AAE Position Statement on Vital Pulp Therapy

About This Document

The following statement was prepared by the AAE Special Committee on Vital Pulp Therapy.

The guidance in this statement is not intended to substitute for a clinician's independent judgment in light of the conditions and needs of a specific patient.

Introduction

The American Association of Endodontists is dedicated to excellence in the art and science of endodontics and to the highest standards of patient care. The basis for endodontic treatment utilizes the best available evidence from scientific and clinical studies in concert with the accumulated clinical knowledge and judgment of the practitioner.

Vital pulp therapy (VPT) techniques are means of preserving the vitality and function of the dental pulp after injury resulting from trauma, caries, or restorative procedures. VPT procedures have traditionally included indirect or direct pulp capping, and partial or complete pulpotomy.[1]

For years, the focus of VPT was on the preservation of the radicular pulp in immature adult teeth, so as to assure completion of root formation (apexogenesis). Today, the focus of VPT is broader; practitioners may have treatment options to consider other than pulpectomy or root canal therapy (RCT) in mature teeth, including teeth previously thought to have irreversibly inflamed pulps.

This position statement addresses diagnostic considerations, caries management, pulp management, placement of biomaterials, and restoration. The intent of the authors is to consider vital pulp therapy from the perspective of the practice of specialty endodontics. However, this statement may be of use to any practitioner in assessing whether they have the appropriate expertise and armamentarium to perform VPT procedures in appropriately selected cases.

Diagnostic Considerations for VPT

A basic tenet for clinical dentistry is that treatment is recommended and performed after the formulation of a sound diagnosis. This has been considered of particular relevance when vital pulp therapy was to be considered.

The current AAE diagnostic terminology assigns a vital pulp to one of three categories: "normal," "reversible pulpitis" or "irreversible pulpitis" (which could be symptomatic or asymptomatic).[2]

Traditionally the designation of a pulpal diagnosis is based upon the clinician's consideration of a patient's pain history, and appropriate clinical testing to assess the status of the pulp including the application of cold stimulus and electric pulp testing. These tests would be best termed pulp sensibility tests, as definitive tests of pulp vitality, such as measures of pulp oxygen tension, are not currently available for clinical use.[3]

The primary provoked response to pulp sensibility testing, indicating more severe pulpal inflammation is described as an exaggerated and "lingering" response to cold stimulus, with the underlying pathomechanisms of c-fiber sensitization and inflammation-induced hypersensitivity.[4,5]

In addition to such pulp sensibility testing, percussion tests may infer pulpal conditions from the presence of symptomatic apical periodontitis; with the presence of percussion pain, i.e., mechanical allodynia, the pulp is considered to be in an irreversibly inflamed state.[6]

Diagnostic quality intraoral radiographs of the suspected teeth are recommended to evaluate accurately the extent of root formation and other concomitant hard tissue changes.[7]

Historically, there has been a widespread belief that, even in aggregate, clinical test results are not well correlated with histologic descriptions of the pulpal status.[8,9]

The viewpoint that VPT is an option only for cases where testing results were consistent with "reversible pulpitis" has recently been challenged.[10,11,12] Based on clinical, biological and theoretical considerations, the irreversibility of the pulpal disease has come into question. Histologic evidence of the progression of pulpitis suggests that there is no discrete boundary that would render a pulp beyond repair.[11] Rather, pulpitis may be interpreted as a temporally and spatially graded disease, with some suggesting the following terms for gradation: "initial", "mild", "moderate" and "severe pulpitis."[10,12]

Research is underway to understand the role of inflammatory mediators that better indicate pulpal status.[13,14] For example, point of care analysis could use dentinal fluid[15] (without pulp exposure) or pulp blood[16] (with pulp exposure) to determine markers associated with tissue degradation, such as matrix metalloproteinase-9.

In the absence of clinically available molecular biologic tests, direct observation of the pulp (use of a surgical microscope is recommended) can give relevant information for determining the suitability of the case for VPT. First, a misdiagnosed necrotic pulp can be accurately identified. Secondly, direct observation of pulp tissue during and after achieving hemostasis offers additional diagnostic information about the condition of the pulpal tissue.[17] Utilizing direct visualization of the pulp, it appears that even symptomatic pulps may be candidates for VPT.[18]

Caries Management

Complete caries removal is essential to eliminate infected tissues and visualize pulp tissue conditions under magnification when pulpal exposures occur.[19,20] Residual caries compromises necessary observations of pulpal inflammation levels and areas of potential necrosis. Accordingly, predictable management of vital pulp tissue should not be performed without complete removal of both demineralized enamel and infected dentin.

Hard or firm dentin and dentin below white spot enamel lesions is infected by bacteria in both active and arrested lesions. Specifically, histobacteriological studies have consistently shown the presence of chronic inflammatory cell infiltrates and subclinical pulp inflammation where carious tissues are retained, thus potentially compromising pulp vitality.[21,22] Additionally, adhesion of bonding resins to sound dentin has shown higher micro-tensile bond strengths compared to caries-affected dentin.[23,24]

The use of caries detectors or laser fluorescence during caries removal can be helpful adjuncts to assist the clinician in removing diseased tissues, particularly when close to the pulp cavity.[25,26,27] Therefore, the clinician can focus on complete removal of demineralized infected dentin, rather than avoiding pulp exposure, to improve the chances of pulpal repair.[28] Detectors can create an objective standard for all clinicians during caries removal without reliance exclusively on clinical philosophy or subjective judgement.[29]

Use of Sodium Hypochlorite

Sodium hypochlorite is an antimicrobial solution that provides hemostasis, disinfection of the dentin-pulp interface, biofilm removal, chemical removal of the blood clot and fibrin, and clearance of dentinal chips along with damaged cells at the mechanical exposure site.[30]

Examination of pulp tissues after exposure with magnification is a critical step in pulp assessment. Hemorrhage must be controlled to allow clinical assessment of inflammatory levels and identify potential necrotic tissues that require removal before application of an appropriate biomaterial. Hemostasis for the pulp tissue is typically achieved by bathing the resected pulp tissue in sodium hypochlorite for 5 to 10 minutes, although recommended durations may vary, either via direct passive irrigation or on a sodium hypochlorite-soaked cotton pellet.[31,32,33,34,35,36,37,38,39,40,41,42,43,44,45]

Although several hemostatic options are available, sodium hypochlorite can be used safely in direct contact with pulp tissue at various concentrations, from dilute solutions to full bottle strength, without compromising pulp integrity.[30,46,47,48] Sodium hypochlorite has not been shown to adversely alter pulp cell recruitment, cytodifferentiation, and hard tissue deposition.[49] Sodium hypochlorite also eliminates composite staining, addressing an aesthetic concern.

Use of Contemporary Materials in VPT

Calcium silicate cements (CSC) have gained momentum for use in vital pulp therapy (VPT) procedures.[50,51] CSCs are a class of materials that include tricalcium silicates, dicalcium silicates, hydraulic calcium silicate cements, and "bioceramics." Clinical outcomes have demonstrated consistent success with these materials and mineral trioxide aggregate (MTA) is one of many tricalcium silicates that is widely used and the most extensively studied. When MTA and other CSCs are used for VPT procedures in permanent teeth with symptomatic or asymptomatic irreversible pulpitis, success rates range from 85-100% at 1-2 years.[26,35,38,42,45,52,53,54] However, it is noteworthy that calcium hydroxide, glass ionomer cements (GICs) and resin-based materials trail in clinical outcomes and demonstrate a lower range of success varying from 43%-92%.[42,55,56]

Immunomodulatory effects of the new generation of biomaterials provide an added and much needed benefit to their biocompatible, osteogenic and bioactive properties.[13,57,58,59,60,61,62,63,64,65,66,67] The formation of mineralized barriers using CSCs show improved quality over calcium hydroxide-based materials.[50,68,69,70]

Silicate materials also possess favorable physicochemical characteristics that include high alkalinity, intratubular mineralization, inhibition of biofilm formation, reduction of robust pro-inflammatory mediators and post-operative pain during dental pulp procedures.[57,58,63,70,71] The newer generations of CSCs do demonstrate improved setting times[72,73,74] including modified compositions that reduce tooth discoloration.[61,71,72,73,75] The choice of a biomaterial must therefore be made on existing evidence with considerations for patient centered outcomes, reliable mineralized tissue formation and continued pulp vitality.

Immediate Placement of Permanent Restorative Material

Restoration of the teeth is a critical step in endodontic procedures. Immediate restoration should be a part of the restorative treatment plan for a tooth receiving VPT.

Teeth undergoing VPT using CSCs as the primary sealing material and restored immediately with a long-term restoration have a high success rate.[19,41,76,77,78,79,80,81,82] Although studies have shown some success with delayed final restoration in the short to medium term[35,83], long-term assessments have demonstrated that a minimal time span[84] between placement of a foundational restoration[44,85] after vital pulp treatment is a strong predictor for successful outcomes.[32,33,34,36,42,43,51,52,86,87,88,89,90,91,92,93,94]

Indicated advantages of immediate restoration include benefits in the prevention of microleakage, protection of the biomaterial layer, reduction of post-operative sensitivity and thermal conductivity, and establishment of a foundation for cuspal coverage restoration should it be required. No negative impacts of restoring the teeth immediately have been indicated.

An appropriate waiting period is recommended prior to additional tooth preparation for definitive (cuspal coverage) restoration. A practitioner, using professional judgment and clinical expertise, should consider absence of signs and symptoms and susceptibility of the tooth to fracture to assess whether the tooth is ready for a definitive restoration after completion of VPT.

Summary

The primary goal of VPT procedures is the creation of optimal conditions for pulp tissue repair and preservation. The amount of pulp tissue removed or retained is dependent on tissue viability assessments based on access for visualization to evaluate hemorrhage control and clinical tissue appearance.[86]

A pretreatment diagnosis of irreversible pulpitis is not necessarily an indication for pulpectomy, as more conservative treatment could be considered.[35,43,44,95,96]

Procedural decisions for the amount of pulp tissue retention or removal should be based on operator assessments, clinical judgement, overall treatment plan, and the patient's general oral and systemic health status. Authors would encourage additional clinical trials to assess long-term outcomes of vital pulp therapy and the development of chairside techniques utilizing biomarkers to assess pulpal viability. A review of the endodontic diagnostic terminology used to classify the severity of pulpal disease is also warranted.

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