position of the mandibular incisors. Because of the limited value to patients in many cases, having final radiographs taken will remain a controversial and individually determined choice.

INTERPRETATION OF RADIOGRAPHS

No matter whether the image is a panoramic radiograph, a cephalometric radiograph, a full-mouth survey, or a CBCT scan, the orthodontist cannot interpret just one aspect of the image. The clinician must fully understand the images and recognize what is normal and what is not. The interpretation should systematically consider the teeth, apical tissues, periodontium, and adjacent structures. All findings should be documented in the patient's chart, with notes indicating whether the abnormalities require immediate treatment, referral, or observation. For children, specific notes should be included about the stage of dental development, whereas for adults, the status of the periodontium is of particular concern. Before any progress radiographs are obtained, the clinician should carefully examine and interpret any images already in the patient's record. This helps in detecting additional or different information, which would justify the use of progress radiographs.

The interpretation of CBCT scans can be technically demanding for orthodontists, but it's widely believed that their interpretation is legally the responsibility of the practitioner who ordered them. The orthodontist is not required to perform this interpretation personally but can refer the images to a qualified oral radiologist. Difficulty in interpretation is most often seen for large field-of-view scans, which are subject to misinterpretation, leading to inaccurate and possibly inappropriate treatment decisions. These are most appropriately referred to an oral radiologist, especially if they include regions of the head and neck that most dentists are not trained to assess.

Small field-of-view scans offer the advantages of reducing the effective dose and shortening the interpretation of the scan. Care must be taken to ensure the entire area of interest is included in the smaller field-of-view scan.

Radiographic reports should be concise, precise, written in the present tense, and free of vague or redundant statements or words. They should be written in standard language, follow a structured format, and be consistent in their content. If further investigations are recommended based on the findings, the rationale for their use should be clearly stated.

Clinical Significance

When obtaining radiographs, it's important to keep in mind the benefit to the patient and whether it outweighs any risk to his or her health. Each orthodontic patient must be evaluated individually to determine the benefits he or she will reap from imaging, although clinicians should be aware that sometimes the benefit is not appreciated until the radiograph is taken and interpreted. The guidelines that orthodontists should follow with respect to prescribing radiographic studies include the following:

1. Perform the clinical examination before prescribing any radiographs.
2. Only prescribe radiographs that are needed and justified.
3. Select the most appropriate radiographic examination.
4. Consider CBCT imaging only when it's likely to benefit to the patient or change the outcome of treatment compared to 2-dimensional radiographs.
5. Be aware that failing to take necessary, appropriate radiographs based on concern over irradiation exposure to the patient can be considered negligence.
6. Fully interpret all radiographic images either personally or with an appropriate referral to an oral radiologist.

Abdelkarim A, Jerrold L: Clinical considerations and potential liability associated with the use of ionizing radiation in orthodontics. *Am J Orthod Dentofacial Orthop* 154:15-25, 2018

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MINIMALLY INVASIVE DENTISTRY

Resin infiltration for proximal enamel lesions

BACKGROUND

Although the numbers of carious lesions in children and young adults are declining, caries remains a significant oral health problem. In particular, the treatment of proximal early caries lesions is complicated by difficulty detecting the lesions early and the need to destroy significant amounts of tooth structure to achieve conventional restorations. The use of a tissue-preserving approach to arrest and control incipient lesions has been suggested. Resin infiltration treatment has proved able to seal the micro porosities of incipient caries lesions and block the diffusion pathway to cariogenic agents using

materials specifically designed for this application. Although considerable clinical evidence supports the technique, the scientific literature has not produced guidelines for clinicians to use in selecting patients, accurately applying the method, and formulating the overall treatment plan. A literature review was done to develop guidelines based on the science and the principles of performing resin infiltration treatment. These guidelines were designed to address all aspects of the management of proximal enamel lesions using resin infiltration.

METHODS

Two certified specialists in restorative dentistry selected the most frequent clinical questions encountered in treating proximal caries. Electronic databases were searched to assess the best available scientific evidence for each question. The search included the Medline database (PubMed), the Cochrane Controlled Clinical Trials Register, and Scopus covering the period from January 1980 to March 2017. After evaluation, 17 in vivo studies, 6 systematic reviews, and 1 economic evaluation were selected. Twenty-six percent of the studies were rated of high quality, 3 studies were low quality, and 3 were rejected after quality assessment. The guidelines that were developed took into account the patient's potential to improve or maintain quality of life and covered patients of all ages.

RESULTS

The results were evaluated based on the key clinical questions that had been posed. Guidelines were suggested on the basis of the resin infiltration technique's ability to arrest proximal caries lesions.

Efficacy of resin infiltration

Resin infiltration is a micro-invasive technique in which less than 30 μm of demineralized and sound enamel is removed. It can hamper or arrest proximal caries lesions, but careful case selection and appropriate supervision are critical to the outcome. Within a follow-up interval of 12 to 4 years, resin infiltration has proved highly efficacious in reducing or halting the progression of non-cavitated proximal caries. Supervision of the lesion and retreatment window should be limited to a period of 6 to 12 months. Further research is needed to determine if an extended observation time is warranted.

Resin infiltration can significantly postpone the need for an initial invasive intervention and avoid the cycle of treatment and retreatment that is responsible for the destruction of tooth structure. It's especially helpful in addressing proximal surfaces, which tend to require relatively large amounts of healthy hard tissues to be removed in conventional restorations. The cost-effectiveness of resin infiltration varies depending on the tooth and surface involved.

Case selection

The cases most suitable for resin infiltration involve lesions detected radiographically as radiolucencies in the inner half of the enamel or in the outer third of the dentin. These active lesions show no signs of cavitation. Further research is needed to facilitate predictable, effective clinical decisions in this regard.

No evidence indicates that resin infiltration can inhibit lesion progression in patients at high risk for caries. In these cases, the success rate is often lower, and longer observation periods are needed. The technique is well-accepted by children and young adults, but the clinician should always select the simplest intervention that provides the least discomfort. Resin infiltration can be effective for treating primary teeth with initial approximal caries, but the application protocol for these teeth versus permanent teeth remains to be defined.

Technique and material considerations

The technique only requires 24 minutes for application by clinicians with no previous experience with resin infiltration. Duration of treatment can be impacted by the location of the site to be treated, patient factors such as separation anxiety, and the clinician's experience. Clinicians do not require special training to apply resin infiltration, but experience is valuable. Training can help dentists understand the philosophy and pitfalls associated with the technique.

An infiltration time longer than 120 seconds in primary teeth does not provide deeper or more complete penetration or a better outcome. Porosity volume is critical. The technique can be combined with conventional resin restorations in more complex restorations, but more research is needed to determine if this approach is advantageous. Re-infiltration is possible if necessary but is not proven to increase effectiveness. Before any re-infiltration is done, the reason for failure should be investigated and any patient considerations addressed. If the lesion is not properly infiltrated, caries progression may be facilitated. The thickness of the eroded etched surface becomes significantly reduced after etching with hydrochloric acid compared to phosphoric acid. This makes the surface more vulnerable to a new acid attack. Fluoridation is not considered useful for an infiltrated lesion, but should be continued for the rest of the dentition. It may increase the ability of resin infiltration to hamper lesion growth. Areas on proximal surfaces, which are less accessible

Clinical Significance

The guidelines suggested should be able to help dentists and other oral care professionals in applying resin infiltration techniques to halt or reduce proximal caries lesions. They can serve as a resource for making decisions and determining the most appropriate treatment plan for each specific patient. Resin infiltration offers a micro-invasive method for dealing with non-cavitated enamel caries lesions. Research is still needed for many aspects of this technique, especially with respect to patient selection, combined approaches, and the availability of improved infiltration materials.

to patients, and mineral islands on the lesion surface may be susceptible to further demineralization of the infiltrated areas at the base of the lesion.

Adhesives may be useful as proximal lesion sealants. However, the application of dental adhesives requires 2 visits, whereas resin infiltration requires just 1. A bonding agent used before resin infiltration or resin sealant has not increased resin penetration depth.

Ideally, resin infiltration materials should be low-viscosity monomers that can both infiltrate caries lesions at depth and form a thick film to resist degradation outside the lesion. Lower viscosity infiltrants may be better for deeper infiltration, but the viscosity of the monomer is inversely proportional to the oxygen inhibition of polymerizing monomers. New resin infiltrants should be tested with fillers that remain on the surface. This increases the resin's properties and allows residual resin to infiltrate the lesions' deeper layers. This synthesis appears to be perfect for infiltration.

Ntovas P, Rahiotis C: A clinical guideline for caries infiltration of proximal enamel lesions with resins. *Br Dent J* 225:299-304, 2018

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Remineralization induction

BACKGROUND

In dental remineralization, minerals are gathered from the surrounding environment into partially demineralized tooth structures to replace minerals that have been lost or create amorphous mineral precipitates in the intercrystal and interred spaces. This can be a natural process or one that is induced by various therapies. Fluoride-based treatments are well-known to induce remineralization and reduce dental caries. Some individuals cannot use fluoride products, however, and the effect of fluoride in reducing dental caries prevalence is plateauing at the population level. New approaches have been developed, most to augment existing fluoride therapies.

METHODS

The PubMed database was searched to identify published data and other sources. In addition, ClinicalTrials.gov and google.com were searched to obtain registered randomized controlled trials (RCTs). The evidence found in the search was analyzed and summarized to offer an up-to-date report on the evidence gathered for remineralization therapies. The primary new approaches identified involved compounds increasing mineral saturation, biofilm modifiers, herbal compounds, and self-assembling peptides.

RESULTS

Mineral Saturation Increasing Compounds

Fluoride

Fluoride (F) treatments remain the primary therapy for remineralizing caries lesions because of their clinical effectiveness in arresting caries lesions. The F is delivered via toothpastes, gels, mouth rinses, and varnishes. The effects are dose-related, with toothpastes with 5000-ppm F more efficacious for remineralizing root caries lesions than those with 1000- to 1500-ppm F. However, current evidence of a superior benefit for remineralizing enamel lesions for these higher-dose dentifrices remains elusive. Thus the higher concentrations of F should not be recommended indiscriminately for patients with active lesions. Other formulations have provided preventive effects on lesion formation but not necessarily an ability to remineralize lesions.

Some metals have been combined with F to enhance its antimicrobial effects. Among these are silver diamine F (SDF), silver nitrate, and stannous F. SDF therapy is highly effective for remineralizing coronal and root surface lesions. Silver nitrate has been suggested as an alternative in countries where SDF is unavailable. Stannous F has the potential to interfere with biofilm formation and alter demineralization/remineralization processes. Tin also offers acid resistance, but this could interfere with remineralization. Further evidence is required before these agents can be recommended.

Calcium and Phosphate-Based Systems

Casein phosphopeptide–amorphous calcium phosphate (CPP-ACP) is a stabilized system of calcium phosphate with significant remineralizing ability. However, studies have had short durations, conflicting results, and concentrated on fluorescence changes in lesions after orthodontics as an outcome, making them unacceptable as remineralization measures. F has also been added to CPP-ACP (CPP-ACPF) to increase its remineralization efficacy. However, there is insufficient evidence that adding F to CPP-ACP increases its efficacy. Functionalized β-tricalcium phosphate (fTCP) is designed to protect calcium from prematurely interacting with ionic F and can act as a low-dose delivery system. No recent data indicating its remineralizing ability are available, but clinical studies are ongoing.

Bioactive glass containing calcium sodium phosphosilicate (CSPS) and sodium trimetaphosphate (TMP) are also suggested as agents to induce remineralization. However, as with the other calcium phosphate–based systems, none of these agents have been