

# **A comparison of PDS and GDS patients in terms of number of interventions and oral health**

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## **Introduction**

The Personal Dental Services initiative in England allowed for the establishment of pilots to test alternative forms of remuneration for independent contractor dentists. Amongst such pilots, most used some form of capitation remuneration method for adult care, compared with the essentially fee-per-item method used by national arrangements for NHS General Dental Services[1].

With any professional group it is suspected that their working patterns will vary in response to incentives inherent in their payment method. Accordingly, capitation may therefore bring the concern that dentists will be tempted to avoid providing treatment for patients where an entirely objective decision would be to provide treatment. Conversely, fee-per-item might result in dentists over-treating their patients, providing treatment not entirely justified by clinical need. This debate is as old as NHS dentistry.

A key theory underpinning experimental approaches to changing dentist remuneration systems and through this clinical practice is that a reduced number of interventions is possible and desirable. The assumption is that what has been termed a 'less interventionist approach' would be better for patients in the long term, or at least as beneficial as existing approaches. Furthermore this new approach could make better use of a limited dental workforce, potentially allowing for more patients to be cared for.

The Rugby PDS pilot introduced a form of capitation for adults, with the capitation fee covering all routine care. This pilot involves three dental practices in Rugby, Warwickshire, and has been operational since October 1998. A study of the clinical health of patients treated within this payment system, compared to that of people treated within mainstream NHS General Dental Services has not been possible to date, though routine probity and quality checks by The Dental Reference Service have not revealed any particular issues for concern.

The objectives of the present study were therefore:

(i) to examine the number of clinical interventions which are made for patients in a capitation-based PDS pilot and compare these with the number of clinical interventions made for patients in equivalent GDS practices, and,

(ii) to compare the Oral Health of patients from both systems by means of a recently-developed Oral Health Index (OHX).

## **Methods**

Five dentists from the PDS pilot in Rugby, Warwickshire, were identified and their participation in the project requested. The Dental Practice Board, Eastbourne, was also asked to collaborate in this work. Patient profiles of dentists operating in the General Dental Services (GDS) in the Rugby area were examined by the Dental Practice Board and a cohort group of dentists identified with similar practitioner and list characteristics to the PDS pilot group. Patient characteristics to determine the participating dentists included, for a randomised selection of patients:

- patient age
- patient sex, and
- patient's exemption status.

Additionally, only patients who had attended the PDS practice for a period of two years prior to its conversion to PDS were included in this aspect of the study.

The number of interventions in the year to April 2003 for a minimum of 500 patients (to provide intervention rate per 100 patients per annum) was assessed for the two groups and these were compared. Interventions assessed were:

- courses of treatment
- individual patients treated
- examination and report
- radiographic examination
- scaling and polishing (Item 10 a and 10b)
- simple restorations
- advanced restorations (e.g. inlays and crowns)
- extractions

A recently developed Oral Health Index(OHX)[2] was used to determine the oral health of a selection of patients from the two groups of patients in the study.. This index provided a numerical measure of Oral Health, with component assessments of restoration adequacy, caries, periodontal disease, presence of calculus, adequacy of occlusion, mucosal health and patient comfort. Results of recent research has indicated that the OHX is capable of good inter- and intra-examiner reliability[3].

Five dentists from the PDS pilot, and five dentists, practising in the GDS, whose patient and practising profile matched those of the PDS pilot, were selected. An additional condition for acceptance into the project was that each of the selected dentists should work for a minimum of three days per week in order to achieve sufficient patient throughput for the OHX examinations to be completed within the timescale of the study. All participating dentists were invited to undertake a three-hour instructional course on the development and use of the Oral Health Index (OHX)[2]. They were provided with the necessary forms and instructions to enable them to use the OHX on their patients. A Power calculation determined that 223 PDS patients and 223 GDS patients should be examined. Accordingly, each dentist of the ten participating dentists (5 PDS and 5 GDS) was requested to use the OHX proformae while examining 50 consecutive patients who attend for their routine dental examination. These patients were not identified in any way, except, to be included in the project, that they were patients who had attended regularly for a period of two years prior to the commencement of the pilot. To minimise any potential differences relating to the time of year at which the patients attended, it was stipulated that patients were seen during the same period of time, during the months of August and September 2003. The OHX scores were computerised and compared using statistical tests.

## **Results**

### Dentist, List and Earnings Characteristics

The GDS group contained five men, the PDS group three men and two women. The average age was similar, in the early to mid 40's ( $p>0.05$ ) and both groups were on average around 20 years post qualification and had been at their present practice for about 13 years (Table 1). Only one of the dentists (from the GDS group) had a postgraduate dental qualification registered with the General Dental Council as at 31/3/03. Three of the GDS dentists obtained

their primary dental qualification at Birmingham; only one of the PDS dentists was a Birmingham graduate. The list sizes were similar (Table 2), as was the age composition and rate of growth over the year to April 2003. The fees earned for NHS work were comparable (Table 3), and, though the proportion of fees earned through patient charges was lower in the PDS group, the difference was not statistically significant. The proportion of claims in various exemption categories was analysed for the period April to June 2003 to see if there were differences between the two groups in terms of the proportion of patients seen who were exempt from NHS dental charges; no significant difference was observed.

### Interventions

The number of interventions reported for the year to April 2003 was expressed using the average number of patients registered in that year as a denominator (Table 4). The GDS dentists made an average of 3,507 claims to the Dental Practice Board in that year compared with 3,441 from the PDS dentists. There were in general no statistically significant differences between the two groups, with considerable diversity within groups, particularly within the GDS group. On average the GDS dentists tended to make fewer claims than the PDS dentists, see fewer individual patients, undertake fewer examinations and extract slightly fewer teeth. The GDS dentists tended to undertake more simple periodontal treatments and provide more fillings. There was no measurable difference in the number of advanced restorations provided. The magnitude of the differences, where present, tended to be small with the exception of simple periodontal treatments where the rate of provision was less than half that of the GDS dentists and the difference was statistically significant ( $p < 0.05$ ).

### Oral Health Index scores

A total of 250 OHX scores were obtained for patients in the PDS and a further 250 patients in the PDS. Initial examination of these data indicated that Dentist 1 in the GDS group (hitherto called GDS1) had a mean OHX score that was significantly lower than the mean OHX scores of the other GDS dentists. This dentist's OHX forms were examined, and this indicated the presence of patients with extensive caries and periodontal disease among this dentist's patients. Given that the dentists had been requested, in the protocol, to only include regular attenders among the patients selected for the OHX assessment, this dentist was contacted by one of the researchers (FJTB) to determine why patients with extensive disease appeared within his list of supposed regularly attending patients. As a result of this discussion, it was

apparent that Dentist GDS1 had misunderstood the protocol and had included new patients among his group of patients for OHX examination. He therefore deleted those patients who were irregular attenders from his group, thereby losing 9 patients from the OHX examination aspect of the study. The OHX scores are presented in Table 5. This indicated that the OHX scores of the PDS patients is different from the OHX scores of the GDS dentists, with the mean OHX score of the GDS dentists being less than the GDS dentists. However, when only the regular attenders from dentist GDS1 are included, the mean OHX scores of the two groups are similar.

### Periodontal component scores in the OHX

The complete analysis of the periodontal component data from the OHX examinations is presented in the Appendix. Given the statistically significant difference between the PDS and GDS dentists in terms of number of scalings provided for their patients, it was decided to examine the periodontal components in the OHX (namely, BPE scores per sextant, and sextants with/without subgingival calculus) and assess whether there were differences in these between the two PDS and GDS dentists. Accordingly, these data were collated and compared statistically. The results indicated no difference between the periodontal components of the OHX, although there were significant differences between dentists. Simply comparing the periodontal components between GDS and PDS resulted in a suggestion of a statistically significant difference in terms of Calculus only. However, further investigation revealed that for Calculus there were significant differences between individual dentists and after correcting for this, there was no overall statistically significant difference between PDS and GDS in terms of Calculus scoring. A similar pattern was apparent for the BPE scores, with significant differences between dentists. After correcting for this, there was a statistically significant difference between PDS and GDS in terms of scoring BPE, but the difference between PDS and GDS was small in comparison to the differences between dentists.

### **Discussion**

This study has compared the treatment characteristics of two groups of five dentists operating under different payment regimes, with the dentists having been matched for dentist age and patient age, these being factors which have been demonstrated to be significant in terms of dentist clinical behaviour (S.Lucarotti, personal communication April, 2003). In an ideal world,

an independent, blinded assessor would carry out all the patient examinations, or PDS dentists would examine GDS patients and vice versa. However, it would be necessary to book specific appointments for these patients and that would require ethical approval, which could lead to a delay in the commencement of the project. The need for this is avoided if the OHX examination is substituted for the form of examination otherwise utilised, and the patient is not disadvantaged, nor his/her time required. The participating dentists undertook a training course in the operation of the OHX and none subsequently expressed any concerns relating to the use of this index. Previous work has demonstrated good inter- and intra-examiner reproducibility for general dental practitioners using the OHX[3], so it may be considered that the scores obtained by the different practitioners are reliable. The mean OHX scores of the two groups were similar, and not statistically significantly different after excluding the OHX scores of 9 patients from GDS1 who were subsequently deemed to be irregular attenders.

The data on number of interventions are interesting. The small numbers of participating dentists makes statistical comparison difficult, but there is a suggestion that the GDS dentists provide more fillings and simple periodontal treatment than the PDS dentists, and that the PDS dentists provide more examinations than the GDS dentists. Apart from the difference in provision of simple periodontal treatment however, these differences were not statistically significant. However, these data may suggest that the PDS dentists provide a service which involves a higher degree of monitoring rather than intervention. The absence of statistically significant differences for other interventions may result from inadequate power through sample size.

The GDS dentists provided more simple periodontal treatment than the PDS dentists. The reasons for this are not clear, but since the oral health of the two groups is similar, it may suggest that the GDS patients request scaling and polishing for reasons of personal comfort and cleanliness in the absence of any disease, and that the GDS dentists provide this treatment. Conversely, the PDS dentists may under-record this type of intervention as the incentives to report activity undertaken and to collect the fees from patients are different under PDS arrangements as they do not impact upon practice income. Further work is indicated to more fully explore these issues and it is suggested that a structured interview with the dentists in the study is now indicated. Informal discussions with dentists suggest that there are a

number of complex issues impacting upon decisions to treat or monitor and the reporting of activity that merit further exploration.

## **Conclusions**

- The oral health of two groups of patients treated under the differing remuneration systems of GDS and a PDS capitation pilot has been compared and found to be similar
- PDS dentists provided significantly fewer simple periodontal treatments than their GDS counterparts: further analysis of the reasons for this difference is indicated by qualitative research
- The results suggest that PDS dentists provide more routine examinations and fewer fillings for their patients than the GDS dentists with whom they were compared, but the differences are not statistically significant: it is therefore suggested that PDS dentists may therefore be providing a more monitoring type of approach
- PDS and GDS dentists provide similar numbers of extractions and crowns for their patients



## References

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**Table 1. Dentist characteristics**

<b>Dentist</b>	<b>Sex</b>	<b>Age at 31/3/03</b>	<b>Years since obtaining primary qualification as at 31/3/03</b>	<b>Years at current practice as at 31/3/03</b>	<b>Patients registered June 2003</b>
<b>GDS1</b>	M	28.96	4.75	2.58	2,963
<b>GDS2</b>	M	57.13	33.25	30.08	2,254
<b>GDS3</b>	M	48.63	26.25	25.25	2,513
<b>GDS4</b>	M	38.21	15.25	3.17	2,771
<b>GDS5</b>	M	38.13	15.25	3.17	3,117
<b>Average</b>		<b>42.21</b>	<b>18.95</b>	<b>12.85</b>	<b>2,724</b>
<b>SD</b>		<b>10.86</b>	<b>11.03</b>	<b>13.64</b>	<b>346</b>
<b>95% CI +/-</b>		<b>9.52</b>	<b>9.67</b>	<b>11.95</b>	<b>303</b>
<b>PDS1</b>	F	29.08	5.75	3.73	3,540
<b>PDS2</b>	F	39.06	15.25	6.25	2,428
<b>PDS3</b>	M	58.65	35.67	28.75	3,263
<b>PDS4</b>	F	35.98	6.25	3.17	2,222
<b>PDS5</b>	M	58.94	34.75	25.71	956
<b>PDS6</b>	M	50.41	26.75	14.48	2,436
<b>Average</b>		<b>45.35</b>	<b>20.74</b>	<b>13.68</b>	<b>2,474</b>
<b>SD</b>		<b>12.48</b>	<b>13.56</b>	<b>11.28</b>	<b>909</b>
<b>95% CI +/-</b>		<b>9.99</b>	<b>10.85</b>	<b>9.03</b>	<b>727</b>

**Table 2. Patient List Characteristics**

Dentist	Adults regd 31/3/2002	% adults over 45+yr 31/3/2002	Adults regd 31/3/2003	% adults over 45+yr 31/3/2003	2002-2003			
					Difference n.	Difference %	Change in % over 44yr	Average list size 2002/3
<b>GDS1</b>	1,465	36.52%	1,845	37.13%	380	25.94%	0.61%	1,655
<b>GDS2</b>	1,916	62.73%	1,866	63.77%	-50	-2.61%	1.04%	1,891
<b>GDS3</b>	2,100	57.10%	1,979	58.46%	-121	-5.76%	1.37%	2,040
<b>GDS4</b>	2,081	50.84%	2,073	53.16%	-8	-0.38%	2.32%	2,077
<b>GDS5</b>	2,278	49.34%	2,254	49.82%	-24	-1.05%	0.48%	2,266
<b>Average</b>	<b>1,968</b>	<b>51.31%</b>	<b>2,003</b>	<b>52.47%</b>	<b>35</b>	<b>3.23%</b>	<b>1.16%</b>	<b>1,986</b>
<b>SD</b>	<b>309</b>	<b>9.83%</b>	<b>167</b>	<b>10.08%</b>	<b>197</b>	<b>12.87%</b>	<b>0.74%</b>	<b>228</b>
<b>95% CI +/-</b>	<b>271</b>	<b>8.62%</b>	<b>147</b>	<b>8.84%</b>	<b>173</b>	<b>11.28%</b>	<b>0.65%</b>	<b>200</b>
<b>PDS1</b>	2,448	48.00%	2,741	47.32%	293	11.97%	-0.68%	2,595
<b>PDS2</b>	1,802	54.38%	1,807	55.84%	5	0.28%	1.46%	1,805
<b>PDS3</b>	2,532	55.57%	2,573	57.40%	41	1.62%	1.83%	2,553
<b>PDS4</b>	1,544	60.56%	1,778	57.26%	234	15.16%	-3.30%	1,661
<b>PDS5</b>	557	51.71%	387	39.28%	-170	-30.52%	-12.43%	472
<b>PDS6</b>	1,817	59.77%	1,960	60.61%	143	7.87%	0.84%	1,889
<b>Average</b>	<b>1,783</b>	<b>55.00%</b>	<b>1,874</b>	<b>52.95%</b>	<b>91</b>	<b>5.10%</b>	<b>-2.05%</b>	<b>1,829</b>
<b>SD</b>	<b>716</b>	<b>4.78%</b>	<b>833</b>	<b>8.05%</b>	<b>169</b>	<b>16.51%</b>	<b>5.42%</b>	<b>772</b>
<b>95% CI +/-</b>	<b>573</b>	<b>3.82%</b>	<b>667</b>	<b>6.44%</b>	<b>135</b>	<b>13.21%</b>	<b>4.34%</b>	<b>618</b>

**Table 3. Fee Characteristics 2002/3**

	PDS Adult Capitation Fee	GDS Adult Continuing Care Payment	Item of Service Payments	Commitment Pay	Gross Fees	Patient Charges	
	£	£	£	£	£	£	%
<b>GDS1</b>		£ 12,028	£ 150,126	£ -	£ 162,154	£ 61,123	37.69%
<b>GDS2</b>		£ 13,686	£ 69,166	£ 3,264	£ 86,115	£ 49,566	57.56%
<b>GDS3</b>		£ 14,771	£ 72,303	£ 3,716	£ 90,789	£ 51,452	56.67%
<b>GDS4</b>		£ 15,133	£ 107,487	£ 2,898	£ 125,518	£ 72,947	58.12%
<b>GDS5</b>		£ 17,045	£ 125,932	£ 2,898	£ 145,875	£ 81,369	55.78%
<b>Average</b>		<b>£ 14,533</b>	<b>£ 105,003</b>	<b>£ 2,555</b>	<b>£ 122,090</b>	<b>£ 63,291</b>	<b>53.16%</b>
<b>SD</b>		<b>£ 1,852</b>	<b>£ 34,763</b>	<b>£ 1,467</b>	<b>£ 33,379</b>	<b>£ 13,723</b>	<b>8.69%</b>
<b>95% CI +/-</b>		<b>£ 1,623</b>	<b>£ 30,470</b>	<b>£ 1,286</b>	<b>£ 29,257</b>	<b>£ 12,029</b>	<b>7.62%</b>
<b>PDS1</b>	£ 124,100		£ 54,038		£ 178,138	£ 70,494	39.57%
<b>PDS2</b>	£ 66,641		£ 22,106		£ 88,747	£ 38,653	43.55%
<b>PDS3</b>	£ 94,917		£ 30,908		£ 125,825	£ 55,419	44.04%
<b>PDS4</b>	£ 61,933		£ 41,790		£ 103,723	£ 49,263	47.49%
<b>PDS5</b>	£ 27,437		£ 13,299		£ 40,736	£ 15,169	37.24%
<b>PDS6</b>	£ 78,094		£ 18,476		£ 96,570	£ 44,469	46.05%
<b>Average</b>	<b>£ 75,520</b>		<b>£ 30,103</b>		<b>£ 105,623</b>	<b>£ 45,578</b>	<b>42.99%</b>
<b>SD</b>	<b>£ 32,614</b>		<b>£ 15,438</b>		<b>£ 45,271</b>	<b>£ 18,467</b>	<b>3.89%</b>
<b>95% CI +/-</b>	<b>£ 26,096</b>		<b>£ 12,353</b>		<b>£ 36,223</b>	<b>£ 14,776</b>	<b>3.12%</b>

**Table 4. Intervention rates 2002/3**

Dentist	Average patients registered 2002/3	Courses of treatment		Patients treated		Examination		Intra-oral & panoramic radiographs		Simple periodontal treatment		Teeth Filled		Teeth Extracted		Teeth inlayed or crowned	
		n	per patient/year	n	per patient/year	n	per patient/year	n	per patient/year	n	per patient/year	n	per patient/year	n	per patient/year	n	per patient/year
<b>GDS1</b>	1,655	2,629	1.59	2,191	1.32	2,101	1.27	1,736	1.05	1,872	1.13	1,504	0.91	464	0.28	241	0.15
<b>GDS2</b>	1,891	3,386	1.79	1,946	1.03	2,740	1.45	367	0.19	1,033	0.55	808	0.43	167	0.09	107	0.06
<b>GDS3</b>	2,040	3,691	1.81	2,462	1.21	2,855	1.40	606	0.30	2,289	1.12	688	0.34	191	0.09	15	0.01
<b>GDS4</b>	2,077	3,810	1.83	2,413	1.16	3,009	1.45	1,119	0.54	2,368	1.14	1,314	0.63	175	0.08	114	0.05
<b>GDS5</b>	2,266	4,019	1.77	2,595	1.15	3,294	1.45	625	0.28	3,016	1.33	1,638	0.72	279	0.12	118	0.05
<b>ALL</b>	<b>9,929</b>	<b>17,535</b>	<b>1.77</b>	<b>11,607</b>	<b>1.17</b>	<b>13,999</b>	<b>1.41</b>	<b>4,453</b>	<b>0.45</b>	<b>10,578</b>	<b>1.07</b>	<b>5,952</b>	<b>0.60</b>	<b>1,276</b>	<b>0.13</b>	<b>595</b>	<b>0.06</b>
<b>Average</b>	<b>1,986</b>	<b>3,507</b>	<b>1.76</b>	<b>2,321</b>	<b>1.17</b>	<b>2,800</b>	<b>1.40</b>	<b>891</b>	<b>0.47</b>	<b>2,116</b>	<b>1.05</b>	<b>1,190</b>	<b>0.61</b>	<b>255</b>	<b>0.13</b>	<b>119</b>	<b>0.06</b>
<b>SD</b>	<b>228</b>	<b>542</b>	<b>0.10</b>	<b>255</b>	<b>0.11</b>	<b>442</b>	<b>0.08</b>	<b>546</b>	<b>0.35</b>	<b>731</b>	<b>0.30</b>	<b>422</b>	<b>0.23</b>	<b>125</b>	<b>0.08</b>	<b>80</b>	<b>0.05</b>
<b>95% CI +/-</b>	<b>200</b>	<b>475</b>	<b>0.09</b>	<b>224</b>	<b>0.09</b>	<b>388</b>	<b>0.07</b>	<b>479</b>	<b>0.30</b>	<b>640</b>	<b>0.26</b>	<b>370</b>	<b>0.20</b>	<b>110</b>	<b>0.07</b>	<b>70</b>	<b>0.04</b>
<b>PDS1</b>	2,595	5,851	2.26	5,026	1.94	4,816	1.86	1,435	0.55	615	0.24	1,529	0.59	305	0.12	142	0.05
<b>PDS2</b>	1,805	2,978	1.65	2,613	1.45	2,540	1.41	221	0.12	769	0.43	821	0.45	125	0.07	95	0.05
<b>PDS3</b>	2,553	4,836	1.89	4,021	1.58	3,894	1.53	519	0.20	1,223	0.48	1,039	0.41	399	0.16	118	0.05
<b>PDS4</b>	1,661	2,953	1.78	2,636	1.59	2,492	1.50	748	0.45	971	0.58	1,043	0.63	254	0.15	129	0.08
<b>PDS5</b>	472	932	1.97	655	1.39	674	1.43	109	0.23	338	0.72	232	0.49	150	0.32	51	0.11
<b>PDS6</b>	1,889	3,097	1.64	1,881	1.00	2,403	1.27	558	0.30	1,185	0.63	1,069	0.57	280	0.15	80	0.04
<b>ALL</b>	<b>10,973</b>	<b>20,647</b>	<b>1.88</b>	<b>16,832</b>	<b>1.53</b>	<b>16,819</b>	<b>1.53</b>	<b>3,590</b>	<b>0.33</b>	<b>5,101</b>	<b>0.46</b>	<b>5,733</b>	<b>0.52</b>	<b>1,513</b>	<b>0.14</b>	<b>615</b>	<b>0.06</b>
<b>Average</b>	<b>1,829</b>	<b>3,441</b>	<b>1.87</b>	<b>2,805</b>	<b>1.49</b>	<b>2,803</b>	<b>1.50</b>	<b>598</b>	<b>0.31</b>	<b>850</b>	<b>0.51</b>	<b>956</b>	<b>0.52</b>	<b>252</b>	<b>0.16</b>	<b>103</b>	<b>0.06</b>
<b>SD</b>	<b>772</b>	<b>1710</b>	<b>0.23</b>	<b>1546</b>	<b>0.31</b>	<b>1421</b>	<b>0.20</b>	<b>472</b>	<b>0.16</b>	<b>343</b>	<b>0.17</b>	<b>424</b>	<b>0.09</b>	<b>102</b>	<b>0.08</b>	<b>34</b>	<b>0.03</b>
<b>95% CI +/-</b>	<b>618</b>	<b>1368</b>	<b>0.19</b>	<b>1237</b>	<b>0.25</b>	<b>1137</b>	<b>0.16</b>	<b>377</b>	<b>0.13</b>	<b>275</b>	<b>0.14</b>	<b>339</b>	<b>0.07</b>	<b>81</b>	<b>0.07</b>	<b>27</b>	<b>0.02</b>

## **APPendix**

### **PDS & GDS Perio Data**

#### Introduction

Each of the 10 dentists (5 PDS and 5 GDS) evaluated up to 45 patients each.

With regard to the perio components, there will not be complete data as the perio components are not measured for patients with dentures.

For both the BPE and the Calculus, the dentist scores each out of a maximum of 6. However, to complicate matters more, the maximum can vary from patient to patient, as there has to be at least one tooth standing in a given sextant for the perio scores to be taken.

Given we have varying maxima per patient, it is difficult to simply summarise and compare the 'average' scores of the GDS and PDS groups – there is no simple method. Therefore I've looked at a couple of different approaches to try and get an overview of the data.

#### **Number of Patients with Perio Scores**

There are 434 patients who were allocated both a BPE and a Calculus score.

Is there a difference between GDS and PDS in terms of %BPE or %Calculus, ignoring any potential ‘dentist’ effect?

I.e. if we just consider the patients as coming from two groups only.

### **BPE Scores**

Taking all 434 scores, the maximum BPE varied from 1 to 6, with the 397 patients having a maximum score of 6. The allocated BPE score varied from 0 to 6. However, obviously what is of interest is the ‘fraction’ or percentage scores, which are summarized in Table A1.

### **Table A1**

*Note that in this Table it is the percentage BPE that is given, where, for example, 100% could be a score of 6 out of a maximum of 6, 5 out of a maximum of 5, and so on.*

<b>%BPE Score</b>	<b>Number of Patients</b>	<b>% of Patients</b>
0%	22	5.1
16.7%	10	2.3
33.3%	23	5.3
40.0%	3	0.7
50.0%	25	5.8

66.7%	39	9.0
75.0%	1	0.2
80.0%	6	1.4
83.3%	69	15.9
100%	236	54.4

From Table A1 we can see that just over half of the patients scored 100% for BPE and over 70% of patients had a BPE score of at least 75%. At the other end, 5% of patients scored zero, and just under 13% of patients had a BPE score of 33% or less.

Table A2 presents the distribution of %BPE by group (PDS or GDS).



**Table A2**

	<b>GDS (n=212)</b>		<b>PDS (n=222)</b>		<b>All</b>	
<b>%BPE Score</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>
0%	13	(6.1%)	9	(4.1%)	22	(5.1%)
16.7%	4	(1.9%)	6	(2.7%)	10	(2.3%)
33.3%	10	(4.7%)	13	(5.9%)	23	(5.3%)
40.0%	3	(1.4%)	0	(0%)	3	(0.7%)
50.0%	15	(7.1%)	10	(4.5%)	25	(5.8%)
66.7%	22	(10.4%)	17	(7.7%)	39	(9.0%)
75.0%	0	(0%)	1	(0.5%)	1	(0.2%)
80.0%	2	(0.9%)	4	(1.8%)	6	(1.4%)
83.3%	31	(14.6%)	38	(17.1%)	69	(15.9%)
100%	112	(52.8%)	124	(55.9%)	236	(54.4%)

There seems to be only small differences between GDS and PDS in terms of the distributions of %BPE scores, with similar percentages of patients with %BPE scores of 33% or less. There is a slightly higher percentage of PDS patients with BPE scores of at least 75% (75% of PDS patients vs 68% of GDS patients).

Given the number of cells with few patients, the usual chi-squared test is not valid. Using monte-carlo methods, the estimate of the p-value from the chi-squared test is 0.449 (95% confidence interval (0.436, 0.462)). This would suggest that there is little evidence to suggest an association between group and %BPE score.

It is possible to 'collapse' the %BPE scores into fewer categories. This has been carried out subjectively with the categories of 0 - 33.3%, 40 – 66.7% and 75+%. Comparing these 3 categories of %BPE across the two groups results in a p-value of 0.145. So again from this we would conclude that there is insufficient evidence to reject the null hypothesis of no association between group and %BPE.

## Calculus Scores

Taking all 434 scores, the maximum Calculus varied from 1 to 6, with the 397 patients having a maximum score of 6. The allocated Calculus score varied from 0 to 6. However, obviously what is of interest is the 'fraction' or percentage scores, which are summarized in Table A3.

### Table A3

*Note that in this Table it is the percentage Calculus that is given, where, for example, 100% could be a score of 6 out of a maximum of 6, 5 out of a maximum of 5, and so on*

<b>%Calculus Score</b>	<b>Number of Patients</b>	<b>% of Patients</b>
0%	31	7.1
16.7%	26	6.0
20.0%	2	0.5
33.3%	28	6.5
40.0%	3	0.7
50.0%	56	12.9
60.0%	3	0.7
66.7%	52	12.0
75.0%	1	0.2
80.0%	5	1.2
83.3%	89	20.5
100%	138	31.8

From Table 3 we can see that just under a third of the patients scored 100% for Calculus and just over half (53.7%) of patients had a Calculus score of at least 75%. At the other end, 7% of patients scored zero, and a fifth of patients had a Calculus score of 33% or less.

Table A4 presents the distribution of %Calculus by group (PDS or GDS).

**Table A4**

	<b>GDS (n=212)</b>		<b>PDS (n=222)</b>		<b>All</b>	
<b>%Calculus Score</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>
0%	15	(7.1%)	16	(7.2%)	31	(7.1%)
16.7%	18	(8.5%)	8	(3.6%)	26	(6.0%)
20.0%	1	(0.5%)	1	(0.5%)	2	(0.5%)
33.3%	16	(7.6%)	12	(5.4%)	28	(6.5%)
40.0%	2	(0.9%)	1	(0.5%)	3	(0.7%)
50.0%	38	(17.9%)	18	(8.1%)	56	(12.9%)
60.0%	2	(0.9%)	1	(0.5%)	3	(0.7%)
66.7%	26	(12.3%)	26	(11.7%)	52	(12.0%)
75.0%	0	(0%)	1	(0.5%)	1	(0.2%)
80.0%	1	(0.5%)	4	(1.8%)	5	(1.2%)
83.3%	44	(20.7%)	45	(20.3%)	89	(20.5%)
100%	49	(23.1%)	89	(40.1%)	138	(31.8%)

From Table A4 there would seem to be differences between GDS and PDS in terms of the distributions of %Calculus scores. For example, 40% of PDS patients score 100% compared to only 23% of GDS patients. 44% of GDS patients have a Calculus score of at least 75% compared to 63% of PDS patients. At the other end of the scale, there is a slightly higher percentage of GDS patients scoring 33% or less compared to PDS patients (24% vs 17%).

Given the number of cells with few patients, the usual chi-squared test is not valid. Using monte-carlo methods, the estimate of the p-value from the chi-squared test is 0.001 (95% confidence interval (0.0004, 0.0022)). Thus there is evidence to reject the null

hypothesis of no association between group and %Calculus score and there is a suggestion that patients in the PDS group are more likely to have a higher %Calculus score.

To try and confirm this pattern in a simpler manner, again the %Calculus scores were collapsed into fewer categories. This has been subjectively done with the categories of 0 - 33.3%, 40 – 66.7% and 75+%. Comparing these 3 categories of %Calculus across the two groups results in a p-value of less than 0.001. This confirms the above conclusion of evidence of a significant association between group and %Calculus.

**Table A5**

	<b>GDS (n=212)</b>		<b>PDS (n=222)</b>		<b>All</b>	
<b>%Calculus Score</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>
0 – 33.3%	50	(23.6%)	37	(16.7%)	31	(7.1%)
40 – 66.7%	37	(32.1%)	46	(20.7%)	26	(6.0%)
75 – 100%	94	(44.3%)	139	(62.6%)	2	(0.5%)

As Table A5 illustrates, a greater percentage of PDS than GDS patients %Calculus score was in the highest category, whilst there were greater percentages of GDS than PDS patients in the other two categories.

Summary so far:

If we consider the patients to have come from two groups, i.e. ignoring any potential effect due to there being different dentists, there would seem to be little evidence of any difference between GDS and PDS in terms of the distribution of %BPE scores. However, there is evidence of a significant difference between groups in terms of the distribution of %Calculus scores, with a greater proportion of patients from PDS with higher scores than from GDS.

However, ignoring the possible dentist effect is probably not wise!

To try and examine whether or not the different dentists scored the perio components differently, a more complicated approach is required.

Is there a difference between GDS and PDS in terms of BPE or Calculus, allowing for any potential 'dentist' effect?

In order to examine the data sensibly, only patients who had perio scores for all 6 sextants are considered here. As there were 397 such patients out of the total of 434 (i.e. over 90% of the patients with a perio score) this would not seem to be unreasonable.



By taking the patients with 'complete' perio scores, we can now consider the data to be ordinal scores. That is each patient scored between 0 and 6 (so a 7 point ordinal scale). We can now model the ordinal scores on both the effects of group and dentist, using ordinal logistic regression.

## BPE

Firstly the data from the 397 patients with 'complete' perio scores are summarised by group in Table A6.

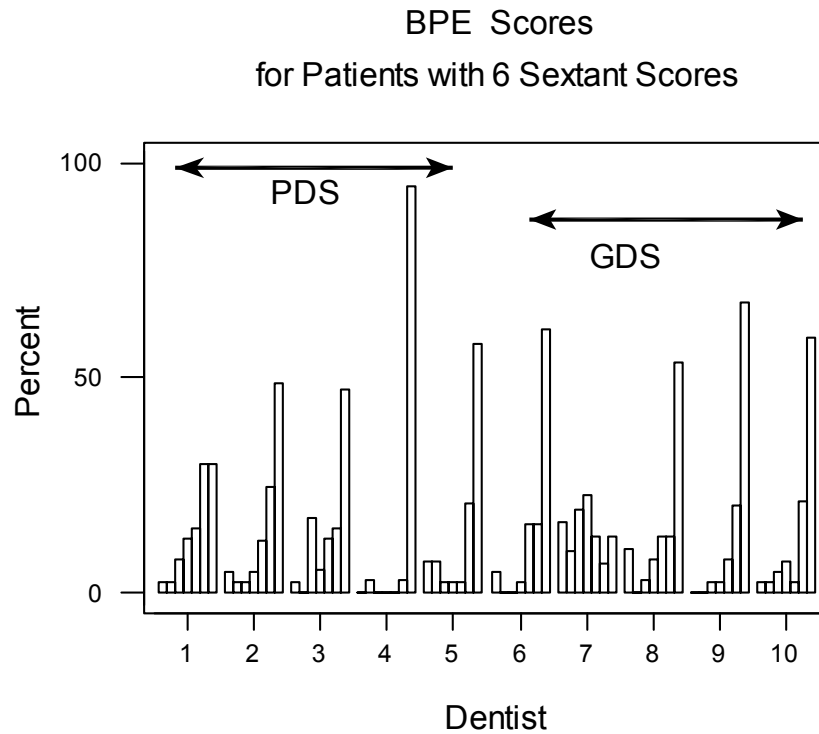
**Table A6**

	<b>GDS (n=196)</b>		<b>PDS (n=201)</b>		<b>All (n=397)</b>	
<b>BPE</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>
0 (0%)	12	(6.1%)	7	(3.5%)	19	(4.8%)
1 (16.7%)	4	(2.0%)	6	(3.0%)	10	(2.5%)
2 (33.3%)	10	(5.1%)	12	(6.0%)	22	(5.5%)
3 (50%)	15	(7.7%)	10	(5.0%)	25	(6.3%)
4 (66.7%)	20	(10.2%)	17	(8.5%)	37	(9.3%)
5 (83.3%)	31	(15.8%)	38	(18.9%)	69	(17.4%)
6 (100%)	104	(53.1%)	111	(55.2%)	215	(54.2%)

Still ignoring any potential dentist effect, for this subset of the patients, the table suggests little differences between the distribution of the BPE scores across the groups. This is confirmed with a p-value of 0.674 from the chi-squared test of association between group and BPE score.

However, as soon as we allow for the effect of 'dentist' a different pattern appears. Figure A1 illustrates the percentage of patients with each BPE score (0 to 6) for each Dentist, within each of the two groups.

**Figure A1**



Most dentists scored some but few patients as having BPE scores of 0, 1, 2 or 3 and more patients as having BPE scores of 4, 5 or 6. However dentist 4 (a PDS dentist) scores virtually all his patients as having BPE score of 6.

The ordinal logistic regression confirms that there are some significant differences between Dentists. In particular from the ordinal logistic regression model, (PDS) Dentist 4 is predicted to score differently from at least the other PDS dentists, scoring virtually all

patients at the top of the scale (score 6). Dentist 7 (GDS) is also atypical to the other dentists, and is predicted to score far more of his patients at the lower end of the scale (scores 0, 1, 2) compared to the other dentists.

After allowing for these differences, there is still a statistically significant difference between Groups ( $p=0.012$ ). However, looking at both the raw data and predicted probabilities, the most important effect on the BPE score is that of the dentist.

## Calculus

Firstly the Calculus data from the 397 patients with 'complete' perio scores are summarised by group only in Table A7.

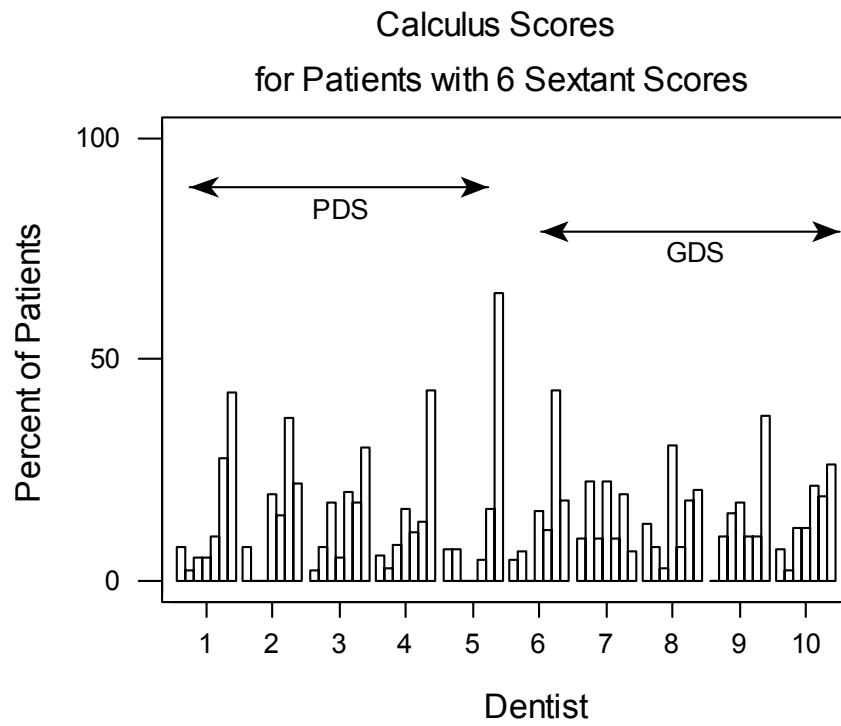
**Table A7**

	<b>GDS (n=196)</b>		<b>PDS (n=201)</b>		<b>All (n=397)</b>	
<b>Calculus</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>	<b>No. of Patients</b>	<b>% of Patients</b>
0 (0%)	13	(6.6%)	12	(6.0%)	25	(6.3%)
1 (16.7%)	18	(9.2%)	8	(4.0%)	26	(6.6%)
2 (33.3%)	15	(7.7%)	12	(6.0%)	27	(6.8%)
3 (50%)	38	(19.4%)	18	(9.0%)	56	(14.1%)
4 (66.7%)	24	(12.2%)	24	(11.9%)	48	(12.1%)
5 (83.3%)	44	(22.5%)	45	(22.4%)	89	(22.4%)
6 (100%)	44	(22.5%)	82	(40.8%)	126	(31.7%)

Still ignoring any potential dentist effect, for this subset of the patients, the table suggests some differences between the distributions of the Calculus scores across the groups, particularly looking at the proportions scoring 6 out of 6. This is confirmed with a p-value of 0.001 from the chi-squared test of association between group and Calculus score.

However, as soon as we examine the effect of dentist a different pattern appears. Figure A2 illustrates the Calculus score across Dentists, within each of the two groups. From this we can see that in particular Dentist 5 (PDS) and Dentist 7 (GDS) have different patterns compared to the remaining dentists.

Figure A2



The ordinal logistic regression confirms that there are some significant differences between Dentists and after allowing for these differences, there is no significant difference between Groups ( $p=0.142$ ).

Note that in particular, (GDS) Dentist 7 is atypical. From the ordinal logistic model being predicted to score more patients at the bottom (scores 0, 1, 2) and fewer patients at the top (scores 5, 6) compared to other Dentists. Dentist 5 (PDS) is predicted to score far more patients at the top (score 6) compared to the other Dentists.



## Overall Conclusion

Simply comparing the distributions of %BPE and %Calculus scores between the two groups leads to the conclusion of no difference between Groups in terms of %BPE and a statistically significant difference between groups in terms of %Calculus. However, these simple comparisons are masking the large differences between Dentists. After adjusting for the differences between Dentists, there is a difference between groups in terms of BPE but not in terms of Calculus. However the most important factor influencing the Perio Scores is the Dentist. In particular Dentist 7 (GDS) seems to score both Perio components differently to the other dentists, at least within the GDS group, whilst PDS Dentist 4 scores BPE differently to the other dentists and PDS Dentist 5 scores Calculus differently to the other dentists within the PDS group.