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IMPROVEMENT OF SURGICAL TREATMENT METHODS FOR CHRONIC DESTRUCTIVE PERODONTITIS USING OSTEOPLASTIC MATERIALS

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Chronic destructive periodontitis is a common inflammatory condition affecting the tissues around the tooth roots, leading to the progressive loss of bone and the formation of periapical lesions. Traditional surgical treatments aim to eliminate the source of infection, but they often fail to fully regenerate bone. The use of osteogenic materials in combination with advanced surgical techniques can significantly improve treatment outcomes, promote accelerated bone regeneration, and restore the structure of alveolar bone.
This article discusses the principles of using osteogenic materials, compares different treatment approaches, and explores opportunities for further improvement in this area.
Keywords: chronic destructive periodontal disease, promote accelerated bone regeneration,osteoplastic substances, PRP.

INTRODUCTION

Chronic destructive periodontitis is a condition characterized by inflammation of the tissues around the teeth and progressive destruction of bone around the tooth roots. This disease often occurs due to impaired local immune defenses, microfractures in bone, and the formation of cyst-like structures. The main goal of surgical treatment is to eliminate the infectious focus, restore anatomical bone integrity, and prevent recurrence.
Unfortunately, conventional surgery does not always result in complete bone regeneration. This has led to the development of osteoplastic materials, which are synthetic, biocompatible substances that can fill bone defects and provide a scaffold for new bone growth. Chronic periodontitis is a common maxillofacial condition. Various reports estimate its prevalence at approximately 16–32% of cases, while associated periarticular cystic lesions occur in about 8–12,5% of cases. Periodontal disease remains one of the leading causes of tooth loss. Despite significant advances in dental care over the past decade, the incidence of acute inflammatory maxillofacial conditions (such as periostitis, abscesses, phlegmon, lymphadenitis, and osteomyelitis) has not declined. In fact, chronic periodontitis underlies roughly 82–87% of these acute conditions. Typically, periodontitis lesions (both acute and chronic) represent the body's protective inflammatory response under normal immune function. However, if systemic immunity is compromised, a persistent focus of chronic infection can undermine the body's nonspecific defense mechanisms, contributing to the development and progression of systemic and localized diseases.

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Given these challenges, there is considerable interest in enhancing regenerative therapy for destructive periodontal lesions. Current endodontic treatments often rely on nonspecific measures and do not directly stimulate bone formation at the site of lesion. Therefore, our study aimed to identify an optimal bone graft material that meets the rigorous requirements of modern endodontic therapy—namely biocompatibility, safety, ease of use, rapid healing, and cost-effectiveness—and to evaluate its clinical efficacy.

MATERIALS AND METHODS

A prospective, controlled clinical study was conducted to evaluate the effectiveness of osteoplastic materials in the surgical treatment of chronic destructive periodontitis. The study lasted for 12 months, during which time the participants were observed.

Clinical assessments and radiographic examinations were conducted at 3-, 6-, and 12-months post-treatment. Treatment success was evaluated according to the following criteria:

Patients were included in the study if they met the following criteria:

- age between 25 and 60 years;
- clinically and radiographically confirmed diagnosis of chronic destructive periodontitis;
- presence of a periapical bone defect exceeding 3 mm in diameter;
- absence of acute inflammatory processes at the time of surgery;
- preserved tooth structure suitable for surgical intervention;
- written informed consent to participate in the study.

Patients were excluded if one or more of the following conditions were present:

- systemic diseases affecting bone metabolism (e.g., osteoporosis, diabetes mellitus, autoimmune disorders);
- immunodeficiency conditions or long-term corticosteroid therapy;
- pregnancy or lactation;
- smoking more than 10 cigarettes per day;
- previous surgical treatment of the same tooth;
- poor oral hygiene compliance.

A total of 60 patients were enrolled and randomly assigned into two equal groups:

- **Control Group (n = 30):** conventional surgical treatment without osteoplastic materials;
- **Experimental Group (n = 30):** surgical treatment combined with osteoplastic material implantation.

Randomization was performed using a computer-generated allocation sequence.

Osteoplastic Materials

The following materials were used in the osteoplasty group:

- β-tricalcium phosphate (β-TCP): a bioactive material with pronounced osteoconductive properties;
- Hydroxyapatite-based composites: providing a stable framework for osteogenesis.

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Material selection was based on the size and morphology of the bone defect.

Surgical Procedure

All surgical interventions were performed by the same experienced oral surgeon to minimize operator-related variability.

After local infiltration anesthesia (articaine 4% with epinephrine 1:100,000), a full-thickness mucoperiosteal flap was elevated. Granulation tissue and necrotic bone were carefully removed, and apicoectomy was performed when indicated. Root-end preparation and retrograde sealing were conducted using biocompatible materials.

In the experimental group, the bone defect was filled with an osteoplastic material (β-tricalcium phosphate or hydroxyapatite-based composite), selected according to defect size and morphology. The flap was repositioned and sutured with non-resorbable sutures.

Outcome Assessment

Clinical and radiographic evaluations were conducted at 1, 3, 6, and 12 months postoperatively. The assessed parameters included:

- severity of postoperative pain,
- rate of bone tissue regeneration,
- residual defect size on radiographic images.

Postoperative Management

All patients received standardized postoperative care, including:

- antibiotic therapy (amoxicillin/clavulanate for 5 days, if indicated);
- nonsteroidal anti-inflammatory drugs for pain control;
- chlorhexidine mouth rinses (0.12%) twice daily for 10 days.

Sutures were removed after 7–10 days.

Outcome Measures

Clinical and radiographic assessments were performed at baseline and at 1, 3, 6, and 12 months postoperatively.

- Primary outcome measures:
- reduction of periapical defect size (radiographic analysis);
- degree of bone regeneration.

Secondary outcome measures:

- postoperative pain intensity (Visual Analog Scale, VAS);
- presence of postoperative complications;
- functional tooth stability.

Radiographic Analysis

Standardized periapical radiographs were obtained using the paralleling technique. Bone regeneration was assessed by measuring defect size reduction using digital image analysis software. Measurements were performed by two independent examiners blinded to group allocation.

Table 1. Radiographic Bone Regeneration Over Time

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№	Parameter	Control Group (n=30)	Experimental Group (n=30)	p-value
1	Mean age (years)	42.3 ± 6.1	41.8 ± 5.9	>0.05
2	Gender (M/F)	14 / 16	15 / 15	>0.05
3	Defect size (mm)	5.2 ± 1.1	5.4 ± 1.0	>0.05

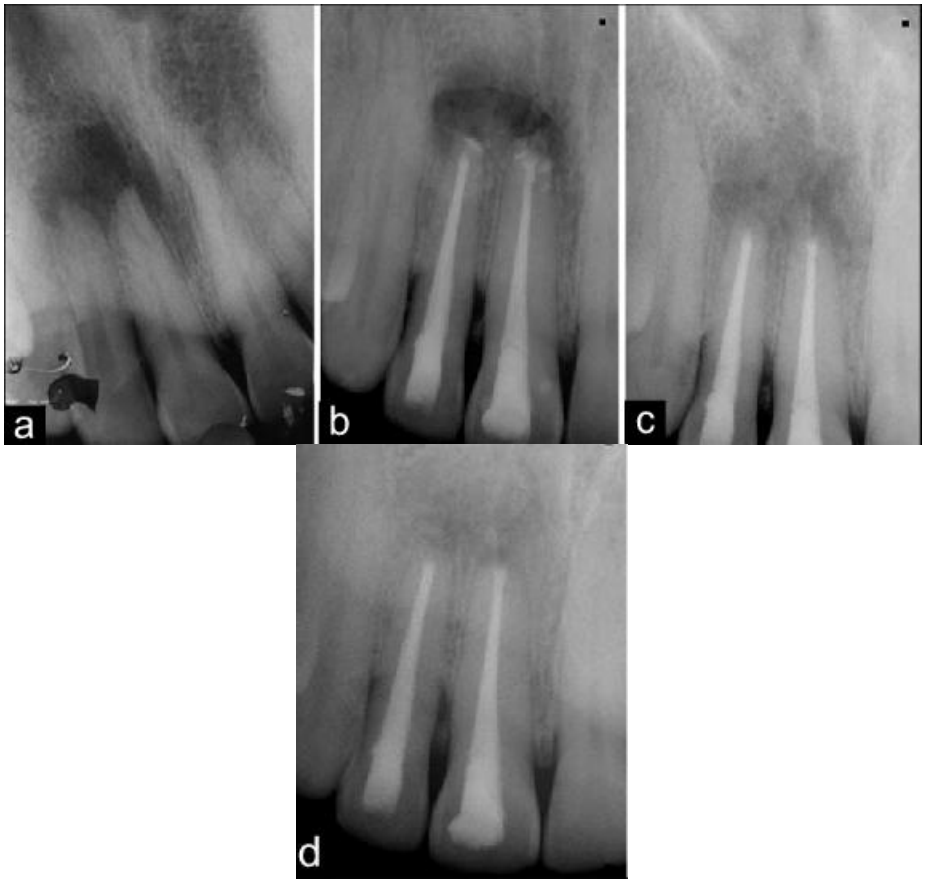

Figure 1. *Preoperative and postoperative radiographs demonstrating bone defect healing at 6 and 12 months.*
(a) preoperative radiograph showing the periapical lesion; (b) immediate postoperative radiograph; (c) 3 months postoperative radiograph showing enhanced bone healing; (d) 12 months postoperative radiograph showing the healed periapical lesion

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Table 2. Radiographic Bone Regeneration Over Time

№	Time point	Control Group (%)	Experimental Group (%)	p-value
1	3 months	22 ± 5	48 ± 6	<0.05
2	6 months	40 ± 7	85±8	<0.05
3	12 months	55 ± 6	90 ± 5	<0.05

Standard descriptive and inferential statistical methods were applied, and differences between groups were considered significant at a level of $\alpha = 0.05$.

During endodontic therapy, root canals were mechanically prepared using the step-back technique with ISO-standard endodontic files. A calcium hydroxide–based paste (Thiodent) was used as an intracanal medicament. The progress of root canal treatment was monitored with radiographic imaging. Final canal irrigation was performed with 5% sodium hypochlorite solution in combination with an EDTA-containing agent, delivered via endodontic syringes, to ensure thorough disinfection.

RESULTS AND DISCUSSION

Clinical Findings

Patients in the main group demonstrated:

- significant reduction in postoperative pain within the first 3–5 days,
- faster recovery of masticatory function.

Radiographic Evaluation

At 6 months post-surgery:

- approximately 85% of patients in the main group showed near-complete filling of bone defects with newly formed bone;
- only 40% of patients in the control group achieved comparable bone regeneration.

At 12 months:

- complete reconstruction of bone structure was observed in 90% of patients treated with osteoplastic materials and in 55% of patients treated without them ($p < 0.01$).

The obtained results confirm the high effectiveness of osteoplastic materials in the surgical treatment of chronic destructive periodontitis. Osteoplasty provides a stable scaffold for osteoblast migration and accelerates osteogenesis. It also reduces the risk of disease recurrence, as it demonstrates high biocompatibility and minimal immune response. β-TCP and hydroxyapatite are particularly suitable for this purpose, as they have good integration with native bone tissue.

However, successful outcomes still depend on proper material selection and accurate placement technique. Additionally, the size of the defect plays a crucial role. A promising direction for future research includes the combined use of osteoplastic materials with biologically active growth factors such as platelet-derived growth factors. This could potentially enhance the effectiveness of the treatment. Additionally, 3D modeling techniques could be used to achieve more precise anatomical reconstruction in future treatments. **(Figure 2)**

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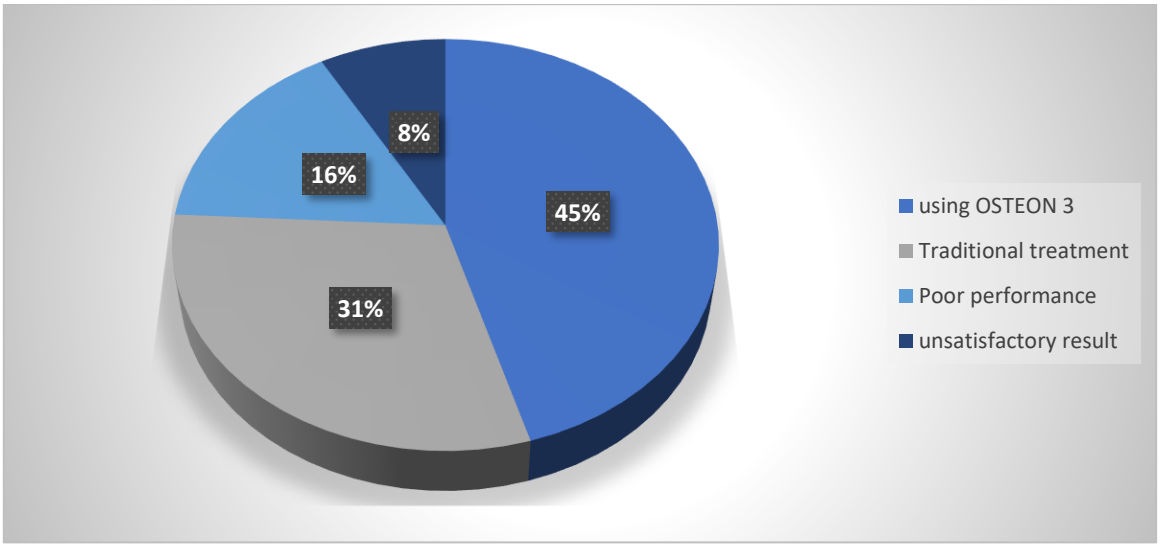

Figure 2. *The results of the use of osteoplastic material*

At the 12-month follow-up, bone regeneration in the experimental group was nearly complete in 85–90% of patients. The newly formed bone appeared with a uniform (homogeneous) structure and well-defined borders, and there were no indications of recurring inflammation. In contrast, the control group (which did not receive any grafting material or PRP) also showed healing trends over time but to a lesser extent. In the control group, complete restoration of the periapical bone structure was observed in only about 60–65% of patients by 12 months, and the healing process generally took longer. ***(Figure 3)***

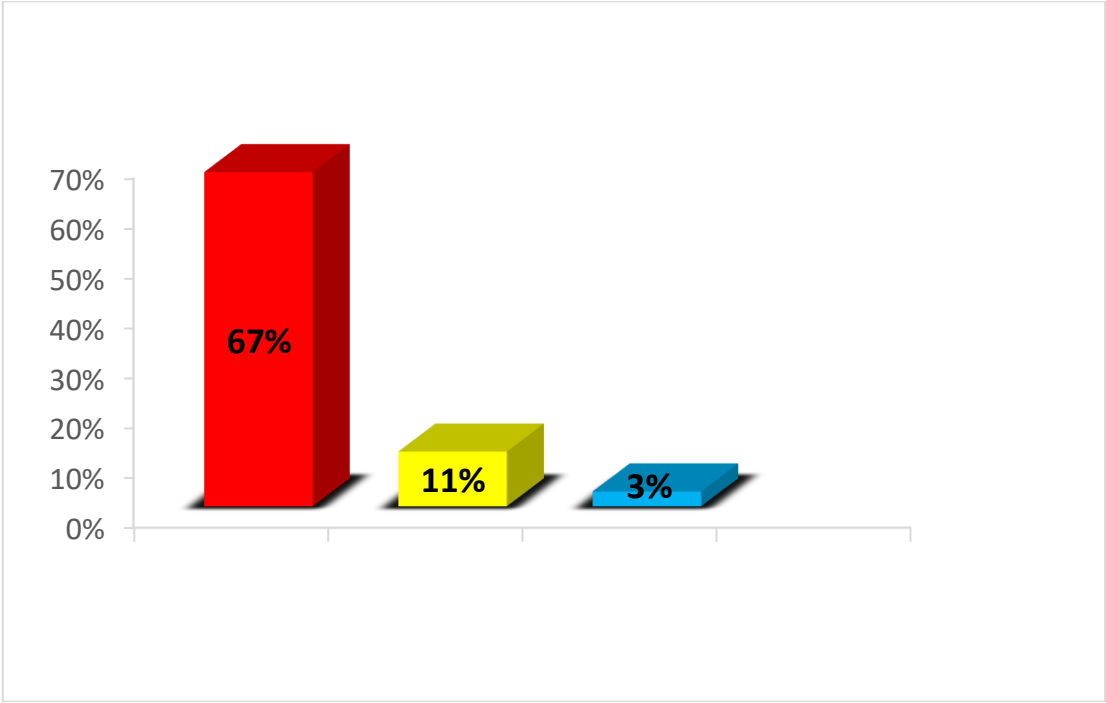

Figure 3. *The degree of bone tissue recovery*

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Table 3 shows that 67% of patients have complete, 11% have partial, and 3% have focal bone tissue restoration.

The use of osteoplastic materials significantly enhances the effectiveness of surgical treatment of chronic destructive periodontitis. Patients receiving osteoplasty demonstrate faster and higher-quality bone regeneration, reduced postoperative discomfort, and a lower risk of recurrence. Further studies should focus on optimizing material combinations, incorporating tissue-regulating factors, and evaluating long-term clinical outcomes.The paper explores the features of bone tissue repair processes in the periapical area when using osteoconductive materials following tooth root tip resection. It has been demonstrated that incorporating osteoplastic materials into the surgical procedure contributes to a more comprehensive restoration of bone architecture compared to traditional treatment methods. This expands our understanding of the potential of regenerative dentistry in treating periodontal inflammatory conditions. The use of bone graft materials in the surgical treatment of chronic periodontitis can increase the effectiveness of the treatment, shorten the recovery time, and reduce the risk of relapse of the inflammatory process. This approach can be recommended for inclusion in clinical protocols for treating patients with severe bone tissue destruction, as well as for use in the educational process for training dental students and residents.

CONCLUSION. The obtained results confirm the high effectiveness of osteoplastic materials in the surgical treatment of chronic destructive periodontitis. Osteoplasty:

1. provides a stable scaffold for osteoblast migration,
2. accelerates osteogenesis,
3. reduces the risk of disease recurrence.

β-TCP and hydroxyapatite demonstrate high biocompatibility, minimal immune response, and good integration into native bone tissue. However, successful outcomes depend on proper material selection, accurate placement technique, and defect size.

A promising direction for future research is the combined use of osteoplastic materials with biologically active growth factors, such as platelet-derived growth factors, as well as the application of 3D modeling technologies to achieve precise anatomical reconstruction.

In this clinical trial, the use of osteogenic materials in combination with autologous platelet-rich plasma (PRP) significantly enhanced the therapeutic outcomes for destructive forms of chronic periodontitis. The collagen matrix acted as a biocompatible support for bone regeneration, while the osteoinductive factors in the PRP stimulated the rapid formation of new bone. As a consequence, the combined treatment accelerated the healing process and reduced the overall recovery time when compared to conventional methods.

Overall, the osteoregenerative effect of osteogenic materials in combination with PRP led to a faster clinical and radiographic recovery, as well as a more complete restoration of the periapical bone tissue. These findings support the integration of this combined approach into the endodontic treatment for challenging cases of chronic periodontitis. By enhancing the efficacy of therapy and reducing the likelihood of relapse, the application of osteogenic materials with platelet-rich plasma represents a significant advancement in periodontal tissue regeneration.

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