzoli L, D'Attilio M, Tecco S, Muratore F, Festa F, Romano F. Prevalence and distribution by gender of occlusal characteristics in a sample of Italian secondary school students: A cross-sectional study. Eur J Orthod 2005; 32(6): 601-606.
› Corruccini RS. An epidemiologic transition in dental occlusion in world populations. American journal of Orthodontics and DentofacialOrthopedics 1984; 86: 419-426.
› Elham SJ, Alhaija A, Al-Katheeb SN, Al-Nimiri KS. Prevalence of malocclusion in 13-15 year-old North Jordanian schoolchildren. Community Dental Health 2005; 22: 266-271.
› Evensen JP, Ogaard B. Are malocclusions more prevalent and severe now? A comparative study of medieval skulls from Norway. American Journal of Orthodontics and Dentofacial Orthopedics 2007; 131: 710-716.
› Ferro R, Besostri A, Denorri G, Campus G. Public community orthodontics in Italy. Description of an experience. Eur J Paediatr Dent 2013;3:237-240
› Gelgor IE, Karaman AI, Ercan E. Prevalence of malocclusion among adolescents in Central Anatolia. Eur J Dent 2007; 1, 125-131.
› Harris EF, Corruccini RS. Quantification of dental occlusalvariation: a review of methods. Dental Anthropology 2008; 21(1): 1-11.
› Hassan R, Rahimah AK. Occlusion, malocclusion and method of measurements – an overview. Archives of Orofacial Sciences 2007; 2: 3-9.
› Joseffson E, Bjerklin K, Lindsten R. Malocclusion frequency in Swedish and immigrant adolescents – influence of origin on orthodontic treatment need. Eur J Orthod 2007; 29: 79-87.
› Kerosuo H, Laine T, Nyyssonen V, Honkala E. Occlusal characteristics in groups of Tanzanian and Finnish urban schoolchildren. Angle Orthodontics 1991 ;61(1): 49-56.
› Komazaki Y, Fuijwara T, Ogawa T, Sato M, Suzuki K, Yamagata Z, Moriyama K. Prevalence and gender comparison of malocclusion among Japanese adolescents: A population-based study. J World Federation of Orthodontics 2012; 1: e67-e72.
› Laganà G, Masucci C, Fabi F, Bollero P, Cozza P. Prevalence of malocclusions, oral habitus and orthodontic treatment need in a 7-to 15-year-old schoolchildren population in Tirana. Progress in Orthodontics 2013; 14: 12.
› Little RM The Irregularity Index: a quantitative score of mandibular anterior alignment. American Journal of orthodontics 1975; 75: 554-563.
› Mohan Das U, Venkatsubramanian, Reddy D. Prevalence of malocclusion among schoolchildren in Bangalore ,India. Jaypee's International Journal of Clinical Pediatrics Dent 2008; 1(1): 10-12.
› Mtaya M, Brudvik P, Astrom AN. Prevalence of malocclusion and its relationship with socio-demographic factors, dental caries, and oral hygiene in 12- to 14-year-old children. European J Orthod 2009;31:467-476.
› Mugonzibwa E, Eskeli R, Kuijpers-Jagtman AM, Laine-Alaya MT, van't Hof MA. Occlusal characteristics during different emergence stages of the permanent dentition in Tanzanian Bantu and Finnish children. European Journal of Orthodontics 2004; 26(3): 251-260.
› Ng'ang'a PM, Ohito F, Ogaard B, Valderhaug J. The prevalence of malocclusion in 13-to 15-year-old children in Nairobi, Kenia. ActaOdontologica Scandinavica 1996;54(2),126-130.
› Nobile CGA, Pavia M, Fortunato L, Angelillo IF. Prevalence and factors related to malocclusion and orthodontic treatment need in children and adolescents in Italy. Eur J Public Health 2007; 17(6): 637-641.
› Olivieri A, Ferro R, Benacchio L, Besostri A, Stellini E. Validity of italian version of the Child Perceptions Questionnaire (CPQ 11-14). BMC Oral Health 2013;13(1):55-61.
› Ovsenik M, Farčnick FM, Verdenik I. Comparison of intra-oral and study casts measurements in the assessment of malocclusion. European J Orthod 2004; 26(3): 273-277.
› Perillo L, Masucci C, Ferro F, Apicella D, Baccetti T. Prevalence of orthodontic treatment need in southern Italian schoolchildren. Eur J Orthod 2010; 32: 49-53.
› Poeung P, Kruger E, Tennant M. The prevalence of malocclusion, dental irregularities and orthodontic treatment need in 13-15 year olds in TeukKlaing, Cambodia, Australia. J Internat Oral Health 2011; 3(5): 19-28.
› Shivakumar KM, Chandu GN, Shafiulla MD. Severity of malocclusion and orthodontic treatment needs among 12-to15-year-old school children of Davangere District, Karnataka,India. Eur J Dent 2010; 4: 298-307.
› Sidlauskas A, Lopatiene K. Theprevalence of malocclusion among 7-15-year-old Lithuanian schoolchildren. Medicina (Kaunas) 2009; 45(2): 147-152.
› Thilander B, Pena L, Infante C, Parada SS, de Mayorga C. Prevalence of malocclusion and orthodontic treatment need in children and adolescents in Bogotà, Colombia. An epidemiological study related to different stages of dental development. Eur J Orthod 2001; 3(2): 153-167.
› World Health Organization Oral Health Surveys. Basic methods. 4th edition. 1997.