



# A History of Arsenic in Dentistry

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**ABSTRACT** The history of the use of arsenic in dentistry has been relegated to dental history. Once hailed as a panacea for the relief of pain and the answer to root canal therapy, it soon fell out of use mainly because of its misuse by unskilled and unscrupulous dentists in search of a quick fix to a complex problem. Such is the story of arsenic.

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**C**hapin A. Harris in 1849 defined arsenic as “The name of a metal of a blackish or steel-gray color. It is found native in a state of oxyd, and also combined with sulfur, under the improper name of yellow and red arsenic. Arsenic and its various preparations are the most active of all the poisons.”<sup>1</sup> Arsenic itself is never used in medicine, but is used in the form of “arsenous acid or the arsenates of sodium, potassium or copper.” It is manufactured in Germany and England where it is a collateral product during the smelting of cobalt ores.<sup>2</sup> Harris added that arsenous acid was “a powerful agent that has been extensively employed, both in America and Europe, during the last few years, for destroying the pulps of teeth, but on consequence of the great liability of a tooth, after the destruction of its lining membrane, to give rise to inflammation of the alveolodental membrane, and abscess, the practice is rapidly falling into disrepute.”<sup>3</sup>

Arsenic is a poison and the symptoms of arsenic poisoning are “a violent, burning pain in the stomach and bowels, retching, vomiting; the matter thrown up being of a greenish or yellowish

color, sometimes streaked with blood, thirst, hoarseness, difficulty of speech, diarrhea, convulsions, the eyes are red and sparkling, delirium and death.”<sup>4</sup>

## History of First Use: 2700 B.C.

The Chinese medical work titled *Nuci-King* written in 2700 B.C. describes the use of a pellet of arsenic placed in the cavity of a painful tooth to kill a tooth worm. Johannes Mesue, an Arabian, used a mixture of yellow arsenic to coat the roots of teeth to be extracted. Gerber (Abou-Moussah-Dschafer-al-Soffi), called the father of chemistry, mentioned arsenous acid in his 8th century writings. Paracelsus reportedly used it as a medicine. In about 1400, Petrus de Larglata treated dental fistulas with caustics and arsenic.<sup>5</sup> Haly Abbas (d. 994) in his medical book, *LiberRegius*, translated from Arabic into Latin in 1492, advocated using arsenic to devitalize the pulps of teeth. He also recommended arsenic and opium for toothache.<sup>6</sup> Arculanus described filling teeth with gold and recommended arsenic as an obtundent. In 1641, John S. Schroeder published his *Pharmacopocia Medico-Chymica*, which described how to obtain arsenic; and in 1733, George Brandt, a Swedish chemist, first introduced its chemical properties when physicians began to use

it. Reportedly, Dr. Alexander Wood of Edinburgh advocated the use of arsenic to destroy dental pulps as early as 1833.<sup>7</sup>

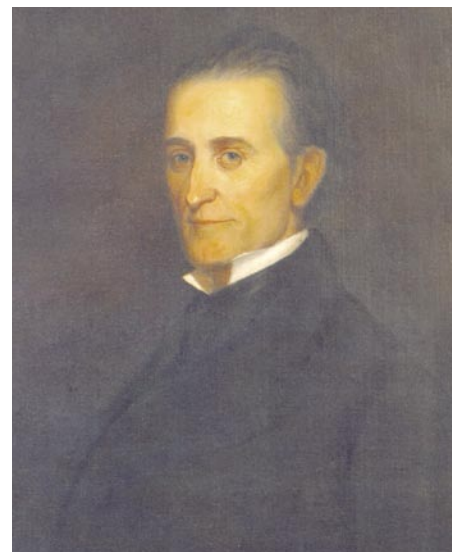
In North America, Dr. John Roach Spooner (**FIGURE 1**) of Montreal, Canada, is generally given credit as the first to use sulfide of arsenic to devitalize the dental pulp; however, the discovery was not made known to the dental profession until 1836 when his brother, Dr. Shearjashub Spooner, published his treatise, *Guide to Sound Teeth*.<sup>8</sup> Chapin A. Harris apparently also used arsenic in 1835 without having any knowledge of the “Spooner discovery.”<sup>9</sup> In 1838, Harvey Burdell in his book, *Observations and Diseases of the Teeth*, condemned arsenic as a “very dangerous treatment resorted to by a few New York dentists, which consists in applying arsenic or rat’s bane, to the excited nerve ... It was supposed, when the Crawcours left this country, that valuable discoveries of this kind were at an end.”<sup>10</sup> In 1842, Solyman Brown extolled its use as the “most prompt, safe, and effectual, when properly applied” to destroy the nerves of “decayed and painful teeth.” However, Dr. Burdell condemned its use as “cruel, ineffectual and dangerous.”<sup>11</sup>

Ide cautioned the profession on using arsenic in 1842 because of the “excruciating” pain it sometimes evoked in molar teeth. He recommended using arsenic mixed with morphine or creosote. Sensitivity and discoloration from a purple to a dark brown, which “permanently destroys the beauty of the tooth,” were other problems.<sup>12</sup> The safety of using arsenic improved somewhat after the availability of gutta-percha in 1847 to seal the cavity. Without this restorative material, the arsenic could leak out and cause “sloughing of the gingival, destruction of the adjacent periodontal ligament, with extrusion of the tooth and attendant severe pain.”<sup>13</sup>

### The Tragic Case of Dr. John Stoughton Wolcott: 1843

In 1843, the death of Dr. John Stoughton Wolcott, the son of Oliver Wolcott, the Connecticut governor and grandson of one of the signers of the Declaration of Independence, “by the application of arsenic to the nerve of a tooth” was reported in the newspapers and periodicals.<sup>14</sup> As the story goes, Dr. Wolcott, suffering from “a severe toothache” on Sunday, Nov. 19, 1843, visited his dentist, M.B. Merriman of Litchfield, who proceeded to place a powdered preparation (one-twelfth of a grain) of two parts of arsenic and one of morphine, moistened with creosote, in a carious lesion of the mandibular right second bicuspid tooth. The mixture was covered with wax. Still receiving no relief, he returned to the dentist that evening and had the tooth extracted. According to Wolcott’s physician, R.M. Woodruff, on Monday morning, Wolcott’s face was swollen. That afternoon, he vomited two or three times, was very thirsty, and was unable to micturate. In the evening, his inferior right jaw was more swollen with severe pain, he had “constriction of the throat, difficulty swallowing, and labored respirations, pulse 130, lips parched, great thirst, chilly, a sensation of stiffness of the whole body, and debility.” He told Woodruff, “I have had arsenic in my tooth and am poisoned.”<sup>15</sup>

By Tuesday, the swelling had increased, “from behind the mastoid process on each side, far up on the temporal and frontal bones, and around his neck, filling it out to the chin and about the face so as to almost close his eyes,” respirations were much more laborious, lips were “greatly distended, parched and livid, vomiting almost incessant, thirst unquenchable, pulse irregular, distress at stomach great, and copious secretions in the throat.” On Wednesday morning the patient died.<sup>16</sup>



**FIGURE 1.** John Roach Spooner, oil portrait by Rembrandt Peale (courtesy of the Dr. Samuel D. Harris National Museum of Dentistry).

Dr. Merriman requested an autopsy, but it was not performed. Dr. J.G. Beckwith of Litchfield thought that Wolcott did not exhibit the “legitimate effects of arsenic upon the system” and that arsenic had been “unjustly charged with the death.” He said that the small amount of arsenic given to Wolcott was a safe dose, even if ingested into the stomach.<sup>17</sup> Dr. Beckwith’s diagnosis was “erysipelatous inflammation of the neck and face,” independent of any “influence arising from the action of arsenic.”<sup>18</sup> This diagnosis would be in keeping with the modern concept of Ludwig’s Angina.<sup>19</sup> Unfortunately, both arsenic and the dentist were blamed for Dr. Wolcott’s death.

### Controversy in 1844

Even in 1844, there was controversy over the value of arsenic in pulp destruction. Hudson S. Burr, MD, used a small pledget of cotton dipped in creosote and then into “arsenic and acetate of morphia,” inserted it into the cavity, and covered it with beeswax and gum mastic melted together. He never allowed it to remain more than 24 hours.<sup>20</sup> On the other hand, Edward Taylor, MD, regarded arsenic as an “unsafe remedy” when the destruction of the pulp was desired, and

had discarded its use altogether, except in certain cases. He thought the vascularity of the tooth carried the drug into the general circulation.<sup>21</sup> Dr. Chapin A. Harris at the Baltimore College of Dental Surgery agreed with Dr. Taylor that arsenic was attended with danger and sometimes resulted in the loss of the tooth being treated. He thought its employment should be “at once and forever be abandoned.” However, he feared that as long as dentists continued to “advertise to cure the toothache in two or five minutes” and it was profitable, it would be continued to be used.<sup>22</sup> In 1845, Dr. Amos Westcott of Syracuse, New York, in a lengthy article in the *American Journal of Dental Science* also condemned arsenic by saying that “it would have been far better for the community and the profession, had not this remedy been discovered.” He believed the nerves of the teeth or their accompanying blood vessels capable of absorbing arsenic, thus, it was dangerous to the general system.<sup>23</sup>

In August 1848, the subject of arsenic was hotly debated at the ninth annual meeting of the American Society of Dental Surgeons in Saratoga, New York. Dr. Westcott somewhat modified his earlier stance because of his contact with Dr. Edward Maynard of Washington, D.C.; Westcott had now used it in many successful cases. Still, he believed it better to destroy the nerve with an instrument. Many of his arsenic cases had gone on to alveolar abscesses.<sup>24</sup> Dr. Chapin A. Harris stated that he had experimented with arsenic in about 300 cases in 1842-43 and found that three out of four cases resulted in alveolar abscess in three months to two years. After hearing of Maynard’s good results, he tried it again on about 20 teeth with more success than he anticipated; however, he rarely left the arsenic in the teeth more than seven hours.<sup>25</sup>

In 1859, another death was attrib-

uted to the use of arsenic during dental treatment. The New York Herald reported that Lt. Sanford of the U.S. Revenue Cutter, Harriet Lane, lost his life from the “effects of arsenic applied to a tooth.” Dr. Chapin A. Harris said that if this were true, the arsenic must have been very carelessly applied and in a dose much stronger than that required to kill the pulp. A 40th- or 50th- of a grain was sufficient to destroy the nerve.<sup>26</sup>

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#### Sensitive Dentin: 1859

Arsenic was also used during this period to treat sensitive dentin. It was placed in the cavity of sensitive teeth and allowed to remain 24 hours; the decay was then painlessly removed.<sup>27</sup> Sir John Tomes in his *A System of Dental Surgery* recommended arsenic to render the pulp “insensible to pain” in the removal of decay. However, he cautioned that the action of arsenic was not “always limited to the surface of the dentine.” It would find its way to the pulp and cause “death of that organ,” a condition which was soon followed by “discoloration of the whole crown of the tooth, and very frequently by the supervention of alveolar abscess.”<sup>28</sup> Arsenic was also used for partial destruction of the pulp. In 1882, Walter W. Allport of Chicago stated that in some cases “a portion of the pulp would slough off and the balance of the pulp would take on a healthy action and live for years.”<sup>29</sup>

#### The Technique: 1860s

In Dr. J. Foster Flagg’s technique in the 1860s, the amount of arsenic usually employed in pulp devitalization was about 1/25 of a grain of arsenic, mixed with the same weight of “acetate of morphia and made into a thick paste with creosote.” Creosote seemed to be the ingredient which “modified the amount of pain.” The cavity was covered by a plug of cotton “moistened with a thin solution of gum sandarac” with a wax filling, and allowed to remain 10 days or two weeks.<sup>30</sup> In 1863, Dr. A.C. Hywes upbraided the profession for the unwarranted “wholesale extraction of teeth,” which could have been saved by “eradicating the diseased part.” He considered it malpractice when root canal therapy could have saved 95 percent of all teeth thus sacrificed. In all cases of exposed dental pulps, he applied “a minute portion of arsenic, combined with creosote” covered by a “plug of cotton moistened with a solution of gum sandarac.” Such teeth could be rendered as “sound and serviceable as when in their normal condition.”<sup>31</sup>

Apparently, there was still some debate in the profession over the merits of adding morphine to the arsenic to allay the pain. Drs. Robert Arthur and Chapin A. Harris felt it diminished the pain of the application of arsenic, whereas Drs. Jonathan Taft and John Tomes thought it produced pain, and should be deleted from the formula for pulp destruction.<sup>32</sup> Dr. F.A. Brewer reported two cases of destruction of the alveolar process by the indiscriminate administration of arsenic during the devitalization of the dental pulp. In one case, the arsenic came in contact with the gums and alveolar process, destroyed the incisive and canine fossa, and resulted in the loss of the tooth under treatment, a sound canine, and first bicuspid on the same side.<sup>33</sup>

### Another Death: 1879

In 1879, another death was attributed to arsenical poisoning. On Oct. 6, *The New York Times* reported that George A. Gardner of Brooklyn had died Sept. 27 “in great agony, after 10 weeks of indescribable suffering.” According to the *Times*, his attending physician, Dr. Samuel S. Guy, said his death was caused “by arsenical poison, placed by a dentist in one of his teeth for the purpose of killing an aching nerve.” However, Guy’s certificate of death stated that the cause of death was “gangrene of the mouth and face, arising from treatment of a tooth.”

Prior to his death, Gardner had been treated by two dentists, Dr. Waters of Boston and Dr. Marvin of Brooklyn, neither one of whom used arsenic in his tooth. Waters had used carbolic acid and Marvin creosote. The *Times* reporter was the first to agitate the subject of arsenic several days after the interment. It was only after being interviewed by the reporter that Dr. Guy said that arsenic caused the death. Dr. Wyckoff of the Brooklyn Health Department said he had never known of a case in which “death was directly and exclusively due to arsenical poisoning.” Furthermore, none of the classical symptoms of arsenical poisoning were reported by Dr. Guy in his death certificate. Careless reporting was apparently responsible for this whole affair which was intended to embarrass and cast a “black eye” on the dental profession.<sup>34</sup>

### The Technique: 1895

In the mid 1890s, cocaine hydrochlorate anesthesia began to replace arsenic as the drug of choice for pulp extirpation. Cocaine was also combined in a formula with arsenic and lanolin as a paste to kill the nerve.<sup>35</sup> The disadvantages of arsenic were that it caused pain, usually required more than one application, and there

was the danger of leakage in class 5 gum line cavities. Cocaine, on the other hand, was effective in a single sitting and the pulp removed without pain.<sup>36</sup> From 1897 on, the technique also changed to using arsenic in the form of a fiber. The fiber was made by “impregnating cotton wool with arsenic oxide, 50 percent, and other drugs such as creosote, morphine acetate, oils of cassia and wintergreen and cocaine, 2 percent.” A very small section of fiber was sufficient for the purpose.<sup>37</sup> By 1903,

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the technique had changed but little. Dr. Frederick I. Bartlett of Washington, D.C., offered the “golden rule” to never repeat an arsenical application and never leave it the tooth more than 48 hours.<sup>38</sup>

### Arsenic in Modern Times: 1928-90s

In the 1920s, arsenic was still being used by some dentists to treat teeth with narrow and curved canals or for patients with severe systemic disease or allergy to local anesthetics. Used with the proper precautions, arsenic was an effective drug; however, problems persisted. Messenger reported a 1928 case where an arsenical paste used in the devitalization of the pulp of a maxillary cuspid tooth, which ultimately resulted in the loss of all the maxillary incisor teeth and a first molar because of necrosis superimposed by a streptococcal infection.<sup>39</sup> In 1937, Curnock of England reported a case of

arsenical poisoning with “abdominal pain, vomiting and diarrhea, the classical symptoms of acute arsenical poisoning.”<sup>40</sup> Glasser reported the case of a 50-year-old female where arsenical paste was inadvertently forced into the apical end of the canal of a maxillary premolar, which resulted in hospitalization of the patient and extraction of the tooth.<sup>41</sup>

In 1985, Yakata et al. and Azumi reported a case in which treatment of a mandibular second molar resulted in extensive osteolysis of the mandible. Following arsenic treatment, the patient developed paresthesia of the lower lip, pain, trismus, swelling, and extensive resorption of the ascending and horizontal rami of the mandible.<sup>42</sup> In 1991, Smart and Barnes reported a case where a cobalt preparation containing arsenic was used to treat a maxillary first molar, which resulted in necrosis of the bone and loss of the tooth.<sup>43</sup> In 1997, Bataineh, Al-Omari, and Owais of Jordan reported two cases of bony necrosis followed by sequestration and in one case pathological fracture of the mandible.<sup>44</sup>

### Conclusion

The majority of the dental profession would agree that there is no longer any “indication or need to utilize arsenic in dental practice today,” and that “unjustified use must be condemned and should be prohibited.”<sup>45</sup> ■■■■■

### REFERENCES

1. Harris CA, A dictionary of dental science, biography, bibliography, and medical terminology. Lindsay & Blakiston, Philadelphia, p 50, 1849.
2. Hinkins JE, The dangerous drug in dentistry. *Dent Review* 26:638, 1912.
3. Harris CA, *Dictionary of Dental Science* p 51m 1849.
4. Frazer SW, An essay on arsenic. *Dent News Letter* 7:200, 1854.
5. Hinkins, The dangerous drug in dentistry, 636-7.
6. Lufkin AW, A history of dentistry, 2nd ed, rev. Lea & Febiger, Philadelphia, p 83, 1948.
7. Hinkins, The dangerous drug in dentistry, 637, 647-8.

8. Taylor JA, History of dentistry: A practical treatise for the use of dental students and practitioners. Lea & Febiger, Philadelphia, p 131, 1922.
9. Hinkins, The dangerous drug in dentistry, 648.
10. Anthony LP, Grossman LI, A brief history of root-canal therapy in the United States. *J Am Dent Assoc* 32:45, 1945.
11. Ide WE, The use of arsenious acid for destroying the nerve in decayed teeth. *Am J and Library of Dent Science* 2: 247-8, 1842.
12. Ide WE, The use of arsenious acid for destroying the nerve in decayed teeth. *Am J and Library of Dent Science* 2: 248-9, 1842.
13. Grossman LI, Endodontics 1776-1976: A bicentennial history against the background of general dentistry. *J Am Dent Assoc* 93:81, 1976.
14. Brown S, Case of Dr. John Stoughton Wolcott, of Litchfield, Conn., son of the late Oliver Wolcott, for many years governor of that state and grandson of Oliver Wolcott, one of the signers of the Declaration of Independence. *Am J Dent Science* 4:145, 1844.
15. Brown S, Case of Dr. John Stoughton Wolcott, of Litchfield, Conn., son of the late Oliver Wolcott, for many years governor of that state and grandson of Oliver Wolcott, one of the signers of the Declaration of Independence. *Am J Dent Science* 4:147-50, 1844.
16. Brown S, Case of Dr. John Stoughton Wolcott, of Litchfield, Conn., son of the late Oliver Wolcott, for many years governor of that state and grandson of Oliver Wolcott, one of the signers of the Declaration of Independence. *Am J Dent Science* 4:147-8, 1844.
17. Brown S, Case of Dr. John Stoughton Wolcott, of Litchfield, Conn., son of the late Oliver Wolcott, for many years governor of that state and grandson of Oliver Wolcott, one of the signers of the Declaration of Independence. *Am J Dent Science* 4:151-3, 1844.
18. Brown S, Case of Dr. John Stoughton Wolcott, of Litchfield, Conn., son of the late Oliver Wolcott, for many years governor of that state and grandson of Oliver Wolcott, one of the signers of the Declaration of Independence. *Am J Dent Science* 4:156, 1844.
19. Thoma KH, Oral Surgery, 2nd ed., CV Mosby Co, St. Louis, pp 944-5, 1952.
20. Burr HS, On the use of arsenic in teeth. *Am J Dent Science* 5:127-8, 1844.
21. Taylor E, On the use of arsenic in destroying the sensibility of a carious tooth, preparatory to filling. *Am J Dent Science* 5:129, 1844.
22. Harris CA, Arsenic as a dental therapeutic agent. *Am J Dent Science* 6:180, 1845.
23. Westcott A, Observations on the use of arsenic for toothache, or for destroying the lining membrane of a tooth. *Am J Dental Science* 6:113-4, 1845.
24. Burr WH, comp, Ninth Meeting of the American Society of Dental Surgeons, held at Saratoga, August 1848. *Am J Dental Science*, ns, 1:49-50, 1850.
25. Burr WH, comp, Ninth Meeting of the American Society of Dental Surgeons, held at Saratoga, August 1848. *Am J Dental Science*, ns, 1:51-2, 1850.
26. Harris CA, Application of arsenic to teeth. *Am J Dent Science*, ns, 9:593-4, 1859.
27. White JD, Arsenic. *Dent Cosmos*, ns, 3:313-4, 1862.
28. Tomes J, A System of Dental Surgery. Lindsay and Blakiston, Philadelphia, pp 400-1, 1859.
29. Anthony, Grossman, History of root-canal therapy, 46.
30. Flagg JF, Arsenous acid as a devitalizer of the dental pulp. In: *Trans Am Dent Assoc, American Dental Association*, Cleveland, pp 37-8, 45, 47,49, 1863.
31. Hywes AC, Exposed pulps and alveolar abscess. In *Trans Am Dent Assoc, Wrightson & Co., Cincinnati*, pp 55, 57, 1863.
32. Ellis GW, Arsenic. *Dent Cosmos*, ns, 3:363-4, 1862.
33. Brewer FA, Gleanings from actual practice. *Mo Dent J* 1:147, 1869.
34. Arsenical poisoning. *Dent Register* 33:481-2, 484-5, 1879.
35. Johnson AG, Arsenic. *Dent Review* 9:81, 1895.
36. Fathergill JA, Cocaine v. arsenic in the removal of pulps. *Br Dent J* 27:244-5, 1906.
37. Messenger HL, Arsenic in dentistry. *Oral Health* 28:545, 1938.
38. Bartlett FI, A golden rule for the use of arsenic. *Dent Brief* 8:715, 1903.
39. Messenger, Arsenic in dentistry, 541-2.
40. Curnock GL, A case of arsenical poisoning: a possible idiosyncrasy. *British Dent J* 63:344, 1937.
41. Glasser MM, Acute periapical necrosis from arsenical pulp devitalization. *Oral Surg Oral Med Oral Pathol* 10:216-7, 1957.
42. Yakata H, Azumi T, et al, Extensive osteolysis of the mandible following devitalization of a tooth by arsenic trioxide. *J Oral Maxillofac Surg* 43:462-3, 1985.
43. Smart ER, Barnes IE, Tissue necrosis after using an arsenical endodontic preparation: A case report. *International Endodontic J* 24:264-5, 1991.
44. Bataineh ABD, Al-Omari MAO, Owais AI, Arsenical necrosis of the jaws. *Int Endodontic J* 30:283-7, 1997.
45. Bataineh ABD, Al-Omari MAO, Owais AI, Arsenical necrosis of the jaws. *Int Endodontic J* 30:287, 1997.

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