A clinical study involved 90 patients with chronic osteomyelitis. Patients were divided into two groups. In group I, 60 patients underwent sequestrectomy and plastic surgery of the sequestral cavity with finely granulated titanium nickelide. In group II, 30 patients after sequestrectomy, the bone cavity was filled in the traditional way (hemoplasty). Both in the early postoperative period and the long follow-up period, the clinical and radiological effects of the proposed methodology for treating residual bone cavities were confirmed. When using titanium nickelide implants, the formation of biocomposite is observed in patients, which ensures the preservation of bone strength. This prevents the occurrence of pathological fractures. Titanium nicelide is characterized by mechanical strength, has osteoconductive properties and allows sufficient filling of cavities with complex anatomical structure. Also, preservation of congruence of composite with bone tissue during bone growth (in case of treatment of children) is noted.

Keywords: dystrophic bone cysts, chronic osteomyelitis, plasty, titanium nickelide

APPLICATION OF FINELY GRANULATED TITANIUM NICKELIDE IN SURGICAL PRACTICE

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ПРИМЕНЕНИЕ МЕЛКОГРАНУЛИРОВАННОГО НИКЕЛИДА ТИТАНА В ХИРУРГИЧЕСКОЙ ПРАКТИКЕ

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A clinical study involved 90 patients with chronic osteomyelitis. Patients were divided into two groups. In group I, 60 patients underwent sequestrectomy and plastic surgery of the sequestral cavity with finely granulated titanium nickelide. In group II, 30 patients after sequestrectomy, the bone cavity was filled in the traditional way (hemoplasty). Both in the early postoperative period and the long follow-up period, the clinical and radiological effects of the proposed methodology for treating residual bone cavities were confirmed. When using titanium nickelide implants, the formation of biocomposite is observed in patients, which ensures the preservation of bone strength. This prevents the occurrence of pathological fractures. Titanium nylon is characterized by mechanical strength, has osteoconductive properties and allows sufficient filling of cavities with complex anatomical structure. Also, preservation of congruence of composite with bone tissue during bone growth (in case of treatment of children) is noted.

Keywords: dystrophic bone cysts, chronic osteomyelitis, plasty, titanium nickelide

В клиническом исследовании участвовали 90 пациентов с хроническим остеомиелитом. Пациенты были разделены на 2 группы. В группе I у 60 пациентов выполнялась секторэктомия и пластика секторальной полости мелкогранулированным никелидом титана. В группе II у 30 пациентов после секторэктомии костная полость заполнялась традиционным способом (гемопломбой). Как в раннем послеоперационном периоде, так и в отдаленном периоде наблюдения подтверждается клинико-рентгенологическая эффективность предлагаемой методики лечения остаточных костных полостей. При использовании имплантатов из никелида титана наблюдается формирование у пациентов биокомпозита, который обеспечивает сохранение прочности кости. Это предотвращает возникновение у больных патологических переломов. Никелид титана отличается механической прочностью, обладает остеоиндуктивными свойствами и позволяет эффективно заполнять полости, имеющие сложную анатомическую структуру. Помимо этого, отмечено сохранение конгруэнтности композита с костной тканью в процессе роста кости (в случае проведения лечения детей).

Ключевые слова: дистрофические костные кисты, хронический остеомиелит, пластика, никелид титана
Undoubtedly, in the surgical treatment of skeletal disorders, the result mainly depends on the skill of the surgeon, as well as the subsequent rehabilitation. However, technological equipment is equally essential for a favorable outcome. The use of implants made of nickel and titanium became a new milestone in the treatment of bone pathologies. Their advantage is high biocompatibility, as well as a maximum approximation of mechanical characteristics to the properties of bone tissue [1]. In addition to bioinertia (biochemical compatibility) and similarity with bone tissue in terms of physical and mechanical properties, titanium nickelide implants have some advantages. The main ones are the following: corrosion resistance, lack of toxicity or carcinogeticity, easy sterilization, ability to provide the necessary porosity and bone ingrowth, ease of germination of living tissues in the pores of the implant and bone [2–6]. However, in the case of transplantation of biological tissues the efficiency of reconstructive surgeries can be significantly reduced as compared to the expected effect due to the high intensity of resorption [8, 9]. This leads to the resorption of the graft in the body before restoration of the lost or corrected bone segment.

The purpose of the study was to an assessment to the effects of fine-granulated titanium nickelide for the plasty in the patients with ChO.

Material and Methods. Ninety patients (67 men and 23 women) with ChO were followed-up. The age of patients ranged from 16 to 60 years (average age was 37.1 years). Patients divided into two groups. The group I included 60 patients whom finely granulated titanium nickelide was used to fill the bone cavity after sequestrectomy. The group II included the remaining 30 individuals, in whom the traditional method was used to fill the bone cavity (blood tap) after sequestrectomy. One or more sequestral cavities were found in study participants with ChO (Table).

Disease duration ranged from 6 months to 13 years. Patients with complications at the background of the underlying diseases were excluded from the study. Specifically, they included individuals in whom disease course was complicated by unconsolidated fracture or formation of a false joint. The composition of the groups was planned, so the groups were similar in terms of age and localization and duration of the pathological process, and the number of previous surgeries. This was necessary to ensure the reliability of the results. The clinical form of ChO was confirmed in each of the participants. 76.7 % of patients (69) suffered from post-traumatic ChO, the remaining 23.3 % (21) had hematogenic osteomyelitis. In 7.8 % patients (5), post-traumatic osteomyelitis was formed due to incorrect treatment of local infectious disorders. 2 patients with hemogenic ChO did not receive surgical treatment before. Other research participants had previously undergone surgical treatment due to complications. In the analyses of 80 % patients different bacterial cultures were isolated: 72.2 % (52) – Staphylococcus aureus, 12.5 % (9) – Streptococcus haemolyticus, 6.9 % (5) – mixed flora (Streptococcus pyogenes+Enterococcus faecalis), 4.2 % (3) – Pseudomonas aeruginosa, and 4.2 % (3) – E. coli. All patients underwent conservative treatment, up to obtaining negative results of culture and the absence of inflammation factors in the wound discharge. Sixty patients in the group I received surgical treatment with new approach. The surgery involved simultaneous bone cavities plasty with titanium nickelide were performed. In the case of emergency admission due to the phlegmons, preliminary treatment during 8–10 days was required. During this period, incision, draining, and debridement of the phlegmons were performed. Subsequently, sequestrectomy and plasty with fine-granulated titanium nickelide were performed. At the initial stage of the surgery, the fistulous tracts were isolated and cut to the bone; the altered periosteum was removed, sequestrum was incised with removal of sequestrum with granulation tissues (Fig. 1). Then thorough cavity curettage was performed before the appearance of the phenomenon of “pinpoint bleeding” from the lumen of the cavity. It is necessary to activate osteogenesis.

### Table

<table>
<thead>
<tr>
<th>Name of bone with ChO</th>
<th>Group I (n=60)</th>
<th>Group II (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abs</td>
<td>%</td>
<td>Abs</td>
</tr>
<tr>
<td>Ankle bone</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Distal phalanges</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fibula</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Heel bone</td>
<td>4</td>
<td>6.7</td>
</tr>
<tr>
<td>Humerus</td>
<td>5</td>
<td>8.3</td>
</tr>
<tr>
<td>Radial bone</td>
<td>2</td>
<td>3.3</td>
</tr>
<tr>
<td>Tibia</td>
<td>21</td>
<td>35.0</td>
</tr>
<tr>
<td>Thigh</td>
<td>22</td>
<td>36.7</td>
</tr>
</tbody>
</table>

Fig. 1. Tibia with the resected sequester

Subsequently, the sequester’s cavity was filled with sterile dry microgranules of titanium nickelide after...
preliminary rinsing with antiseptic solutions. The amount of implant required for plasty should be not less than 1/3 of the bone cavity volume (Fig. 2).

Results and Discussion. The particular interest is the results of the analysis of the postoperative period in patients of both groups. It was noted that during the assessment of the condition on the 5th day after surgery such signs as edema in the area of surgical intervention and pain in the sutured wound in patients from the group I were less frequent vs. patients in the group II. They were noted in 74.1 % and 58.8 % of patients of the group I, respectively, vs. 89.3 % and 85.7 % in group II (p<0.05). The occurrence of complications in the early postoperative period in the group I was also slightly lower than in the comparison group. Suppuration of postoperative wound occurred in 6.7 % subjects (n=4) in the group I versus 13.2 % (n=4) subjects in the group II; 3.3 % (n=2) subjects in group I noted the absence of pain in the operated limbs; in 16.7 % (n=5) subjects, fistulae were found, and also swelling of soft tissues was noted in the same number of patients. X-ray examination showed signs of bone regeneration in patients of both groups. However, in the group I this process was much more active than in group II. Thus, all patients of the group I had a periostal bone reaction in the area of destruction, whereas in group II it was found only in 42.1 % subjects (n=24). The endosteal response was observed in 40.3 % subjects (n=23) in group I versus 35.7 % (n=10) in group II. The difference in treatment outcomes in patients from the groups was significant. An X-ray performed one month after the surgery showed that in all patients from the group I I had shadows of implant materials with unclear contours in the area of the corrected bone lesions. Over time, the intensity of the darkness increased starting from the edges of the defect. Six months after the surgery, the findings obtained during the examination corresponded to healthy bone tissue and did not change in future (Fig. 3).

At the end of the surgery, the wound was sutured (tightly) with the rubber drainage left for one day. Postoperative management of patients included a 5-day course of antibiotic therapy (Ceftriaxone, Cephatoxin), regular wound dressings, and physiotherapy. The operated limb was immobilized in a physiological position using a plaster bandage for six weeks. Sutures were removed after ten days.

Variation statistics processed data according to Fischer-Student in Statistics 6.0 (StatSoft, USA). Differences were considered significant at p<0.05. None of the patients in group II had a complete obliteration of the bone cavity after the same time. The number of relapses of ChO in the long-term follow-up in the group I did not have, in group II – 10.7 % (n=3). The results of the surgical treatment performed with titanium nickelide, as well as the cosmetic effect, can be characterized as good. Complete restoration of the functions of the operated limbs has been achieved. Based on clinical experience, it can be concluded that the treatment of ChO using sequestrectomy with cavities plasty with finely granulated titanium nickelide allows achieving more favorable outcomes vs. traditional methods. At the same time, small traumatism and simplicity of the new approach should be noted. Its use has some advantages. The main advantages include reduction of the number of postoperative complications, as well as unfavorable long-term outcomes; reduction of the number of relapses; shorter hospital stay; restoration of bone defects in a
shorter period; improvement of the quality of life of the patients.

Conclusions. The results of the experimental studies confirmed good prospectivity and high potential of the use of finely granulated porous titanium nickelide as an implant for the treatment of ChO. Filling bone cavities with biocompatible porous titanium nickelide in the form of microgranules in the surgical treatment of ChO had several advantages. The main ones are the following: faster and more effective resolution of inflammatory processes in the bone tissue, comparative simplicity of the technique and shorter duration of surgery, reduced length of inpatient treatment, and rehabilitation.

When using titanium nickelide implants, the formation of biocomposite is observed in patients, which ensures the preservation of bone strength. This prevents the occurrence of pathological fractures. Titanium nickelide is characterized by mechanical strength, has osteoconductive properties and allows effective filling of cavities with complex anatomical structure. Also, preservation of congruence of composite with bone tissue during bone growth (in case of treatment of children) is noted. The use of titanium nickelide implants significantly increases the quality of life of patients and reduces the likelihood of disability.

Disclosures:
The author declares no conflict of interest.

References

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THE EFFECT OF OXIDATIVE STRESS ON SEMEN QUALITY.
PATHOGENETIC ASPECTS

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ОКСИДАТИВНЫЙ СТРЕСС ПРИ ПАТОСПЕРМИИ.
ПАТОГЕНЕТИЧЕСКИЕ АСПЕКТЫ

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It is known that one of the main pathogenetic mechanisms of male infertility is increasing the level of reactive oxygen species (ROS) in the ejaculate. Thereby identify of pathogenetic factors of oxidative stress in pathospermia is very actually. A retrospective analysis of 230 men with poor semen quality (according to criteria of semen, WHO 2010) and increased ROS