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Journal of Diagnostics and Treatment of Oral and Maxillofacial Pathology

Editors
Oleksii Tymofieiev • Rui Fernandes
(Kyiv, Ukraine • Jacksonville, FL, USA)

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Ukrainian Association for
Maxillofacial and Oral Surgeons

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About the Journal: Aims and Scope

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Aims & Scope

This is a monthly peer-reviewed oral and maxillofacial surgery journal focused on: Microvascular and jaw reconstructive surgery, dental implants, salivary gland tumors/diseases, TMJ lesions, virtual surgical planning, implementation of ultrasonography into the practice of oral and maxillofacial surgeons.

Editorial Board (EB) Composition

- EB shows significant geographic diversity representing 27 opinion leaders from 13 countries: Brazil, Canada, Colombia, Greece, Hong Kong (SAR, China), India, Israel, Italy, Slovak Republic, Spain, Ukraine, United Arab Emirates, and United States.
- The majority of the EB Members have a discernible publication history in Scopus, Web of Science, and journals with a high impact factor.
- The publication records of all EB members are consistent with the stated scope and published content of the journal.
- The journal has a several full-time professional editors.
- Gender distribution of the editors: 11.11% women, 88.88% men, 0% non-binary/other, and 0% prefer not to disclose.

Frequency

12 print/online issues a year (from January 2020)

Publication History

2017: 4 issues a year
2018: 4 issues a year
2019: 10 issues a year
From 2020: 12 issues a year

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Journal of Diagnostics and Treatment of Oral and Maxillofacial Pathology is a fully open access and peer-reviewed publication.

Type of Peer Review

The journal employs "double blind" reviewing.

Article Publishing Charge (APC)

During hard times of Covid-19 pandemic our journal trying to support authors by reducing the APC by 50%. And by the end of October 2021 the APC will be 100 USD and 50 USD (excluding taxes) depending on the article`s type. Details at website: dtjournal.org.

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Editorials/Guest Editorials/Post Scriptum Editorials, Images, Case Reports/Case Series, Original Articles, Review Articles, Discussions, Paper Scans (*synonyms*: Review of Articles, Literature Scan), Book Scans (*synonym*: Book Reviews), Letters to the Editor (*synonym*: Letters), and Viewpoints.

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See page A5.

Editorial Board

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TANTUM VERDE®

INFORMATION LEAFLET
for the medicinal product

Composition:
active substance: **benzydamine hydrochloride**;
100 mL of solution contain benzydamine hydrochloride 0.15 g;
excipients: ethanol 96%, glycerol, methyl parahydroxybenzoate (E 218), flavor (menthol), saccharin, sodium hydrocarbonate, Polysorbate 20, Quinoline Yellow (E 104), Patent Blue V (E 131), purified water.

Dosage form. Oromucosal solution.
Basic physical and chemical properties: a clear green liquid with a typical mint flavor.

Pharmacotherapeutic group. Dental preparations. Other agents for local oral treatment.
ATC code: A01A D02.

Pharmacological properties.
Pharmacodynamics.
Benzydamine is a non-steroidal anti-inflammatory drug (NSAID) with analgesic and antiexudative properties.

Clinical studies have shown that benzydamine is effective in the relief of symptoms accompanying localized irritation conditions of the oral cavity and pharynx. Moreover, benzydamine has anti-inflammatory and local analgesic properties, and also exerts a local anesthetic effect on the oral mucosa.

Pharmacokinetics.
Absorption through the oral and pharyngeal mucosa has been proven by the presence of measurable quantities of benzydamine in human plasma. However, they are insufficient to produce any systemic pharmacological effect. The excretion occurs mainly in urine, mostly as inactive metabolites or conjugated compounds.

When applied locally, benzydamine has been shown to cumulate in inflamed tissues in an effective concentration due to its ability to permeate through the mucous membrane.

Clinical particulars.
Indications.
Symptomatic treatment of oropharyngeal irritation and inflammation; to relieve pain caused by gingivitis, stomatitis, pharyngitis; in dentistry after tooth extraction or as a preventive measure.
Contraindications.
Hypersensitivity to the active substance or to any other ingredients of the product.

Interaction with other medicinal products and other types of interaction.
No drug interaction studies have been performed.

Warnings and precautions.
If sensitivity develops with long-term use, the treatment should be discontinued and a doctor should be consulted to get appropriate treatment.

In some patients, buccal/pharyngeal ulceration may be caused by severe pathological processes. Therefore, the patients, whose symptoms worsen or do not improve within 3 days or who appear feverish or develop other symptoms, should seek advice of a physician or a dentist, as appropriate.

Benzydamine is not recommended for use in patients hypersensitive to acetylsalicylic acid or other non-steroidal anti-inflammatory drugs (NSAIDs).

The product can trigger bronchospasm in patients suffering from or with a history of asthma. Such patients should be warned of this.

For athletes: the use of medicinal products containing ethyl alcohol might result in positive antidoping tests considering the limits established by some sports federations.

Use during pregnancy or breast-feeding
No adequate data are currently available on the use of benzydamine in pregnant and breastfeeding women. Excretion of the product into breast milk has not been studied. The findings of animal studies are insufficient to make any conclusions about the effects of this product during pregnancy and lactation.

The potential risk for humans is unknown.

TANTUM VERDE should not be used during pregnancy or breast-feeding.

Effects on reaction time when driving or using machines
When used in recommended doses, the product does not produce any effect on the ability to drive and operate machinery.

Method of administration and doses.
Pour 15 mL of TANTUM VERDE solution from the bottle into the measuring cup and gargle with undiluted or diluted product (15 mL of the measured solution can be diluted with 15 mL of water). Gargle 2 or 3 times daily. Do not exceed the recommended dose.

Children.
The product should not be used in children under 12 years due to a possibility of ingestion of the solution when gargling.

Overdosage.
No overdose has been reported with benzydamine when used locally. However, it is known that benzydamine, when ingested in high doses (hundreds times higher than those possible with this dosage form), especially in children, can cause agitation, convulsions, tremor, nausea, increased sweating, ataxia, and vomiting. Such acute overdose requires immediate gastric lavage, treatment of fluid/salt imbalance, symptomatic treatment, and adequate hydration.

Adverse reactions.
Within each frequency group, the undesirable effects are presented in order of their decreasing seriousness.

Adverse reactions are classified according to their frequency: very common (≥ 1/10); common (≥ 1/100 to <1/10); uncommon (≥ 1/1,000 to <1/100); rare (≥ 1/10,000 to <1/1,000); very rare (<1/10,000); frequency unknown (cannot be estimated from the available data).

Gastrointestinal disorders: rare – burning mouth, dry mouth; *unknown* – oral hypesthesia, nausea, vomiting, tongue edema and discoloration, dysgeusia.

Immune system disorders: rare – hypersensitivity reaction, *unknown* - anaphylactic reaction.

Respiratory, thoracic and mediastinal disorders: very rare –laryngospasm; *unknown* – bronchospasm.

Skin and subcutaneous tissue disorders: uncommon – photosensitivity; *very rare* – angioedema; *unknown* – rash, pruritus, urticaria.

Nervous system disorders: unknown – dizziness, headache.

TANTUM VERDE contains methyl parahydroxybenzoate, which can cause allergic reactions (including delayed-type reactions).

Shelf life. 4 years.

Storage conditions.
Do not store above 25°C. Keep out of reach of children.

Packaging.
120 mL of solution in a bottle with a measuring cup; 1 bottle per cardboard box.

Dispensing category.
Over-the-counter medicinal product.

Manufacturer.
Aziende Chimiche Riunite Angelini Francesco A.C.R.A.F. S.p.A., Italy.

Location of the manufacturer and its business address. Via Vecchia del Pinocchio, 22 – 60100 Ancona (AN), Italy.

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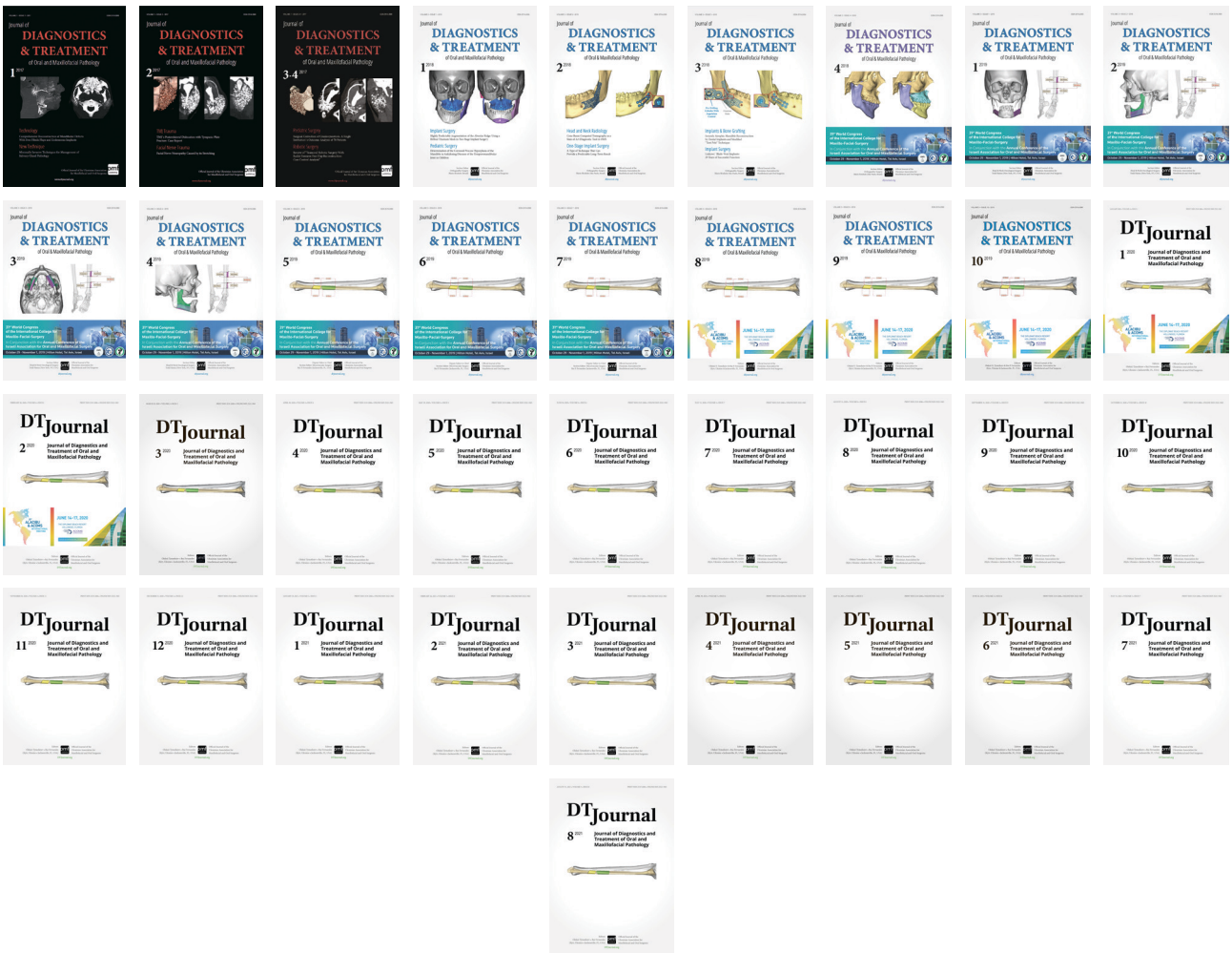

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COURTESY

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Image was taken from the article: Fernandes RP, Quimby A, Salman S. Comprehensive reconstruction of mandibular defects with free fibula flaps and endosseous implants. *J Diagn Treat Oral Maxillofac Pathol* **2017**;1(1):6–10.

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SECTION BUSINESS: LETTER

Ivan V. Nagorniak, MSc, PhD, *Section Editor*

Opening New Markets for Your Private Practice Business and Manufacturing in Oral Surgery Needs

Sebastien Camara[a] & Dmytro M. Zagorodnyi[b,*]

A little competition is a good thing and severe competition is a blessing. Thank God for competition.
—Jacob Kindleberger
Germany-borned United States mill owner

Oral surgery and dentistry are highly competitive fields. Competition among private practices in Ukraine is intensifying. Moreover, according to the 2016 data, 3,734 private dental/stomatological clinics (offices) were registered in this country.[1,2] And this despite the fact that the first private clinics in modern Ukraine start to appear only in 1991, the year of independence after the collapse of the Soviet Union. That is, we can assume that the market of private clinics for 25 years in Ukraine has grown by phenomenal 3,734 percent. At the same time, there is a tendency towards a decrease in the number of state stomatological policlinics what is also a part of the field`s evolution.[1,2]

The interesting thing we should understand is that some of private clinics and their owners can compete not only in the treatment process, but also as manufacturers and sellers of the products for dentistry/oral surgery.

Previously, only a CE marking (*CE* abbreviation of *Conformité Européenne* [in French] mean *European Conformity*) and a dealer's office were required to operate in the EU market, but now, due to the reformatting of the legislation, it is necessary to have an authorized representative. Such companies` sectors as U-Represent[3] can help Ukrainian manufacturers in uncomplicated and inexpensive way to reach European Union and Switzerland markets. The services of U-Represent are: *1)* Pre-audit document review, *2)* conformation of documents, *3)* archive and storage location, *4)* products registration in European database on medical devices (EUDAMED), *5)* post-market surveillance monitoring, etc.[3]

Thus, with authorized representatives, who are doctors with PhD and certified ISO (ie, the International Organization for Standardization) professionals, your dental business and manufacturing can hold a strong position not only on domestic market but also to take a share in the growing European and Switzerland marketplaces.

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2. Mazur IP, Pavlenko OV, Blyzniuk VG. The current state of dental care in Ukraine (in Ukrainian). *Medical newspaper "Health of Ukraine of the XXI century"* **2017**;415(18):74–5.
3. U-represent: authorised representative for EU and Swiss markets [document on the internet]; June 01, **2021** [cited 2021 Aug 02]. Available from: https://u-represent.com/

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ORIGINAL

Influence of the Neural Crest-derived Stem Cells to Optic Nerve Regeneration after Its Experimental Injury

Yurii V. Chepurnyi[a,*], Andrii V. Kopchak[a], Alina Korsak[a], Volodymyr Likhodievskyi[a], Yurii Chaikovskyi[a], Alona Zlatska[b], Olga Gubar[c], Inna Gordiienko[d], & Anzhela E. Rodnichenko[b]

ABSTRACT

Purpose: Orbital trauma is a challenging problem due to such severe sequel as diplopia, decrease of vision or eye motility disorder. However, the conditions of orbital soft tissue content still have been underestimated. The aim of this study was to investigate structural changes in the rat optic nerve after experimental injury followed by treatment with stem cells.

Materials and methods: An experimental model of injury to the orbital soft tissue content in the rat was developed. Forty Wistar rats maintained under daylight were divided into two equal experimental groups. Unlike the rats of Group I, the site of injury to the orbital soft tissue mass in rats of Group II received the postnatal multipotent stem cells, namely epidermal neural crest stem cells (eNCSCs) derived from the bulge of hair follicles.

Results: Comparing the number of glial cells per certain area of the slice (NC – number of cells) between Group I and site without injury (control) after 3 week of observation shows that it was higher in Group I more than 258.8% ($P < 0.0001$) and 272.4% in Group II ($P < 0.0001$). After 6 weeks NC in Group I was higher than at previous terms: more then 128.9% ($P < 0.0001$). At the same, NC in group II was higher comparing with previous terms only 17.1% ($P = 0.0212$). Between the animals of Group I at terms of 12 and 24 weeks the NC was high and didn't differ significantly between this terms of observation (ANOVA $P = 0.4379$). In contrast, the NC in Group II stopped rising between 6 and 12 weeks demonstrating statistical equality ($P = 0.4563$).

Conclusions: It can be assumed that the application of mesenchymal stem cells, namely derivates of the neural crest, after the experimental orbital trauma stimulates a recovery of the optic nerve. Further studies should be performed to study more deeply the neural crest derived stem cell populations, involved into recovery of damaged optic nerves.

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INTRODUCTION

Orbital trauma still become a challenging problem due to such severe sequel as diplopia, decrease of vision or eye motility disorder. All mentioned sequelae dramatically decrease the quality of life of the patients, influencing their social activity and lead in some cases to partial or total professional disability.[1–3] In most cases, orbital trauma results from the direct or indirect injuries of orbital bony structures, as well as orbital soft tissue content. Orbital wall fractures lead to appearance of the bony defects requiring reconstruction. Besides, soft tissue structures may be injured by the little bony fragments or due to compression and hypoxia of increasing swelling or hematoma.[4–6]

Usually, much attention is paid to precise reconstruction of the orbital walls, when the conditions of the soft tissue content remains underestimated. Such nervous structures as cranial nerves and optic nerve can be damaged with loose of their inherent function and following functional disability. Injuries to the organs of the nervous system have been especially difficult to treat due to their potential for regeneration.[7,6] Although numerous relevant studies have been conducted, and the pathogenesis of optic nerve damage has been thoroughly investigated, effective methods to promote regeneration of damaged optic nerve are still to be developed.[2, 8–11] Due to this, therapeutic influence to the regeneration of the nervous structures of the orbital soft tissue content could be recognized as appropriate component of complex orbital trauma management in addition to surgical reconstruction. However, treatment strategies capable of effecting major phases of the regenerative process should be developed. The use of stem cells for this purpose has been found especially promising.[12]

Among the variety of the different types of stem cells, used in regenerative medicine, the adult neural crest-derived stem cells (aNCSCs) could be the most promising ones, concerning regeneration of orbital soft-tissue content. According to Blentic et al[13] a significant part of the maxilla-facial skeleton, including bones of the orbit except minor wing of the sphenoid, originates from ectomesenchyme – derivate of neural crest. After specification and migration to target tissues and organs the neural crest cells originate different types of tissues, including the bone, cartilage and connective tissue in the head and neck region, neurons and glia of the peripheral nervous system, melanocytes, endothelial cells etc. The main advantages of aNCSCs, mentioned in the literature, are capability to most wide-ranging multilineage differentiation and the plasticity of the HOX code, which allows modifying their original one after transplantation into the damaged tissue site, acquiring the characteristic of recipient tissues' HOX code. Due to above mentioned, therapeutic application of the aNCSCs allows to suspect the restoration of a bone,[14,15] as well as damaged nerves and muscles, which makes them attractive candidates for application in regenerative medicine,[16,15] especially in the field of orbital trauma managements.

The aim of this study was to investigate structural changes in the rat optic nerve after experimental injury followed by treatment with stem cells.

MATERIALS AND METHODS

This study was performed in accordance with the ethical standards of the institutional and national research committees, the laws of Ukraine and the 1964 Helsinki declaration and its later amendments. The study protocol was approved by the Bogomolets National Medical University Bioethics Committee (Protocol No 126).

An experimental model of injury to the orbital soft tissue content in the rat was developed. Forty Wistar rats (weight, 180-220 g) maintained under daylight were divided into two equal experimental groups. With the animal under thiopental sodium anesthesia (50 mg/kg, intraperitoneally), the orbital soft tissue content was injured by separation of the fat tissue and oculomotor muscles with following clamping with forceps of the middle third of the intraorbital portion of the optic nerve for 30 seconds.[17] Unlike the rats of Group I, in rats of Group II, the site of injury to the orbital soft tissue mass received postnatal multipotent stem cells, epidermal neural crest stem cells (eNCSCs) derived from the bulge of hair follicles.[18] The surgical wound was sutured in layers.

At weeks 3, 6, 12 and 24 after experimental injury, the optical nerve (intraocular portion, intraorbital portion, intracanalicular portion and intracranial portion going up to the optic chiasma) was taken for study and compared with that of the normal (control) contralateral orbit. Animals were euthanized with an overdose of thiopental sodium prior to taking the

material for study. The material was fixed in 10% neutral phosphate buffered formalin. Hematoxylin and eosin staining, silver nitrate impregnation, and Spielmeyer staining were used to investigate the structure of the optic nerve. Optic nerves were washed in phosphate buffer solution. Sections of the optic nerve were cut on a freezing microtome and impregnated by the silver nitrate method ("rapid method for impregnation of the components of the peripheral nervous system with silver nitrate").[19] In addition, the material was stained for the demonstration of myelin sheaths by the Spielmeyer method. After conventional histological processing, the optic nerve was embedded in paraffin, and longitudinal and transverse sections were cut serially and stained with hematoxylin and eosin. Photographs were taken with a digital camera (C-4040 Zoom; Olympus, Tokyo, Japan) attached to a light microscope (Olympus model BX51). ImageJ 1.51a (National Institutes of Health [NIH], Bethesda, Maryland, United States; http://rsbweb.nih.gov/ij) was used for the analysis of digitized images.

For morphometric evaluation the number of glial cells per certain area of the slice (NC – number of cells) was measured. The measurement was performed in ImageJ 1.50 (NIH, Bethesda, Maryland, United States, freeware). Acquired data were processed in the software environment SPSS Statistics (version 18.0, SPSS, Chicago, Illinois, USA) for statistical evaluation.

To determine the nature of the sample distribution, Shapiro-Wilk test for normality was performed. Statistical analysis involved the calculation of mean values, standard deviation and mean error. The assessment of the reliability of discrepancies between the studied indicators was based on the use of ANNOVA test with following pared parametric Student's t-test. Statistical discrepancies were considered significant at a confidence level of 95 percent ($P < 0.05$).

RESULTS

Due to pared comparison of groups, it was noted that the NC in all groups and at all terms of experiment were significantly higher, comparing with control ($P < 0.0001$ for all comparisons) (Fig 1).

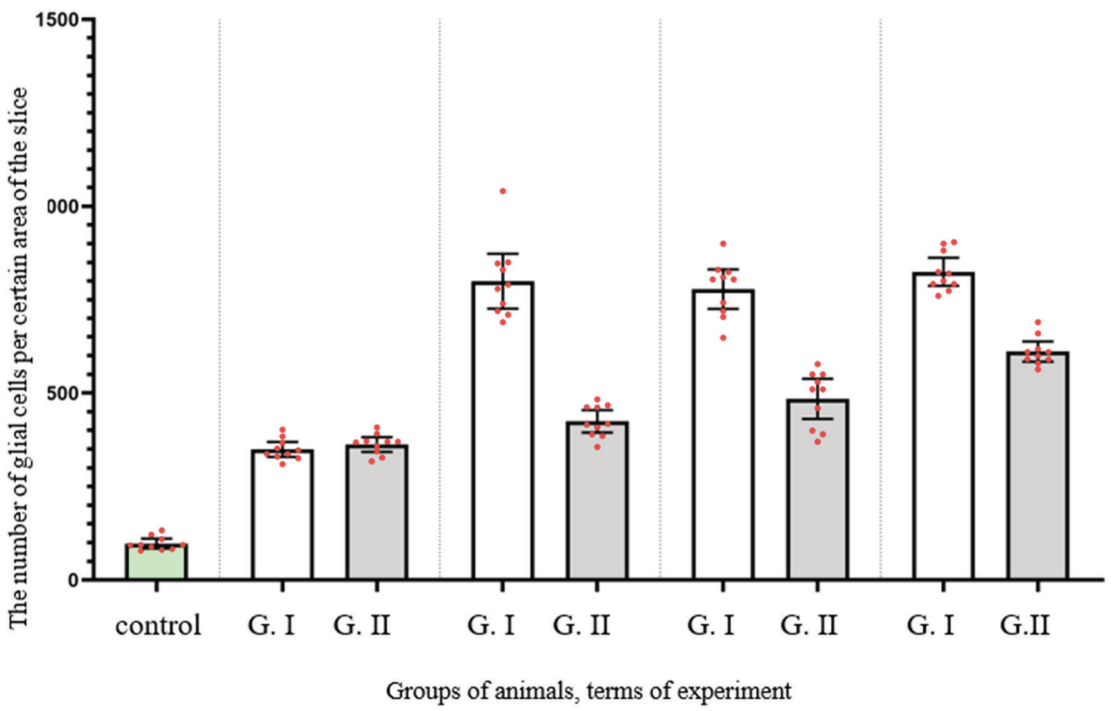

FIGURE 1. Results of morphometric evaluation of the number of glial cells per certain area of the slice at the area of the optic nerve injury between experimental groups.

Common to animals of both experimental groups was the development of early degenerative changes in response to injury. Such changes were manifested not only by the development of retrograde, but also by anterograde degeneration of nerve fibers at the observation period of 3 and 6 weeks. The general trend in animals of both groups was a slower course of an anterograde degeneration than of a retrograde one. Differences were also found between animals of experimental Groups I and II: at 3 weeks the degeneration process was faster and more complete in Group II animals, which was manifested in less amount of myelin and less number of cells in all parts of the nerve.

Comparing the NC between Group I and control after 3 week of observation (Fig 2) it was higher in Group I more than 258.8% ($P < 0.0001$). The same tendency was noted in Group II in the same terms of observation (Fig 3): the NC was 272.4% higher than in control ($P < 0.0001$).

After 6 weeks of observation in animals of both experimental groups the changes indicated both the completion of degeneration and the beginning of regeneration. However, animals of Group II demonstrated more intensive regeneration processes and earlier onset, what was probably due to faster decay of degraded myelin and is manifested by more nerve fibers in the central part of the nerve, fewer astrocytes and a more orderly arrangement. The NC in Group I decreased and became much higher than at previous terms: more then 128.9% ($P < 0.0001$). At the same time, the NC in Group I have not risen so dramatically and was higher comparing with previous terms only 17.1% ($P = 0.0212$).

The changes noted at 12 weeks (Figs 4 and 5) after injury indicated a more pronounced and complete regeneration of the nerve fibers, which was manifested in greater numbers in all parts of the optic nerve in animals of Group II. Also, a less number of astrocytes in all parts of the optic nerve in animals of Group II was observed, which can be regarded as less pronounced signs of glial scarring in animals of this group.

Between the animals of Group II at terms of 12 and 24 weeks, the NC was high and did not differ significantly between this terms of observation (ANOVA $P = 0.4379$). In contrast, the NC in Group II stopped rising between 6 and 12 weeks demonstrating statistical equality ($P = 0.4563$).

The changes detected at 24 weeks were typical for late neural regeneration. In animals of Group I, regeneration was defective, manifested only by single fibers that have sprouted through the site of injury, which contained a large number of cells and could be regarded as the formation of a glial scar. The decrease in the number of nerve fibers in Group II animals at this observation period could probably be explained by the degeneration of those nerve fibers that have not reached the end point of innervation. At this terms there were no significant differences in Group I comparing with results, noted after 12 weeks. At the same time, Group II demonstrated increase of the NC in 26.1%, comparing with previous term of observation ($P = 0.0059$).

Comparing both groups, the NC was statistically equal only after two weeks of experiment ($P = 0.9923$). However, after 6 weeks, it was lower than 46.9 % in Group II ($P < 0.0001$). The same tendency was noted at the terms of 12 and 24 weeks, when it was lower more then 37.7% and 25.9% respectively ($P < 0.0001$ for both terms) (Table 1).

TABLE 1. Number of Glial Cells per Certain Area of the Slice in Different Terms of the Experiment.

Groups	Weeks of Examination			
	3	6	12	24
Control	97.39			
Group I (injury)	349.4±27.95*	799.7±102.4* †	778.6±73.87*	824.8±52.46*
Group II (injury + HF-NCSC)	362.7±27.19*	424.8±41.88* † ‡	484.8±74.87* ‡	611.3±37.79* † ‡

* Significant differ than in control

† Significant differ than in previous terms of experiment

‡ Significant differ than in previous group

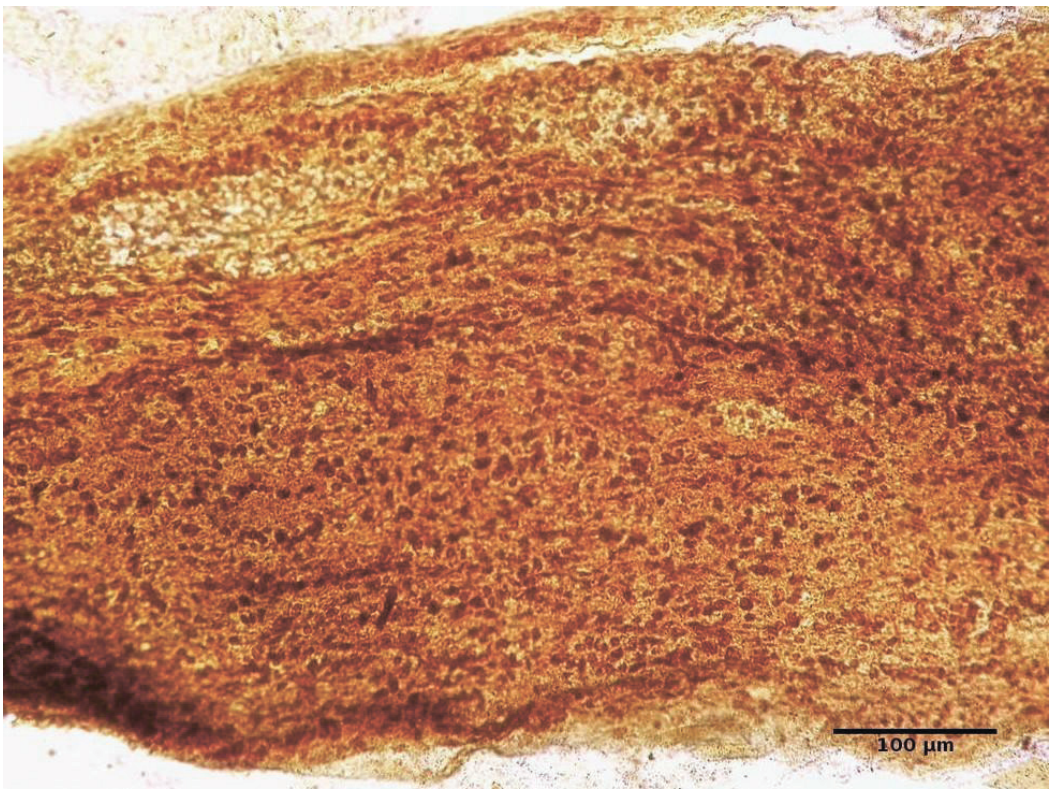

FIGURE 2. Infraorbital part of the optic nerve of the rat. Group I: 3 weeks after injury. Silver nitrate impregnation.

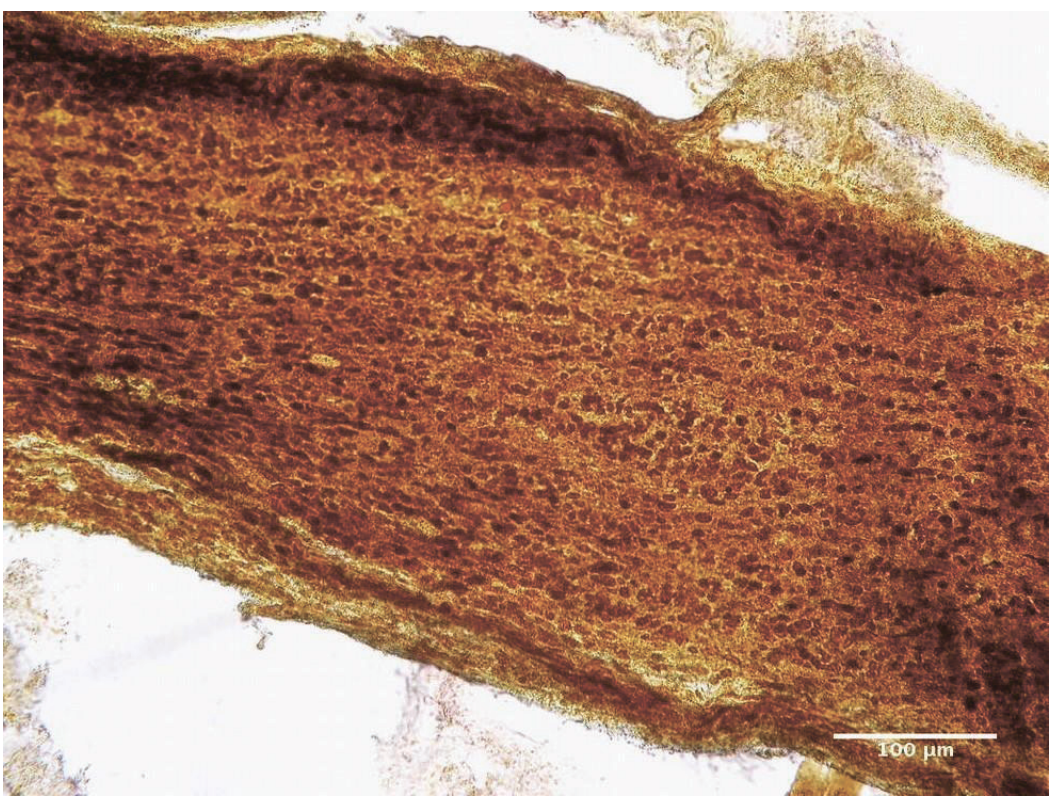

FIGURE 3. Infraorbital part of the optic nerve of the rat. Group II: 3 weeks after injury. Silver nitrate impregnation.

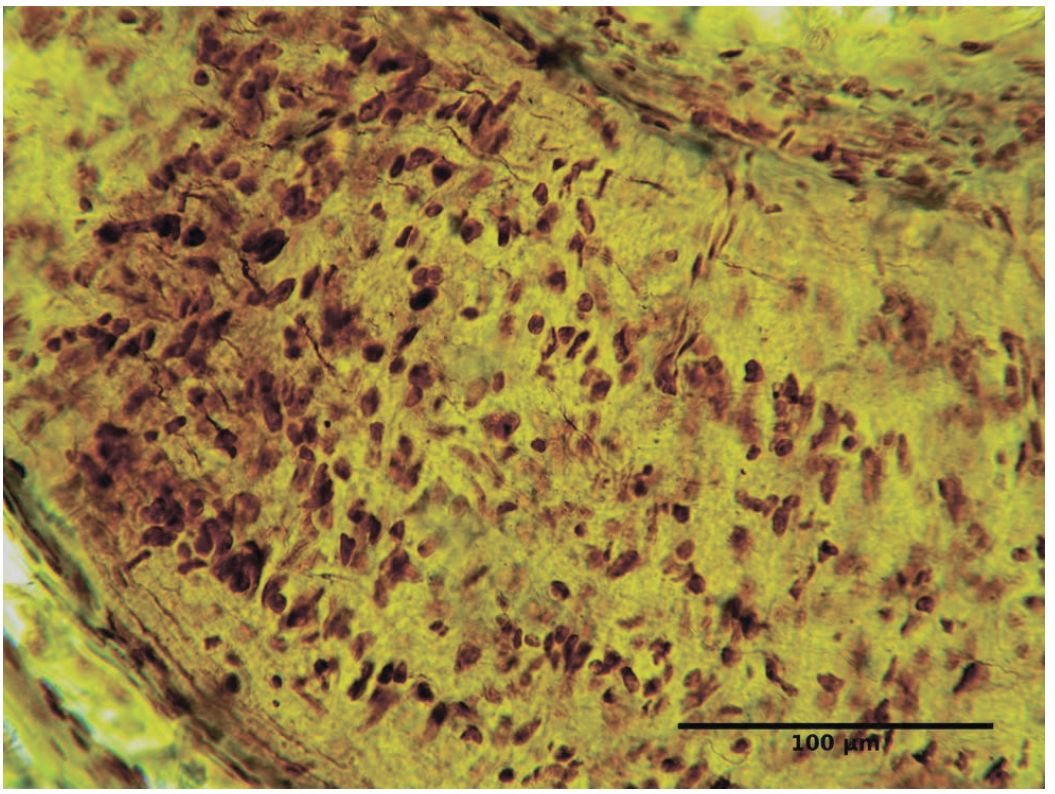

FIGURE 4. Infraorbital part of the optic nerve of the rat. Group I: 12 weeks after injury. Silver nitrate impregnation.

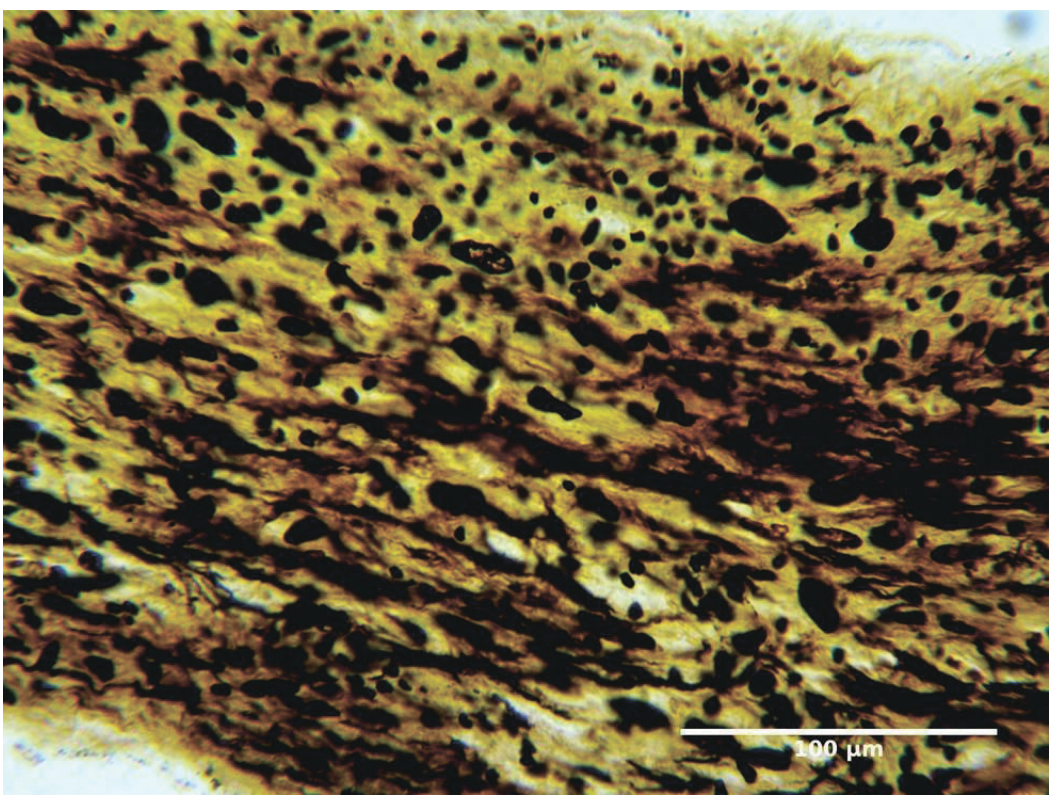

FIGURE 5. Infraorbital part of the optic nerve of the rat. Group II: 12 weeks after injury. Silver nitrate impregnation.

DISCUSSION

The developed model of orbital trauma of the orbital allows reproducing destructive changes in its content and deep degeneration of the optic nerve, which is consistent with the literature.[11,1,7] According to the literature there are several major factors that complicate the regeneration of the optic nerve. On the one hand, trauma induces apoptosis of retinal ganglion neurons and there is a genetically determined weak ability of injured axons of mature retinal ganglion cells of the retina to regenerate. On the other hand, slow elimination of destructured myelin and formation of glial scar at the site of injury delay the growth of regenerating axons.[5] Additionally, there is a difficulty of directed growth and restoration of initial connections with the brain during regeneration of injured nerve fibres.[16]

According to the literature, NCSCs have properties that can be used to achieve the goal of the study and can be applied to stimulation of the optic nerve regeneration. The most important of them are ability to multilineage differentiation to glial cells, as well as indirect influence to regeneration due to homing, excretion of vasculogenic or other trophic factors, cytokines and cellular messengers. Numerous studies have proven the survival of stem cells at the site of spinal cord injury up to 6 months after implantation and their low ability to migrate and the lack of tumorigenic potential.[16,20–22] It has also been shown that one third of the injected stem cells begin to express RIP (marker of oligodendrocytes), which indicates their differentiation into immature oligodendrocytes. The other part of the stem cells expresses bIII-Tubulin, which indicates their differentiation into neurons.

It was found that NCSCs at the site of injury begin to express VEGF-A and VEGF-B, which contribute to the vascularization of the site of injury.[8,12] Analysis of the genetic profile of eNCSCs revealed that these cells express NGF and BDNF (growth factors), which maintain the viability of neurons. It was also found that the axons in the white matter of the injured spinal cord grow towards the implanted eNCSCs.[23]

According to our study, the use of stem cells initiates the acceleration and improvement of the regeneration of the optic nerve, as evidenced by the appearance of young newly formed nerve fibers, glial cell columns, which are formed mainly of oligodendrocytes, reducing glial scarring by reducing the number of astrocytes and remnants of destroyed myelin. The presence of nerve fibers in the second group of animals at week 6 of the study in the central and peripheral segments can be explained by the ability of stem cells to protect retinal ganglion neurons and the ability of eNCSCs to transform into neurons. The appearance of more ordered columns of oligodendrocytes can be attributed to the ability of stem cells to differentiate in the direction of immature oligodendrocytes. An increase in the number of oligodendrocytes and a decrease in the number of astrocytes may reduce the severity of the glial scar at the site of injury. Acceleration of elimination of the destroyed myelin remains is possible due to improvement of vascularization of the injured nerve that is caused by ability of stem cells to express the corresponding factors.

The changes detected after 12 and 24 weeks of the study, in the form of a decrease in the number of nerve fibers in group I can be regarded both as a delay in regeneration and as a consequence of its inferiority, because of an increase of glial cell number. According to studies, conducted by Fitzgerald et al[4] and Zhang et al[24], an increase of glial cell number is a universal response to trauma and axonal degeneration or death of retinal ganglion cells. In contrast, in group II animals after 12 and 24 weeks, although there was a decrease in the number of nerve fibers in the peripheral segment, the growth of the gliocytes number was not so rapid, indicating less pronounced scarring and more successful regeneration.

CONCLUSIONS

It can be assumed that the application of mesenchymal stem cells, namely derivates of the neural crest, after the experimental orbital trauma, stimulates a recovery of the optic nerve. Further studies should be performed to study more deeply the neural crest derived stem cell populations, involved into recovery of damaged optic nerves.

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ROLE OF CO-AUTHORS IN WRITING

All authors contributed equally to the concept and design of the study; writing, editing, and final

review of the manuscript.

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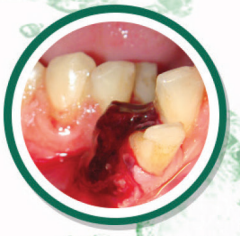

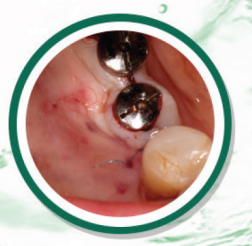

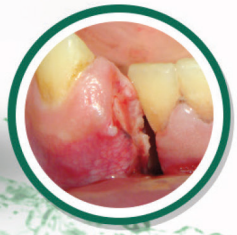

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