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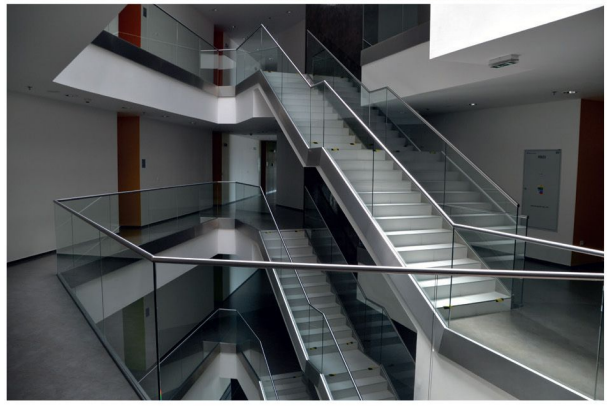

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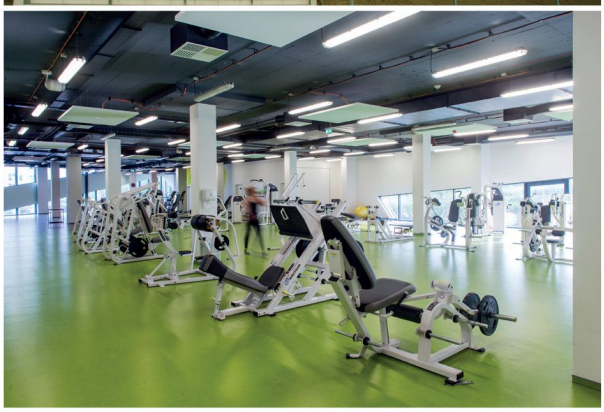

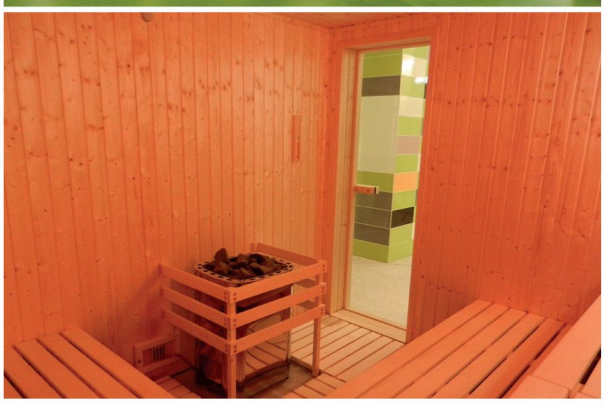

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Reviewers

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editorial

Dear Readers,

The journal "Zdravotníctvo a sociálna práca" (Health and Social Work) was renamed in 2021 to International Journal of Health, New Technologies and Social Work.

Our long-term effort is to gradually acquire for the journal European significance and be included in international databases. Starting with issue No. 4 in 2016, the journal accepted the Harvard style of referencing, and changed guidelines for the authors. The aim of the changes was to move closer to the standard in international journals published in English in the area of health and helping professions. The editors are aspiring for registration in other relevant international databases. Since last 2020 the journal has published all articles in English only.

The journal "Zdravotníctvo a sociálna práca" *(Health and Social Work)* was established in 2006 at Faculty of Health and Social Work blessed to P. P. Gojdič in Prešov and St. Elizabeth University College of Health and Social Work in Bratislava. In 2022, the journal celebrated its 17th year of publication.

Previously professional journal, within 5 years developed into an international, peer-reviewed scholarly journal, published quarterly (4 issues per year). The journal were published by the St. Elizabeth University of Health and Social Work in Bratislava. The journal became international in 2009. The journal was published and distributed in the Slovak Republic and also in the Czech Republic.

Since 2011, the journal is published both in print and as electronic issues, available from: www.zdravotnictvoasocialnapraca.sk. Starting by issue No. 3 in 2014, the scope of the journal has broaden and the journal is covering health sciences, such as Public Health, Nursing, Laboratory Medicine, but also helping professions such as Social Work or Pedagogy. Collaboration with Faculty of Health and Social Work of Trnava University in Trnava was initiated.

The journal is indexed in the following databases: Central and Eastern European Online Library — CEEOL (since 2018), Bibliographia Medica Slovaca (BMS), and Slovak reference database CiBaMed.

The part of journal is Supplementum, to publish abstracts from international conferences organized by the St. Elizabeth University of Health and Social Work in Bratislava.

prof. Miron Šrámka, MD, DSc.
redactor-in-chief

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The effect of Physiotherapy on painful heel affections after the Covid-19 pandemic

Efekt fyzioterapie bolestivých afekcií päty po pandémii Covid-19

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ABSTRACT

Introduction: Painful affections of the heel represent a condition that affects up to 10 % of the world's population. In the framework of the Covid-19 pandemic, a large part of the working population worked in a home environment, among other things, the consequences of prolonged sitting were subsequently disorders of the musculoskeletal apparatus.

Objective: The aim was to verify the effectiveness of the established physiotherapy options and procedures used in the treatment of painful heel affections.

Material and Methods: In order to find out our goals, we decided on a prospective clinical study in combination with a questionnaire, and we evaluated its results using descriptive statistical methods. To verify the effectiveness of physiotherapy procedures, we used the VAS scale, a modified version of the "functional index of the foot" questionnaire, to record pain, we measured the range of mobility in the ankle joint and evaluated muscle shortening.

Results: The results of this study show that using selected physiotherapy procedures, we achieved a statistically significant reduction in pain, improved foot functionality, increased range of motion in the ankle joint and a reduction in muscle shortening

Conclusion: In conclusion, using the results obtained, we pointed out that painful heel affections negatively affect the quality of life of patients after the Covid-19 Pandemic who suffer from any of these pathologies. The combination of the above-mentioned selected physiotherapy options can be successfully used in the framework of therapy in such patients.

Keywords: painful affections of the heel, physiotherapy, physiotherapy procedures, Covid-19

ABSTRAKT

Úvod: Bolestivé afekcie päty predstavujú stav, ktorý postihuje až 10 % svetovej populácie. V rámci pandémie Covid-19 množstvo pracujúcej populácie pracovalo v domácom prostredí, okrem iného boli dôsledkom dlhodobého sedenia následne poruchy muskuloskeletálneho aparátu.

Cieľ: Cieľom bolo overiť účinnosť stanovených fyzioterapeutických možností a postupov využitých v liečbe bolestivých afekcií päty.

Materiál a metódy: Pre zistenie našich cieľov sme sa rozhodli pre prospektívnu klinickú štúdiu v kombinácii s dotazníkom, pričom jej výsledky sme vyhodnotili pomocou metód deskriptívnej štatistiky. Pre overenie účinnosti fyzioterapeutických postupov sme použili na zaznamenanie bolesti VAS škálu, modifikovanú verziu dotazníku *„Funkčný index nohy"*, zmerali sme rozsah pohyblivosti v členkovom kĺbe a zhodnotili svalové skrátenie.

Výsledky: Výsledky tejto štúdie poukazujú na to, že využitím zvolených fyzioterapeutických postupov sme dosiahli štatisticky významné zníženie bolesti, zlepšenie funkčnosti nohy, zvýšenie rozsahu pohybu v členkovom kĺbe a redukciu svalového skrátenia.

Záver: Záverom možno konštatovať, že pomocou získaných výsledkov sme poukázali na to, že bolestivé afekcie päty negatívnym spôsobom vplývajú na kvalitu života pacientov po pandémii Covid 19, ktorí trpia niektorou z týchto patológií. Kombináciu vyššie spomínaných zvolených fyzioterapeutických možností je možné úspešne využiť v rámci terapie u takýchto pacientov.

Kľúčové slová: bolestivé afekcie päty, fyzioterapia, fyzioterapeutické postupy, Covid 19

INTRODUCTION

As part of the Covid 19 pandemic, a large number of the working population worked at home, among other things, as a result of prolonged sitting, musculoskeletal system disorders (Mašán 2020; Mašán 2021). The pandemic represents a serious health and socio-economic problem. The WHO has declared COVID-19 a pandemic and a threat to international public health (Šrámka, 2021). Painful affections of the heel represent a condition that affects up to 10 % of the world's population. This condition is associated with the need to limit activities, reduce the quality of life and can lead to the development of depression. Although painful affections of the heel have a high prevalence of occurrence, the etiology of the origin of most of these troubles is not well known. They also occur in some diseases such as. rheumatoid arthritis, gout, plantar fasciitis, calcar calcanei, Haglund's exostosis or after trauma there are several risk factors that can lead to the development of these difficulties. These include: pronation type of foot position, limited range of motion to dorsal flexion in the ankle joint and in the first metatarsophalangeal joint, or a decrease in the muscular strength of the muscles in the foot and ankle. However, the main risk factor is increased weight and The Associated increased BMI. Painful affections of the heel are also associated with some types of sports, with the most risky sport being running, as up to 10 % of runners suffer from painful conditions in the heel area. Heel pain occurs from 8 years and until late in life, however, the most common are in the active population over the age of 40 years. The increased prevalence of heel pain associated with increasing age may be due to a decrease in the elasticity of the plantar fascia and a slowdown in the healing process of tissues in the human body (Gúth 2019; Menz *et al.* 2018; Agyekum 2015; Plačková 2019).

MATERIALS AND METHODS

We included 25 patients in the research set, of whom 9 were women (36 %) and 16 were men (64 %) who had any of the painful affections of the heel. Of these, three had disability on both DCS. These were included in the evaluation as separate cases, therefore the total number of cases in the parameter evaluation and testing is 28. The patients ranged in age from 31 to 63 years. The average age in the set was 50.4 years. All of them initially underwent a medical examination to establish a diagnosis. We have established several criteria for the inclusion of patients in the file. By these criteria were: the doctor diagnosed a painful affection of the heel, which can be positively influenced by methods of physiotherapy, passing a full number of therapeutic sessions and the patient's consent to be included in the set.

To determine our goals and evaluate the results, we decided on a prospective clinical study in combination with a questionnaire, and we evaluated its results using descriptive statistical methods. The input and output measurements, as well as the determined physiotherapeutic interventions, were carried out in a private rehabilitation facility in Piestany. The overall collection, analysis and evaluation of the data obtained lasted from November 2021 to December 2022.

To verify the effectiveness of the established physiotherapy options and procedures, it is necessary to objectively evaluate the presence of pain, the extent of mobility in the ankle

joint to the dorsal and plantar flexion, and the presence of muscle shortening m. triceps surae. For the initial and final examination, we used the recording of pain through the VAS scale. To further confirm the recorded data on pain, but also difficulties or limitations of activities and The Associated overall assessment of foot function, we used a modified shortened version of the questionnaire "foot Function Index" (FFI). The three questionnaire scales provide us with data on pain, discomfort, and activity restriction. Evaluation can be carried out for the whole questionnaire, but also for individual scales separately in our study we used a shortened modified version of the questionnaire translated into Slovak, which consists of 23 questions divided into 3 sub-scales (Budiman 1991). We also measured the range of mobility to plantar and dorsal flexion in the ankle joint using a goniometer and evaluated the presence of muscle shortening m. triceps surae by Gúth (2016).

Each of the patients underwent 8 therapy sessions of at least 45 minutes. Therapies were conducted regularly 2 times a week, for a total of 4 weeks. During the therapies, we applied the chosen physiotherapy methods (manual therapy techniques, means of physical therapy — radial shock wave, ultrasound and quantum therapy). During the first therapeutic session, the patient was always instructed on selected elements of kinesiotherapy (exercise unit), which he performed regularly at home once a day. Manual therapeutic interventions in patients focused on the implementation of soft techniques lasting 10 — 15 minutes in the calf and Achilles tendon. The second element of manual therapy that we used was the Pir mobilization technique, with which we worked to increase the range of mobility in the ankle joint and also to release the shortening of the m muscle. triceps surae by Lewit (2003). In kinesiotherapy, we used a total of 4 Exercises to support the achievement of goals. The first exercise was micromassage of the sole of the foot with the use of a ball — "Hedgehog". The exercise was aimed at micromassage of the foot plate and stimulation of proprioreceptors located on the foot plate. The second exercise was the "little leg" exercise according to Freeman's methodology, as indicated by Pavlov (2003). The patient performed the exercise first in a sitting position, and when he mastered it, he moved to a more difficult standing position. The exercise was aimed at strengthening the muscles of the arch of the foot. The third exercise was stretching and at the same time strengthening the calf muscle on the step. The patient initially performed the exercise simultaneously on both legs and then alternately on one and the other. Repeat the exercise in 3 sets of 10 repetitions. The last exercise was to perform movements in the ankle joint to the dorsal flexion using a towel or theraband. The exercise was mainly aimed at stretching the calf muscle. We used the gymnast Shock Master 300 for shock wave therapy. This is a radial shock wave. Each patient underwent 8 sessions at a frequency of 2 times a week, with a break between each session always at least 48 hours. The parameters of shock wave therapy were: 2 × 2000 shocks during one session, with a frequency of 10 — 14 Hz and an intensity ranging from 1.6 to 2.4 bar depending on the individual patient's tolerance, while we tried to continuously increase the intensity with each therapy. Ultrasound therapy was applied using the Gymna 400 apparatus. Each patient underwent 8 sessions at a frequency of 2 times a week, with this therapy always applied following the shock wave. The parameters of ultrasound therapy were: intensity of 1 — 2 W/cm^2 with a frequency of 1.2 MHz and a duration of application of 5 minutes. Quantum therapy was applied using the RIKTA apparatus. Each patient underwent 8 sessions at a frequency of 2 times a week simultaneously with shock wave therapy and ultrasound. Laser light with a magnetic component was applied for 2 × 5 minutes to the area of the calcaneal spur (respectively, to the area of the plantar fascia) with a radiation frequency of 1000 Hz. Subsequently, the application continued for 2 minutes from each side to the area of the lateral sides of the Achilles tendon at a radiation frequency of 1000 Hz. The last part of the application in a duration of 1 minute with a radiation frequency of 50 Hz was localized to the entire posterior surface of the Achilles tendon. The application of quantum therapy was carried out according to Fedorov (2013).

For statistical processing, evaluation and subsequent presentation of the obtained data and data, we used the methods of descriptive statistics. Overall statistical processing was performed using IBM SPSS and MS Excel.

RESULTS

For the description of the file, in addition to gender, the age, BMI and duration of the patient's difficulties were determined. The average age in the research group was 50.4 years, ranging from 31 to 63 years. The patients' BMI ranged from 25.62 to 37.62, with an average BMI of 29.36. The duration of the difficulties varied from less than a month to 36 months, with an average of 9.63 months. The duration of difficulties was further considered as a differentiating variable, dividing the group into two groups, therefore we will further describe the group from the point of view of the group with the duration of difficulties up to 6 months and the group with the duration of difficulties of 7 months or more. The following graph (Graph 1) shows information about the diagnoses of the patients included in the research. The diagnosis of Calcar Calcanei occurs in 21.4 % of the entire group, Calcar Calcanei + plantar fasciitis in 39.3 %, Dorsal heel spur in 25 % and Plantar fasciitis alone in 14.3 % of patients in the research group. Considering the duration of the difficulties, it can be noticed that in the group with a longer duration (7 months or more) the diagnosis of Plantar fasciitis appears independently in a third of the cases (33.3 %), while in the group with a duration of up to 6 months it occurs independently diagnosis of Calcar Calcanei (37.5 %).

In the research part, a non-parametric test was used to evaluate the results for the comparison of two dependent (related) samples — the Wilcoxon signed-rank test. Significance of pain reduction was determined by testing the difference between the first and second VAS measurements. We present the results of the Wilcoxon test in the table (Table 1), where we see Sig. < 0001. Statistical significance indicates the significance of the difference between measurements. Based on the order where negative orders occur in 28 (all) cases, we interpret lower VAS scale values for everyone at the second measurement than at the first measurement. Lower values mean lower pain levels.

The representation of the VAS variable during the first and second measurements can be found in the graph (Graph 2).

Furthermore, the difference between the first and second measurements of the "Feet Functional Index" (FFI) was also tested using the Wilcoxon test. As can be seen in the table (Table 2), the value of the statistical significance of the difference is at the level of Sig. < 0001, and the ranks of the difference between the 2nd and 1st measurements in all 28 cases are negative. We consider the differences to be significant and interpret significantly lower FFI values at the second measurement compared to the first measurement, which indicates an improvement in foot functionality in all patients.

Graph 1 Representation of diagnoses (%) in the entire group and in subgroups according to the duration of the difficulties

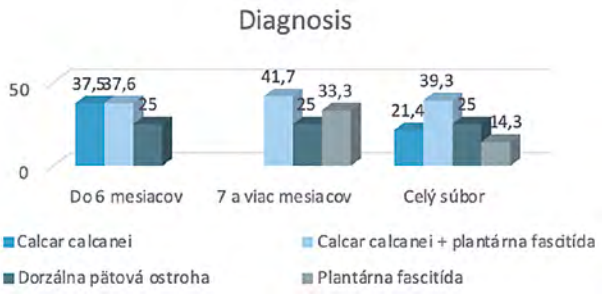


Table 1 Results of testing H1: Wilcoxon signed-rank test

	Sequences	N	Average rank	Wilcoxon test	
VAS 2 – VAS 1	Negative	28	14,5	Z	–4,67
	Positive	0	0	Sig.	0,000
	Identical	0			
	Together	28			

Graph 2 Boxplots showing the VAS variable at the first and second measurements

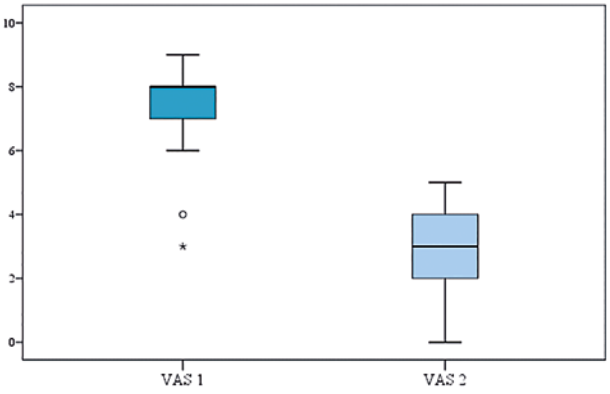


Table 2 Results of testing H2: Wilcoxon signed-rank test

	Sequences	N	Average rank	Wilcoxon test	
FFI 2 – FFI 1	Negative	28	14,5	Z	–4,623
	Positive	0	0	Sig.	0,000
	Identical	0			
	Together	28			

The graph (Graph 3) shows the variables of the first and second FFI measurements. We can see overall lower descriptive parameters in the second measurement.

To compare the results of mobility in the ankle joint, the same procedure was used — the Wilcoxon test, the results of which are presented in the table (Table 3). Based on the detected statistical significance of Sig. < 0001, we interpret the difference between measurements of Dorsal flexion in the ankle joint as significant, considering the ranks we note in all cases (28) higher values in the second measurement (positive ranks). In the course of the therapy, the patients experienced a significant increase in the values of the range of mobility in the Dorsal flexion parameter. Display of the variable Dorsal flexion in the ankle joint during the first measurement and during the second measurement is shown in the graph (Graph 4).

Graph 3 Boxplots showing the FFI variable at the first and second measurements

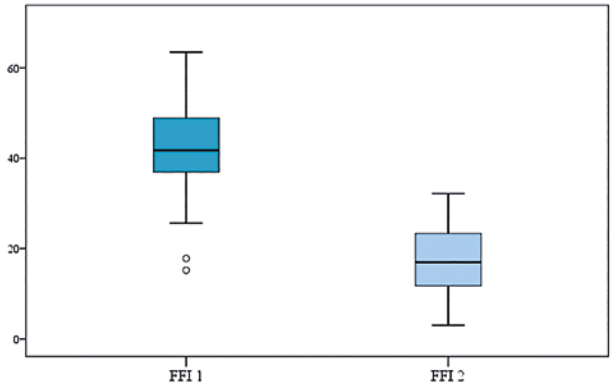
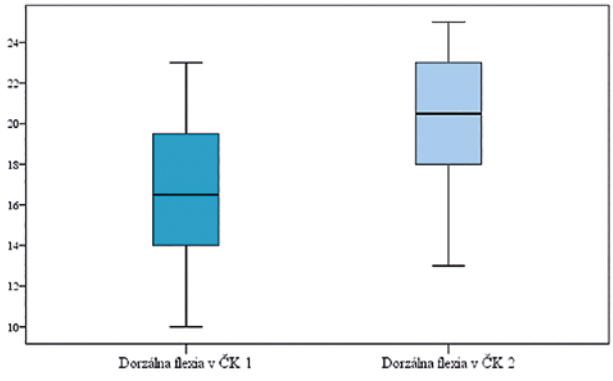


Table 3 Results of H3 testing: Wilcoxon signed-rank test

	Sequences	N	Average rank	Wilcoxon test	
Dorsal flexion in the ankle joint 2 – Dorsal flexion in the ankle joint 1	Negative	0	0	Z	–4,678
	Positive	28	14,5	Sig.	0,000
	Identical	0			
	Together	28			

Graph 4 Boxplots showing the variable Dorsal flexion in the CK during the first and second measurements



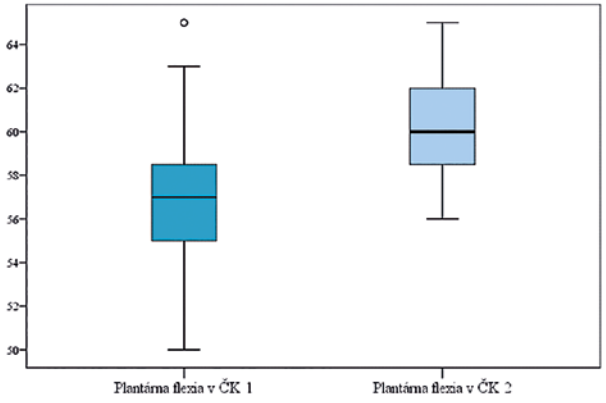
As part of further testing, we compared the difference between the first and second measurement of Plantar flexion in the ankle joint and the Wilcoxon test was used. The results can be seen in the table (Table 4). Statistical significance Sig. < 0001 indicates a significant difference between measurements. Positive differences between the second and first measurements are shown in 22 cases, identical values occurred in 6. We interpret the predominance of positive orders as overall higher values measured during the 2nd measurement of Plantar flexion in ankle joint, which according to Sig. statistically significant. In the course of the therapy, patients experienced a significant increase in the range of mobility to plantar flexion in the ankle joint.

Table 4 Results of testing H4: Wilcoxon signed-rank test

	Sequences	N	Average rank	Wilcoxon test	
Plantar flexion in ankle joint 2 – Plantar flexion in ankle joint 1	Negative	0	0	Z	–4,139
	Positive	22	11,5	Sig.	0,000
	Identical	6			
	Together	28			

The distribution of the values of the first and second measurement of Plantar flexion in the ankle joint is illustrated by the Boxplot in the graph (Graph 5).

Graph 5 Boxplots showing the variable Plantar flexion in the ankle joint during the first and second measurements



The table (Table 5) shows the results of the Wilcoxon test for testing differences between two measurements of the ordinal variable Muscle Shortening. Considering the statistical significance value of Sig. < 0001 we interpret the differences between the measurements as significant and further observe the direction of the order. In 21 cases, there was a negative value of the difference between the 2nd and 1st measurement, which indicates higher values (a higher value of Muscle Shortening indicates a more severe degree of shortening of the triceps surae muscle) in the first measurement. In the mentioned patients, there was a reduction in the shortening of the m. triceps surae. Further in the table we see the same rankings — the values of the first and second measurements in 7 cases were unchanged. Based on the improvement (relaxation — lower values) of muscle shortening m. triceps surae, in most cases we can state the statistical significance of the results of the monitored parameter.

Table 5. Results of H5 testing: Wilcoxon signed-rank test

	Sequences	N	Average rank	Wilcoxon test	
Muscle shortening 2 – Muscle shortening 1	Negative	21	11	Z	–4,413
	Positive	0	0	Sig.	0,000
	Identical	7			
	Together	28			

DISCUSSION

The authors were Yelverton, Rama *et* Zipfel (2019), Yinilmez Sanmak *et al* (2018), Thong-On *et al.* (2019), Rompe *et al.* (2015) and Al Khadhrawi et Alshami (2019) looked at the use of various physiotherapeutic procedures in the treatment of painful heel affections and plantar fasciitis in particular in their studies. Li *et al.* (2018) conducted a network meta-analysis, which was aimed at comparing the effectiveness of various therapeutic procedures in the treatment of plantar fascitis. The physiotherapeutic procedures used by these authors in their studies were similar to those used by us in our study. The results of the above authors correlate with the results of our research, since, like the above authors, we also achieved statistically significant improvements using similar physiotherapy methods, procedures and interventions in the parameters of pain, foot functionality, range of motion in the ankle joint to dorsal and plantar flexion. We also achieved an improvement in the M muscle shortening parameter. triceps surae. The combination of several commonly used therapeutic procedures and interventions, which we also used in our research, seems to be an appropriate way to conduct therapy in patients with painful heel affections.

CONCLUSION

The results of this study show that using the selected physiotherapy procedures, we achieved a statistically significant reduction in pain, improved foot functionality, increased range of motion to dorsal and plantar flexion in the ankle joint, and a reduction in shortening of the m muscle. triceps surae. Using a research question, we tried to find out whether there are differences in the rate of improvement achieved in the parameters studied by US depending on the duration of the complaints (up to 6 months, 7 and more months) in patients with painful heel affections before seeking physiotherapeutic help. From the results, we found that a statistically significant higher improvement occurred only within the studied parameter of muscle shortening m. triceps surae in the group with a duration of difficulty up to 6 months. Improvements in pain, foot functionality, and range of motion to dorsal and plantar flexion in the ankle were not statistically significant, given the duration of difficulty prior to Seeking physiotherapeutic assistance. In conclusion, using the results obtained, we pointed out that painful affections of the heel negatively affect the quality of life of patients suffering from any of these pathologies, and also that the combination of the above-mentioned chosen physiotherapy options can be successfully used as part of therapy in such patients.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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Possible solutions to the condequences of abuse and Ill treatment of the elderly relevant also for the Post-COVID-19 period

Možnosti riešenia dôsledkov zneužívania a zlého zaobchádzania so seniormi, relevantné aj pre postcovidové obdobie

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ABSTRACT

Introduction: Elements of Gestalt therapy and cognitive-behavioural therapy can be of help to seniors who are struggling to report abuse or maltreatment (Corey 2009; Yontef 1993; Beck 2011). Elements of Gestalt therapy and cognitive-behavioral therapy can help seniors with problems communicating abuse or mistreatment (Corey 2009; Yontef 1993; Beck 2011). Gestalt therapy aims to achieve self-awareness, intensify the sense of responsibility and improve concentration on the present moment in the respondents. Her goal is to get them to align with their thoughts, feelings, desires and behavior. Cognitive-behavioral therapy seeks to help respondents set short-term goals for changing negative influences in their environment.

Aim: The aim of this research is to determine the negative consequences of elder abuse and mistreatment during the COVID-19 pandemic, as well as the lingering post-pandemic effects and options to help mitigate them.

Material and methods: To date, 150 seniors aged between 65 and 70 years. The research uses a qualitative approach, specifically an in-depth online interview method.

Results: Based on the statements of seniors, it was shown that 46.5 % of them suffer from poor mental health, which is related to experiences of neglect and mistreatment during care. 38 % of them have already experienced some form of domestic violence, although they often do not talk about it. It is a combination of various forms of abuse, from psychological to economic abuse or exposing a senior to psychological pressure, name-calling and neglect of basic needs (25.5 %), combined forms of ill-treatment of seniors occur in 37.5 %.

Conclusion(s): Gestalt therapy can greatly improve future social work with seniors who are abused or ill-treated. Cognitive-behavioural therapy strategies applied in the field of social work can empower abused seniors, help them work on their skills, and improve their general well-being.

Keywords: seniors, abuse, post-COVID-19 period, post-COVID-19 syndrome

ABSTRAKT

Úvod: Pri problémoch komunikovať zneužívanie alebo zlé zaobchádzanie môžu seniorom byť nápomocné práve prvky Gestalt terapie a kognitívno-behaviorálnej terapie (Corey 2009; Yontef 1993; Beck 2011). Gestalt terapia sa usiluje dosiahnuť sebauvedomenie, zintenzívniť pocit zodpovednosti a zlepšiť sústredenie na prítomný okamih u respondentov. Jej cieľom je dosiahnuť, aby sa zosúladili so svojimi myšlienkami, pocitmi, túžbami a správaním. Kognitívno-behaviorálna terapia sa usiluje pomôcť respondentom stanoviť si krátkodobé ciele na zmenu negatívnych vplyv v ich prostredí.

Cieľ: Cieľom výskumu je zistiť negatívne dôsledky zneužívania seniorov a hrubého zaobchádzania s nimi počas pandémie COVID-19, ako aj pretrvávajúce následky po jej skončení a možnosti, ktoré by ich pomohli zmierniť.

Materiál a metódy: Výskumu sa dosiaľ zúčastnilo 150 seniorov vo veku od 65 do 70 rokov. Výskum využíva kvalitatívny prístup, konkrétne metódu hĺbkových online rozhovorov.

Výsledky: Na základe výpovedí seniorov sa ukázalo, že 46,5 % z nich trpí zlým mentálnym zdravím, ktoré súvisí so skúsenosťami so zanedbávaním a zlým zaobchádzaním pri starostlivosti. 38 % z nich už zažilo nejakú formu domáceho násilia, hoci často o tom navonok nehovoria. Ide o kombináciu rôznych foriem zneužívania od psychického až po ekonomické zneužívanie či vystavovanie seniora psychickému nátlaku, osočovaniu a zanedbávaniu v základných potrebách (25,5 %), dochádza ku kombinovaným formám zlého zaobchádza so senioromi u 37,5 %.

Záver(y): Gestalt terapia môže v budúcnosti značne zlepšiť prácu v sfére sociálnej práce so seniormi, ktorí sú zneužívaní alebo sa s nimi zaobchádza hrubo. Stratégie kognitívno-behaviorálnej terapie dokážu v sfére sociálnej práce pomôcť zneužívaným seniorom znova posilniť ich postavenie, budovať ich zručností a zlepšovať tak ich fungovanie.

Kľúčové slová: seniori, zneužívanie, postcovidové obdobie, postcovidový syndróm

INTRODUCTION

Elder abuse, mistreatment, and maltreatment are among the growing trends worldwide that pose a serious threat to public health. It also increases the risk factors that adversely affect the health status of the elderly (Son, Cho 2022). Elder abuse and maltreatment as well as mistreatment can be characterised as an absence of adequate care and behaviour towards seniors. It can occur once or repeatedly. It often takes place in close relationships or in professional relationships with formal or informal caregivers in whom the elderly place their trust and hope for adequate care and good treatment. The absence of such care and treatment causes seniors psychological and emotional distress as well as harm in various areas of life and health (Ho, Wong, Chiu, Ho 2017). Elder maltreatment and abuse can be divided into the following basic categories: the first category is the type of abuser, i.e. a family member, spouse, children, another relative, or caregiver; the second category is the characteristics of the abuse or maltreatment, i.e. whether the abuse or maltreatment manifests itself at the psychological, physical (including neglect), financial, or sexual level; and the third category is the setting in which the maltreatment, abuse, and mistreatment occur, i.e. in a domestic or institutionalised setting (Payne, Fletcher 2005). The causes behind elder abuse in institutionalised care can be varied. For example, caregivers, nursing staff, and other healthcare workers may be emotionally unfit, easily stressed and frustrated due to a lack of training or further education. As a result, they may harm seniors by taking out their frustrations on them, for instance by hitting or pushing seniors during nursing care, inappropriate verbal treatment, or various forms of manipulation (Yon, Mikton, Gassoumis, Wilber 2019). Other causes that may lead to probable cases of abuse and mistreatment in institutionalised care settings include staff shortages, according to some authors. Based on their findings, staff shortages may lead to seniors not receiving proper attention and care. Such neglect due to staff shortages may then gradually lead to further abuse or mistreatment that manifests itself on both physical and emotional levels (Lindbloom, Brandt, Hough, Meadows 2007).

Understanding the causes of under-reporting of abuse and mistreatment is key to providing more effective assistance as well as adequate protection to abused and maltreated seniors in domestic or institutionalised settings. On the part of seniors, fear of retaliation or the inability to communicate abuse and maltreatment is a common reason for such under-reporting (Yon, Mikton, Gassoumis, Wilber 2019). Elements of Gestalt therapy and cognitive-behavioural therapy can help them in their struggle to communicate abuse or maltreatment (Corey 2009; Yontef 1993; Beck 2011).

MATERIAL AND METHODS

The aim of the present research, which has been ongoing since November 2022, is to explore the negative consequences of elder abuse and mistreatment during the COVID-19 pandemic, as well as the lingering post-pandemic effects and options to help mitigate them. The research is being conducted in Slovakia, Italy Canada and Poland in selected

hospitals, rehabilitation facilities, and social service establishments. Thus far, 150 seniors aged 65 to 70 years have participated in the research, who were selected based on lived experience with neglect, mistreatment and a combination of different forms of domestic violence with the cooperation of social workers, professional caregivers and representatives of local governments. Seniors who are provided with long-term social and health care in social and hospital facilities in the mentioned countries were involved in the research, their primary cause of hospitalization was not the consequences of poor treatment, but the investigation revealed that they survived or are surviving various forms of poor treatment, economic abuse and neglect.

The basic research tool was the qualitative approach using in-depth interviews. One interview lasted approximately 70 minutes. The interviews were conducted online or in person in the case of placement of the senior in a social service facility or in a hospital, which were conducted under the supervision of professional staff. Another group of seniors was included in the research online.

For the purpose of this research, the research respondents participate in a specially designed online intervention programme based on certain elements of Gestalt therapy and cognitive behavioural therapy. Via the elements of Gestalt therapy and cognitive-behavioural therapy, we used in the specially designed intervention programme for seniors to identify effects of abuse and maltreatment during the pandemic period.

The article was written by authors who form part of the research team. As such, they first approach the research participants and conduct all interviews, and then record transcripts and write down research notes. They conduct discussions on the research results in a plenary session, making note of anything unusual. The research records the unique experience of those interviewed.

All ethical principles are followed in the course of the research, including the voluntary participation of respondents in the research with the option to leave at any time, the preservation of respondents' anonymity, respondents' written consent to the processing of personal data, the provision of legal protection for respondents and the research, and the final research report. To some extent, the number of respondents in the research to date has been limiting.

RESULTS

The research findings thus far have shown that the effects of abuse and ill-treatment of the elderly have an impact on exacerbating certain aspects of post-COVID-19 syndrome. These include, for example, a deterioration in cognitive functions such as the reduced ability to process executive and memory tasks such as reading, remembering, thinking and paying attention, impaired performance in day-to-day activities, dementia, or "difficulty concentrating and brain fog" (Guo, Benito Ballesteros, Yeung *et al.* 2022 p. 2). Participants involved in interview were basically provided by home-based long-term care during the period of abuse and ill-treatment. During the long-term care they were visiting social or health programmes in the daily care centre or hospitals, where you could interview them to answer research question.

As a result of abuse and mistreatment in home-based long-term care, seniors experienced the following from November 2022 to February 2023:

- Serious mental health problems or substance use problems with significant effects on cognitive decline;
- Increased frailty, which also exacerbated their poor cognitive health;
- Depression, increased emotional distress, fear;
- Significantly reduced ability or capacity of seniors to maintain regular contact with members of their social circle in order to maintain good social relationships;
- Increased social isolation;
- Objectively reduced frequency of social contact with members of the same social circle, ultimately reflecting a lack or absence of frequent contact.

Although some seniors reported that they had more frequent social contact during the period of abuse and ill-treatment, they were afraid to talk about their problems or they experienced feelings of shame. Thus, they experienced a sense of isolation. They considered this subjective sense of isolation to be loneliness. It also reflected their own psychological interpretation of good social relationships, which they felt played a central role in maintaining good health and well-being.

Based on the results of the research, the lack of social support was another consequence of abuse and mistreatment for seniors. It contributed to an increased risk of adverse health consequences and also mortality compared to seniors who, in contrast, had high levels of social support during the COVID-19 period.

Another consequence of abuse and ill-treatment of seniors was their negative perception of ageing, which worsened during the COVID-19 period and persisted in the post-COVID-19 period. In this context, the interviewed seniors had a significantly higher risk of depression. They were and continue to be forced to face the threat of ageist stereotypes by individuals, organisations and systems of governments that have adopted negative perceptions of ageing, or various forms of age discrimination (a type of hostile, benevolent, or new ageism).

The psychological and social consequences of abuse and ill-treatment of seniors during the COVID-19 period,

which negatively impact their emotional experience and cognitive health even in the post-COVID-19 period, are addressed in the research through a specially designed online intervention programme, which for the purpose of this research is based on certain elements of Gestalt therapy and cognitive behavioural therapy.

Seniors who have been victims of abuse and ill-treatment generally need considerable help to cope with their feelings of ill-treatment and abuse.

According to them, elements of Gestalt therapy included in a specially designed online intervention programme help them express their feelings.

Through a specially designed online intervention programme, the elements of Gestalt therapy offer them many opportunities to express outwardly their inner experiences in a safe environment. They find them particularly beneficial in exploring, and not trying too hard to modify, their own behaviour. They focus on growth and autonomy by increasing their awareness. They help them embrace the present which is an opportunity for them to experience a totally unconditioned self in relation to others.

According to the respondents, elements of Gestalt therapy are also helpful in dealing with their problems such as a lack of physical strength due to older age. Awareness helps facilitate the change that has occurred for them in terms of how they perceived themselves during the period in which they were subjected to abuse and ill-treatment and how they perceive themselves during the course of completing the special online intervention programme and what they consider to be important now, in the present moment.

To facilitate both the process and the perception of this change, the special online intervention programme also asks respondents to try some new behaviours, focus on experiencing the present moment, and become aware of what they are experiencing. For example, they practise imagining an encounter that is scary for them or exaggerating certain positions.

DISCUSSION

A society is considered developed when it can take care of its weakest members (children, the elderly and the sick, people with disabilities, people dependent on help, whose living standards have fallen below the socially acceptable threshold and are exposed to any form of ill-treatment, they must receive special protection and support in solving their life situation, for example with a quality system of social services (Ludvigh Cintulová, Buzalová 2022). Ludvigh Cintulová, Budayová, Buzalová (2022) defined social services complex system of social and health care and it is necessary to ensure increased awareness, preparedness and implementation of uniform procedures for applying changes aimed at improving the quality of social services with an emphasis on social changes, European priorities and individual needs of social services clients.

The findings of the research conducted thus far have demonstrated the following results. In regard to more frequent social contact among abused seniors, it is interesting to note that it is not possible to conclude with certainty that sufficient social interaction reduces the likelihood of abuse or mistreatment. This is because abuse or mistreatment can occur in any relationship, including relationships between friends or as part of neighbourly relations. Abuse or mistreatment that occurs in friendly and neighbourly relations can also be caused by changes in society (Son, Cho 2022).

Another observation is that, according to the respondents' statements prior to entering the specially designed online intervention programme, they were only aware of painful symptoms arising from their own repressed feelings and experiences, and experienced feelings of shame, helplessness, and insecurity. They manifested problems related to low self-esteem, depression, and apathy. Enns (1992) notes in this regard that it is important for them clearly identify the complexity of their experiences, and to do this they need to have an awareness of their current problems and social strengths. Therefore, the specially designed online intervention programme focuses on their concentration, language patterns, voice, gestures, and interaction with others. The goal is to get them to develop a presence-oriented consciousness and to become fully identified with their thoughts, feelings, desires, selection choices, and behaviours. Emphasis is placed on their responsibility and self-awareness. This enables them to gradually build their self-confidence while understanding the ways in which they may be influenced by their lived experiences (Corey 2009; Yontef 1993; Wagner-Moore 2004; Brownell 2010; Levine 2012).

Similarly to the elements of Gestalt therapy, elements of cognitive-behavioural therapy are also included in the specially designed online intervention programme.

The specially designed online intervention programme focuses on stress reduction, relaxation, cognitive restructuring of negative thoughts and restoration of positive cognitions, role-playing, skill development, problem-solving, and the use of imagery for the respondents.

The goal is to use certain elements of cognitive behavioural therapy to assist responders in setting and achieving short-term goals that would in turn enable them to rebuild their self-esteem and confidence while promoting accountability as well as develop their assertive skills and address cognitions that have developed as a result of the abuse.

A common example of such cognitions is low self-esteem (Beck 2011).

CONCLUSION

A specially designed online intervention programme based on certain elements of Gestalt therapy and cognitive-behavioural therapy can help respondents improve their self-understanding and also better understand what they can do to be able to accept their experience and, if necessary, change their perception of that particular experience. As such, Gestalt therapy itself can enable respondents to complete the gestalts of the past, to have richer experiences with themselves and others in the process of the present, while opening up a future full of new meanings that are continually taking shape. The application of Gestalt therapy principles may also have great potential for future improvements in the field of social work with seniors who are exposed to ill-treatment and abuse.

Elements of cognitive behavioural therapy contained in a specially designed online intervention programme can help respondents become better at decision-making and also increase their sense of power as well as their self-esteem and assertiveness. Also, the application of cognitive-behavioural therapy principles in the field of social work through its strategies can help abused seniors re-empower themselves, work on their skills, and thus ultimately improve their level of well-being.

Conflicts of interest
The authors declare no conflicts of interest.

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Subjective signs in patients after glaucoma surgeries in every day life

Subjektívne príznaky u pacientov po glaukómových operáciách v bežnom živote

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ABSTRACT

Introduction: Glaucoma is defined as a group of diseases of different etiology, the common feature of which is progressive neuropathy of the optic nerve, which results in irreversible damage to visual functions. Globally, glaucoma is the second leading cause of blindness and represents a serious health and socioeconomic problem.

Methods: In our study, by using a questionnaire of visual functions and its slight modification, we evaluated the results of the surgical solution of secondary glaucoma in the postoperative period.

Results: The questionnaire was sent to 98 patients, 65 patients submitted a completed questionnaire with all questions answered, which represents a 66.3 % return rate of the questionnaire.

Conclusion: The results evaluate the quality of the patients' health care, as well as the impact on their long-term quality of life and health.

Keywords: glaucoma disease, glaucoma surgery, quality of life

ABSTRAKT

Úvod: Glaukóm je definovaný ako skupina ochorení rôznej etiológie, ktorých spoločným znakom je progresívna neuropatia zrakového nervu, ktorá má za následok nezvratné poškodenie zrakových funkcií. V celosvetovom meradle je glaukóm druhou najčastejšou príčinou slepoty a predstavuje vážny zdravotný a socioekonomický problém.

Metodika: V našej štúdii sme pomocou dotazníka zrakových funkcií a jeho miernej modifikácie zhodnotili výsledky operačného riešenia sekundárneho glaukómu v pooperačnom období.

Výsledky: Dotazník bol zaslaný 98 pacientom, vyplnený dotazník s zodpovedanými všetkými otázkami odovzdalo 65 pacientov, čo predstavuje 66,3 % návratnosť dotazníka.

Záver: Výsledky hodnotia kvalitu zdravotnej starostlivosti o pacientov, ako aj vplyv na ich dlhodobú kvalitu života a zdravia.

Kľúčové slová: glaukómové ochorenie, chirurgická liečba glaukómu, kvalita života

INTRODUCTION

The first written mentions of glaucoma disease can be found already in the Middle Ages, but Hippocrates in ancient Greece already described blindness in an elderly man as a condition of "green color of sea water" in Greek "glaykoseis". In 1622, the English ophthalmologist Banister described four symptoms of turbidity; the length of the reaction time of the eye, light perception, eye tension and greater pupil width. During this period, however, attention was not paid to his description, and other research similar to Banister's did not appear until 120 years later. An important landmark in ophthalmology, as well as in the diagnosis of glaucoma, is the invention of the ophthalmoscope in 1850 by von Hemholtz, which made it possible to diagnose glaucomatous background changes for the first time. The characteristic feature of glaucoma did not appear until 1862, when Donders described high intraocular pressure as a cause of blindness. He called this condition "Glaucoma simplex"(Erb *et al.* 1998; Gerinec 2005; Schuster *et al.* 2020).

According to the latest conclusions of the European Glaucoma Society, the main goal of glaucoma treatment is to achieve the target intraocular pressure (IOP) value, lifelong preservation of the patient's visual functions and maintaining an acceptable quality of life of the patient, taking into account his individual needs, depending on the type and progress of the glaucoma disease, expected life expectancy, overall diseases and risk factors (Huang *et al.* 2020; European Glaucoma Society Terminology and Guidelines for Glaucoma, 5th Edition 2021). In addition to reducing, the aim of glaucoma treatment is to improve blood flow in the area of the optic nerve, prevent the progression of nerve fiber loss and damage to the optic nerve, as well as minimize side effects and complications of treatment. Glaucoma treatment can be divided into conservative (medicated), laser and surgical. The standard algorithm for the treatment of glaucoma begins with conservative monotherapy, which, in case of failure, is increased by additional active substances with a maximum combination of four active substances. In case of insufficient effect, we approach laser treatment and then surgical treatment. In special cases and specific types of glaucoma, the algorithm is adjusted and individualized to the current needs of the patient (Mlčák *et al.* 2009). Different techniques of surgical treatment have different indication criteria depending on the type and current state of glaucoma in a particular patient. The choice of procedure and surgical technique is highly individual and depends on several criteria from both the patient and the surgeon: — set target IOP for a specific patient — previous treatment — medication, laser, previous procedures and operations — degree of damage to the visual field and central visual acuity — risk profile of the patient, such as monoculus, refractive disorders, risky occupation — preferences and experience of the surgeon — patient expectations and patient compliance with the proposed treatment When deciding when and how to start the surgical treatment of glaucoma, it is necessary to take into account all the above-mentioned criteria, including the latest knowledge and recommendations. It is necessary to use surgical treatment whenever the previous drug and laser treatment is ineffective or if it is the only option to maintain visual functions in the glaucomatous eye. In severe secondary glaucoma there is need in some patients to enucleate the eye globe (Zahorjanová *et al.* 2020). Currently, due to the effectiveness and improvement of surgical procedures, as well as long-term good postoperative results, surgical treatment should not represent the last treatment options (Vijaya *et al.* 2011).

MATERIAL AND METHODS

Our follow-up was carried out in the glaucoma outpatient clinic and the eye department of the Dept. of Ophthalmology, Faculty of Medicine of the Comenius University in 4 years interval. We analyzed the data analysis of a group of patients after glaucoma surgery. The file includes patients hospitalized with diagnosis of secondary glaucoma, according to the international classification of diseases, based on data in the operating book and the hospital information system. The age and gender of the patients were not taken into account when enrolling the patients. In addition to the established diagnosis, the included patients had to meet the following criteria: we recorded the patients' subjective feelings, such as the feeling of pain and discomfort in the preoperative period, during the operation, and in the postoperative period. We used the method of quantitative research in the form of a questionnaire. At the beginning of the questionnaire, we informed the patients about the aim and purpose of the questionnaire and they were also assured of its anonymity. The questionnaire was based on the "Visual Functions Questionnaire-25" containing questions related to anti-glaucoma surgery added by us. Patients filled out the questionnaire electronically via the website "survio.com" or in printed form, which we then processed electronically. The questionnaire contained 36 questions, which were divided into 5 parts. The first part consisted of 2 introductory questions regarding basic demographic data — age and gender. The third question related to the type of anti-glaucoma surgery that was performed on the patient. The given question served as a criterion for dividing the answers for further processing. In the second part of the questions, we investigated subjective feelings (quality of vision, pain) during the operation and in the postoperative period. The other three parts of the questionnaire were based on the "Visual Functions Questionnaire 25". The third and fourth part of the questions focused on general difficulties with vision during daily activities, reading, watching TV, working on the computer, playing games, looking into the distance, as well as the feeling of discomfort or other difficulties. Questions 23 to 27 deal in detail with subjectively perceived difficulties in driving. The fifth part analyzes the effects of the above-described difficulties on the patient's psyche and his

perception and feelings of the surrounding world, as well as the need for help from the environment. Over the past 2 years, we have contacted 98 patients who underwent anti-glaucoma surgery trabeculectomy, cyclocryopexy, implantation of a drainage implant or other surgery to reduce IOP during the years 2015 — 2019. The questionnaire was sent to 98 patients, 65 patients submitted a completed questionnaire with all questions answered, which represents a 66.3 % return rate of the questionnaire.

RESULTS

Analysis of the subjective characters of the set — questionnaire

As part of the research, a survey was conducted in the form of a questionnaire among 65 patients who underwent anti-glaucoma surgery between 2015 and 2019. The questionnaire was sent to 98 patients, 65 patients submitted a completed questionnaire with all questions answered, which represents a 66.3 % return rate of the questionnaire.

Table 1 involves the number of surgical interventions for individual types of secondary glaucoma in the analyzed group in the respective calendar year. The "other causes" group includes 14 choroidal melanomas, 2 choroidal melanomas, and 2 malignant glaucomas as a complication of cataract surgery as the cause of the development of secondary glaucoma.

The average age of the analyzed group was 63.4 ± 14.5, while in the trabeculectomy group the average age was 63.7 ± 16.4, in the cyclocryopexy group 64.9 ± 12.4, drainage implants 57.0 ± 14.1 and in the others operations, the average age was 59.5 ± 18.1 (Table 2).

The first two questions divide the respondents based on demographic data as follows: 34 men (52.3 %) and 31 women (47.7 %).

The next question was: "Do you have difficulty reading ordinary print (newspaper, magazine, book etc.)?" The most frequent answer among respondents is "I have some difficulties, especially with details" 35 times (53.8 %), followed by the answer "I have no difficulties" with 15 respondents (23.1 %) and "difficulties are more frequent — I don't read smaller text" with 10 respondents (15.4 %). 4 respondents (6.2 %) marked the answer "difficulties with every reading — I can only see large text, headings,…"; one respondent (1.5 %) marked the answer "I can't read at all" from the group of patients after trabeculectomy. The same most frequent answer also in the group "cyclocryopexy" by 23 respondents (63.9 %) and in the group "drainage implants" by 4 respondents (57.1 %). In the "trabeculectomy" group, the earliest answer is "I have no difficulties" for 7 respondents (43.8 %).

The next question was: "Do you have difficulties with normal work and performing hobbies and activities close to you (e.g. cooking, sewing, using hand tools,…)?". The most frequent answer among respondents is "I have a little difficulty, especially with details" 37 times (56.9 %), followed by the answer "I have no difficulties" for 17 respondents (26.2 %) and "difficulties are more frequent" for 8 respondents (12.3 %). The answer "difficulties with every reading or work" was indicated by 2 interviewees (3.1 %), one respondent (1.5 %) indicated the answer "I cannot do them at all", again from the group of patients after trabeculectomy. The same most frequent answer with the entire set of respondents is also in the "cyclocryopexy" group, namely 25 respondents (69.4 %). In the "trabeculectomy" group, the earliest answer is "I have no difficulties" for 7 respondents (43.8 %). In the "drainage

Table 1. Number of surgical interventions of individual types of secondary glaucoma

Secondary glaucoma type	2015	2016	2017	2018	2019	Total
Pseudoexfoliative glaucoma	10	6	5	3	4	**28**
Pigmented glaucoma	1	0	0	0	0	**1**
Neovascular glaucoma in diabetic patients	13	11	9	2	4	**39**
Neovascular glaucoma — other	4	11	5	4	3	**27**
After the trauma	3	2	2	0	2	**9**
After inflammation	9	3	3	3	6	**24**
After vitreoretinal surgery (PPV)	6	1	3	4	1	**15**
Induced by the lens	1	0	0	1	0	**2**
Other	2	4	5	5	2	**18**

PPV — pars plana vitrectomy

Table 2. Descriptive statistics of the set (operations) — age, BCVA, complications, reoperation

		age	BCVA before OP	BCVA after OP	Reoperation	Complications
		[years]	[decimal]	[decimal]	0/1	0/1
Total	N	163	146	146	146	163
	Average	**63,4**	**0,20**	**0,20**	**0,20**	**0,20**
	SD	14,5	0,30	0,30	0,40	0,40
	Maximum	92	1,00	1,00	1,00	1,00
	Median	64	0,05	0,05	0,00	0,00
	Minimum	19	0,00	0,00	0,00	0,00
Trabeculectomy	N	35	35	35	35	35
	Average	**63,7**	**0,6**	**0,6**	**0,1**	**0,3**
	SD	16,4	0,3	0,3	0,3	0,5
	Maximum	85,0	1,0	1,0	1,0	1,0
	Median	68,0	0,6	0,6	0,0	0,0
	Minimum	23,0	0,0	0,0	0,0	0,0
Cyclocryopexy	N	96	96	96	96	96
	Average	**64,9**	**0,1**	**0,1**	**0,3**	**0,1**
	SD	12,4	0,2	0,2	0,5	0,3
	Maximum	92,0	1,0	1,0	1,0	1,0
	Median	63,5	0,1	0,1	0,0	0,0
	Minimum	19,0	0,0	0,0	0,0	0,0
Drainage implants	N	11	11	11	11	11
	Average	**57,0**	**0,3**	**0,2**	**0,3**	**0,5**
	SD	14,1	0,2	0,1	0,4	0,5
	Maximum	71,0	0,5	0,3	1,0	1,0
	Median	63,0	0,3	0,2	0,0	0,0
	Minimum	28,0	0,0	0,0	0,0	0,0
Other	N	21	4	4	4	21
	Average	**59,5**	**0,3**	**0,3**	**0,0**	**0,3**
	SD	18,1	0,2	0,2	0,0	0,5
	Maximum	85,0	0,6	0,5	0,0	1,0
	Median	65,0	0,3	0,3	0,0	0,0
	Minimum	19,0	0,0	0,0	0,0	0,0

BCVA — best corrected visual acuity; OP — operation, surgery; N –number; SD — standard deviation

implants" group, the answers "I have no difficulty"and "I have a little difficulty" are represented by 3 respondents (42.9 %) in each of the answers.

In the next question we asked: "How much difficulty is there in seeing small things or details (for example on a crowded shelf)?". The most common answer for 29 respondents (44.6 %) is "I have no difficulties", followed by the answer "I have a little difficulty" with 27 marks (41.5 %). The answer "moderately difficult to recognize details" was indicated by 8 respondents (12.3 %). "I can't see small things on a crowded shelf at all" was indicated by one respondent (1.5 %). None of the respondents indicated "very difficult to recognize details". The answer "I don't have difficulty" was also the most frequent in the "cyclocryopexy" group with 16 respondents (44.4 %) and in the "trabeculectomy" group with 10 respondents (62.5 %). "A little difficulty" is experienced by 5 respondents (71.4 %) in the group drainage implants.

The next question was: "How much difficulty is there in reading street or shop signs?".

The most frequent answer among all respondents is "I have no difficulties at all" 30 times (46.2 %), followed by the answer "I have a little difficulty" among 28 respondents (43.1 %). The answer "moderately difficult to recognize details" was marked by 1 respondent (1.5 %) from the group of patients after trabeculectomy. "I don't see them at all" was not indicated by a single respondent. The same most frequent answer as for all respondents is in the group "trabeculectomy" with the number of 10 respondents (62.5 %). In the "cyclocryopexy" group, the earliest answer is "some difficulty" for 18 respondents (50.0 %). In the "drainage implants" group, the answers "I have no difficulty" and "I have a little difficulty" are represented by 3 respondents (42.9 %) in each of the answers.

The next question was: "Do you have difficulty going down stairs or a curb in the dark or at night?". The answer "I have no difficulties" was indicated by 30 respondents (46.2 %), "I have some difficulties" by 22 respondents (33.8 %), "it is moderately difficult for me" by 10 respondents (15.4 %) and "very difficult" 3 respondents (4.6 %). None of the respondents marked the answer "extremely demanding — I need the help of another". In the "cyclocryopexy" group, 14 respondents (38.9 %) and "somewhat difficult" answered 13 respondents (36.1 %). The almost unequivocal answer "I have no problems" is in the group of patients after trabeculectomy in 13 cases (81.3 %). In the "drainage implants" group, the answers "I have no difficulty" and "I have a little difficulty" are represented by 3 respondents (42.9 %) in each of the answers.

The next question was: "Do you have difficulty noticing surrounding objects while walking?" yields the following results; The answer "I have no difficulties" was indicated by 34 respondents (52.3 %), "I have some difficulties" by 23 respondents (35.4 %), "it is moderately difficult for me" by 7 respondents (10.8 %) and "it is very difficult for me" 1 respondent (1.5 %). None of the respondents marked the answer as "extremely demanding". In the "cyclocryopexy" group, the most frequent answer is "I have no difficulties" for 16 respondents (44.4 %) and "I have some difficulties" for 15 respondents (41.7 %). The answer "I have no difficulties" is also the most common in the "trabeculectomy" group, with 13 respondents (81.3 %). In the "drainage implants" group, the leading answer is "I have no problems" for 4 respondents (57.1 %).

The next question was: "Do you have trouble recognizing people's reactions to what you say or do with your eyes?". The most common answer for 45 respondents (69.2 %) is "I have no difficulties", followed by the answer "I have some difficulties" with 15 respondents (23.1 %). The answer "it is moderately difficult for me (I can recognize details)" was indicated by 4 respondents (6.2 %). "It is very difficult for me (I can only recognize larger gestures)" was indicated by one respondent (1.5 %). None of the respondents did not mark "extremely difficult". The answer "I have no difficulties" was also the most frequent in the "cyclocryopexy" group with 22 respondents (61.1 %), in the "trabeculectomy" group with 15 respondents (93.8 %) as well as in the "drainage implants" group for 6 respondents (85.7 %).

In the next question we asked: "Do you have difficulty choosing or coordinating clothes (color, pattern etc.) because of your eyesight?". The most common answer for 41 respondents (63.1 %) is "I have no difficulties", followed by "I have some difficulties" with 20 indications (30.8 %). The answer "it is moderately difficult for me" was marked by 4 respondents (6.2 %). None of the respondents marked the answers "it is very difficult for me" and "extremely difficult". The answer "I have no difficulties" was the most frequent even in the subgroups: "cyclocryopexy" by 20 respondents (55.6 %), "trabeculectomy" by 13 respondents (81.3 %), and "drainage implants" by 5 respondents (71.4 %).

In the next question we asked: "Do you have difficulty seeing in a foreign environment (visiting, in a restaurant, at work…)?". The most frequent answer is "I have no difficulties" with 43 respondents (66.2 %), followed by the answer "I have some difficulties" with 17 respondents (26.2 %). The answer "it is moderately difficult for me" was marked by 3 respondents (4.6 %). "It is very difficult for me, but I can manage it without help" was marked by 2 respondents (3.1 %). None of the respondents marked "extremely difficult", I don't know how to orient myself in a foreign environment without help". The answer "I have no difficulties" was also the most frequent in the "cyclocryopexy" group with 25 respondents (69.4 %), in the "trabeculectomy" group with 12 respondents (75.0 %) as also in the "drainage implants" group for 4 respondents (57.1 %).

In the next question we asked: "Do you have difficulty watching movies, sporting events, playing games?". The most common answer for 30 respondents (46.2 %) is "I have some difficulties", followed by "I have no difficulties" with 19 respondents (29.2 %). The answer "it is moderately difficult for me (I can recognize minor details)" was indicated by 14 respondents (21.5 %). "It is very difficult for me (I cannot recognize details at all)" was indicated by 2 respondents (3.1 %). None of the respondents did not mark "extremely difficult (I can't see the image at all, I only hear the sound)". The answer "I have a little difficulty" was the most frequent in the "cyclocryopexy" group with 18 respondents (50.0 %), as well as in the "drainage implants" group with 6 respondents (85.7 %). In the "trabeculectomy" group, the most frequent answer is "I have no difficulties" for 8 respondents (50.0 %).

In the next question were the respondents divided into 2 groups; respondents who drive — 35 (53.8 %) and respondents who do not drive — 30 respondents (46.2 %).

The next question was: "Have you never driven a car or have you given up driving?" Of the respondents, 35 (53.8 %) still drive, 12 respondents (18.5 %) do not drive because of their eyesight, 9 respondents (13.8 %) have given up driving since other reasons, and 9 respondents (13.8 %) answered "I have no driving license".

The next question was: "If you drive, how often during the day do you have difficulty driving in familiar places?". The most common answer among 32 respondents (49.2 %) is "I have no difficulties", 6 respondents state "I have a little difficulty", and one each is represented by the answers "moderately difficult", "very difficult" and "extremely difficult". 24 respondents do not drive at all. The answer "I have no problems" was the most frequent in the "cyclocryopexy" group with 18 respondents (50.0 %), as well as in the "drainage implants" group with 4 respondents (57.1 %). In the "trabeculectomy" group, the two most represented answers are "I have no difficulties" and "I don't drive" by 7 respondents (43.8 %).

In the next question we asked: "If you drive, how often do you have difficulty driving at night?". The most frequent answer is "I don't drive" with 24 (36.9 %). Of the other answers, "I have a little difficulty" with 21 (32.3 %), followed by the answer "I have no difficulty" with 11 respondents (16.9 %). The answer "moderately difficult" was marked by 6 (9.2 %), "very difficult" was marked by 2 respondents (3.1 %) and one (1.5 %) marked "extremely difficult". 24 respondents, which represents 36.9 % he does not drive at all. The most frequent answer in the "cyclocryopexy" group for 16 respondents (44.4 %) was "a little difficulty", in the "trabeculectomy" group for 3 respondents (18.8 %) and "I have no difficulty" was stated by 4 respondents (25, 0 %).

In the next question we asked: "If you drive, how much difficulty do you have when driving in difficult conditions?" (e.g., bad weather, traffic jam, highway, city traffic)?". The most frequently indicated answer is "I don't drive" by 24 respondents (32.3 %), followed by the answer "I have some difficulties" with 23 respondents (35.4 %), "I have no difficulties" with 10 respondents (15.4 %), it is "moderately difficult for me" was indicated by 6 respondents (9.2 %) and two (3.1 %) indicated "extreme difficulty — I don't drive at all". 17 respondents (47.2 %) reported some difficulty after cyclocryopexy and three (42, 9 %) after drainage implants. For trabeculectomy, a large proportion do not drive (7 respondents; 43.8 %) or "have no difficulty" (4 respondents; 25.0 %).

In the next question we asked: "Are you achieving less than you would like in your daily functioning because of your vision?". Out of all the respondents, the most frequent answer is "not at all" and that is for 39 respondents (60.0 %). The answer "sometimes" was indicated by 15 respondents (23.1 %) and "sometimes" by 9 respondents (13.8 %). The answers "mostly" and "always" are represented by only one respondent. The answer "not at all" was the most frequent even in subgroups: "cyclocryopexy" 24 respondents (66.7 %), "trabeculectomy" 8 respondents (50.0 %) and "drainage implants" 4 respondents (57.1 %).

In the next question: "Does your vision limit you at work or daily activities?". The answer "not at all" was indicated by 32 respondents (49.2 %) and the answer "sometimes" by 23 respondents (35.4 %). The other answers had a comparatively lower representation, "sometimes" 7 respondents (10.8 %), "mostly" 2 respondents (3.1 %) and "always" only one respondent (1.5 %). The "cyclocryopexy" group replicates the overall results with the most frequent answer being "mostly no" in 19 respondents (52.8 %), similar to the trabeculotomy group with 8 answers (50 %). For "drainage implants", 4 respondents (57.1 %) marked "sometimes" and three (42.9 %) "not at all".

In the next question respondents had to answer the question: "Does pain or discomfort in or around the eyes, for example burning, itching or pain, prevent you from daily activities or doing work or hobbies?". Out of all the respondents, the most frequent answer is again "not at all" by 39 respondents (60.0 %). The answer "sometimes" was indicated by 16 respondents (24.6 %) and "sometimes" by 9 respondents (13.8 %). Only one respondent marked the answer "mostly". None of the respondents gave the answer "still". The answer "not at all" was the most frequent even in subgroups: "cyclocryopexy" 24 respondents (66.7 %), "trabeculectomy" 9 respondents (56.3 %). The answers in the "drainage implants" group were the same as in question no. 29.

Question no. 31: "Because of my poor eyesight, I stay at home…". As many as 51 respondents, representing 78.5 %,

Table 3 Questionnaire — answers to questions in absolute numbers and percentages

Question Question + Answer	***Surgery type***											
	Cyclocryopexy		**Trabeculectomy**		**Drainage implants**		**Enucleation**		**Other type of surgery**		**Total**	
	N	%	**N**	%	**N**	%	**N**	%	**N**	%	**N**	%
Question: Are you achieving less than you would like in your daily functioning because of your vision?												
All the time	**0**	0	**1**	6,3	**0**	0	**0**	0	**0**	0	**1**	1,5
Frequently	**0**	0	**0**	0	**0**	0	**1**	25,0	**0**	0	**1**	1,5
Sometimes	**6**	16,7	**2**	12,5	**0**	0	**1**	25,0	**0**	0	**9**	13,8
Occasionally	**6**	16,7	**5**	31,3	**3**	42,9	**1**	25,0	**0**	0	**15**	23,1
Never	**24**	66,7	**8**	50,0	**4**	57,1	**1**	25,0	**2**	100	**39**	60,0
Question: Does your vision limit you at work or everyday activities?												
All the time	**0**	0	**1**	6,3	**0**	0	**0**	0	**0**	0	**1**	1,5
Frequently	**1**	2,8	**0**	0	**0**	0	**1**	25,0	**0**	0	**2**	3,1
Sometimes	**5**	13,9	**1**	6,3	**0**	0	**1**	25,0	**0**	0	**7**	10,8
Occasionally	**11**	30,6	**6**	37,5	**4**	57,1	**2**	50,0	**0**	0	**23**	35,4
Never	**19**	52,8	**8**	50,0	**3**	42,9	**0**	0	**2**	100	**32**	49,2
Question: Pain or discomfort in or around the eyes, such as burning, itching or pain in daily activities or doing work or hobbies, makes it difficult for you												
All the time	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Frequently	**0**	0	**0**	0	**0**	0	**1**	25,0	**0**	0	**1**	1,5
Sometimes	**7**	19,4	**1**	6,3	**0**	0	**1**	25,0	**0**	0	**9**	13,8
Occasionally	**5**	13,9	**6**	37,5	**4**	57,1	**1**	25,0	**0**	0	**16**	24,6
Never	**24**	66,7	**9**	56,3	**3**	42,9	**1**	25,0	**2**	100	**39**	60,0
Question: I have to stay at home due to my sight problems												
Yes	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Mostly yes	**2**	5,6	**1**	6,3	**0**	0	**2**	50,0	**0**	0	**5**	7,7
I can´t judge	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Mostly no	**6**	16,7	**1**	6,3	**1**	14,3	**1**	25,0	**0**	0	**9**	13,8
Never	**28**	77,8	**14**	87,5	**6**	85,7	**1**	25,0	**2**	100	**51**	78,5
Question: I feel frustrated due to my sight problems												
Yes	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0
Mostly yes	**0**	0	**0**	0	**0**	0	**2**	50,0	**0**	0	**2**	3,1
I can´t judge	**5**	13,9	**1**	6,3	**0**	0	**0**	0	**0**	0	**6**	9,2
Mostly no	**8**	22,2	**1**	6,3	**2**	28,6	**2**	50,0	**0**	0	**13**	20,0
Never	**23**	63,9	**14**	87,5	**5**	71,4	**0**	0	**2**	100	**44**	67,7

marked the answer "not at all", 9 respondents (13.8 %) "mostly no", 5 respondents (7.7 %) marked "mostly yes". None of the respondents marked the answers "definitely yes" and "can't judge". The groups "cyclocryopexy", "trabeculectomy" and "drainage implants" again copy the results of the whole set.

The next question was: "I often feel frustrated because of my vision…". The answer "not at all" was indicated by 44 respondents (67.7 %) and the answer "mostly no" by 13 respondents (20 %). Other answers had a lower representation, "I don't know" 6 respondents (9.2 %), "mostly yes" 2 respondents (3.1 %). The answer "definitely yes" was not marked by anyone. In the "cyclocryopexy" group, the answer "mostly no" dominates with 23 respondents (63.9 %), similar to the group of patients after trabeculotomy with 14 answers (87.5 %) "not at all", similar to "drainage implants" with 5 respondents (71.4 %).

In the next question the respondents were asked to say: "I can control the things or activities I do worse…". The answer "not at all" was indicated by 43 respondents (66.2 %) and the answer "mostly no" by 13 respondents (20 %). The answer "I don't know" was indicated by 5 respondents (7.7 %), "mostly yes" by 4 respondents (6.1 %). None of the interviewees marked the answer "definitely yes". The overall results are again a reflection of the "cyclocryopexy" group, where 26 respondents (72.2 %) marked the answer "mostly no" as well as the group of patients after trabeculotomy with 11 respondents (68.8 %). For "drainage implants", 4 respondents (57.1 %) marked "not at all" and three (42.9 %) "mostly no".

In the next question: "Because of my eyesight, I have to rely on what other people say…" Out of all 48 respondents, representing 73.8 %, marked the answer "not at all", 9 respondents (13.8 %) "mostly no", 4 respondents (6.2 %) "don't know" and 4 respondents (6.2 %) "mostly yes". None of the respondents marked the answers "definitely yes". In the individual defined groups, the situation with the most frequent answers is as follows: "not at all" in 28 patients (77.8 %) after cyclocryopexy, in 13 (81.3 %) in the case of "trabeculectomy" and in 5 respondents (71.4 %) in to the "drainage implants" group.

In the next question "Because of my eyesight, I need help from my surroundings…" The representation of the answers is as follows: "I don't need" 47 respondents, which represents 72.3 %, "mostly no" 13 respondents (20 %), "mostly yes" 4 respondents (6, 2 %) and "definitely yes" for one respondent. No one marked the answer "don't know". In the group of patients after cyclocryopexy, the most frequent answer is "I don't need" for 27 respondents (75 %), for "trabeculectomy" 12 respondents (75 %) and in the group of "drainage implants" 5 respondents (71.4 %).

The last question of questionnaire was: "Because of my sight, I am afraid to do things that might embarrass or embarrass me…" The answer "not at all" was indicated by 49 respondents (75.4 %) and the answer "mostly no" by 13 respondents (20 %). The answer "I don't know" was represented 2 times (3.1 %), "mostly yes" once (1.5 %). None of the interviewees marked the answer "definitely yes". In the "cyclocryopexy" group, 27 respondents (75 %) marked the answer "mostly no", similar to the group of patients after trabeculotomy with a given answer occurring up to 15 times, representing (93.8 %). For "drainage implants", 5 respondents (71.4 %) marked "not at all" and two (28.6 %) "mostly not".

DISCUSSION

The issue of the patient's subjective perception of individual operations is not well clarified in the professional literature (Huang *et al.* 2020). As part of our questionnaire, the selected patients had to answer questions related to the subjective perception of the surgical performance and the postoperative period in terms of pain, discomfort, near vision, distance, medium distance, and normal activities. We were also interested in the overall quality of life and the impact on the patient's psyche during specific surgical techniques. Of the patients who underwent cyclocryopexy, 35 respondents (97.2 %) reported tolerable, minimal or no pain during the operation and shortly after the operation, with most patients reporting only minimal pain. Up to the first year after surgery, 21 respondents (58.3 %) reported no pain. Bellows (Bellows 1981) describes that with cyclocryopexy there is a risk of loss of functional vision up to phthisis of the bulb, but he also emphasizes the importance of this method in the treatment of patients with some specific types of glaucoma and advanced glaucoma. In his 10-year retrospective analysis, Benson (Benson & Nelson 1990) admits that the apparently high rate of complications such as vision loss and bulbar phthisis cannot be attributed directly to the procedure because the method was used in eyes with a poor prognosis. Despite the possible risks, from the point of view of pain, cyclocryopexy appears to be very suitable and subjectively well-tolerated by patients both intraoperatively and long-term after the operation. Also, most patients reported no change in near or distance vision (23 respondents; 63.9 %) within two years after surgery, with a small percentage of patients reporting even a slight improvement in vision. Only 6 patients (16.7 %) describe a slightly worse vision during daily activities and 8 patients (22.2 %) during close and short distance work. Up to 30 respondents (83.3 %) describe a good overall quality of vision with both eyes, while 32 respondents (88.9 %) indicate occasional or exceptional visual impairment, or eye pain or discomfort. This does not fully correspond to the opinions of several sources about the subsequent impairment of visual functions in patients after the cyclodestructive method (Li 1990; Mlčák *et al.* 2009; Kalyani *et al.* 2020). Other answers to the questions in our questionnaire concerning other daily

activities also bring similar results. Reading ordinary press such as books, newspapers, or magazines was a minimal or no problem for 27 respondents, which represents 75 % of respondents after cyclocryopexy. An even higher number, up to 30 respondents (83.3 %) reported no or minimal difficulties with normal work and performing hobbies and activities close by. Recognizing small details such as things on an overcrowded shelf and also surrounding objects while walking had no or only a slight problem after surgery for up to 31 respondents, which represents 86.1 %, and an even larger percentage of 88.9 % (32 respondents) had minimal or no difficulties when reading street or store signs. For the remaining respondents, these activities are only moderately demanding. Slightly fewer respondents — 27 respondents (75 %) describe minimal or no difficulties when going down stairs or a curb in the dark or at night. Here, 3 respondents (8.3 %) describe that it is very difficult for them. 33 to 35 respondents (91.7 — 97.2 %) have no difficulties or only minimal difficulties when recognizing people on the street, seeing them in a foreign environment, in a restaurant, when visiting, as well as when choosing or matching clothes according to color or pattern. 10 respondents, which represents 27.8 %, have difficulty watching movies, sporting events or playing games. These findings from our questionnaire represent evidence of the minimal impact of cyclocryopexy on vision, the feeling of pain or discomfort from the patient's point of view, and the overall postoperative comfort of the patient in the postoperative period, as described in the work of Miljiković et al from 2021 (Miljiković *et al.* 2021). According to the questionnaire, there were 16 respondents who undervent trabeculectomy (25 %). Most respondents reported tolerable pain during surgery, minimal pain within two weeks of surgery, and no or minimal pain within two years of surgery. 11 respondents (68.8 %) reported an improvement in vision during daily activities, but for short distances, close work and reading, the majority — 9 respondents (56.3 %) did not report any changes in vision. As reported by Kyari (Kyari & Abdull 2016), soreness after trabeculectomy can occur as a result of applied sutures or as a result of the surgical procedure itself. Despite the various modifications, trabeculectomy is a relatively demanding method, especially due to the extent of surgical intervention in the anterior chamber and in the anterior segment of the eye in general. A short-term change in the patient's vision in the postoperative period may also be related to this (Maris *et al.* 2007; Murdoch 2012; Ramona *et al.* 2015). Patients also reported only occasional, exceptional or no deterioration of vision or burning or discomfort in the postoperative period. It is common for vision to be temporarily blurred in the first few days after surgery. The same problems may have patients after single cataract surgery also (Žiak *et al.* 2017, 2019). Patients may experience redness, irritation, swelling and a foreign body sensation. Vision improves within a few days to weeks after surgery. Nevertheless, after trabeculectomy, there is no need to monitor IOP (Maris *et al.* 2007; Kaburaki *et al.* 2009; Jeong *et al.* 2018; Pandav *et al.* 2021; Kang *et al.* 2022).

CONCLUSION

Healthcare for any patient must be individualized and tailored to all the patient's needs, taking into account their current health status, knowledge and skills, and taking into account their socioeconomic status. Glaucoma is a serious eye disease that, without adequate treatment, leads to gradual damage to the optic nerve and visual functions. Which method of treatment we will use depends on several factors, such as the state of visual impairment and visual functions, the stage of the disease in which the disease is present, the cooperation and willingness of the patient to be treated and follow the treatment procedure, but also the possibilities of the workplace itself, or the knowledge and skills of the attending physician. Timely determination of risk factors, establishment of an accurate diagnosis with the implementation of the most suitable treatment method based on the latest knowledge and recommendations make it possible to prevent the development of glaucomatous changes. Regular check-ups and dispensary examination of the patient is very important in the management of glaucoma, especially for a timely response to the onset of disease progression and adaptation of treatment based on the latest knowledge and recommendations.

Declarations

Conflict of interest: The authors declare no conflict of interest.

Competing interests: The authors declare no competing interests.

Consent for publication: The authors consent the publication of this work.

Data availability: The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Satisfaction of seniors with the provision of the health care and services in selected healthcare facilities in the Slovak Republic

Spokojnosť seniorov s poskytovaním zdravotnej starostlivosti a služieb vo vybraných zariadeniach v Slovenskej Republike

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ABSTRACT

Introduction: Satisfaction with the provision of quality nursing care and services among patients placed in health care facilities for the elderly is important.

Aim: The aim of our exploratory analysis was to map and analyze the views of seniors on the provision of health care and services in the health care facilities in which they are placed.

Methods: The research was conducted in three selected health care facilities in the Slovak Republic, in Košice. Number of respondents — 50. We used a structured questionnaire. We used descriptive statistics.

Results: Of the 50 (100 %) respondents, 45 (90 %) expressed satisfaction with their healthcare provision. Only 5 (10 %) patients were dissatisfied. 47 (94 %) respondents were satisfied with the nursing care provided by the nurses, only 3 (6 %) were dissatisfied. Satisfaction with the services provided was reported by 12 (24 %) respondents, while dissatisfaction was reported by 38 (76 %) respondents.

Conclusion: Many negative aspects affect the satisfaction of seniors with the provision of quality nursing care and services in health care facilities. To eliminate them, it is necessary to be aware of them. A comprehensive intervention by a team working in health care facilities for the elderly is helpful.

Keywords: senior, old age, health care, service, health care facilities, patient satisfaction

ABSTRAKT

Úvod: Spokojnosť s poskytovaním kvalitnej ošetrovateľskej starostlivosti a služieb u pacientov umiestnených v zdravotníckych zariadeniach pre seniorov je dôležitá.

Cieľ: Cieľom našej exploračnej analýzy bolo zmapovať a analyzovať názory seniorov na poskytovanie zdravotnej starostlivosti a služieb v zdravotníckych zariadeniach, v ktorých sú umiestnení.

Metódy: Výskum sa uskutočnil v troch vybraných zdravotníckych zariadeniach v Slovenskej republike, v Košiciach. Počet respondentov — 50. Použili sme štruktúrovaný dotazník. Použili sme deskriptívnu štatistiku.

Výsledky: Z 50 (100 %) respondentov vyjadrilo spokojnosť s poskytovaním zdravotnej starostlivosti 45 (90 %) respondentov. Nespokojných bolo len 5 (10 %) pacientov. S ošetrovateľskou starostlivosťou poskytovanou sestrami bolo spokojných 47 (94 %) respondentov, nespokojní boli len 3 (6 %). Spokojnosť s poskytovanými službami vyjadrilo 12 (24 %) respondentov, nespokojnosť 38 (76 %) respondentov.

Záver: Spokojnosť seniorov s poskytovaním kvalitnej ošetrovateľskej starostlivosti a služieb v zdravotníckych zariadeniach ovplyvňujú mnohé negatívne aspekty. Na ich elimináciu je potrebné si ich uvedomiť. Nápomocná je komplexná intervencia tímu pracujúceho v zdravotníckych zariadeniach pre seniorov.

Kľúčové slová: senior, staroba, zdravotná starostlivosť, služba, zdravotnícke zariadenia, spokojnosť pacientov

INTRODUCTION

With a growing ageing population and a lower ratio between the active and dependent population, population ageing is considered a global social and health challenge that is associated with increased demand for health and social care (Lamnisos *et al.* 2021).

After the age of sixty, many older people have increasing health problems and their need for social and health services increases (Seberini *et al.* 2022).

The ageing process brings with it many factors affecting quality of life. Seniors develop various diseases that reduce their self-sufficiency or their economic situation worsens, resulting, for example, in reduced social contacts (Böger, Huxhold 2018). It is important not to ignore the elderly, to be patient and keep calm, to actively support and encourage them, to motivate, guide and advise them (Danková 2022).

As people with advanced age have various overlapping problems that they cannot resolve even with family members, they come to health care facilities for the elderly. They expect total care about their health condition and suitable conditions. Nursing care is centred on meeting the needs of the sick person and on achieving as much as possible his or her self-sufficiency (Raková 2018). According to Repkova (2016), society universally tends to treat such people worse and deny them access to things important for a dignified and fulfilling life. Therefore, it is important for the elderly maintain valuable social roles. Nurses should inform patients about each application and procedure and provide necessary explanations about the disease, diagnosis, and treatment to ensure patient satisfaction and the delivery of high-quality nursing care (Karaca, Durna 2019). We acknowledge the patient's feelings, allowing them to express themselves sufficiently (Danková 2022). In order to take into account the individual wishes and capabilities of each client an appropriate starting point is offered by person-centred planning (Musialová, Gulová 2022).

Application of effective communication, creativity, adaptability, stress management, decision making, teamwork, and critical thinking adds a dimension of nursing intelligence essential to patient diagnosis, interventions and interventions (Štefková, Zamboriová 2021).

In many societies, we are experiencing an ageing population and the capacity to care for the elderly is constantly being depleted. This process is referred to as the "care crisis" (Fraser 2016). It is important to retain employees — to create conditions for continuous learning and development, all as a guarantee of acting in the best interests of the beneficiaries (Repkova 2017). The results of research by Cintulova, Buzalova (2021) showed a rapid decline in the number of low-threshold social services, day care centres for the elderly.

Patient satisfaction is used as a criterion in many hospitals to measure nurses' behaviors in providing care (Abdullah, *et al.* 2017). Also Mulugeta *et al.* (2019) reported in their study that patient satisfaction with nursing care is considered to be the most important predictor of overall patient satisfaction with hospital services and the quality of healthcare services in general. Patient satisfaction with care is a subjective perception of the quality of care provided in a given facility (Maconko *et al.* 2016). Osiya *et al.* (2017) report that patients' satisfaction with their healthcare predicts the likelihood of their continued use of available healthcare,

adherence to doctor's orders, and improvements in the overall scope and effectiveness of care. Patients' willingness to recommend a hospital is a recognized indicator of the qualityof patient-centered care (Borowska, Rigioni, Augustinowicz 2023). Quality of health care and client satisfaction are key elements in improving performance of health systems (Akinyinka, Oluwole, Odusanya 2019).

The best representation of old age is an actively aging person. It is therefore desirable to look for inspiring solutions that will contribute to the elimination of existing shortcomings so that care for the elderly in the future will be provided at a level that corresponds to the 21st century (Průša et al. 2021).

METHODS

The research was carried out in three different health care facilities in Košice — St. Luke's Institute of Geriatrics, Specialized Facility and Equipment for the Elderly (ARCUS) and the Archdiocesan Charity. Ethical approval for the permission to conduct the survey was obtained from the deputy directors of nursing care in the selected health care institutions. The number of respondents was 60. The total number of questionnaires distributed was 60. The number of questionnaires returned was 50. The return rate of the questionnaires was 95 %. The survey was carried out in the months of January and February 2020. The data obtained from the questionnaire survey were processed using the statistical program Excel. Descriptive statistics were used. The information obtained was evaluated by frequency analysis in the whole set are interpreted in the form of tables.

RESULTS

Demographics

The total number of respondents was 50, with the ARCUS facility being the most represented. There were more females (62 %; n = 31) than males (38 %; n = 19) in the cohort. In relation to gender and facility, the largest number of respondents were women from the ARCUS social services facility with a percentage of 40 % (n = 20), and conversely, the smallest number of respondents were men from ADOS with a percentage of 8 % (n = 4). Further, the largest number of respondents in the sample were aged between 60-74 years old with a percentage of 48 % (n = 24). Slightly fewer respondents were between the ages of 75 — 89 years old at 46 % (n = 23). The least number of respondents were aged over 90 years old in a representation of 6 % (n = 3). In relation to age and facility, most respondents were aged 75 — 89 years from ARCUS facilities. The fewest were from the same facility aged 90 years and over at 6 % (n = 6).

Tab. 1. Characteristics of the study population

	VŠÚG n/ %	**ARCUS** n/ %	**ADOS** n/ %	**Total n/ %**
Gender				
Women	5/10	20/40	6/12	**31/62**
Man	5/10	10/20	4/8	**19/38**
Total	10/20	30/60	10/20	**50/100**
Age				
60 – 74 years	6/12	12/24	6/12	**24/48**
75 – 89 years	4/8	15/30	4/8	**23/46**
90 and over	0/0	3/6	0/0	**3/6**
Total	**10/20**	**30/60**	**10/20**	**50/100**

Satisfaction and comparison of satisfaction in the surveyed areas in relation to gender and age within facilities

The highest level of satisfaction of seniors with the provision of health care was found in the VŠÚG facility, while satisfaction was slightly lower in ADOS, and the lowest in ARCUS. Of the total respondents, females were the most satisfied with the provision of health care (60 %, n = 30). Dissatisfaction was lowest among women (total for all facilities 10 %; n = 5). In relation to negative ratings of satisfaction with health care delivery, women were the most dissatisfied with ARCUS facilities (8 %; n = 4). From the above data, it can be concluded that respondents were highly satisfied with their care delivery (90 % combined for both men and women).

In relation to the services provided in the above mentioned facilities, the highest dissatisfaction was in VŠÚG, followed by ARCUS and ADOS as well. Of the respondents, women were the most dissatisfied (48 %, n = 24). Satisfaction was lowest among males (total for all facilities 10 %; n = 5), specifically, one male (2 %) from ADOS was the least satisfied. In relation to positive ratings of satisfaction with services, women were most satisfied with the ARCUS facility (10 %; n = 5). From the above data, it can be noted that a high proportion of respondents were dissatisfied with the services (76 % for both men and women combined).

Satisfaction of seniors with the experience of old age in the mentioned facilities was highest in VŠÚG and ADOS as well, followed by ARCUS. Among the respondents, women were the most satisfied (56 %, n = 28). Dissatisfaction was lowest among men (total for all facilities 0 %; n = 0). In relation to negative ratings of satisfaction with services, women were most satisfied with the ARCUS facility (6 %; n = 3). From the above data, it can be concluded that to a high extent, respondents were satisfied with experiencing old age in the above facilities (94 % combined for both men and women).

Tab. 2. Satisfaction of respondents in selected areas in each facility compared with gender

	VŠÚG n/ %	**ARCUS** n/ %	**ADOS** n/ %	**Total n/ %**
Satisfaction/dissatisfaction of seniors with health care provision in health facilities (1) vs. gender				
Yes/women	5/10	20/40	5/10	**30/60**
No/ women	0/0	4/8	1/2	**5/10**
Yes/man	5/10	6/12	4/8	**15/30**
No/man	0/0	0/0	0/0	**0/0**
Total satisfaction/ dissatisfaction (1)	***100 % /0 %***	***87 % /13 %***	***90 % /10 %***	
Satisfaction/dissatisfaction of seniors with services provided (2) vs. gender				
Yes/women	0/0	5/10	2/4	**7/14**
No/ women	5/10	15/30	4/8	**24/48**
Yes/man	0/0	4/8	1/2	**5/10**
No/man	5/10	6/12	3/6	**14/28**
Total satisfaction/ dissatisfaction (2)	***0 % /100 %***	***30 /70 %***	***30 % /70 %***	
Satisfaction/dissatisfaction of seniors with the experience of old age (3) vs. gender				
Yes/women	5/10	17/34	6/12	**28/56**
No/ women	0/0	3/6	0/0	**3/6**
Yes/man	5/10	10/20	4/8	**19/38**
No/man	0/0	0/0	0/0	**0/0**
Total satisfaction/ dissatisfaction (3)	***100 % /0 %***	***90 % /0 %***	***100 % /0 %***	

We examined the satisfaction with experiencing old age among respondents of different age categories. Respondents aged 75 — 89 years had the highest satisfaction scores at 48 % (n = 24). The second most similarly satisfied group was the 60 — 74 age category at 46 % (n = 23). The lowest dissatisfaction scores were reported by seniors aged 90 years and older from ARCUS facilities (6 %; n = 3).

Tab. 3. Respondents' satisfaction with the experience of old age in individual facilities in selected areas compared with age categories

	VŠÚG n/ %	**ARCUS** n/ %	**ADOS** n/ %	**Total n/ %**
Satisfaction/dissatisfaction of seniors with the provision of health care in health facilities vs. gender				
Yes/60 – 74 years	5/10	12/24	6/12	**23/46**
No/60 – 74 years	0/0	0/0	0/0	**0/0**
Yes/75 – 89 years	5/10	15/30	4/8	**24/48**
No/75 – 89 years	0/0	0/0	0/0	**0/0**
Yes/90 years and over	0/0	0/0	0/0	**0/0**
No/90 years and over	0/0	3/6	0/0	**3/6**

DISCUSSION

n terms of gender, 62 % of women and 38 % of men participated in the research. Age distribution of respondents 60 — 74 year olds were 48 % of respondents, 75 — 89 year olds were 46 % of respondents, 90+ year olds were 6 % of respondents. Respondents from all three facilities 50 (100 %) indicated that they lived in the city. All respondents reported that they do not work.

Very good health status was recorded for 5 (10 %) respondents, good health status was recorded for 14 (28 %) respondents, fairly good health status was recorded for 21 (42 %) respondents, and poor health status was recorded for 10 (20 %) respondents.

Diseases — there were 2 (4 %) respondents not treated, 14 (28 %) respondents were treated for cardiovascular disease, 9 (18 %) respondents were treated for high blood pressure, 8 (16 %) respondents were treated for diabetes mellitus, stomach 9 (18 %) respondents, 8 (16 %) respondents reported treatment for other diseases (osteoporosis, prostate disease, asthma, cancer, arthrosis).

Of the 50 (100 %) respondents in our sample, 45 (90 %) respondents expressed satisfaction with their health care delivery and 5 (10 %) respondents were dissatisfied. Hrnčárová (2018), in her study reported similar results of satisfaction with health care delivery among 41(66 %) respondents and dissatisfaction was expressed by 21 (34 %) respondents. The authors' collective Babatola *et al.* (2022) from Nigeria reported in their study that more than half of the participants 63,6 % were very satisfied with the health care services provided by the health and nursing teams. Zhi et al. (2022) reported the overall satisfaction level is high, but satisfaction with health

advice is relatively low in Chinese tertiary hospitals. In a study by Borowska, Religioni, Augustinowicz (2023), respondents categorized as critics (38 %) reported long waiting times for hospital admission.

We were interested in respondents' views on the suitability and accessibility of facilities for the elderly — 45 (90 %) respondents expressed the view that these facilities were suitably located and accessible; 5 (10 %) respondents disagreed with this view. Similar results on the accessibility of facilities for the elderly were reported by Hrnčárová (2018), with 58 % of respondents agreeing and 4 % disagreeing. According to Babatola, Popoola, Olatubi (2022), in Ondo State 62, 8 % of the respondents expressed satisfaction with the availability of places in the hospital and 64,5 % of the respondents are satisfied with the location of the hospital. Gyarmati (2019) reports in his research that care in Hungary, close to home, is available for only 7 % of people in the 65+ age group.

Availability of reimbursement for health and social facilities for patients — 29 (58 %) of the respondents indicated the answer that reimbursement is available for everyone and 21 (42 %) of the respondents indicated that it is not available for everyone.

Finding out patients' satisfaction with nurses' work. 47 (94 %) respondents were satisfied with nurses' provision of nursing care and 3 (6 %) respondents gave a negative response. Sharewa et al. (2018) reported the results of patient satisfaction levels with nursing care in several countries — Serbia (51,7 %), Philippines (57,8 %)Turkey (54,8 %), India (73 %), Iran (82,8 %), Malaysia (82,7 %) and Ethiopia (49,2 %). The level of patient satisfaction with nursing care in our study (94 %) was higher compared to the results of the above studies. Finding out the patients' satisfaction with the work of the doctor — 45 (90 %) respondents were satisfied and 5 (10 %) respondents expressed dissatisfaction. 36 % of respondents in a similar survey reported high quality of medical and nursing care (Borowska, Religioni, Augustinowicz 2023).

There are 34 respondents who use services in health facilities. 12 (24 %) respondents reported satisfaction with the services provided and 38 (76 %) respondents were dissatisfied with the services provided. The authors' collective Seberíni et al. (2022) came to the results that general services are not fully integrated and there will be a shortage of social and health care services in Slovakia in the coming years. Health services play a key role in patient satisfaction (Manzoor *et al.* 2019).

Sufficient facilities to accommodate the elderly in Slovakia. 12 (24 %) respondents report that there are many facilities for the elderly in Slovakia and 38 (76 %) respondents report that there are not enough facilities for the elderly in Slovakia. Cintulová, Buzalová (2022) reports a 43 % decrease in non-public social service providers in the Nitra, Trnava and Bratislava regions.

Satisfaction with experiencing old age — 46 (92 %) are satisfied with experiencing old age. Dimunova et al. (2013) states in her study that seniors placed in Austrian facilities are satisfied with their opportunities to achieve more in life, they get the recognition they deserve, they are satisfied with what they have achieved in life as well as with the things they have to look forward to.

RECOMMENDATIONS

We would like to direct our recommendations and outcomes, which are in line with the needs of seniors, to health professionals working in clinical practice. It is very important to:

- maintain the self-sufficiency of seniors,
- to improve cognitive function in older people,
- to contribute to the expansion of knowledge, clarification of unrealistic facts,
- to organise activities that are oriented towards social activities of interest,
- to raise awareness among older people about the University of the Third Age,
- to motivate seniors who are not active to carry out activities that interest them and fill their free time,
- to seek out seniors with negative fears related to the future in an effort to eliminate them,
- actively listen to the views of seniors and accept the comments identified.

CONCLUSION

With the current increase in the elderly population, it is necessary to ensure quality management of nursing care and to pay due attention to this area. It would be most ideal for each of us to "live out our lives" in a natural environment. There are groups of people who are unable to look after themselves in old age or who do not have relatives to help them. The alternative for them are facilities for the elderly. The most important thing is to treat each elderly person individually, to create the right conditions and environment to preserve their physical abilities, and to promote the integration of the elderly into society. It was confirmed that in the selected facilities for the elderly in Košice, the majority of the participants of this study were fully satisfied with the health care, but in the areas of service provision the respondents expressed dissatisfaction. Therefore, there is a need for assistance from the society to continuously upgrade and improve the quality of services and health care for the dignified survival of the elderly.

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Conflicts of Interest:
The authors declare no conflict of interest in the connection with the published article.

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Important functions of serotonin in the gastrointestinal tract

Významné funkcie serotonínu v gastrointestinálnom trakte

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ABSTRACT

Introduction: The gastrointestinal tract contains the largest endocrine organ in the human body, which includes various types of enteroendocrine cells. The best characterized subset of enteroendocrine cells are the enterochromaffin cells and are found in the intestinal mucosa. These cells are responsible for the release of various biologically active compounds, including serotonin (5-HT).

Research objectives: The aim of this review is to summarize the current knowledge on the role of serotonin (5-HT) in various functions and disease pathogenesis, with a focus on the gut.

Core of work: Serotonin (5-HT) is a monoamine neurotransmitter that is known for its many complex and multifaceted biological functions. It modulates mood, regulates body temperature, sleep, appetite, and cognitive function in the central nervous system. However, more than 90 % of serotonin is synthesized and stored in the enterochromaffin cells of the gastrointestinal tract. Serotonin acts primarily through its receptors. When 5-HT interacts with its receptors, it regulates several physiological functions in the gastrointestinal tract, such as fluid absorption and secretion and peristaltic reflexes. The basic physiological functions of serotonin are reasonably well understood and described. But it is becoming increasingly clear that 5 hydroxytryptamine also plays a role in disease processes, particularly those related to inflammation.

Conclusion: The role of serotonin in the physiology and pathophysiology of GIT disorders remains an unanswered question after various studies. But it is becoming increasingly clear that serotonin plays a key role and is associated with inflammatory processes that lead to many GIT disorders.

Keywords: serotonin, enterochromaffin cells, 5-HT receptors, gastrointestinal tract

ABSTRAKT

Úvod: Gastrointestinálny trakt obsahuje najväčší endokrinný orgán v ľudskom organizme, ktorého súčasťou sú rôzne typy enteroendokrinných buniek. Najlepšie charakterizovaná podskupina enteroendokrinných buniek sú bunky enterochromafínové a nachádzajú sa v črevnej sliznici. Tieto bunky sú zodpovedné za uvoľňovanie rôznych biologicky aktívnych zlúčenín, medzi ktoré patrí aj serotonín (5-HT).

Ciele práce: Cieľom tohto prehľadu je zhrnúť súčasné poznatky o úlohe serotonínu (5-HT) v rôznych funkciách a patogenéze ochorení so zameraním na črevo.

Jadro práce: Serotonín (5-HT) je monoamínový neurotransmiter, ktorý je známy pre svoje mnohé komplexné a mnohostranné biologické funkcie. Moduluje náladu, reguluje telesnú teplotu, spánok, chuť do jedla a kognitívne funkcie v centrálnom nervovom systéme. Viac ako 90 % serotonínu sa však syntetizuje a ukladá v enterochromafinných bunkách gastrointestinálneho traktu. Serotonín pôsobí predovšetkým prostredníctvom svojich receptorov. Keď 5-HT interaguje so svojimi receptormi, reguluje niekoľko fyziologických funkcií v gastrointestinálnom trakte, ako je absorpcia a sekrécia tekutín a peristaltické reflexy. Základné fyziologické funkcie serotonínu sú pomerne dobre pochopené a popísané. Ale je čoraz jasnejšie, že 5 hydroxytryptamín zohráva úlohu aj v chorobných procesoch, najmä tých, ktoré súvisia so zápalom.

Záver: Úloha serotonínu vo fyziológii a patofyziológii porúch GIT po rôznych štúdiach je stále nezodpovedanou otázkou. Ale je čoraz jasnejšie, že serotonín hrá kľúčovú úlohu a je spojený so zápalovými procesmi, ktoré vedú k mnohým poruchám GIT.

Kľúčové slová: serotonín, enterochromafinné bunky, 5-HT receptory, gastrointestinálny trakt

INTRODUCTION

Serotonin also known as 5-hydroxytryptamine, 5-HT or enteramine, is one of the monoamine neurotransmitters (Young 2007). It is known for its many complex and multifaceted biological functions, modulating mood, cognition, learning, memory but also affecting physiological functions such as regulating body teperature, sleep, sexual behavior, vasoconstriction and vomiting. Serotonin can be classified as a hormone, neurotransmitter and a mitogen (Costedio *et al.* 2007; Kendig *et al.* 2015).

HISTORY

The first mention of the existence of 5-HT is from 1935, when the Italian Vittorio Erspamer isolated indolalkylamine from the gastrointestinal tract and identified it as enteramin. It is the major secretory product from enterochromaffin cells (EC) that causes intestinal contractions (Negri 2006; Rapport *et al.* 1948). A few years later in 1948, Maurice M. Rapport, Arda Green, and Irvine Page of the Cleveland Clinic isolated a compound in the blood serum with vasoconstrictive action, which they called serotonin. Rapport and colleagues identified the structure of serotonin as 5-HT, and Erspamer proved that enteramin is in fact 5-HT (Rapport *et al.* 1948).

BIOLOGY

According to previous findings, the human body contains about 10 mg of serotonin, 95 % of which is found in the gastrointestinal tract, while the remaining 5 % remains in the central nervous system and specifically in the raphe nuclei located in the brainstem, Merkel cells located in the skin, pulmonary neuroendocrine cells, and taste receptors in the tongue. In addition, serotonin is stored in platelets and released during excitation and vasoconstriction (Schlienger *et al.* 2003). 90 % of the serotonin present in the gastrointestinal tract is found in enterochromaffin cells (EC) and 10 % in enteric neurons, which are part of the enteric nervous system (ENS) (Kim *et al.* 2000; Sanger 2008).

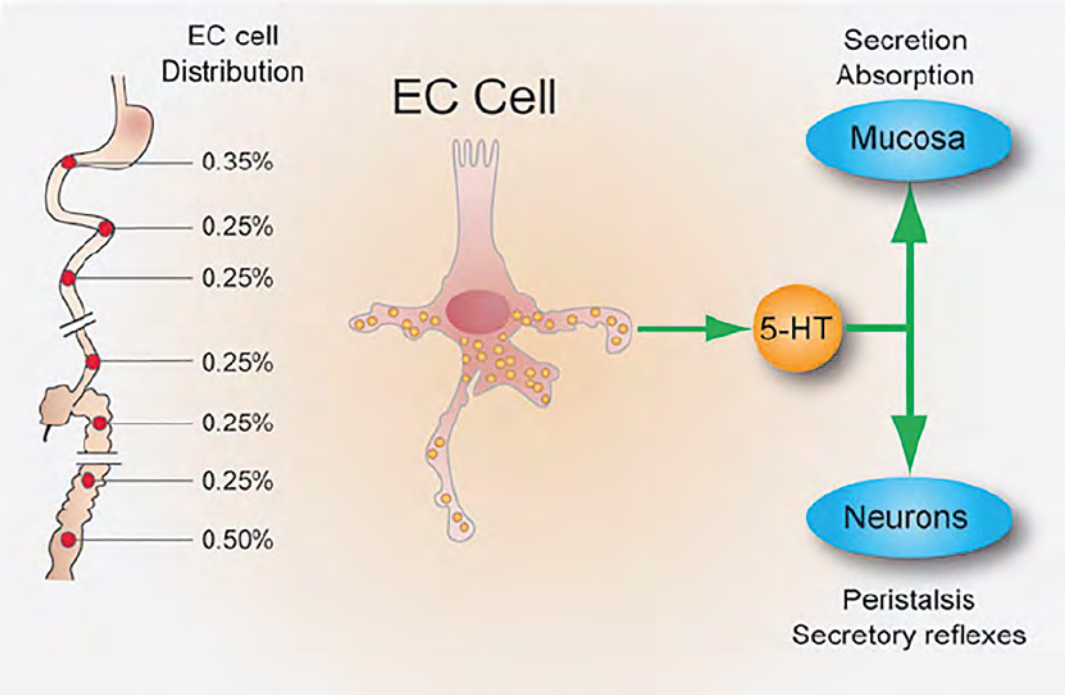
Enterochromaffin cells represent the largest population of enteroendocrine cells of the intestinal epithelium. They are small polygonal cells that are found in crypts between intestinal villi. They are distinguished from other cells by the presence of basally located granules that contain serotonin and other peptides. Enterochromaffin cells are the primary site of serotonin synthesis, storage, and release in the body (Wade *et al.* 1985) (Figure 1).

BIOSYNTHESIS

Enterochromaffin cells in the intestinal mucosa contain enzymes that are capable of synthesizing serotonin from L-tryptophan. L-tryptophan is a precursor to many physiologically essential substances including 5-HT, melatonin and kynurenine. Only 1 — 2 % of L-tryptophan is degraded to 5-HT and melatonin, as 95 % is converted to kynurenine, kynurenic acid, xanthurenic acid, quinolinic acid, and picolinic acid via the kynurenic pathway (Liu *et al.* 2021) (Figure 2).

The synthesis of 5-HT occurs in two steps. In the first step, the essential amino acid L-tryptophan is hydroxylated to

Figure 1: The distribution and role of serotonin secreting EC cells within the gastrointestinal tract. EC cells are ubiquitous throughout the gut and represent 0.25 — 0.5 % of the total mucosal volume.



(Source: Wade et al. 1985

Figure 2: The serotonin, kynurenine and indolic pathways of tryptophan degradation. Trp: tryptophan, 5-HTP: 5-hydroxytryptophan, 5-HT: serotonin, 5-HIAA: 5-hydroxyindolacetic acid, Kyn: kynurenine, KYNA: kynurenic acid, IS: indoxyl sulphate, 3-IAA: 3-indolacetic acid (Source: Liu *et al.* 2021).

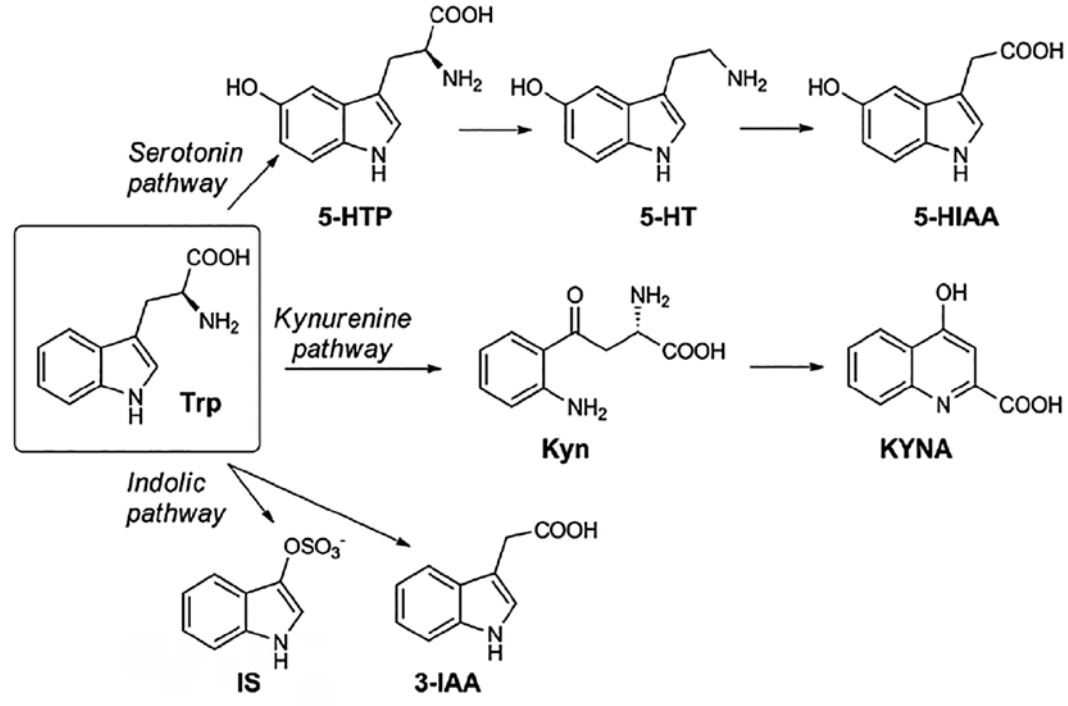
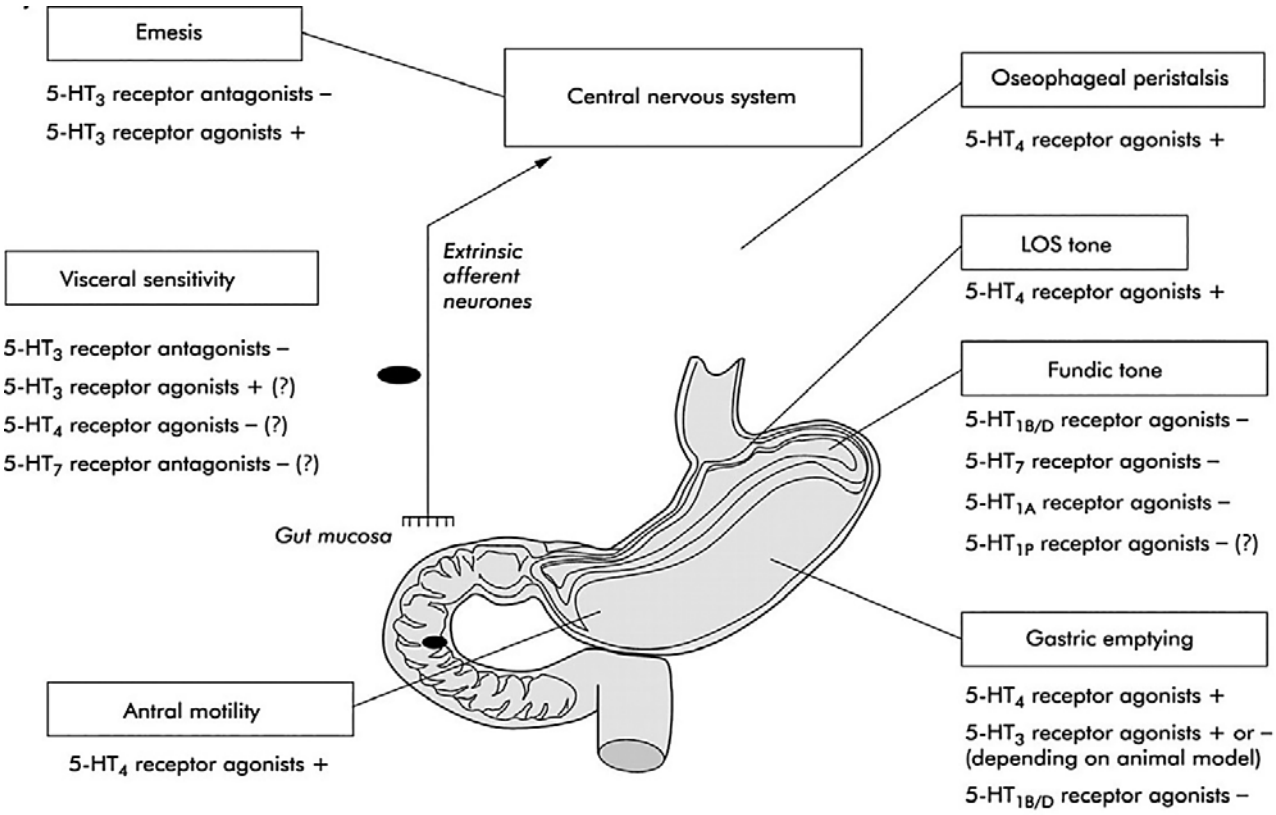


Table 1: Serotonin receptors and their functions in the gastrointestinal tract

Receptor Family	Subsets or Subtypes	Function
5-HT1	5-HT1A, 5HT1D 5-HT1B/1D 5-HT1D 5-HT1B 5-HT1P	Gastric fundus relaxation Prokinetic intestinal stimulation Contraction of intestinal circular muscle Contraction of intestinal longitudinal muscle Peristaltic and secretory reflexes
5-HT2	5-HT2A 5-HT2B	Contraction of smooth muscles Contraction of smooth muscles in stomach fundus, relaxation of longitudinal muscle in the intestine
5-HT3	5-HT3 5-HT3A	Chloride secretion and serotonin release from EC cells Increase intestinal motility
5-HT4	7 splice variants	Increase intestinal motility, contraction of esophagus, relaxation of colon, chloride secretion
5-HT5	–	Not known in gastrointestinal tract (essential solely in central nervous system CNS)
5-HT6	–	Not known in gastrointestinal tract (essential solely in central nervous system CNS)
5-HT7	5 splice variants	Excitatory effect, anti-inflammatory activity

(Source: Barnes *et al.* 2021)

Figure 3: Effects of serotonin (5-HT) receptors on the upper gastrointestinal tract



(Source: Hoyer *et al.* 2002)

5-hydroxy-tryptophan (5-HTP) by the enzyme tryptophan hydroxylase (TPH). In a second step, 5-HTP is then decarboxylated by non-specific aromatic L-amino acid decarboxylase (L-AADC), leading to the formation of 5-HT. This reaction requires some necessary cofactors such as vitamin B6, vitamin B3, and magnesium. The TPH-mediated reaction is the rate-limiting step in this pathway. TPH has been shown to exist in two forms: TPH1, which is found in multiple tissues in the EC, and TPH2, which is found in the CNS and enteric neurons (Beattie *et al.* 2008; Hasler 2009; Manocha *et al.* 2012).

One of the main breakdown products of serotonin is 5-hydroxyindoleacetic acid (5-HIAA), which is excreted in the urine (Figure 2). Serotonin and especially 5-HIAA are sometimes produced in excessive amounts in certain tumors such as neuroendocrine tumors, carcinoids and levels of these substances can be measured in the urine (Alarcón *et al.* 2008).

SEROTONIN RECEPTORS

Many of the physiological effects of serotonin (5-HT) in the human body are receptor mediated. The major functions of serotonin in the gut occur through the action of 5-HT on a diverse array of receptors present on smooth muscle, enteric neurons, enterocytes, and immune cells. The 5-HT receptors are classified into seven families comprising at least 15 receptor subsets. The receptor families are 5-HT1, 5-HT2, 5-HT3, 5-HT4, 5-HT5, 5-HT6, 5-HT7 (Table 1). With the exception of the 5-HT3 receptor, which is a ligand-activated cation channel, all other 5-HT receptors are coupled to the G-protein, which is a membrane protein consisting of three subunits (alpha, beta, gamma), interacts with guanine nucleotides (GTP and GDP), and conjugates to a variety of receptors that can result in multiple intracellular effects. The most common types of receptors in the gastrointestinal tract are 5-HT1, 5-HT2, 5-HT3, 5-HT4, and 5-HT7 (Barnes *et al* 2021; Pytliak *et al.* 2011; Hoyer *et al.* 2002) (Figure 3).

90 % of the serotonin present in the gastrointestinal tract is found in enterochromaffin cells (EC) and 10 % in enteric neurons, which are part of the enteric nervous system (ENS) (Kim *et al.* 2000; Sanger 2008).

ENTERIC NERVOUS SYSTEM

The enteric nervous system (ENS) is one of the main divisions of the autonomic nervous system (ANS). It is the largest grouping of neurons (a number of interconnected networks or plexuses consisting of neurons and their axons and intestinal glial cells) outside the CNS. In humans, it contains approximately 500 million neurons, which are divided into about 20 functional groups. Based on its size, complexity, and several structural similarities, the ENS is referred to as the second or gut brain. The ENS contains components of reflex pathways (afferent neurons, interneurons, efferent neurons) that allow it to function without regulatory influence from the CNS. Although the ENS can function independently of the CNS, it communicates with it via the afferent and efferent pathways of the parasympathetic and sympathetic nervous systems. The small intestine contains approximately 100 million nerve cells (there are about the same number in the spinal cord), which are located in the wall of the GIT organs (beginning in the esophagus and extending to the upper edge of the internal sphincter of the rectum) (Li *et al.* 2003; Martinucci *et al.* 2015; Smitka *et al.* 2013).

The ENS is embedded in the walls of the gastrointestinal tract and contains two nerve plexuses: the plexus myentericus (Auerbach's plexus) and the plexus submucosus (Meissner's plexus).

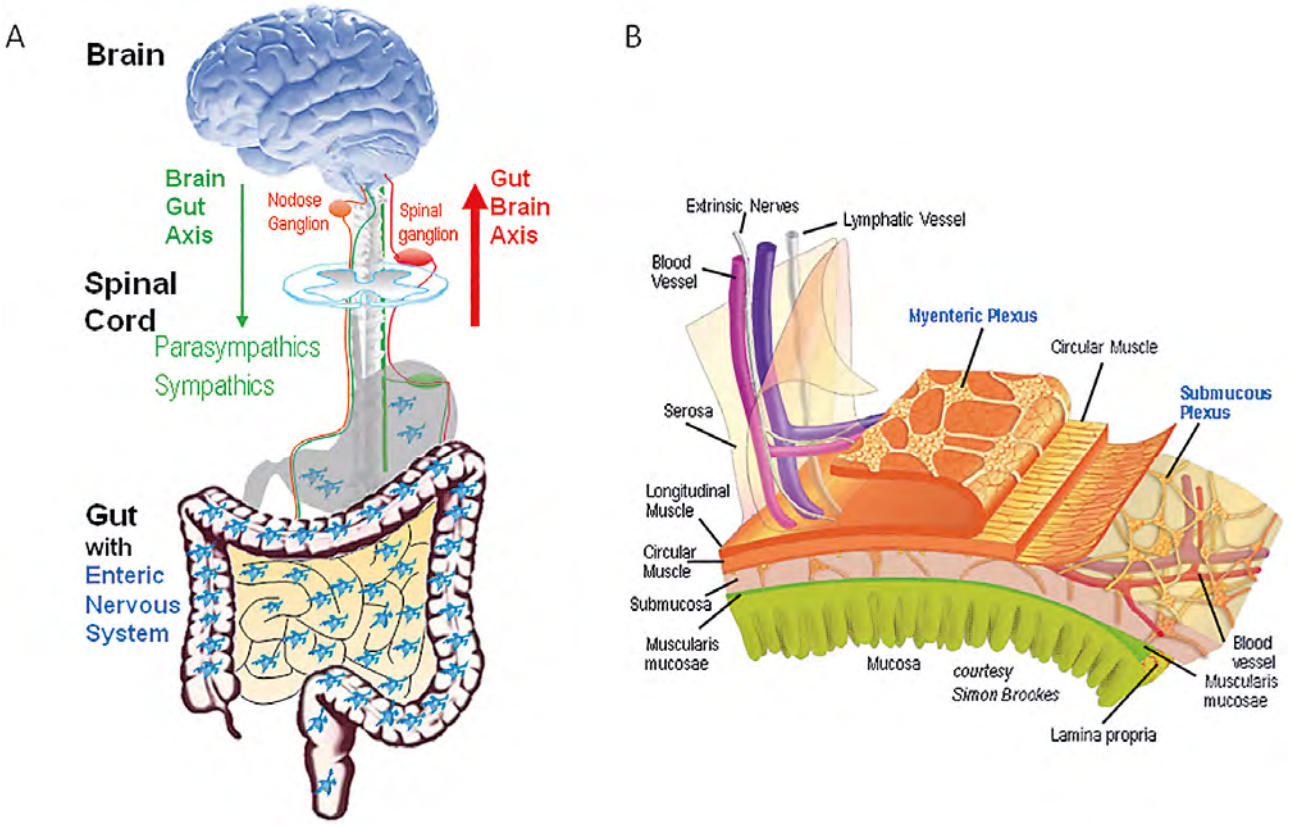
1. The myenteric plexus, also known as Auerbach's plexus, is located between the inner and outer layers of the muscularis externa. It is a network of autonomic motor nerve fibers and myenteric ganglia whose main function is to maintain movements of the digestive tract (peristalsis). Its function is partly controlled by the nervus vagus, which is the link between the central and enteric nervous systems. The function of the myenteric plexus is mediated by numerous neurotransmitters and neuromodulators, in particular acetylcholine and nitric oxide.
2. The submucosal plexus, also known as Meissner's plexus, is located in the submucosal layer of the gastrointestinal tract. It contains submucosal neurons that are arranged as a plexus, which is a form of network of ganglia connected by connective tissue. Its function is to regulate fluid secretion and absorption, modulate blood flow, and also respond to stimuli from the epithelium and lumen to promote intestinal function (Avetisyan *et al.* 2015; Nezami *et al.* 2010) (Figure 4).

ENS neurons synthesize several GIT hormones, and these chemicals can act as neurotransmitters. These hormones are also synthesized by neurons in several CNS regions that are involved in the regulation of autonomic nervous system activity. The outer and inner neurons innervating the GIT and these gastrointestinal hormones form the so-called brain-gut axis. The ENS is evolved to function independently but in an integrated manner. Thus, it receives signals from the CNS via sympathetic and parasympathetic receptors in the wall of the GI tract and then passes on information about the state of the GI tract. Signals from autonomic systems are relayed to ENS interneurons up to effectors that are inhibited or stimulated by the signal (Cooke 1998; Benarroch 2007).

SEROTONIN IN THE GASTROINTESTINAL TRACT

In order for the gut to control its own function and trigger any reflexes, it needs to understand what is going on in the

Figure 4: Functional anatomy of gut-brain communication and the enteric nervous system



(Source: Nezami *et al.* 2010)

lumen of the gut. It does this using two detectors: the intestine's intrinsic primary afferent neurons (IPANS) and enterochromaffin (EC) cells.

Clusters of primary afferent neurons found in the mucosa conduct intrinsic and extrinsic nerve information to the CNS. Submucosal clusters of intrinsic primary afferent neurons (IPANs) cause peristalsis and secretion, and myenteric clusters are responsible for contraction and provide excitatory neurotransmission regulating gastrointestinal motility (Zaucha 2012). A mechanical or chemical stimulus applied to the intestinal mucosa causes degranulation of serotonin from the cells. The latter is secreted by EC cells apically into the lumen of the intestine and baso-laterally into the lamina propria of the mucosa where the endings of the aforementioned nerve fibers containing 5 HT receptors are located. These neurons have synaptic connections with both ascending and descending interneurons. Stimulation of ascending interneurons activates excitatory motoneurons, which secrete various substances such as acetylcholine, substance P and neurokinin A, causing smooth muscle contraction. Conversely, descending interneurons stimulate inhibitory motoneurons, causing smooth muscle relaxation due to the secretion of nitric oxide (NO), vasoactive intestinal peptide (VIP), and pituitary adenylate cyclase activating peptide (PACAP)(Beattie et al. 2008; Benarroch 2007). Longitudinal smooth muscles contract and relax in the opposite manner to circular muscles under the regulation of the same neurotransmitters. Through this entire mechanism, local reflex activity of ENS neurons occurs, resulting in contraction of intestinal smooth muscle in the proximal direction and coordinated relaxation in the distal direction, thereby moving intestinal contents in the caudal direction. Movements of intestinal contents in the distal direction cause mechanical interaction with the intestinal wall, causing a domino effect of further serotonin release, proximal contraction, distal relaxation, and subsequent passage of gastrointestinal contents. Serotonin also increases intestinal secretion of water and electrolytes, causing easier movement of intestinal contents. Since nerve fiber endings from the central nervous system are located in the gastrointestinal tract, serotonin is responsible for influencing the gut-brain axis. It plays a key role in visceral sensations and makes it possible to experience discomfort and pain. This interaction is often the subject of hypotheses about the pathogenesis of irritable bowel syndrome and functional dyspepsia (Cirrilo *et al.* 2011; Sanger 2008; Camilleri 2012).

SEROTONIN REUPTAKE TRANSPORTERS

Since there are no cellular mechanisms for degradation of 5 HT in the intercellular space, serotonin remains biologically active in this space. A significant amount of 5 HT is taken up by the serotonin reuptake transporters SERT. The serotonin transporter (SERT or 5-HTT) is a monoamine transport protein that transports the neurotransmitter serotonin from the synaptic cleft back to the presynaptic neuron in a process known as serotonin reuptake (Beattie *et al.* 2008). The serotonin transporter removes serotonin from the intercellular space. This terminates the action of serotonin while allowing its reuse by presynaptic neurons, epithelial and enterochromaffin cells. Neurons communicate between cells using chemical messengers such as serotonin. By recycling serotonin, the transport protein regulates its concentration in the gap junction or synapse and thus its effects on the receptors of the receiving neuron. The remaining serotonin reaches the blood vessels where it binds to platelets (Costedio *et al.* 2007; Sanger 2008; Cirillo *et al.* 2011). In the case of platelets, the gastrointestinal tract plays a major role in serotonin absorption. They are unable to produce 5 HT on their own. Therefore, the gastrointestinal tract is considered to be a system involved in the process of hemostasis (Sanger 2008). Once serotonin is released from the enterochromaffin cells, it enters the intercellular space, and due to the anatomical structure of the intestinal wall, this is a relatively large barrier for serotonin to reach the neurons of the muscular plexus, which controls the motility of the gastrointestinal tract. This protects the organism from an excessive increase in gastrointestinal motility following any serotonin-releasing stimulus (e.g., caused by movement of intestinal contents) (Sanger 2008). In addition to mechanical stimulation, other factors are known to release serotonin from enterochromaffin cells. In the small intestine, these are most commonly vagus nerve stimulation, low pH, amino acids, hypotonic and hypertonic solutions, and caffeine. In the colon, it is short-chain fatty acids that have a stimulatory effect on serotonin release (Sanger 2008; Hasler 2009; Manocha *et al.* 2012). Since serotonin is continuously synthesized in our body, there are mechanisms of biodegradation of this substance. After reabsorption into cells, oxidative deamination of serotonin occurs by the enzyme monoamine oxidase. The main end product of the biochemical degradation of serotonin is 5-hydroxyindoleacetic acid, which is excreted from the body in the urine (Cirillo *et al.* 2011; Moskwa *et al.* 2007; Wiśniewska-Jarosińska *et al.* 2010).

SEROTONIN IN GASTROINTESTINAL TRACT DISORDERS

Serotonin profoundly affects gut function and plays a critical role in the regulation of important physiological functions such as motility, secretion, fluid transport, nutrient absorption, exocrine and endocrine activity, and visceral sensitivity. It is also involved in the regulation of immune and inflammatory processes by the ENS and is involved in the maintenance of the barrier functions of the GIT, protection of the body from harmful substances, thus being significantly involved in the maintenance of homeostasis of the body (Costedio *et al.* 2007).

The effect of serotonin in the gut depends on these important factors:

- the amount of serotonin in the gut wall
- the length of time free serotonin remains in the gut wall
- the type of receptor
- the localisation of the receptor
- the function of the SERT (serotonin transporter)

As mentioned above, serotonin regulates physiological functions of the gastrointestinal tract. Enterochromaffin cells that surround the intestine release serotonin in response to food in the lumen. If irritants are present in the food, the enterochromaffin cells release more serotonin to make the bowels move faster, i.e., to cause diarrhea, and thus empty the bowels of the noxious substance. 5-HT is thought to be involved in the pathophysiology of several gastrointestinal disorders such as functional bowel disorders, specifically irritable bowel syndrome (IBS), carcinoid diarrhea, inflammatory bowel disease (IBD) — Crohn's disease and ulcerative colitis, celiac disease, idiopathic constipation and chemotherapy-induced vomiting (Beattie *et al.* 2008; de Wit *et al.* 2005).

In GIT diseases, it is a disruption of the interaction between the gut, brain and the autonomic nervous system, which includes the sympathetic, parasympathetic and ENS. The aforementioned 5HT receptors, located in the enteric nervous system in the intestinal wall, are involved in GIT motility and secretory functions (Coates *et al.* 2004; Crowell 2004).

5HT receptors are also present on the external sensory nerves, which are critical for sending signals from the gut back to the brain. So when the gut is exposed to a painful stimulus, such as over-stretching or contraction in normal individuals, these external nerves are stimulated and information is sent to certain areas of the brain that are involved in the response to pain. Under normal conditions, these areas of the brain are activated and lead to the activation of other nerve pathways and the release of chemicals that suppress and reduce pain. This mechanism is disrupted in various gastrointestinal tract diseases, but especially in patients with irritable bowel syndrome IBS (Coates *et al.* 2004; Crowell 2004; Lee *et al.* 2008). In various studies, the subtypes of 5-HT receptors known to affect intestinal function have been found to be the most interesting targets for pharmacological intervention in intestinal disorders. These are receptors that belong to the 5-HT1, 5-HT3, 5-HT4, and 5-HT7 receptor families (Hasler 2009).

Various data from human and animal studies suggest that inflammation causes different aspects of serotonin signaling in the gastrointestinal mucosa. Acute infection causes an inflammatory response that is evident in biopsies approximately three months after the initial infection. These inflammatory changes are accompanied by increased numbers of EC cells. EC cells are in close proximity to cells associated with the immune, nervous and vascular systems. It is thought that the immune system influences the increase in EC cell numbers and consequently serotonin, however serotonin itself influences the immune system. 5-HT receptors have been found on B and T lymphocytes, monocytes, macrophages, and dendritic cells. In addition, mast cells, macrophages, and T cells have the ability to synthesize 5-HT from tryptophan (*Lee et al.* 2008).

IRRITABLE BOWEL SYNDROME

Nowadays, a very common problem in humans and especially in the young is irritable bowel syndrome IBS. It affects approximately 9-23 % of the world's population. It is an unpleasant chronic disease associated with a functional bowel disorder that manifests itself mainly by problems in emptying the colon. The main manifestations include abdominal pain with cramps, diarrhea, constipation. IBS is classified according to the Rome IV criteria into 4 types according to whether it is diarrhea-predominant IBS (IBS-D), constipation-predominant IBS (IBS-C), mixed type (IBS-M), or unclassified type (IBS-U). The Rome criteria for classifying IBS into the 4 groups are: abdominal pain and discomfort lasting on average at least 1 day per week during the last 3 months (Manocha *et al.* 2012). Pain and discomfort are associated with defecation. Both irritable bowel syndrome with predominant constipation (IBS C) and irritable bowel syndrome with predominant diarrhoea (IBS D) are characterised by impaired serotonin signalling. Serotonin plays an important role in the abnormalities in IBS, particularly in visceral sensitivity (Mishima *et al.* 2021). Abnormal serotonin concentrations, changes in the number and proportion of serotonin receptors as well as in the number of enterochromaffin cells have been found in patients with IBS. In patients suffering from IBS associated with diarrhea, rectal biopsies have shown a dramatic increase in EC cell populations as well as abnormal serotonin concentrations, with predominantly elevated concentrations causing an amplification of gastrointestinal motility and mucosal secretion from the intestinal mucosa. Similarly, a decrease in EC cell populations has been observed in patients suffering from chronic constipation, indicating a deficiency of 5-HT and thus reduced motility and secretion from the gastrointestinal tract (Cirillo *et al.* 2011; Moskwa *et al.* 2007; Coates *et al.* 2004; Crowell 2004; Lee *et al.* 2008; Chen *et al.* 2017).

Today, drugs affecting the serotonin system, especially serotonin receptors, are used in clinical practice in the treatment of IBS. Therefore, treatment in the patients in question consists in either blocking or stimulating serotonin receptors, mainly 5HT3 and 5HT4. Advances in the development and understanding of the mechanism have led to the development of the drugs in question:

- 5HT4 agonists — stimulating effect on gut motility and secretion (useful in IBS with constipation) — stimulate 5HT4 receptors
- 5HT3 antagonists — inhibit gut motility and secretion (useful in IBS with diarrhoea and also in the treatment of chemotherapy-related nausea and vomiting) — inhibit 5HT3 receptors

Receptor agonists and antagonists are characterized by high affinity and selectivity for serotonin receptors in the gut to avoid the presence of adverse effects in the brain (Chen *et al.* 2017; Aboumarzouk *et al.* 2011).

IRRITABLE BOWEL DISEASES

IBD consists of two diseases — ulcerative colitis (UC) and Crohn's disease (CD). CD affects the entire small and large intestine, while UC localized in the colon. Both diseases involve inflammation of the gastrointestinal tract in which different types of immune reactions are involved. CD is characterized with increased production of IL-12, IL-17, IL-23, IFN and TGF, whereas UC is characterized with higher levels of IL-5 and IL-13. There is a high heterogeneity of symptoms in both diseases and the main factors that influence the course of IBD are mainly genetic predisposition, infection and diet (Strober *et al.* 2011; Abraham *et al.* 2009).

The pro-inflammatory effect of serotonin has been demonstrated, as well as inflammation itself promotes increased serotonin activity. Inflammation leads to a decrease in the activity of serotonin reuptake proteins and also leads to an increase in the number of enterochromaffin cells. This makes serotonin longer biologically active in the extracellular space (Magro *et al.* 2002; Margolis *et al.* 2016).

Peripheral serotonin is important for a proper immune response, but it also influences various inflammatory conditions such as IBD. The main source of 5-HT for the immune response is platelets. Platelets do not make 5-HT themselves, but take it up from the bloodstream via SERT. Conversely, mast cells, monocytes/macrophages and T-cells are partly involved in the production of serotonin. Serotonin increases pro-inflammatory cytokine secretion and enhances phagocytosis. It may also influence both T cells and lymphocytes via their 5-HT receptors. 5-HT increases the production of reactive species, enhances cytokine production, and promotes monocyte adhesion to epithelial cells of the gastrointestinal tract (Magro *et al.* 2002; Margolis *et al.* 2016; Wu *et al.* 2019; Herr *et al.* 2017; Shaijb *et al.* 2015; Deuerschmied *et al.* 2013; Regmi *et al.*2014).

CARCINOID SYNDROME

Another disease in which the action of serotonin in the GIT has been confirmed is carcinoid syndrome. It is a syndrome that is a clinical manifestation of neuroendocrine tumors, especially carcinoid tumors. Neuroendocrine tumors, including carcinoids, are most commonly found in the GI tract and nearly 60 % are diagnosed in the gut. They also occur in the bronchopulmonary tract, but there are also very unusual and extremely rare localisations of primary carcinoid — gallbladder and bile ducts, ovaries, testes, bladder, prostate, mammary gland, thymus (Liu *et al.* 2017; Pandit *et al.* 2017; Cingam *et al.* 2017).

Symptoms of carcinoid syndrome arise primarily from biologically active substances, and one of the most important of these is serotonin. The classic carcinoid syndrome typically includes vasomotor, cardiac, and gastrointestinal symptoms. The most common manifestations are flush, diarrhea, cardiac damage, bronchial asthma or asthma-like syndrome, hypotension or hypertension (Pandit *et al.* 2017; Cingam *et al.* 2017; Krishnan *et al.* 2017).

The main manifestations of carcinoid syndrome include skin flush. It occurs in 25-73 % of cases of metastatic carcinoma. In its typical form, it is manifested by the sudden appearance of red or reddish-purple erythema of the upper part of the body, mainly on the face and neck. It is perceived by the patient as a sensation of heat and itching. Often accompanying symptoms are diarrhea, palpitations, lacrimation, swelling of the face or conjunctivae (Cingam *et al.* 2017; Krishnan *et al.* 2017; Saslow *et al.* 1998).

The second very common clinical manifestation of carcinoid syndrome is diarrhoea. It is the result of excess serotonin, Serotonin secreted into the lumen of the intestine acts locally and has a secretory effect. By a complex action, it increases peristalsis in the duodenum and jejunum and decreases peristalsis in the stomach and colon. Serotonin stimulates colonic motor function via 5-HT3 and chloride ion secretion via 5-HT2A and 5-HT4. Typically, symptoms of carcinoid syndrome appear in advanced forms of serotonin-secreting tumors, usually with the presence of liver metastases (Saslow *et al.* 1998).

CELIAC DISEASE

Celiac disease is another common disease in which T-cell enteropathy is associated with elevated mucosal 5-HT levels. This disease is also known by the following names: primary malabsorption syndrome, gluten enteropathy, idiopathic steatorrhea, nontropical sprue, Herter-Heubner disease, intestinal infantilism. It is a systemic disease in genetically predisposed people mediated by immune reactions that is caused by persistent intolerance of the immune system to wheat gluten (Lordal *et al.* 1998; Sjolund *et al.* 1982).

It has been shown in several studies that an immune reaction in the intestine and subsequent chronic inflammation and atrophy of the villi of the small intestine occur after administration of a gluten-containing diet to patients suffering from celiac disease. This increases the number of serotonin-containing EC cells, leads to increased 5-HT release and decreased 5-HT absorption. In this disease, there is also an increase in TNF-α and IFN-γ levels and this decreases SERT levels, thereby reducing the absorption of 5-HT by cells in the intestine (Sjolund *et al.* 1982; Challacombe *et al.* 1972).

CONCLUSION

From a current review of publications focusing on the function of serotonin in the gastrointestinal tract, it is clear that the effects of its activity vary according to the receptors it acts on. Serotonin is involved in both the physiology and pathophysiology of the gastrointestinal tract. It is increasingly clear that it plays a key role and is associated with inflammatory processes that lead to many GIT disorders. In general, it increases intestinal motility, but depending on the receptors, it may play opposite roles in the upper and lower GI tract. The immunological response that occurs in the inflammatory response at the 5-HT receptor involves immune cells including dendritic cells, macrophages, neutrophils and lymphocytes and is altered by the pro-inflammatory cytokines TNF, IL-1, IL-6 and IFN and the anti-inflammatory IL-10. Despite inconsistencies in the current literature, alterations in serotonin signaling have now been demonstrated in inflammatory bowel disease, irritable bowel syndrome, postinfectious irritable bowel syndrome, and idiopathic constipation. For example, in IBS with diarrhea, plasma serotonin levels are elevated, whereas in patients with constipation they are reduced. Considering the many studies going on in the world, it is clear that serotonin is a molecule that plays an important role in physiological functions in the gastrointestinal tract, but it is also an incompletely studied molecule in pathological conditions in the gastrointestinal tract. A broader investigation of this issue in the future may allow for a more thorough understanding of the subject and for finding effective and safe therapies for patients with inflammatory diseases in the gastrointestinal tract.

Conflict of Interest
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Classification of variabilities of the spinal nerve roots (historical overview and perspective)

Klasifikácia variabilít miechových nervových koreňov (historický prehľad a perspektíva)

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ABSTRACT

Introduction: Variabilities of spinal nerve roots have attracted the attention of researchers since the second half of the last century. The interest in them was raised mainly by the failure of the intervertebral disc herniation operations due to the frequent finding of anomalies of the spinal nerve root exits, mainly in the lumbosacral region. Many of them were not detected by preoperative imaging examinations.

Historical overview: Operative, radiographic, and anatomical studies used several classification systems to classify their findings, which made it difficult to compare them with each other. The classification systems according to Neidre and MacNab, Postacchini et al. and Kadish and Simmons were most often used. In 2020, we also proposed a classification system, unifying the aforementioned three previous classification systems.

Perspective: In 2021 Nikolenko et al. proposed a new simple unifying classification system of spinal root variabilities. Practice will show which system will be used next.

Keywords: variabilities, spinal nerve root, classification system, unification

ABSTRAKT

Úvod: Variability miechových koreňov priťahujú pozornosť vyskumníkov už od druhej polovice minulého storočia. Záujem o ne bol podmienený hlavne neúspechom operácií herniácie medzistavcových platničiek pre častý nález anomálií výstupu miechových koreňov hlavne v lumbosakrálnej oblasti. Mnohé z nich neboli odhalené predoperačnými zobrazovacími vyšetreniami.

Historický prehľad: Operačné, radiografické aj anatomické štúdie používali viaceré klasifikačné systémy na triedenie svojich nálezov, ktore sťažovali ich vzájomné porovnávanie. Najčastejšie sa používali klasifikačné systémy podľa Neidre a MacNaba, Postacchiniho a spol. a Kadisha a Simmonsa. V roku 2020 sme aj my navrhli klasifikačný systém, zjednocujúci spomínané tri predošlé klasifikačné systémy.

Perspektíva: V roku 2021 Nikolenko a spol. navrhol nový jednoduchý zjednocujúci klasifikačný system variabilít miechových koreňov. Prax ukáže, ktorý systém sa bude ďalej používať.

Kľúčové slová: variability, miechový koreň, klasifikačný systém, zjednotenie

INTRODUCTION

The advances in lumbosacral disc herniation treatment options (and their failures) gave rise to a huge number of studies aimed at the description of various "anomalies" of the spinal nerve roots. Many of them surprised the surgeon during the operation (intraoperatively) and were the reason for operation failure, not all of them were revealed by the radiographic preoperative examinations. They were found mainly in the most exposed lumbosacral region, followed by the cervical region, with the lowest frequency reported in the thoracic region (Haviarová 2020). As reported by Schmidt (2017) these reported congenital anomalies include several types:

1. conjoined nerve roots (2 adjacent nerve roots which, at some point during their course from the dural sac, share a common dural sheath),
2. closely adjacent nerve roots (2 nerve roots arise through closely adjacent openings in the dural sac),
3. caudal or cranial nerve root origin (nerve roots are sometimes found arising from the dura in an abnormally cranial or caudal location),
4. anastomosed nerve roots (interconnections — often by mistake termed as anastomoses, have been found to occur both intradurally and extradurally) (Schmidt 2017).

Table 1. Summary of the mean reported nerve root anomaly prevalence, sorted by the setting of discovery and anomaly type (Schmidt 2017).

	Surgical	Radiographic	Cadaveric
Post dural sac			
Anastamosis between roots	0.17	0.19	3.90
Closely adjacent nerve roots	0.55	1.68	1.67
Root exit from dural sac at abnormally cranial level	0.02	0.32	2.00
Root exit from dural sac at abnormally caudal level; transverse root		0.78	
Conjoined nerve roots—arise from dural sac in common trunk (intra/extra foraminal division)	1.68	1.64	8.82
Extradural division of nerve root			5.00
Two nerve roots exit one foramen (a) leaving one foramen unoccupied	1.82		
Two nerve roots exit one foramen (b) nerve roots in all foramina, but one foramen contains two separate roots	0.33	1.14	
Intradural			
Anastamosis between rootlets at different levels		0.92	11.71
Anastamosis between rootlets at different levels, external division of nerve root			
Intradural and extradural division of nerve root			
Mean total	2.38	2.60	20.48

All values expressed as mean percentages

Table 2. Summary of nerve root classification systems (Schmidt 2017).

	Cannon (1962) [13]	Postacchini (1982) [14]	Neidre (1983) [4]	Kadish (1984) [3]	Chotigavanich (1989) [9]
Post dural sac					
Anastamosis between roots	Type II	Type V	Type III	Type III	Type II
Closely adjacent nerve roots		Type III	Type I (B)	Type II (C)	Type VI
Root exit from dural sac at abnormally cranial level		Type I		Type II (A)	
Root exit from dural sac at abnormally caudal level; transverse root	Type III	Type II		Type II (B)	
Conjoined nerve roots—arise from dural sac in common trunk (intra/extra foraminal division)	Type I	Type IV	Type I (A)	Type II (D)	
Extradural division of nerve root				Type IV	Type III
Two nerve roots exit though one foramen (a) leaving one foramen unoccupied or (b) nerve roots in all foramina, but one foramen contains two separate roots			Type II (A)/(B)		
Intradural					
Anastamosis between rootlets at different levels				Type I	Type I
Anastamosis between rootlets at different levels, external division of nerve root					Type IV
Intradural and extradural division of nerve root					Type V

The embryologic background for the occurrence of nerve root anomalies is still not fully clear: they are most likely results from defective migration of nerve roots during embryonic development (Schmidt, 2017).

The occurrence of these nerve root anomalies differs according to the type of reporting study: most frequently they are reported by cadaveric studies, less frequently by radiographic studies and their least frequency is reported by surgical studies (Table 1, Schmidt 2017).

For better comparison among the results of various studies, several classification systems were proposed — summarized in Table 2 according to Schmidt (2017). Several overlappings exist in these nerve root classification systems (Schmidt 2017).

RESEARCH OBJECTIVES

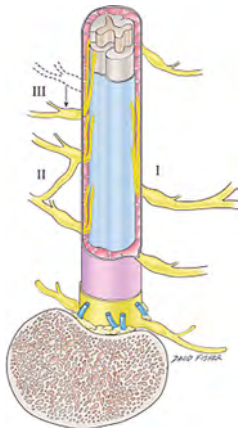
Research objective is to provide an overview of the principles of the proposed classification systems of found variabilities of spinal nerve roots and attempts to unify them.

HISTORICAL OVERVIEW OF NERVE ROOT CLASSIFICATION SYSTEMS

In 1962, **Cannon *et al*** first identified the three most common variants of spinal root: The combined Type I, anastomotic Type II and transverse Type III (Cannon 1962; Schmidt 2017)**.** He originally classified nerve root anomalies into 3 general morphologically determined categories (Figure 1):

- Type I (conjoined roots): 2 adjacent root sleeves show a common origin when exiting the dural sac. They may either exit through the same or independent foramina.
- Type II (extradural anastomoses): a nerve which branches shortly after emitting from the dural sac, joining the root immediately below.
- Type III (caudal origin): a root which originates from the dural sac at a more caudal level than average, forming an approximately right angle with the dural sac.

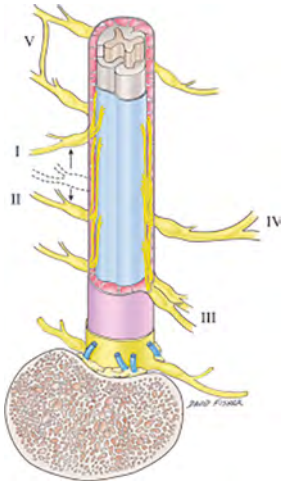
Figure 1 Cannon et al. classification: conjoined nerve root (I), extradural anastomosis (II), and caudal origin (transverse root) (III) (Schmidt 2017)



In 1982, **Postacchini *et al.*** classified common abnormalities of spinal nerve roots into 5 different variations (Postacchini 1982; Schmidt 2017) (Figure 2):

- Type I: one or more nerve roots emerge from the dural sac at an abnormally cranial level.
- Type II: one nerve root emerges from the dural sac at an abnormally caudal level.
- Type III: two or more nerve root emerge through closely adjacent openings in the dural sac.
- Type IV: two nerve roots emerge from the dural sac in a common nerve trunk. The conjoined nerve roots either remain joined, leaving through a single foramen, or separated before exiting through their appropriate foramen.
- Type V: an interconnection between two nerve roots distal to the dural sac.

Figure 2 Postacchini et al. classification: cranial origin (I), caudal origin (transverse root) (II), closely adjacent nerve roots (III), and conjoined nerve root (IV), and extradural anastomosis (V) (Schmidt 2017)



In 1983, **Neidre and MacNab** expanded Cannon's classification based on the angle and position of the spinal cord spacing by adding subtypes for types I and II (Neidre 1983, Schmidt 2017). This classification has been used most frequently (Figure 3):

- Type I (A): two nerve roots arise from the dural sac in a common dural sheath, (B): two nerve roots are almost conjoined, resulting in a nerve exiting the dural sac at a right angle, similarly to cervical nerve roots.
- Type II (A): two nerve roots exiting through one foramen, leaving one root canal unoccupied, (B): there are nerve roots in all foramina, but one foramen has two individual roots.
- Type III: adjacent nerve roots interconnected.

In 1984, **Kadish and Simmons** introduced a classification system based on anatomical and radiological findings. They classified nerve root anomalies into 4 general types, containing several subtypes (Kadish 1984, Schmidt 2017) (Figure 4):

- Type I: intradural connection between rootlets at different levels.
- Type II: anomalous origin of nerve roots: (a) cranial origin, (b) caudal origin, (c) combination of (a) and (b) affecting more than one nerve root (closely adjacent roots), and (d) conjoined nerve roots.
- Type III: extradural connection between nerve roots.
- Type IV: extradural division of the nerve root.

Figure 3 Neidre and Macnab classification: conjoined nerve root (IA); closely adjacent nerve roots (IB); two nerve roots exit through common foramen leaving one foramen unoccupied (IIA); nerve roots in all foramina, but one foramen contains two separate roots (IIB); and extradural anastomosis (III) (Schmidt 2017)

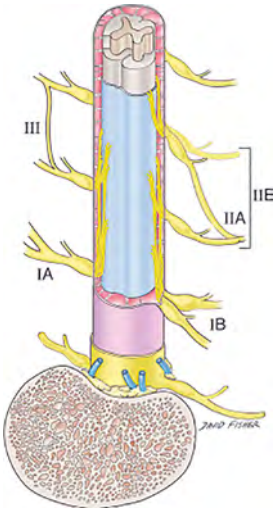
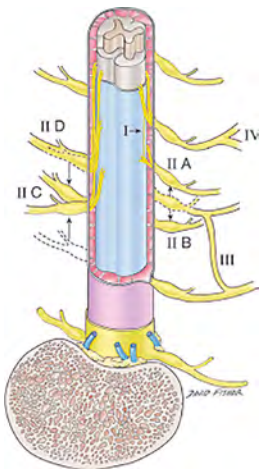


Figure 4 Kadish and Simmons classification: intradural anastomosis (I), cranial origin (IIA), caudal origin (IIB), closely adjacent nerve roots (IIC), conjoined nerve roots (IID), extradural anastomosis (III), and extradural division of nerve root (IV) (Schmidt 2017)



Chotigavanich and Sawangnatra also provided a single classification in 1992. They classified nerve root anomalies into 6 basic groups, based on findings from their 60-cadaver study (Figure 5) (Chotigavanich 1992, Schmidt 2017):

- Type I: intradural connection between rootlets at different levels.
- Type II. extradural connection between nerve roots.
- Type III: extradural division of the nerve root.
- Type IV: intradural connection between rootlets and extradural division of nerve root.
- Type V: intradural and extradural division of nerve root.
- Type VI: closely adjacent nerve roots.

Figure 5 Chotigavanich and Sawangnatra classification: intradural anastomosis (I), extradural anastomosis (II), extradural division of nerve root (III), intradural anastomosis and extradural division of nerve root (IV), intradural and extradural division of nerve root (V), and closely adjacent nerve roots (VI) (Schmidt, 2017)

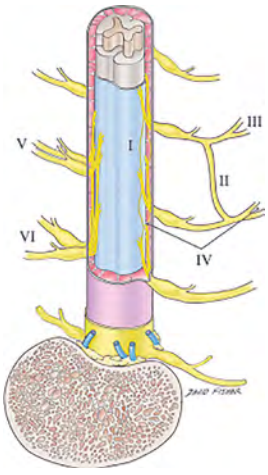
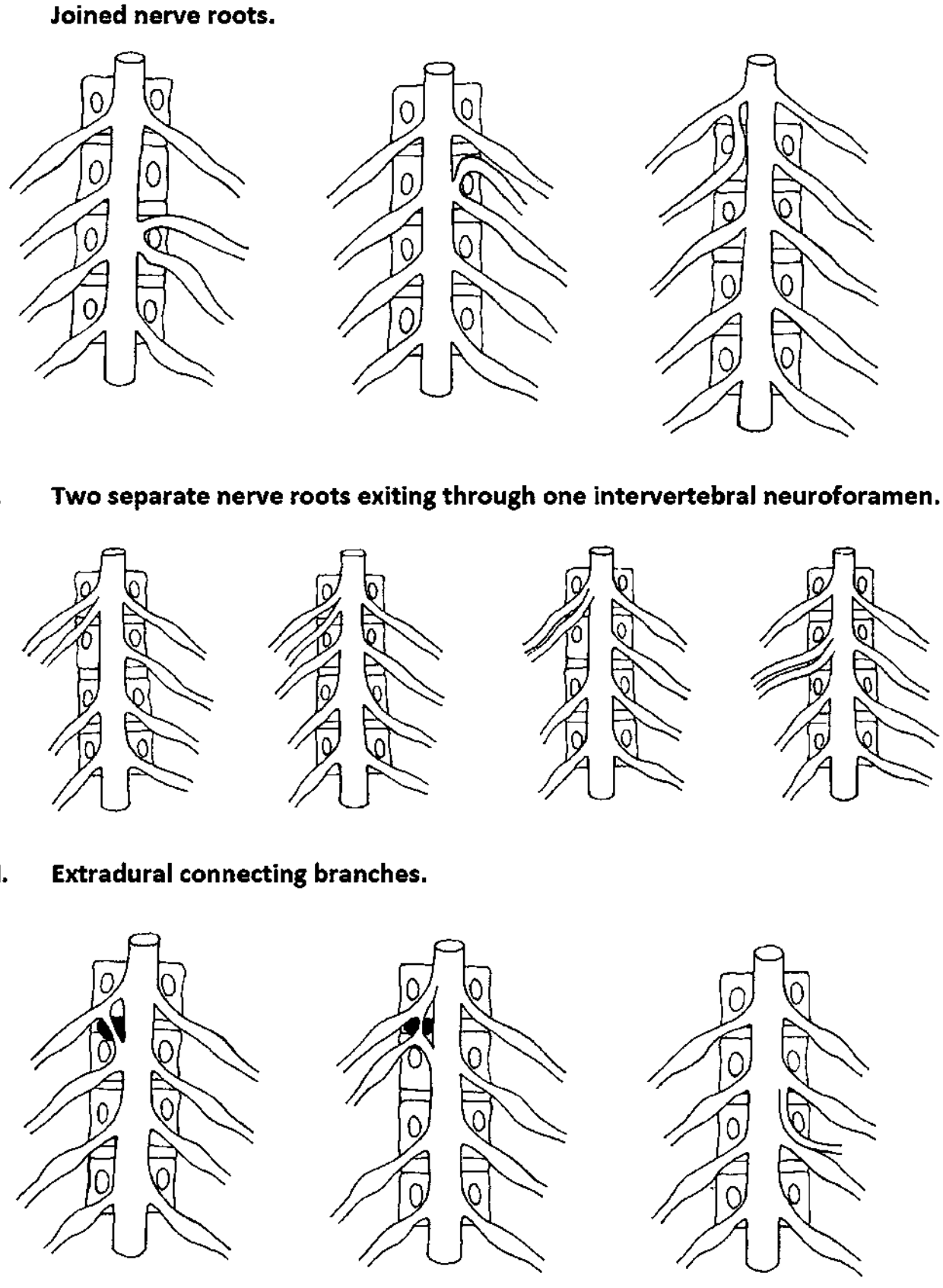


Figure 6. Our proposed classification of the spinal nerve root anomalies (the combination of 3 previous classifications: Kadish and Simmons, Postacchini et al., and Neidre and MacNab with our improvements applied to cervical spinal nerve roots) (Haviarová, 2020)



The later classification is that proposed by us: by describing the variability of the cervical and lumbosacral spinal roots within the spinal canal, we have proposed our own classification of spinal root variabilities, which in our view unifies the 3 variability classifications of spinal roots (Haviarová, 2020) used so far (Figure 6).

Our proposed classification (presented in association with the extradural and intradural cervical nerve root anomalies) (Figure 6) summarises mentioned 3 classifications (Kadish and Simmons, Postacchini *et al,* and Neidre and MacNab) into one: nerve root anomalies are specified into 3 basic groups (I. joined nerve roots, II. two separate nerve roots exiting through one intervertebral neuroforamen, III. extradural connecting branches), each basic group is then further subdivided into 3–4 specific subtypes.

Group I. joined nerve roots include 3 types: A, B-two nerve roots leave from one dural sleeve (Figure 6 I. A, B). The cranial nerve root component is separated from the common nerve root at an acute angle and passes under its corresponding pedicle. The lower component of the nerve root continues downward in the spinal canal and lies below the corresponding pedicle. For type 1B and 1C (Figure 6 I. B, C), the cranial nerve root component lies at a 90-degree angle from the common nerve root.

Group II. of the two separate nerve roots exiting through one intervertebral foramen includes 4 subtypes: (A) two separate nerve roots exit through one intervertebral neuroforamen and one neuroforamen is empty; (B) two nerve roots can be separated from one nerve root and exit above the pedicle, so the nerve roots exit through all neuroforamens; (C) two nerve roots exit through one neuroforamen, one neuroforamen is free (unoccupied); (D) two nerve roots exit through a common neuroforamen, the nerve roots are in all foramens, but one neuroforamen contains two separated roots (Figure 6 II A, B, C, D).

Group III represents extradural connecting branches: in subtypes A and B (Figure 6 III A, B), the adjacent nerve roots are joined by the vertical anastomosis, and subtype C presents extradural nerve root branching (Figure 6 III. C) (Haviarová 2020).

PERSPECTIVE (CONCLUSION).

Nikolenko *et al.* (2021), based on an analysis of existing, most-used classification systems, proposed unifying classification criteria, dividing the different types of variation (according to location) into intradural and extradural. And each location for 2 more subtypes: anastomotic and spatial (see Table 3). This means that it recognises 4 main types of variability: intradural anastomotic variation, intradural spatial variation, extradural anastomotic variation and extradural spatial variation (Table 3, Figure 7) (Nikolenko 2021).

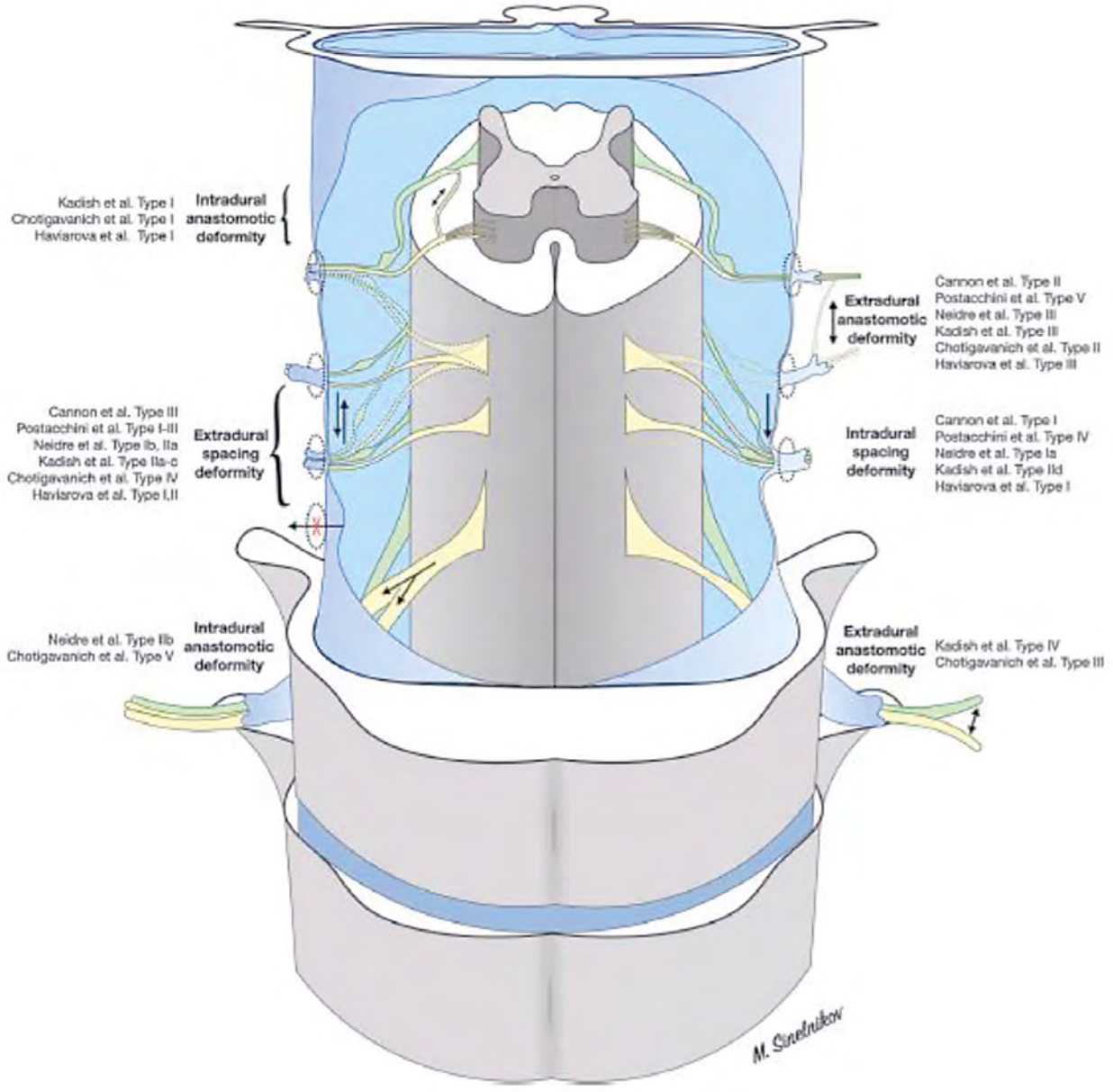
These 4 proposed variations include all previously classified types of anomalies and may serve as a single classification system. Such a uniting is justified in view of the significant differences in the existing classification systems, which complicate the comparison of the data obtained by various studies from different authors. Time will tell whether this unifying classification will be affected in practice.

Table 3. Ranking of existing classification systems on the basis of uniform criteria (Nikolenko 2021).

Table. Existing Classifications of Spinal Nerve Root Anomalies Arranged by Unifying Criteria

Existing Classification Reference	Unifying Criteria			
	Intradural Anastomotic Deformity	Intradural Spacing Deformity	Extradural Anastomotic Deformity	Extradural Spacing Deformity
Cannon et al, 1962[2]	–	Type I	Type II	Type III
Postacchini et al, 1982[3]	–	Type IV	Type V	Types I-III
Neidre and MacNab, 1983[5]	Type IIb	Type Ia	Type III	Types Ib, IIa
Kadish and Simmons, 1984[6]	Type I	Type IId	Types III, IV	Types IIa-c
Chotigavanich and Sawangnatra, 1992[7]	Type I, V	–	Type II, III	Type IV
Haviarová et al, 2020[8]	Type I	Type I	Type III	Types I, II

Figure 7. Schematic representation of spinal nerve root anomalies according to a unifying classification (Nikolenko 2021).



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