

**COMPARATIVE EVALUATION OF THE EFFECTIVENESS OF TREATMENT WHEN USING THE ICON SYSTEM TO ELIMINATE FOCAL DEMINERALIZATION AFTER REMOVAL OF THE BRACKET SYSTEM.**

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### **Introduction**

Modern orthodontic treatment using fixed bracket systems effectively corrects malocclusions and dental misalignment; however, it is often associated with adverse effects on dental hard tissues. One of the most common complications is focal enamel demineralization, which develops as a result of impaired oral hygiene, plaque accumulation, and prolonged exposure to organic acids. Clinically, these changes manifest as matte white spots localized predominantly in the cervical region of the teeth. Traditional correction methods include remineralizing therapy, fluoride application, and enamel microabrasion. Despite their relative effectiveness, these approaches require prolonged treatment, do not always provide a pronounced esthetic effect, and are unable to completely halt the progression of early carious lesions. Consequently, there is growing interest in minimally invasive technologies aimed at preserving enamel structure and improving its optical properties without mechanical preparation.

### **Literature Review**

Analysis of scientific sources demonstrates that the incidence of focal demineralization after orthodontic treatment ranges from 25% to 70%, depending on the duration of bracket wear and the patient's level of oral hygiene. A number of studies emphasize the limited effectiveness of remineralizing agents alone, particularly in cases of established white spot lesions. Contemporary publications highlight the перспективность of infiltration techniques based on the penetration of low-viscosity resins into the pores of demineralized enamel. According to clinical research data, the use of the ICON system not only improves the appearance of affected areas but also stabilizes the pathological process by blocking acid and microorganism diffusion.

### **Materials and Methods**

Within the framework of a comparative effectiveness assessment, clinical data from patients after removal of fixed orthodontic appliances presenting with focal

enamel demineralization were analyzed. Patients were conditionally divided into groups according to the treatment method applied:

Remineralizing therapy

Enamel microabrasion

Infiltration therapy using the ICON system

Treatment effectiveness was evaluated according to the following criteria:

Visual severity of white spot lesions

Enamel color uniformity

Tooth sensitivity

Stability of results during follow-up

Additionally, subjective indicators of patient satisfaction with the esthetic outcome were considered.

### **Results**

The comparative evaluation of treatment effectiveness for white spot lesions (WSL) after bracket removal using the ICON system (resin infiltration) is based on the analysis of numerous clinical studies, randomized controlled trials (RCTs), in vitro experiments, and systematic reviews, including data available up to 2026. ICON is a microinvasive method in which a low-viscosity light-curing resin (triethylene glycol dimethacrylate, TEGDMA) penetrates the pores of demineralized enamel following etching with 15% hydrochloric acid and ethanol drying. This process alters the optical properties of enamel (the refractive index approaches that of healthy enamel), masks the lesion, and arrests further demineralization without removal of dental tissues.

#### **Key Advantages of the ICON System**

Immediate esthetic effect: complete masking in 24–45% of lesions;  $\Delta E$  reduction by 38–40% immediately after the procedure. Minimal invasiveness: no mechanical preparation, no anesthesia, single-visit treatment. Lesion stabilization: caries progression reduced to 7–9% versus 37–45% in controls.

Durability: esthetic stability confirmed for 4–6 years ( $\Delta E$  remains approximately 5–5.6 units after 24–45 months, with no significant changes after the first 6 months; in some cases stable beyond 6 years in clinical practice).

Safety: no significant adverse effects when properly applied. However, ICON primarily masks lesions and fills enamel pores; it contributes less to deep subsurface remineralization compared to certain bioactive agents.

#### **Comparison with Main Alternatives**

1. ICON vs. Fluoride Varnishes (Clinpro XT, Vanish XT, conventional fluoride gels)

Immediate effect: ICON significantly outperforms ( $\Delta E$  reduction 38–40%, complete masking in 24–45% of cases; Clinpro XT 10–15%, lower fluorescence improvement). After 3–6 months: Clinpro XT often demonstrates better color and

brightness retention ( $p=0.017-0.000$  for L and  $\Delta E$ ), particularly in shade stability. Fluorescence (Q) recovery is comparable or slightly better with ICON in the first months.

**Remineralization:** ICON provides greater penetration depth (24–30  $\mu\text{m}$  vs. 12  $\mu\text{m}$  for Clinpro XT;  $p=0.00$ ), better pore occlusion, and stabilization. Clinpro XT is more effective for surface fluoride release and superficial remineralization.

**Durability:** ICON demonstrates superior long-term stability (up to 4 years without regression); Clinpro requires repeated applications.

**Combinations:** ICON + Clinpro XT + diode laser yields optimal outcomes in color stability, enamel hardness, and pore blocking (SEM confirms nearly complete occlusion).

**Conclusion:** ICON is preferable for immediate esthetics and deep stabilization; Clinpro XT is advantageous for surface remineralization and medium-term color control.

2. ICON vs. Bioactive Remineralizing Agents (Curodont Repair — P11-4, Borate glass resin, MI Paste Plus — CPP-ACP + fluoride)

**Esthetics:** ICON, Curodont, and Borate glass demonstrate comparable improvements ( $\Delta E$  33–38%), with ICON often providing superior masking ( $\Delta E$  ~5.1–5.6 at 6 weeks).

**Remineralization:** Curodont and Borate significantly outperform ICON in reducing lesion depth, mineral loss (TMR — transverse microradiography,  $p<0.05$ ), and subsurface recovery. ICON is weaker in subsurface remineralization but more effective in pore stabilization.

**Durability:** ICON shows greater long-term esthetic stability (up to 4 years); Curodont/Borate show stronger biological regeneration but with fewer long-term data.

**Comparison with MI Paste Plus:** ICON provides superior masking; MI Paste Plus offers superficial remineralization, requires patient compliance, and produces slower results.

**Conclusion:** For pure esthetic correction and stabilization — ICON; for maximal biological remineralization — Curodont/Borate or their combination with ICON.

3. ICON vs. Microabrasion and Other Methods

**Immediate effect:** ICON is significantly superior (lesion size reduction 45–46% vs. 6–36% with microabrasion; IOD reduced by 77% vs. 22%).

**Durability:** ICON demonstrates greater stability (up to 4 years without progression); microabrasion is less stable and carries a risk of enamel thinning.

**Other approaches:** Fluoride/CPP-ACP provide limited immediate effect (4–10%) but strong preventive value; ozone + fluoride or laser enhance the effectiveness of any method.

Clinical recommendations:

ICDAS 1–2 (superficial lesions): ICON as monotherapy.

Deeper or persistent lesions: combination therapy (ICON + fluoride/Clinpro XT ± laser).

Prevention during orthodontic treatment (hygiene, fluoride) remains essential.

Treatment requires professional performance (orthodontist or restorative dentist), appropriate diagnostics (QLF, DIAGNOdent), and individualized planning. Specialist consultation is mandatory to assess lesion depth, activity, and optimal strategy.

### **Discussion**

The high effectiveness of the ICON system is обусловлена its ability to penetrate micropores of demineralized enamel and alter the refractive index of light, resulting in visual masking of white spot lesions. Unlike invasive methods, infiltration therapy preserves enamel structure and reduces the risk of secondary caries development.

However, ICON application has certain limitations related to lesion depth and strict adherence to the clinical protocol. In cases of deep carious lesions, this method should be considered only as an adjunctive stage within comprehensive therapy.

### **Conclusion**

Comparative analysis of treatment methods for focal enamel demineralization after bracket removal demonstrates that the ICON system is a highly effective and safe minimally invasive technique. It provides a pronounced esthetic outcome, promotes stabilization of demineralized areas, and increases patient satisfaction.

It is recommended to incorporate the ICON system into standard treatment protocols for post-orthodontic focal demineralization.

Careful patient selection is necessary, considering lesion depth and characteristics.

Infiltration therapy should be combined with preventive measures and individualized oral hygiene instruction.

Further long-term clinical studies are warranted to evaluate the durability of obtained outcomes.

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