consistently superior to products with F, so they cannot be recommended as replacements for the regular use of F products.

Biofilm Modifiers

Arginine

The clinical trials of arginine show that it has a clear potential to significantly increase the performance of toothpaste with F alone. Final recommendations for the use of this agent await confirmation by high-quality, long-term studies lacking bias.

Triclosan

Triclosan offers antibacterial power that may alter biofilm acid production, leading to higher saturation and resulting in better remineralization. Adding triclosan to dentifrices may produce modest but statistically significant reductions of coronal and root caries in children and adults. Studies are underway to verify the usefulness of triclosan-loaded dendrimers.

Xylitol

Antimicrobial and potentially anticaries effects have been attributed to the naturally occurring sugar alcohol xylitol. Data on its ability to remineralize is sparse, however, Sugar-free chewing gum containing 36% xylitol and 32% sorbitol can remineralize enamel lesions, but there is insufficient evidence to fully evaluate these remineralization abilities.

Herbal Compounds

Depending on the specific compounds involved, herbal compounds may be able to affect mineral saturation and precipitation, act as antimicrobial agents, or stabilize collagen, which may function as a scaffold for mineral deposition. A synergistic effect between proanthocyanidins and calcium phosphate–based materials may affect the remineralization of artificial root caries in vitro, but in situ and in vivo studies are required for confirmation.

Self-Assembling Peptides

A biomimetic technology has been developed to promote faster remineralization. The introduction of monomeric low-viscosity peptide solutions into enamel lesions has been able to create scaffolds that can promote remineralization. Although some in vitro and laboratory data show this remineralization potential, the results of ongoing clinical trials are needed to confirm or refute the potential of this technology.

STRATEGIES OF NEW REMINERALIZING AGENTS

Significant progress has been made in the development of remineralizing strategies. Most prolong the mineral supersaturation periods by creating stable systems that supply bioavailable calcium, phosphate, and F directly to the lesion or the biofilm. It's challenging to develop a system that can deliver the right concentration of minerals at the right time and avoid unwanted surface precipitation. Some agents promote environmental changes around lesions or create scaffolds to which minerals can cling. Finally, a new iontophoresis technology can accelerate the flow of mineral ions into deeper areas of demineralized enamel. Although early results seem promising, more study of this method's remineralization potential is needed.

Clinical Significance

Studies are needed to assess the efficacy and effectiveness of newer therapies to induce remineralization. Various populations should be included in these investigations, along with lesions in different surfaces. Only with such studies can the remineralization of carious lesions move forward.

González-Cabezas C, Fernández CE: Recent advances in remineralization therapies for caries lesions. *Adv Dent Res* 29:55-59, 2018

Reprints available from C González-Cabezas, Dept of Cariology, Restorative Sciences, and Endodontics, School of Dentistry, Univ of Michigan, 1011 N University Rm 2395, Ann Arbor, MI 48109-1078; e-mail: carlosgc@umich.edu

ORAL SURGERY

Autotransplantation

BACKGROUND

Dental autotransplantation can be described as the extraction of a tooth to be implanted in another site in the individual's oral cavity. With the widespread use of implants, this option is often overlooked but has some applicability, especially in pediatric patients. However, the principles of autotransplantation and guidelines for its use have not been defined, so an evidence-based approach was taken to define best practices for this technique.

METHODS

The databases of the Cochrane Library, PubMed, and CINAHL, along with trial registers, professional body publications, and

OpenGrey for unpublished literature, were searched. No randomized controlled trials were included in the literature, but 4 systematic reviews were identified for critical appraisal.

RESULTS

Although the evidence is scarce, the systematic reviews did offer some guidance in the areas of success rate, factors that influence success, and recommendations. The success rate overall exceeded 81%, with 5-year survival rates as high as 80.5%. The teeth associated with the best success rates have an immature open root apex rather than a closed root apex. Those with open apices have a 70% lower risk for extraction post-autotransplantation. Single-rooted teeth, such as anterior teeth and premolars, appear to fare better than molars. The need for extraction is apparently less than 10%. The technique used also can influence outcome, but no reliable data are available to analyze this further.

The recommendations for practice have been extrapolated from the literature review. With respect to indications for undertaking autotransplantation, this option should be considered for replacing missing or ectopic teeth in pediatric patients. To maximize success rates, survival, and acceptable functional and esthetic results, a multidisciplinary treatment plan should be formulated. Alternate treatments should be considered if they would be to the patient's benefit. Although age limitations have not been set, most treatment is completed in early adolescence. Two-dimensional imaging is often sufficient for planning autotransplantation, but 3-dimensional imaging can be a useful adjunct to develop a surgical template of the donor tooth so the surgeon can accurately contour the recipient site (Table 2).

Tooth characteristics associated with the best outcome in terms of success and survival include having an open, immature apex. The prognosis is impacted by atraumatic extraction of the autotransplanted tooth, use of sufficient 3-dimensional augmentation of alveolar bone at the donor site, and the absence of inflammation and infection at both the donor and recipient sites.

Surgically, no standardized guidelines or plans for follow-up currently exist. No surgical method has demonstrated a significant effect on success and survival rates, although technique does contribute to success or failure. Splinting teeth postoperatively may reduce instability and decelerate the rate of destruction of the periodontal ligament, but limited evidence addresses the material to be used and the length of time for transplanted teeth to be splinted. Prophylactic antibiotic coverage after autotransplantation is not supported by evidence indicating better success rates. If endodontic treatment is needed, its timing should be based on the stage of root development at the time of autotransplantation. Each patient's condition should be monitored with clinical and radiographic evaluations to determine the apical status of the autotransplanted tooth.

Table 2. Ideal Properties of Donor Tooth and Recipient Site for Autotransplantation

	Clinical examination	Radiographic examination
Donor tooth	Healthy virgin tooth A non-functioning position in the occlusion A tooth previously planned for an orthodontic extraction Appropriate crown width for aesthetics and function Extracted with an atraumatic technique Single >Multiple rooted teeth No increased pocket probing depths Patient age <40 years old	Open apex Root length between one-half to two-thirds completed root development Use to construct surgical template (if appropriate)
Recipient site	Free of chronic inflammation Free of acute infection Sufficient mesio-distal width Adequate bone levels Healthy attached gingivae No functional or non-functional occlusal interferences	Assessed in three dimensions (if appropriate) Proximity to adjacent structures - no involvement with maxillary sinus, mandibular canal Good adaptation to donor tooth

Clinical Significance

Autotransplantation has been done for a very long time and offers a high success rate and long-term survival. However, evidence supporting many aspects of this approach is limited or unavailable currently. Further controlled methodical studies and research are needed to develop a clinical treatment plan that coordinates the care required and sets criteria for success as well as indicating appropriate options should further follow-up care be required.

Martin K, Nathwani S, Bunyan R: Autotransplantation of teeth: An evidence-based approach. *Br Dent J* 224:861-864, 2018

Reprints available from K Martin; e-mail: Katy.Martin3@nhs.net