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The Effectiveness of an Elastomeric Module Dispenser in Cross-Infection Control

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Orthodontic patients and staff members are exposed to transmission of infectious agents through direct contact (for example, with infected blood), indirect contact (from injury with contaminated instruments or sharps), and aerosols. The means of entry may be through inhalation, ingestion, contact with mucous membranes, or breaks in the skin.1

Although orthodontists may feel they are less exposed than other dentists to needle sticks, injuries from archwires and ligatures are far from uncommon.2,3 The preponderance of orthodontic patients are adolescents, who are considered less likely than adults to be carriers of infection. With the increasing number of adult patients seeking treatment, however, this assumption is no longer valid.2-4

The main objective of cross-infection control is the elimination or reduction of the number of microbes exchanged between individuals.5 Since many carriers of infectious diseases are unaware of or unwilling to reveal their status, clinicians should consider every patient a potential carrier and adopt universal precautions.6-8

A 1977 study found that only 6% of California orthodontists used ADA-approved sterilization procedures.9 Clinicians frequently used cold sterilization rather than autoclaving because of concerns about corrosion and damage of instruments. Jones and colleagues found, however, that test pliers had adequate resistance to a combination of regular clinical use and steam autoclaving.10 The use of dry-heat and chemiclave sterilization increased markedly in the late 1980s,3 and measures have improved further in recent years, although there is little up-to-date literature to back up that observation.11 A more recent study by Hunter found sterilization procedures and storage of orthodontic pliers and instruments to be satisfactory.12

Metal and elastomeric ligatures are potential agents in the transmission of infectious diseases. Mulick recommended single-use dispensing of elastomeric materials to eliminate contact of canes or sticks with contaminated hands.13 Schneeweiss described a method of cutting elastomeric modules into smaller sections and covering them with clear tubing, which could then be cold-sterilized.14 More recently, dispensers have been introduced onto the market, but the effectiveness of such dispensers in controlling cross-infection has yet to be fully evaluated.

The aim of this study was to determine, both qualitatively and quantitatively, the effectiveness of a new elastomeric module dispenser in reducing bacterial contamination, as compared with the existing method of storing and dispensing elastomeric modules on canes.

MATERIALS AND METHODS

The Alastik System dispenser Fig. 1 holds four refillable cartridges, with built-in blades against which elastic chain or modules (in units of six) can be cut one-handed. The base can be mounted on the wall or the work surface.

This dispenser was compared with elastomeric modules on canes, which were returned to their chairside drawers until they were used up. Silver modules were placed in the same drawers as controls, along with the routinely used clear modules. Operators were told to use only the clear modules during the experimental period.

A pilot study tested the elastomeric materials on five occasions: immediately after unpacking, before the clinical session, and after one day, one week, and one month. Four control and four experimental samples were tested at each time interval.

The results of the pilot study led to a number of modifications. None of the materials showed any contamination after unpacking or prior to use, and the contaminants present after one month were mainly gram-positive and -negative rods, which are aerobic spore bearers present in the environment (such as dust). Therefore, for the main study, it was decided to restrict testing to days 1 and 10 after clinical use.

Dispensers were mounted in each of four operatories, holding a total of 16 cartridges. Samples were taken by cutting 3cm lengths from each cartridge. The control samples were complete canes, with all modules attached. Two samples were taken randomly from each of eight operatories. Thus, a total of 16 samples from each method were compared on each occasion. The same number of postgraduate students used the materials in each operatory every day.

Samples were taken aseptically and placed in universal containers of sterile nutrient broth. The containers were labeled, closed tightly, vortex-mixed, then incubated at 37°C for 24 hours to allow microbial growth. The containers were removed, and a series of 1-in-10 dilutions were prepared from each.

Aliquots from each dilution were spread over the surfaces of blood agar (for total count) or Mitis-Salivarius agar (MSA) plates and incubated at 37°C for 24 hours (Fig. 2). The resulting colonies were counted. Each colony was then gram-stained and examined under the microscope (Fig. 3). Gram-positive (Gr+) cocci were tested for catalase production; those giving a positive reaction were designated as staphylococci, while those giving a negative result were considered to be streptococci.

The presence of streptococci (taken as an indication of contamination with saliva) was determined, therefore, based on four criteria:

- 1. Growth on a medium selective for streptococci – in this case, MSA.
- 2. Gram-positive result after gram-staining.
- 3. Appearance of cocci.
- 4. Absence of catalase.

Because neither of the groups followed a normal distribution pattern, non-parametric tests were used. The level of contamination of the samples was compared within each group at both time intervals, and then between the two groups at both intervals, using the Mann-Whitney U-test.

Results

At day 1, only two control samples were uncontaminated (Table 1). The level of contamination ranged from 1.1 X 10^8 colony forming units (cfu)/ml to a maximum of 1.3 X 10^11 cfu/ml. A variety of bacteria were isolated, with streptococci in 12 of the 16 samples, staphylococci in eight, and Gr+ rods in two.

By contrast, only four of the 16 test (dispenser) samples were contaminated at day 1 (Table 2). These showed contamination levels ranging from 6.7 X 10^7 cfu/ml to 4.3 X 10^11 cfu/ml. Streptococci were isolated in only two of the samples, compared with 12 in the control group. Staphylococci were present in all four samples, and Gr+ rods in only one.

At day 10, 15 of the 16 control samples were contaminated (Table 3). The level of contamination varied from 3.7 X 10^8 cfu/ml to 1.7 X 10^11 cfu/ml. Streptococci were isolated in 10 of the 16 samples, staphylococci in seven, and Gr+ rods in four.

The number of contaminated dispenser samples increased from four at day 1 to 11 at day 10 (Table 4). However, the range of contamination levels was lower than in the control group–2.2 X 10^7 cfu/ml to 3.2 X 10^10 cfu/ml. Streptococci were isolated in only one sample, staphylococci in five samples, and Gr+ rods in four samples.

There was a significant difference ($p = .0018$) in the levels of contamination of control group samples between day 1 and day 10 (Table 5). The same comparison for the dispenser samples produced a slightly significant difference ($p = .0221$). When the control samples were compared with the test samples, the difference was highly significant for both time intervals ($p = .0006$).

Discussion

A relatively high number of the control samples showed contamination at both intervals, and there was a significant increase in contamination between days 1 and 10. The finding that the microorganisms were mainly streptococci (22 of 29 contaminated samples) and staphylococci (15 of 29 contaminated samples) emphasizes the importance of careful handling of elastomeric materials. It is likely that streptococci were present as a result of salivary contamination from one patient before the remainder of the cane was returned to the drawer. Staphylococci were probably derived from the skin of staff members. Although the department strictly requires new gloves for each patient, it appears there may have been occasions between patients or at the beginning and end of treatment sessions when this gloving regimen may not have been followed.

The dispenser samples showed a lower level of contamination in general, although the level still increased between days 1 and 10. Isolated microorganisms were mainly staphylococci (nine of 15 contaminated samples) and Gr+ rods (five of 15 contaminated samples). The high incidence of staphylococci again suggests handling at some stage during the test period. Gr+ rods suggest that the contamination may have been of atmospheric origin, which is not surprising since the dispensers were installed on work surfaces and hence were exposed to the atmosphere and to dust.

Although the sample size in this study was small, the overall findings support the recommendation of Mulick regarding single-use dispensing.13 Whether this involves the new Alastik dispensers or sterile single-use packs is up to the individual orthodontist. The only disadvantage of the dispenser mentioned by the participants in this study was that it was difficult to cut off short lengths of elastomeric modules.

The Alastik dispenser proved to be efficient in limiting cross-infection through single-use dispensing, although it did not offer protection against handling and environmental factors, such as dust.

We offer the following recommendations:

- 1. Elastomeric materials should be handled only with surgical gloves.

- 2. Partially used canes should not be returned to the general stock of elastomeric modules.
- 3. A strict single-use dispensing policy is the ideal situation. □

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FIGURES

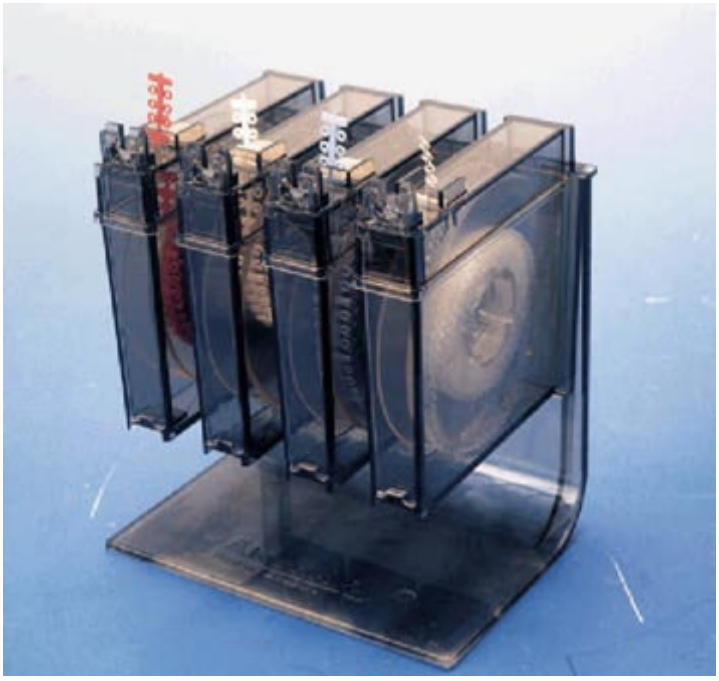

Fig. 1 Alastik System dispenser.

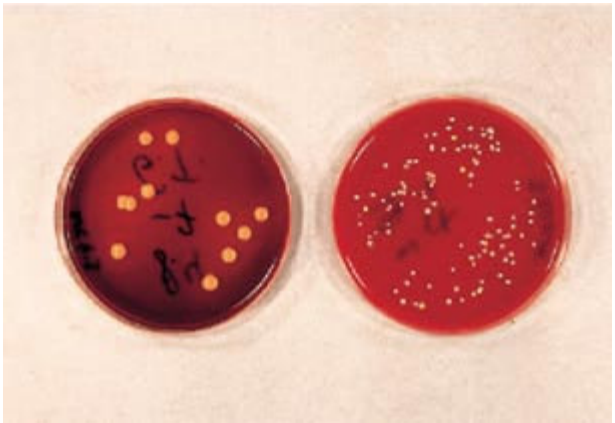

Fig. 2 Growth of streptococci on MSA (right) and blood agar (left).

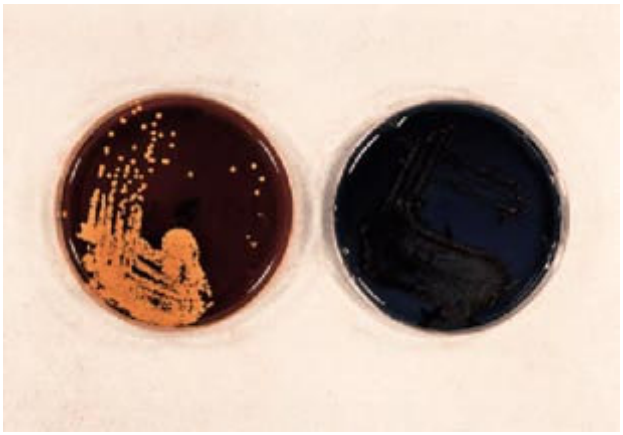

Fig. 3 Plates of gram-positive cocci at different concentrations.

TABLES

TABLE 1
CONTAMINATION OF CONTROL SAMPLES AT DAY 1 (TEST A)

Sample No.	cfu/ml × 10^6	Catalase Test	MSA Growth	Identification
1	2,667	–	++	strep
2	6,593	–	++	strep
3	0	NA	–	–
4	29,537	–	+	Gr+ rods, staph
5	107	–	++	strep
6	21,362	–	+	strep, staph
7	134,250	–	+	Gr– rods, strep
8	325	–	++	strep
9	1,980	–	+	strep, staph
10	23,178	–	+	strep, staph
11	3,495	+	+	strep, staph
12	0	NA	–	–
13	1,073	–	++	strep, Gr+ diplococci
14	6,620	+	–	strep, staph
15	6,198	–	+	strep, staph
16	238	+	–	Gr+ rods, staph

Table. 1

TABLE 2
CONTAMINATION OF DISPENSER SAMPLES AT DAY 1 (TEST A)

Sample No.	cfu/ml × 10^6	Catalase Test	MSA Growth	Identification
1	0	NA	–	–
2	0	NA	–	–
3	0	NA	–	–
4	0	NA	–	–
5	0	NA	–	–
6	0	NA	–	–
7	0	NA	–	–
8	101	+	–	staph, few Gr+ diplococci
9	5,550	+	++	staph, few strep
10	0	NA	–	–
11	433,500	+	–	Gr+ rods, staph
12	0	NA	–	–
13	67	+	+	staph, strep
14	0	NA	–	–
15	0	NA	–	–
16	0	NA	–	–

Table. 2

TABLE 3
CONTAMINATION OF CONTROL SAMPLES AT DAY 10 (TEST B)

Sample No.	cfu/ml × 10^6	Catalase Test	MSA Growth	Identification
1	30,908	+	++	staph, strep
2	29,776	+	++	staph, strep
3	77,875	+	++	staph, strep
4	97,000	–	+	Gr+ rods, strep
5	0	NA	–	–
6	367	NA	–	Gr+ rods
7	168,000	–	++	strep
8	39,175	NA	–	Gr+ rods
9	28,337	+	+	staph, strep
10	11,678	+	++	staph, strep
11	3827	NA	–	Gr- rods
12	48,700	–	++	strep
13	140,000	+	+	staph, strep
14	11,581	NA	–	Gr– rods
15	65,550	+	++	staph, strep
16	92,966	–	+	Gr+ rods, Gr+ cocci

Table. 3

TABLE 4
CONTAMINATION OF DISPENSER SAMPLES AT DAY 10 (TEST B)

Sample No.	cfu/ml × 10^6	Catalase Test	MSA Growth	Identification
1	401	+	–	staph
2	4,188	+	+	staph, few strep
3	5,176	+	–	staph
4	0	NA	–	–
5	0	NA	–	–
6	5,400	NA	–	Gr+ rods
7	6,995	+	–	staph
8	62	–	+	Gr+ cocci
9	22	NA	–	Gr+ rods
10	12,572	+	–	staph
11	31,530	NA	–	Gr+ rods
12	0	NA	–	–
13	0	NA	–	–
14	0	NA	–	–
15	132	–	+	Gr+ cocci
16	28,000	NA	–	Gr+ rods

Table. 4

TABLE 5
"P" VALUES FOR DIFFERENT TEST COMBINATIONS

Comparison*	Total Samples	U	p
C(A) vs. C(B)	32	45.0	0.0018
D(A) vs. D(B)	32	72.0	0.0221
C(A) vs. D(A)	32	41.0	0.0006
C(B) vs. D(B)	32	37.5	0.0006

*C = control; D = dispenser; (A) = test A (Day 1); (B) = test B (Day 10)

Table. 5

REFERENCES

1 Miller, C.H. and Cottone, J.A.: The basic principles of infectious diseases as related to dental practice, Dent. Clin. N. Am. 37:1-20, 1993.

2 Cash, R.G.: Sterilization and disinfection procedures: A survey of Georgia orthodontists, J. Clin. Orthod. 22:22-27, 1988.

3 Cash, R.G.: Trends in the sterilization and disinfection procedures in orthodontic offices, Am. J. Orthod. 98:292-299, 1990.

4 Evans, R.: Acceptance of recommended cross infection procedures by orthodontists in the United Kingdom, Br. J. Orthod. 16:189-194, 1989.

5 Molinari, J.A.: Practical infection control for the 1990s: Applying science to government regulations, J. Am. Dent. Assoc. 125:1189-1197, 1994.

6 Shovelton, D.S.: The prevention of cross-infection in dentistry, Br. Dent. J. 153:260-264, 1982.

7 British Dental Association: Guide to Blood-Borne Viruses and the Control of Cross Infection in Dentistry, British Dental Association, London, 1996.

8 British Dental Association: The control of cross infection in dentistry, Advice Sheet A12, British Dental Association, London, 1996.

9 Matlack, R.E.: Instrument sterilization in orthodontic offices, Angle Orthod. 49:205-211, 1979.

10 Jones, M.; Pizarro, K.; and Blunden, R.: The effect of routine steam autoclaving on orthodontic pliers, Eur. J. Orthod. 15:281-290, 1993.

11 Starnbach, H. and Biddle, P.: A pragmatic approach to asepsis in the orthodontic office, Angle Orthod. 50:63-65, 1980.

12 Hunter, L.M.: Cross infection control in the orthodontic environment, master?s dissertation, University of London, 1994.

13 Mulick, J.F.: Upgrading sterilization in the orthodontic practice, Am. J. Orthod. 89:346-351, 1986.

14 Schneeweiss, D.M.: Avoiding cross-contamination of elastomeric ligatures, J. Clin. Orthod. 20:538-539, 1993.

FOOTNOTES

Alastik System: Trademark of 3M Unitek, 2724 S. Peck Road, Monrovia, CA 91016.