

Review Article

Periodontal Dressing: A Review Article

Zahra Baghani¹ • Mahdi Kadkhodazadeh^{2*}

¹Assistant Professor, Shahid Beheshti University of Medical Sciences (International Branch), Tehran, Iran

²Associate Professor, Shahid Beheshti University of Medical Sciences, Tehran, Iran

*Corresponding Author; E-mail: kadkhodazadehmahdi@yahoo.com

Received: 9 July 2012; Accepted: 12 May 2013

J Dent Res Dent Clin Dent Prospect 2013;7(4):183-191 | <http://dx.doi.org/10.5681/joddd.2013.040>

This article is available from: <http://dentistry.tbzmed.ac.ir/joddd>

© 2013 The Authors; Tabriz University of Medical Sciences

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract

The purpose of this paper was to review the commercially available periodontal dressings, their physical and chemical properties, biocompatibility and therapeutic effects. Electronic search of scientific papers from 1956 to 2012 was carried out using PubMed, Scopus and Wiley InterScience search engines using the searched terms periodontal dressing, periodontal pack. Numerous *in vitro* and *in vivo* studies have evaluated various properties of periodontal dressings. Physical and chemical properties of dressings are directly related to their dimensional changes and adhesion properties. Their biocompatibility and therapeutic effect are among the other factors evaluated in the literature. Chlorhexidine is the most commonly used antibacterial agent in studies. In general, when comparing the advantages with the disadvantages, application of periodontal dressing seems to be beneficial. Numerous factors are involved in selection of an optimal dressing such as surgeon's intention, required time for the dressing to remain on the surgery site and its dimensional changes.

Key words: *Biocompatibility, Coe-Pak, cytotoxicity, periodontal dressing, therapeutic agent, wounds.*

Introduction

Periodontal dressings were first introduced by Dr. A.W Ward in 1923, who suggested the use of periodontal dressing following periodontal surgery. Periodontal dressings are now widely used for various purposes by periodontists, although some controversy exists regarding the necessity of their application following periodontal surgery.^{1,2}

In some cases use of periodontal dressing is really beneficial. Protecting the wound from mechanical trauma and stability of the surgical site during the healing process are among the most important advantages of periodontal dressing application after surgery.^{3,4} Other advantages include: patient comfort during tissue healing after surgery, good adaptation

to underlying gingival and bone tissue, prevention of post-operative hemorrhage or infection, decreasing tooth hypersensitivity in the first hours after surgery, protecting the clot from the forces applied during speaking or chewing, preventing gingival detachment from the root surface,⁵ prevention of coronal flap displacement in apically repositioned flaps, providing additional support in free gingival grafts, and the last but not the least⁶ protection of denuded bone during the healing process and splinting of mobile teeth after surgery. In non-surgical procedures, use of periodontal dressing can be helpful in aggressive periodontitis patients.⁷

However, despite all the aforementioned advantages, indications for use of periodontal dressings are limited. The present study is a literature review to

assess the clinical application of periodontal dressings.

Method

This study was a structured literature review of articles published from 1956 to 2012.

PubMed (<http://www.ncbi.nlm.nih.gov/pubmed/>), Scopus (www.Scopus.com), and Wiley InterScience databases were used to search periodontal pack and periodontal dressing key words.

The search was limited to English language publications. Searching of key words limited to dental publications yielded a total of 116 results. By application of inclusion criteria the obtained results further reduced to 83 citations that formed the basis for this review (Figure 1).

Physical and Mechanical Properties

Only a limited number of studies have evaluated the physical and mechanical properties of periodontal dressings. These properties depend on the composition of periodontal dressing. To date, there is no exact and standardized reproducible technique to evaluate these properties. In addition, regarding new periodontal dressings, there is not sufficient research available.

Periodontal dressing material should be slow-setting to allow manipulation and to create a smooth surface causing no irritation, should be flexible enough to withstand distortion and displacement, should be adhesive and coherent without being bulky, and must have dimensional stability to prevent salivary leakage and plaque accumulation.^{11,12} Evaluation of physical properties is valuable because these properties can affect the material's clinical behavior, including its adaptation to the underlying tissues, which is directly related to dimensional changes and its adhesion properties to gingiva and tooth.¹³ Assessment of dimensional changes is also beneficial because improved adaptation (less dimensional changes) decreases the accumulation of plaque under the dressing.

Gjerdet evaluated the dimensional changes of three currently available periodontal dressings after setting (Coe-Pak, Ward's Wondrpak and Peripac).

All the dressings showed contraction during the first minutes after completion of their setting. This contraction culminated in Peripac at approximately 40 minutes and after about 2.5 hours the dressing exhibited expansion; however, the contraction continued at a slower pace in other products. Thus, greater dimensional changes that occur in Peripac

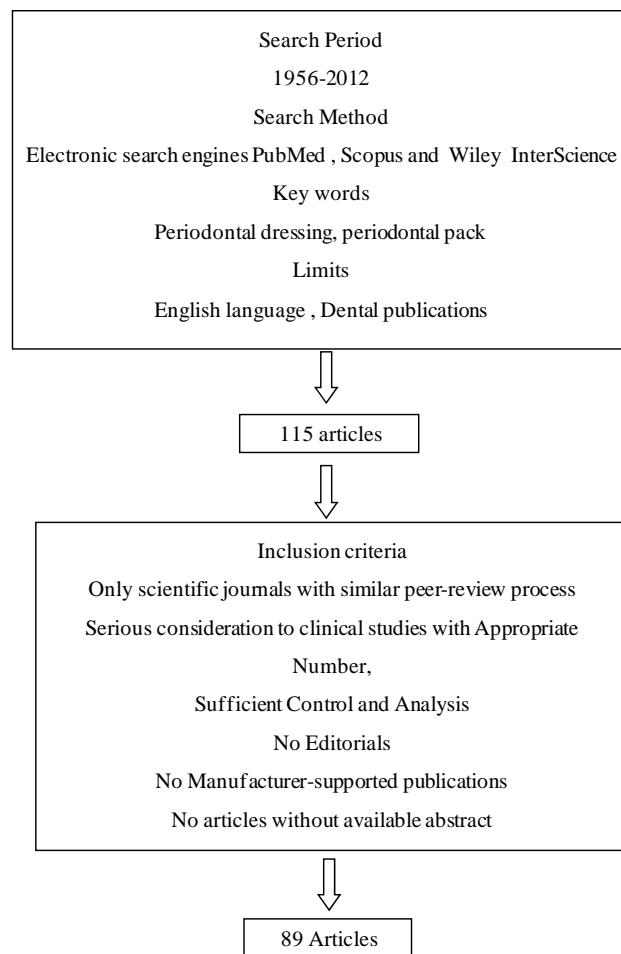


Figure 1. Literature search criteria.

can be harmful, leading to the distortion of surgical area.^{13,14}

The dimensional changes of Coe-pak, Ward's Wondrpak and Coe-Pak Hard and Fast Set periodontal dressings were evaluated in another study. As expected, contraction occurred in three materials after mixing but it was more significant in Ward's Wondrpak than in other products and continued for 24 hours.¹⁰

Another physical property evaluated in the study mentioned above was working and setting times. Working and setting times differ based on the composition of the dressing, and have been assessed in a limited number of studies.¹⁰ This study showed that Ward's Wondrpak had a significantly longer working time than the other two products, but no significant differences were found between the two Coe-Pak products. Setting time of Ward's Wondrpak under oral conditions was 24 minutes which was shown to be less than its working time under room conditions because both heat and moisture accelerate the reaction of ZOE.

Another physical property evaluated in studies was the adhesive rate of periodontal dressing to both gingiva and tooth. This property is especially important considering its role in prevention of microbial penetration. Studies have used two methods to increase the retention of periodontal dressings.^{15,16}

The first method is by application of dressing into interdental spaces to physically increase retention. By doing so, a rigid material is formed around the teeth after the completion of setting. Different means have also been described in studies to enhance retention such as wire, dental floss, acrylic compound, copper band, tin foil, etc.¹⁶⁻¹⁸ However, these tools have been shown to result in weaknesses, leading to the failure of the dressing instead of fortifying it. The retention by splint and stent is like the other devices used. Ideally, the dressing should be sufficiently retentive without the need for additional devices.^{19,20}

Different investigators have evaluated the adhesion properties of periodontal dressing by tensile and shear strength assessment.

Goldman and Cohen (1973) emphasized the need for a rigid and secure periodontal dressing with good adhesive properties.¹² They pointed out that this property would be achieved by adding polyacrylic acid and cyanoacrylate to the dressing material composition.²¹

Some studies have introduced new periodontal dressings like quaternary aluminum borate cement, suggesting that this material is worthy of investigation as a potential dressing material after the assessment of its tensile and shear strengths.²² Several researchers have used cyanoacrylate without suturing and have protected the wound from bacterial invasion.²³

In a comparative study, adhesive strength of various dressings to tissue (Coe-Pak Hard and Fast Set, Coe-Pak, and Ward's Wondrpak) was evaluated. In Ward's Wondrpak, shear and tensile adhesive bond strength to enamel was significantly less than the other product. In another study, adhesive properties of different dressings to enamel were evaluated (Coe-Pak, Peripac and Peripac Improved) and the three materials were found to have poor adhesive properties; however, Coe-Pak showed higher adhesive properties.⁹

Clinical Studies

Surgical area is covered with periodontal dressing for 3-14 days following periodontal surgery whenever necessary. It has been reported that the dressing accelerates the healing process, but a general consensus has not been reached on the necessity of ap-

plication of periodontal dressing on periodontal wounds. In a study, it was concluded that dressing per se can cause little damage to the normal periodontium, but in the long term, inflammation increases because of plaque accumulation under the dressing.²⁴

Assessment of plaque indexes after the application of dressing, apart from the surgical technique, revealed no significant differences between the test and the control groups.^{18,25,26}

Less plaque accumulation was observed when a light-cured periodontal dressing (Barricaid) was used, but no differences were found in clinical indexes.²⁷ Barricaid has been used in specific surgical and orthodontic procedures as well.^{28,29}

Another study evaluated clinical indexes after reversed bevel flap and found no significant differences in gingival fluid assessment among groups. However, the situation was reversed for gingival index assessment. On day 7, the undressed area showed more bleeding and sensitivity.¹

It seems regarding the differences in the method of clinical studies evaluation of the definite effect of periodontal dressings on the clinical indexes is not possible. Overall, there were no statistically significant differences in clinical indexes.

The effect of periodontal dressing on pain and the amount of analgesics taken by the patient is another factor that has been evaluated in the literature. In a study on the amount of analgesics taken by the patients, apart from the surgical technique, no statistically significant differences were detected in this respect between the dressing and non-dressing groups;³⁰ however, no other study has confirmed this result.³¹ Haugan et al compared Peripac with another commercially available dressing and reported that patients in the Peripac group showed significantly more pain, swelling, and inflammation,³² but no significant differences were detected in this respect in some other studies.³⁰

In another study on pain severity after gingivectomy, two periodontal dressings (Coe-Pak, Ward's Wondrpak) and different local anesthetic agents were compared. They showed that the local anesthetic combination of lidocaine-adrenalin (1:80,000) results in a higher mean post-operative pain experience after gingivectomy. Eugenol present in Wondrpak is responsible for less pain experience reported in this group due to its analgesic properties.

Haugan et al (1973) evaluated three periodontal dressings (Coe-Pak, Peripac, Ward's Wondrpak) in terms of pain, swelling, bleeding and use of analgesics in patients. These criteria were higher in Peripac

group, but no statistically significant differences were reported in another clinical study. Greater pain experience in the test group (with dressing) seems to be due to plaque accumulation under periodontal dressing and subsequent microbial invasion. As a result, reduction of microbial contamination can lead to wound healing and less pain.³³

In addition, better wound healing has been reported after using chlorhexidine in periodontal dressings.³⁴ However, Peripac had no antibacterial effect on salivary bacteria after setting.³⁵ Clinically visible plaque accumulations under the dressing has been reported by numerous researchers.^{36,37} The present inflammatory reaction can be explained by the presence of microorganisms, and physical and chemical properties of dressing are important as well.³⁵

Biocompatibility of Periodontal Dressings

A wide range of materials are used in dentistry that can cause allergic reactions in the oral cavity, although due to the presence of saliva and the vascularization of the oral mucosa, prevalence of allergic reactions in the oral cavity is less than that on the skin. Contact stomatitis as the result of application of periodontal dressing has been frequently reported in the literature.³⁸⁻⁴¹ Some *in vitro* tests have been introduced to evaluate the cytotoxicity of dressings by cell media.⁴² Implantation tests have also been used to assess local cytotoxicity.⁴³⁻⁴⁵ Many cells from human and animals have been used to monitor the cytotoxicity of dressings (Figure 2).⁴⁶⁻⁴⁸

Therapeutic Effects of Periodontal Dressings

Previously, periodontal dressings used to be applied to cause gingival shrinkage in cases where surgery was medically or psychologically inadvisable. Also, Orban (1943) described a technique of chemo-

surgery by using paraformaldehyde in a dressing.⁶⁰

Thus, the therapeutic effects of substances used in the composition of dressings after periodontal surgery has been the aim of numerous investigations. These materials are classified into two categories:

1. Agents with effects on oral bacteria
2. Agents with effects on periodontal tissues

In this regard, several agents have been added to the composition of periodontal dressings such as: tetracycline, zinc bacitracin, non-eugenol phenol derivatives, chlorothymol, oil of bergamot and chlorhexidine.⁶¹⁻⁶⁵

Steroids and Dilantin were also added to facilitate and accelerate tissue healing. It is important to note that chemical inactivation of the materials added may occur during the process.^{66,67}

In some limited research studies, surgical side effects, like root hypersensitivity, were also improved by adding some agents. Besides, new materials such as cyanoacrylate have been introduced as a substitute for periodontal dressing.⁶⁸

Evaluation of Microorganisms and Antibacterial Properties

The results of these studies are summarized in Figure 3.

Other Properties

Addition of other agents to periodontal dressing with different properties was also evaluated by some researchers. Of these materials we may name two synthetic pyrimidine compounds (MS-430, MS-818) that have been added to Coe-Pak. These ingredients can accelerate angiogenesis. The effect of MS-818 on the formation of tubule-like structures was higher. The solubility of MS-818 was less than MS-430 in the medium and the MS-818 reinforced the effect of

Figure 2. Studies assessing periodontal dressing cytotoxicity.

1. Haugen et al (1979): Under laboratory conditions fresh samples of Coe-Pak and Wondrpak cause more hemolysis than another product and the cytotoxicity of Coe-Pak increases with time.⁴⁹
2. Haugen et al (1978): By an *in vitro* cell culture technique suggested that the solubility of the leachable toxic substances in cell culture medium is an important factor responsible for various behaviors of dressings.⁵⁰
3. Alpar et al (1999): By using cell culture medium, Barricaid was introduced as a cyto-compatible dressing, where human gingival fibroblasts, 3T3 mouse fibroblasts and human osteoblast-like cells (HOB1) were used.⁵¹
4. Su et al (1993): By using scanning electron microscopy and L-929 cell media assessed the cytotoxicity of some periodontal dressings. They showed that all the materials had an insignificant toxic effect on L-929 cell lines and Sne-Pack and Coe-Pak dressings were smoother than ZOE.²⁸
5. Smeecken et al, (1992) in an animal study, suggested that the products that contain eugenol trigger greater inflammatory reactions, although this increase was not significant in other studies.⁵²
6. Haugan et al (1978) introduced Wondrpak as the most irritating product, followed by Coe-Pak and Peripac.⁵³
7. Nezwek et al (1980) and Wennberg et al, (1982) in their *in vitro* studies, investigated tissue reactions to some periodontal dressings. They reported that the greatest inflammatory reaction was caused by Wondrpak. Also, Wennberg et al showed that when the contact period increased to 3 days, Peripac showed a more severe tissue reaction than Wondrpak.^{54,55}
8. Baer (1961), Haugen (1979) and Satio (2008) in their studies showed that periodontal dressings can cause greater inflammatory infiltration on the bone and the inflammatory reaction is greater when the dressing is directly placed on the bone compared to the time when it is placed on the periosteum.^{52,56-58}
9. Petelin et al (2003) revealed less inflammatory reaction by histological analysis among new products and Myzotect-Tincture had the highest cytotoxicity for fibroblasts but in beagle dogs Reso-Pac was found to be the most suitable dressing.⁵⁹

Figure 3. Microorganisms evaluation and antibacterial properties of periodontal dressings

1. In some in vitro studies (1962, 1968, 1975, 1977), antibacterial properties of periodontal dressings against bacterial plaque have been reported to be inconsistent.⁶⁹⁻⁷²
2. Heaney et al (1972) took a bacterial sample from the areas under two periodontal dressings. They revealed that the most frequent microorganisms under Coe-Pak were gram-negative rods, although the incidence of yeasts was higher under ZOE dressing.⁷³
3. Coppes et al, (1967) in comparison of microorganism types between eugenol and non-eugenol dressings, revealed the frequency of *Bacteroides melaninogenica* to be higher under eugenol-free dressings.⁷⁴
4. Volozhin et al (2004) showed that the frequency of aggressive microorganisms in periodontal pockets of patients with generalized chronic periodontitis reduced when the periodontal dressing consisting of collagen and *Lactobacillus casei* 37 cell suspension was used.⁷⁵
5. Haugen et al (1978) revealed that the tested periodontal dressings (Wondrpak, Coe-Pak and Peripac) had antibacterial effects on salivary microorganisms.³⁵
6. Pluss (1975) showed that significantly less plaque formed under periodontal packs with chlorhexidine powder than under control packs.⁶⁵
7. The effect of chlorhexidine supplementation on periodontal dressing was assessed by Othman et al (1989). They showed that the durability of chlorhexidine efficacy in periodontal dressing depends on its concentration.⁷⁶
8. In some studies it was revealed that biguanides like PHMB (polyhexamethylene biguanide) have better physical properties than chlorhexidine. PHMB has extensive antibacterial activity against a wide range of gram-positive bacteria and fungi and causes destabilization of the bacterial cell membrane.⁷⁷⁻⁷⁹ Also, Thorstensen showed that addition of water-soluble antibacterial agent to Barricaid may alter its physical properties.⁸⁰
9. In evaluation of healing process, O'Neil et al (1975) revealed that tested periodontal dressings (Coe-Pak, Cross-Pak, Peripac, Septo-Pak, ZOE) had no antibacterial properties, and ZOE had minimal antifungal properties.⁷⁰
10. Sustained-release varnish of chlorhexidine as an inhibitor of plaque accumulation under periodontal dressings was evaluated by Zyskind et al (1992). The application of chlorhexidine varnish under tested dressings caused less plaque accumulation compared to the control group.⁸¹

VEGF on the endothelial cells.⁸²

Review of Different Periodontal Dressings

Periodontal dressing composition has changed during the years; at present, these materials are divided into the following three categories:

1. Those containing zinc oxide and eugenol
2. Those containing zinc oxide without eugenol
3. Those containing neither zinc oxide nor eugenol

Periodontal Dressings Containing Zinc Oxide and Eugenol

Ward's Wondrpak

This product was marketed in the form of powder and liquid (the product is no longer produced commercially). The liquid contains eugenol, rose oil or peanut and resin. The powder contains zinc oxide, powdered resin and tannic acid. The powder and liquid are mixed on paper pad, and then the prepared paste is used immediately or is wrapped in aluminum foil to be frozen for one week.⁶

Periodontal Dressings Containing Zinc Oxide without Eugenol

Coe-Pak

The reaction between a metallic oxide and fatty acids is the basis for Coe-Pak (*De Trey/Denstply, Konstanz, Germany*). It is supplied in two tubes, the contents of which are mixed immediately before use. One tube contains zinc oxide, oil, a gum, and loricidin. The other tube contains liquid coconut fatty acids thickened with colophony resin and chlorothymol.⁸

PeriPac

PeriPac (GC America Inc., Chicago, USA) is supplied as one paste, and is composed of calcium sulfate, zinc sulfate, zinc oxide, polymethylmethacrylate, dimethoxytetra-ethylene glycol, ascorbic acid, flavor and iron-oxide pigment. To use this material, a small quantity should be taken from the jar with a dry sterile spatula and deposited on a paper napkin.

Medications in powder form can be added if desired. Hardening of PeriPac begins as soon as it comes into contact with water and is complete in about 20 minutes. Application of the dressing should not take more than 2-3 minutes. A correctly applied dressing remains with no change for 8-10 days.

One advantage of this material is to treat necrotic gingivitis. In such cases an antibiotic powder should be added by rolling it into the material on the paper napkin. The dressing keeps the medicament in contact with the ulcerated area. Protection of non-specific lesions or sutured margins, fixation of dressing medicaments to cervical area and temporary re-basing of immediate dentures in periodontal surgery are among other indications of this paste.⁸³

Vocopac

Vocopac (Voco, Cuxhaven, Germany) is supplied as two pastes (base and catalyst) that cure chemically. This material remains elastic in the patient's mouth and is not brittle. Vocopac contains purified colophony, zinc oxide, zinc acetate, magnesium oxide, fatty acids, natural resin and natural oils and colorant e127. Its use is contraindicated in patients who are allergic to these ingredients and contact with the bone should be avoided as well. Slight discoloration of synthetic materials may also occur.⁸⁴

SeptoPack

This product (*Septodont, saint-maur-des-fosses cedex, France*) is supplied in 60-g jars. The composition of this product includes amyl acetate, dibutyl phthalate (10-25%), methyl polymethacrylate, zinc oxide (20-50%) and zinc sulfate (2.5-10%). This product is a self-setting plastic paste containing fibers in its mass. Working time in the mouth is only 2 or 3 minutes following application. Setting time is about 30 minutes.

This product contains dibutyl phthalate which is very toxic to aquatic organisms. This product may harm the eyes in an unborn child and has possible risk of impaired fertility. Therefore, protective clothing, gloves and respiratory equipment are mandatory.⁸⁵

Periocarea

This product (*Voco, Cuxhaven, Germany*) is supplied in two tubes (paste and gel). Equal amounts of paste and gel must be mixed on the mixing pad until the color becomes uniform. Setting time of this product is 45-60 seconds and the working time is 4-5 minutes.⁸⁶

Periodontal Dressings Containing neither Zinc Oxide nor Eugenol

This group includes cellulose-based periodontal dressings like Reso-pac and Mucotect.

Reso-pac

This product (*Hager & Werken Gm bH & Co. KG, Post fach, Germany*) is supplied as one hydrophilic paste and is ready for use without mixing. This dressing remains in place for up to 30 hours, even on bleeding wounds, because of its hydrophilic properties. Reso-pac swells up to a gel-like consistency after about 3 minutes.⁸⁷

Mucotect

This product (*Hager & Werken Gm bH & Co. KG, Germany*) is supplied in one tube and contains carboxymethyl cellulose, polyvinyl acetate, ethyl alcohol, vaseline and polyethylene oxide resin. Mucotect is a hydrophilic paste and adheres to the area for up to 30 hours. Due to its composition, it adheres very well to damp and even bleeding areas.⁸⁸

Barricaid

Barricaid (*Pupdent, watertown, USA*) is available in a syringe for direct placement. The syringe is also suitable for an alternate indirect technique. A visible light-curing unit is required for the setting of this dressing.

This product has a translucent character which provides superior esthetics. Barricaid is mainly composed of polyether dimethacrylate, silanized silica, accelerator, VLC photo-initiator and colorant.⁸⁹

Materials Compared with Periodontal Dressings in the Literature

Some studies have used different materials as dressing such as carboxymethyl cellulose, aluminum borate, Myzotect-Tincture and fittydent (denture adhesive cream to increase retention). Adhesion to soft tissue is the reason for their application for this purpose, and there is no brand name to label them as periodontal dressing. Cross-Pack is another material which has just been used in one article, and English literature search on this product yielded no results.

Conclusion

Physical properties, availability, biocompatibility and therapeutic effects of periodontal dressings were briefly discussed in this review article.

Use of periodontal dressings after surgery seems beneficial. But, it would be better to limit their application to specific cases; for example, their application is not necessary in undisplaced flaps where the flap returns to its previous position and gingival bleeding and root hypersensitivity are minimal.

Overall, when the advantages outweigh the disadvantages, application of periodontal dressing would be beneficial. Multiple factors are involved in selection of the dressing of choice, such as:

- Surgeon's aim of using periodontal dressing
- Required time for periodontal dressing to remain on the surgical area: long-term application of Coe-Pak may increase its cytotoxic effects. Ward's Wondrpak is more cytotoxic than other products and Barricaid is cytocompatible when its polymerization is complete. It seems that cellulose-based periodontal dressings lead to less inflammatory reactions and are probably more acceptable by the patient.
- Dimensional changes: All dressings have weak adhesive properties. Thus, plaque accumulates under them and decelerates the healing process. Based on the literature, Peripac and Ward's Wondrpak have the greatest dimensional changes, although the other dressings have not been thoroughly evaluated in this respect.

Choosing an optimal periodontal dressing is a difficult decision to make because they have to be compared under equal conditions.

In general, it seems that cellulose-based periodontal dressings can replace the traditional dressings. In

terms of therapeutic effects, the expected success is not always achievable by changing the physical properties of therapeutic agents.

References

- Greensmith AL, Wade AB. Dressing after reverse bevel flap procedures. *J Clin Periodontol* 1974;1:97-106.
- Harpenau LA. Periodontal dressings. In: Prichard JF, ed. *Advanced Periodontal Disease*, 2nd ed. W.B. Saunders Co: Philadelphia; 1972. p. 280.
- Ariaudo AA, Tyrrell HA. Repositioning and increasing the zone of attached gingiva. *J Periodontol* 1957;28:106-10.
- Prichard JF. Present state of the interdental denudation procedure. *J Periodontol* 1977;48:566-9.
- Wikesjo UM, Nilveus RE, Selvig KA. Significance of early healing events on periodontal repair: a review. *J Periodontol* 1992;63:158-65.
- Harpenan LA. Periodontal dressing. In: Hall WB, ed. *Critical Decisions in Periodontology*, 4th ed. Ontario: BC Decker; 2003. p. 280-1.
- Sigusch BW, Pfitzner A, Nietzsche T, Glockmann E. Periodontal dressing (Vocopac) influences outcomes in a two-step treatment procedure. *J Clin Periodontol* 2005;32:401-5.
- Klokkevold PR, Takei HH, Carranza FA. General principles of periodontal surgery. In: Newman MG, Takei HH, Klokkevold PR, Carranza FA, eds. *Carranza's Clinical Periodontology*, 11 ed. Saunders: St. Louis; 2011. p. 528.
- Watts TL, Combe EC. Rheological aspects of non-eugenol periodontal dressing materials. *J Oral Rehabil* 1982;9:291-300.
- Rubinoff CH, Greener EH, Robinson DJ. Physical properties of periodontal dressing materials. *J Oral Rehabil* 1986;13:575-86.
- Haugen E, Espevik S, Mjör IA. Methods for evaluation of working and setting times of periodontal dressings. *Acta Odontol Scand* 1979;37:309-15.
- Raben MP, Smulier H, Schalman SM, Kon S, Bloom AA. Healing of periodontal therapy. In: Goldman HM, Cohen DW, eds. *Periodontal Therapy*, 6th ed. St. Louis: C.V. Mosby Co; 1980. p. 646.
- Bhaskar SN, Frisch J, Margetis PM, Leonard F. Oral surgery—oral pathology conference No. 18, Walter Reed Army Medical Center. Application of a new chemical adhesive in periodontic and oral surgery. *Oral Surg Oral Med Oral Pathol* 1966;22:526-35.
- Gjerdet NR, Haugen E. Dimensional changes of periodontal dressings. *J Dent Res* 1977;56:1507-10.
- Addy M, Douglas WH. A chlorhexidine-containing methacrylic gel as a periodontal dressing. *J Periodontol* 1975;46:465-8.
- Hirschfeld AS, Wasserman BH. Retention of periodontal packs. *J Periodontol* 1958;29:199-204.
- Eslami A, Van Swol RL. Use of a copper band to enhance the retention of periodontal dressing on solitary teeth. *Int J Periodontics Restorative Dent* 1989;9:376-81.
- Glendinning DE. A method for retention of the periodontal pack. *J Periodontol* 1976;47:236-7.
- Ariaudo AA, Tyrrell HA. Repositioning and increasing the zone of attached gingiva. *J Periodontol* 1957;28:106-10.
- Watts TL, Combe EC. Periodontal dressing materials. *J Clin Periodontol* 1979;6:3-14.
- Trevor LP, Watts BW, Edward C, Comb E. Adhesion of periodontal dressing to enamel invitro. *J Clin Periodontol* 1980;7:62-5.
- Watts TL, Bertenshaw BW, Combe EC. Initial physical tests of aluminoborate cements in the context of periodontal dressing development. *J Oral Rehabil* 1983;10:393-8.
- Sachs HA, Farnoush A, Checchi L, Joseph CE. Current status of periodontal dressings. *J Periodontol* 1984;55:689-96.
- Heaney TG, Appleton J. The effect of periodontal dressings on the healthy periodontium. *J Clin Periodontol* 1976;3:66-76.
- Sodek J, Limeback HF. Comparison of the rates of synthesis, conversion, and maturation of type I and type III collagens in rat periodontal tissues. *J Biol Chem* 1979;254:10496-502.
- Addy M, Dolby AE. The use of chlorhexidine mouthwash compared with a periodontal dressing following the gingivectomy procedure. *J Clin Periodontol* 1976;3:59-65.
- Richard S, Caffesse RG, Smith BA. Light cured periodontal dressing: a clinical evaluation. *J Dent Res* 1989;68:1824
- Su R, Huang ZR, Zhang B. [The cytotoxicity of Sne-Pack periodontal dressing and scanning electron microscopic study]. *Shanghai Kou Qiang Yi Xue* 1993;2:80-3. [Abstract]
- Ferguson JW. The use of visible light cured periodontal dressing after surgical exposure of palatal canines. *Dent Update* 1992;19:380-2, 84.
- Checchi L, Trombelli L. Postoperative pain and discomfort with and without periodontal dressing in conjunction with 0.2% chlorhexidine mouthwash after apically positioned flap procedure. *J Periodontol* 1993;64:1238-42.
- Jorkjend L, Skoglund LA. Effect of non-eugenol- and eugenol-containing periodontal dressings on the incidence and severity of pain after periodontal soft tissue surgery. *J Clin Periodontol* 1990;17:341-4.
- Haugen E, Gjermo P. Clinical assessment of periodontal dressings. *J Clin Periodontol* 1978;5:50-8.
- Kidd EA, Wade AB. Penicillin control of swelling and pain after periodontal osseous surgery. *J Clin Periodontol* 1974;1:52-7.
- Asboe-Jorgensen V, Attstrom R, Lang NP, Loe H. Effect of a chlorhexidine dressing on the healing after periodontal surgery. *J Periodontol* 1974;45:13-7.
- Haugen E, Gjermo P, Orstavik D. Some antibacterial properties of periodontal dressings. *J Clin Periodontol* 1977;4:62-8.
- Persson G, Thilander H. Experimental studies of surgical packs. 2. Tissue reaction to various packs. *Odontol Tidskr* 1968;76:157-62.
- Pluss EM, Engelberger PR, Rateitschak KH. Effect of chlorhexidine on dental plaque formation under periodontal pack. *J Clin Periodontol* 1975;2:136-42.
- Koch G, Magnusson B, Nyquist G. Contact allergy to medicaments and materials used in dentistry. II. Sensitivity to eugenol and colophony. *Odontol Revy* 1971;22:275-89.
- Koch G, Magnusson B, Nobreus N, Nyquist G, Soderholm G. Contact allergy to medicaments and materials used in dentistry. IV. Sensitizing effect of eugenol-colophony in surgical dressing. *Odontol Revy* 1973;24:109-14.
- Poulsom RC. An anaphylactoid reaction to periodontal surgical dressing: report of case. *J Am Dent Assoc* 1974;89:895-6.
- Lysell L. Contact allergy to rosin in a periodontal dressing. A case report. *J Oral Med* 1976;31:24-5.
- Spangberg L, Langeland K. Biologic effects of dental materials. 1. Toxicity of root canal filling materials on HeLa cells in vitro. *Oral Surg Oral Med Oral Pathol* 1973;35:402-14.

43. Boyd JB, Mitchell DF. Reaction of subcutaneous connective tissue of rats to implanted dental cements. *J Prosth Dent* 1961;11: 174-83.
44. Roydhouse RH. Implant testing of polymerizing materials. *J Biomed Mater Res* 1968;2:265-77.
45. Haugen E, Mjor IA. Subcutaneous implants for assessments of dental materials with emphasis on periodontal dressings. *J Periodontal Res* 1978;13:262-9.
46. Eber RM, Shuler CF, Buchanan W, Beck FM, Horton JE. Effect of periodontal dressings on human gingiva fibroblasts in vitro. *J Periodontol* 1989;60:429-34.
47. Kreth KK, Zimmermann ER, Collings CK. Effect of periodontal dressings on tissue culture cells. *J Periodontol* 1966;37:48-53.
48. Rivera-Hidalgo F, Wyan VJ, Horton JE. Effect of soluble extracts from periodontal dressings on human granulocytic leukocytes in vitro. *J Periodontol* 1977;48:267-72.
49. Haugen E, Espevik S, Mjor IA. Adhesive properties of periodontal dressings--an in vitro study. *J Periodontal Res* 1979;14:487-91.
50. Haugen E, Hensten-Petersen A. In vitro cytotoxicity of periodontal dressings. *J Dent Res* 1978;57:495-9.
51. Alpar B, Gunay H, Geurtsen W, Leyhausen G. Cytocompatibility of periodontal dressing materials in fibroblast and primary human osteoblast-like cultures. *Clin Oral Investig* 1999;3:41-8.
52. Smeekens JP, Maltha JC, Renggli HH. Histological evaluation of surgically treated oral tissues after application of a photocuring periodontal dressing material. An animal study. *J Clin Periodontol* 1992;19:641-5.
53. Haugen E, Hensten-Petersen A. The sensitizing potential of periodontal dressings. *J Dent Res* 1978;57:950-3.
54. Nezwak RA, Caffesse RG, Bergenholtz A, Nasjleti CE. Connective tissue response to periodontal dressing. *J Periodontol* 1980;51:521-9.
55. Wennberg A, Mjor IA. Short term implantation studies of periodontal dressings. *J Periodontal Res* 1983;18:306-10.
56. Baer PN, Wertheimer FW. A histologic study of the effects of several periodontal dressing on periosteal—covered and denuded bone. *J Dent Res* 1961;40:858.
57. Saito CT, Bernabe PF, Okamoto T, Murata SS, Hamata MM, Sundefeld ML. Evaluation of tissue response to periodontal dressings: histological study in tooth sockets of rats. *J Appl Oral Sci* 2008;16:219-25.
58. Haugen E, Mjor IA. Bone tissue reactions to periodontal dressings. *J Periodontal Res* 1979;14:76-85.
59. Petelin M, Pavlica Z, Batista A, Stiblar-Martincic D, Skaleric U. Effects of periodontal dressings on fibroblasts and gingival wound healing in dogs. *Acta Vet Hung* 2004;52:33-46.
60. Weinreb MM, Shapiro S. A clinical and histological investigation of the pressure pack method in periodontia. *J Periodontol* 1964; 35:167-72.
61. Fraleigh CM. An assessment of topical terramycin in post-gingivectomy pack. *J Periodontol* 1956;27:201-8.
62. Baer PN, Goldman HM, Scigliano J. Studies on a bacitracin periodontal dressing. *Oral Surg Oral Med Oral Pathol* 1958;11:712-20.
63. Baer PN, Sumner CF, 3rd, Scigliano J. Studies on a hydrogenated fat-zinc bacitracin periodontal dressing. *Oral Surg Oral Med Oral Pathol* 1960;13:494-8.
64. Schultz JG. Method of using a fabric lining material under periodontal packs. *J Periodontol* 1962;33:172-5.
65. Pluss E.M, Engelbryger PR, Rateitschak K.H. Effect of chlorhexidine on dental plaque formation under periodontal pack. *J Clin Periodontol* 1975;2:136-42.
66. Saad LJ, Swenson HM. Corticosteroid and periodontal packs. *J Periodontol* 1965;36:407-12.
67. Swann WP, Swenson HM, Shafer WG. Effects of dilantin on the repair of gingival wounds. *J Periodontol* 1975;46:302-5.
68. Binnie WH, Forrest JO. A study of tissue response to cyanoacrylate adhesive in periodontal surgery. *J Periodontol* 1974;45:619-25.
69. Colman G. A study of some antimicrobial agents used in oral surgery. *Br Dent J* 1962;113:22-8.
70. O'Neil TC. Antibacterial properties of periodontal dressings. *J Periodontol* 1975;46:469.
71. Pihlstrom BL, Thorn HL, Folke LE. The effect of periodontal dressing on supragingival microorganisms. *J Periodontol* 1977;48:440-5.
72. Persson G, Thilander H. Experimental studies of surgical packs. 1. In vitro experiments on antimicrobial effect. *Odontol Tidskr* 1968;76:147-55.
73. Heaney TG, Melville TH, Oliver WM. The effect of two dressings on the flora of periodontal surgical wounds. *Oral Surg Oral Med Oral Pathol* 1972;33:146-51.
74. Coppes L, Grevers A, Hoogendijk JL. A comparison between a eugenol and a non-eugenol periodontal dressing. *Ned Tijdschr Tandheelkd* 1967;74:43-9.
75. Volozhin AI, Il'in VK, Maksimovskii Iu M, Sidorenko AB, Istranov LP, Tsarev VN, et al. [Development and use of periodontal dressing of collagen and Lactobacillus casei 37 cell suspension in combined treatment of periodontal disease of inflammatory origin (a microbiological study)]. *Stomatologiya (Mosk)* 2004;83:6-8.
76. Othman S, Haugen E, Gjermo P. The effect of chlorhexidine supplementation in a periodontal dressing. *Acta Odontol Scand* 1989;47:361-6.
77. Woodcock PM. Biguanides as industrial biocides. In: Payne KR, ed. *Critical Reports on Applied Chemistry: Industrial Biocides*, Vol. 23. New York: John Wiley & Sons; 1988. p. 52-67.
78. Broxton P, Woodcock PM, Gilbet P. A study of the antibacterial activity of some polyhexamethylenebiguanides towards *Escherichia coli* ATCC 8739. *J Appl Bacteriol* 1983;54:345-53.
79. Ikeda T, Ledwith A, Bamford CH, Hann RA. Interaction of a polymeric biguanide biocide with phospholipid membranes. *Biochim Biophys Acta* 1984;769:57-66.
80. Thorstensen AE, Duguid R, Lloyd CH. The effects of adding chlorhexidine and polyhexamethylene bisguanide to a light-cured periodontal dressing material. *J Oral Rehabil* 1996;23:729-32.
81. Zyskind D, Steinberg D, Friedman M, Bernimoulin JP. Inhibition of plaque accumulation under periodontal dressing by sustained-release varnish of chlorhexidine. *Clin Prev Dent* 1992;14:29-33.
82. Imai K, Awaya A, Ueda A, Nakamura M. Effects of test periodontal dressing materials on tubulous structure formation in vitro. *Journal of Oral Tissue Engineering* 2004;1:50-8.
83. Peripac [Internet]. Germany: DENTSPLY, Inc.; 1999. Available at: http://www.dentsply.es/DFU/eng/Peripac_eng.pdf
84. VOCO pac [Internet]. Germany: VOCO GmbH, Inc.; [Updated 2010 Oct 10]. Available at: http://www.voco.com/au/products/_products/voco_pac/index.html
85. Septo-Pack [Internet]. France: Septodont, Inc.; 2004[update 2006 Nov 21]. Available at: <http://www.septodont.co.uk/products/septo-pack>

86. PerioCare [Internet]. U.S.A: PULPDENT, Inc.; [date unknown]. Available at: <http://www.pulpdent.com/products/view/133>
87. Reso-pac the first ready-to-use periodontal dressing [Internet]. Germany: Hager Worldwide, Inc.; [date unknown]. Available at: <http://www.hagerwerken.de/dentalproducts/n21550/ResoPac>
88. Mucotect [Internet]. Germany: Moehrle-Dental, Inc.; [date unknown]. Available at: <http://www.moehrle-dental.de/chemie/obturalr/was-ist-obturalr/>
89. Barricaid [Internet]. U.S.A.: DENTSPLY, Inc.; [date unknown]. Available at: http://www.caulk.com/assets/pdfs/products/Barriciad_English.pdf