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MUSCULOSKELETAL SYMPTOMS IN PATIENTS WITH POST COVID-19 SYNDROME AND OPPORTUNITIES FOR INCREASED FUNCTIONAL ACTIVITY

Galina Mratskova

Department of Medical Rehabilitation and Ergotherapy, Physical Medicine and Sports, Faculty of Medicine, Trakia University, Stara Zagora, Bulgaria e-mail: doc_mratzkova@abv.bg

Abstract: There is an increasing number of patients surviving SARS-CoV-2 infection who have no evidence of acute infection but who continue to have symptoms that persist and shape the post COVID-19 symptoms (PCS). Musculoskeletal symptoms (MSK), as part of the PCS, lead to reduced functional activity and cause prolonged suffering. The purpose of this review is to identify the main MSK symptoms in PCS and to review physical interventions that may have a beneficial effect in reducing MSK complaints and increasing functional activity in PCS. Materials and methods: A review of the literature was performed, including articles about MSK symptoms in patients with PCS and the possible physical interventions used in rehabilitation of these patients, with impact on symptoms, functional capacity, and functional activity. The scientific articles research took place in the bibliographic database of PubMed. The search results were found for: post-COVID-19 (PCS) syndrome, long COVID, post-acute sequelae of SARS-CoV-2 infection (PASC), chronic COVID syndrome (CCS), Musculoskeletal symptom, Pain post-COVID, physical function, Rehabilitation post-COVID, exercise, physical activity, functional capacity, traditional Chinese medicine. Results: The review found evidence of prolonged persistence of MSK symptoms as part of PCS syndrome. Fatigue, myalgia, back, waist and neck pain and arthralgia (pain in the peripheral joints) are the most reported symptoms. Data showing the need for rehabilitation and the positive effect of physical therapy and therapeutic exercises in patients with PCS to reduce pain and increase functional activity was found. Conclusion: Increasing physical activity in patients with PCS is likely to have a beneficial effect on general conditioning, physical function, and functional recovery, helping to overcome the effects of infection, reducing pain, and reducing emotional stress. Individually targeted physical interventions are recommended, including multimodal programs, exercises for overall muscle strengthening, increasing joint stability, cycling training, Individually targeted physical interventions are recommended, including multimodal programs, exercises for overall muscle strengthening, increasing joint stability, cycling training, electrical modalities -Transcutaneous electrical nerve stimulation (TENS) for pain symptoms. Rehabilitation should be applied after detailed functional assessment and shaped be carried out with the participation of a multidisciplinary rehabilitation team. The development of appropriate rehabilitation strategies will allow the achievement of optimal functional recovery and increased functional activity, satisfactory to the patient and will reduce the economic burden of prolonged reduced work capacity.

Keywords: Post-COVID-19 (PCS) syndrome, Musculoskeletal symptom, Pain post-COVID, Physical function, Rehabilitation post-COVID, Therapeutic exercise, TENS.

1. INTRODUCTION

The pandemic spread of coronavirus infection caused by coronavirus 2 (SARS-CoV-2) causing severe acute respiratory syndrome (Dong et al. (2020)) has posed new challenges to modern medicine and, at the same time, to healthcare systems worldwide. Although it mainly affects the respiratory system, COVID-19 is already considered a multisystem disease that is severe, often lethal (Barker-Davies et al. (2020)) and has a wide range of manifestations. Evidence has been gathered that coronavirus infection occurs not only with lung but also with cardiovascular, neurological, musculoskeletal, hepatic, renal, dermatological, psychosocial, and cognitive impairment (Barker-Davies et al. (2020); Shi et al. (2020); Herman et al. (2020); Zhang et al. (2020); Wang al. (2020)).

Like the post-acute viral syndromes described in other coronavirus epidemics, there have been increasing reports of persistent and prolonged effects after acute COVID-19. (Nalbandian et al. (2021)) The number of patients who have survived coronavirus infection and whose need for post-COVID care and recovery is increasing. The long-term effects of COVID-19 are not yet fully understood, but evidence of previous coronavirus infections indicates impaired pulmonary and physical function, reduced quality of life and emotional distress. Many patients who have survived COVID-19 need long-term medical care because of psychological, physical, and cognitive impairment. (Barker-Davies et al. (2020)).

The data collected and the accumulated clinical experience made it possible to describe a

*Corresponding author: doc_mratzkova@abv.bg

condition that can be identified as post-acute COVID-19 (PCS) syndrome, characterized by persistent symptoms and/or delayed or long-term complications after 4 weeks of onset of symptoms. Cardiovascular, neuropsychiatric, gastrointestinal, musculoskeletal, dermatological, or other general symptoms are observed (Nalbandian et al. (2021)). At present, the definition of a clinical case of PCS is not well defined (Augustin et al. (2021)). Various terms are used, such as "long COVID" (Mandal et al. (2021)), "chronic COVID syndrome" (Baig AM (2021)), "post-COVID syndrome" (Goërtz et al. (2021)), "post-acute COVID-19 syndrome" (Hirschtick Baig et al. 2021)).

The full clinical picture of PCS is complex and probably not fully described at this time. (Augustin et al. 2021)). It is likely that the ability of the virus to enter cells through the widely expressed ACE-2 receptor (Hoffmann et al. (2020)) leads to the possibility of many organs to undergo acute and chronic changes, which explains the heterogeneity of clinical symptoms. (Gavriatopoulou et al. (2020)).

A large number of patients in the recovery phase after SARS-CoV-2 have clinical symptoms months after the acute infection (Chopra et al. (2021)); Goërtz et al. (2021); Mandal et al. (2021)) and have not returned to the the usual health condition. The ongoing assessment of PCS patients will become a key task in identifying and reducing the socio-economic and medical long-term effects of COVID-19. (Augustin et al. 2021)).

There are currently no uniform criteria for effective cause-and-effect treatment of PCS. Based on their clinical experience, Augustin et al. (2021) recommend further research and development of new therapeutic options for patients with PCS, which include individualized care by multidisciplinary teams and specific and general methods of physical rehabilitation.

2. MATERIALS AND METHODS

A review of publications, including articles related to MSK symptoms in patients with PCS and possible physical interventions used in the rehabilitation of these patients, which demonstrated effect on symptoms, functional capacity and functional activity was performed. The scientific articles search was conducted in the bibliographic database of PubMed and included articles published until February 14, 2022. The searched results were defining post-COVID-19 (PCS) syndrome, long COVID, post-acute sequelae of SARS-CoV-2 infection (PASC), chronic COVID syndrome (CCS), Musculoskeletal symptom, Pain post-COVID, Physical function, Rehabilitation post-COVID, exercise, Physical activity, Functional capacity, traditional Chinese medicine. The review examines published, available randomized studies, recommendations, prospective controlled clinical trials, reports, guidelines, letters to the editor in English, meeting the set search criteria.

3. RESULTS

The review of the available publications found evidence of prolonged persistence of musculoskeletal symptoms as part of the post-COVID-19 (PCS) syndrome. Fatigue, myalgia, back, waist and neck pain, and arthralgia (pain in the peripheral joints) are most reported. Data showing need for rehabilitation and the positive effect of the physical therapy and the therapeutic exercises in PCS in reducing pain and increasing functional activity were found.

4. DISCUSSIONS

Prolonged health effects can occur even after very mild COVID-19 treated in an outpatient setting. Augustine et al. (2021) report that in about 81% of all infected patients, the disease is mild (WHO 2020), and PCS can be expected to affect more individuals than originally thought and that these effects will pose medical, social, and economic challenges. Males are associated with a lower PCS risk. (Augustin et al. (2021)). In a large prospective study, Augustin et al. (2021) with 958 convalescent patients after mild SARS-CoV-2 infection in 12.8% - 27.8% long-term health effects and at least one symptom (anosmia, ageusia, fatigue or shortness of breath) at fourth and seventh month after the illness were reported. Lower SARS-CoV-2 IgG titer at the beginning of the follow-up period is associated with a higher incidence of PCS. Low IgG levels six weeks after the onset of symptoms may lead to an insufficient humoral immune response, which is likely to be the cause of long-term PCS in these patients.

Severe COVID-19 infection causes catabolic muscle loss, difficulty eating and weakness, which may be the probable cause of bad treatment outcomes. (Hosey & Needham (2020)). Many studies

after acute COVID-19, which include assessments of health-related measurements of quality of life and functional capacity, report significant functional deficits, even 6 months after the infection. (Carfì et al. (2020); Chopra et al. (2020)) It is assumed that early rehabilitation programs are both safe and effective (Nalbandian et al. (2021).

The exact musculoskeletal consequences after COVID-19 have not yet been described, but it has been found in patients admitted to the intensive care units during previous epidemic outbreaks that these patients needed rehabilitation due to MSK complications (Chan et al. (2003); Barker-Davies et al. (2020)). In a systematic review, Appleton et al. (2015) reported that patients undergoing intensive care and those undergoing mechanical ventilation are prone to develop muscle weakness and physical impairment (Appleton et al. (2015)). Muscle changes that involve atrophy and loss of muscle mass begin to develop as early as the first week (Barker-Davies et al. (2020)). These changes should be taken into account during the recovery period and in patients with PCS, because the presence of general muscle weakness and deconditioning can slow down and complicate the recovery process. Lower levels of physical function are also associated with deteriorating quality of life in the recovery period after acute infection of patients (Hui et al. (2005); Rooney et al. (2020)). Musculoskeletal symptoms of fatigue, myalgia and arthralgias are common in COVID-19. (Vaishya et al. (2021)). Accurate assessment of functional capabilities is needed, and it will allow the gradual inclusion of physiotherapy methods that are most effective in terms of functional recovery of patients, without inadequately burdening the cardiovascular and the respiratory systems.

The outcomes of studies show that patients with PCS have at least one symptom (Carfì et al. (2020); Huang et al. (2021)) Carfi et al. surveyed 143 patients for an average of 60.3 days after the onset of the first symptom. Only 12.6% were completely asymptomatic after COVID-19, while 32% had 1 or 2 symptoms and 55% had 3 or more: fatigue (53.1%), shortness of breath (43.4%), joint pain (27.3%) and chest pain (21.7%). 87.4% reported persistence of at least 1 symptom. None of the patients had fever or symptoms of acute illness. Deteriorated quality of life is observed in 44.1% of patients (Carfì et al. (2020); Huang et al. (2021)).

Bakılan et al. (2021) in a retrospective study of 280 patients with PCS, divided into two groups: 1 - patients whose MSK symptoms began or worsened by COVID-19 and patients with no MSK changes related to COVID-19. They reported that 88.2% had at least one or more symptoms, regardless of gender, 85.7% had at least one or more MSK symptoms that had started or worsened with COVID-19, while MSK problems in 14.3 % of the patients have not changed since COVID-19. The most common symptoms are fatigue (71.8%), back spine pain (70.7%) and myalgia (60.7%). The most common area of spine pain is the back (30.4%). The incidence of dyspnea is 30%, cough 18.5% and chest pain 10.7%. (Bakılan et al. (2021))

Karaarslan et al. (2021) in a prospective study of 300 patients found that about three-quarters of the participants had one or more symptoms, and 56.3% of them some MSK symptom at 1st month. The most common MSK symptom is fatigue (44.3%), followed by back pain (22.7%), arthralgia (22.0%), myalgia (21.0%), low back pain (16.3%). %) and neck pain (10.3%) at 1st month. The study proved that the increased BMI is associated with a higher likelihood of persistence of fatigue, myalgia, and arthralgia at 1st month, but there is no relationship discovered associated with age/sex/length of hospital stay and the persistence of these symptoms. (Karaarslan et al. (2021))

According to Rooney et al. (2020) appropriate type and dosage of exercises necessary to achieve beneficial effects on the post-infectious condition should be selected. Exercises need to be modified at different stages of recovery to optimize recovery of function. In addition, attention should be paid to the way the exercises are performed to ensure safety and effectiveness of the intervention (Rooney et al. (2020)).

Zheng et al. (2015) in a study observed a decrease in the secretion of tumor necrosis factor-α (TNF-α) and interleukin-6 (IL-6) in response to non-antigenic stimulation in a group that regularly engages with physical activity compared to the control group. Probably moderate activity supports a healthy immune response to infection and suppresses autoimmune activity in the absence of infection, while reduced physical activity impairs the immune response. (Barker-Davies et al. (2020)). Decreased physical activity leads to increased insulin resistance, which may be the cause of impaired immune response against microbial agents, including activation of macrophages and proinflammatory cytokines. (Luzi et al. (2020)). Exercise may play an important role in influencing the immune response, which may also be important. (Barker-Davies et al. (2020)).

At this stage, a lot of data has been collected and reported from studies and meta-analyzes that exercise is effective in terms of health and causes both short-, medium-, and long-term positive effects associated with preventing and delaying the development of metabolic, pulmonary, cardiovascular

vascular, neurocognitive, inflammatory, rheumatic, and musculoskeletal diseases (Jimeno-Almazán et al. (2021); Metsios, Moe & Kitas (2020); Posadzki et al. (2020); Ruegsegger & Booth (2018)). Decreased physical activity is thought to be associated with a higher risk of severe post-COVID 19 symptoms (Jimeno-Almazán et al. (2021); Salliset al. (2021)) and it is likely that exercise applied could be beneficial in patients with PCS. Symptom-appropriate physical activity and exercise are recommended for the rehabilitation of these patients (Jimeno-Almazán et al. (2021)).

Individually targeted exercise is highly recommended as a non-pharmacological treatment for rheumatic and MSK diseases in which there is chronic pain, muscle weakness, physical limitations, fatigue, and low tolerance to exercise. (Jimeno-Almazán et al. (2021); Metsios, Moe & Kitas (2020); Rausch Osthoff et al. (2018); Hilberdink et al. (2020)). Strength training and multicomponent exercise programs are recommended as safe and effective in reducing weakness and restoring functional capacity. (Jimeno-Almazán et al. (2021); Courel-Ibáñez et al. (2021); Cadore et al. (2021)). In addition, regular exercise can affect depression and anxiety, reduce psychological stress, and modulate pain perception, thus improving the quality of life. (Chen et al. (2020))

A strategy that includes overall muscle strengthening, including cycling, could probably be effective. In adult patients with limited daily activity, Occupational therapy is recommended with the aim to increase their autonomy. (Asly & Hazim (2020)) For this purpose, it is recommended to test the patient's assessment of daily living activities (ADL), including Basic Daily Living Activities (BADL) and Instrumental Daily Living Activities (IADL). (Demeco et al. (2020))

Nalbandian et al. (2021) in a review reported that joint pain was the third most common consequence (27.3%) after fatigue (53.1%) and dyspnea (43.4%). Onset and persistence of chronic pain after COVID-19 is becoming an increasingly pressing issue for pain rehabilitation and control. (Kemp, Corner & Colvin, (2020); Clauw et al. (2020); Angotti et al. (2022)) Bakılan et al. (2021) reported that back pain is the most common symptom of PMR outpatient care, with the most common musculoskeletal symptoms being fatigue, back pain, and myalgia. They found that back pain, low lymphocyte counts and higher levels of D-dimer, as well as CAT findings in the lung in acute COVID-19, prolonged hospitalization, and chronic disease were likely to contribute to PCS and MSK symptoms. (Bakılan et al. (2021))

To reduce pain, Wang et al. (2020) propose the application of transcutaneous electrical nerve stimulation (TENS). TENS is a physical modality that works in the low frequency range and is characterized by parameters capable of stimulating the sensory and peripheral nerves. Applied with the purpose to reduce pain, TENS stimulates A αfiber to reduce pain, the action of which is explained by the gate control theory. (Tashani & Johnson (2009)) Studies show that TENS can successfully reduce acute and chronic pain. (Tang et al. (2017); Wang et al. (2020)) in order to optimize the analgesic effect, it is recommended that TENS parameters are set individually. (Tang et al. (2017)) Concurent use of TENS and therapeutic exercises (can also be performed at home) is recommended, such as stretching exercises in the affected area, strengthening exercises to increase stability and to facilitate strengthening peripheral weak muscles to improve stability. Strengthened muscles and improved stability can help reduce the pain of instability. (Steilen et al. (2014). In chronic pain for more than 6 months, exercises to facilitate weak muscles in combination with drug therapy are recommended (Wang et al. (2020))

Application of traditional Chinese medicine (TCM) methods is likely to promote functional recovery after the acute phase of COVID-19, but there is still no evidence that TCM can be an effective option for restoring body functions. (Sun et al. (2020)) Feng et al. (2020) suggest that Qigong is likely to be potentially effective in the prevention, treatment, and rehabilitation of COVID-19. They suggest several mechanisms of action to reduce stress, regulate emotions, strengthen respiratory muscles, reduce inflammation, and strengthen immune function. (Feng et al. (2020))

Active participation and assistance of patient are important for the success in the process of functional recovery and rehabilitation. Psycho-emotional instability, anxiety, or refusal to cooperate or incomplete cooperation could negatively affect the results. The presence of cognitive dysfunction, fatigue, or depression in patients with PCS may affect the outcome and effectiveness of rehabilitation. (Rooney et al. (2020))

Unexpected complications from concomitant diseases may occur during rehabilitation. This may temporarily stop or delay rehabilitation, but rehabilitation should begin as soon as possible after the complication has been resolved. At the same time, rehabilitation activities need to be adequately dosed so that they do not lead to complications.

Physical and rehabilitation medicine (PRM) is focused not only on the functional recovery of patients with chronic disabling conditions, but also in patients during the convalescent period and with combined pathologies, with the aim to reduce the duration of treatment. (Grabowski et al. (2020)) New questions arise that require creation of new patterns of behavior, such as how many patients with COVID-19 need

rehabilitation, how effective and safe rehabilitation strategies can be, what are the possible problems and complications, which physical modalities will be effective for optimal functional recovery.

In moderate and severe infections during the convalescence period, residual changes are possible, such as fibrotic changes, which in the future may lead to respiratory disorders or problems with reduced physical tolerance (Huang et al. (2020); Choon-Huat Koh, G., & Hoenig, H. (2020)) in combination with persistent MSK symptoms and reduced functional activity. The rehabilitation of PCS requires the formation of a multidisciplinary rehabilitation team, with the participation of various specialists. The activities of the rehabilitation team should be coordinated by a specialist in Physical and Rehabilitation Medicine depending on the needs of the individual patient in order to improve the effectiveness of rehabilitation and to provide comprehensive medical care. In preparing and implementing rehabilitation programs it is necessary to follow the basic principles of PRM for individual approach to each patient, gradual increase in load, comprehensiveness of different muscle groups, and in rehabilitation it is necessary to take into account the general clinical condition and psycho-emotional patient tone. New development opportunities are emerging for PRM, such as telemedicine, and in particular telerehabilitation, as an effective alternative for patients with COVID-19, as well as patients with chronic diseases. (Papathanasiou et al. (2022))

5. CONCLUSIONS

Increasing physical activity in patients with PCS is likely to have a beneficial effect on general condition, physical function, and functional recovery, helping to overcome the effects of infection, reducing pain, and reducing emotional stress. Individually targeted physical interventions are recommended, including multimodal programs, exercises for overall muscle strengthening, increasing joint stability, cycling training, electrical modalities (TENS) for pain symptoms. Rehabilitation should be applied after detailed functional assessment and should be carried out with the participation of a multidisciplinary rehabilitation team. At this stage, the study of musculoskeletal symptoms in PCS continues. A better understanding of the syndrome itself, the pathophysiological mechanisms of its occurrence, duration and severity of complaints will help to develop appropriate pharmacological treatment and rehabilitation strategies that will achieve optimal functional recovery and increased functional activity, satisfying the patient and to reduce the economic burden of reduced working capacity.

Conflict of interests

The author declares no conflict of interest.

REFERENCES

Appleton, R. T., Kinsella, J., & Quasim, T. (2015). The incidence of intensive care unit-acquired weakness syndromes: A systematic review. Journal of the Intensive Care Society, 16(2), 126–136.

Asly, M., & Hazim, A. (2020). Rehabilitation of post-COVID-19 patients. Pan Afr Med J. 36, 168.

Augustin, M., Schommers, P., Stecher, M. et al. (2021). Post-COVID syndrome in non-hospitalised patients with COVID-19: a longitudinal prospective cohort study. The Lancet regional health. Europe, 6, 100122.

Baig A. M. (2021). Chronic COVID syndrome: Need for an appropriate medical terminology for long-COVID and COVID long-haulers. Journal of medical virology, 93(5), 2555–2556.

Bakılan, F., Gökmen, İ. G., Ortanca, B. et al. (2021). Musculoskeletal symptoms and related factors in postacute COVID-19 patients. International journal of clinical practice, 75(11), e14734.

Barker-Davies, R. M., O'Sullivan, O., Senaratne, K., et al. (2020). The Stanford Hall consensus statement for post-COVID-19 rehabilitation. British journal of sports medicine, 54(16), 949–959.

Cadore, E. L., Casas-Herrero, A., Zambom-Ferraresi, F. et al. (2014). Multicomponent exercises including muscle power training enhance muscle mass, power output, and functional outcomes in institutionalized frail nonagenarians. Age (Dordrecht, Netherlands), 36(2), 773–785.

Carfì, A., Bernabei, R., Landi, F., & Gemelli Against COVID-19 Post-Acute Care Study Group (2020). Persistent Symptoms in Patients After Acute COVID-19. JAMA, 324(6), 603–605.

Chan KS, Zheng JP, Mok YW, et al. (2003) SARS: prognosis, outcome and sequelae. Respirology. 8(1):S36-S40.

Chen, Z., Lan, W., Yang, G., et al. (2020). Exercise Intervention in Treatment of Neuropsychological Diseases: A Review. Frontiers in psychology, 11, 569206.

Choon-Huat Koh, G., & Hoenig, H. (2020). How Should the Rehabilitation Community Prepare for 2019-nCoV? Archives of physical medicine and rehabilitation, 101(6), 1068–1071.

Chopra, V., Flanders, S. A., O'Malley, M., Malani, A. N., & Prescott, H. C. (2021). Sixty-Day Outcomes Among Patients Hospitalized With COVID-19. Annals of internal medicine, 174(4), 576–578.

Clauw, D. J., Häuser, W., Cohen, S. P., & Fitzcharles, M. A. (2020). Considering the potential for an increase in chronic pain after the COVID-19 pandemic. Pain, 161(8), 1694–1697.

Courel-Ibáñez, J., Pallarés, J. G., García-Conesa, S., et al. (2021). Supervised Exercise (Vivifrail) Protects Institutionalized

Older Adults Against Severe Functional Decline After 14 Weeks of COVID Confinement. Journal of the American Medical Directors Association,
Demeco, A., Marotta, N., Barletta, M. et al. (2020). Rehabilitation of patients post-COVID-19 infection: a literature review. The Journal of international medical research, 48(8), 300060520948382.
Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. The Lancet. Infectious diseases, 20(5), 533–534.
Feng, F., Tuchman, S., Denninger, J. W., Fricchione, G. L., & Yeung, A. (2020). Qigong for the Prevention, Treatment, and Rehabilitation of COVID-19 Infection in Older Adults. The American journal of geriatric psychiatry: official journal of the American Association for Geriatric Psychiatry, 28(8), 812–819.
Gavriatopoulou, M., Korompoki, E., Fotiou, D. et al. (2020). Organ-specific manifestations of COVID-19 infection. Clinical and experimental medicine, 20(4), 493–506.
Goërtz, Y., Van Herck, M., Delbressine, J. M. et al. (2020). Persistent symptoms 3 months after a SARS-CoV-2 infection: the post-COVID-19 syndrome? ERJ open research, 6(4), 00542-2020.
Grabowski, D. C., & Joynt Maddox, K. E. (2020). Postacute Care Preparedness for COVID-19: Thinking Ahead. JAMA, 323(20), 2007–2008.
Herman, C., Mayer, K., & Sarwal, A. (2020). Scoping review of prevalence of neurologic comorbidities in patients hospitalized for COVID-19. Neurology, 95(2), 77–84.
Hilberdink, B., Vlieland, T. V., van der Giesen, F., et al. (2020). Adequately dosed aerobic physical activity in people with axial spondyloarthritis: associations with physical therapy. Rheumatology international, 40(9), 1519–1528.
Hirschtick, J. L., Titus, A. R., Slocum, E. et al. (2021). Population-Based Estimates of Post-acute Sequelae of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection (PASC) Prevalence and Characteristics. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 73(11), 2055–2064.
Hoffmann, M., Kleine-Weber, H., Schroeder, S. et al. (2020). SARS-CoV-2 Cell Entry Depends on ACE2 and TMPRSS2 and Is Blocked by a Clinically Proven Protease Inhibitor. Cell, 181(2), 271–280.e8.
Hosey, M. M., & Needham, D. M. (2020). Survivorship after COVID-19 ICU stay. Nature reviews. Disease primers, 6(1), 60.
Huang, C., Huang, L., Wang, Y. et al (2021). 6-month consequences of COVID-19 in patients discharged from hospital: a cohort study. Lancet (London, England), 397(10270), 220–232.
Huang, C., Wang, Y., Li, X. et al. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet (London, England), 395(10223), 497–506.
Hui, D. S., Wong, K. T., Ko, F. W. et al. (2005). The 1-year impact of severe acute respiratory syndrome on pulmonary function, exercise capacity, and quality of life in a cohort of survivors. Chest, 128(4), 2247–2261.
Jimeno-Almazán, A., Pallarés, J.G., Buendía-Romero, Á. et al. (2021). Post-COVID-19 Syndrome and the Potential Benefits of Exercise. Int J Environ Res Public Health. 18(10), 5329.
Karaarslan, F., Demircioğlu Güneri, F., & Kardeş, S. (2021). Postdischarge rheumatic and musculoskeletal symptoms following hospitalization for COVID-19: prospective follow-up by phone interviews. Rheumatology international, 41(7), 1263–1271.
Kemp, H. I., Corner, E., & Colvin, L. A. (2020). Chronic pain after COVID-19: implications for rehabilitation. British journal of anaesthesia, 125(4), 436–440.
Kilova, K., Kitova, T., & Kasnakova, P. (2021). Telemedicine in help of rehabilitation in the conditions of COVID-19. Health policy and technology, 10(2), 100508.
Luzi, L., & Radaelli, M. G. (2020). Influenza and obesity: its odd relationship and the lessons for COVID-19 pandemic. Acta diabetologica, 57(6), 759–764.
Mandal, S., Barnett, J., Brill, S. E. et al. (2021). 'Long-COVID': a cross-sectional study of persisting symptoms, biomarker and imaging abnormalities following hospitalisation for COVID-19. Thorax, 76(4), 396–398.
Metsios, G. S., Moe, R. H., & Kitas, G. D. (2020). Exercise and inflammation. Best practice & research. Clinical rheumatology, 34(2), 101504.
Nalbandian, A., Sehgal, K., Gupta, A., Madhavan, M. V., McGroder, C., Stevens, J. S., Cook, J. R., Nordvig, A. S., Shalev, D., Sehrawat, T. S., Ahluwalia, N. et al. (2021). Post-acute COVID-19 syndrome. Nature medicine, 27(4), 601–615.
Papathanasiou, J., Kashilska, Y., Bozov, H., et al. (2022). The outbreak of the SARS-CoV-2 Omicron variant make imperative the adoption of telerehabilitation in the Bulgarian health care system. European journal of translational myology, 10.4081/ejtm.2022.10355. Advance online publication.
Posadzki, P., Pieper, D., Bajpai, R. et al. (2020). Exercise/physical activity and health outcomes: an overview of Cochrane systematic reviews. BMC public health, 20(1), 1724.
Rausch Osthoff, A. K., Niedermann, K., Braun, J. et al. (2018). 2018 EULAR recommendations for physical activity in people with inflammatory arthritis and osteoarthritis. Ann Rheum Dis. 77(9), 1251–1260.
Rooney, S., Webster, A., & Paul, L. (2020). Systematic Review of Changes and Recovery in Physical Function and Fitness After Severe Acute Respiratory Syndrome-Related Coronavirus Infection: Implications for COVID-19 Rehabilitation. Physical therapy, 100(10), 1717–1729. https://doi.org/10.1093/ptj/pzaa12928
Ruegsegger, G. N., & Booth, F. W. (2018). Health Benefits of Exercise. Cold Spring Harbor perspectives in medicine, 8(7), a029694.
Sallis, R., Young, D. R., Tartof, S. Y. et al. (2021). Physical inactivity is associated with a higher risk for severe COVID-19 outcomes: a study in 48 440 adult patients. British journal of sports medicine, 55(19), 1099–1105.
Shi, S., Qin, M., Shen, B. et al. (2020). Association of Cardiac Injury With Mortality in Hospitalized Patients With COVID-19 in Wuhan, China. JAMA cardiology, 5(7), 802–810.
Steilen, D., Hauser, R., Woldin, B., & Sawyer, S. (2014). Chronic neck pain: making the connection between capsular ligament laxity and cervical instability. The open orthopaedics journal, 8, 326–345.
Sun, T., Guo, L., Tian, F. et al. (2020). Rehabilitation of patients with COVID-19. Expert review of respiratory medicine, 14(12), 1249–1256.
Tang, Z. Y., Wang, H. Q., Xia, X. L. et al. (2017). Sheng li xue bao: [Acta physiologica Sinica], 69(3), 325–334.
Tashani, O., & Johnson, M. (2009). Transcutaneous Electrical Nerve Stimulation (TENS) A Possible Aid for Pain Relief in

Developing Countries?. The Libyan journal of medicine, 4(2), 62–65.
Vaishya, R., Jain, V. K., & Iyengar, K. P. (2021). Musculoskeletal manifestations of COVID-19. Journal of clinical orthopaedics and trauma, 17, 280–281. https://doi.org/10.1016/j.jcot.2021.03.002
Wang, C. C., Chao, J. K., Chang, Y. H. et al. (2020). Care for patients with musculoskeletal pain during the COVID-19 pandemic: Physical therapy and rehabilitation suggestions for pain management. Journal of the Chinese Medical Association: JCMA, 83(9), 822–824.
Wang, D., Hu, B., Hu, C. et al. (2020). Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. JAMA, 323(11), 1061–1069.
WHO Working Group on the Clinical Characterisation and Management of COVID-19 infection (2020). A minimal common outcome measure set for COVID-19 clinical research. The Lancet. Infectious diseases, 20(8), e192–7.
Zhang, C., Shi, L., & Wang, F. S. (2020). Liver injury in COVID-19: management and challenges. The lancet. Gastroenterology & hepatology, 5(5), 428–430.
Zheng, Q., Cui, G., Chen, J. et al. (2015). Regular Exercise Enhances the Immune Response Against Microbial Antigens Through Up-Regulation of Toll-like Receptor Signaling Pathways. Cellular physiology and biochemistry: international journal of experimental cellular physiology, biochemistry, and pharmacology, 37(2), 735–746.

Janjić, J. M. (2022). Episiotomy – trends and prevalence in health center Vranje for the period 1996 – 2021. year, *MEDIS - Medical Science and Research, 1*(1), 9-13. doi: 10.35120/medisij010109j UDK: 618.41:618.18-089.85

EPISIOTOMY – TRENDS AND PREVALENCE IN HEALTH CENTER VRANJE FOR THE PERIOD 1996 – 2021. YEAR

Marina J. Janjić

Department of Gynecology and Obstetrics, Health Center Vranje, Srbija,
The Academy of Applied Technical and Preschool Studies, Department of Vranje, Serbia,
e-mail: janjicjmarina@gmail.com

Abstract: With this paper, we wanted to determine the prevalence of episiotomy in the completion of childbirth in the Gynecology and Obstetrics Department of the General Hospital in Vranje in the twenty-five-year period (1996-2021), and this is the period since it is recommended to abandon routine episiotomy. We also wanted to compare the obtained results with the results of similar studies by other authors and thus determine whether the general trend of reduced use of this obstetric operation due to the numerous complications that its use causes, exists in our country. Retrospective analysis includes data obtained from birth protocols with special reference to patients born vaginally and their parity. Childbirth completed using a vacuum extractor and caesarean section were analyzed separately. Such births for the first and last year of the examined period were presented and analyzed (1996, 2021). Aggregate data for both years were also analyzed. The obtained results are expressed numerically and presented using tables. Based on the data, it was concluded that the total number of births decreased, that the number of cesarean sections increased, that episiotomy in vaginal delivery was the most common among primiparous women and that episiotomy was significantly higher in our sample than in other studies.

Keywords: pregnancy, childbirth, episiotomy, parity.

1. INTRODUCTION

Episiotomy is a surgical procedure (very common in obstetric practice), which is performed to facilitate the passage of the fetus during vaginal birth. Seven episiotomy incisions have been described in the literature, although only midline, mediolateral, and lateral episiotomies are commonly used (Kalis et al., 2012). It is recommended to prevent more serious injuries in a normal birth. The episiotomy was first mentioned and described in the scientific literature in 1741 (Harrison, Brennan, & North, 1984). At the beginning of the 20th century, it became widely used and became part of the doctor's routine. It is a time of increased women going to hospitals for childbirth, when doctors are involved in the normal uncomplicated birth process. It has been introduced into clinical practice without a clear medical justification and scientific basis (Schantz et al., 2015). Some justifications for the use of episiotomy have been accepted: it facilitates childbirth, saves the baby's head from trauma and prevents perineal lacerations and stretching of the pelvic floor muscles, which prevents the consequent uterovaginal prolapse. In the 1980s, the real benefits of its routine application began to be questioned. During the 1990s, large studies showed that the benefits of episiotomy were small and that the frequency of complications was higher with routine use. The recommendations of the World Health Organization (WHO) that this surgical procedure is applied only in certain cases date from that period (Harrison, Brennan, & North, 1984). Like all surgical interventions, episiotomy is not without consequences. Its main disadvantages are: increased postpartum hemorrhage, local pain that lasts for weeks and months and which prevents sitting, makes breastfeeding and sexual intercourse more difficult, because the scar makes the vagina less elastic, wound infections, rectovaginal fistulas, tearing and consequent weakening of the pelvic muscles bottoms with consequent incontinence.

For all these reasons, episiotomy has its place in obstetric practice and it is impossible to never apply it (Amorim et al., 2014) but it should be reserved only for special cases and it is necessary in case of risk of serious perineal injuries and fourth degree rupture with anal sphincter injury and consequent fecal and urinary incontinence (Swift et al., 2014). It is necessary for fetal macrosomia, use of forceps or vacuum extractors, abnormal postures (pelvic, personal ...), shoulder dystocia, fetal hypoxia, etc. (Dinulović et al., 1996) .Some clinicians believe that routine episiotomy, surgical incision of the vagina and perineum, will prevent serious injuries during childbirth. On the other hand, episiotomy guarantees perineal trauma and suture application.In women who do not have an instrumental delivery, a policy of selective episiotomy leads to fewer women with severe perineal and vaginal trauma. Other findings, neither short-term nor long-term, provide clear evidence that selective episiotomy policies lead to harm to the mother or baby.

*Corresponding author: janjicjmarina@gmail.com

Research has shown that the belief that routine episiotomy reduces perineal and veginal trauma is not justified (Jiang et al., 2017).

2. MATERIAL AND METHODS

With this paper, we wanted to determine the prevalence of episiotomy in the completion of childbirth in the Gynecology and Obstetrics Department of the General Hospital in Vranje in the twenty-five-year period (1996-2021), and this is the period when it is recommended to abandon routine episiotomy. We also wanted to compare the obtained results with the results of similar studies by other authors and thus determine whether the general trend of reduced use of this obstetric operation due to the numerous complications that its use causes, exists in our country.

The retrospective analysis included data obtained from birth protocols on patients born at the Gynecology and Obstetrics Department of the General Hospital in Vranje, with special reference to patients born vaginally and their parity. Childbirth completed using a vacuum extractor and caesarean section were analyzed separately. Such births in the twenty-five-year period for the first and last year of this period were presented and analyzed (1996, 2021). Aggregate data for both years were also analyzed. The obtained results are expressed numerically and presented using tables.

3. RESULTS

Table 1 in the first part indicates the number and percentage of spontaneous births, births with vacuum extraction and caesarean section in relation to their total number. There is a noticeable decrease in the number of births completed spontaneously from 84.6% in 1996 to 59.9% in 2021, as well as a decrease in the number of deliveries completed by vacuum extraction from 3.6% in 1996 to 1.6% in 2021, with a simultaneous increase in the number of caesareans from 11.7% in 1996 to 38.5% in 2021.

Table 1. Ways of ending childbirth

Years	Spontaneous delivery		Vacuum extractor		Caesarean section		∑
	n	%	n	%	n	%	
1996	1958	84,6	84	3,6	271	11,7	**2313**
2021	814	59,9	21	1,6	522	38,5	**1357**
∑	**2772**	**75,5**	**105**	**2,9**	**793**	**21,6**	**3670**

Table 1 in the second part shows that in the examined years the total number of births was 3670 and that there was a significant decrease in the total number of births in 25 years, from 2313 births in 1996 to 1357 in 2021. In these two examined years, there were 2772 (75.5%) deliveries completed spontaneously, 105 (2.9%) by vacuum extraction and 793 (21.6%) by caesarean section.

Table 2 Shows the parity of patients born spontaneously. It can be noticed that in the examined years the percentage of patients by parity is almost the same: 42.6% were first-born in 1996 and 41.3% in 2021, 36.4% in the second-born in 1996 and 37.1% in 2021, and 1996 in multi-year-olds. 21.0% in 2121 and 21.6% in 2021.

Table 2. Parity of patients born spontaneously

Years	First-born		Second-born		Multi-born		∑
	n	%	n	%	n	%	
1996	834	42,6	713	36,4	411	21,0	**1958**
2021	336	41,3	302	37,1	176	21,6	**814**
∑	**1170**	**42,2**	**1015**	**36,6**	**587**	**21,2**	**2772**

In our research, first-borns are the most common - there were 1394 (42.1%), followed by second-born 1216 (36.6%), while there were at least 705 multi-born (21.3%).

Table 3. Frequency of episiotomy in spontaneous births depending on the parity of patients

Years	Episiotomy and vaginal delivery						∑
	First-born		Second-born		Multi-born		
	yes	no	yes	no	yes	no	
1996	749(38,3)	58(3,0)	413(21,1)	325(16,6)	67(3,4)	346(17,6)	**1958**
2021	258(31,7)	19(2,3)	126(15,5)	157(19,3)	22(2,7)	232(28,5)	**814**
∑	**1007(35,6)**	77(2,7)	**539(18,8)**	482(17,7)	**89(3,1)**	578(22,1)	**2772**

Considering the prevalence of episiotomy in vaginal delivery according to the parity of patients, we obtained data that it is the most common among primiparous women (25.6%) and that this percentage is slightly lower in the last study year 2021 (31.7%) compared to the first study year 1996. (38.3%). Episiotomy is least common in multiples (2.7%).

Table 4. Prevalence of episiotomy in the two examined years

Years	Vaginal delivery				∑
	With episiotomy		Without episiotomy		
	∑	%	∑	%	
1996	1229	62,8	729	37,2	**1958**
2021	471	57,9	343	42,1	**814**
∑	**1700**	**61,3**	**1072**	**38,7**	**2772**

Table 4. Shows that the prevalence of episiotomy in vaginal delivery is slightly different in the first year of 1996, 62.8% and in 2021, 57.9%.

In our examined material, episiotomy was present in 61.3% of vaginal births.

4. DISCUSSION

Starting from the fact that there is no consensus in the scientific community on the optimal frequency of practicing episiotomy, our research was conducted.

The obtained results show that the number of women born at the Gynecology and Obstetrics Department in Vranje is evidently decreasing - from 2313 in 1996 to 1357 in 2021. In the examined years, the total number of births was 3670. Out of that number, 793 births were completed by caesarean section, which is 21.6%. The percentage of caesareans was the lowest in 1996 (11.7%). The trend line of caesarean section application is ascending with a peak in the last examined year 2021 (38.5%). Comparing these data with the data for Serbia and with our data for the period 1991-2000 (which we announced at the Gynecology and Obstetrics Week in Belgrade in 2010), (Janjić, 2010), it is noticeable that the upward trend of increasing the percentage of cesarean sections has begun in that decade and continues to do so. In the same years, there was a decrease in deliveries completed spontaneously from 84.6% in 2016 to 59.9% in 2021, as well as a decrease in deliveries completed by vacuum extraction from 3.6% in 2016 to 1.6% in 2021. years.

This increased prevalence of caesarean section, with a simultaneous reduction in deliveries completed by vacuum extraction, was found in other maternity hospitals. It is, perhaps, the result of the general pressure of the environment, the public and the media on obstetricians that has lasted for years, and it is related to the misinterpretation of patients' rights, and perhaps the result of inexperience of young obstetricians. Cesarean section under this pressure reduces the responsibility and stress of the obstetrician.

Parity is defined as the number of pregnancies completed by delivery after 24 weeks of gestation before the analyzed pregnancy - delivery. The largest number of spontaneously born women were first-born and the least multi-born. Considering the prevalence of episiotomy in vaginal delivery according

to the parity of patients, we obtained data that it is most common among primiparous women (35.6%) and that this percentage is almost the same in the first study in 1996 (38.3%) and in the last 2021 (31 , 7%), and the least represented in multiples (3.1%) with almost the same 3.4% in the first survey in 1996 as in the last 2021. These data are correlated with data from similar studies, where the prevalence of episiotomy in primiparous women in spontaneous delivery was ≥ 30% (Lede, Belizan, & Carroli, 1996).

In our examined material, episiotomy is present in 61.3% of vaginal births, which is significantly more than the recommendation of the World Health Organization, which advises that the procedure be applied in 10% of births, which is the reality in most European countries. indicate that this rate should be 15 and 30%, (Harrison, Brennan, North, 1984; Lede, Belizan, & Carroli, 1996). ie that the use of episiotomy in one of five spontaneous births would be ideal (Henriksen et al., 1992). In contrast to ours, data in the domestic literature indicate that the frequency of episiotomy in spontaneous births is 80%, with primiparous women also representing 80% (Dinulović et al., 1996). Comparison of our data with data from some other authors, according to which episiotomy was performed in about 40% of all vaginal births in the United States, (Weeks, & Kozak, 2001) and that in Canada, as recommended, this frequency was reduced from 37.7% to 29 , 1% (Graham, & Graham, 1997), showed that there is a far higher prevalence of episiotomy in our sample.

The question remains today whether to routinely or selectively apply episiotomy in primiparous women as a method of preventing laceration of the perineum to a greater degree and consequent complications? However, it must be taken into account that in the selective application of episiotomies, periurethral, small lips and high lacerations of the vagina are more frequent (Rodriguez et al., 2008; Carroli, & Mignini, 2009) Further research in women with instrumental termination of labor with standardized outcome assessment methods may help clarify whether routine episiotomy is useful in this particular group (Jiang et al., 2017).

This paper, we believe, can be another contribution to resolving this dilemma.

5. CONCLUSION

The conducted research showed:

– that the number of women born at the Gynecology and Obstetrics Department in Vranje is permanently decreasing, with a simultaneous increase in the number of caesareans, which coincides with the general trend of their increase,

– that episiotomy in vaginal birth is the most common among primiparous women,

– that the prevalence of episiotomy in our sample is significantly higher than in other available studies,

– that without a doubt the final decision on the use of episiotomy due to consequent complications may be made by the obstetrician at the time of immediate childbirth and

– that every woman should be informed about the episiotomy and that she should express a wish not to be done, but she must be aware that it is necessary in some situations. This would avoid cases classified as “obstetric violence”. It is an intervention on the body and the patient should be consulted.

Conflict of interests

The author declares no conflict of interest.

REFERENCES

Amorim, M.M., Coutinho, I.C., Melo, I. & Katz, L. (2017). Selective episiotomy vs. implementation of a non-episiotomy protocol: a randomized clinical trial, Reproductive Health 14, 55.

Amorim, M.M., Franca- Neto, A.H., Leal, N.V., Melo, F.O., Maia, S. B. & Alves, J.N. (2014). Is It Possible to Never Perform Episiotomy During Vaginal Delivery? Obstetrics and Gynecology, 123 Suppl 1, 38S.

Carroli, G. & Mignini, L. (2009). Episiotomy for vaginal birth, Cochrane Database Syst Rev. 21(1), CD000081. Doi: 10.1002/1465185.

Dinulović, D. i sar. (1996). Normalan porođaj-Partus, Opstetricija, Službeni list SRJ, Beograd, 330-339.

Graham, I.D., & Graham, D.F. (1997). Episiotomy counts: trends and prevalence in Canada, 1981/1982 to 1993/1994, Birth, 24(3), 141-7.

Harrison, R.F., Brennan, M., & North P.M. (1984). Is routine episiotomy necessary? British Medical Journal, 288, 1971-1975.

Henriksen, T.B., Bek, K.M., Hedegaard, M., & Seacher, N.J. (1992). Episiotomy and perineal lesions in spontaneous vaginal deliveries, Br J Obstet Gyneacol. 99(12), 950-4.

Janjić, J. M., (2010), Mesto carskog reza u vođenju porođaja sa posebnim osvrtom na blizanačke trudnoće, U: Zbornik radova 54. Ginekološko akušerska nedelja. Beograd, 298-303.

Jiang, H., Qian, X., Carroli, G. & Garner, P. (2017). Selective versus routine use of episiotomy for vaginal birth. Cochrane Database Syst Rev, 8,2(2):CD000081.

Kalis, V.,Laine,J.,W de Leew, J., Ismail K.M. & Tincello, D.G.(2012). Classification of episiotomy: towards a standardisation of terminology. BJOG An International Journal of Obstetrics and Gynaecology, 119(5), 522-526.

Lede, R.L., Belizan, J.M., & Carroli, G. (1996). Is routine use of episiotomy justified? Am J.Obstet Gynecol, 174(5),1399-402.

Rodriguez, A., Arenas, E.A., Osorio, A.L, Mendez, O. & Zuleta, J. J. (2008). Selective vs routine midline episiotomy for the prevention of third - or fourth-degree lacerations in nulliparous women. Am J Obstet Gynecol, 198(3), 285.

Schantz, C., Kruy Leang S. et al. (2015). Reasons for routine episiotomy. Reproductive health matters, 23(45), 68-77.

Swift, A., Webster, J., Conroy, A.M., Hampton, S., Kirby, S.J., Minuzzo, L. & Komble, R. (2014). Curved versus straight scissors to avoid 3rd and 4th degree perineal tears: a randomised feasibility study, Women Birth, 27(3), 163-167.

Weeks, J. D., & Kozak, L. J. (2001). Trends in the use of episiotomy in the United States:1980-1998, Birth, 28(3), 152-160.

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PERIODONTAL STATUS OF INSTITUTIONALIZED ELDERLY

Mihajlo Petrovski

Faculty of medical sciences, Goce Delcev University, Stip, Republic of N. Macedonia
e-mail: mihajlo.petrovski@ugd.edu.mk

Abstract: Impaired general health in institutionalized elderly has an impact on oral health and dental status, especially on periodontal health and oral hygiene. The periodontal health of institutionalized elderly people is influenced by a number of other factors such as: multimorbidity, dependence in maintaining oral hygiene, limited abilities and mobility and the use of numerous medications. Progression of periodontal disease is characterized by the presence of increased destruction of periodontal tissues. The destruction of periodontal tissues is seen through the presence and increased clinical loss of the attachment, but also through the presence of gingival recession and resorption of the alveolar bone. The most common form of periodontal disease in older adults is chronic periodontitis. Due to the chronicity of this disease, most of the detected periodontal disorders are due to the accumulation of the disease over time. The interaction of the highly prevalent xerostomia and the inability to maintain oral hygiene at a satisfactory level in institutionalized elderly leads to an increased incidence of dental plaque. Due to that, the elderly have an increased risk of manifesting dental caries and periodontal diseases. Taking into account the aforementioned facts about oral health, the presence of numerous dental and oral problems, as well as the increased health needs and impaired health in institutionalized elderly people, the aim of this paper was to assess periodontal health among institutionalized elderly people over 65 years of age. Assessment of periodontal status among institutionalized elderly was done by using the Ramfjord Periodontal Disease Index. The research was conducted in the period from April to July 2018 in the Department "Mother Teresa", part from the Gerontological Institute "Thirteenth November" - Skopje. It included a total number of 75 people over the age of 65 who were accommodated in the department and gave their consent to participate in the research. The dental clinical examination was performed in the long-term care institution, in the office or in the rooms of the institutionalized elderly or in a room determined for that purpose. The examination of the subjects was performed on a patient sitting on a chair, lying in bed or placed in a wheelchair. For the examination a dental probe, a dental mirror and disposable gloves and a portable lamp for artificial illumination were used. The average number of present (remaining) teeth in the respondents was 5.81± 7.34 (range 0-24, with Confidence interval from 4.09 to 5.52).The mean value of the simplified OHI Green Vermilion index obtained for the presence of dental plaque was 2.33 ± 0.51 (range from 1.33 to 3.00, with Confidence interval from 2.15 to 2.51). The average value for the Ramfjord index (for assessment of periodontal health) was 4.57 ± 0.74 (range 2.5 to 6.00, with Confidence interval 4.33 to 4.82). Most of the subjects after the appropriate analysis had moderately advanced periodontitis (68.42% of the subjects). Based on the obtained data and subsequent analysis of the results we had found high percentage of people with unsatisfactory oral hygiene and high prevalence of periodontal disease.

Keywords: periodontal status, institutionalized elderly, long-term care patients, oral hygiene.

INTRODUCTION

Among institutionalized elderly there is a high prevalence of comorbidities and barriers for achieving adequate health care. Impaired general health in these people has an impact on oral health and dental status, especially on periodontal health and oral hygiene. The periodontal health of institutionalized elderly people is influenced by a number of other factors such as: multimorbidity, dependence on maintaining oral hygiene, limited abilities and mobility and the use of numerous medications.

Periodontal health is among the not-worrying problems within the so-called long-term care, for which with minimal interventions the maximum benefit can be achieved in terms of quality of life, psychological well-being and of course life satisfaction in adults. (Thorne et al, 2001)

Oral health care has an even greater and more significant role in institutionalized older people because there is an association of dental status with mortality and morbidity in the elderly population. Holmlund et al. (2010) concluded that tooth loss may indicate an increased risk for developing serious general diseases.

According to Alian et al. (2006) , the high prevalence of coronary dental caries and root caries is seen in the elderly population worldwide and advanced dental caries and periodontal disease are considered to be the most important causes of tooth extraction.

With age, the thickness of tooth cement increases, and this phenomenon is based on the successive deposition of new layers of dental cementum. (Bosshardt & Selvig, 1997)

*Corresponding author: mihajlo.petrovski@ugd.edu.mk

Progression of periodontal disease is characterized by the presence of increased destruction of periodontal tissues. The destruction of periodontal tissues is seen through the presence and increased clinical loss of the attachment, but also through the presence of gingival recession and resorption of the alveolar bone. Periodontal disease is not considered to be an inevitable consequence of aging, but aging itself is thought to increase the sensitivity of periodontal tissues. (Lindhe et al, 2004) The progression of periodontal tissue diseases can be influenced by some other factors such as trauma, systemic diseases, drug use, as well as reduced oral hygiene and the hygiene of prosthetic devices.

According to Stavrevska-Minovska et al.(2004), the general health condition of the elderly has significant influence reflecting on the health of periodontal tissues. They also noticed that among the elderly a healthy periodontium can be found (extremely rare), but most often persons with periodontal infection or elderly with a treated periodontium are present.

Periodontal changes become more evident over the years. According to Lindhe et al. (2004) there is an increased presence and increased gingival recession with increasing age. According to Lamevski and Ivanovski(2011) there is a high and statistically significant positive correlation between the degree of alveolar bone resorption and the age of the subjects.

The most common form of periodontal disease in older adults is chronic periodontitis. Due to the chronicity of this disease, most of the detected periodontal disorders are due to the accumulation of the disease over time. Saliva is a key element in oral homeostasis, oral function, and oral health. Hyposalivation is a risk factor not only for dental caries and periodontal disease, but also for taste disturbances, speech problems, swallowing problems, poor chewing ability and malnutrition. According to Samnieng et al.,(2012) patients with hyposalivation have a higher number of carious teeth and a higher prevalence and progression of periodontitis than those with normal salivation. But hyposalivation is also associated with other factors such as gender, systemic diseases, drug use and smoking. More than 400 drugs cause xerostomia, as a side effect of their use. Gupta et al. (2006) and Liu et al. (2012) in their research found that more than 80 percent of commonly prescribed drugs can cause xerostomia. Some of them are the following groups of drugs: analgesics, antipsychotics, antihypertensives, anticholinergics, antihistamines, diuretics, narcotics, cytostatics and others. According to a study by Ursache et al., (2006) the prevalence of xerostomia is 60 percent of older institutionalized individuals, both sexes equally. The interaction of the highly prevalent xerostomia and the inability to maintain oral hygiene at a satisfactory level in institutionalized elderly leads to an increased incidence of dental plaque. Due to that, the elderly have an increased risk of manifesting dental caries and periodontal diseases.

Taking into account the aforementioned facts about oral health, the presence of numerous dental and oral problems, as well as the increased health needs and impaired health in institutionalized elderly people, the aim of this paper was to assess periodontal health among institutionalized elderly people over 65 years of age.

MATERIAL AND METHODS

Assessment of periodontal status among institutionalized elderly was done by using the Ramfjord Periodontal Disease Index. Six representative teeth (16,21,24,36,41,44) are used to determine the index. The large number of lost teeth in the examined population led to the inability to apply this index consistently. If it was noticed that one of the representative teeth is missing, it was replaced. So, if one of the premolars or molars were missing, it was replaced with the first tooth located more distally than the representative tooth, if one of the representative incisors was missing, then it was replaced first with one of the contralateral central incisions, then, if it was missing, it was taken the value for the adjacent lateral incision, and if it was missing, the value for the opposite lateral incision was taken. In case of lack of some of the replacement teeth (absence of all incisions or absence of teeth distally from the second molar) then that tooth was not replaced, and the index is obtained as the average value of the examined sides of the remaining teeth present.

Only the gingival and periodontal component of this index was used to fulfill the objectives of this paper. During our examination, the gingival status was first determined. Depending on the criteria, the condition was assessed with numerological values from 1 to 3. When examining the condition of the gingiva, the following criteria were taken : color, position, consistency and the presence of exudate on the gingiva. Thus, if the changes were small and occupy certain parts of only one area of the tooth, then the value 1 according to the proposed values of the index was noted. If the changes were localized on more than one surface, but do not occupy the surface of the gingiva around the entire tooth, a value of 2 was noted. If the changes are localized on the gingiva around the entire tooth and occupy the gingiva

along its entire length, but there were no periodontal pockets according to the index there was a value of 3. The presence of periodontal disease was then determined through the presence and magnitude of clinical attachment loss. This criterion determines the clinical loss of attachment to each of the tooth surfaces (mesial, distal, buccal, and lingual sides). Buccal and lingual measurements are performed in the middle of the buccal or lingual surface. The middle measurement was performed during the approximal measurements in case of absence of an adjacent tooth. When measuring the clinical loss of attachment of the proximal sides in the presence of a contact tooth, the buccal parts of the interproximal surfaces were measured. The estimated values were numbered 4, 5 or 6, while in the final result the value is taken as the average for each examined tooth. The final result is obtained as a quotient of the average value of all examined teeth with the number of examined teeth.

The following criteria were taken as reference values when measuring the clinical loss of attachment: presence of clinical attachment loss up to 3 mm, presence of clinical attachment loss of 4-6 mm and presence of periodontal pocket over 7 mm. So in index value 4 was noted if the clinical loss of attachment was up to 3 mm, value 5 when clinical loss of attachment was from 4 to 6 mm and value 6 when there was presence of clinical loss of tooth attachment over 7 mm .

The dental clinical examination was performed in the long-term care institution, in the office or in the rooms of the institutionalized elderly or in a room determined for that purpose. The examination of the subjects was performed on a patient sitting on a chair, lying in bed or placed in a wheelchair.

For the examination a dental probe, a dental mirror and disposable gloves and a portable lamp for artificial illumination were used. After the examination, the used instruments and disposable medical gloves were stored in appropriate places for storage of medical waste.

The data obtained from after being collected were statistically processed. For statistical processing was used special software for statistical data processing - Statistics 7.1.

RESULTS

In this part of the paper are presented the results obtained from the research that was conducted in the period from April to July 2018 in the Department “Mother Teresa”, part from the Gerontological Institute “Thirteenth November” - Skopje. It included a total number of 75 people over the age of 65 who were accommodated in the department and gave their consent to participate in the research.

According to the results, the mean age of the participants in the research was 74 years (more precisely 73.79 ± 6.92 years, with a range of 65-93 years with Confidence interval from 73.18 to 75.41 years)

After processing the data, it was found that the average length of stay in this long-term care institution for the examined elderly was 5 years and seven months on average (5.64 ± 6.92 years, range from 0.06 to 24.00 years with Confidence interval from 4.19 to 7.10 years)

The average number of present (remaining) teeth in the subjects was 5.81. 7.34 (range 0-24, with Confidence interval from 4.09 to 5.52).

The mean value of the simplified OHI Green Vermilion index obtained for the presence of dental plaque was 2.33 ± 0.51 (range from 1.33 to 3.00, with Confidence interval from 2.15 to 2.51). Most of the respondents have values above 2.00 for the simplified OHI index.

The average value for the Ramfjord index (for assessment of periodontal health) was 4.57 ± 0.74 (range 2.5 to 6.00, with Confidence interval 4.33 to 4.82) (Fig. No. 1)

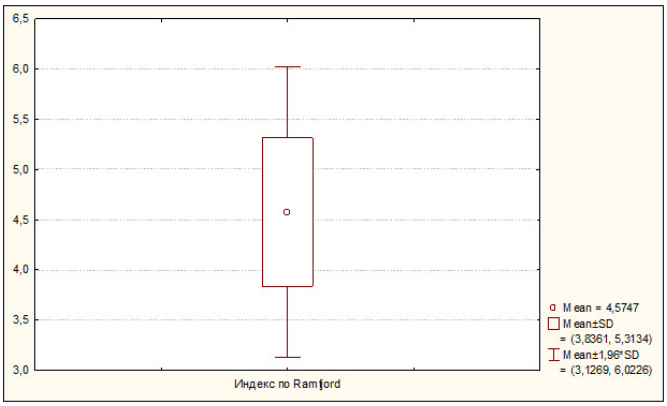

Fig. No. 1. Average value for the Ramfjord Index in the examined elderly who have natural teeth.

The average value obtained for the Ramfjord index among female subjects was 4.51 ± 0.81, while the average value of the Ramfjord index in males was 4.63 ± 0.69 (Fig. No. 2). After statistical processing, it was found that there was no significant difference in the specific Ramfjord Index between males and females (for p <0.001).

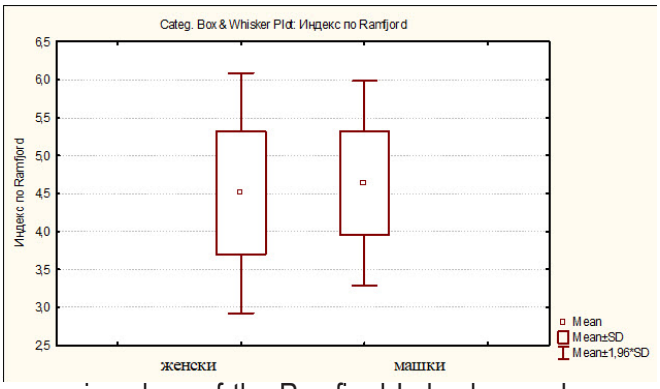

Fig. No. 2. Differences in values of the Ramfjord Index by gender among institutionalized older people

Among two (5.26%) of the subjects the changes were localized only on the gingiva. Most of the subjects after the appropriate calculation had moderately advanced periodontitis (68.42% of the subjects). (Table No. 1.)

Table No.1. Progression of periodontitis among institutionalized elderly

Ramfjord index	No	Percent
Value 4	4	10,52 %
Value 5	26	68,43 %
Value 6	6	15,79 %

DISCUSSION

This study refers to the periodontal health assessment of institutionalized elderly people institutionalized in the Department “Mother Teresa”, part from the Gerontological Institute “Thirteenth November” - Skopje. It is a cross-sectional study and all the results presented in it are original.

The limiting effect of this study is the small number of people participating in this study. However, during the research, all institutionalized persons accommodated in the institution were examined. Thus the small number of participants in this study does not adversely affect the validity of the results.

The comparison of the data of this study with other epidemiological studies is complex due to the existence of numerous variations in terms of diagnostic methodology and criteria between different studies. A special problem was the lack of published data regarding the periodontal health of institutionalized elderly in our country. This prevents the possibility of comparison with our literary data.

Glazar et al. (2010) found a higher prevalence of xerostomia in the institutionalized than in the non-institutionalized elderly. Also, oral hygiene habits of institutionalized elderly people is bad and inappropriate. According to Gaiao et al. (2009) 41.3% of respondents brush their teeth at least twice a day, compared to 10.6% of subjects who never brush their teeth. About 75% of people placed in long-term care facilities have large amounts of oral debris. According to Petelin et al. (2012) 23.3% subjects brush their teeth once a day, while 48.2% brush their teeth at least twice a day. The same authors found that 8.8% of patients never brush their teeth. In our study, the percentage of people who never maintain oral hygiene is 68.5% and is one of the largest in the literature.

The Ramfjord Periodontal Disease Index from 1959 was used to assess periodontal status in the study group. It contains three basic components: a plaque component, a component associated with dental calculus and a gingival-periodontal component. Only the gingival-periodontal component is used to fulfill the purposes of this paper. This index is used to assess the presence and severity of gingivitis and periodontal disease in each individual and at the level of the entire study population.

The main disadvantage of this index is that it is not completely reliable, because it is performed only on a certain number of teeth, but it is practical and used in larger epidemiological studies. Its speed is of particular importance because it is about the elderly in whom the examination should be quite rational in time. Perhaps the most important reason for choosing this, is to measure the loss of epithelial attachment relative to the enamel-cement junction, rather than measuring the depth of periodontal pockets.(Rams et al, 1993)

Six teeth were selected to determine the index, while in the absence of any of the representative teeth, they are not replaced. But due to the large number of lost teeth, it could not be made to be applied consistently. Therefore, if one of the premolars or molars was missing, it was replaced with the first tooth that is located distally from the representative tooth, and if one of the representative incisors was missing, then it was replaced with one of the contralateral central incisions, then, if it was missing, the value for the adjacent lateral incision is preferred, and if it was missing, the value for the opposite lateral incision was taken. In case of lack of some of the replacements (absence of all incisions or absence of teeth distal from the second molar) then that tooth is not replaced, and the index is obtained from the remaining teeth.

The prevalence of periodontal age increases with age and is thought to be associated with periodontal disease and age. (Beck, 1996) Today, the modern view in periodontology is that periodontal disease in the elderly is not due to increased but is the result of the cumulative progression that occurs with age.

According to the Ramfjord index for the examined institutionalized elderly, it was found that the largest percentage of the examinees have moderately advanced periodontitis (68.43%)- Ramfjord value 5 (distance from the enamel-cement junction to the junctional epithelium was from 4 to 6 mm). Next are the subjects with a value of Ramfjord 6, subjects where the distance from the enamel-cement junction to the junctional epithelium is over 7 mm (15.73%) and the subjects with clinical loss of attachment up to 3 mm-Rumfjord 4 (10.52%). In 5.26% of the subjects the changes are localized only on the gingiva (Table No. 1)

A similar prevalence of advanced periodontal disease as demonstrated by Basima in our study. (2005) Miyazaki et al. (1991) found a lower prevalence of advanced forms of periodontal disease in institutionalized elderly people, in contrast to Morales-Suarez et al. (2011) who reported a lower prevalence. Contrary to the high prevalence of moderate periodontal disease among institutionalized elderly people in our study, Iglesias et al. (2008) and Ajwani and Ainamo (2001) showed a lower prevalence of moderate periodontal disease in institutionalized elderly people.

Although it is an older population that has poor habits for maintaining oral hygiene, there is still no high percentage of advanced periodontal disease and high value for the clinical loss of attachment. This is thought to be due to the relatively small number of remaining teeth being measured.

CONCLUSION

Based on the obtained data and subsequent analysis of the results, we can draw the following conclusions : (1) Small percentage of subjects who maintain daily hygiene of remaining teeth, (2) High percentage of subjects with unsatisfactory oral hygiene and most important there was (3) High prevalence of periodontal disease.

Conflict of interests

The author declares no conflict of interest.

REFERENCES

Ajwani, S., & Ainamo, A. (2001). Periodontal conditions among the old elderly: five‐year longitudinal study. Special Care in Dentistry, 21(2), 45-51.

Alian, A. Y., Mcnally, M., Fure, S., & Birkhed, D. (2006). Assessment of caries risk in elderly patients using the Cariogram model. Journal of the Canadian Dental Association, 72(5).

Basima, G.H.A. (2005). Prevalence and severity of periodontal disease among insitutionalised elderly in Baghdad-Iran. Mustansiria DJ, 2(1); 120-3

Beck, J. D. (1996). Periodontal implications: older adults. Annals of periodontology, 1(1), 322-357.

Bosshardt, D. D., & Selvig, K. A. (1997). Dental cementum: the dynamic tissue covering of the root. Periodontology 2000, 13(1), 41-75.Lindhe, J. T., Karring, T., & Lang, N. P. (Eds.). (2004). Klinička parodontologija i dentalna implantologija. Nakladni zavod Globus.

Glazar, I., Urek, M. M., Brumini, G., & Pezelj‐Ribaric, S. (2010). Oral sensorial complaints, salivary flow rate and mucosal lesions in the institutionalized elderly. Journal of oral rehabilitation, 37(2), 93-99.

Gupta, A., Epstein, J. B., & Sroussi, H. (2006). Hyposalivation in elderly patients. Journal of the Canadian Dental Association, 72(9).

Holmlund, A., Holm, G., & Lind, L. (2010). Number of teeth as a predictor of cardiovascular mortality in a cohort of 7,674 subjects followed for 12 years. Journal of periodontology, 81(6), 870-876.

Iglesias Corchero, A. M., & García Cepeda, J. R. (2008). Oral health in people over 64 years of age, institutionalized in Centres for the Aged in the Vigo Health District Spain, 2005.

Ламевски, М., & Ивановски, К .(2011) Влијание на стареењето врз степенот на пародонтална деструкција. Макед Стом Прегл. 1-2 :12-8

Liu, B., Dion, M. R., Jurasic, M. M., Gibson, G., & Jones, J. A. (2012). Xerostomia and salivary hypofunction in vulnerable elders: prevalence and etiology. Oral surgery, oral medicine, oral pathology and oral radiology, 114(1), 52-60.

Miyazaki, H., Shirahama, R., Ohtani, I., Takehara, T., Shimada, N., & Pilot, T. (1991). CPITN assessments in institutionalised elderly people in Kitakyushu, Japan. Community Dental Health, 8(3), 239-243.

Morales-Suárez-Varela, M., Ibáñez-Cabanell, P., Gimeno-Clemente, N., Roig-García, J. M., Nieto-García, M. A., & Llopis-González, A. (2011). Oral and dental health of non-institutionalized elderly people in Spain. Archives of Gerontology and Geriatrics, 52(2), 159-163.

Petelin, M., Cotič, J., Perkič, K., & Pavlič, A. (2012). Oral health of the elderly living in residential homes in Slovenia. Gerodontology, 29(2), e447-e457.

Rams, T. E., Oler, J., Listgarten, M. A., & Slots, J. (1993). Utility of Ramfjord index teeth to assess periodontal disease progression in longitudinal studies. Journal of clinical periodontology, 20(2), 147-150.

Ribeiro Gaião, L., Leitão de Almeida, M. E., Bezerra Filho, J. G., Leggat, P., & Heukelbach, J. (2009). Poor dental status and oral hygiene practices in institutionalized older people in Northeast Brazil. International Journal of Dentistry, 2009.

Samnieng, P., Ueno, M., Shinada, K., Zaitsu, T., Wright, F. A., & Kawaguchi, Y. (2012). Association of hyposalivation with oral function, nutrition and oral health in community-dwelling elderly Thai. Community dental health, 29(1), 117-123.

Ставревска- Миновска, А. ,Пандилова, М. , & Ивановски, К. (2004). Орална Хигиена. Стоматолошки факултет - Скопје , Скопје

Thorne, S. E., Kazanjian, A., & MacEntee, M. I. (2001). Oral health in long-term care: the implications of organizational culture. Journal of Aging Studies, 15(3), 271-283.

Ursache, M., Grădinaru, I., Nechifor, M., & Cherciu-Ciubotaru, B. (2006). Implications of xerostomia in oral dis-homeostasis. Revista medico-chirurgicala a Societatii de Medici si Naturalisti din Iasi, 110(2), 432-437.

Gjurovski, S. R., & Stojmenova, V. T. (2022). The benefits of using the socket shield technique in partial extraction therapy: an article review , *MEDIS - Medical Science and Research, 1*(1), 21-24. doi: 10.35120/medisij010121r
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THE BENEFITS OF USING THE SOCKET SHIELD TECHNIQUE IN PARTIAL EXTRACTION THERAPY: AN ARTICLE REVIEW

Sonja Rogoleva Gjurovski[1], Verica Toneva Stojmenova[1]

[1]Faculty of Medical Sciences, "Goce Delcev" University, Stip, Republic of North Macedonia,
e-mail: sonja.rogoleva@gmail.com; verica.stojmenova@ugd.edu.mk

Abstract: The technique with socket shield is used like not total extraction therapy which is based on preserving segment from one of the sides on the root from the tooth that is going to be extracted. The main use of this technique is in cases for implant placement that is combined with grafting bone. The goal of this technique is to preserve as much as possible tissue from the periodontal ligament and also to spare the gingival tissue from unnecessary damaging during the therapy.

Indications for this technique are : 1. To support and to preserve buccofacial bone part of extraction socket in cases that require immediate implants.2. Socket shield technique is indicated in cases with vertical fractures of teeth that are without any pathology of the pulpal tissue, where the bone tissue sparing and also attractive look are a main goal.3. To preserve the papilla between the placed dental implants.

In spite of that to have a full success of this therapy is required to have enough bone tissue that will allow stability of the future implant and also absence of any kind of infection. The advantages from application of this technique are many, such as prevention from resorption of the lamellar bone, high aesthetics results, improved primary stability of the future implant, minimal invasiveness during the procedure, prevention from forming a connective tissue with the implant, low cost compared with other procedures etc. There are also disadvantages such as possibility of displacement of the buccal lamellar bone. The purpose of this study is to analyze the efficiency of this socket shield approach in immediate implant treatment. This study was based on Narrative review on published surveys, using PubMed, Medscape, Webmd, Mdconsult, Emedicine data bases. The preservation of the whole attachment apparatus of the tooth to maintain complete preservation of the alveolar bone tissue, makes the socket shield approach a very good technique that results with high level efficiency. The clinical outcomes from different studies is believed for this technique to be the best approach for alveolar ridge sparing in the future and also to use as less material as possible.

Keywords: Socket-shield technique, bone grafting, immediate implant, partial extraction, bone preservation.

INTRODUCTION

The partial extraction therapy is advanced surgical procedure which is used to establish protective socket wall. The socket shield technique is type of partial extraction therapy which is based on preserving a thin segment from the one site from the tooth's root which is being extracted. Preserving the segment of the root also allows preservation of the periodontal ligament that connects the root with the bone, meanwhile the bone and the gingival tissue on it are being spared too. This technique is mostly used for placing implants right after extraction in combination with bone grafting in the space between implant and root segment of the tooth that is being extracted.

Hurzeler et al. first explained about this technique in year 2010 that is good approach to prevent bone ridge loss after extraction, in combination with implant placement (Hürzeler, 2010).

This therapy technique is very effective when the aim is preserving the bone and gums tissue if the required conditions are met, such as absence of any kind of infection and sufficient bone tissue for primary stability of future implant.

The socket shield approach most often is used in cases that require immediate implant placement of tooth that needs to be extracted, mostly in the upper jaw. The crown is reduced 1mm above crest, the root is split longitudinally into two halves. The palatal root part is examined carefully and if it is not healthy it is removed. Then the facial part gets concave form with a drill. After that an implant is being placed and if there is need, a bone graft material can be inserted inside. (Sáez-Alcaide, 2021)

Advantages

- Helps to preserve the bone structures and prevents the resorption of the lamellar bone.

*Corresponding author: sonja.rogoleva@gmail.com

- Smaller amount of material is used
- The aesthetics are kept on high level.
- Helps in placing the implants in the correct position.
- Complete osteointegration can be achieved with thistechnique.
- Prevents formation of fibrous tissue around the future implant.
- This treatment is with lower cost but very effective.
- This technique requires minimal level of invasiveness in the procedure.

Disadvantages and limitations

- Resorption of the bone may be found in patients with periodontal infection and inflammation.
- This approach is very sensitive for patients.
- There is a possibility of displacement of the lamellar bone.
- Long term consequences are not known for now.

Instruments that are used for this technique are: drill longer than the standard ones, for canal resection; extra long drill with diamond head; gums protector; surgical engine with irrigation system; micro periotome; micro forceps; instruments for alveolar wall construction; grafting instruments; SM 69 scalpel;6/0 nonresorbable surgical thread for stitches.

Purpose: The purpose of this work is to assess the efficiency and benefits of the socket shield approach in patients that need immediate treatment with implants.

MATERIALS AND METHODS

This study was based on narrative analysis on articles in English language, that have gathered results that are in relation to the socket shield technique. The survey was conducted in the period of four months, from March 2021 to July 2021. The wideresearch was made using PubMed, Medscape, Webmd, Mdconsult, Emedicine. The search was done by using terms as: partial extraction therapy, extraction alveola preservation, tooth sparing and socket shield. In this assessment were included clinical studies, case reports, systematic reviews and qualitative studies. The survey was conducted with online research of the above-mentioned data bases by both authors, with discussion about selection of the articles, all articles were screened, while the studies that met the correct subject were analyzed in details. The criteria was based: socket shield technique principles, benefits from partial extraction therapy, the usage of socket shield approach, advantages in the treatment with immediate implants using this technique. From the total number of 95 articles that were found by searching the keywords, 28 articles were taken for further analysis, containing information about the implementation of the socket shield approach and the advantages of this therapy.

DISCUSSION

The extraction of teeth is followed by the normal reactive behavior of the alveolar bone known as resorption, in various degrees. The alveolar bone tissue under the tooth is mostly having vascularisation from the periodontal space. If the vascularization of the alveolar bone is not enough, it can cause total or partial resorption of it (Staehler, 2020). Bone resorption approximately is being estimated in width of 50% or 3.8 mm. However the process of resorption is very different in every case individually. As a consequence, mostly approximately 1% of the whole bone tissue of the alveolar ridge is resorbed after the process of tooth extraction (Gluckman, 2020). The use of preventive tissue techniques after tooth extraction was tested for their contributions in some clinical works. Filippi, et al. were investigating about sparing root of vital or avital and it was concluded that if the root is saved and the crown is removed, the bone resorption will be smaller before placing an implant.

Andersson, et al. (2003) conducted studies which have shown that if the root is kept, the alveolar bone is being less resorbed and also there is an influence on the process of the vertical growth of the bone tissue, as an occurrence that has been found in vivo in patients. Another study performed by Bjorn O. et al. has shown that in some cases it was found a new tissue of cementum and a connective tissue placed on the upper surface of the roots that were spared during this procedure.

The preservation of the whole attachment apparatus of the tooth to maintain complete preservation of the alveolar bone, makes socket shield approach a very practical procedure. Before performing the procedure, anamnesis, clinical evaluation and diagnosis must be done, and also the bone should be estimated. That is why for every patient it is good to make an individual plan for the treatment.

Tarnow et al. stated that it is required to have at least 3 mm distance between the implant and the rest of the teeth to have an ideal interdental papilla.

From the reported results found by Hürzeler(2010) et al. it was shown that if part of the buccal side of the root is spared during the procedure, and implant is placed, after that the following osseointegration will be efficient and without big resorption of the bone tissue. That is why socket shield approach is preferably used in cases where it is needed to reduce complications after the implant placement.

When the socket – shield approach is used, it has to be considered that there are two protocols that can be used, first if the implantation is immediate, it needs to be used bone graft to fill the space between the implant and the bone, or if the procedure is delayed, there will need to be more surgical procedures for correction of the bone defect on the alveolar ridge that will be done.

To partly compensate the following defect, there can be used guided bone regeneration and tissue augmentation. In some studies it was found that as a result of this process there can be partly reducement in the bone tissue, however also there are big chances for other complications such as infections in the post operative period and in some cases even a total nonsuccess can be expected.

After many years, in the first case where this technique has been used in 2010 is seen a huge progress compared with the approaches in the 1950s which were used for bone preserving during a tooth extraction.

The implementation of these techniques mostly has been with the aim to keep the volume of the bone after extractions in patients with total dental prosthesis.

With this technique the tooth is being reduced in his crown part in the level of 1 mm above the bone crest in order to keep the collagen fibers and the connective tissue. However, by using of this technique unfortunately the inter dental bone can not be spared from resorption and also the interdental papillae. Hürzeler et al. have found that after the healing process, there were no inflammatory consequences and the attachment was kept well.

In the buccal part of the bone there wasn't any osteoclastic activity, whish shows that the bone tissue was not remodeled, and also if was free of any inflammation.

In their conclusion, it was stated that the osteointegration process was successful and using this technique and the clinical results were good considering the aesthetics.

However, by now it was concluded that total preservation of the bone tissue and the other tissues can not be achieved by using this or any other known technique so far.

Chen et al. have made success with this approach, with bone resorption of only 0,72 mm. However, for this technique to be applied as everyday standard procedure and practice, there need to be done more long term studies for a longer periods in the future.

We may highlight the fact that using of this technique many times can result in serious consequences such as displacing the fragment of the root or affecting the bone. During this procedure, there needs to be paid attention to the cutting of the root that needs to be done vertically, and to be careful to not punctuate the mucosa.

Anyway, it is supposed to achieve for the implant to be surrounded on all its' sides with bone, because according to the current principles of osseointegration (Schwimer,2019), for successful outcome the implant must have a total contact only with bone tissue, without any other. Because the time that these cases were followed is short, still there can not be gathered enough information about the long term consequences of this technique.

In some cases, there can be formed periodontal membrane between the implant and the bone tissue, as a result from the existing gap.

As many clinicians have found that this approach allows protection of the alveolar bone volume and retention of the implant, still in the future new studies should pay attention to inventing or modifying this technique with lower costs and with other materials. Also it should be considered if the sparing the part of the root of the tooth is a good idea, or does it make harm with bone resorption on a long term.

CONCLUSION

The partial extraction therapy is improved procedure used in the latest years which provides protective socket wall. The socket-shield technique is type of extraction therapy based on leaving thin segment from the buccal site of the root on the tooth that is being extracted. This technique is mostly used for immediate implant placement combined with bone graft appliance in the space between the implant and the root segment of the extracted tooth.

The usage of this technique has shown regeneration of alveolar bone around endodontic treated teeth reported a a presence of formed cementum tissue on the upper surface on the roots. Also it was showed that there is osseointegration without resorption of the alveolar bone. The socket-shield technique was found to be the most practical solution for managing the postextraction changes and the complications associated with the immediate implant placement. It also provides high level of aesthetics if it's used in the front area teeth.

The clinical outcomes from different studies showed that this technique is considered to be good method for keeping the bone tissue, and also to use less material as collagen compared to other techniques. Still many studies in the future are expected to give us more results on the evaluated subject.

Conflict of interests

The author declares no conflict of interest.

REFERENCES

Abd-Elrahman, A., Shaheen, M., Askar, N., & Atef, M. (2020). Socket shield technique vs conventional immediate implant placement with immediate temporization. Randomized clinical trial. Clinical implant dentistry and related research, 22(5), 602–611. https://doi.org/10.1111/cid.12938

Andersson, l.; Emami-Kristiansen, Z.; Högström, J. (2003) Single tooth implant treatment of tooth loss after trauma: A retrospective clinical and interview study.Dent. Traumatol., 19, 126–131.

Atieh, M. A., Shah, M., Abdulkareem, M., AlQahtani, H. A., & Alsabeeha, N. (2021). The socket shield technique for immediate implant placement: A systematic review and meta-analysis. Journal of esthetic and restorative dentistry : official publication of the American Academy of Esthetic Dentistry ... [et al.], 33(8), 1186–1200. https://doi.org/10.1111/jerd.12812

Blanco, J., Carral, C., Argibay, O., & Liñares, A. (2019). Implant placement in fresh extraction sockets. Periodontology 2000, 79(1), 151–167. https://doi.org/10.1111/prd.12253

Comut A, Mehra M, Saito H.(2013) Pontic site development with a root submergence technique for a screw-retained prosthesis in the anterior maxilla. J Prosthet Dent;110:337–343.

Du Toit, J., & Gluckman, H. (2018). The Modified Socket-Shield Technique. The Journal of craniofacial surgery, 29(7), 2005–2006. https://doi.org/10.1097/SCS.0000000000004750

Gluckman H, Du Toit J, Salama M. (2016) The pontic shield: Partial extraction therapy for ridge preservation and pontic site development.Int J Periodontics Restorative Dent:36;417–423.

Gluckman, H., Du Toit, J., Salama, M., Nagy, K., & Dard, M. (2020). A decade of the socket-shield technique: a step-by-step partial extraction therapy protocol. The international journal of esthetic dentistry, 15(2), 212–225.

Hürzeler MB, Zuhr O, Schupbach P, RebeleSF, Emmanouilidis N, Fickl S. (2010) The socket shield technique: A proof-of-principle report.J Clin Periodontol;37:855–862.

Kan, J., Rungcharassaeng, K., Deflorian, M., Weinstein, T., Wang, H. L., & Testori, T. (2018). Immediate implant placement and provisionalization of maxillary anterior single implants. Periodontology 2000, 77(1), 197–212. https://doi.org/10.1111/prd.12212

Malmgren B, Cvek M, Lundberg M, FrykholmA(1984) Surgical treatment of ankylosed and infrapositioned reimplanted incisors in adolescents. Scand J DentRes;92:391–399.

Sáez-Alcaide, L. M., González Fernández-Tresguerres, F., Cortés-Bretón Brinkmann, J., Segura-Mori, L., Iglesias-Velázquez, O., Pérez-González, F., López-Pintor, R. M., & Torres García-Denche, J. (2021). Socket shield technique: A systematic review of human studies. Annals of anatomy = Anatomischer Anzeiger : official organ of the Anatomische Gesellschaft, 238, 151779. https://doi.org/10.1016/j.aanat.2021.151779

Salama M, Ishikawa T, Salama H, FunatoA, Garber D. (2007) Advantages of the rootsubmergence technique for pontic site development in esthetic implant therapy. Int JPeriodontics Restorative Dent ;27:521–527.

Schwimer, C. W., Gluckman, H., Salama, M., Nagy, K., & Du Toit, J. (2019). The socket-shield technique at molar sites: A proof-of-principle technique report. The Journal of prosthetic dentistry, 121(2), 229–233. https://doi.org/10.1016/j.prosdent.2018.05.006

Staehler, P., Abraha, S. M., Bastos, J., Zuhr, O., & Hürzeler, M. (2020). The socket-shield technique: a step-by-step protocol after 12 years of experience. The international journal of esthetic dentistry, 15(3), 288–305.

Testori, T., Weinstein, T., Scutellà, F., Wang, H. L., & Zucchelli, G. (2018). Implant placement in the esthetic area: criteria for positioning single and multiple implants. Periodontology 2000, 77(1), 176–196. https://doi.org/10.1111/prd.12211

Yan, S. J., Zhou, C., Liu, J., Xu, X. N., Yang, Y., Chen, X., & Lan, J. (2019). Hua xi kou qiang yi xue za zhi = Huaxi kouqiang yixue zazhi = West China journal of stomatology, 37(6), 615–620. https://doi.org/10.7518/hxkq.2019.06.008

Stojmenova V. T., & Gjurovski, S. R. (2022). Periapical lesions: current modalities, *MEDIS - Medical Science and Research, 1*(1), 25-28. doi: 10.35120/medisij010125t UDK: 616.314.17-008.1

PERIAPICAL LESIONS: CURRENT MODALITIES

Verica Toneva Stojmenova[1], Sonja Rogoleva Gjurovski[1]

[1]Faculty of Medical Sciences, "Goce Delcev" University, Stip, Republic of North Macedonia,
e-mail: verica.stojmenova@ugd.edu.mk; sonja.rogoleva@gmail.com

Abstract: In cases with periapical lesions, there are two types of treatment modalities: noninvasive and invasive. The first one noninvasive is also known as nonsurgical or endodontic treatment. The second one – invasive method is surgical approach. In some cases, there is a need for combination of both aproaches. In everydays clinical treatment, the first choice is less invasive method and has better outcomes. Treatment of some periapical lesions (like cysts) are a theme of discussion and we do not have best option to treat them. The patient should make the definitive decision about the treatment. The doctor should inform him about the advantages and disadvantages of endodontic-noninvasive and surgical-invasive procedure. The therapeutic modalities for these pathologies are a wide range of treatment from endodontic treatment to different surgical options. We like to find out and present the best way about healing the periapical lesion. We wanted to know whenever surgical or non-surgical approach is better, and if using them might improve healing of those pathologies. The aim was clear and to reach it, we make an electronic search of medical and dental literature. We searched the following electronic databases: PubMed and Embase Ovid. Inclusion and exclusion criteria were used to reach the aim of this review study. We place restriction about language (only those articles that are written on English) and publication date (articles that are not older than 2010 year). We excluded duplicate article. We searched the references of the studies that we included for those review. We searched by hand the reference list of the studies and journals in the fields of endodontics and oral surgery. Every periapical lesion should firstly begin with good performed endodontic treatment. In some cases, there is a need for surgical approach of periapical pathologies because the endodontic treatment is not successful. Some cases might fail because of multipurpose factors such as: foreign body reaction, the size of the periapical lesion, biofilm, oral health and oral hygiene. A surgical approach is an option in cases when periapical lesion is large. Marsupialization might be the adequate option of treatment for those lesions in some cases. In cases with postoperative periapical lesion there is a need for surgical retrograde treatment. The procedure can be performed with hand endodontic instruments to make mechanical treatment of the root canal especially the part that is untreated. The advantages, disadvantages and modalities of treatment of periapical lesions are discussed in this review. According to these review there is no evidence that the first approach leads to better results compared to the second approach. This conclusion is based on electronic research of the literature database and clinical trials. There are several options for treatment to eliminate the clinical problems of periapical lesions but furder research is necessary. This review article is about the benefits of both approaches, and to determinate the best treatment modalities of cases with periapical pathologies, healing and postoperative quality of dental life.

Keywords: periapical lesions, endodontic treatment, surgical treatment.

INTRODUCTION

Periapical lesions (PAL) are pathological conditions that did not allow the bacteria to spread into the periapical tissues. PAL are commonly of endodontic origin and rarely of the pulp (Tsesis I., 2020). The majority of PAL are: granulomas, periapical cysts, or abscesses. Those lesions are radiolucent and that means we can detect them on RTG view. Cone beam computed tomography (CBCT) has better results about imaging the lesions because of the three-dimensional view (Pitcher B, 2017). In this study where 2030 cysts are analyzed, the prevalence of periapical cysts was 42% and the most common diagnosis were: cysts of the jaws. The majority of periapical lesions heal with the help of immune defense of the human, but in some cases, there is a need of therapeutic treatment. Nonsurgical and surgical treatment have high level of success of treating and healing them. Firstly, there is a need for less invasive methods that have better outcomes. All inflammatory periapical lesions should be initially treated with conservative nonsurgical procedures (Lin, 2007). Treatment of some periapical lesions (like cysts) are a matter of discussion and the best possible way to treat them is still optional depending of the characteristics of case. The patient should make the definitive decision about the treating process. The clinician should inform him about the advantages and disadvantages of endodontic-noninvasive and surgical-invasive procedure. The therapeutic aproaches for PAL are a wide range of treatment from endodontic treatment to different surgical options. The decision which therapy is better is often based on the experience of the

*Corresponding author: verica.stojmenova@ugd.edu.mk

doctor. More studies have assessed the relative importance of the different factors involved in the decision to perform periapical surgery (Şimşek-Kaya, 2018).

AIM

The purpose of this review study is: to find out and present the best way to treat and heal the periapical lesion. We wanted to know whenever surgical or non-surgical treatment is better, and to find out the new specific procedure for healing the periapical pathologies.

MATERIALS AND METHODS

SEARCH METHOD:

This article review was carried out by two electronic data researchers. The first one was the electronic database MEDLINE via PubMed and the second one was the electronic database Embase Ovid. Key words: “periapical lesions”, “endodontic treatment of periapical lesion” and “surgical treatment of periapical lesion” were entered in research zone. Inclusion and exclusion criteria were used to reach the aim of this review study.

SELECTION CRITERIA:

The inclusion criteria for the articles selection were: articles published after 2010, “full text” articles, literature review articles and research articles. “Case report” articles, articles with publication date prior to 2010 and duplicate articles were excluded. Also, we place restriction about language (only those articles that are written on English). Those were exclusion criteria.

We searched the references of the studies that are included. In addition, we searched by hand the references and journals in the fields of endodontics and oral surgery. We wanted to know whenever surgical or non-surgical approach is better, and if using them might improve healing of those pathologies.

DISCUSSION

The patients should make the definitive decision about the treatment. The clinician should help in this decision process by providing the relevant information. The patient should decide for treatment that the doctor mostly recommend (Prada, 2019). CBCT compared to two-dimensional imaging methods, can preview more details about the periapical pathosis (Kruse C, 2015), and can help in treatment process, no matter it is endodontic or surgical approach (Karabucak, 2016), especially low dose CBCT (Al-Haj Husain, 2021).

Patients decide for endodontic treatment because they feel less discomfort, there is no flaps and it is a minimally invasive technique (Karamifar, 2020). The bacteria, which are in root canal, play main role in the formation of periradicular pathosis.

It is possible, to stop bacteria to take part in periapical tissue, through non-surgical and non-invasive endodontic treatment. When first treatment option is endodontic, chlorhexidine is used. The role of it, is: root canal irrigant and an intracanal medicament (Naenni N, 2014).

In other study by Haapasalo, et al. (2014), is used NAOCL like intracanal irrigation and shown that the role of tissue dissolution is completed with Multisonic Ultracleaning System and has the fastest rate. (with the next protocol: 1.0% ± 0.1% per second using 0.5% NaOCl, 2.3% ± 0.9% per second using 3% NaOCl, and 2.9% ± 0.7% per second using 6% NaOCl). According to some researchers in the endodontic treatment, some systemic antibiotic therapy is needed to restrict the infection (Segura-Egea, 2017). Disinfection with diode laser could be more effective in combination with any other irrigant in treatment of periapical lesions (Bytyqi, 2021). In addition, ultrasonic devices versus handpiece burs, types of root-end filling material: gutta-percha, super-ethoxy benzoic acid, some restorative material, glass ionomer cement, mineral trioxide aggregate, are the most common used endodontic options when periapical pathosis are the cases. Del Fabbro et al. (2016) have shown that after one year following up, there was better result of healing when root canal filling is with MTA ending, than when they were with smoothing of orthograde root filling. (RR 1.60, 95% CI 1.14 to 2.24; one RCT, 46 participants; low quality evidence). This study has shown that CBCT is not rather than radiography for preoperative evaluation and his role in healing is not important. It should be noted when orthograde retreatment fails to provide predictable outcomes or cannot be performed. Some researchers claim endodontic surgery technique is the appropriate procedure for periapical lesions, and can be performed with ultrasonic or hand files to make mehanohemical processing of the untreated part of the canal (Alghamdi, 2020). Periapical surgery

is an endodontic procedure to treat periapical lesion, where firstly surgical flap is done. The treatment focuses on removing a part of a root with anatomical complexities and untreated part of the canal. It stops the bacteria to leak in the canal by sealing the root canal apically. It eliminate the apical part of the root canal, and remove the periapical lesion. The purpose was to optimize the conditions and to heal the PAL (Del Fabbro, 2016).

Root canal treatment fails in cases when the treatment is not done with the basic standards. In some cases with PAL, there is failure of the endodontic treatment, especially when lege artis is made, such as: ledges, zipping, and perforation. This is because of the interferation between uninstrumented part of the canal that is infected and the part with lege artis. (Lopes, 2010)

A study made by Metzger at al. (2010) compared the healing process of the technique of Apexum with the conventional root canal treatment. After three months, 87% of the periapical lesions completely healed. After six months, 95% of the lesions in the Apexum group showed advanced or complete healing. Apexum is minimally invasive removal of periapical chronically inflamed tissues through a root canal access to heal the periapical pathosis.

The surgical treatment options for periradicular lesions (cysts) include the enucleation of small lesions, marsupialization to decompress in case with large lesions and it can be combination of these two modalities (Consolo, 2020). Decompression relieves the pressure within a cyst.

Zubizarreta-Macho et al. (2022) has shown the use of bovine-derived and synthetic hydroxyapatite bone grafts in cases where bone loss is, because of periapical lesion. They make a comparative analyze of the clinical and radiographic results of bovine-derived and synthetic hydroxyapatite bone grafts after treatment with endodontic surgery.

In some cases, there are results of use of colostrum as a good biomaterial to fill the part where the bone defect is, after appropriate periapical invasive surgery (Veeramachaneni, 2017).

CONCLUSION

In cases with periapical pathologies, the current treatment modalities are: endodontic treatment and retreatment, periapical surgery, marsupialization and decompression. Those treatment aproaches show results of recovery and healing and elongate the dental life. In literature, there is a high success rate of nonsurgical treatment of periapical lesions. First option of treatment before we decide to surgery should be nonsurgical approach.

This knowledge would not only help clinicians about the decision for endodontic treatment and realization. Some pathological conditions has remained a matter of discussion because we do not have best option to treat them. The main problem is that, in most cases, there is a need for surgical treatment after endodontic failure treatment. There is no clear evidence in the literature, of superiority of the first or of the second option in healing and recovery period of dental life. Further research is necessary to complete the imagine about the surgical or non-surgical approaches, and to make a decision about which surgical procedures provide quality dental life.

Conflict of interests

The author declares no conflict of interest.

REFERENCES

Alghamdi, F., Alhaddad, A. J., & Abuzinadah, S. (2020). Healing of Periapical Lesions After Surgical Endodontic Retreatment: A Systematic Review. Cureus, 12(2), e6916. https://doi.org/10.7759/cureus.6916

Al-Haj Husain, A., Döbelin, Q., Giacomelli-Hiestand, B., Wiedemeier, D. B., Stadlinger, B., & Valdec, S. (2021). Diagnostic Accuracy of Cystic Lesions Using a Pre-Programmed Low-Dose and Standard-Dose Dental Cone-Beam Computed Tomography Protocol: An Ex Vivo Comparison Study. Sensors (Basel, Switzerland), 21(21), 7402. https://doi.org/10.3390/s21217402

Bytyqi, A., Aliu, X., Barani, M., Stubljar, D., Jukic, T., Starc, A., & Krasniqi, S. (2021). Disinfection of Infected Artificial Dental Periapical Lesions with Diode Laser: An In Vitro Study. Medical science monitor basic research, 27, e932492. https://doi.org/10.12659/MSMBR.932492

Consolo, U., Bellini, P., Melini, G. M., Ferri, A., & Lizio, G. (2020). Analysis of Marsupialization of Mandibular Cysts in Improving the Healing of Related Bone Defects. Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons, 78(8), 1355.e1–1355.e11. https://doi.org/10.1016/j.joms.2020.02.034

Del Fabbro, M., Corbella, S., Sequeira-Byron, P., Tsesis, I., Rosen, E., Lolato, A., & Taschieri, S. (2016). Endodontic procedures for retreatment of periapical lesions. The Cochrane database of systematic reviews, 10(10), CD005511. https://doi.

org/10.1002/14651858.CD005511.pub3
Del Fabbro, M., Corbella, S., Sequeira-Byron, P., Tsesis, I., Rosen, E., Lolato, A., & Taschieri, S. (2016). Endodontic procedures for retreatment of periapical lesions. The Cochrane database of systematic reviews, 10(10), CD005511. https://doi.org/10.1002/14651858.CD005511.pub3
Haapasalo, M., Wang, Z., Shen, Y., Curtis, A., Patel, P., & Khakpour, M. (2014). Tissue dissolution by a novel multisonic ultracleaning system and sodium hypochlorite. Journal of endodontics, 40(8), 1178–1181. https://doi.org/10.1016/j.joen.2013.12.029
Karabucak, B., Bunes, A., Chehoud, C., Kohli, M. R., & Setzer, F. (2016). Prevalence of Apical Periodontitis in Endodontically Treated Premolars and Molars with Untreated Canal: A Cone-beam Computed Tomography Study. Journal of endodontics, 42(4), 538–541. https://doi.org/10.1016/j.joen.2015.12.026
Karamifar, K., Tondari, A., & Saghiri, M. A. (2020). Endodontic Periapical Lesion: An Overview on the Etiology, Diagnosis and Current Treatment Modalities. European endodontic journal, 5(2), 54–67. https://doi.org/10.14744/eej.2020.42714
Kruse, C., Spin-Neto, R., Wenzel, A., & Kirkevang, L. L. (2015). Cone beam computed tomography and periapical lesions: a systematic review analysing studies on diagnostic efficacy by a hierarchical model. International endodontic journal, 48(9), 815–828. https://doi.org/10.1111/iej.12388
Lin, L. M., Huang, G. T., & Rosenberg, P. A. (2007). Proliferation of epithelial cell rests, formation of apical cysts, and regression of apical cysts after periapical wound healing. Journal of endodontics, 33(8), 908–916. https://doi.org/10.1016/j.joen.2007.02.006
Lo Muzio, L., Mascitti, M., Santarelli, A., Rubini, C., Bambini, F., Procaccini, M., Bertossi, D., Albanese, M., Bondì, V., & Nocini, P. F. (2017). Cystic lesions of the jaws: a retrospective clinicopathologic study of 2030 cases. Oral surgery, oral medicine, oral pathology and oral radiology, 124(2), 128–138. https://doi.org/10.1016/j.oooo.2017.04.006
Lopes, H. P., & Siqueira Junior, J. F. (2010). Endodontia: biologia e técnica. In Endodontia: biologia e técnica (pp. 951-951).
Metzger, Z., Huber, R., Slavescu, D., Dragomirescu, D., Tobis, I., & Better, H. (2010). Healing kinetics of periapical lesions enhanced by the apexum procedure: a clinical trial. Journal of endodontics, 35(2), 153–159. https://doi.org/10.1016/j.joen.2008.11.019
Naenni, N., Thoma, K., & Zehnder, M. (2014). Soft tissue dissolution capacity of currently used and potential endodontic irrigants. Journal of endodontics, 30(11), 785–787. https://doi.org/10.1097/00004770-200411000-00009
Pitcher, B., Alaqla, A., Noujeim, M., Wealleans, J. A., Kotsakis, G., & Chrepa, V. (2017). Binary Decision Trees for Preoperative Periapical Cyst Screening Using Cone-beam Computed Tomography. Journal of endodontics, 43(3), 383–388. https://doi.org/10.1016/j.joen.2016.10.046
Prada, I., Micó-Muñoz, P., Giner-Lluesma, T., Micó-Martínez, P., Collado-Castellano, N., & Manzano-Saiz, A. (2019). Influence of microbiology on endodontic failure. Literature review. Medicina oral, patologia oral y cirugia bucal, 24(3), e364–e372. https://doi.org/10.4317/medoral.22907
Ricucci, D., & Siqueira, J. F., Jr (2010). Biofilms and apical periodontitis: study of prevalence and association with clinical and histopathologic findings. Journal of endodontics, 36(8), 1277–1288. https://doi.org/10.1016/j.joen.2010.04.007
Segura-Egea, J. J., Gould, K., Şen, B. H., Jonasson, P., Cotti, E., Mazzoni, A., Sunay, H., Tjäderhane, L., & Dummer, P. (2017). Antibiotics in Endodontics: a review. International endodontic journal, 50(12), 1169–1184. https://doi.org/10.1111/iej.12741
Şimşek-Kaya, G., Saruhan, N., Yapıcı-Yavuz, G., & Ertaş, Ü. (2018). A decision analysis for periapical surgery: Retrospective Study. Journal of clinical and experimental dentistry, 10(9), e914–e920. https://doi.org/10.4317/jced.53334
Tsesis, I., Krepel, G., Koren, T., Rosen, E., & Kfir, A. (2020). Accuracy for diagnosis of periapical cystic lesions. Scientific reports, 10(1), 14155. https://doi.org/10.1038/s41598-020-71029-3
Veeramachaneni, C., Gayathri, C., Kakani, A. K., & Mohini, R. (2017). Use of bovine colostrum in periapical defects following surgical endodontics: Two case reports. Journal of conservative dentistry : JCD, 20(5), 374–377. https://doi.org/10.4103/JCD.JCD_411_15
Yee, K., Bhagavatula, P., Stover, S., Eichmiller, F., Hashimoto, L., MacDonald, S., & Barkley, G., 3rd (2018). Survival Rates of Teeth with Primary Endodontic Treatment after Core/Post and Crown Placement. Journal of endodontics, 44(2), 220–225. https://doi.org/10.1016/j.joen.2017.08.034
Yu, V. S., Messer, H. H., Yee, R., & Shen, L. (2012). Incidence and impact of painful exacerbations in a cohort with post-treatment persistent endodontic lesions. Journal of endodontics, 38(1), 41–46. https://doi.org/10.1016/j.joen.2011.10.006
Zubizarreta-Macho, Á., Tosin, R., Tosin, F., Velasco Bohórquez, P., San Hipólito Marín, L., Montiel-Company, J. M., Mena-Álvarez, J., & Hernández Montero, S. (2022). Influence of Guided Tissue Regeneration Techniques on the Success Rate of Healing of Surgical Endodontic Treatment: A Systematic Review and Network Meta-Analysis. Journal of clinical medicine, 11(4), 1062. https://doi.org/10.3390/jcm11041062