

IN BRIEF

- Orthodontists work in two distinct practice organisations: one with limited access to a restorative opinion and one with ready access to restorative opinions.
- The type of practice environment influences the type of treatment offered.
- Orthodontists working with limited or no access to restorative dentists evaluate the space for implants from the inter-crown distance.
- Orthodontists who work regularly with restorative colleagues evaluate the distance between the roots of adjacent teeth from an intra-oral radiograph.
- Orthodontists who work in isolation are recommended to evaluate the space for implants and hence the need for orthodontics from intra-oral radiographs.
- There is a need to promote clearer guidelines and protocols for practitioners involved in the management of hypodontia.

The management of developmentally absent maxillary lateral incisors – a survey of orthodontists in the UK

J. D. Louw,¹ B. J. Smith,² F. McDonald³ and R. M. Palmer⁴

Objective To investigate the orthodontic management of patients with developmentally absent maxillary lateral incisors.

Materials and methods A questionnaire was mailed to all orthodontists on the specialist list held by the British Orthodontic Society.

Results The questionnaires (57.3% response) were analysed in two groups: Group 1 consisted of orthodontists who worked only in an orthodontic practice environment; Group 2 consisted of orthodontists who worked full-time or part-time in an environment where there were restorative dentists available for advice. Group 1 orthodontists were significantly more likely to recommend ($p = 0.006$) space closure in the management of developmentally absent maxillary lateral incisors. Group 2 orthodontists were significantly more likely to recommend ($p = 0.004$) minimal preparation bridges. Group 2 orthodontists also saw significantly more patients with hypodontia ($p \leq 0.001$) and were significantly more likely to routinely obtain a restorative dentistry opinion before orthodontic treatment commenced ($p = 0.001$). Group 1 orthodontists were significantly more likely to assess the space required for implants by measurement between the crowns of adjacent teeth ($p = 0.001$). Group 2 orthodontists were significantly more likely to assess the space by use of intraoral radiographs ($p = 0.019$) or by measurement between teeth at the gingival margin ($p = 0.029$).

Conclusions The management of developmentally absent maxillary lateral incisors by orthodontists in the UK appeared to be influenced by their practice environment, their experience and the availability of

restorative dentistry advice. The influence of these factors was greater for the treatment options of space closure or replacement via resin-retained bridges but less so for implant treatment. This reinforces the need for multidisciplinary involvement.

INTRODUCTION

Approximately 2% of the UK population have developmentally absent maxillary lateral incisors.¹ The prevalence is higher in Europe and Australia than in North America, females are affected about 1.4 times more than males and bilateral absence is more common than the unilateral scenario.² The data on hypodontia suggests that it follows an autosomal dominant mode of inheritance with incomplete penetrance.³

The maxillary lateral incisor is the third most frequent developmentally absent tooth after third molars and mandibular second premolars² and its absence can also occur in a number of conditions such as ectodermal dysplasia, cleft lip and palate, Down's Syndrome, Incontinentia pigmenti and following early irradiation of tooth germs.

There are two fundamentally different approaches to the management of developmentally absent maxillary lateral incisors: the first is closure of the space via orthodontic management; the second is the replacement of the absent teeth via restorative dentistry procedures. The aim of this study was to investigate which approach was adopted by orthodontists in the UK and to investigate whether or not restorative dentistry advice was obtained to influence that approach.

MANAGEMENT

(a) Space closure

For many years, the use of orthodontic treatment to move the maxillary canines adjacent to the maxillary central incisors has been a recommended approach.^{4,5} Robertsson and Mohlin⁶ carried out a retrospective study of space closure *versus* restorative treatment and concluded that disturbing a perfect

¹Postgraduate Student, Implant Dentistry, ²Consultant in Restorative Dentistry, ³Professor of Orthodontics, ⁴Professor of Implant Dentistry and Periodontology, King's College London Dental Institute, Guy's Hospital Campus, London Bridge, London, SE1 9RT

*Correspondence to: Professor Richard M. Palmer
Email: richard.m.palmer@kcl.ac.uk

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Class I molar relationship and canine protected occlusion was not considered to be as damaging as conventional bridge preparations or the maintenance of long-term periodontal health below the bridge pontic. Nordquist and McNeill⁷ found that patients who had undergone space closure had significantly better periodontal health than those who had undergone space opening followed by a fixed partial denture.

Bergendal *et al.*⁸ mentioned that moving the maxillary canine mesially can take longer than expected owing to the reduced mass of the bone in the absent tooth site. The existing malocclusion could favour space closure (for example if crowding were already present), whereas, in other cases, the shape, shade, lip line, position and inclination of the maxillary canines as well as the tooth size relationships could favour prosthetic replacement.⁹

The main disadvantage of space closure is that large rounded canines may be difficult to disguise. Enamel can be removed to flatten the profile but there is the risk that the underlying dentine may show through. Composite resin material can be added to change the incisal edge and in extreme instances, veneers can be employed to simulate a lateral incisor. In addition, movement of the canine into the space of the missing lateral incisor would bring the prominence of the canine eminence forward and may alter the maxillary arch into a more square shape, depending on the volume of the alveolar bone.

(b) Space opening and replacement of the absent tooth

The development of resin-retained bridges and single tooth implants have allowed an alternative approach to space closure but without the risks associated with preparing teeth for bridges. There have been several studies on the long-term survival rate for resin-retained bridges. Two of the most recent, Djemal *et al.*¹⁰ and Ketabi *et al.*,¹¹ showed a median survival rate of eight years and a 70% survival rate over 13 years, respectively. The cantilever design was found to be superior.

Single tooth implants are also a well-established treatment option for single missing teeth and have been shown to be successful in the replacement of developmentally absent maxillary lateral incisors. Zarone *et al.*¹² reported a cumulative survival rate of 97.06% and a cumulative success rate of 94.12% after 39 months of loading of narrow-necked ITI implants. It is essential that the roots of the maxillary canine and central incisor are parallel following orthodontic treatment so that there is sufficient space to place an implant.

Autotransplantation is another option for replacement of missing teeth, with varied success rates. A suitable donor tooth is needed with a suitable root shape and diameter and the donor site must be prepared to accept the transplanted tooth. The developmental stage of root formation of the transplanted tooth at the time of surgery plays an important role in the long-term success of this procedure.¹³

MATERIALS AND METHODS

A questionnaire and covering letter was sent to all 790 orthodontists in the UK whose names were on the specialist list held by the British Orthodontic Society. After 30 days, the questionnaire was sent to all those orthodontists who had not responded. After another 30 days, the questionnaire was sent again to all those orthodontists who had not responded to the first and second mailings.

Table 1 Experience of treatment of hypodontia

Group	<10 patients/year	10-30 patients/year	>30 patients/year	Total
1	152	57	8	217
2	85	74	22	181
Total	237	131	30	398

Pearson chi-square (2) = 21.9988; p < 0.001

Table 2 Recommendation of space closure, resin-retained bridge (RRB) or denture by orthodontists in Groups 1 and 2

Recommendation	Group 1	Group 2	P value*
Space closure	221	176	0.006
RRB	213	174	0.004
Denture	215	171	0.004

*Two-sample Wilcoxon rank-sum (Mann-Whitney)

Table 3 Ranking (1-5) by Group for space closure and resin-retained bridges

RANKING	SPACE CLOSURE		RESIN-RETAINED BRIDGE	
	Group 1	Group 2	Group 1	Group 2
1	154	101	45	76
2	38	57	121	81
3	16	15	26	12
4	3	1	4	3
5	5	0	2	0
P value*	0.002		0.001	

*Pearson chi-square

Table 4 Size of space created for an implant replacing a maxillary lateral incisor

Group	5 mm	6 mm	7 mm	7.5 mm	8 mm	Total
1	6	32	89	1	14	142
2	1	28	89	1	11	131
Total	7	60	178	2	25	273

Pearson chi-square (5) = 4.7626; p = 0.446

Following the guidelines set out by Williams *et al.*,¹⁴ the two-page questionnaire was piloted on consultants and specialist registrars in the Department of Orthodontics at King's College London Dental Institute, London, UK. The first page of the questionnaire contained questions on demographic details of the orthodontist, experience and management of hypodontia. The second page contained questions on the application of implants in the management of developmentally missing maxillary lateral incisors.

All data collected were entered into Microsoft Office Excel and then analysed with the STATA 6 (Stata Co. TX, USA) statistical software package. The two-sample rank-sum (Mann-Whitney) test and Pearson chi-square calculation were used to

compare variables. Results were considered significant when p was ≤ 0.05 .

RESULTS

A total of 450 questionnaires were received, a response rate of 57.25%. Of these, 200 were received from the first mailing, 200 from the second mailing, and 50 from the third mailing. Twenty-four questionnaires were discarded as there were a significant number of unanswered questions. The results were based on the remaining 426 questionnaires. However, many of these 426 questionnaires had some unanswered questions so some of the results were calculated from totals less than 426.

The 426 completed questionnaires were divided into two groups for the analysis based on a question concerning practice environment. Group 1 (233 respondents, 54.7%, 160 males, 73 females, mean age 45.2 ± 9.2 years) consisted of orthodontists who worked only in an orthodontic practice environment. Group 2 (193 respondents, 45.3%, 139 males, 54 females, mean age 48.3 ± 8.6 years) consisted of orthodontists who worked part-time or full-time in an environment where there were likely to be restorative dentistry specialists available for advice, eg dental schools. The mean age of the orthodontists in Group 1 was significantly lower than the mean age of the orthodontists in Group 2 ($p = 0.0002$) but there was no significant difference between Groups 1 and 2 with respect to gender.

Clinical experience and management of hypodontia

Table 1 shows the distribution of orthodontists in Groups 1 and 2 with respect to the numbers of patients with hypodontia that they treated per year. The orthodontists in Group 2 saw a significantly greater number of patients with hypodontia per year than the orthodontists in Group 1 ($p < 0.001$).

Under the section 'Management of hypodontia', the orthodontists were asked what they usually recommended to replace maxillary lateral incisors with percentages against the options of space closure, resin-retained bridge, implants, dentures or conventional bridges. Orthodontists in Group 1 were significantly more likely to recommend space closure when compared with orthodontists in Group 2, but orthodontists in Group 2 were significantly more likely to recommend resin-retained bridges or dentures when compared with orthodontists in Group 1 (Table 2). There were no significant differences between Group 1 and Group 2 with respect to recommendations of implants or conventional bridges.

The responses to a second question on the management of missing maxillary lateral incisors, 'How are most of your cases treated? (please rank in order 1 to 5)' produced similar differences between Groups 1 and 2. The orthodontists in Group 1 ranked space closure significantly higher than Group 2 whereas Group 2 ranked resin-retained bridge significantly higher than Group 1 (Table 3). There were, however, no significant differences between the two groups with respect to ranking of implants, conventional bridges, or dentures.

Fifty percent of the orthodontists in Group 1 routinely obtained a restorative dentistry opinion. In Group 2, however, 66% routinely obtained such an opinion. The difference between the two groups was significant ($p = 0.001$).

Significantly more orthodontists in Group 1 obtained the restorative dentistry opinion from either a restorative

general dentist ($p < 0.001$) or specialist prosthodontist ($p = 0.043$) but significantly more orthodontists in Group 2 obtained the restorative dentistry opinion from a consultant in restorative dentistry ($p < 0.001$). There were no significant differences between the two groups with respect to an opinion obtained from an oral surgeon, implant specialist, consultant in paediatric dentistry, or other dentist.

Significantly more orthodontists in Group 2 obtained a restorative dentistry opinion before orthodontic treatment commenced ($p = 0.001$). However, significantly more orthodontists in Group 1 obtained the opinion midway through treatment ($p = 0.008$) or after debanding ($p = 0.001$). There was no significant difference between Group 1 and Group 2 for obtaining the opinion just before debanding.

Two hundred and sixty-six (57%) of the total respondents in Groups 1 and 2 recommended the age of 18 for implants. There was no significant difference between the groups (Group 1 $n = 143$, Group 2 $n = 123$, $p = 0.27$). Fourteen respondents in each Group stated that implants should only be placed when growth had ceased ($p = 0.626$).

Significantly more patients of the orthodontists in Group 2 were treated with Nobel Biocare ($p = 0.003$) or Straumann ($p = 0.019$) implants than the patients of the orthodontists in Group 1. There were no significant differences between Groups 1 and 2 for AstraTech, 3i or other implant systems. A significantly greater number of orthodontists in Group 1 (66%) did not know which implant system was used for their patients when compared with Group 2 (47%) ($p < 0.001$).

Table 4 shows the frequency of the responses to the question 'What size space do you try to achieve for the replacement of a maxillary lateral incisor with an implant?' There were no significant differences between the responses of Group 1 when compared to Group 2 ($p = 0.446$).

In response to the question 'How do you assess the size of the space?', significantly more orthodontists in Group 1 assessed the size of the space by means of a clinical measurement between the crowns of adjacent teeth ($p = 0.001$). However, significantly more orthodontists in Group 2 assessed the space by radiographic measurement using intra-oral radiographs ($p = 0.019$) or by measurement at the gingival margin ($p = 0.029$). There were no significant differences between Group 1 and Group 2 for the other two responses: radiographic assessment using DPT radiographs, or measurement of casts.

DISCUSSION

This cross-sectional survey of specialist orthodontists in the UK investigated the management of patients with absent maxillary lateral incisors. The purpose was to determine whether or not experience level and access to restorative dentistry advice could influence the way orthodontists approached the treatment of such patients. The results of this survey may also provide information which can lead to improvement in the communication between the specialties of orthodontics and restorative dentistry.

A total of 450 questionnaires were returned after the three mailings, a response rate of 57.25%. The initial low response ($n = 200$) may have been influenced by the first mailing being over the Christmas holiday period. Some respondents ($n = 11$) commented that they had not received the first mailing. Some respondents ($n = 9$) commented that they thought they had

already responded to the questionnaire. The 340 non-responders may not have completed the questionnaire because of lack of interest in the topic, poor questionnaire design, local political or work-related pressures.¹⁵

Based on the responses to Question 2, respondents were placed into two groups which were of comparable size but the mean age of Group 2 orthodontists was significantly higher than Group 1. Hospital consultants would fall into Group 2 but an additional possible explanation is that the older non-consultant orthodontists had become interested in teaching and were therefore more likely to have a hospital connection. Perhaps the younger orthodontists were still busy establishing their clinical practice.

Orthodontists in Group 2 saw significantly more patients with hypodontia per year than orthodontists in Group 1. This can be explained by the orthodontists in Group 2 seeing more patients referred to hospitals and academic institutions to access a multidisciplinary approach. Severe hypodontia attracts an IOTN grading of 4 or more, which usually falls within the guidelines for hospital orthodontic treatment in the UK.¹⁶

Orthodontists in Group 1 were significantly more likely to recommend space closure in the management of missing lateral incisors when compared to Group 2. Group 2 were significantly more likely to recommend resin-bonded bridges or dentures as replacement for missing lateral incisors compared to Group 1. This latter finding could have been caused by the availability of restorative dentistry advice for Group 2 prior to commencement of orthodontic treatment, particularly when the canine teeth could be identified as being likely to be difficult to disguise. When the two Groups had to rank the way most of their patients were treated, Group 1 ranked space closure higher and Group 2 ranked resin-retained bridges higher.

However, there were no significant differences with respect to ranking of implants between the Groups. Since the availability of advice from restorative dentists appeared to influence the choice of space closure or replacement via a resin-retained bridge, then one would expect there to be a difference between the groups with respect to use of implants since the planning of implant treatment requires specific restorative requirements during orthodontic treatment. It was clear that the majority of those orthodontists who answered the implant-related questions were aware of the space requirements.

The reasons why orthodontists in practice apparently prefer to close spaces are not entirely clear. Certainly, space closure has been recommended as a standard approach for several years.^{4,5} What is also possible is that this approach was formulated before the resin-retained bridge was first described by Rochette¹⁷ in 1972 so, at that time, the only options for a bridge involved tooth preparation. It is reasonable to assume that the orthodontists of 30 years or more ago would have preferred a non-destructive approach for young patients to preserve long-term dental health.⁹

The finding that orthodontists in orthodontic practice assessed the space for implants by the traditional method of measurement between the crowns of adjacent teeth was not surprising. As long as there is sufficient space to place an implant, the actual width of the finished crown can be adjusted to fit the available space. The finding that orthodontists with access to restorative dentistry advice assessed the space by intraoral radiographs or measurements at the gingival margin

probably reflects the emphasis on the implant surgery, ie providing sufficient space for the implant, abutment, bone, adjacent periodontal ligament and gingival cuff rather than the emphasis on providing sufficient space for the crown.

Nobel Biocare and Straumann implants were more likely to be used in the treatment of patients by orthodontists in Group 2. This may be a reflection of historical choices in selection of an implant system by the UK institution with which the orthodontists were associated. What was slightly surprising was that 191 of the 335 orthodontist involved in implant treatment did not know what system was being used for their patients.

Orthodontists in Group 1 routinely obtained a restorative dentistry opinion in 50% of cases compared to orthodontists in Group 2 who obtained an opinion in 66% of cases. It can be assumed that the greater availability of and access to restorative dentistry advice, particularly hospital-based consultants in restorative dentistry, in Group 2 orthodontists probably caused this difference between the Groups.

Significantly more orthodontists in Group 2 obtained a restorative dentistry opinion before orthodontic treatment commenced. Significantly more orthodontists in Group 1 obtained the opinion midway through treatment or after debanding. This difference in timing is difficult to explain since orthodontists in Group 1 had clearly made an effort to obtain an opinion.

There are several areas of future investigation which have been suggested from the results of this national survey. The most important would be to investigate why orthodontists in practice appear to prefer space closure to space opening. Another would be the investigation of the reasons behind the timing of requests for restorative dentistry opinions.

Improved communication between the disciplines of orthodontics and restorative dentistry is recommended to improve treatment planning in the management of hypodontic patients. This study has further highlighted the value of multidisciplinary evaluation and management of hypodontia before embarking on treatment and throughout treatment.^{18,19}

CONCLUSIONS

1. The management of developmentally absent maxillary lateral incisors by orthodontists in the UK appeared to be influenced by their practice environment, their experience and the availability of restorative dentistry advice
2. These factors appeared to influence the options of space closure or replacement by resin-retained bridges but did not appear to influence management when implants were planned.

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