

A closer look at General Dental Service orthodontics in England and Wales

II: What determines appliance selection?

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Aim To elucidate factors that influence choice of appliance type in General Dental Service (GDS) orthodontics in England and Wales.

Method Records were obtained for 1527 cases, representing a systematic 2 per cent sample of GDS cases completed during 1990–91. Evaluation involved Discriminant Analysis to find the most influential factors in appliance choice. Factors considered included patient and practitioner characteristics, and features of the malocclusion as assessed by Occlusal Indices.

Results Full data were available for 1217 cases. 24 per cent of treatments included use of dual- and 26 per cent single-arch fixed appliances. Appliance choice was predictable in 55 per cent of cases. Older patients, orthodontically qualified practitioners, high Peer Assessment Rating score at start, permanent dentition, lower grades of the Dental Health Component of the Index of Orthodontic Treatment Need at start, and practitioners with high gross earnings from orthodontics, all tended to be associated with more frequent use of fixed appliances.

Conclusions Possession of a diploma or membership in orthodontics was associated with more frequent use of both dual- and single- arch fixed appliances. Better appliance selection, and thus more effective treatments in the GDS, may result from a greater availability of practitioners with formal postgraduate training in orthodontics.

The importance of appliance type used^{1–6} in the effectiveness of orthodontic treatment is now well accepted. Appropriate choice of appliances has been suggested to be of particular importance.^{7,8}

Generally, regardless of the sphere of practice considered and of other factors involved, dual arch fixed appliances have been shown to be the most reliable,^{3–6,8} whilst single arch fixed appliance treatments tend to be more effective than those involving only removable appliances.^{5,6} Appliance type was shown to over ride differences due to hospital grade of operator and individual hospital departments.⁵ Whether or not the operator was orthodontically qualified was shown to have no overall effect on outcome, once appliance type was included in multivariate analyses for General

Dental Service (GDS) orthodontics,^{3,4,6,8} although it has recently been shown that orthodontic standards of general dental practitioners were improved by clinical assistant attachments (in the south-west of England),⁹ whilst a similar localised study in the north-west of England suggested that the standards of orthodontically qualified practitioners were in fact rather better still.¹⁰

Although the relevance of selection of the appropriate appliance for each case has been emphasised,^{7,8} it is generally accepted that removable appliances can only perform a limited range of tooth movements, and the overall picture is that more judicious appliance selection, and in particular, wider use of fixed appliances, would result in better standards in the GDS.

Use of fixed appliances in the GDS has increased since the 1987–88 GDS study. In particular, the partial relaxation in prior approval and fee change of October 1987 coincided with an increase in treatments involving fixed appliances.⁶ None of the other fee or regulation changes of the late 1980s and early 1990s seemed to be associated with any change in prescription, although the frequency of such changes made full assessment of their potential impact rather difficult.⁶ However, earlier analysis of the data from the 1990–91 GDS study has suggested a higher usage of fixed appliances among high-earning orthodontic practitioners,^{11,12} among practitioners with higher orthodontic qualifications and among those in areas with fewer manual class households (see Table 1).¹²

The aim of this study was therefore to investigate this large database of cases to establish which practitioner and patient characteristics most influence appliance choice in the General Dental Services, and perhaps thus to elucidate ways of improving appliance selection in the future.

Methods

The Dental Practice Board of England and Wales (DPB) routinely request pre- and post-treatment study models for every 50th case for whom a National Health Service FP17(0) form is submitted to claim fees at completion of treatment.¹³ One thousand five hundred such consecutively requested cases were sought, and data were collected as described in the earlier paper of this pair.⁸

Appliance types investigated

Too few treatments involved myofunctional appliances (1%) for these to be considered separately. The treatment regimes were therefore divided into the following three broad groups, whether or not myofunctionals were used alone or as adjunctive appliances:

- Treatments involving only removable or myofunctional appli-

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- ances ('Removable/other appliance' group).
- Treatments which included use of a fixed appliance to one arch only at some stage in the treatment, or as the sole treatment modality ('Single arch fixed' group).
- Treatments which included fixed appliances to both arches at some stage in the treatment, or alone ('Dual arch fixed' group).

Statistical analysis

This was done using stepwise discriminant analysis.¹⁴ This defines groups, in this case appliance regimes, as co-ordinates on axes (functions), the maximum number of which is one less than the number of groups to be defined (or equal to the number of predictor variables, whichever is the smaller). The functions are calculated as the sum of factors of the significant independent variables. Having calculated the best-fit model, the program then cross-validates it by 'jack-knifing' i.e. it tests its model by re-fitting the data to it, excluding one variable at a time. Ideally the independent variables should be normally distributed continuous data, but categorical data can be used as long as they can be reduced to bi-variate form.¹⁵ The variables submitted to this analysis were:

- Peer assessment rating score at start of treatment (SPAR) as continuous data.
- Aesthetic need for treatment at start, assessed using the aesthetic component (AC) of the Index of Orthodontic Treatment Need, broken down into a bi-variate: clear need for treatment (AC grades 8–10) or little/borderline need (grades 1–7).
- Dental Health need assessed using the Dental Health Component of the Index of Orthodontic Treatment Need: clear (DHC grades 4 and 5) or little/borderline need (grades 1–3).
- Age of patient at start (as a continuum).
- Status of dentition at start: mixed or permanent (uncharted cases were excluded from this analysis).
- Percentage of manual class workers in patient's neighbourhood (continuum).
- Percentage of manual class workers in practice area (continuum).
- Whether or not the operator possessed a Membership or Diploma in Orthodontics or Dental Orthopaedics from one of the Royal Colleges.
- Caseload (orthodontic) of practitioner (i.e. whether in DPB's 'top-twenty' earners or not.¹¹)

Results

The usage of various appliance types in the sample was stated in our earlier papers.^{6,8} The PAR descriptives at start and finish of treatment, and factors influencing them, were described earlier.⁸

Of 1527 cases collected, 1217 had full information available on all the putative independent variables. Appliance usage for the whole sample, and among the various practitioner and patient groups is

shown in Table 1.

Variables influencing appliance selection

Table 2 summarises the results of the Discriminant Analysis for variables affecting appliance usage; the original 'prediction rate' of the model, and that on cross-validation are shown in Table 3.

Six submitted variables were selected by the analysis as significant in appliance selection. Their effects on appliance use are explained below, in the order of selection by the analysis.

- **Age at start** was the first variable selected by the analysis. Increasing age was linked to likelihood of treatment with fixed appliances in one or both arches.
- **Orthodontic qualification of the practitioner** was associated with greater likelihood of fixed appliances being used, particularly dual arch fixed appliances.
- **Higher Starting PAR score** had some association with more frequent use of fixed, particularly dual arch fixed appliances.
- **Permanent dentition** increased the likelihood of fixed appliance use to one or both arches.
- **Dental health need**, cases with DHC grade 4 or 5 tended to be associated with more frequent use of treatments involving only removable or myofunctional appliances.
- **High-earning orthodontic practitioners** were more likely to use fixed appliances generally, but in particular, they were associated with treatments involving fixed appliances to only one arch.

Almost half the variance was unexplained by any variable known to us. Of the excluded variables, social class of practice area was initially significant ($P < 0.0005$), but was displaced from the analysis by 'Orthodontic Qualification' of practitioner alone (P increased to >0.8). Social class of home area was not selected as significant by the analysis at all ($P > 0.5$).

Discussion

To a large extent the findings concerning dentition and age are as one would expect, and may well be inter-linked; certainly there would be few indications for fixed appliances in the early mixed dentition. However, some cases starting treatment in the late mixed dentition may go on to fixed appliances as more of their teeth erupt, which may explain why some of the variability is explained by age rather than status of the dentition.

The 1987–88 study³ and the earlier of these two papers,⁸ showed that orthodontic qualification was not a factor in measures of outcome on a national scale, once appliance type was included in the analysis. It is interesting, however, that these results identify orthodontic qualification as quite a strong predictor of fixed appliance use, and in particular, of dual arch fixed appliance use.

Perhaps we can suggest, therefore that it may indeed be a significant

Table 1 Appliance usage amongst different categories of practitioner and patient (cases with complete data for analysis)

	Base	Dual Arch Fixed*	Single Arch Fixed*	Removable/myofunctional only
Orthodontic Qualification	639	31 %	28%	41%
No Ortho Qualification	578	18%	23%	59%
High Earning Orthodontists	838	28%	33%	39%
Non-high earning orthodontists	379	23%	23%	54%
Practices in 'higher class' areas	707	28%	28%	44%
Practices in 'lower class' areas	510	19%	24%	57%
Patients from 'higher class' areas	705	25%	27%	48%
Patients from 'lower class' areas	512	23%	26%	51%
Patients in mixed dentition at start	464	15%	17%	68%
Patients in permanent dentition	753	31%	31%	38%
Patients under 11 years at start	216	7%	9%	84%
Patients 11-15.99 years at start	922	28%	29%	43%
Patients 16 years and over	79	29%	44%	28%
Whole group	1217	25%	26%	49%

factor also in outcome, but one which exerts its effect via appliance selection. Appliance selection is the main criterion in outcome,^{1-6,8} but those who have had a formal training in orthodontics are more likely to use fixed appliances. Where other practitioners had learned to use these appliances, whether on short courses, clinical assistant attachments, or indeed, perhaps when they were self-taught, their results appeared to have been similar to those attained by orthodontic diplomates or members. This may explain the apparent disparities between this and earlier studies on outcome.^{3,8,10}

While it is likely that some practitioners can gain a degree of proficiency with fixed appliance techniques after short courses, or a few perhaps by private study alone, most would be more competent and confident in their use after a period of practise under a mentor. The need for more practitioners who have been trained on formal post-graduate courses is therefore underlined as an important factor in any future improvement of GDS orthodontics. We acknowledge, however, the value of clinical assistant attachments such as those described by earlier authors^{9,16,17} in making simpler fixed appliance treatments more widely available.

Another indicator of fixed appliance use was higher Starting PAR scores. This has been suggested by earlier studies^{4-6,8} and is perhaps as one would expect. The apparently contradictory finding that removable/myofunctional appliances tended to be used more frequently for higher DHC grade cases may be associated with some interceptive treatments in cases with high need in the mixed dentition. It would also be consistent with the use of myofunctional appliances for treatment of cases with moderately increased overjets in otherwise well aligned arches.

The association of practitioners with high gross earnings from orthodontics and use of fixed appliances was seen in an earlier study.¹¹ That they were associated more notably with frequent use of single arch fixed (in contrast to the orthodontically qualified group), may be associated with the slight trend for them to treat more cases with milder malocclusions, also shown previously.¹¹

Social class factors appeared not to be of direct significance in practitioners' selection of appliances, despite the observation (see Table 1) that patients attending practices in 'more manual class' areas were less often treated with fixed appliances. The displacement of 'Percentage manual class workers in practice area' from the analysis by 'Orthodontic Qualification' suggests that the latter was the key variable, and that the lower prescription rate of fixed appliances in manual class areas relates primarily to the distribution of orthodontically qualified practitioners. However, the influence of levels of interest and general oral care discussed previously⁸ can not be ruled out completely.

Table 2 Appliance usage — Summary of discriminant analysis to examine the deciding variables

Rank	Variables in order selected	Canonical Discriminant coefficients		
		Function 1	Function 2	Probability
1	Age at start	0.208	-0.149	<0.0005
2	Ortho Qualification	0.878	0.611	<0.0005
3	Starting PARa	0.031	0.091	<0.0005
4	Permanent dentition	1.015	0.286	<0.0005
5	DHCb need group	-0.776	-0.191	<0.0005
6	High earning orthodontist	0.393	-0.557	<0.0005
	Constant	-4.080	-0.728	
	Variance explained	82.0%	18.0%	
	Correlation	0.393	0.196	
Co-ordinates for group centroids				
	Appliance type:	Function 1	Function 2	
	1 Removable/Other	-0.429	0.003	
	2 Single fixed	0.331	-0.299	
	3 Dual arch fixed	0.504	0.256	

What the models could not account for

Other factors, which may be expected to influence appliance choice, but are not specifically covered by any of the data available for this study, would include:

- Individual qualities of practitioners, and arguably economic factors within their practices.
- Patients' oral hygiene and willingness to wear various appliances.
- Aspects of malocclusion not specifically identified by the indices, such as tooth inclinations and rotations and anchorage/space considerations.

Where a practitioner had no experience of fixed appliance treatments, significant factors in provision of such treatments may also be:

- Whether there was easy access to one who had such a faculty.
- The willingness of the practitioner to refer to such a practitioner.
- The patient's willingness to travel.

The general picture in the GDS is that since 1991, orthodontic treatment claims have risen steadily each year.^{18,19} However, removable, spring-type appliances to the upper jaw alone are still by far the commonest form of treatment in the GDS of England and Wales, and although there is substantial regional variation in relative prescription rates, fixed appliances to both arches remain only the third most common prescription.¹⁸ This is perhaps disappointing when one considers that the number of principal GDPs completing 100 or more orthodontic cases per year has also risen,¹⁹ and that in this sample, over half of the cases were treated by an orthodontically qualified practitioner.¹¹ There does therefore seem to be a reluctance among many practitioners to use fixed appliances, at least for NHS treatments, and this may well relate to service conditions within the GDS. These may need to be reviewed if orthodontics within the GDS is to keep in line with modern public expectations.

Conclusion

A model was found which successfully 'predicted' appliance choice in 55% of a sample of 1217 GDS cases. There was a marked overall trend to use of removable appliances in the sample, but four factors were associated with greater use of fixed appliances. These were:

- Older patients.
- Orthodontic qualification of the practitioner (particularly for dual arch fixed appliance treatments).
- Higher degree of malocclusion (PAR score) present at start, (particularly dual arch fixed appliances).

Table 3 Success rates of 'predicted' group membership — Group sizes estimated from sample

Actual appliances	'Predicted' appliance use — Original		
	Removable/Other	Single arch fixed	Dual arch fixed
Removable/Other:	81.5%	10.1%	8.4%
Single arch fixed:	55.5%	27.3%	17.2%
Dual arch fixed:	50.7%	15.8%	33.5%
Overall success rate = 55.5%			
Actual appliances	'Predicted' appliance use — Cross validated		
	Removable/Other	Single arch fixed	Dual arch fixed
Removable/Other:	81.4%	10.1%	8.5%
Single arch fixed:	56.3%	26.5%	17.2%
Dual arch fixed:	51.3%	16.6%	32.1%
Overall success rate = 54.9%			

- Practitioners with high gross earning from orthodontics (particularly single arch fixed appliances).

Two variables were associated with more likely use of removable or myofunctional appliances only:

- Mixed dentition at start.
- Higher dental health need for treatment (DHC grade 4 or 5) at start.

Social class did not have a direct influence on selection of appliance type, but the data suggest that there are fewer orthodontically qualified practitioners in 'manual class' areas.

The consensus of previous studies is that judicious appliance selection is paramount in the outcome of orthodontic treatment. While we do not wish to detract from the value of GDP training in the form of clinical assistant attachments, which have been shown also to be of value,^{9,16,17} this study highlights the value of formal post-graduate courses leading to a higher qualification in orthodontics, and suggests that they may, after all, have an underlying influence on outcome for GDS orthodontics.

Our results suggest that if the standard of GDS orthodontics is to be raised, there is a need for a wider availability of orthodontically qualified practitioners, and perhaps for a more widespread recognition of the need to refer appropriately when practitioners can not offer certain types of treatment themselves.

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BDA Community Dental Services Group

Notice is hereby given that the Annual General Meeting of the Community Dental Services Group will be held in the Moat House Hotel, Glasgow, on Saturday 9 October 1999 at 10.00am to transact the following business.

- 1) Minutes of the AGM held on 24 October 1998.
- 2) Matters arising from the minutes.
- 3) Correspondence or other communications.
- 4) Annual report of the Honorary Treasurer
- 5) Annual report of the Group Management Committee.
- 6) Report of the Group Representatives on CCCDS.
- 7) Report of the Group Representatives on the Representative Board
- 8) To elect:
 - a. President-Designate — a nomination will be made by the Group Management Committee.
 - b. President-Elect:
David Baird will be nominated by the Group Management Committee.
 - c. Chairman.
 - d. Honorary Treasurer

- e. One ordinary members of the Group Management Committee to serve for 2 years.
 - f. Group Representative on the BDA Benevolent Fund.
 - g. Two Group Representatives on the Faculty Development Group.
 - h. One Group Representative to the CCCPHD
- 9) To elect Honorary Auditors.
 - 10) To consider motions duly proposed and seconded, of which at least 28 days' notice shall have been given in writing to the Group Secretary

Nominations should be received by the Group Secretary no later than 14 September 1999.

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