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The evolution of periodontology in the 19th and 20th century

Razvoj parodontologije u 19. i 20. veku

Verica Pavlić*†, Tijana Adamović*, Smiljka Cicmil‡, Danijela Staletović§, Saša Dabić‖, Zlata Brkić¶, Zdenka Stojanović¶

***University of Banja Luka, Faculty of Medicine, Department of Periodontology and Oral Medicine, Banja Luka, Republic of Srpska, Bosnia and Herzegovina; †Republic of Srpska Institute of Dentistry, Department of Periodontology and Oral Medicine, Banja Luka, Republic of Srpska, Bosnia and Herzegovina; ‡University of East Sarajevo, Faculty of Medicine, Department of Oral Rehabilitation, Banja Luka, Republic of Srpska, Bosnia and Herzegovina; §University of Priština/Kosovska Mitrovica, Faculty of Medicine, Clinic for Dentistry, Kosovska Mitovica, Serbia; ‖Specialist Clinic in Oral Surgery "Implantodent Dr. Saša Dabić", Banja Luka, Republic of Srpska, Bosnia and Herzegovina; ¶Military Medical Academy, Clinic for Dentistry, Belgrade, Serbia**

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Introduction

Periodontology in the 19th century

The 19th century was the time when possible etiology and, therefore, prevention and treatment of periodontal disease have been proposed. Furthermore, the gained knowledge was transferred to clinical practice through the development of techniques and instruments for curettage, debridement, and scaling. This was the time when periodontal surgery started.

Leonard Koecker (1785–1850) was a dentist originally from Germany who later practiced in Baltimore (Figure 1) and emphasized the importance of dental health in his work [1]. In a paper published in the "Philadelphia Journal of Medicine and Physical Sciences" in 1821, he highlighted the inflammatory changes in the gums and the presence of tartar on teeth, which could lead to tooth loss. Koecker believed that poor dental health was linked to various disorders. His influential book *Principles of Dental Surgery*, released in 1826, advocated for the use of astringent powder and a horsehair toothbrush and a toothbrush placing bristles at the spaces of the teeth after each meal to maintain oral hygiene. He also supported the odontogenic focal infection theory early on, recommending the extraction of severely affected teeth and roots to prevent systemic infections [2]. Even though Koecker advocated for adequate oral hygiene practice, Levi Spear Parmly (1790–1859) was considered the father of oral hygiene and the inventor of the oral floss [3].

Fig. 1 – Leonard Koecker [1].

John Mankey Riggs (1811–1885) was the leading figure in the study of periodontal disease, and at that time, periodontal disease was commonly known as "Riggs' disease". Born in Seymour, Connecticut, Riggs was often credited as the first to practice exclusively in periodontics,

Correspondence to: Verica Pavlić, University of Banja Luka, Faculty of Medicine, Department of Periodontology and Oral Medicine, Bulevar Petra Bojovica 1a 50, 78 000 Banja Luka, Republic of Srpska, Bosnia and Herzegovina. E-mail: verica.pavlic@med.unibl.org

thus marking him as the pioneer and the first specialist in this field (Figure 2) [4]. Riggs believed that periodontitis was an inflammatory response of gingiva to present subgingival calculus that caused necrosis and resorption of alveolar bone, eventually leading to pocket formation, increased tooth mobility, and loss. Riggs' publications strongly advocate for what is known as the conservative approach to periodontal therapy, which prioritizes oral prophylaxis and prevention [5]. Riggs emphasized the importance of maintaining oral cleanliness and opposed surgical interventions such as gingival resections, which were prevalent during his time [5, 6]. Riggs designed a series of six hand instruments that were not sophisticated and suitable for fine scaling. At a meeting of the Connecticut Valley Dental Association in 1867, Riggs delivered a presentation deemed fundamental in educating participants about his understanding of periodontal disease and the treatment methods he advocated for. His work was followed by L. Taylor, D. D. Smith, R. B. Adair, and W. J. Younger [2]. Riggs passed away in 1885 after a short respiratory illness [6].

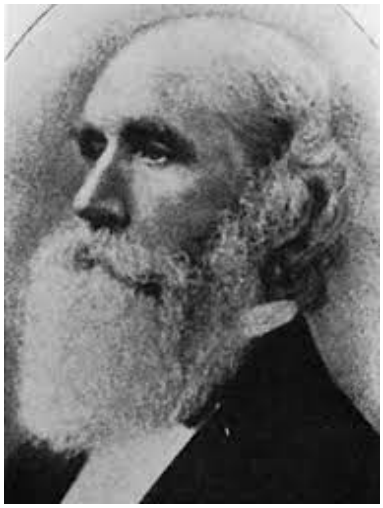

Fig. 2 – John M. Riggs [4].

William John Younger (1838–1920) proposed the concept of "dento-gingival reattachment", the development of granulation tissue following surgery. He also designed the scaling instruments that have served as a basis for modern instruments still in use today [2].

Greene Vardiman Black (1863–1915) was born in Winchester, Illinois (Figure 3) [7]. Even though he was an American pathologist, he made significant contributions to restorative dentistry. These contributions included the concept of polymicrobial nature and pathogenesis of dental caries, the design of cavity preparations, the development of alloys, and the invention of a foot-powered dental handpiece. However, his work had significant importance in the area of periodontology, too. His book *Special Dental Pathology* outlined a practical approach to diagnosing and treating periodontal disease with a particular focus on the detection of the early signs of periodontal disease. Black is often called the father of modern dentistry, sharing this title with Fauchard [2].

During the 19th century, many dental practitioners had limited formal training and lacked a comprehensive understanding of physiology. Dental clinicians, like Koecker [1], Riggs [4], and Black [7], believed that dental calculus played an important role in the development of inflammation and, consequently, periodontal disease. However, at that time, there was no universal consensus regarding this matter. Due to the lack of a precise understanding of the etiology of periodontal disease, therapy approaches ranged from teeth deposit removal, gingival massage, and dietary changes to teeth extraction.

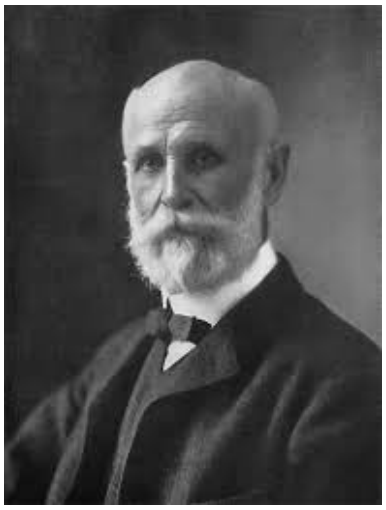

Fig. 3 – Greene V. Black [7].

Adolf Witzel (1847–1906) was the first to identify periodontal bacteria, but the pioneer of oral microbiology was Willoughby Dayton Miller (1853–1907) from Alexandria, Ohio. He practiced dentistry in Berlin, Germany, and collaborated in the laboratory of Robert Koch. Robert Koch was a follower of the theory of bacterial etiology of many diseases, such as pneumonia, cholera, puerperal fever, diphtheria, meningitis, plague, dysentery, and syphilis [2]. Miller transferred the knowledge he gained from Koch and his collaborators in the area of dentistry, and he was soon named the "father of dental prevention". He described the features of periodontal disease and their contribution to the disease development in his work titled *The Microorganisms of the Human Mouth*, in 1890, Miller outlined the features of periodontal disease and proposed the "non-specific plaque hypothesis". He believed that periodontal disease was not caused by one, but many bacterial species present normally in the oral cavity. Miller was among the first to suggest that antiseptics applied topically or *via* mouth rinsing might be useful in the treatment of periodontal diseases [5]. Although Miller did not identify and differentiate oral plaque [2], James Leon Williams (1852–1932) later did. Williams was the founder of the plaque hypothesis and described dental plaque as a "gelatinous accumulation of bacteria adhering to the enamel surface" [2]. However, he did not give evidence linking bacterial plaque to periodontal disease, but he laid the groundwork for this theory, which became mainstream 75 years later [5].

Joseph Lister (1827–1912) of England transferred the knowledge about microorganisms to the clinical and surgical practice and started the era of antiseptics (and later asepsis) in surgery [8].

French physician Jean Hyacinthe Vincent (1862–1950) identified the spirochete (*Borrelia vincentii*) and fusiform bacilli (*Bacillus fusiformis*) that are now associated with Vincent's angina [2, 5, 6]. In 1904, Vincent observed these microorganisms in cases of acute infection of the oral soft tissues, including the tonsils and pharynx, which he termed ulceronecrotic gingivitis [6].

Moritz Károlyi (1865–1945) published an original idea attributing a possible role of dental occlusion and trauma from occlusion in the etiopathogenesis of periodontal diseases. In the second half of the 19th century, there were several very important findings, which are described in the text that follows [5].

Invention of anesthesia

Horace Wells (1815–1848) was the first to use nitrous oxide anesthesia in 1844, and that was the first application of anesthesia to surgery. William Green Morton (1819–1868) used a combination of nitrous oxide and ether in 1846 in Boston. In 1905, Munich chemists Alfred Einhorn and Richard Willstätter introduced procaine [2, 5]. The combination of already-known local anesthesia with epinephrine (adrenaline), what quickly became a golden standard in local anesthesia, was introduced by Thomas Bell Aldrich (1861–1938) and Jōkichi Takamine (1854–1922) [9].

Invention of X-ray method

The discovery of radiographs was credited to the German physicist Wilhelm Conrad Röntgen, who lived from 1845 to 1923 (Figure 4) [10]. Charles Edmund Kells Jr. (1856–1928) was the first to demonstrate the use of Röntgen X-rays in dentistry in 1896 and the first to use dental X-ray on patients. The use of dental X-rays eventually led to the amputation of Kells' left arm. He is known as a person who introduced an era of accurate diagnosis of dental pathology. This invention, along with the discovery of anesthetics, dramatically changed the history of dentistry [2].

Fig. 4 – Wilhelm Conrad Röentgen [10].

Establishment of the first dental school

In 1840, Horace H. Hayden and Chapin A. Harris founded the first dental school named Baltimore College of Dental Surgery opened in Baltimore, Maryland [11].

Periodontology in the 20th century

Etiology of periodontal disease

In the 20th century, periodontics thrived in Europe, particularly in two leading centers: Vienna and Berlin. In Vienna, Bernhard Gottlieb (1885–1950) conducted extensive microscopic studies on human periodontal disease. He emphasized that merely removing calculus and other deposits was not enough; it was also crucial to eliminate the periodontal pocket. Gottlieb's scientific work sought to explain the biology of cementum, the tooth-eruption process, gingival epithelium attachment to the tooth, and traumatic occlusion. Balint J. Orban (1899–1960), a younger colleague of Gottlieb, continued his work and expanded his knowledge through detailed histological studies. In Berlin, prominent figures in periodontology included Oskar Weski (1879–1952) and Robert Neumann (1882–1958). Weski introduced the concept of the periodontium and its components: cementum, gingiva, alveolar bone, and the periodontal ligament. He also conducted pioneering studies on the relationship between histopathological changes in periodontal disease and radiographic images [12].

From the 1950s onward, the United States and Scandinavia played a leading role in both basic and clinical periodontal research, achieving significant progress in experimental pathology, microbiology, and immunology. Irving Glickman (1914–1972) emerged as a leading researcher in the United States during this period, while Jens Waerhaug (1907–1980) of Oslo, Norway, was a key figure in Scandinavia. His dissertation, *The gingival pocket; anatomy, pathology, deepening and elimination*, published in 1952, marked the beginning of a new era in understanding the biology of the periodontium [13-15]. The researchers at that time knew that the cause of periodontal disease was chronic inflammation, probably on the clinical and histologic levels. However, there was insufficient data for understanding inflammation or inflammation-resolving mechanisms to explain the etiology of periodontal disease [15].

The first experimental gingivitis studies conducted by Harald Löe (1926–2008) and his Scandinavian colleagues in the mid-1960s brought about a significant paradigm shift in the understanding of periodontal disease among both scientists and clinicians. Their research uncovered a robust correlation between the accumulation of dental plaque and the onset of periodontal disease in dogs. Furthermore, their findings illustrated that maintaining a daily tooth-brushing regimen was closely linked with the presence of clinically healthy periodontal tissues. As a consequence, teeth that

were not cleaned regularly developed gingival inflammation and, ultimately, periodontal disease. Subsequent research by other investigators further validated these results, indicating that experimental gingivitis in the majority of dogs progressed to periodontitis within four years if dental plaque was not removed on a daily basis [13-15].

Inspired by these findings, many clinical studies regarding the etiology and microbiology of periodontal disease were conducted [13]. Among many findings, the most significant ones were related to the presence of aerobic and anaerobic bacteria as causative agents of periodontal infection. It became clear that bacteria such as *Aggregatibacter* (formerly *Actinobacillus*) *actinomycetemcomitans*, *Tannerella forsythia*, *Porphyromonas gingivalis*, *Treponema denticola*, *Campylobacter rectus*, *Streptococcus intermedius*, and *Prevotella intermedia* were key members of the consortium of microorganisms responsible for periodontal disease. By the late 1990s, emerging evidence indicated that the intensity of inflammation and susceptibility to periodontal damage resulting from microbial challenges were influenced by the host response, which encompassed genetic polymorphisms [12, 16].

Treatment of periodontal disease

At the beginning of the 20th century, two major approaches to treating periodontal disease emerged. One approach continued to follow the beliefs of Riggs and William J. Younger that periodontal disease is caused by local irritation from dental calculus [12, 16]. They advocated for rigorous oral hygiene measures and were against gingival resection as a surgical approach. They believed that surgical intervention should be the last choice used in advanced cases only. The second approach defined the use of surgical resection of periodontal pockets followed by curettage of the underlying bone. The main goal of mechanical periodontal therapy was to efficiently clean the root surface. That concept was generally accepted. Later, mechanical periodontal therapy was enhanced by the application of antiseptics and antimicrobials as adjuncts, as they were found to be insufficient in eliminating periopathogens when used alone. At the same time, many microbiologists raised concerns about the possibility of microbial resistance to antibiotics, allergic reactions, and gastrointestinal disturbances. Consequently, topically applied antiseptics, particularly chlorhexidine, deserved their position as highly effective in the treatment and prevention of gingivitis [16].

As the field of periodontology advanced, periodontists began to utilize periodontal flap procedures, either alone or in conjunction with the insertion of bone-replacement graft materials, to address periodontal issues [12, 16]. Robert Neumann from Berlin and Leonard Widman (1871–1956) from Sweden first described flap surgery in detail, including osseous recontouring. A significant development in periodontal regeneration occurred with the introduction of guided tissue regeneration (GTR) procedures introduced in 1982. Sture Nyman and his colleagues were pioneers in a technique that involved placing a barrier membrane between the periodontal flap and a tooth slated for extraction in a patient with severe periodontitis. This method effectively excluded the gingival epithelium and connective tissue from the osseous defect, enabling pluripotent cells from the periodontal ligament to populate the wound. Histological studies showed the formation of new cementum, bone, and a functional periodontal ligament as a result of this approach [16].

Over the past two decades, researchers have refined the basic GTR approach by incorporating growth and differentiation factors, demonstrating an enhanced regenerative potential for periodontal tissues [12, 16]. Moreover, during the past two decades, researchers refined the basic GTR approach using growth and differentiation factors demonstrating enhanced regenerative potential of the periodontal tissues. While GTR has shown promise in regenerating the periodontium, achieving a completely normal periodontal status has not yet been achieved [16, 17].

Establishment of periodontal organizations

In 1914, in Cleveland, America, doctors Gillette Hayden (1880–1929) and Grace Roger Spalding (1881–1953) spearheaded the establishment of the first national organization, the American Academy of Oral Prophylaxis and Periodontology, which was later, in 1919, renamed the American Academy of Periodontology (AAP). The AAP focused on patient care, particularly the diagnosis and treatment of periodontal disease, while also promoting research and scientific development [5]. In 1930, the AAP launched "The Journal of Periodontology", and subsequently, several other journals were introduced, including "The Journal of Periodontal Research" (1966), "The Journal of Clinical Periodontology" (1974), "International Journal of Periodontics and Restorative Dentistry" (1981), and "Periodontology 2000" (1993). In Europe, in 1991, the European Federation of Periodontology (EFP) was founded. These organizations serve as a vital link between clinical and research centers with dental schools and private practitioners [14].

During the 1920s, the first peer-reviewed scientific journal dedicated to periodontal disease was initiated. Shortly after its inception, the journal began publishing randomized clinical trials to promote an evidence-based approach to clinical practice, thanks to the efforts of Sigurd P. Ramfjord and his team. Inspired by their work, many other scientists throughout the world conducted their own clinical investigations in an attempt to replicate their results [14, 15].

In 1947, periodontics was recognized as a specialty of dentistry by the American Dental Association [11].

Effects of periodontal disease on general health

In 1828, Riggs recognized the role of oral sepsis in rheumatic and other diseases. Later on, researchers revisited the idea that untreated periodontal infections might negatively impact overall health, potentially leading to conditions such as diabetes mellitus, myocardial infarction, stroke, and adverse pregnancy outcomes. Additionally, there

is growing evidence suggesting that other diseases may also contribute to the development of periodontal disease (bidirectional relationship). However, as of now, the precise relationship between periodontal disease and general health, the underlying risk factors, and the mechanisms involved remain unclear [16].

Implantology

In 1913, Edwin J. Greenfield, an American dentist, demonstrated the inaugural modern and effective dental implant, which laid the foundation for the flourishing implant dentistry we have today. The introduction of the first commercially viable water-driven turbine drill in 1953, pioneered by American dentist Robert Nelson, marked the beginning of the high-speed dental drill era. The Borden air-turbine drill, introduced in 1957 and now universally utilized by dentists, has significantly enhanced patient comfort and control during dental procedures [8, 12]. Per-Ingvar Brånemark (1929–2014) was a Swedish physician and researcher known as the "father of modern dental implantology" [12,16].

Conclusion

Clearly, we have learned a lot about periodontal disease and therapy over the past years. The major breakthroughs were the understanding of periodontal inflammation, fundamental microbiology in identifying and altering biofilms, and regeneration of periodontal structures. Further, implantology will continue to develop. As a result, it will be possible to expect healthy and functional dentition for a lifetime. The collaboration between researchers, clinicians, and educators remains crucial in advancing the understanding and management of periodontal diseases.

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