ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Improving The Efficiency Of Dental Implantation Through The Application Of Platelet-Rich Autoplasma. Clinical Study.

S. V. Sirak*, E. N. Iarygina, D. V. Mikhalchenko, A. V. Mikhalchenko, I. V. Firsova, and I. V. Koshel.

Stavropol State Medical University, Stavropol, Mira Str. 310.
Volgograd State Medical University, Pavshikh Bortsov Square 1, Volgograd

ABSTRACT

Reducing the number of complications related with dental implantation and accelerating the recovery periods of patients is one of the most discussed problems in the current dentistry. Understanding the pathophysiology of the processes around the dental implant after it is installed, as well as the body's reaction to the implant, makes scientists and implant manufacturers search for means and methods of influence on the process of osseointegration, including its stimulation and acceleration methods. A large number of ways was proposed for optimization of the process of dental implant osseointegration. This paper presents the results of treatment of patients with partial absence of teeth by dental implantation with the use of platelet-rich autoplasma. The effectiveness of the proposed method was evaluated using clinical methods and periotest data. The obtained results show the effectiveness of the proposed method and indicate the feasibility of its application.

Keywords: implantation, osseointegration, autoplasma, autohemotherapy.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Dental implantation has become generally accepted, affordable and effective treatment for various forms of dentition defects in nowadays. Nevertheless, reducing the number of complications related with dental implantation and accelerating the recovery periods of dental patients still remains an urgent problem [3,5,9]. A number of authors have already conducted studies of the effects on the process of osseointegration. Both additional methods of its stimulation and various methods of preparation of the bone bed or a surface of dental implants have been suggested [2,4,7,8].

To date, the use of platelet-rich autoplasma is promising for dental implantation. The positive effect of autohemotherapy has been already known for a long time, it was originally used in treatment of fractures by creating artificial hematomas, then for the treatment of patients with infectious diseases, furunculosis, and chronic inflammatory diseases [6,11].

Last decade is characterized by a significantly grown interest in the use of platelet autoplasma, due to its high efficiency with a simultaneously high safety level and low cost. Platelet-rich autoplasma has a number of useful properties such as acceleration of tissue regeneration, a pronounced anti-inflammatory effect, and reduction of pain syndrome. Nowadays, a platelet-rich autoplasma is actively used in surgery, dentistry, traumatology, orthopedics, sports medicine, cosmetology, and dermatology [10,12]. Platelet autoplasma is a highly active biological stimulator of regenerative processes due to the platelets of various growth factors contained in its alpha granules, which affect all structural units of the surrounding tissue and stimulate the regeneration processes [1,13]. Platelets are trapped in fibrin network, release their content, and stabilize the clot with their fibrin, collagen and adhesive glycoproteins. The developing fibrin matrix represents a natural fibrin clot, which facilitates normal cellular infiltration of monocytes, fibroblasts and other cells that play an important role in wound healing process. During degranulation, the platelets release a large amount of substances that ensure primary hemostasis as well as growth factors that improve wound healing through autocrine and paracrine mechanisms.

In addition to growth factors, platelet autoplasma contains other proteins, which are considered critical for the initiation of the regeneration process. Plasma contains various adhesion molecules that bind undifferentiated cells together within the clot structure. In addition, platelets produce signaling proteins that attract white blood cells.

Currently, there is information occurring in the professional literature about the use of platelet autoplasma in treating the inflammatory diseases of the maxillofacial region. However, clinical studies based on demonstrative data are scarce, and the obtained results require further study.

OBJECTIVE OF RESEARCH

To study the saturation effectiveness of the porous dental implants surface with platelet-rich plasma in order to stimulate osseointegration of dental implants.

MATERIALS AND RESEARCH METHODS

To achieve the set objectives, a clinical examination of 60 patients with partial absence of teeth being treated in a "dental clinic" was carried out. This group of respondents underwent installation of 78 "Osstem" implants.

The age of patients ranged from 35 to 44 years. The choice of this age group is based on the laws and features of reparative system functioning in healthy people, and is recommended for the clinical trials by the World Health Organization.

The study involved 28 men and 32 women, the citizens of Volgograd and Volgograd region. All patients were divided into two groups. The first (basic) clinical group (30 people) included patients with installed "Osstem" screw dental implant systems. During their installation, the method of saturation of the porous dental implants surface with platelet-rich plasma was applied. The second (control) group of patients consisted of

30 patients. This group of patients were operated by standard technique. They refused from the method of saturation of the porous dental implants surface with platelet-rich plasma. All patients were grouped by simple randomization.

The criteria for inclusion of patients in the study were their written consent, the absence of any comorbidity or the state of remission for more than 6 months.

The patients were examined by standard methods, including clinical, radiological and laboratory studies. Clinical observation was performed in all groups of patients on day 3, 5, 7, 14, and 90. All information was recorded in the case records of dental patients.

The platelet-rich gel preparation protocol includes blood sampling from the cubital vein in a volume of 8-10 ml. Blood is centrifuged 8 min at 1500 rev/min. Centrifugation results in obtaining three fractions (red fibrin clot with erythrocytes, white suspension of lymphoid cells, and platelets, and yellow blood plasma). 2ml supernatant is collected with syringe or pipette, and approximately the same amount of material is left over the lymphoid ring (2 ml or less). The collected plasma is transferred to a vial with 0.5 ml 10% calcium chloride. The solution is let stand for 10 minutes in horizontal position. The remaining plasma is mixed with a lymphocyte suspension, and then transferred with a syringe or pipette to a sterile petri dish. Then, calcium-activated plasma is added gradually. The prepared platelet rich autoplasma is slightly mixed and placed into a sterile container with the implant for 5-7 minutes.

Protocol of dental implant installation and intra-procedure medication were standardized. All patients were under dynamic observation. Treatment efficacy was assessed by clinical and instrumental survey methods. Immediately after the implantation, as well as on day 3, 5, 7, 14, and 90 an objective measurement of implant stability was carried out with Periotest M, by Medizintechnik Gulden e.K. The device is compact, consist of two parts - an instrument unit of electronic analyzer and a tip, interconnected by a cable. The measurement results are presented in the form of digital information on the screen and accompanied by an audiosignal. The device program provides 16-times automatic percussing (4 times at 4 bps). After pressing a button on the tip, an electric pulse is converted into mechanical, which initiates shot stroke on the vestibular surface of the implant at intervals equal to 250 ms. During this period, the stroke-excited pulse passes through the implant body and transferred to the surrounding tissue and reflected therefrom. The method is highly informative, with sufficient level of measurement accuracy, simple, noninvasive, ant convenient for clinical use.

Data obtained from studies were processed by variation statistical method using the application package Statistica 6 and Microsoft Exsel Windows 2000.

RESULTS

Immediately after dental implantation, the implant stability was measured in all patients with the use of “Periotest M” instrument, and the values in the range of -2.22 to -5.78 were obtained. Average index value of the basic group was 3.81 ± 1.08, and “Periotest M” index value of the control group was -3.6 ± 1.29.

On day one after the operation in the main group with the application of saturation of dental implant porous surface with platelet-rich plasma, 4 of 30 patients complained of pain in the wounds (13.3%). Increased body temperature to 37.5°C occurred in 2 patients (6.66%). Changes in facial configuration in the form of postoperative edema of soft tissues were observed in 14 patients (46.6%). The control group, in turn, amounted to 8 (26.6%), 3 (10%), and 18 patients (60%), respectively.

Increased regional, submandibular, genial, and parotid lymph nodes was found in 2 patients (6.66%) of the main group and in 3 patients (10%) of the control. Limited opening of mouth was observed in 2 patients (6.66%) of the main group and in 3 patients (10%) of the control.

During examination of the oral cavity, hyperemia and edema in the area of the surgical wound were detected in 23 patients (76.6%) of the main group and in 27 patients (90%) of the control group, and these changes were localized both in the established standard healing abutments, and in the surrounding soft tissues. Hygienic assessment of the established healing abutments is satisfactory, a half of patients (50%) in both groups has insignificant amount of soft food plaque.

ISSN: 0975-8585

On day three, 3 patients (10%) of the main group and 5 patients (16.6%) of the control group had sensation of pain and changes in facial configuration. None of patients had increased temperature. One patient (3.33%) of the main group and 2 patients (6.6%) of the control group had an enlarged lymph node remaining in the submandibular region, painless on palpation. All patients could freely open their mouth.

During examination of the oral cavity, slight edema and hyperemia of the soft tissue in the operated area was observed in 8 patients (26.5%) of the main group and 12 patients (40%) of the control group.

"Periotest M" readings ranged from -3.4 to -4.2 in the main group, and from -2.8 to -4.32 in the control group. The average index value was -3.63 ± 0.12 and - 3.5 ± 0.691, respectively.

On day five of observation, only one patient (3.3%) from the control group had complaints of pain syndrome. None of patients had disorders of facial configuration.

Examination of oral cavity revealed no visible changes. Slight edema and hyperemia remained in 2 patients (6.66%) of the control group. Stitches were fixed well in all patients. Satisfactory hygienic condition of healing abutments. Only 3 patients (10%) in both groups had soft food plaque detected.

"Periotest M" readings ranged from -3 to 4.6 in the main group, and from -2.1 to -4.32 in the control group. The average index value was -3.41 ± 0.14 and - 3.2 ± 0.51, respectively.

On day seven after dental implantation, the patients of both groups had neither complaints of pain syndrome nor increased temperature. Examination of oral cavity revealed no changes. No edema or hyperemia of soft tissues. Stitches were fixed well in all patients. Satisfactory hygienic condition of stitch lines and healing abutments.

Measurement of implant stability with "Periotest M" in the main group on day seven resulted in the values ranging from -3.1 to -4. Average index value was -3.35 ± 0.13. Control group indices were from -3 to -3.85. Average index value on day 7 was -3.31 ± 0.17.

On day 14, all patients had their sutures removed. By this time, implant stability indices according to periotest findings were -3.71 ± 0.24 in the main group and -3.23 ± 0.18 in the control group.

Clinical observation and study in both groups of patients were conducted also on day 30 and 90. The dynamics of implant stability indices measured with "Periotest M" in the main group was as follows (Table 1).

Table 1. "Periotest M" dynamics of average implant stability indices in the main group

Terms / Group	1 day	3 day	5 day	7 day	14 day	30 day	90 day
Main	-3.81 ± 1.08	-3.63 ± 0.12	-3.41 ± 0.14	-3.35 ± 0.13	-3.71 ± 0.24	-5.15 ± 0.13	-5.43 ± 0.31

The dynamics of implant stability indices measured with "Periotest M" in the control group (Table 2).

Table 2. "Periotest M" dynamics of average implant stability indices in the control group

Terms / Group	1 day	3 day	5 day	7 day	day 14	30 day	90 day
Control	-3.6 ± 1.29	-3.5 ± 0.69	-3.2 ± 0.51	-3.1 ± 0.17	-3.23 ± 0.18	-3.81 ± 0.23	-4.66 ± 0.14

Comparative dynamics of implant stability indices measured with "Periotest M" in the main and control groups was as follows (Fig. 1).

ISSN: 0975-8585

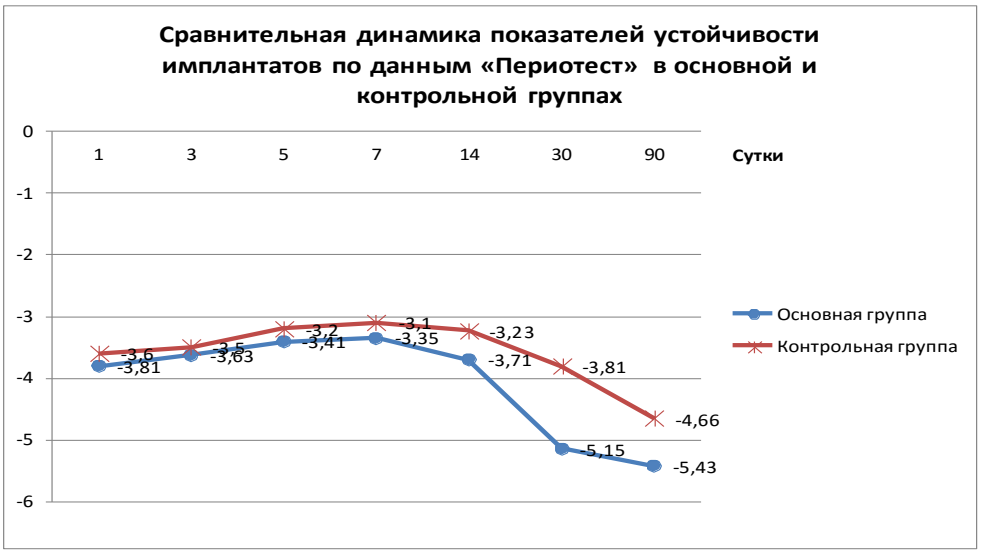

Fig. [1]. "Periotest M" comparative dynamics of implant stability indices.

The most significant differences in the stability indices of the main and control groups were on day 30, a decrease in the difference between indices was observed on day 90.

SUMMARY

Results of the study confirmed the clinical efficacy of platelet autoplasma in the stimulation of osseointegration process of dental implants. Subject to clinical data and hardware monitoring, we can conclude that the use of platelet-rich autoplasma improves the general condition of patients in the postoperative period, reduces pain, and decreases periods of inflammatory response. Despite the availability of multiple techniques that ensure hemostasis after an injury, only a few of them are able to initiate and accelerate tissue regeneration. Use of autologous platelet concentrate enriched with growth factors influences the organization of peri-implant bone by optimizing the process of implant osseointegration, which leads to a more stable "implant-bone" connection. The functional activity of the repaired tissue stimulated by the action of platelet-rich plasma can be increased with the course of time. In all cases, the therapeutic effect affects only the initial stage of the osseointegration process during the first month. It was the increase in implant stability during this period that determined the final acceleration, in particular, of the integration process. Only after, the possibility of manufacturing dentures at an earlier stage, as a consequence, led to reduced general terms of dental treatment on the background of dental implants.

CONCLUSION

The findings of clinical study of the platelet-rich plasma efficiency in the implantation process demonstrate convincingly the accelerated process of dental treatment conducted on the implants.

CONFLICT OF INTERESTS

The author declares that the provided information has no conflicts of interest.

REFERENCES

[1] Vorobiev A.A., Shemonaev V.I., Mikhalchenko D.V., Velichko A.S. Focus on problem of dental implantation in the light of modern scientific concepts / Volgograd scientific and medical journal. 2009. No. 2 (22). Pp. 19-24.

[2] Korobkeev A.A., Sirak S.V., Kopylova I.A. Study of features of the anatomical and topographical structure of the mandible for planning endodontic and implant treatment. In: Medical Bulletin of the North Caucasus. 2010. Vol. 17. No. 1. Pp. 17-22.

[3] Kolesova T.V., Kolesov O.Iu., Mikhalchenko D.V., Denisenko L.N. Analysis of complications of orthopedic treatment with implant-fixed dentures / Fundamental Research. 2013. No. 5-2. Pp. 296-299.

[4] Perikova M.G., Sirak S. Kazieva I., Martirosian A. Assessing the impact of the bioactive coating of screw dental implants on the osseointegration periods (experimental-morphological research) / Modern problems of science and education. 2013. No. 2. P. 35.

[5] Sirak S.V., Kopylova I.A. Planning the endodontic and implantological treatment based on the anatomical and topographical features of the mandibular structure / Bulletin of the Smolensk State Medical Academy. 2010. No. 2. Pp. 129-131.

[6] Mikhalchenko D.V., Poroshin A.V., Mikhalchenko V.F., Firsova I.V., Sirak S.V. Influence of transcranial electrostimulation on the osseointegration of dental implant in the experiment // Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2014. Vol. 5. No. 5. Pp. 705-711.

[7] Mikhalchenko D. V., Badrak E.Yu., Mikhalchenko A. V., Yarygina E. N. The internal interface of dental implants as a hotbed of chronic infection / Medical News of North Caucasus. - 2015. – Vol. 10. № 3- P. 307-309.

[8] Grimm, W.D. Translational research: palatal-derived ecto-mesenchymal stem cells from human palate: a new hope for alveolar bone and cranio-facial bone reconstruction / W.D.Grimm, A.Dannan, B.Giesenhagen, I.Schau, G.Varga, M.A.Vukovic, S.V.Sirak // International Journal of Stem Cells. – 2014. - 7(1). – P.23-29.

[9] Grimm, Dr.W.-D. Complex, three-dimensional reconstruction of critical size defects following delayed implant placement using stem cell-containing subepithelial connective tissue graft and allogenic human bone blocks for horizontal alveolar bone augmentation: a case report as proof of clinical study principles / Dr.W.-D.Grimm, M.Ploger, I.Schau, M.A.Vukovic, E.V.Shchetinin, A.B.Akkalaev, R.A.Avanesian, S.V.Sirak // Medical Bulletin of North Caucasus. - 2014. - Vol. 9. - No. 2. - Pp. 125-127. DOI: 10.14300/mnnc.2014.09037

[10] Grimm W.D. Prefabricated 3d allogenic bone block in conjunction with stem cell-containing subepithelial connective tissue graft for horizontal alveolar bone augmentation:a case report as proof of clinical study principles/Grimm W.D., Plöger M., Schau I., Vukovic M.A., Shchetinin E., Akkalaev A.B., Arutunov A.V., Sirak S.V.//Medical Bulletin of North Caucasus. - 2014. - Vol.9. - No. 2(34). - Pp. 175-178.

[11] Mikhalchenko, D.V. Influence of transcranial electrostimulation on the osseointegration of dental implant in the experiment/Mikhalchenko D.V., Poroshin A.V., Mikhalchenko V.F., Firsova I.V., Sirak S.V.//Research Journal of Pharmaceutical, Biological and Chemical Sciences. - 2014. - Vol.5. - No. 5. Pp. - 705-711. 2014. -

[12] Sirak, S.V. Microbiocenosis of oral cavity in patients with dental implants and over-dentures/Sirak S.V., Avanesyan R.A., Akkalaev A.B., Demurova M.K., Dyagtyar E.A., Sirak A.G.//Research Journal of Pharmaceutical, Biological and Chemical Sciences. - 2014. - Vol.5. - No. 5. - Pp. 698-704. 2014. -

[13] Sirak, S.V. Clinical and morphological substantiation of treatment of odontogenic cysts of the maxilla/Sirak S.V., Arutyunov A.V., Shchetinin E.V., Sirak A.G., Akkalaev A.B., Mikhalchenko D.V.//Research Journal of Pharmaceutical, Biological and Chemical Sciences. - 2014. - Vol. 5. - No. 5. - Pp. 682-690.