European Journal of Orthodontics 29 (2007) 161–165
doi:10.1093/ejo/cjl085
Advance Access publication 22 February 2007

Bacteraemia following debanding and gold chain adjustment

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SUMMARY The purpose of this research was to estimate the prevalence, intensity, and nature of bacteraemia following deband and gold chain adjustment. Forty-nine children, 25 males and 24 females, mean age 15.4 years, attending the Orthodontic Department at the Eastman Dental Hospital were recruited. A cannula was inserted into either the left or the right antecubital fossa using an aseptic technique. A 6 ml sample of blood was taken before treatment and another 6 ml, 30 seconds after either upper deband ($n = 42$) or gold chain adjustment ($n = 7$). McNewmar's test was used to determine differences in the proportion of positive blood cultures and Wilcoxon matched pairs test to compare continuous variables.

There was no significant difference ($P > 0.05$) in the prevalence of bacteraemia between baseline (eight, 19 per cent) and following upper deband (11, 26 per cent) or between baseline (four, 57 per cent) and gold chain adjustment (four, 57 per cent). There was also no significant difference ($P > 0.05$) in the intensity of the anaerobic bacteraemia between baseline and following deband or gold chain adjustment.

Although the number of subjects undergoing gold chain adjustment was small, the findings demonstrate that neither upper debanding nor gold chain adjustment is associated with a significant bacteraemia.

Introduction

It is clear that an individual's susceptibility to infective endocarditis (IE) is related to the underlying cardiac lesion. This is particularly so with congenital heart disease where the degree of susceptibility is determined by both the haemodynamic severity of the lesion and whether or not the surgery has been palliative or definitive. These factors further determine if the affected individual has a high, moderate, or low risk of developing IE as a result of instrumentation of a mucosal surface.

The recommendations from the British Cardiac Society (Ramsdale and Turner-Stokes, 2004) are that all dental procedures with a statistically significantly greater bacteraemia post-procedure compared with pre-procedure should be covered by antibiotic prophylaxis in the moderate and high-risk cardiac groups. It is important to emphasize that statistical significance does not equate to clinical significance. The British Society of Antimicrobial Chemotherapy has recently published recommendations (Gould *et al.*, 2006). These state that only subjects with prosthetic valves, surgically constructed systemic or pulmonary shunts and conduits, or a history of IE should be treated with antibiotic prophylaxis. The general consensus of the American Heart Association now appears to be that susceptible individuals are more at risk from everyday procedures such as toothbrushing (Al-Karaawi *et al.*, 2001).

Until very recently, antibiotic prophylaxis for the prevention of IE in susceptible individuals has been recommended for extractions, scaling, and periodontal surgery (Simmons, 1993) and for all dental procedures that are likely to cause gingival bleeding (Horstkotte *et al.*, 2004). Although bleeding is a poor predictor of bacteraemia, the relationship between bacteraemia and dentogingival manipulative procedures is well documented. These procedures include extraction of teeth (Burket and Burn, 1937; Coulter *et al.*, 1990; Roberts *et al.*, 1997), placement of a rubber dam, gingival retraction cord, and matrix band and wedge (Roberts *et al.*, 1998). Provisional data from professional tooth cleaning with a slow handpiece and rubber cup and use of an electric toothbrush with an up and down oscillating movement appear to cause a significant bacteraemia.

Early researchers reported no significant difference in the prevalence of bacteraemia following debanding or debonding compared with pre-procedure (Erverdi *et al.*, 2000). The prevalence of bacteraemia following alginate impressions was 31 per cent, placement of separators 36 per cent, fit and placement of molar band 44 per cent, and archwire adjustment 19.4 per cent, but none of these were significantly different from baseline (Lucas *et al.*, 2002b).

Most published work has not reported the intensity of bacteraemia. The technique of broth culture, while enabling a rapid microbial identity, does not provide information about the intensity of bacteraemia. Although the pour plate method has been used (Coulter *et al.*, 1990), it has not been validated. The technique of lysis filtration enables both identification of the micro-organisms and calculation of the intensity of bacteraemia in colony-forming units per millilitre (cfus/ml) of blood and has recently been validated (Lucas *et al.*, 2002a).

The purpose of this investigation was to record the prevalence and intensity of bacteraemia following upper arch debanding and gold chain adjustment using lysis filtration.

Subjects

Ethical approval was granted by the Eastman Dental Institute and Hospital Joint Research and Ethics Committee. Each parent was given an information sheet and was asked for written consent for children aged less than 16 years.

Children aged over 12 years but less than 16 years were asked for verbal consent. Patients aged 16 years and above were given an information sheet and asked for written consent. Toothbrushing was not restricted.

From an initial sample of 84 fit and healthy children and adolescents, 49 were included in the study of which 42 were in the deband group and a further seven underwent gold chain adjustment. The reasons for exclusion from the initial sample were poor venous access ($n = 7$), refusal to participate ($n = 27$), and withdrawal of consent ($n = 1$). Twenty-five subjects were males and 24 females with a mean age of 15.4 years [standard deviation (SD) 1.5 years].

Methods

The same clinical and laboratory techniques were used as reported previously (Lucas *et al.*, 2002a).

Outcome measures

These were as follows:

1. The prevalence of bacteraemia recorded as the number of positive blood cultures and expressed as the percentage prevalence.
2. The intensity of bacteraemia, recorded as the number of cfus/ml of blood.
3. The identity of the bacteria.

Statistical analysis

All data were tested for normality using the Shapiro–Wilk test (Altman, 1991). Categorical data were subjected to cross-tabulation. The McNemar test was used to detect any difference in the proportion of positive blood cultures between baseline and debanding. The Wilcoxon matched pairs test was used to compare continuous variables.

Results

Bacterial dental plaque and gingival inflammation

The mean plaque score was 6.3 (SD 4.6) and the mean gingivitis score 4.6 (SD 3.8; Table 1).

Prevalence of bacteraemia following debanding

There was no significant difference between the proportion of positive cultures at baseline, 19 per cent and post-deband, 26 per cent There was no significant association between the mean plaque and gingivitis score and the number of positive blood cultures following deband (Table 2).

Intensity of bacteraemia following debanding

There was no significant difference in the aerobic, the anaerobic, or the sum of the combined aerobic and anaerobic intensity of bacteraemia (cfus/ml of blood) between baseline and 30 seconds after debanding (Tables 3–5).

Prevalence of bacteraemia following gold chain adjustment

There was no significant difference in the prevalence of bacteraemia between baseline and following adjustment of a gold chain (both 57 per cent; Table 2).

Table 1 Bacterial dental plaque and gingivitis scores.

	Plaque score					Gingivitis score				
n	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max
49	6.3	4.5	5	1	19	4.6	3.8	4.0	0	15

n, number of subjects.

Table 2 Prevalence of bacteraemia: number of positive blood cultures.

Group	*n*	Baseline (%)	Post-procedure (%)	Significance
Deband	42	8 (19)	11 (26)	ns
Gold chain adjustment	7	4 (57)	4 (57)	ns

n, number of subjects; ns, not statistically significant.

Table 3 Intensity of bacteraemia as colony-forming units per millilitre of blood: aerobic.

Group	*n*	Mean	SD	Median	Min–Max	Significance
Deband	42					
Baseline		0.02	0.06	0	0–0.17	ns
Post-procedure		0.07	0.16	0	0.83	$P = 0.06$
Gold chain adjustment	7					
Baseline		0.17	0.19	0	0–0.5	ns
Post-procedure		0.40	0.72	0	0–2.0	ns

n, number of subjects; ns, not statistically significant.

Table 4 Intensity of bacteraemia as colony-forming units per millilitre of blood: anaerobic.

Group	*n*	Mean	SD	Median	Min–Max	Significance
Deband	42					
Baseline		0.03	0.07	0	0–0.33	ns
Post-procedure		0.03	0.08	0	0–0.33	ns
Gold chain adjustment	7					
Baseline		0.05	0.08	0	0–0.17	ns
Post-procedure		0.02	0.06	0	0–0.17	ns

n, number of subjects; ns, not statistically significant.

Table 5 Intensity of bacteraemia: sum of colony-forming units per millilitre of blood: aerobic and anaerobic bacteria.

Group	*n*	Mean	SD	Median	Min–Max	Significance
Deband	37					
Baseline		0.05	0.1	0	0–0.33	ns
Post-procedure		0.1	0.2	0	0.83	ns
Gold chain adjustment	7					
Baseline		0.21	0.23	0	0–0.5	ns
Post-procedure		0.43	0.78	0	0–2.2	ns

n, number of subjects; ns, not significant.

Table 6 Bacterial species isolated from blood cultures: deband and gold chain adjustment groups.

Species	Baseline		Post-procedure	
	Aerobic	Anaerobic	Aerobic	Anaerobic
Streptococcus spp.	—	—	1	—
Aerococcus viridans	—	—	1	—
Stomatococcus mucilaginous	—	—	1	1
Corynebaterium spp.	1	—	—	—
Staphylococcus auricularis	1	—	2	1
Staphylococcus epidermidis	1	1		
Staphylococcus capitis	—	—	1	—
Staphylococcus caprae	—	—	2	—
Staphylococcus hominis	1	—	2	4
Staphylococcus lentus	—	—	—	1
Staphylococcus saprophyticus	—	1	—	—
Micrococcus luteus	2	—	5	—
Micrococcus lylae	—	—	1	—
Micrococcus roseus	—	—	2	—
Gram-positive cocci*		1 ng	4	1

ng, isolate failed to grow.
*not further identified.

Intensity of bacteraemia

There was no significant difference in the aerobic, the anaerobic, or the sum of the combined aerobic and anaerobic intensity of bacteraemia between baseline and following gold chain adjustment (Tables 3–5).

Identity of bacteria isolated

The bacteria isolated following debanding and gold chain adjustment were similar to those following placement of separators and alginate impressions. These were coagulase-negative staphylococci, *Micrococcus* spp., *Aerococcus* spp., and *Stomatococcus mucilaginous*. Bacteria isolated from the baseline blood samples included *Streptoccus* spp., *Corynebacterium* spp., coagulase-negative staphylococci, and *Micrococcus* spp. (Table 6).

Discussion

The purpose of this research was to investigate the prevalence, intensity, and identity of bacteraemia following upper debanding and gold chain adjustment. The baseline prevalence of bacteria in the deband group (21 per cent) was of a similar magnitude to that of adolescents undergoing alginate impressions (23 per cent), placement of separators (27 per cent; Lucas *et al.*, 2002b), and also following extractions at timed intervals (14 to 32 per cent; Roberts *et al.*, 2006). Both the baseline and the post-deband prevalence were greater than those reported by other workers (Erverdi *et al.*, 2000, 2001). This is because of the increased sensitivity of lysis filtration at low concentrations of bacteria compared with the pour plate or broth culture technique (Heimdahl *et al.*, 1990; Lucas *et al.*, 2002b).

Recent work has demonstrated that the maximum bacteraemia following extraction of teeth is between 30 and 60 seconds following the most vigorous dentogingival manipulation (Roberts *et al.*, 2006). After 60 seconds, the prevalence of bacteraemia decreases, thus it is important to ensure that post-operative blood is withdrawn between 30 and 60 seconds post-procedure. In the present investigation, all the second blood samples were taken 30 seconds post-procedure to be consistent with earlier work (Lucas *et al.*, 2002b). Other workers have completed the deband and blood sampling within 2 minutes (Erverdi *et al.*, 2000, 2001) which is not only not sufficiently accurate but not comparable with the work reported here.

In addition, subjects for debanding have been recruited with either ‘acceptable’ oral hygiene (Erverdi *et al.*, 2000) or following use of chlorhexidine mouthrinse immediately before debanding (Erverdi *et al.*, 2001). This does not give a true reflection of the prevalence and nature of bacteraemia following deband since the placement of full orthodontic bands increases the mean population of oral bacteria (Bloom and Brown, 1964).

Although there was no significant difference in the prevalence and intensity of bacteraemia between baseline and adjustment of a gold chain, this should be treated with caution because of the small sample size. A sample size of 934 would be necessary to demonstrate a significant difference, but this is clearly impractical.

The range of bacteria isolated was similar to that found after orthodontic procedures (Erverdi *et al.*, 2000; Lucas *et al.*, 2002b) with a high prevalence of coagulase-negative *Staphylococcus* and *Micrococcus* spp. *Streptococcus* spp. have been the most frequently implicated oral micro-organism in the development of IE (Young, 1987; van der Meer *et al.*, 1991; Felder *et al.*, 1992; Li and Somerville, 1998). More recently, infection with *Staphylococcus* spp., particularly, *S. aureus* has increased, causing almost 50 per cent of cases of IE (Watanakunakorn and Burkert, 1993; Siddiq *et al.*, 1996; Mylonakis and Calderwood, 2001; Cabell *et al.*, 2002). In the current investigation, several species of coagulase-negative staphylococci, including *S. hominis*, *S. capitis*, and *S. epidermidis* were isolated following debanding, all of which have been implicated in both native and prosthetic valve endocarditis (Chu *et al.*, 2004).

Staphylococcus spp. are transient oral colonizers in healthy individuals (Tanner *et al.*, 1994). Between 94 and 100 per cent of healthy adults (Percival *et al.*, 1991) and 84 per cent of healthy children (Miyake *et al.*, 1991) have *Staphylococcus* spp. in the mouth. In individuals with periodontal disease and in healthy controls, subgingival *Staphylococcus* spp. has been isolated, predominantly *S. epidermidis*, *S. capitis*, *S. hominis*, and *S. warneri* (Murdoch *et al.*, 2004). *Staphylococcus* spp. has also been isolated from the oral mucosa and fit surface in complete denture wearers (Monsenego, 2000) and the saliva of partial denture wearers (Marsh *et al.*, 1992). The presence of a prosthesis or an orthodontic appliance encourages an increased prevalence of *Staphylococcus* spp. Hence, the greater prevalence of oral *Staphylococcus* spp. compared with *Streptococcus* spp. in this group of adolescents undergoing orthodontic treatment.

Micrococcus spp. have generally been associated with both central venous line infection (Oudiz *et al.*, 2004) and IE namely *M. luteus* (Seifert *et al.*, 1995; Uso *et al.*, 2003). *M. luteus* was the most frequently isolated *Micrococcus* spp. in this investigation and has also been isolated from the gingivae of adults with periodontitis (Anesti *et al.*, 2005).

Conclusions

The findings of this research demonstrate that there is no difference in the prevalence or intensity of bacteraemia between baseline and following debanding of the upper arch or gold chain adjustment. Clearly, the gold chain adjustment group was small and no definitive conclusions can be drawn. It will be interesting to see how these results relate to the new recommendations for the antibiotic prophylaxis of IE which have been recently published by the British Society for Antimicrobial Chemotherapy (Gould *et al.*, 2006).

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