The orthodontic condition of children in England, Wales and Northern Ireland 2013

S. L. Rolland,*[1] E. Treasure,[2] D. J. Burden,[3] E. Fuller[4] and C. R. Vernazza[5]

In brief

Highlights that 9% of 12-year-olds and 18% of 15-year-olds were undergoing orthodontic treatment, most with fixed appliances.

Shows that 44% of 12-year-olds and 29% of 15-year-olds expressed a desire for straighter teeth, however over half of this group would not qualify for NHS treatment.

Suggests that unmet treatment need was higher in children eligible for free school meals.

Background The 2013 Children's Dental Health Survey is the fifth in a series of national surveys. **Aims** This paper reports the orthodontic condition of 12- and 15-year-olds and how they and their parents feel about the appearance of their teeth. **Methodology** A representative sample of children (5y, 8y, 12y, 15y) in England, Wales and Northern Ireland were invited to participate in dental examinations. A modified Index of Orthodontic Treatment Need (IOTN) was used as a measure of orthodontic treatment need for 12- and 15-year-olds. Children and parents were invited to complete a questionnaire about oral health behaviour and attitudes. **Results** Nine percent of 12-year-olds and 18% of 15-year-olds were undergoing orthodontic treatment at the time of the survey. Forty-four percent of 12-year-olds and 29% of 15-year-olds expressed a desire for straighter teeth, however over half of this group would not qualify for NHS treatment. Unmet treatment need was higher in children eligible for free school meals (P <0.05 at 15y). **Conclusions** Provision of and demand for orthodontic treatment is increasing, with a significant proportion of children who desire orthodontic care not eligible to receive it. Children from deprived backgrounds have greater unmet orthodontic treatment need.

Introduction

The 2013 Children's Dental Health Survey is the fifth in a series of national surveys that have been carried out in the UK. This paper details the orthodontic condition of 12- and 15-year-olds, how children and their parents feel about the appearance of their teeth and the impact they perceive their oral health has on daily activities and interactions. Where possible, this data is compared to that from previous surveys to describe how trends in orthodontic treatment and treatment need are changing. The demand for, and provision of orthodontics within the UK is increasing. NHS orthodontic activity commissioned in England in 2012-13 increased by 2.6% compared to 2011-12 and 7.1% since 2008-09.[1]

[1]Clinical Lecturer in Child Dental Health (Orthodontics), Centre for Oral Health Research, Newcastle University; [2]Professor and Deputy Vice Chancellor, Cardiff University; [3]Centre Director and Clinical Professor, School of Medicine, Dentistry and Biomedical Sciences, Queens University, Belfast; [4]Research Director, NatCen Social Research, 35 Northampton Square, London; [5]NIHR Clinician Scientist, Centre for Oral Health Research, Newcastle University
*Correspondence to: S Rolland
Email: s.l.rolland@ncl.ac.uk

Refereed Paper. Accepted 23 June 2016
DOI: 10.1038/sj.bdj.2016.734
©British Dental Journal 2016; 221: 415-419

Methodology

Full details of sampling, response, examination protocols and statistical methods can be found elsewhere.[2] The 2013 survey was based on a representative sample of children aged 5, 8, 12, and 15 years, attending government maintained and independent schools in England, Wales and Northern Ireland. The survey involved 775 primary schools and 219 secondary schools. A total of 13,628 children were sampled within participating schools and asked to take part in a dental examination. In total, 9,866 children were examined, a response rate of 72.4%.

The survey was ethically reviewed (University College London, Project ID: 2000/003) following changes made as a consequence of piloting and it received a favourable ethical opinion.

Clinical examinations

Clinical examinations were undertaken in school settings by dentists who had undergone training and calibration. Consent was opt-in for 12- and 15-year-olds with children opting in on the day, with the possibility for parental opt-out in advance of the examination day. The examination was undertaken in a reclining chair using standardised dental epidemiological lighting, drying with cotton wool and visual examination. A standard orthodontic ruler was used for linear measurements, such as displacement of contact points and overjet. Dental nurses recorded the results of the examination on standardised forms.

Dentists recorded if the child was wearing an appliance at the time of the examination. Orthodontic treatment need was measured clinically, based upon a modified IOTN[3] (Index of Orthodontic Treatment Need), which essentially assessed if the child had an IOTN dental health component (DHC) 4 or 5, indicating a need for treatment or definite need for treatment respectively. The dental health component of the IOTN assesses five aspects – missing teeth,

Table 1 Percentage of population in treatment and types of orthodontic appliance worn by children wearing an appliance at the survey examination (percentages may not add up to 100 as some children wearing more than one kind of appliance)

	12-year-olds			15-year-olds		
	1993	2003	2013	1993	2003	2013
Percentage of UK population in treatment	9	8	9	11	14	18
Fixed	49	72	82	68	83	80
Removable	50	28	17	37	18	13
Other	2	3	2	2	4	10

overjet, crossbite, displacement of contact points and overbite. Additionally an IOTN aesthetic component (AC) score was awarded, based upon comparison of the appearance of the child's anterior teeth to a series of ten standardised photographs.[4] Treatment need was based on either dental health or aesthetic grounds or both.

Questionnaires

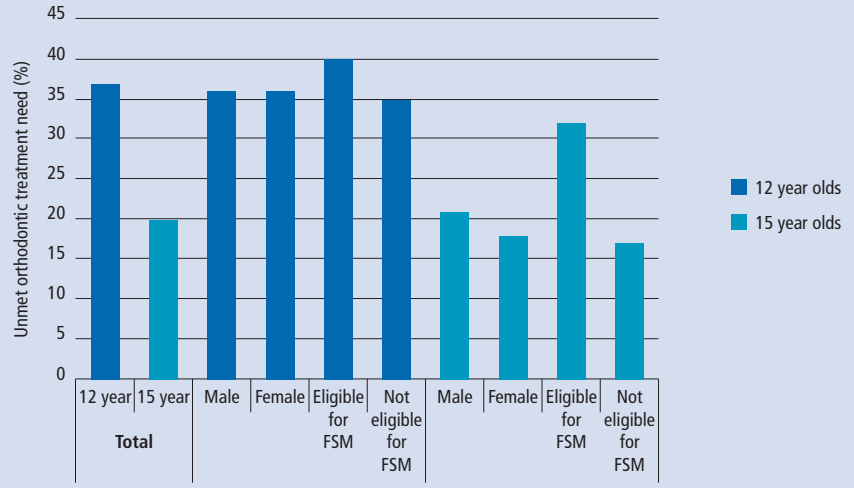
Alongside the clinical data collected at the dental examinations, the child dental health survey measured behavioural and attitudinal information collected about the children involved in the survey through the use of questionnaires. In the past, these questionnaires were sent only to the parents of the children involved, but an innovation for the 2013 survey was the introduction of a pupil questionnaire for 12- and 15-year-olds to complement the questionnaires sent to parents.

The orthodontic aspects of the parent and child questionnaires included similar questions related to their perceptions of their orthodontic treatment need. Pupils and parents were asked if they felt their (or their child's) teeth were 'all right' as they are, or whether they would prefer to have them straightened, or whether they could not tell because they were already in treatment.

Data analysis

In view of the complexity of the sampling design and resultant weighting procedures, sampling errors were quantified using statistics programme STATA,[5] and were calculated using a design factor (deft) to take account of the complex sampling and weighting procedures. The statistical significances in means and percentages between sub-groups were tested by calculating the confidence interval for the differences observed, based on the standard errors calculated using the design factor. This ensured that sampling error was taken into account in the testing procedure. Where statistically significant differences between groups are reported, the 5% threshold ($P < 0.05$) was used.

Fig. 1 % unmet orthodontic treatment need for 12- and 15-year-olds, in total, by sex and by eligibility for free school meals (FSM)



Results

Treatment in progress

In total, 2523 12-year-olds and 2412 15-year-olds were examined. Of these, 9% of 12-year-olds and 18% of 15-year-olds were undergoing orthodontic treatment at the time of the survey. This was higher in Northern Ireland, significantly so at 12 years (17% at 12y; 19% at 15y) than in England (8% at 12y; 18% at 15y) and Wales (8% at 12y; 16% at 15y). The proportion of children in treatment at the time of the survey has remained relatively stable in 12-year-olds since 1993, but steadily increased in 15-year-olds (Table 1).

Trends in current appliance wear

Trends in appliance wear over the last three surveys are shown in Table 1.

There is a steady decline in the use of removable appliances in both age groups across the three surveys. In contrast, fixed appliances remain the most common appliance to be used and their use has increased in 12-year-olds, but remained fairly steady since 2003 in 15-year-olds. There is an increase in appliances categorised as 'other' in 15-year-olds, and the nature of these appliances is unclear.

Treatment need

Unmet orthodontic treatment need (Fig. 1) indicates a treatment need based upon either the dental health component score of 4-5 or an aesthetic component score of 8-10. This is similar among the three countries, with the average total unmet need 37% for 12-year-olds and 20% for 15-year-olds. The 2003 survey identified similar overall unmet need (35% 12-year-olds; 21% 15-year-olds). However, in 2003 greater treatment need was identified in 15-year-old boys compared to girls (24% compared to 19%). This difference has reduced by 2013 with 21% of 15-year-old boys still considered in need of treatment compared to 18% of girls.

Deprivation was judged at a school level and was defined as 30% of children at a school being eligible for free school meals. Unmet

orthodontic treatment need was significantly higher in those eligible for free school meals (40% at 12y; 32% at 15y) compared to those ineligible (35% at 12y; 17% at 15y), with the difference particularly noticeable at 15 years. The difference between these two groups has become more apparent since the 2003 survey, particularly in 15-year-olds, with unmet treatment need in those eligible for free school meals in 2003 (35% at 12y; 24% at 15y) and those ineligible (35% at 12y; 20% at 15y).

Perception of treatment need

When children were asked if they would like their teeth to be straightened, significantly more girls reported that they would like their teeth straightened than boys in both age groups, with a greater difference at age 15 years (Table 2). Girls were also more likely to report being in treatment at age 12 than boys.

When comparing children's rating of their teeth, compared to their parents, if children rated their teeth as 'all right' parents tended to agree with this assessment (Table 3) with only a small proportion of parents in both age groups disagreeing with their child's assessment. However, there was less agreement between children and their parents when children felt that they would prefer their teeth straightened. Children were more likely to report that they felt their teeth need straightening with 44% of 12-year-old children (compared to 26% parents) and 29% of 15-year-old children (compared to 14% parents). For children who felt their teeth need straightening, at 12 years one-third of their parents felt their teeth were 'all right' and this increased to 50% at 15 years.

Comparison of the child's opinion regarding whether or not they would like their teeth straightened and orthodontic treatment need based upon their IOTN dental health component score reveals some discrepancies (Table 4). Generally, there is little treatment need identified in children who feel that their teeth are alright. However, in those who would like their teeth straightened, just over half of 12-year-olds and two-thirds of 15-year-olds exhibit no definite need for treatment using an objective measurement scale.

Impact of unmet treatment need on problems with oral health

Impact of oral health is discussed in an earlier paper in this series. Of relevance to orthodontics, 15-year-olds not currently undergoing orthodontic treatment and who had unmet orthodontic treatment need were significantly more likely to report problems due to oral health in the last three months (Table 5). Those who had unmet treatment need were significantly more likely to have been embarrassed when smiling or laughing or to report difficulty cleaning their teeth than those not deemed in need of orthodontic treatment.

Table 2 Self-assessed need for teeth to be straightened in total and by gender

		12 years (%)	15 years (%)
All children	Prefer teeth straightened	44	29
	Already in treatment	11	15
Male	Prefer teeth straightened	41	23
	Already in treatment	7	12
Female	Prefer teeth straightened	48	35
	Already in treatment	14	17

Table 3 Comparison of child's assessment of whether their teeth need straightening with parental assessment

Self-assessment	Parent Assessment	12 years (%)	15 years (%)
My teeth are all right	Their teeth are all right	86	88
	Would prefer them straightened	7	5
	Child in treatment	7	7
Would prefer my teeth straightened	Their teeth are all right	35	50
	Would prefer them straightened	46	42
	Child in treatment	18	8

Table 4 Comparison of child's assessment regarding whether their teeth need straightening with dental health component of the IOTN

Child's assessment	DHC IOTN 4-5	12 years (%)	15 years (%)
My teeth are all right	Treatment need	20	9
	No treatment need	80	91
Would prefer my teeth straightened	Treatment need	45	33
	No treatment need	55	67

Table 5 Problems due to oral health reported in the last three months by 15-year-olds, by presence of unmet orthodontic treatment need

	No unmet treatment need (%)	Unmet treatment need (%)
Embarrassed smiling or laughing	25	40
Difficulty in eating	15	22
Difficulty cleaning teeth	10	21
Felt different	8	15
Difficulty relaxing or sleeping	6	7
Difficulty speaking	4	10
Difficulty enjoying being with people	7	14
Difficulty doing school work	2	4
Any of these	40	57

Discussion

While the proportion of children aged 12 years undergoing treatment has remained relatively stable, there is a steady increase in the proportion of 15-year-olds undergoing treatment at the time of the survey. It is difficult to explain the higher proportion of 12-year-olds in treatment in Northern Ireland but this may be a reflection of differences in orthodontic manpower and/or differences in eligibility criteria used for NHS orthodontic treatment, with England and Wales adopting eligibility criteria in 2006 and Northern Ireland in April 2014, shortly after the survey was conducted. However, significant regional variation was identified by the NHS Dental Epidemiology Programme for England (2008/9) which demonstrated similar overall appliance wear in 12-year-olds (7.9%) but with variation ranging from 0.4% in Blackpool to 17.8% in the London Borough of Brent.[6]

The use of removable appliances has reduced dramatically over the last 20 years, contrasted by a steady rise in the use of fixed appliances in both age groups. Surprisingly, the use of fixed appliances in 15-year-olds appears to have reached a plateau since 2003, with a rise in children reported to be wearing 'other' appliances. However, the exact nature of these appliances is unclear, but it could be speculated that this refers to either bonded retainers or removable retainers placed following the completion of orthodontic treatment.

The DHC and AC of the IOTN were recorded during examinations, however, the DHC was used for statistical comparisons. Significantly fewer cases were identified as in need of treatment according to the AC (8-10) of the IOTN, and nearly all of these were identified as in need of treatment according to the DHC (4-5). The DHC is also a more objective score which achieved better reliability during training and calibration, and is therefore considered to be a more reliable measure of treatment need.

There may be a number of factors influencing unmet treatment need, including lack of awareness of treatment, access and referral issues or dental factors such as poor dental attendance, active caries or oral hygiene precluding the provision of treatment. Unmet treatment need based upon both the IOTN dental health component and aesthetic component score is unsurprisingly higher at age 12 years than 15 because most children will not have commenced orthodontic treatment aged 12 years. There is little difference in unmet need between males and females, although there is a slightly lower unmet need in girls compared to boys at 15 years, possibly suggesting that girls are more likely to pursue treatment than boys. Girls are significantly more likely than boys to report brushing twice daily[7] and may therefore be considered better candidates for orthodontic treatment. Unmet treatment need was significantly greater in 15-year-old children attending schools where at least 30% of the children were eligible for free school meals. This may in part be because children in this group reported significantly lower attendance at the dentist for regular check-ups and are therefore less likely to be referred.[7] Children in this group, are twice as likely to have severe or extensive decay[8] and are also less likely to report brushing their teeth twice daily (particularly males) and may therefore be poor candidates for orthodontic care.[7] They may also be less aware of what orthodontic care can offer and are therefore less likely to request referral for orthodontic treatment. These inequalities in oral health are significant and concerning and should be used to prioritise care. Further research and close monitoring of this situation is warranted.

However, the impact of unmet treatment need has demonstrated a potentially significant impact on their social well-being.[9] Over half of the children with unmet orthodontic treatment need reported problems due to their oral health in the last three months. Those with unmet need were significantly more likely to report embarrassment when smiling or laughing and difficulty cleaning teeth. However, all measured parameters were higher in those with unmet treatment need compared to those with no unmet need. The higher incidence of embarrassment, 'feeling different' and difficulty enjoying being with people could alter social interactions, the impact of which would be difficult to measure. The relationship between the severity of a child's malocclusion and their perceived oral health-related quality of life has previously been demonstrated,[10,11] although other factors, principally psychosocial factors (mainly psychological well-being) have been shown to influence how much impact a malocclusion may have on a child.[11]

The pupil question regarding whether they would like to have their teeth straightened was intended to give an indication of their perceived need for orthodontic treatment. Almost one-third of 15-year-olds questioned at the time of the survey wanted their teeth to be straightened; however, two thirds of those who wanted their teeth straightening may not qualify for treatment within the UK National Health Service, based upon the objective measure of treatment need currently used to determine eligibility, while recognising that IOTN criteria used to determine NHS treatment eligibility (IOTN DHC 3 with AC ≥6) are slightly more relaxed than those adopted for this survey (IOTN DHC 4–5). On the contrary, nearly one in ten children who felt that their teeth were alright would qualify for treatment on the NHS. This highlights the difficulty in using an objective clinical assessment scale to assess who is able to receive treatment for malocclusion which could be perceived as a deviation from an accepted norm and does not account for the needs of individual patients.[12] There is also likely to be an element of adolescent peer pressure,[13] combined with heightened consciousness of body image during childhood,[12] reflected in the increased desire for tooth straightening between 12 and 15 years.

Parents were less likely than children to express a desire for their children's teeth to be straightened, which is perhaps not surprising as factors such as peer pressure and social norms may drive a desire for treatment among adolescents alongside a tendency for adults to underestimate orthodontic treatment need.[12] However, the response rate for the parent questionnaire was much lower (43%) compared to the child questionnaire (99.7%) and therefore the data could be skewed. Interestingly, the proportion of adolescents expressed that they were 'dissatisfied with the appearance of their teeth'[7] was about half the number of those wanting their teeth straightened, further suggesting that factors other than appearance could be driving the desire for orthodontic treatment among adolescents.

Conclusion

The demand for and provision of orthodontic treatment in the UK is rising. Nearly half of 12-year-old children and a quarter of their parents feel that their teeth need straightening. Clearly, state-funded treatment cannot be provided for all who desire it, however, based on a recognised measure of treatment need a significant proportion of 15-year-olds who would like their teeth straightened will not be able to access this care through the NHS. Children from socially deprived backgrounds are more likely to have unmet treatment need, which may be influenced by

lower dental attendance, reduced frequency of reported toothbrushing and less awareness of and therefore less demand for orthodontic treatment. A link between need for orthodontic treatment and reported problems due to oral health is evident, providing further justification for the provision of orthodontic care and making the link between social deprivation and unmet need more concerning.

Acknowledgements

The authors wish to thank the children and young people who took part in the research as well as their parents and guardians. In addition, the authors express gratitude to the dental examining teams, field workers from the Office for National Statistics, staff in the schools visited and the individuals involved in the consortium for their invaluable contributions.

The 2013 CDHS was commissioned by the Health and Social Care Information Centre (HSCIC) and the research was carried out by a consortium led by the Office for National Statistics. We particularly extend our thanks to Tom Anderson of the ONS Social Survey Division and the wider ONS research team. CRV was funded by a clinical lecturership and subsequently a clinician scientist award both supported by the National Institute for Health Research during this independent research. The views expressed in this publication are those of the authors and not necessarily those of supporting organisations.

1. NHS. NHS Dental Statistics for England: 2012/13. Health and Social Care Information Centre, 2013.
2. Pitts N, Chadwick B, Anderson T. Children's Dental Health Survey 2013. Report 2: Dental disease and damage in children. England, Wales and Northern Ireland. London: Health and Social Care Information Centre, 2015.
3. Burden D J, Pine C M, Burnside G. Modified IOTN: an orthodontic treatment need index for use in oral health surveys. *Community Dent Oral Epidemiol* 2001; **29:** 220–225.
4. Brook P H, Shaw W C. The development of an index of orthodontic treatment priority. *Eur J Orthod* 1989; **11:** 309–320.
5. StataCorp. Stata Statistical Software: Release 11. 11th edition. College Station, TX: StataCorp LP, 2009.
6. Rooney E, Daview G, Neville J, Robinson M, Perkins C, Bellis M. Oral Health Survey of 12 year old Children 2008 / 2009. NHS Dental Epidemiology Programme for England, 2010.
7. Tsakos G, Hill K, Chadwick B, Anderson T. Children's Dental Health Survey 2013. Report 1: Attitudes, behaviours and children's dental health. England, Wales and Northern Ireland. London: Health and Social Care Information Centre, 2015.
8. Steele J, White D, Rolland S, Fuller E. Children's Dental Health Survey 2013. Report 4: The burden of dental disease in children. England, Wales and Northern Ireland. London: Health and Social Care Information Centre, 2015.
9. Watt R, Anderson T, Fuller E. Children's Dental Health Survey 2013. Report 5: Contemporary Challenges in Children's Dental Health, England, Wales and Northern Ireland. London: Health and Social Care Information Centre, 2015.
10. De Baets E, Lambrechts H, Lemiere J, Diya L, Willems G. Impact of self-esteem on the relationship between orthodontic treatment need and oral health-related quality of life in 11-to 16-year old children. *Eur J Orthod* 2012; **34:** 731–737.
11. Foster Page L A, Thomson W M, Ukra A, Farella M. Factors influencing adolescents' oral health-related quality of life (OHRQoL). *Int J Paediatr Dent* 2013; **23:** 415–423.
12. Livas C, Delli K. Subjective and objective perception of orthodontic treatment need: a systematic review. *Eur J Orthod*. 2013; **35:** 347–353.
13. Taghavi Bayat J, Hallberg U, Lindblad F, Huggare J, Mohlin B. Daily life impact of malocclusion in Swedish adolescents: a grounded theory study. *Acta Odontol Scand* 2013; **71:** 792–798.