Original Contributions

Potassium oxalate mouthrinse reduces dentinal hypersensitivity

A randomized controlled clinical study

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ABSTRACT

Background. Dentinal hypersensitivity is a prevalent oral condition that can be treated with in-office application of potassium oxalate (KO), which has US Food and Drug Administration 510(k) clearance. In this study, the authors assessed a KO mouthrinse for home use. The authors evaluated clinically meaningful improvement by analyzing the proportions of participants who responded to treatment.

Methods. In this multicenter, double-blind, parallel-group controlled study, the authors randomly assigned 375 participants with dentinal hypersensitivity to 1 of 2 mouthrinse groups: KO (189 participants) and placebo (186 participants). Participants used their assigned mouthrinses for 4 weeks. Each participant's success (defined as a $\geq$ 30% reduction from baseline in mean cold air stimulus response) was the primary efficacy measurement. The authors further defined success, on the basis of 2012 criteria from the American Dental Association, as a statistically significant difference of 20% or more between experimental and placebo groups for 1 sensitivity index.

Results. KO mouthrinse had statistically significantly higher success rates (the primary efficacy measurement) than did placebo (69.3% versus 44.6%; estimated odds ratio [OR], 2.817; 95% confidence interval [CI], 1.843 to 4.307; $P < .001$). At week 4, KO had statistically significant improvements compared with placebo in cold air stimulus score (estimated difference, −14.27 millimeters; 95% CI, −18.68 to −9.87; 35.6% improvement; $P < .001$) and tactile sensitivity (estimated difference, 13.45 grams; 95% CI, 9.83 to 17.08; 88.0% improvement; $P < .001$). The authors also observed statistically significant improvements for KO at week 2. Cold air stimulus and tactile sensitivity scores at weeks 2 and 4 were secondary efficacy measurements.

Conclusions. This study's results demonstrated that KO mouthrinse used as an adjunct to toothbrushing statistically and clinically significantly controlled and reduced dentinal hypersensitivity.

Practical Implications. Clinicians can use these results when determining appropriate at-home care regimens for patients with hypersensitivity.

Key Words. Potassium oxalate; sensitivity; cold air stimulus; Yeaple probe; visual analog scale; mouthrinse; dentin

ClinicalTrials.gov: NCT02113579.

JADA 2018:■(■):■-■
https://doi.org/10.1016/j.adaj.2018.02.027

Cervical dentinal hypersensitivity is a condition characterized by sharp pain associated with thermal, evaporative, tactile, osmotic, or chemical stimuli.[1] Investigators have described this condition clinically as an exaggerated response to nonnoxious stimuli that is dependent on dentin exposure and the lack of obstruction of the dentinal tubules. More than 90% of hypersensitive tooth surfaces are at the cervical margin on the facial aspects of the teeth.[2] The cause of dentinal hypersensitivity can be the result of dentinal tubules exposure because of loss of enamel or gingival recession.[3] The prevalence of dentinal hypersensitivity varies from 4% through 57% in the general population studied.[4] In our study, we evaluated the potential of a potassium oxalate

(KO) mouthrinse formulation to reduce and control dentinal hypersensitivity compared with a placebo control mouthrinse.

Results from previous in vitro permeability and scanning electron microscope studies and in vivo studies have shown that pastes or aqueous solutions containing KO occlude dentinal tubules by creating acid-resistant calcium oxalate crystals on the dentinal surface and inside the dentinal tubules.[5] This precipitation blocks fluid movement and so reduces dentinal hypersensitivity discomfort or pain. Various desensitizing devices containing KO (Remesense [K082594],[6] Seal Block [K123653],[7] and Super Seal [K983477][8]) have US Food and Drug Administration (FDA) 510(k) clearance. In particular, Super Seal (Bisco) was designed specifically as an in-office, topical, single-use product for exposed dentinal surfaces. The KO mouthrinse in this study is intended as an over-the-counter product used as a twice-daily mouthrinse to reduce and control dentinal hypersensitivity. The FDA clearance, coupled with prior clinical experience with KO mouthrinse and risk assessment, shows that KO can be used in humans without causing harm and that twice-daily use (up to 20 milliliters per day, maximum dose) does not pose significant risk, although we did not include people prone to developing kidney stones in this study.[9]

The FDA, in response to previous KO device study results submitted for review, requested an additional study to demonstrate the clinically significant effectiveness of the mouthrinse device that included sensitivity to cold as a primary measure because this is a common symptom among those who experience dentinal hypersensitivity, as well as detailed documentation of adverse events (AEs). In our study, we incorporated feedback from the FDA on demonstrating safety and effectiveness in reducing and controlling dentinal hypersensitivity.

METHODS

Study design

We conducted this multicenter, double-blind, randomized, parallel-group, controlled clinical study in the United States. After a 2-week screening period, participant random assignment began April 11, 2014, and the study ended by May 30, 2014, at Salus Research in Fort Wayne, Indiana (site 1001) and Silverstone Research Group in Las Vegas, Nevada (site 1002).

We conducted the study in accordance with the International Conference on Harmonisation Harmonised Tripartite Guideline for Good Clinical Practice (E6),[10] in agreement with the Declaration of Helsinki[11] and applicable local regulations. The institutional ethics committee on research involving humans approved the study protocol (14.03.0049 for site 1001; 14.03.0050 for site 1002). We obtained written informed consent from all participants after each received a thorough explanation of the study and had the opportunity to ask questions in private.

Participants

Participants at site 1001 were from the Fort Wayne, IN, area, and those at site 1002 were from the Las Vegas, NV, area. Investigators at both sites selected participants from their databases or recruited through advertising. Participants were men and women 18 years or older, in good general and oral health, with a minimum of 2 natural premolars, canines, or incisors with caries-free facial or buccal surfaces with cervical abrasion, erosion, or gingival recession. We selected up to 2 eligible teeth per quadrant, each separated by 2 other teeth, as study teeth, and the teeth exhibited these criteria: cold air stimulus visual analog scale (VAS) scores of 40 to 80 millimeters on a 100-mm VAS,[12] tactile sensitivity scores of 10 to 30 grams of pressure after Yeaple probe application, and VAS scores after Yeaple probe application of 40 to 80 mm at screening (−2 weeks) and baseline. In addition, participants had no significant oral soft-tissue disease, adequate oral hygiene, no severe marginal gingivitis or moderate or advanced periodontitis, and no extensive supragingival calculus, on the basis of results from a clinical examination at each visit and the discretion of the investigator.

Exclusion criteria included kidney disease, celiac or inflammatory bowel disease, chronic pancreatitis, weight-loss surgery or stomach or intestinal problems, eating disorders, uncontrolled gastroesophageal reflux disease, excessive dietary or environmental exposure to acids or other systemic conditions that would predispose the participant to sensitivity, chronic medical disease associated with episodes of daily pain, and long-term use of analgesics (more than 7 days). Exclusion criteria also included use of certain products or procedures before screening: desensitizing agents (8 weeks previously), whitening or tooth bleaching products (4 weeks), participation in another

ABBREVIATION KEY

ADA: American Dental Association.
AE: Adverse event.
FDA: US Food and Drug Administration.
KO: Potassium oxalate.
NA: Not applicable.
VAS: Visual analog scale.