

# Foundations of fluoride prophylaxis in Poland and the prosthetic rehabilitation of the masticatory organ in arthropathies and malocclusion: Scientific achievements of Professor Noemi Wigdorowicz-Makowerowa

## Podwaliny profilaktyki fluorkowej w Polsce oraz rehabilitacji protetycznej narządu żucia w artropatiach i w wadach zgryzu – dorobek naukowy Profesor Noemi Wigdorowicz-Makowerowej

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### Abstract

Professor Noemi Wigdorowicz-Makowerowa was born in Warsaw to a Polish Jewish family on November 24, 1912. She graduated from the Medical University of Warsaw in 1937 and from the Academy of Dentistry in 1939. In early 1940, she was forcibly relocated to the Warsaw Ghetto, from which she escaped in January 1943. Shortly after the Second World War, in 1946, she started working at Wrocław University. She conducted multiple studies there on the fluoride prophylaxis of caries, and on temporomandibular joint arthropathy and its etiology. She proved the efficiency of tap water fluoridation in caries prevention through a comparative study on children from schools in Wrocław and Malbork, where the fluoride concentrations were 0.1 mg/L and 3.2 mg/L, respectively. The incidence of deep caries and the rate of tooth mortality were significantly lower in Malbork. Her long-term studies on the fluoride prophylaxis of caries prompted Professor Wigdorowicz-Makowerowa to found the Scientific and Technical Team for Fluoride Prophylaxis, based at the Department of Dental Prosthetics in the Institute of Dentistry of Wrocław Medical University, which led to the creation of 35 fluoride water treatment plants in Poland by 1980. Moreover, she emphasized that malocclusion caused by dental caries and tooth loss, bruxism, higher susceptibility to stress, and increased muscle tone may constitute reasons for masticatory organ disorders. In her long career of over 30 years, she published 68 articles about fluorine and its use in dentistry, and 50 articles about temporomandibular joint arthropathy and other masticatory organ disorders.

**Key words:** caries, fluoride prophylaxis, temporomandibular joint disorders

**Słowa kluczowe:** próchnica, profilaktyka fluorkowa, zaburzenia stawu skroniowo-żuchwowego

## Introduction

In the etiology of dental caries, 4 factors are considered to be significant: the presence of dental plaque with bacteria, the supply of substrates for bacteria – mainly sucrose – the susceptibility of the tooth surface to acids, and the time in which all these factors work together.<sup>1,2</sup> In order to prevent tooth decay, it is enough to remove just one of these factors. This can be accomplished, for example, by frequent tooth brushing and regular plaque removal, eliminating sucrose from the diet, reducing bacterial metabolism, or reducing tooth susceptibility by strengthening its structure with fluoride compounds. The discovery that fluorine inhibits tooth decay is one of the greatest achievements in caries prevention. Fluorine itself acts endogenously at the stage of enamel formation and strengthens its structure from the very beginning; it also works exogenously, enhancing the remineralization of enamel and weakening carbohydrate metabolism by caries-forming bacteria.<sup>3</sup> The progression of caries without proper treatment leads to tooth loss, which affects not only the condition of the masticatory organ, facial esthetics and the development of disorders in the temporomandibular joints, but also the well-being of the individual and the health of their whole body.<sup>4,5</sup>

The aim of the article is to present the biography and the most important achievements of an outstanding Polish doctor and dentist, Professor Noemi Wigdorowicz-Makowerowa, who devoted her scientific career to the subject of fluoride prophylaxis in dental caries, the prosthetic rehabilitation of the masticatory organ in temporomandibular joint disorders (TMD) and malocclusion, and the education of the Polish society in the field of oral hygiene.

## Methodology

We searched for articles which mention all the achievements of Professor Noemi Wigdorowicz-Makowerowa.<sup>6</sup> We included articles that were in Polish or English and concerned fluorine and arthropathy. We found 68 articles about fluorine and 50 about temporomandibular joint arthropathy. Six of these 118 articles were excluded, because they were written in German or French. From the remaining 112 articles written in Polish or English, we excluded 84 articles, because they covered the same research, they were the same articles published in Polish or English, the topic was not crucial, or they were post-conference materials or articles about the achievements of employees. We then searched Jagiellonian University Library for the articles, of which 23 were available. Only 1 out of 8 monographs was available.

## Biography

Professor Noemi Wigdorowicz-Makowerowa was born in Warsaw to a Polish Jewish family on November 24, 1912. In 1930, she graduated from the Zofia Kalecka gymnasium and – following family tradition – she began studies at the Department of Medicine of the Józef Piłsudski Medical University in Warsaw in 1931. After 6 years, on June 22, 1937, she obtained her medical degree. Shortly afterward, she started studying at the Academy of Dentistry, also in Warsaw, and graduated in 1939. That same year, on January 28, she registered at the Warsaw-Białystok Medical Chamber and accepted a job at the Warsaw Academy of Dentistry.<sup>7,8</sup>

Shortly after the outbreak of World War II – at the beginning of 1940 – in accordance with the ordinance of the General Governor, she was forcibly relocated to the Warsaw Ghetto. There, she started working at the Department of Surgery in the Orthodox Jewish Hospital in Czyste under the supervision of Dr. Alexander Wertheim. In addition, she was responsible for running a dental clinic in an outpatient department for the Jewish community. In the summer of 1942, during *Grossaktion Warschau* – the operation which liquidated the ghetto – she married Dr. Henryk Makower (1904–1964), with whom she escaped from the ghetto in January 1943. Then, for over a year, the couple hid in the family home of Janusz Tadeusz Urzykowski in Nowa Miłosna, near Warsaw.<sup>9,10</sup> In August 1944, she and her husband joined the Polish Army in Lublin, where she worked in the Evacuation Hospital as a dental consultant and assistant at the Surgical Department.<sup>8,11</sup>

In 1946, she was dismissed from military service and at the invitation of Prof. Ludwik Hirszfeld, MD, PhD (1884–1954), dean of the Faculty of Medicine at Wrocław University, she took up the post of senior assistant there. Initially, she worked at the Clinic of Dental Surgery under the supervision of Professor Tadeusz Szczęsny Owiński (1904–1995), later moving to the Clinic of Conservative Dentistry, which was headed by Professor Ignacy Pietrzycki (1885–1964). After 2 years, on September 2, 1948, she started working as a senior assistant at the Department of Prosthodontics of Dental Division under the leadership of Professor Henryk Gorczyński. On December 28, 1948, based on a dissertation entitled “Infectious Gingivitis and Oral Mucositis with Particular Emphasis on Fusospirochetosis and its Treatment Applying the Author’s Own Method”, supervised by Professor Witold Grabowski (1902–1963), she earned the degree of PhD in Medicine.<sup>8</sup>

From May 1959 to August 1960, she volunteered at École Dentaire in Geneva, Switzerland. There, she had an opportunity to observe and train alongside prominent dentists, such as professors Arthur-Jean Held, Louis Joseph Baume and Francois Ackermann.<sup>8</sup>

Her scientific achievements and undertaking a series of studies on dental prophylaxis using fluorine enabled her to start a post-doctoral habilitation procedure at the Faculty of Medicine of the Medical University of Lodz. On January 12, 1963, based on her habilitation dissertation, “The Development and Fluoride Prophylaxis of Tooth Decay in Children”, Noemi Wigdorowicz-Makowerowa, PhD was awarded the academic degree of assistant professor.<sup>7</sup>

On April 1, 1964, she was appointed full-time assistant professor at the Department of Prosthodontics of Wrocław Medical University by Jerzy Sztachelski, PhD, the then Minister of Health and Social Care. On December 1, she obtained the title of associate professor of Wrocław Medical University. On May 1, 1965, she assumed the position of Head of the Department of Prosthodontics at Wrocław Medical University, which she held until she retired on September 30, 1983. Professor Noemi Wigdorowicz-Makowerowa died on February 7, 2015 in Stockholm.

## Fluoride prophylaxis introduced by Prof. Noemi Wigdorowicz-Makowerowa

Fluorine, like any other element, exerts a dose-dependent influence, which is why it can be stated to have both beneficial and harmful effects on human health. The first laboratory tests on the use of fluorine in the prophylaxis of oral contagious diseases were conducted by Gerald J. Cox, who proved that small doses of fluoride, applied to drinking water given to rats, significantly improved oral health.<sup>12</sup> Grand Rapids, Michigan, USA, became the first city in the world to introduce fluoride water treatment on January 25, 1945. The aforementioned study was initiated by Henry T. Dean and Francis A. Arnold Jr., who also jointly investigated the optimal dose of fluorine in drinking water. After carrying out a number of prospective studies, they proposed a safe dose of 1 mg/L fluorine in water.<sup>13</sup> Ten years after the implementation of water fluoridation in Grand Rapids, F.A. Arnold Jr. conducted a comprehensive analysis of dentition among children aged 4–16 years, which proved that the prevalence of caries was reduced by 60–65% in comparison with the baseline data.<sup>14</sup>

As early in 1948, Professor Wigdorowicz-Makowerowa took up the subject of applying fluorine in the prophylaxis of caries. In her publications on arthropathy and myoarthropathy, she repeatedly emphasized the impact of tooth decay and tooth loss on the development of these disorders.<sup>15</sup> In her article “Problem of fluorine in stomatology”, Professor described the methods of caries prevention that were in use at the time, consisting of oral hygiene, the reduction of carbohydrate intake in the diet, and the early

treatment of dental caries.<sup>16</sup> She considered all of these activities to be definitely insufficient in relation to the entire population, both Polish and global. Professor Wigdorowicz-Makowerowa advocated more decisive steps to combat tooth decay. She was in favor of fluoridating tap water, drinking water and kitchen salt, and of applying topical fluoride salts to the teeth. She believed that only a combination of these 2 methods and their application to the entire population could contribute to improved dental health in society.<sup>16,17</sup>

In 1946, the Polish Ministry of Health commissioned the National Institute of Hygiene in Warsaw to conduct tests of fluorine concentration in tap water all over the country. An accurate fluorine map was prepared, which showed that the level of fluorine exceeded 1 mg/L in only 8 cities, and that in 6 cities, the level varied between 0.5–1 mg/L.<sup>18</sup> The aforementioned studies revealed that the concentration of fluorine in tap water was very low in Poland. Professor Wigdorowicz-Makowerowa decided to compare the teeth of schoolchildren from Malbork (where the natural level of fluorine in water was 3.2 mg/L) with ones from Wrocław (0.1 mg/L).<sup>19</sup> The condition of their teeth was determined using the indicator DMF (D – decayed, M – missing, F – filled) and a modified version, DMF-N, which is an indicator of superficial caries that does not require treatment. In the years 1955 and 1956, 5,864 schoolchildren aged 7–13 years were examined in Wrocław. These children constituted a random sample selected from the entire population of children at this age living in Wrocław. In 1958, 1,417 children aged 7–13 years who were born and attended schools in Malbork were examined. The percentage of children with caries, determined by the DMF index, increased with age – in Wrocław, from 73% at the age of 7 to 97% at the age of 13, and in Malbork from 49% to 90%, respectively. Also, the percentage of children with superficial caries, as determined by the DMF-N index, increased with age: in Wrocław, from 49% at the age of 7 to 94% at the age of 13, and in Malbork from 19% to 74%, respectively. In addition, the average tooth mortality rate in all age groups in Wrocław was significantly higher than in Malbork. The corresponding average values in Wrocław ranged from 0.33 at the age of 10 to 0.90 at the age of 13. In Malbork, tooth mortality also increased with age, although in the first 12 years of life it constituted only a small fraction and at the age of 13 it represented an average of 0.16. In the conclusion of the study, Professor Wigdorowicz-Makowerowa stated that the results clearly proved the protective effect of fluorine in preventing tooth decay in healthy teeth and the inhibiting effect of fluorine on the further development of existing caries. She indicated that the results pointed to the urgent need for mass fluoride treatment in Poland.<sup>19</sup>

In September 1957, the World Health Organization (WHO) issued a resolution in which it recommended the widest possible introduction of artificial water fluoridation as a preventive measure for dental caries.<sup>20</sup>

On July 23, 1969 at its 22<sup>nd</sup> session in Boston, USA, WHO adopted a proposal prepared and presented by a delegation of 37 countries, including Poland, which obliged Member States to fluoridate drinking water where appropriate.<sup>21</sup>

Professor Noemi Wigdorowicz-Makowerowa founded the Scientific and Technical Team for Fluoride Prophylaxis, based at the Department of Dental Prosthetics in the Institute of Dentistry of Wrocław Medical University, which she later headed. This team launched the first fluoride water treatment plant in Wrocław in 1967. Professor Wigdorowicz-Makowerowa promoted the introduction of fluoride water treatment plants throughout Poland. Her efforts met great societal resistance, from people reluctant to introduce a new form of prevention and from media, reporting on the harmful effects of fluorine on humans. Professor repeatedly presented the results of her original research and of studies conducted in Western countries, which showed that fluorine at a dose of 1 mg/L prophylactically prevents caries.<sup>22</sup> In 1972, 4 years after the introduction of water treatment in Wrocław, she carried out a controlled trial, which she presented in 1973. Tooth decay was significantly lower than in 1967. The DMF index decreased by 60.6% in 3-year-old children, by 46.4% in 4-year-old children, by 50% in 7-year-old children, by 31.5% in 8-year-old children, and by 14.2% in 12-year-old children. These studies suggested that the older the child, the less difference in caries reduction can be expected after 4 years of consuming fluoridated water; this finding may have resulted from the fact that older children had begun consuming fluoridated water after partial tooth formation and may have had tooth decay before.<sup>23,24</sup>

Due to the efforts of Professor Wigdorowicz-Makowerowa, in 1977 the Polish Sejm adopted a resolution requiring fluoridation of tap water with sodium fluorosilicate when fluorine content in water is lower than 0.5 mg/L. The many years of work of the Scientific and Technical Team under the leadership of Professor Wigdorowicz-Makowerowa led to the creation of 35 fluoride water treatment plants, serving 2.5 million people in Poland by 1980.<sup>25</sup>

## Studies on the rehabilitation of patients with myoarthropathy

Professor Wigdorowicz-Makowerowa explained myoarthropathy (from Greek: *μυς* *mys* – muscle, *ἄρθρον* *árrhron* – joint, and *πάθος* *páthos* – suffering) as a dysfunction of the masticatory organ – either painless or painful – caused by the contact of premature teeth and malocclusion.<sup>26</sup> She described bruxism (from Greek: *βρυγμός* *brygmós* – teeth grinding) as fixed, abnormal jaw movements involving the unconscious grinding and clenching of the teeth.<sup>27</sup> In today's terminology, myoarthropathy is diagnosed as TMD.

One of the main areas of interest of Professor Noemi Wigdorowicz-Makowerowa was the rehabilitation of patients with temporomandibular joint arthropathy and myoarthropathy. Her first publications on this subject appeared in 1968 and concerned toothless patients using complete dentures, those with partially missing teeth and those with occlusal problems.<sup>28–31</sup> More detailed research on the incidence of temporomandibular joint arthropathy was published 5 years later.<sup>32</sup> These were population-based studies, which also covered the etiopathogenesis of arthropathy. In 1974, she published a study involving a group of 1,000 soldiers on the relationship between temporomandibular joint arthropathy and bruxism.<sup>33</sup> In subsequent years, she continued to explore the topic of myoarthropathy and wrote papers on the types of pain in temporomandibular joint myoarthropathy as well as treatment methods, on functional disorders in children and adolescents, and also presented a modern view on the etiology of this arthropathy.<sup>15,34–41</sup> Professor Wigdorowicz-Makowerowa published 2 monographs and 50 articles, and supervised 7 doctoral students and 2 post-doctoral students, all works revolving around the subject of temporomandibular arthropathy and masticatory disorders. The last article by Professor Wigdorowicz-Makowerowa on the subject of myoarthropathy was published in 1984.<sup>6</sup>

## Studies on the etiology of myoarthropathy

According to the research of Professor Wigdorowicz-Makowerowa, 50% of the middle-aged population had functional disorders of the masticatory organ at that time.<sup>15,27</sup> They were more often observed in people with malocclusion, and in such cases, functional disorders were particularly frequently manifested as arthropathy.<sup>27</sup> In her articles, Professor Wigdorowicz-Makowerowa emphasized that the problem of myoarthropathy had a complex etiology, and originated from increased muscle tone and bruxism, among other things. She listed the main risk factors in the following order: malocclusion, bruxism, and increased sensitivity to stress. She proved that bruxism and malocclusion increased the risk of disorders 1.4–2 times and that excessive neuromuscular excitability doubled the risk, while tooth wear reduced the frequency unless it occurred along with malocclusion.<sup>15,27</sup> She pointed out in numerous publications that increased stress in society was one of the causes of bruxism and of the functional disorders of the masticatory organ, which were being observed more and more frequently.<sup>15,27,28,37</sup> She stated that the temporomandibular joints were extremely resistant to cancer and infectious agents, but were susceptible to occlusal microtraumas and took a very active part in showing emotions, especially negative ones (fear, anger

or fury) through the clenching of the teeth. In addition, they were somewhat overloaded in people with abnormal masticatory function. This problem was most often the result of a lack of compensation for stress related to the environment (biting pencils, lips or cheeks). Professor Wigdorowicz-Makowerowa also pointed out the important role of a properly conducted interview in determining the cause of the disease and proposed that the best specialist to help patients with the problem was a prosthodontist. An imperative issue which she drew attention to was the need to combine a physical examination directly with an interview in order to determine the individual's susceptibility to stress. She repeatedly emphasized that in the etiology of problems with joints, the impact of the environment and stress were more important than age, for example. In the prevention of functional disorders, she proved that fluoride prophylaxis was vital in preventing tooth decay as well as tooth loss and occlusal disorders.<sup>15,28,32</sup> Based on her research, Professor invented the concept of 'traumatic occlusion.'

## Treatment of myoarthropathy

Other aspects of TMD which Professor Wigdorowicz-Makowerowa focused on were the types of pain in myoarthropathy and the treatment methods thereof as well as the relationship with bruxism.<sup>34–38</sup> In her articles, she reported other authors' results of causal treatment as being positive in 50–90% of research participants, while in her own research in Wrocław it was 85%. The method of treatment depended on whether the case was acute or chronic. For the former, she recommended a soft diet, biting on the problematic side, compresses, painkillers, muscle relaxers, and leveling the occlusal surface, but advised against immobilization, which she said was indicated only in cases of fractures. In situations of chronic arthropathy, she maintained that the most appropriate method was causal treatment, i.e., the alignment of the occlusal surface, the elimination of bruxism and prosthetic rehabilitation; as the muscles stop working synchronously, which is necessary for the proper functioning of the masticatory organ, the treatment should consist in practicing opening the mouth without lateral deviations, exercises also with the excessive mobility of the mandible (helping to stabilize the joint) to increase suprahyoid muscle tone, and – in exceptional cases – injections of adrenal gland hormone.<sup>28</sup> Professor Wigdorowicz-Makowerowa emphasized the need for periodic monitoring, causal treatment and good contact with the patient, as these are factors which determine the success of treatment. She regarded bruxism and bad emotional condition as causes of relapses. In her opinion, patients with emotional disorders, and numerous somatic symptoms of stress in particular, did not have a good prognosis for the treatment.<sup>37</sup>

## Conclusions

The scientific achievements of Professor Wigdorowicz-Makowerowa are clearly part of modern dentistry in Poland. She published 68 articles on fluorine and its use in dentistry, and analyzed its mechanism of action in caries prophylaxis and the most effective methods for applying it in Poland. Based on many years of research, she came to the conclusion that the best method of prevention should be the fluoridation of tap water and the topical application of the solutions of fluoride salts to the teeth. In Poland, there are currently no fluoride water treatment plants, and caries prophylaxis relies on the daily use of fluoridated toothpaste. Although more than half a century has passed since Professor's research, it is still valid in many matters. Then and today, problems with joints are mainly dealt with by prosthodontists, often in cooperation with physical therapists and psychologists, which can be interpreted as following the path of Professor, because these specialists help relax muscles and reduce stress.<sup>42</sup> Until the 1980s, she used the term 'arthropathies', but later realized that temporomandibular joint problems are not only caused by occlusal problems, but also problems with the muscles. The first time she used the term 'myoarthropathies' was in 1978.<sup>25</sup> It is important to point out that she considered that problem before the currently used Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) were invented in 1992. Currently in medical practice, there is a biaxial approach to functional disorders, i.e., including a physical examination of the patient as well as a medical interview and the determination of the stress level – RDC/TMD and the latest Diagnostic Criteria/Temporomandibular Disorders (DC/TMD).<sup>43,44</sup> Another issue that remains controversial these days is malocclusion in the etiology of functional disorders and their impact on the outcome of treatment.<sup>45–47</sup>

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