Comparative Study

EPIDEMIOLOGICAL ANALYSIS OF ORTHODONTIC TREATMENT NEEDS IN ITALY: A COMPARISON BETWEEN TWO STUDIES

P. Caccianiga and G. Caccianiga*

School of Medicine and Surgery, University of Milano-Bicocca, 20900 Monza, Italy

Correspondence to:
Gianluigi Caccianiga DDS,
School of Medicine and Surgery,
University of Milano-Bicocca,
20900 Monza, Italy
e-mail: gianluigi.caccianiga@unimib.it

ABSTRACT

This study aims to verify the prevalence and distribution of various types of malocclusion in a cross-section of patients in the province of Bergamo. A comparison is also presented with one study conducted 16 years earlier in the same location. The patient evaluation was made utilising cephalometric analysis. The study was conducted on a sample of 441 patients in Italy and area treated in the Alzano Lombardo Hospital. Gender, age, SNA, SNB, ANB, intermaxillary angle, SNP-A, Go-Me, Wits index, OVJ, OVB and gonial angles (total, upper and lower) are investigated. There are 49.21% skeletal class I, 44.9% class II and 5.9% class III. More than 50% of children are normodivergence, 8.54% hypodivergent and 39.76% hyper-divergent. Only 39.23% of subjects have a correctly positioned maxilla. Only 30.61% of patients presented correct mandibular positioning. A normomandible is present in about one-third of children. The presence of maxillary deficit is found in 48% of patients. An analysis of skeletal bite data demonstrates that only 17% of subjects have a normo bite. 40.82% of patients present a negative Wits appraisal. 71% of children have a normo-overbite, whereas 12% have a diminished overbite and 16% present an increased overbite. A previously performed study showed a higher prevalence of class II and hyperdivergence. In this study, it was possible to present an overview of the different malocclusion indices in a sample of children in the province of Bergamo. Most of them have malocclusion and require orthodontic treatment.

KEYWORDS: *epidemiological analysis, orthodontic treatment, malocclusion*

INTRODUCTION

Orthodontic treatment has received much attention from specialists and patients due to the impact of such treatment on social life (1-3). In clinical practice, many patients are interested in orthodontic treatment to increase their quality of

life, and statistics confirm that 20% of children are already affected by malocclusion by age 6, and 6% of these patients require urgent treatment (4).

A recent study conducted in Northern Europe confirmed that there has been an increase in the incidence of malocclusions in the last 400-700 years (5). Furthermore, malocclusions mainly affected women in the past, whereas today, there is no significant difference between the two genders.

Today malocclusions do not self-correct with age but tend to worsen (6). A study by Heikiheimo et al. highlights the necessity for urgent treatment and how the presence of a relatively severe malocclusion increases from 23% at 7 years of age to 46% at 12 years of age (7). Profitt et al. conducted a study on the American population by applying the "indicators of the need for orthodontic treatment" (8). The study's results suggested that 57% to 59% of people require orthodontic treatment. The same study suggested that the Mexican-American population has a higher prevalence of incisor malposition, class II malocclusion and class III malocclusion compared to the rest of the American population but also a lower prevalence of deep bite and open bite. The most severe cases of malocclusion tend to be seen in the African-American population.

An epidemiological study conducted in Nigeria on a sample of 493 patients aged 7 to 10 years revealed that 1/3 required interceptive orthodontic treatment - the type of malocclusion most commonly found is a crossbite, followed by the inclusion of permanent teeth and premature loss of deciduous teeth, all accompanied by poor dental hygiene habits. However, this study did not reveal significant differences between boys and girls (9). Ten years later, a new study was conducted in Nigeria on 320 patients aged 13 to 20 years, which found that 11.8% of patients had normal occlusion, 80.3% had class I malocclusion, 6.3% presented class II malocclusion and 1.6% were affected by class III malocclusion (10).

Similar results have been found in Italy in a study conducted on 3017 patients aged between 8 and 13; 75.8% of patients have malocclusions accompanied by widespread premature loss of deciduous teeth and increased overjet and overbite (11).

In accordance with past results, Siriwat and Jarabak (12) have come to the conclusion that the most frequent cases of malocclusion are class I (47%), followed by class II (46.2%) and finally, class III (6.6%). Furthermore, Aldrees conducted a study in South Arabia, confirming that the most common malocclusions are class I (13).

The same results have been found in a study performed in China: once again, the most common cases of malocclusion are class I (48%), but what differentiates the results obtained in this study from those obtained in European and American studies is the predominance of class III malocclusion (21%) (14). In addition, various studies reported that the most common problem is the crowding of incisors, present in 38.9 % of patients examined (15-16).

Dental agenesis is also very common. In decreasing order, the most common elements affected by agenesis are the third molars, second premolars, and lateral maxillary incisors. The latter has an incidence of 5%, and after third molars, they are the dental elements most affected by agenesis though different populations (15-16).

Moreover, among permanent teeth, maxillary canines are most often included teeth (5.24%), followed by second lower premolars (2.23%), second superior premolars (1.11%) and inferior canines (0.92%) without statistical differences between men and women and with arch length as a risk factor. None of the patients with dental inclusions had a squared arch shape (17-18).

Regarding canine inclusion, a literature review shows that palatally displaced canines correlate with genetic anomalies, while labially impacted canines result from lack of space (17-18).

The main purpose of this study is to analyse the predominance of malocclusions Italy and compare the results with those obtained from international literature and those of studies performed in the Bergamo area 16 years ago (19).

MATERIALS AND METHODS

The study was conducted on 441 patients (219 men and 222 women) from the Bergamo area in the Alzano Lombardo Hospital. It was performed with respect to the Declaration of Helsinki of 2013. All patients had a first evaluation, and the following documents were collected and investigated:
• lateral radiography: cephalometric analysis was then performed in accordance with the parameters of Giannì school;
• orthopantomography;
• cast model of upper and lower jaws.

All data were included in a database, and particular attention was focused on the following:

- skeletal class: identified through the analysis of ANB angle;
- divergence: given by the intermaxillary angle;
- presence of agenesis ;
- presence of impacted canines;
- maxillary position: obtained from the value of SNA angle;
- lower jaw position: given by the value of SNB angle;
- maxillary dimension: Sna-A;
- mandibular dimension: Go-Me/S-N;
- transversal dimension;
- Wits index;
- overjet;
- overbite;
- ethnic group;
- gender

RESULTS

In the analysed sample of 441 patients living in Italy treated in the Department of Dentistry in Alzano Lombardo Hospital, a correspondence can be seen between the number of female (50.34%) and male patients (49.66%) (Table I).

Considering the total sample, without any distinction between gender, only 49.21% have a class I malocclusion, while 44.9% have a class II malocclusion and only 5.9% are affected by a class III malocclusion. However, if a distinction between men and women is made when analysing the types of occlusions, the following conclusions can be drawn: class I is equally distributed between men and women, class II malocclusion is more frequent in women by a factor of 1.54%, while class III malocclusion is more frequent in men (6.39%) than in women (5.39%).

Regarding divergence, there are significant differences in the distribution of normodivergent, hypodivergent and hyperdivergent facial patterns: there is a prevalence of normodivergence in more than 50% of cases examined, whereas in the remaining cases, 8.54% are hypodivergent and 39.76% are hyperdivergent (Table II).

There are differences between males and females: it can be seen that normodivergence is more frequent in women than in men, with a difference of about 4% percentage points. The difference is even greater in the distribution of hypodiveregence, which is more common in men (12.08%) than women (5.08%). However, hyperdivergence is more common in women (3%).

Regarding agenesis, these occur in a significant part of the sample (5.44%) and are distributed very differently between men and women. There is a higher presence of agenesis in women (7.41%) compared to men (3.65%) (Table II).

Table I. *Percentage analysis of distribution of different skeletal classes by gender.*

PATIENTS	M	F	SKELETAL CLASS I	SKELETAL CLASS II	SKELETAL CLASS III
TOTAL	219	222	217	198	26
	441		441		
	49.66%	50.34%	49.21%	44.90%	5.90%
MEN	219	0	108	97	14
	219		219		
			49.32%	44.29%	6.39%
WOMEN	0	216	106	99	11
		216	216		
			49.07%	45.83%	5.09%
DIFFERENCE			0.24%	-1.54%	1.30%

Also, the presence of impacted canines is distributed differently in the population, with a difference of 2.87% between men and women (with a higher prevalence in women).

Regarding maxillary positioning, only 39.23% of patients present a correctly positioned maxilla, and there is a difference in maxillary normoposition with 43.84% of men against 34.26% of women (Table III).

The maxillary protrusion is present in 14.74% of patients, distributed differently in men and women (11.87% *vs* 18.06%); a maxillary retrusion can be seen in 46.03% of cases, non-uniformly distributed between men and women: a higher frequency of alterations in maxillary position is found in women.

The data regarding mandibular positioning suggests that only 30.61% of patients present correct mandibular positioning, with significant differences between men and women (a normopositioned mandible is 1.88% more frequent in women than men). In addition, more than two-thirds of patients (with equal distribution between men and women) present mandibular retrusion. Instead, only 2.49% have a mandibular protrusion (Table IV).

Table II. *Percentage analysis of divergence, presence and number of agenesis, and impacted canines (the results on divergence are referred to a sample of 410 patients).*

PATIENTS	Normo div.	Hypo Div.	Hyper Div.	Agenesis	N° agenesis	Presence of impacted canines
TOTAL	212	35	163	24	49	38
	410					441
	51.71%	8.54%	39.76%	5.44%		8.62%
	100.00%					100.00%
MEN	103	25	79	8	20	15
	207					219
	49.76%	12.08%	38.16%	3.65%		6.85%
	100.00%					100.00%
WOMEN	106	10	81	16	29	21
	197					216
	53.81%	5.08%	41.12%	7.41%		9.72%
DIFFERENCE	-4.05%	7.00%	-2.95%	-3.75%		-2.87%

Table III. *Maxillary position in the examined sample and differences between genders.*

PATIENT	M	F	Maxillary normoposition	Maxillary protrusion	Maxillary retrusion
TOTAL	219	222	173	65	203
	441		441		
	49.66%	50.34%	39.23%	14.74%	46.03%
	100.00%		100.00%		
MEN	219	0	96	26	97
	100.00%	0.00%	43.84%	11.87%	44.29%
WOMEN	0	216	74	39	103
	0.00%	100.00%	34.26%	18.06%	47.69%
DIFFERENCE			9.58%	-6.18%	-3.39%

Table IV. *Mandibular position divided by genders.*

PATIENT	(Mandible) Mandibular normoposition	(Mandible) Mandibular protrusion	(Mandible) Mandibular retrusion
TOTAL	35	11	295
	441		
	30.61%	2.49%	66.89%
MEN	68	4	147
	31.05%	1.83%	67.12%
WOMEN	63	7	146
	29.17%	3.24%	67.59%
DIFFERENCE	1.88%	-1.41%	-0.47%

Considering jaw dimension, we can see a normomandible in about one-third of patients, without any significant difference between males and females. On the contrary dimensional differences are distributed in a heterogeneous way. Hypomandible is found primarily in men (41.12%), with a difference of 8% compared to women. Hypermandible, instead, is found in 29.49% of patients, with a higher frequency in women. Maxillary dimension is reported in Table V; maxillary deficit is found in 48% of patients .

An analysis of bite data demonstrates that only 17% of patients, without any significant difference between males and females, have a normo bite. On the other hand, 53.53% have a deep bite, and 28.7% have a skeletal openbite, with a difference of about 2 % between the two genders (Table VI).

Maxillary constriction is very common: only 53.51% of patients examined have no transverse contraction, 35.83% have a maxillary constriction, and 10.66% have a severe transversal deficit with a higher frequency in men (13.76%) than in women (6.91%).

Regarding Wits index, overjet and overbite, 40.82% of patients present a negative Wits appraisal: in 4 patients (2M and 2F), a value lower than -7 was obtained, representing 0.91% of the sample. Moreover, one-third of patients have normal Wits with values between -1 and +1 (36% in women and 29% in men) (Table VII).

Table V. *Dimension of maxilla and lower jaw in relation to the total number of patients and gender.*

PATIENT	Normo mandible	Hypo mandible	Hyper mandible	Normo maxillia	Hypo maxillia	Hyper maxillia
TOTAL	147	159	128	128	210	99
	434			437		
	33.87%	36.64%	29.49%	29.29%	48.05%	22.65%
	100.00%			100.00%		
MEN	74	88	52	67	101	49
	34.58%	41.12%	24.30%	30.88%	46.54%	22.58%
WOMEN	69	70	75	58	106	50
	32.24%	32.71%	35.05%	27.10%	49.53%	23.36%
DIFFERENCE	2.34%	8.41%	-10.75%	3.77%	-2.99%	-0.78%

Table VI. *Skeletal bite and maxillary constriction (parameters were obtained from cast models).*

PATIENT	Normo-bite	Deep-bite	Open-bite	Maxillary constriction	No Maxillary constriction	Severe maxillary constriction
TOTAL	78	235	126	158	236	47
	439			441		
	17,77%	53,53%	28,70%	35,83%	53,51%	10,66%
	100,00%			100,00%		
MEN	39	118	60	79	109	30
	17,97%	54,38%	27,65%	36,24%	50,00%	13,76%
WOMEN	38	114	64	78	124	15
	17,59%	52,78%	29,63%	35,94%	57,14%	6,91%
DIFFERENCE	0,38%	1,60%	-1,98%	0,29%	-7,14%	6,85%

Table VII. *Distribution of Wits values, overjet and overbite.*

PATIENT	wits <-7	wits>-7; <-1	wits >-1; <+1	wits >+1; <+6	wits >+6	overjet <0.5	overjet >0.5; <4.5	overjet > +4.5	overbite <0.5	overbite >0.5; <4.5	overbite >+4.5
TOTAL	4	180	144	111	2	11	282	130	52	302	71
	441					423			425		
	0.91%	40.82%	32.7%	25.17%	0.45%	2.6%	66.67%	30.73%	12.24%	71.06%	16.71%
	100.0%					100%			100%		
MEN	2	90	65	62	1	6	134	69	22	142	45
	0.91%	40.91%	29.5%	28.18%	0.45%	2.9%	64.11%	33.01%	10.53%	67.94%	21.53%
WOMEN	2	86	78	48	1	5	145	59	29	157	25
	0.93%	40%	36.3%	22.33%	0.47%	2.4%	69.38%	28.23%	13.74%	74.41%	11.85%
DIFFERENCE	-0.02%	0.91%	-6.73%	5.86%	- 0.01%	0.48%	-5.26%	4.78%	-3.2%	-6.46%	9.68%

In analysing the distribution of anomalies of skeletal classes, it can be concluded that first and second-class malocclusions are uniformly distributed between men and women. On the contrary, the third class is found more often in men (53.85%) (Table VIII). Table IX describes children originating from different ethnic groups living in the province of Bergamo and treated at the Department of Dentistry in Alzano Lombardo Hospital. Noteworthy, only 23% of children who underwent a first examination in this hospital are foreigners, and only a very small portion of these patients underwent orthodontic treatment; this indicates a low motivation in diagnosis and treatment of malocclusions.

DISCUSSION

In the present study, a comparative analysis is presented with a similar epidemiological study conducted in 2000 (19).

As can be seen from Table X, the most recent study has a greater number of patients enrolled and a greater ethnic heterogeneity of the sample.

Skeletal class, hyperdivergence and agenesis are common parameters investigated in both studies. However, regarding the skeletal class, some significant differences can be noted. In fact, in the 2000 study, class II is more represented than in the 2016 study (56.2% *vs* 44.9%) and class I less (41.2% *vs* 49.21%) (Table XI).

Regarding the divergence, some significant differences can be noted. In fact, in the 2000 study, the hyperdivergence is

Table VIII. *Distribution of different skeletal classes in both genders.*

N.	Male	Female
1^ CLASS	108	109
	49.77%	50.23%
2^ CLASS	97	101
	48.99%	51.01%
3^ CLASS	14	12
	53.85%	46.15%

Table IX. *Number and percentage distribution of patients from different ethnic groups.*

PATIENT	Caucasic	Asiatic	North african	African	South american
TOTAL	403	7	21	2	8
	441				
	91.38%	1.59%	4.76%	0.45%	1.81%

Table X. *Comparison of the number and ethnic groups of patients enrolled in the epidemiological studies of 2000 and 2016.*

	N° patients	Ethnic groups
2000 Study	342	Caucasic (100%)
2013 Study	441	Caucasic (91.38%). North African (4.76%). South American (1.81%). Asiatic (1.59%). African (0.45%)

Table XI. *Comparison of the distribution of skeletal classes in patients enrolled in the epidemiological studies of 2000 and 2016.*

	Class I	Class II	Class III
2000 study	41.2%	56.2%	2.6%
2013 study	49.21%	44.9%	5.9%

Table XII. *Distribution of different skeletal classes in both genders.*

	Normo Div.	**Hypo Div.**	**Hyper Div**
2000 study	27.8%	0.6%	71.7%
2016 study	51.71%	8.54%	39.76%

more represented than in the 2016 study (71.7% *vs* 39.76%) and the hypodivergence (0.6% *vs* 8.54%) and normodivergence less (27.8% *vs* 51.71%) (Table XII).

In 2000, agenesis was noted only in 4.38% of a total of 342 patients, corresponding to a total of 40 missing elements, which is similar to the 5.44% of the 2016 study (49 missing teeth on 441 patients).

The major limitation of the present study is the ethnic homogeneity of the sample (91.38% of patients are Italian); This is probably due to the lower socio-economic level of patients of different ethnic groups coming to the hospital for diagnosis and treatment. In addition, since orthodontic treatment is not entirely free (like other medical treatments in Italy), it could be an additional barrier to treating young patients. Therefore, the future should conduct new epidemiological investigations on more heterogeneous pediatric population samples to differentiate the various cephalometric parameters based on ethnicity.

There are substantial differences in the distributions of skeletal classes and divergence between the studies performed in 2000 and the present analysis: in the previous study, there is a higher prevalence of Class II and hyperdivergent patients. A plausible explanation for detecting mild and minor malocclusion in the recent data presented here is that greater attention is paid by families to the malocclusions of their children in recent years compared to 2000, thanks to the numerous interventions to raise awareness of the mitigated orthodontic problems. In addition, this fact can explain because patients with "less severe" malocclusion come to the hospital now compared to patients 16 years ago.

CONCLUSIONS

In this study, it was possible to present an overview of the different malocclusion indices in a sample of children in Italy. Most of them have malocclusion and are needed for orthodontic treatment.

Conflict of Interest
The authors declare no conflict of interest.

REFERENCES

1. Liu Z, McGrath C, Hägg U. The Impact of Malocclusion/Orthodontic Treatment Need on the Quality of Life. *The Angle Orthodontist*. 2009;79(3):585. doi:https://doi.org/10.2319/0003-3219(2009)079%5B0585:tiootn%5D2.0.co;2

2. Mohlin B, al-Saadi E, Andrup L, Ekblom K. Orthodontics in 12-year old children. Demand, treatment motivating factors and treatment decisions. *Swedish Dental Journal*. 2002;26(2):89-98.

3. Jenny J. A social perspective on need and demand for orthodontic treatment. *International Dental Journal*. 1975;25(4):248-256.

4. Jarvinen S. Need for interceptive intervention for malocclusion in 6-year-old Finnish children. *Community Dentistry and Oral*

Epidemiology. 1981;9(6):285-288. doi:https://doi.org/10.1111/j.1600-0528.1981.tb00347.x

5.   Evensen JP, Øgaard 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(6):710-716. doi:https://doi.org/10.1016/j.ajodo.2005.08.037

6.   Heikinheimo K, Salmi K, Myllarniemi S. Long term evaluation of orthodontic diagnoses made at the ages of 7 and 10 years. *The European Journal of Orthodontics*. 1987;9(2):151-159. doi:https://doi.org/10.1093/ejo/9.2.151

7.   Heikinheimo K, Salmi K, Myllärniemi S. Identification of cases requiring orthodontic treatment. A longitudinal study. *Swedish Dental Journal Supplement*. 1982;15:71-77.

8.   Proffit WR, Fields HW, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the NHANES III survey. *The International Journal of Adult Orthodontics and Orthognathic Surgery*. 1998;13(2):97-106.

9.   Onyeaso CO. Need for preventive/interceptive orthodontic treatment among 7-10-year-old children in Ibadan, Nigeria: an epidemiological survey. *Odonto-Stomatologie Tropicale = Tropical Dental Journal*. 2004;27(107):15-19.

10. Aikins EA, Onyeaso CO. Prevalence of malocclusion and occlusal traits among adolescents and young adults in Rivers State, Nigeria. *Odonto-Stomatologie Tropicale = Tropical Dental Journal*. 2014;37(145):5-12.

11. Grippaudo C, Pantanali F, Paolantonio EG, et al. Prevalence of malocclusion in Italian schoolchildren and orthodontic treatment need. *European Journal of Paediatric Dentistry*. 2013;14(4):314-318.

12. Siriwat PP, Jarabak JR. Malocclusion and facial morphology is there a relationship? An epidemiologic study. *The Angle orthodontist*. 1985;55(2):127-138.

13. Aldrees AM. Pattern of skeletal and dental malocclusions in Saudi orthodontic patients. *Saudi Medical Journal*. 2012;33(3):315-320.

14. Chu CH, Choy BHB, Lo ECM. Occlusion and orthodontic treatment demand among Chinese young adults in Hong Kong. *Oral Health & Preventive Dentistry*. 2009;7(1):83-91.

15. Mohan Das U, Reddy D, LNU V. Prevalence of Malocclusion Among School Children in Bangalore, India. *International Journal of Clinical Pediatric Dentistry*. 2008;1(1):10-12. doi:https://doi.org/10.5005/jp-journals-10005-1002

16. Tang ELK. The Prevalence of Malocclusion Amongst Hong Kong Male Dental Students. *British Journal of Orthodontics*. 1994;21(1):57-63. doi:https://doi.org/10.1179/bjo.21.1.57

17. Topkara A, Sari Z. Impacted teeth in a turkish orthodontic patient population: prevalence, distribution and relationship with dental arch characteristics. *European Journal of Paediatric Dentistry*. 2012;13(4):311-316.

18. Jacobs SG. The impacted maxillary canine. Further observations on aetiology, radiographic localisation, prevention/interception of impaction, and when to suspect impaction. *Australian Dental Journal*. 1996;41(5):310-316. doi:https://doi.org/10.1111/j.1834-7819.1996.tb03139.x

19. G.L Caccianiga, L.Baldini, R.Pappagna, M.Baldoni.Trattamento ortodontico della popolazione bergamasca in età scolare. *Mondo Ortodontico Masson* 2001;gennaio:61-67.