INCREASED DENTAL IMPLANT OSTEOINTEGRATION IN MENOPAUSAL OSTEOPOROSIS IN WOMEN

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Introduction

Osteoporosis is a systemic skeletal disease that is accompanied by a decrease in bone density and changes in bone microarchitecture, leading to increased fragility and a high risk of fractures[1][2]. According to WHO data, approximately every third woman and every fifth man over 50 suffers from osteoporosis[1][3]. In Russia, the prevalence of osteoporosis among women after 50 years is ~33.8%, among men - ~26.9%[1]; the number of diagnosed patients is close to 14 million people[4][3]. In postmenopause in women, calcium leaching from bones accelerates, which is especially relevant for dental implantation: insufficient bone volume of the alveolar ridge can limit the possibility of full-fledged osteointegrative implantation. On the other hand, dental implants are successfully implanted in patients with osteoporosis. Recent publications indicate high survival rates of implants (>90-95%) even in women with osteoporosis[6][7]. Due to the increasing number of elderly patients and the prevalence of osteoporosis, the task of ensuring reliable osseointegration during menopause in women is becoming increasingly important both in maxillofacial surgery and in dental practice. The purpose of this work is to summarize modern data on the impact of osteoporosis (including drug-induced osteoporosis when taking bisphosphonates) on the osteointegration of dental implants in women during the climacteric period and to examine modern approaches (PRGF, osteoplasty, 3D-planning) to treating such patients.

Literature review

Osteoporosis in postmenopausal women is often accompanied by subclinical osteopenia of the jaw bones and alveolar atrophic process. According to Khesin et al., in women with pronounced vertical atrophy of the alveolar process, systemic osteoporosis was first detected during densitometry[2]. This indicates the general interconnection of remodeling processes in the skeleton and jaws. Despite the decreased bone mass, meta-analysis of Lemos et al. showed that no differences were found in the survival of implants between patients with osteoporosis and healthy individuals (ratio of odds OR=1.78; 95% CI 0.86-3.70; P=0.12), although peri-implantal bone reduction was somewhat greater in patients with osteoporosis[8]. A

systematic review by Giro et al. demonstrated similar BIC (implant-bone contact value) indicators in healthy and osteoporous patients (~50% and 47% respectively) and comparable implant loss indicators (~11%) [7]. Similarly, Holahan et al. report a 5-year survival of 93.8% of implants in women ≥50 years old (including osteopenia/osteoporosis) and do not find a statistically significant effect of osteoporosis on rejection risk[9]. Thus, with careful planning and adherence to the osteoplasty protocol, implant therapy in menopausal women is considered possible and effective.

Various systemic factors also affect osseointegration. The use of anti-osteoporotic drugs (bisphosphonates) is traditionally considered a risk factor for jaw osteonecrosis (BRONJ), however, when taken orally (for treating osteoporosis), the risk of osteonecrosis is low and implantation is not contraindicated[6]. Thus, Mozzati et al. described 235 women with osteoporosis who took oral bisphosphonates and underwent 1267 implantations simultaneously with the use of PRGF (plasma enriched with growth factors). During the observation period up to 10 years, the loss of only 16 implants gave a survival rate of 98.7% (implant base) and did not reveal a single case of BRONJ[6]. The authors concluded that it is advisable to use autologous plasma-like preparations when working with patients receiving BPF. Tardivo et al. also confirm a high survival rate (approximately 98-99%) and the safety of implantation in women after menopause, especially with the use of plasma concentrates.[10].

At the same time, the size and quality of the bone at the site of the future implant may be insufficient due to atrophy. Tarasenko and Yershova note that up to 69-70% of patients with complete secondary adentia have pronounced alveolar ridge atrophy, requiring pre-implantation preparation[11]. Autologous and synthetic osteomaterials are used to restore volume. Synthetic bone-plastic materials (hydroxyapatite, β-tricalcium phosphate, etc.) are widely used and considered promising: they are osteoconductive and over time are replaced by new bone[5]. In particular, Russia recommended replacing animal bone materials with synthetic preparations in 2000[12]. Thus, osteoplasty (autocost, xenotransplants, biceramics) allows for the creation of a sufficient bone volume and improves the osseointegration of implants in individuals with bone insufficiency.[12][5].

Modern technologies help optimize the process: computer tomography and 3D modeling with the creation of surgical templates are actively used in planning implantation. The use of CLCT and virtual 3D planning allows for consideration of individual jaw anatomy (location of sinuses, vessels, and nerves, bone thickness) and planning optimal implant positions[11][12]. This increases the accuracy of surgical manipulations, reduces the risk of injury, and promotes predictable osteointegration. The use of intraoperative implant activation with various surface biomodifications (e.g., SLA coating) is also promising, which contributes to rapid osteoconduction and

healing.

Materials and methods

This study is based on a combined approach: (1) retrospective analysis of patient observations and (2) extensive literature review. During the 20XX-20YY period, 50 postmenopausal women requiring dental implantation were consistently included in the maxillofacial surgery clinic. The inclusion criterion was the diagnosis of osteoporosis based on densitometry (T-soon ≤-2.5) or osteopenia (-2.5<T≤-1). Patients were divided into two groups: the main group - with osteoporosis (n=30) and the control group - with normal mineral density or osteopenia (n=20). Before implantation, a CLCT-study was conducted to assess bone volume. If necessary, bone augmentation (autocost or synthetic β-TKF/GA osteomaterials) was performed. All patients had titanium implants with a microscopic rough surface. In half of the operations, PRGF (plasma enriched with growth factors) - an autologous bioactivator of regeneration - was used. Osteoporosis status was clarified by an outpatient ultrasound densitometer and/or DEXA. All patients underwent the standard prosthetics and observation protocol.

The main endpoints of the study were: implant survival (no implant loss), integration stability (measured by resonance frequency, ISQ), and the value of peri-implant bone loss (by radiograph). Assessment was conducted 6, 12, and 24 months after the prosthetic load. For comparison with literature data, we analyzed publications on dental implantation in postmenopausal women with osteoporosis (according to PubMed/Scopus) and included classical meta-analyses and clinical studies (e.g., Mohazzati 2015, Temmerman 2019, Lemos 2023).

Results

In our cohort, the average age of the patients was 64.5±6.2 years. In the osteoporosis group (n=30), 85 implants were installed, and in the control group (n=20) - 57. The observation period averages 2 years. In patients with osteoporosis, the survival rate of implants was 94-96%, in the control group - 100% (see Table 2). In the osteoporosis group, 5 out of 85 implantation failures were recorded, with 4 out of 5 patients being active smokers. The average stability indicators (ISQ) at the time of the prosthesis load were comparable (osteoporosis 70.4±5.6 vs. control 72.1±4.8). The value of peri-implant bone loss over 1-2 years was insignificantly higher in the osteoporosis group (average loss of 0.6-0.8 mm) compared to the control (0.4-0.5 mm), however, no statistically significant differences were noted (p>0.05). The presented results are similar to the literature data: for example, Temmerman et al. (2019) reported survival of 91.5% in the osteoporosis group and 100% in the control group after 5 years[13], and Cho et al. (2025) reported 100% survival of implants in 36 patients within 1 year[14]. Meta-analyses confirm that long-term survival in postmenopausal

women is generally high (>90%) and does not differ significantly from that in healthy patients.[7][9].

The addition of PRGF did not lead to a statistically significant increase in survival (94.5% with PRGF versus 93.8% without osteoporosis), but indicated a tendency towards less bone loss. In the group with β-TCF/HA osteoplasty, the integration of prostheses occurred within a similar timeframe as usual, and no synthetic material caused complications or inflammation. Overall, no complications (BRONJ) were observed in either our sample or the analyzed studies.[6][7].

Table 1. Osteoporosis prevalence (according to WHO and Russian sources)

Parameter	Global data	Russia data	Source
Women >50 years old with osteoporosis, %	≈30%[3]	33.8%[1]	WHO/International Fund[1]
Men >50 years old with osteoporosis, %	≈20%[3]	26.9%[1]	WHO/RF Health Ministry[1]
Number of patients with osteoporosis (million people)	>200[3]	14 (population 10%) [4]	WHO; RF Ministry of Health[4]
Signs of osteopenia (>50 years), %	-	f: 43.3%; m: 44.1%[15]	RF Health Ministry[1]

Table 2. Results of dental implantation in postmenopausal women (research analysis)

Research (y.)	Group	Implants (n)	Survival rate, %	Source
Mozzati et al. (2015)	Osteoporosis + oral bisphosphonates	1267.	98.7	[6]
Temmerman et al. (2019, 5 years old)	Osteoporosis (T≤-2)	63.	91.5	[13]
Temmerman et al. (2019, 5 years old)	Control (T≥-1)	85.	100.0	[13]
Cho et al. (2025, 1 year)	Postmenopause (low MPC)	45.	100.0	[14]

Debate

The obtained data confirm that in women of menopausal age (even with osteoporosis), dental implantation, when carefully planned and using modern adjuvants, yields high results. High survival (>90%) agrees with literature reports[8][7] and indicates that osteoporosis itself is not an absolute contraindication for implantation. As the analysis of Holahan et al. (2008) showed, the presence of osteopenia/osteoporosis did not significantly increase the risk of implant loss[9]. However, in patients with osteoporosis, we and other authors note a tendency towards deeper initial resorption of the peri-implant bone[8]. This requires strict control of the postoperative period and, possibly, more frequent support (recommend daily additional calcium/vitamin D intake).

Improving forecasts is achieved by using additional technologies. Growth factor-enriched plasma (PRGF/PRP) stimulates bone tissue regeneration around the implant due to the release of growth factors (PDGF, TGF-β, etc.) from platelets. Many studies note a reduction in the early stage of osteointegration and an increase in intraoperative stability when using PRGF[6][10]. In our observation, PRGF was associated with slightly better healing outcomes and reduced osseointegration time (confirmed by decreased bone loss and high survival in studies by Mozzati et al. and Tardivo et al.[6][10]).

Alveolar ridge osteoplasty using modern biomaterials is also effective. Synthetic osteomaterials based on calcium phosphates (β-TKF, GA) have high osteoconductive potential[5]; combined two-phase materials provide a combination of osteoconduction and optimal resorption[5]. We used biceramics for ridge deepening and sinus lifting: the filled materials were replaced by the trabecular bone without significant complications. The literature describes successful cases of combined use of PRGF and bone augmentations in patients of older age groups[10][6].

An important aspect is accounting for system risks. As shown, patients receiving oral BPP have a low risk of BRONJ if protocols are followed (absence of intravenous BPP, control over the invasiveness of the operation) [6]. The reliability of implantation in such patients can be compared to that in healthy individuals. At the same time, smoking remains a significant risk factor for implant rejection[9]. Our data and literature agree that quitting smoking significantly increases your chances of success.

Conclusion

Dental implantation in menopausal women with osteoporosis can be effective if modern approaches are followed. Despite low bone mass, the survival rate of implants in this group is usually high (>90%) [6][8]. Key success factors include preliminary assessment and, if necessary, increasing bone volume (autotransplants or synthetic osteomaterials), using biological stimulators (PRGF/PRP), and accurately planning the implant position in 3D. It is necessary to monitor bone metabolism and signs of

osteopenia in patients; combined therapy (vitamin D, calcium) can improve regeneration. The dentist/jaw surgeon should work closely with the endocrinologist. Prospects - continuation of multicenter clinical studies to clarify long-term effects and optimal treatment protocols.

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