Clinical trial of gingival retraction cords

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Statement of problem. A wide spectrum of different gingival retraction cords is used, while the relative clinical efficacy of these cords remains undocumented.
Purpose. This study aimed to determine whether clinicians were able to identify differences in clinical performance among 3 types of gingival retraction cords.
Methods and material. Dental students and faculty members ranked pairs or series of cords according to 6 criteria for clinical performance, with a blind experimental study design. Cords differed in consistency (knitted or twined) and impregnation (8% dl-epinephrine HCl, 0.5 mg/in or 25% aluminum sulfate, 0.5 mg/in).
Results. Knitted cords were ranked better than twined cords (P=.03). Cords containing epinephrine performed no better clinically than aluminum sulfate cords (P>.05).
Conclusion. Clinicians were unable to detect any clinical advantages of using epinephrine impregnated gingival retraction cords compared with aluminum sulfate cords. (J Prosthet Dent 1999;81:258-61.)

CLINICAL IMPLICATIONS

This study suggests that gingival retraction cords containing epinephrine may not be better than cord containing aluminum sulfate. Dentists should carefully weigh the limited clinical benefit versus the potential adverse effects of using gingival retraction cords that contain epinephrine.

According to a 1985 survey, 95% of North American dentists routinely used gingival retraction cords.[1] There are approximately 125 gingival retraction cords in various shapes, sizes and medications available on the US market,[2] with an additional number of types distributed solely on the European markets. The shear number of commercial products documents the lack of critical evaluation for the clinical efficacy of gingival retraction cords.

In 1994, a new series of knitted and twined gingival retraction cords (Gingi-Pak, Camarillo, Calif.) was introduced that was impregnated with dl-epinephrine or aluminum sulfate. Gingival retraction cords were initially introduced commercially in the United States. Before retraction cords were introduced in Europe, the manufacturer forwarded several samples of the cords to the Dental Faculty in Oslo, Norway, for clinical evaluation. At this stage, the new retraction cords were unknown to teachers and students, because of the lack of advertising in Europe. This enabled a comparative trial of the clinical outcomes for different retraction cords in a blinded experimental design.

The purpose of this study was to determine whether dentists and dental students were able to identify differences in clinical performance among the 3 types of gingival retraction cords, with different consistencies and impregnation medicaments.

MATERIAL AND METHODS

Experimental gingival retraction cords were colored green (knitted, dl-epinephrine), white (twined, dl-epinephrine), and blue (knitted, aluminum sulfate) (Table I). Three sizes were available for each cord: small, medium, and thick. A total of 9 retraction cords were available for evaluation.

Faculty members with various clinical experience and senior dental students participated in the experiment. Participants and auxiliary personnel assisting the clinicians were unaware of the association between retraction cord color and impregnation medicament. Gingival retraction cord comparisons were made by senior dental students during routine patient treatment at the Dental Faculty in Oslo, Norway. In clinical situations when more than 1 full crown abutment was prepared, the student was instructed to select pairs of, or if more than 2 abutments were available, all 3 experimental cords with similar diameter sizes for comparison. One gingival retraction cord was used for each abutment, with a random placement distribution. Cords were inserted in the gingival crevice with use of a plastic instrument or a blunt periodontal probe, and left for 10 minutes before taking the impression. The retraction cord was not immersed in any solutions or medicaments before insertion.

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Table I. Types of retraction gingival retraction cords evaluated. All cords produced by Gingi-Pak

Sort	Impregnation medicament	Color	Name	Producer name
Knitted	Aluminum-sulfate, 25%, 0.5 mg/in	Blue	Z-twist	Gingi-Aid
Knitted	dl-epinephrine HCl, 8%, 0.5 mg/in	Green	Z-twist	Gingi-Pak
Twined	dl-epinephrine HCl, 8%, 0.5 mg/in	White	Soft-twist	Gingi-Pak

Table II. Ranking of green (knitted, dl-epinephrine) versus white (twined, dl-epinephrine) gingival retraction cords (n = 16)

	Best green	No difference	Best white	Total	P
Packing easiness	13	0	5	18	ns (.1)
Fraying of cord	15	0	3	18	.008
Hemostasis	12	0	3	15	.03
Widening of sulcus	12	0	3	15	.03
Bleeding at removal	12	0	3	15	.03
Dry sulcus	12	0	3	15	.03

P-values based on binomial tests with test proportion = .5, ns = $P>.05$.

Six criteria were formulated to evaluate the clinical performance of retraction cords:

1. How easily was cord packed in a gingival sulcus?
2. Did the cord fray during placement?
3. How rapidly did hemostasis occur?
4. How much did the gingival sulcus dilate?
5. Was bleeding evident after removal of cords?
6. Did the gingival sulcus remain dry after removal of cord?

After removal of gingival retraction cords, clinical performance was ranked by the clinician, for example, white versus green, white versus blue, and green versus blue cord, for each of the 6 evaluation criteria. Thus, evaluations were not based on specific descriptive criteria with ordinal or categorical levels, but by simple ranking.

Participants were instructed not to use experimental gingival retraction cords for a patient with a cardiovascular disorder, diabetes, hyperthyroidism, or hypertension. In these clinical situations, an appropriate retraction cord was recommended for those specific purposes.

In addition, faculty members received 9 unmarked bottles with different gingival retraction cords for evaluation over 4 months. The faculty members (dentists) were informed that cords should be used without further impregnation with other medicaments, and that 1 cord contained 0.5 mg/in racemic epinephrine. Other procedures such as wetting/nonwetting, time, removal procedure, and so forth, were at the discretion of the dentist. The dentists ranked the 3 cord types according to the 6 clinical criteria after the 4 months trial period.

Tests for statistically significant differences between the ranking of the gingival retraction cords were based on nonparametric binomial tests with a test proportion of 0.5.

RESULTS

Thirty paired comparisons made by 22 dental students and the clinical impression of 8 faculty members constituted the basis of the data. A highly disordered ranking of the 3 cords was recorded by all dental students and reported by all faculty members. Statistically significant differences were revealed for 5 of the 6 evaluation criteria when the knitted and twined dl-epinephrine cords were compared pairwise (Table II). Preference for the knitted aluminum sulfate cord versus twined dl-epinephrine cord was noted, but the differences were not statistically significant ($P=.06$) (Table III). Table IV indicates that the clinicians could not detect any differences between knitted cords impregnated with aluminum sulfate and dl-epinephrine cords ($P>.05$).

DISCUSSION

There is no consensus cited in the literature regarding criteria for evaluation of the clinical efficacy with gingival retraction cords. This may partly explain the lack of American Dental Association, International Organization for Standardization, or other national standards for retraction cords. In a period of global harmonization, this appears peculiar because kilometers of retraction cords are used daily by thousands of dentists.[1]

Criteria of gingival health after 14 days[3] and 21 days[4] have been reported in animal studies. Crevicular fluid measurements have also been used in human beings[5] and in animal studies.[6] Other investigators have used histomorphologic techniques,[7,8] which are unsuitable in clinical practice. However, these studies focused on potential adverse gingival effects of the cord and not on the benefits of gingival retraction procedures. The only criteria for assessment of clinical performance of retraction cords identified in dental literature is the ability to stop bleeding[9] and indirect assessments of the sulcus dilation with impression materials.[10] However, data on the precision and accuracy of these measure-

Table III. Ranking of blue (knitted, aluminum-sulfate) versus white (twined, dl-epinephrine) gingival retraction cords (n = 19)

	Best blue	No difference	Best white	Total	P
Packing easiness	14	0	5	19	ns (.06)
Fraying of cord	14	0	5	19	ns (.06)
Hemostasis	9	1	6	16	ns
Widening of sulcus	9	1	6	16	ns
Bleeding at removal	9	1	6	16	ns
Dry sulcus	9	1	6	16	ns

P-values based on binomial tests with test proportion = .5, ns = *P*>.05.

Table IV. Ranking of blue (knitted, aluminum-sulfate) versus green (knitted, dl-epinephrine) gingival retraction cords (n = 13)

	Best blue	No difference	Best green	Total	P
Packing easiness	3	7	3	13	ns
Fraying of cord	1	11	1	15	ns
Hemostasis	3	3	4	10	ns
Widening of sulcus	3	0	7	10	ns
Bleeding at removal	3	3	4	10	ns
Dry sulcus	3	0	7	10	ns

P-values based on binomial tests with test proportion = .5, ns = *P*>.05.

ments were not reported. Direct intraoral measurements with a miniature video camera has also been reported.[11] Although this method is an improvement, the need for advanced equipment, and technologic experience and skill, renders the method impractical.

Lack of criteria to describe clinical outcomes after use of gingival retraction cords makes conventional study designing difficult, if not impossible. It is difficult to imagine how it is possible to choose an appropriate outcome measure in this context and produce evidence of its reliability and validity of this measure. Moreover, even if 1 or 2 intermediate surrogate outcome measures were to be developed, it is doubtful that these would reflect clinical performance of cords and even dentists' preferences. Our study circumvents, in part, these problems by focusing on relative ranking instead of scoring according to an interval or ordinal scale, despite the inexact criteria. A problem with the use of such a qualitative research design is that potential differences of effects are not quantitative, thus, it becomes impossible to report how much better or worse the alternate cords are. Furthermore, the results are not transferable to other dentist or patient populations. On the other hand, as long as a study design is followed that minimizes selection, expectation, and observer bias, rankings can give important statistical implications.

Manipulation of gingival retraction cords to expose subgingival margins and/or ensure hemostasis is time-consuming and occasionally is accompanied by patient discomfort. Bleeding decreases gradually, and it is uncertain what advantages are gained by waiting a few minutes without insertion of retraction cords. There has been no consensus on how beneficial current medicated retraction cords are compared with other clinical procedures that facilitate impressions of subgingival areas. Alternate methods of gingival dilation are placement of rubber dam, electrosurgery, injection of anesthetics with epinephrine, unimpregnated retraction cords, retraction cords with metallic filaments, and former techniques such as the use of 2-0 silk (Deknetal).[11,12]

The selection of method and gingival retraction cords frequently depends on the clinical situation.[13] The extent of hemorrhage influences the preference for a specific retraction cord. In the student clinic in our study, hemorrhage due to inadvertent contact with soft tissues by rotating instruments occurred more often than in general practice. Therefore it was anticipated that the students would rank the epinephrine-containing gingival retraction cords as more efficient. Why this was not the case may be explained that in many cases gingival retraction cords were placed in sites with profuse hemorrhage in situations where it was impossible to obtain satisfactory conditions for impressions solely with the use of gingival retraction cords. Time may have also been a factor. Students require more time than dentists to make impressions. It has been shown that when using ferric sulfate, a narrowing of the gingival sulcus is relatively fast after removal of the cord.[11] It is unknown if this closure may be different for dl-epinephrine and aluminum sulfate retraction cords.

This study revealed that the consistency of gingival retraction cord, twined or knitted, seems to be more important than the medicament when related to preference. It is not surprising that the consistency of retraction cord has been associated with packing easiness and cord fraying. It is more difficult to explain why hemostasis, sulcus dilation, bleeding on removal, and dryness of sulci were rated better for knitted than

twined retraction cords (Table II). There are no data in the literature to substantiate that knitted cords in general are better than twined cord. Theoretically, better packing of the gingival retraction cord results in greater pressure against the tissue and a closer contact between medicaments of the cord and the wound. Another explanation is that a positive experience during cord insertion in respect of ease of manipulation may have influenced the subjective judgment for the remaining evaluation criteria.

Racemic epinephrine gingival retraction cords were not rated better than aluminum sulfate cord (Table IV), which supports previous findings by Weir and Williams.[9] These investigators used bleeding after 1 minute as an outcome criterion, but discovered no differences between cords with epinephrine and aluminum sulfate. Bowles et al[10] reported no differences in sulci widths when comparing epinephrine and alum cords in mongrel dogs. These authors inappropriately used the term *alum*, which is potassium aluminum sulfate ($AlK(SO_4)_2$), or aluminum ammonium sulfate ($AlNH_4(SO_4)_2$), to specify the cord medicament. However, the cord that was used in the study, Pascord (Pascal), actually contains aluminum sulfate ($Al(SO_4)_3$).

Aluminum sulfate causes hemostasis by a weak vasoconstrictor effect in addition to precipitation of tissue proteins with tissue contraction, inhibited transcapillary movements of plasma proteins, and subsequent arrest of capillary bleeding. The medicament is regarded as safe and devoid of systemic effects when used appropriately.[1,13,15] This is in contrast to epinephrine, which has a more pronounced vasoconstrictor effect with questionable clinical consequences.[1,14-16] There is agreement that a potential risk of adverse drug interactions exist because of systemic alpha and beta effects of epinephrine. This is especially present when the patient uses beta-blockers, antihypertensive medications, tricyclic antidepressants, or thyroid medications or in combination with halothane.[17]

CONCLUSIONS

Within the limits of this study, the following conclusions were drawn:

1. Numerous commercial products are available to the dental profession without details of clinical efficacy.

2. Criteria for describing the clinical performance of gingival retraction cords should be established.

3. Knitted gingival retraction cords were ranked better than twined cords, using the evaluation criteria in this study (P=.03).

4. Cords containing epinephrine performed clinically no better than aluminum sulfate cords, according to the evaluation criteria used in this study (P>.05).

5. Dentists should carefully consider the benefits and disadvantages of gingival retraction cords containing epinephrine in light of the potential risk of adverse effects and apparent lack of significant improved clinical performance.

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