SCIENTIFIC SECTION

Effectiveness of community-based salaried orthodontic services provided in England and Wales

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Abstract

Objectives: To assess the effectiveness of the salaried Community Orthodontic Services in England and Wales, using occlusal indices, and to determine the predictors of treatment outcome.

Design: A retrospective investigation. A random stratified sample of districts where Community Orthodontic Services are provided was selected and visited during 1997.

Method: All community orthodontists in England and Wales, and CDS managers who could be identified were asked to take part in this study. A stratified random sample of 15 per cent of the districts where community orthodontic services were provided was selected and a sample of the records of treated patients was examined.

Results: The orthodontists in the sample were providing treatment for patients clearly in need of treatment. There were, however, some variations between districts. Similarly, when the effectiveness of treatment in terms of dento-alveolar change was evaluated, the mean change in PAR and percentage PAR reduction was high. Again, there were variations between the districts.

Conclusions: The Community Orthodontic Service provides effective orthodontic treatment to many individuals clearly in need of that treatment. The most significant predictor of treatment outcome was the use of two-arch fixed appliances, which produced the best treatment outcome

Index words:
CDS, Senior Dental Officer, Community Orthodontist, IOTN, PAR.

Introduction

The role of the salaried Community Dental Service was originally to provide dental care for socially and geographically disadvantaged priority groups. This care included the provision of orthodontic treatment. However, in 1989, the role of the Community Dental Service was significantly redefined[1] and, in addition to providing basic orthodontic training and treatment planning for Community Dental Officers, the role of the Community Orthodontist became one of providing Orthodontic services, where these were not readily available in the General Dental Service.

Treatment need and treatment effectiveness

To date, there has been no published work on orthodontic treatment need and treatment effectiveness in the Community Dental Service. However, O'Brien[2] examined some aspects retrospectively of the orthodontic care provided, and established a relationship between community orthodontic manpower and the use of fixed appliances. He found the available data was of limited usefulness for epidemiological purposes and recommended that changes in the type of data collected should be considered.

Previous investigations into treatment need and effectiveness

The General Dental Services

The first large-scale study into the effectiveness of orthodontic treatment was carried out by Richmond [3,4] who studied the General Dental Service. He used a systematic 5 per cent sample of 1210 cases submitted for payment to the Dental Practice Board, and assessed

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them for orthodontic treatment need using the Index of Orthodontic Treatment Need and for effectiveness of treatment using the Peer Assessment Rating. Disappointingly, he found that the standard of treatment was generally poor, with many cases showing no improvement.

The greatest influence on the degree of occlusal change appeared to be the treatment method employed. Two-arch fixed appliances were found the most effective and removable appliances were the least effective. This has been supported by the findings of other more recent studies. [5,6]

The Hospital Dental Service

Using similar outcome measures, the effectiveness of orthodontic treatment provision in the salaried Hospital Orthodontic Services in England and Wales was evaluated.[7,8] A representative sample of 17 District General hospital orthodontic departments was identified, stratified in terms of rural, metropolitan, and urban catchment areas. Each hospital department was invited to collect the records and study casts of 100 consecutively started patients from 1985 (1 year). Data were collected from a total 1630 patients. He concluded that the Hospital Orthodontic Services provided treatment of high standard to a caseload of patients that included many in need of treatment. However, there was a marked degree of variation between departments. He also found that the method of treatment had the greatest influence upon benefit i.e. improvement in occlusal index scores. Two-arch fixed appliances were found to be more effective than single-arch fixed appliances or removable appliances.

There was a degree of non-response to the investigation (16 per cent) and the author felt that the method of patient selection may have introduced a degree of bias. He felt that the results of the study should be reviewed in the light of further information that may become available from clinical audit.

Aim of the investigation

The aims of this study were:

1. To investigate the need and effectiveness of treatment provided by the salaried Community Orthodontic Service in England and Wales.
2. To determine any predictors of treatment outcome.

Method

In 1996, as part of a larger investigation into the effectiveness of Community Orthodontic Services questionnaires were sent to all Community Dental Service Managers requesting details of service provision, and to Senior Dental Officers (SDO in Orthodontics) in England and Wales requesting details about treatment provided.[9] SDOs were identified primarily from the most recent membership list of the Community Group of the British Orthodontic society, together with information supplied by Community Dental Service Managers in England and Wales.

The procedure recommended by Dillman for postal questionnaire surveys was followed.[10] A period of 6 weeks was allowed for initial responses to the questionnaires.

From the questionnaire responses, 76 districts were identified where Community Orthodontic Services were being provided. A random stratified sample of 12 (15 per cent) of these districts was selected, reflecting the underlying geographical distribution of London: Metropolitan: Non-metropolitan districts in England and Wales. The community orthodontists within these districts were approached and asked to produce records of 120 consecutively treated patients whose treatment had either been completed or discontinued over a 3-year period.

These districts were visited over a 9-month period during 1997, and treatment need and effectiveness evaluated using the established occlusal indices of IOTN and PAR. Additionally, details were obtained from the patient's case notes to record the number and type of appliances used, the duration of treatment, the numbers of treatment visits and failed appointments. The orthodontic qualification (if any) of the operator was also recorded. The evaluation was carried out by the author who had undergone successful calibration in the use of IOTN and PAR indices prior to the investigation. The calibration exercise was repeated at the end of the study to evaluate error.

Statistical methods

Evaluation of inter- and intra-examiner error for PAR index were carried out using Root mean square of error (RMS error). Any bias present was evaluated using a paired *t*-test. Error for IOTN and other categorical variables was evaluated with a Chance corrected measure of agreement, the Kappa statistic.[11] Evaluation of bias

was carried out using a Wilcoxon signed rank test. The results of IOTN and PAR application were analysed with basic descriptive statistics.

Multiple regression analysis was used to evaluate the predictive effect of several independent variables on the percentage change in PAR score (treatment outcome).

The dependent variables used in this study were: percentage reduction in PAR (expressed as the $\log_{10}$ of the proportion of post-treatment PAR to pre-treatment PAR).[6]

Predictor variables were inserted and removed experimentally to find the models with the strongest value of adjusted R^2 and, consequently, the smallest amount of unexplained variance. The predictor variables finally used in the regression models were: appliance type (two-arch fixed, single-arch fixed, removable, and functional), number of treatment visits, treatment duration, number of failed appointments, and operator qualified or not. The data were transformed when it was established that residuals were not normally distributed.

Results

The final response rate to the questionnaires was 75 per cent for the CDS managers and 74 per cent for the

SDOs. Twelve districts in England and Wales were visited over a period of approximately 9 months. Two whole working days were spent at each centre in order to carry out the assessments using IOTN and PAR indices, with only short breaks during each day. An average of 100 sets of study models were examined at each centre together with the patients' case notes. A total of 1254 sets of study casts and case notes were ultimately examined.

Treatment need and effectiveness

Treatment need using IOTN. Table 1 shows the mean change in IOTN Aesthetic and Dental Health Components for all districts. It was evident that the service provided treatment to patients who were in need of treatment and when this treatment was provided the change in both components of IOTN was high.

Effectiveness of Treatment using PAR. Tables 2 and 3 show the outcomes of treatment as measured by the PAR index. This reveals that the amount of dento-occlusal change was high with a mean percentage PAR reduction of 74.79 per cent. There were variations between districts, with district 6 showing the lowest reduction and district 12 the highest. However, the variations were not statistically significant. Nevertheless, eight out of the 12 districts had mean percentage PAR reductions greater than 70 per cent. The results are generally consistent with the high proportion of two-arch fixed appliance usage.[9] District 6, perhaps not surprisingly, also showed the lowest use of fixed appliances.

Table 1 IOTN–Aesthetic and Dental Health Components.

All districts	Mean pre-treatment grade	Mean post-treatment grade	Change
Aesthetic component	7.46	2.77	4.69
Dental Health component	4.16	2.15	2.01

Table 2 Peer Assessment rating (PAR): change in weighted scores.

District (identity) change	Pre-treatment weighted score	Post-treatment weighted score	Change	Percentage
1	28.72	6.46	22.26	74.64
2	29.93	4.79	25.14	82.98
3	27.75	7.33	20.30	72.40
4	28.75	8.38	20.43	69.09
5	26.76	6.25	20.50	75.35
6	29.83	10.33	19.50	61.74
7	29.86	6.75	23.11	77.41
8	26.77	8.65	18.12	64.92
9	30.33	4.93	25.37	82.66
10	29.43	5.90	23.63	79.65
11	26.86	7.25	19.61	69.82
12	32.59	4.44	28.15	84.73
All districts:	28.99	6.75	22.24	74.79

In terms of treatment outcome, nine out of the 12 districts had more than 40 per cent of finished cases in the 'greatly improved' category and six out of the 12 districts had less than 5 per cent of finished cases in the 'worse or no different' category with most of cases being 'improved'. Again, there was considerable variation. Districts 3, 6, 7, and 8 had a higher percentage of treatments showing no improvement than the rest and perhaps, not surprisingly, three of these districts (3, 7, and 8) also had the highest percentage of post-treatment cases with residual malocclusions (grade 4 and 5 IOTN-DHC).

Table 3 Peer Assessment rating (PAR): treatment outcome.

District (identity)	Percentage ** worse or no different	Percentage improved	Percentage *** greatly improved
1	4	39	57
2	3	47	50
3	10	48	42
4	9	49	42
5	4	53	43
6	10	50	40
7	11	37	52
8	12	52	36
9	3	42	55
10	4	43	53
11	9	54	37
12	3	31	66

**Less than 30 per cent reduction in weighted PAR score.
***Greater than 22 point reduction in weighted PAR score.

The results therefore suggest that, when evaluated by the PAR index, the salaried Community Orthodontic Service in England and Wales is providing effective orthodontic treatment.

Table 4 includes data on treatment outcomes resulting from the use of different appliances.

Predictors of treatment effectiveness. The results of the multiple regression analyses are shown in Table 5. The most significant predictor variable in the regression analyses evaluating treatment outcome was the use of two-arch fixed appliances. The other appliance types did not have a significant effect in the model. This is in accord with other studies.[3, 6, 7]

Discussion

The results of this investigation suggest that the salaried Community Orthodontic Service provides treatment to a case load of patients who are in clear need of treatment; when treatment is provided this is done effectively to a high standard. In this respect, the results of this investigation are similar to those detected in studies of the salaried Consultant Orthodontic Service.[7] Importantly, when we compare the results of this investigation with the studies carried out into the General Dental Service the general effectiveness of the Community Orthodontic Service appears superficially to be greater than the General Dental Service.[3–5]

Table 4 Comparison using different appliances (all districts).

Appliance type used	Pre-treatment weighted PAR	Post-treatment weighted PAR	Percentage change weighted appliance PAR	Percentage usage
Removable used alone:	26.14	9.80	61.74	5
Functional used alone	33.26	15.70	53.74	2
Single-arch fixed used alone	22.16	6.81	67.99	12
Two-arch fixed used alone	28.68	5.91	77.51	28

Table 5 Summary of the multiple regression analysis showing the effects of the significant predictor variables on the dependent variable. Dependent variable: (Log_{10} post-treatment PAR – $\log_{10}$ pre-treatment PAR) as an approximation of percentage reduction in weighted PAR. Multiple R: 0.433; R^2: 0.188; adjusted R^2: 0.172 SE: 0.386.

Variables in the equation Variable	B	SE B	Beta	T	Significance of T
Two-arch fixed appliance	–0.423	0.123	–0.433	–3.43	0.0012
Constant	–0.455	0.061		–7.45	0.0000

Significant if $P < 0.05$.

Predictors of treatment outcome

The use of two-arch fixed appliances was the most significant predictor of treatment outcome, which is in accordance with other studies.[3,5–7] These results add considerably to the weight of evidence that states that the most effective orthodontic treatment method is two-arch fixed appliances. Other methods, for example, single-arch fixed appliances and removable appliances are not as effective.

It was also interesting to find that the possession of an orthodontic qualification did not influence the effectiveness of treatment provided. This finding was also reported by Richmond.[3] However, this does not mean that is not necessary for an orthodontist to have a specialist qualification, but suggests that the effect of dual arched fixed appliances in the regression model is so great that the possession of an orthodontic qualification may not have an influence. As a result, we can conclude that the method of treatment is the most important factor influencing the effectiveness of treatment, but specialist training is needed to provide a high level of expertise in the effective and efficient use of orthodontic appliances.

Deficiencies of this investigation

The major deficiency of this investigation was its retrospective nature and, as a result, the findings must be interpreted carefully. In any retrospective investigation of this type where information is supplied voluntarily by the participants, the sample can only be assumed to be broadly representative of the situation in England and Wales as a whole, and selection bias can never be eliminated despite taking careful precautions in sampling.

Conclusions

The salaried Community Orthodontic service provides effective orthodontic treatment to many individuals clearly in need of that treatment, but there were wide variations between individual districts.

The most significant predictor of treatment outcome was the use of two-arch fixed appliances.

References

1. Health Services Circular HC(89)2. Health Services Management, The future development of the Community Dental Services. Department of Health, London.

2. O'Brien K. An Analysis of Retrospective Data Concerning the Provision of Orthodontic Treatment by the Community Dental Service. *Br J Orthod* 1990; **17**: 101–107.

3. Richmond S. A Critical Evaluation of Orthodontic Treatment in the General Dental Service in England and Wales. Ph.D Thesis 1990. University of Manchester.

4. Richmond S, Shaw WC, Stephens CD, Webb WG, Roberts CT, and Andrews M. Orthodontics in the General Dental Service of England and Wales: a critical assessment of standards. *Br Dent J* 1993; **174**: 315–327.

5. Turbill EA, Richmond S, Wright JL. A Critical Assessment of Orthodontic Standards in England and Wales (1990–1991) in relation to prior approval. *Br J Orthod* 1996; **23**: 221–228.

6. Turbill EA, Richmond S, Wright JL. A Critical Assessment of High-earning Orthodontists in the General Dental Services of England and Wales (1990–1991). *Br J Orthod* 1998; **25**: 47–54.

7. O'Brien K. An Analysis of the Effectiveness of the Provision of Orthodontic treatment by the Hospital Orthodontic Service of England and Wales. Ph.D Thesis 1991. University of Manchester.

8. O'Brien KD, Shaw WC, Roberts CT. The Use of Occlusal Indices in Assessing the Provision of Orthodontic Treatment by the Hospital Orthodontic Service of England and Wales. *Br J Orthod* 1993; **20**: 25–35.

9. Radnzic D. Effectiveness of Community Orthodontic Services in England and Wales. Ph.D. Thesis 1999. University of Manchester.

10. Dillman DA. Mail and Telephone surveys: The Total Design Method. A Wiley Interscience Publication; 1978.

11. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics* 1977; **33**: 159–174.