

The prevalence of malocclusion in Maltese schoolchildren as measured by the Index of Orthodontic Treatment Need

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Abstract

The Index of Orthodontic Treatment Need (IOTN), a widely-used, standardised epidemiological tool was used to determine the prevalence of malocclusion in Maltese schoolchildren.

The use of an internationally-accepted, graded index based on both health and aesthetic scales allows prioritisation of treatment and appropriate direction of resources. Furthermore it allows training curricula to be tailored to the population requirements. This will maximise cost-benefit ratios to the advantage of both the patient and the service provider.

This study highlights the similarities and differences between the Maltese and other populations and draws attention to the traits most prevalent for our population.

Introduction

Malocclusion describes a spectrum of deviation from the normal or ideal to very severe anomalies. Clinicians, patients and their families may have differing views of what should be treated and what should be accepted as a modest and harmless variation. There is also likely to be variation among groups of clinicians and also between primary care referring practitioners and specialist orthodontists.

The development of the Index of Orthodontic Treatment Need (IOTN) by Brook and Shaw has gained wide acceptance in Europe and the rest of the world. It is a useful, standardised tool for those interested in research into Dental Public Health and the epidemiology of malocclusion.¹

The evolution of the School Dental System has led to the provision of free orthodontic treatment for Maltese citizens under the age of 16. Although the range of treatment provided is limited, this has generated long waiting lists of patients. Evaluation of self perceived and actual need for orthodontic treatment as well as other factors affecting these needs such as personal, socio-demographic, and psychosocial factors help in planning orthodontic services and estimating the required resources and manpower. Moreover, unnecessary referrals by general practitioners and lengthy waiting lists for orthodontic treatment can be eliminated by limiting treatment to patients with the more severe malocclusions^{2,3} as patients with a low IOTN score are unlikely to show a great change as a result of even the highest standard of treatment.

As orthodontic treatment needs to be justified on either dental health or aesthetic needs, the index has two components:

- The Dental Health Component (DHC) (Figure 1)
- The Aesthetic Component (AC) (Figure 2)

The DHC of the IOTN has five categories ranging from 1 (no need for treatment) to 5 (great need) which may be applied clinically or to patients' study casts. The most severe occlusal trait is identified for any particular patient and the patient is then categorised according to this most severe trait. Patients in Grade 1 would include those with minor tooth displacements where there is little need for treatment. Those in Grade 5 would include patients with Cleft Lip and Palate, multiple missing teeth or a destructive malocclusion.

The AC of the IOTN consists of a ten-point scale illustrated by a series of photographs which were rated for attractiveness by a lay panel and selected as being equidistantly spaced

Key words

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through the range of grades.⁴ A rating is allocated for overall dental attractiveness rather than specific similarities to the photographs. The final value reflects the treatment need on the grounds of aesthetic impairment and by implication the sociopsychological need for orthodontic treatment. Both parents and patients find this easy to apply and there is a high level of agreement between the scores obtained by dentists, parents and children.

Methods and materials

The survey was carried out over April and May of 2003. A sample of 530 twelve-year-old Maltese and Gozitan schoolchildren was selected at random from the rolls of all private and state schools in Malta and Gozo. This is representative of the twelve-year-old population at the 95% confidence level.

Examination was conducted by two qualified orthodontists (KM and SC). Inter-examiner error was determined prior to

Figure 1: The Dental Health Component of the IOTN

Grade 1	No treatment required	Extremely minor malocclusions, including displacements less than 1 mm
Grade 2	Little	
	2.a	Increased overjet > 3.5 mm but ≤ 6 mm (with competent lips)
	2.b	Reverse overjet greater than 0 mm but ≤ 1mm
	2.c	Anterior or posterior crossbite with ≤ 1mm discrepancy between retruded contact position and intercuspal position
	2.d	Displacement of teeth > 1mm but ≤ 2mm
	2.e	Anterior or posterior open bite > 1mm but ≤ 2mm
	2.f	Increased overbite ≥ 3.5mm (without gingival contact)
	2.g	Prenormal or postnormal occlusions with no other anomalies. Includes up to half a unit discrepancy
Grade 3	Borderline need	
	3.a	Increased overjet > 3.5 mm but ≤ 6 mm (incompetent lips)
	3.b	Reverse overjet greater than 1 mm but ≤ 3.5mm
	3.c	Anterior or posterior crossbites with >1mm but ≤ 2mm discrepancy between the retruded contact position and intercuspal position
	3.d	Displacement of teeth >2mm but ≤4mm
	3.e	Lateral or anterior open bite > 2mm but ≤ 4mm
	3.f	Increased and incomplete overbite without gingival or palatal trauma
Grade 4	Treatment required	
	4.a	Increased overjet > 6mm but ≤ 9 mm
	4.b	Reverse overjet > 3.5 mm with no masticatory or speech difficulties
	4.c	Anterior or posterior crossbites with > 2 mm discrepancy between the returned contact position and intercuspal position
	4.d	Severe displacements of teeth > 4
	4.e	Extreme lateral or anterior open bites > 4 mm
	4.f	Increased and complete overbite with gingival or palatal trauma
	4.h	Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis
	4.l	Posterior lingual crossbite with no functional occlusal contact in one or more buccal segments
	4.m	Reverse overjet > 1 mm but < 3.5 mm with recorded masticatory and speech difficulties
	4.t	Partially erupted teeth, tipped and impacted against adjacent teeth
	4.x	Existing supernumerary teeth
Grade 5	Treatment required	
	5.a	Increased overjet > 9 mm
	5.h	Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant requiring pre-restorative orthodontics)
	5.i	Impeded eruption of teeth (apart from 3rd molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathological cause
	5.m	Reverse overjet > 3.5 mm with reported masticatory and speech difficulties
	5.p	Defects of cleft lip and palate
	5.s	Submerged deciduous teeth

Table 1: Studies of comparable populations where the IOTN index was used

Study	Country
Brook and Shaw	UK
Burden and Holmes	UK
Abu Alhaija	Jordan
Hamdan	Jordan
Ucuncu	Turkey
So and Tang	Hong Kong

the study and was found to be 0.15%. Intra-examiner error was determined by re-examining 20 subjects after a period of at least two weeks. This was 0.10%.

Inspection was carried out using a mirror and probe and a pen light wielded by an assistant. The survey was carried out over a period of four weeks. Both the DHC and AC components of the IOTN were assessed.

A search of the literature found comparable surveys of school populations, from various countries, on children of similar age, where the IOTN was used (Table 1).^{1,5-9}

Results and discussion

Dental health component

Twenty-nine percent of children in our study fell into Grade 1 and 2, that is, they required little or no need for treatment. A further 29% fell into Grade 3, indicating borderline need and 42% fell into categories 4 and 5 and therefore definitely required treatment (Table 2).

The studies of Brook and Shaw, Burden and Holmes, Hamdan and So and Tank were published with sufficient raw data to allow comparison of the groups. Chi squared tests showed significant differences for groups 1, 2 and 5 (Table 3).

The inference here is that we have a high amount of Grade 1 occlusions as compared to other countries and a lesser amount of Grade 2 malocclusions. This difference between the Maltese and other studies may be due to subjective judgment, as neither of these categories requires treatment. The Grade 5 figure is

Table 2: Percentage scores of the Dental Health Component as applied to Maltese Schoolchildren

Grade	Percent
Grade 1	13.96
Grade 2	15.09
Grade 3	28.87
Grade 4	25.85
Grade 5	16.23

also significantly different. This is due to the high '5i' score and is discussed below.

The scoring of the individual traits is listed in Table 4.

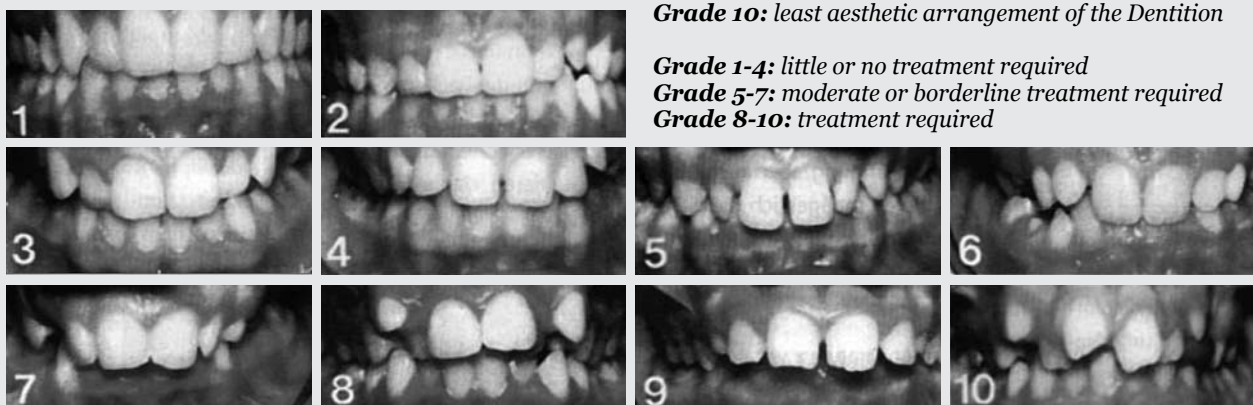
Increased overjets account for 21% of the total sample. Thirty per cent of these overjets scored Grade 3, twenty-two per cent Grade 4 and thirteen per cent Grade 5. Burden and Holmes⁶ quote 25% for increased overjet in the total Mancunian sample and 27% for the Sheffield sample. Hamdan⁷ gives a figure of 42% for Grade 3 and 22% for Grade 4. Here again, there is little difference between the samples.

A previous survey of Maltese schoolchildren, which did not use the IOTN scale, found that increased overjets accounted for 21% of the sample, comparing well with the present figure.¹⁰ These figures are comparable as overjet measurement is carried out with a ruler. However it seems that incisor protrusion requiring treatment is only present in 16% of the sample of Maltese children.

The figure given for reduced and reversed overjets is at the lower end of the ranges quoted in the international literature.¹¹⁻¹⁷ It is also not in accordance with the results of the previous survey, which gave a figure of 8%. However, as this is the first published survey using the IOTN scale on Maltese children, different measuring methods may account for this discrepancy.

As regards crowding, Burden and Holmes⁶ quote 26% for the total Mancunian sample and 28% for the Sheffield sample. The Maltese figure is given at 35% (fifteen per cent of Grade 3 and 13% of Grade 4). Abu Alhaija⁵ gives the prevalence of crowding at 45% of the Grade 4 sample, as does Hamdan.⁷ The

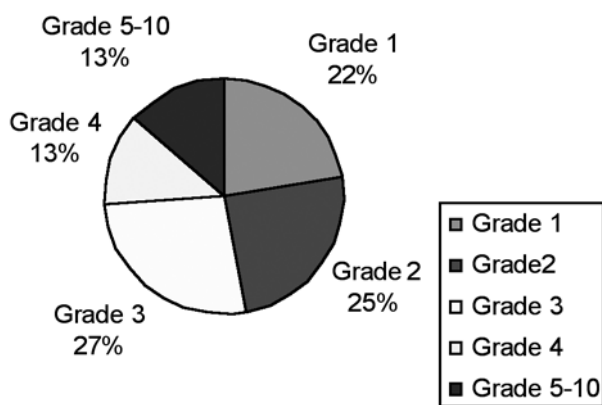
Figure 2: The Aesthetic Index of the IOTN



Grade 1: most aesthetic arrangement of the Dentition
Grade 10: least aesthetic arrangement of the Dentition

Grade 1-4: little or no treatment required
Grade 5-7: moderate or borderline treatment required
Grade 8-10: treatment required

Figure 3: The scores of the Aesthetic Index as applied to Maltese schoolchildren



Maltese sample is fairly similar to the UK sample. It is difficult to compare to the Middle Eastern samples as the relevant breakdown of figures is not given.

Hypodontia cases were found to comprise 3% of the total (12% of Grade 4). There were no scores in Grade 5. Burden and Holmes⁶ quote 4% for the total Mancunian sample and 6% for the Sheffield sample. Hamdan⁷ cites 2% for Grade 4.

The figure quoted for Maltese children excludes premolar hypodontia as it is often not possible to tell whether these teeth are present at age 12 without radiographic investigation. Therefore the 3% covers chiefly missing upper lateral incisors in addition to missing lower incisors. The published figure for lateral incisor hypodontia is 1.9%.¹⁸ This may mean that the Maltese population has a slightly higher prevalence of missing lateral incisors than that quoted in the international literature.

Impacted and unerupted teeth (Grade 5i) account for 74% of the Grade 5 (great need) score. This figure may be inflated as there has been no radiographic follow-up to this group. What may have been thought to be impacted may possibly be developmentally delayed or missing and should be assigned to another group. This applies in particular to second premolars whose eruption is sometimes delayed.

Hamdan⁷ reports that, in Jordanian children, 24% of the Grade 5 group are classified as Grade 5i, Abu Alhaija⁵, quotes 17%. According to Burden and Holmes⁶ impacted teeth account

Table 4: Percentage scores of individual malocclusion traits scored for in the Maltese IOTN

Trait	Percent
Increased Overjets	21.13
Reverse Overjet	2.08
Crossbite	5.29
Deep Overbite	2.26
Open Bite	1.00
Scissor Bite	0.57
Mild Crowding	6.98
Moderate Crowding	14.91
Severe Crowding	12.64
Hypodontia	3.21
Impacted Teeth	12.07
Submerged Deciduous Teeth	1.89

for the Grade 5 score in 30% of Mancunian children and 26% of Sheffield children respectively. Thus, the Maltese population scores very high in this respect.

10 subjects (2%) of the sample had infraoccluded deciduous teeth, making up 12% of Grade 5s. This may not be a totally accurate representation, as nearly all first and most second deciduous molars would be shed at age 12. Of a sample of 1539 children aged 5-11, Andlaw⁹ found only five 11 year olds (0.032%) with infraoccluded deciduous teeth.

Infraoccluded deciduous teeth are associated with premolar hypodontia and so this high score may mean that the figure for the 5h group would be revised upwards if radiographic investigation of these children is undertaken. Infraoccluded deciduous teeth, hypodontia and ectopic canines are genetically linked anomalies^{20,21} and there is a high prevalence of ectopic canines on the island.²² Therefore the figures for groups 5i and 5s are in accord with the existing evidence.

It is difficult to compare the figures more precisely obtained as subcategories are often selectively quoted in the literature.

Aesthetic index

As can be seen from Figure 3, the vast majority (87%) of children rated themselves as being in categories 1-4, i.e. did not think they required Orthodontic treatment.

This does not correlate with the findings of the DHC as 42% did, in fact need treatment rather badly. This figure should

Table 3: The raw data for various IOTN studies compared to the present study. Chi squared tests showed significant differences in groups 1, 2 and 5

Study	N	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Brook and Shaw	333	24*	93*	107	92	17***
Burden and Holmes (Manchester)	874	44*	358*	210	175	87*
Burden and Holmes (Sheffield)	955	57*	277*	315	201	105*
Hamdan	320	30	131**	71	65	23*
So and Tank	100	2*	21	25	49*	3
Camilleri and Mulligan	530	74	80	153	137	86

* p<0.05, *** p<0.001

increase with age as self-awareness improves with maturity. It may be instructive to repeat the test on a sample of children prior to their leaving school.

The situation is similar to Turkey where Ucuncu⁹ found that the majority of children (90.4%) did not express any burning desire for Orthodontic treatment either, despite a substantial score in the DHC Grade 3 and 4 categories.

On the other hand, Brook and Shaw¹ found 41.7% of children in the 'require treatment' categories. Abu Alhaija⁵ found 49% of children in North Jordan were not satisfied with the appearance of their teeth despite only 34% exhibiting a definite need for treatment. Maltese children appear to be far more relaxed in this respect.

Conclusions

- 1) The pattern of malocclusion in the Maltese Islands is, in general, similar to that published in the international literature. It differs in that:
 - a. We have a higher number of Grade 1 occlusions but a lower number of Grade 2 malocclusions.
 - b. We have a high number of Grade 5 malocclusions, this being due to a large number of impacted or unerupted teeth.
- 2) 12 year old Maltese schoolchildren exhibit a low sociopsychological need for Orthodontic treatment.

Follow-up of the 5h, 5i and 5s subgroup is necessary to validate the prevalence of impacted teeth and hypodontia in the population.

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