International journal Orofacial Sciences (IJOS)
E-ISSN: 0000-0000

Original Article,

Alkasite Restoratives: A New Era in Esthetic, Bioactive, and Bulk-Fill Dental Material

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Received: 23/10/2025
Revised: 02/11/2025
Accepted: 06/01/2026
Published: 01/03/2026

DOI:

10.32649/ijos.2026.0000

How to Cite:

Abstract: Metallic restorative materials such as gold and silver amalgam have demonstrated clinical success for decades due to their inherent antibacterial activity and favorable mechanical properties. However, their poor esthetics, particularly their metallic color, have limited their use in anterior teeth. This limitation prompted researchers to develop tooth-colored restorative materials, beginning with silicate cements and progressing to modern composite resins. Throughout this development, the primary focus was to produce a durable, esthetic restorative material. Despite achieving acceptable strength and appearance, resin-based composites were found to exhibit several drawbacks, including polymerization shrinkage, absence of antibacterial properties, and the release of free monomers that may irritate pulpal tissues. Moreover, these monomers can stimulate the activity of destructive enzymes such as matrix metalloproteinases (MMPs). Such shortcomings pose significant risks when composite materials are used in deep cavities near the pulp, underscoring the need for biocompatible, tooth-colored restorative alternatives. Most commercially available composites also lack remineralizing capabilities and require complex placement techniques. These factors increase the likelihood of bacterial microleakage at the tooth–composite interface, leading to secondary caries—one of the main causes of composite restoration failure. Consequently, the demand has increased for a restorative material that can serve as a practical alternative to amalgam, glass ionomer cement, and conventional composites. The ideal material would be cost-effective, capable of fluoride release, easy and quick to apply, and able to provide both mechanical strength and an acceptable aesthetic. The emergence of alkali restorative materials represents a new era in restorative dentistry. Alkasites are considered a subclass of composite resins and are designed as bulk-fill materials suitable for direct posterior restorations, offering enhanced biocompatibility and therapeutic ion release.

Keywords: Alkasite; cention-N; resin composite.

1.Introduction

Despite considerable advancements in restorative dentistry, methacrylate-based composite resins still present significant limitations. Their inherent polymerization shrinkage can result in marginal gaps at the restoration–tooth interface, promoting bacterial adhesion, biofilm accumulation, and, ultimately, secondary caries adjacent to composite restorations . Most commercially available composite materials lack remineralizing capabilities and typically require multi-step, technique-sensitive placement procedures. These factors collectively increase the likelihood of bacterial microleakage at the tooth–composite interface, contributing substantially to restoration failure due to secondary caries . As a result, clinicians have increasingly sought alternative restorative materials that combine esthetics, mechanical stability, ease of use, and biological benefits such as ion release. The ideal material would serve as a practical substitute for amalgam, glass ionomer cement, and resin composites while offering simplicity, affordability, and adequate strength. A new class of restorative materials, alkasites, has emerged to address these needs. Cention N (Ivoclar Vivadent; Schaan, Liechtenstein), the first representative of this category, is a bulk-fill, direct posterior restorative material considered a subgroup of composite resins, comparable in concept to compomers and ormocers . Alkasites incorporate an alkaline-reactive filler that releases acid-neutralizing ions. The term “alkasite” reflects this characteristic composition, while the name “Cention” is derived from the Latin “Centum” meaning one hundred, referring to its ability to release multiple beneficial ions . The release of calcium and fluoride ions from alkasite materials is believed to contribute to tooth remineralization and caries prevention. Calcium plays a central role in rebuilding demineralized enamel, whereas fluoride accelerates the remineralization process and enhances resistance to acid attack . Cention N can be activated either chemically or with light-curing, enabling simplified bulk-fill placement without the need for complex layering protocols .

Alkasite Restorative Materials

Alkasite materials constitute a novel subclass of ion-releasing, resin-based restorative systems. The term alkasiteoriginates from the material's intrinsic alkalizing capability, specifically its ability to release hydroxide ions (OH^-), which contribute to acid neutralization in the oral environment. Currently, Cention N is the only commercially available restorative material within this category. Developed by Ivoclar Vivadent (Schaan, Liechtenstein), the formulation of alkasite materials has undergone continuous refinement over recent years as part of ongoing material innovation .

2. Cention N: Characteristics and Clinical Concept

Cention N is an esthetic bulk-fill restorative material designed for direct placement. The term Cention is derived from the Latin word centum, meaning "one hundred" reflecting the material's ability to release multiple ions . Its formulation incorporates alkaline glass fillers that release calcium (Ca^{2+}), hydroxide (OH^-), and fluoride (F^-) ions. These ions are liberated particularly under acidic conditions, such as during biofilm activity, thereby supporting demineralization prevention and promoting remineralization of tooth structure. Cention N can be placed with or without an adhesive system, depending on cavity design. In retentive preparations, the material may be used without bonding agents, whereas in non-retentive cavities, an adhesive is recommended to enhance micromechanical retention .

3. Material Supply and Manipulation

Cention N is supplied as a two-component system consisting of powder and liquid, similar to conventional glass ionomer cement. The components are manually mixed on a paper pad using a plastic spatula, with a standardized powder-to-liquid ratio of one scoop to one drop, corresponding to a weight ratio of approximately .

4. Composition of Cention N

4.1 Powder Phase

The powder comprises inorganic silanated fillers and initiator components. Fillers include ytterbium trifluoride, barium aluminum silicate glass, calcium–barium–aluminum fluorosilicate glass, isofillers, and alkaline calcium fluorosilicate glass fillers. Particle sizes range from 0.1 to 35 μm. Except for ytterbium trifluoride, all fillers are surface-modified to enhance wettability and integration within the polymer matrix.8

4.2 Liquid Phase

The liquid contains the organic monomer matrix along with initiators and catalytic additives. Four methacrylate monomers constitute 21.6% of the final mixed material:

Urethane dimethacrylate (UDMA)
Aromatic–aliphatic UDMA
Polyethylene glycol 400 dimethacrylate (PEG-400 DMA)
Tricyclodecan-dimethanol dimethacrylate (DCP)

UDMA is hydrophobic and exhibits low water absorption; aromatic–aliphatic UDMA contributes stiffness and reduced discoloration; DCP, a low-viscosity difunctional monomer, facilitates hand mixing and enhances mechanical strength; and PEG-400 DMA improves flowability and the ability of the material to wet and adapt to the tooth substrate, owing to its hydrophilic nature [7, 9].

5. Setting Mechanisms

Cention N undergoes dual-curing through both chemical and light-activated polymerization.

5.1 Chemical (Self) Polymerization

Self-curing begins immediately upon mixing the powder and liquid. The reaction involves a redox system of thiocarbamide, copper salts, and hydroperoxide. Copper ions accelerate polymerization by alternately oxidizing hydroperoxide and reducing thiocarbamide . This initiator system offers superior color stability and storage resistance compared to traditional amine–peroxide systems. Thiocarbamide replaces amines to minimize discoloration, and hydroperoxide substitutes for benzoyl peroxide to improve heat stability .

5.2 Photo-Polymerization

Light curing, facilitated by Ivocerin, an acyl phosphine oxide photoinitiator and a Norrish Type I compound, enhances the speed of polymerization. Ivocerin, a dibenzoyl germanium derivative, requires only a single component to initiate radical formation . Cention N's dual-cure nature allows effective polymerization even in deeper bulk increments, unlike traditional composite resins, which show reduced curing depth with increasing opacity .

6. Ion Release Capability

Ion release occurs following water sorption, similar to compomers and giomers. The pH of the environment strongly influences ion liberation: acidic conditions enhance the release of fluoride, calcium, and hydroxide ions . Alkaline glass fillers comprise 24.6% of the final material weight and provide fluoride release comparable to glass ionomer cements (GICs). Studies have shown that Cention N releases more ions than Activa BioActive and can even form apatite on its surface, contributing to remineralization of adjacent dentin when used without adhesive .

7. Polymerization Shrinkage and Stress Relief

Marginal integrity is critical for preventing secondary caries. Polymerization shrinkage can lead to postoperative sensitivity, marginal discoloration, cracking, and microgap formation. Cention N minimizes shrinkage stress through its unique isofillers, which are partially silanated and function as stress-relieving components. During polymerization, the low elastic modulus (10 GPa) of the material and the spring-like behavior of the isofiller particles help dissipate stresses generated between the resin matrix and cavity walls. This enables safe bulk-fill placement with minimal risk of interfacial gaps .

Conclusions

Alkasite restorative materials, particularly Cention N, offer a promising alternative to conventional composites by combining ion release, reduced polymerization shrinkage, and bulk-fill capability. Their ability to release calcium, fluoride, and hydroxide ions supports remineralization and enhances protection against secondary caries. Overall, alkasite materials offer a practical, esthetic, and bioactive option for modern restorative dentistry.

Supplementary Materials:

No Supplementary Materials.

Author Contributions:

Author: methodology, writing—original draft preparation; methodology (sample collections and measurements); writing—review and editing. Author has read and agreed to the published version of the manuscript.

Funding:

Not applicable

Institutional Review Board Statement:

Not applicable.

Informed Consent Statement:

Not applicable.

Data Availability Statement:

Data available upon request.

Conflicts of Interest:

The authors declare no conflict of interest.

Acknowledgments:

Not applicable

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