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## History of non-electric dental drill

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### Abstract

The dental drill has a rich history of technological advancement, evolving from the 9,000-year-old bow drill to the electric drill and, more recently, to the laser drill.

**Keywords:** drill, restoration, cavity preparation, caries, rotations per minute,

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The mechanical removal of decayed tooth structure has been a foundational aspect of restorative dentistry, defining the profession for most of its history. Only in the past two decades has minimally invasive dentistry gained prominence, and over the last 75 years, preventive and non-invasive dentistry has emerged as a new direction. Nevertheless, for much of modern dentistry, restorative procedures were closely linked to drilling.

The earliest evidence of mechanically removing decayed tooth structure dates back to 7000 BCE. During the excavation of ancient graves in Pakistan in 1995 (1), researchers discovered several teeth with drill marks, likely made using a stone flint. These primitive drills were originally intended for starting fires, but with further adaptation, they became essential tools for early dental practices.

In Ancient Egypt, trephines were used, sometimes with a hot iron, to open the skull or drain abscessed teeth. Signs of new bone deposits around these charred openings suggest that some patients survived the procedure. Primitive drills operated by rotating the shaft between two hands or with the aid of a string or bow. The bow drill was particularly suited for working on hard tissues like enamel. Evidence shows that ancient cultures, including the Aztecs and Mayans, used drills to set semi-precious stones in teeth as ornaments. The Greeks and Romans also used string and bow drills and employed trephines for dental and medical purposes.

Giovanni d'Arcoli was the first known practitioner to restore teeth with gold foil, likely using a similar drill. Giovanni da Vigo (1460-1520), personal physician to Pope Julius II, advanced this technique in 1514 by cleaning carious teeth (referred to as "corrosio") before filling them with gold foil, using tools such as a *string drill*, *files*, and *scrapers* (*trapano*, *lima*, and *scalpo*) (Figure 1).

The 1530 publication *Zene Artzney*, a dental manual intended for itinerant tooth drawers, includes a section on using drills and scrapers. One of the earliest depictions of the string drill in medieval medical texts appears in Andrea della Croce's (1500-1575) illustrated work *Chirurgiæ*, published in 1573.(2)

About a century later, Cornelius Solingen (1641–1687) used a hand drill to smooth the rough edges of carious lesions. A more detailed description and illustration of the bow drill appear in the 1746 second edition of Pierre Fauchard's work. However, Fauchard's drill was primarily used to drill holes into denture bases made of bone (Figure 2) and was too bulky for intraoral use. Instead, Fauchard relied on files, rasps, and hand scrapers to remove carious lesions from teeth rather than using drills. The French author Anselme-Louis-Bernard-Brechillet Jourdain (1734-1816), in his 1756 book *Nouveaux élémens d'odontalgie*, describes what is considered the first drill (*porte écarissoir*).

A major advancement in cavity preparation drills came from John Greenwood (1760–1810), one of George Washington's favorite dentists. In 1790, Greenwood modified his mother-in-law's foot-treadle spinning wheel, creating the first foot-operated dental drill, which is currently displayed at the New York Academy of Medicine.

In 1803, Berlin dentist Heinrich Lautenschläger developed a small, hand-cranked drill suitable for use within the oral cavity. This drill was not designed to remove carious lesions from the crown but to enlarge the root canal, allowing the insertion of a pin to anchor the crown—a technique that preceded formal root canal treatment, which emerged in the mid-19th century.

The significance of future dental drills went unrecognized in 1829 when Scottish engineer James Nasmyth invented a flexible shaft and coiled spring to rotate a drill ("suitably close-coiled spiral steel wire conveyed rotary motion"). This invention eventually found application in dental drill designs about thirty years later.

One of the innovative practitioners of the early 19th century was Charles F. Maury, a Parisian dentist who introduced a hand drill operated by a plunger (*porte-forêt*), which activated a small bur via a cord, reaching any tooth like a contra-angle drill. The 19th century also saw the reintroduction of simple Archimedean drills (Figure 3), operated by pulling a handle to turn the drill bit back and forth.

In 1838, John Lewis from Burlington, Vermont, patented a dental drill he called a universal bevel gear. Several other drills were introduced in the 19th century, including one by the French dentist Pierre Joachim LeFoulon in 1841. In 1846, Amos Wescott introduced the ring drill (Figure 4), designed to fit over the index finger and into the palm, allowing the dentist to wind it with his fingers. This innovation enabled a slow, controlled pace for precise operations.

That same year, American Josiah Foster Flagg (1846), along with later contributions from John A. Chevallier (1850) and Charles Merry (1858), designed additional drills, although these required one or two hands, limiting the dentist's ability to hold a mirror or retract the cheek. (5)

In 1864, British dentist George Fellows Harrington invented a clockwork dental drill called "Erado," meaning "it will erase" (Figure 5). This small hand drill included a key to wind the clock spring, allowing it to run continuously for about two minutes. Harrington's design featured interchangeable angled or straight heads, improving accessibility to different teeth. Despite its innovations, the drill was short-lived due to its noise and difficulty of control.

The breakthrough in dental drilling technology arrived in 1871 with the invention of a foot-pedal-operated dental drill by Ohio dentist James Beall Morrison (1829–1917) (Figure 6). Morrison's design was based on

Greenwood's 1790 foot-treadle spinning wheel and reached speeds of 2,000 rpm, allowing the dentist to use both hands during procedures.

In 1883, a foot pedal-operated dental drill suspended from the ceiling further enhanced convenience for dental practitioners (Figure 7, from Ref. 6). However, these designs were eventually outpaced when George Green patented the first electric dental drill in 1875, marking the beginning of modern dental drilling technology.

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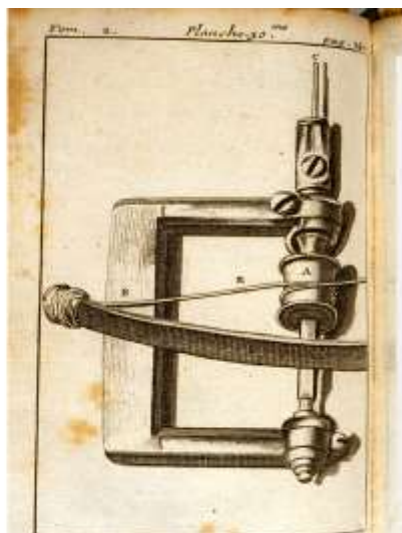
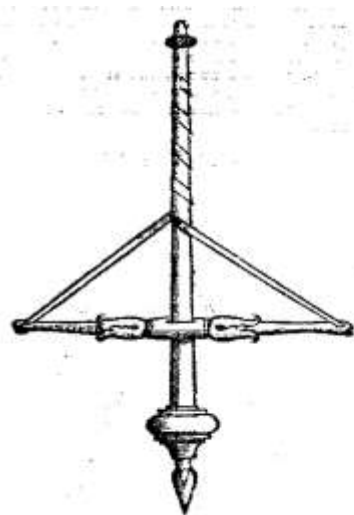


Figure 1. *Drille de bijoutier* (jeweler's drill) (from Ref 2. Image in public domain)

Figure 2. Pierre Fauchard's drill. (from Ref 3.)

Figure 3. Dental Archimedean Drill (named after the Greek polyhistor, Archimedes – Early 19th century. (Science Museum, London)



Figure 4. Amos Wescott's Ring-drill – 1846. (From Ref. 4.)

Figure 5. Harrington's „Erado” drill – 1846 - (Science Museum, London)

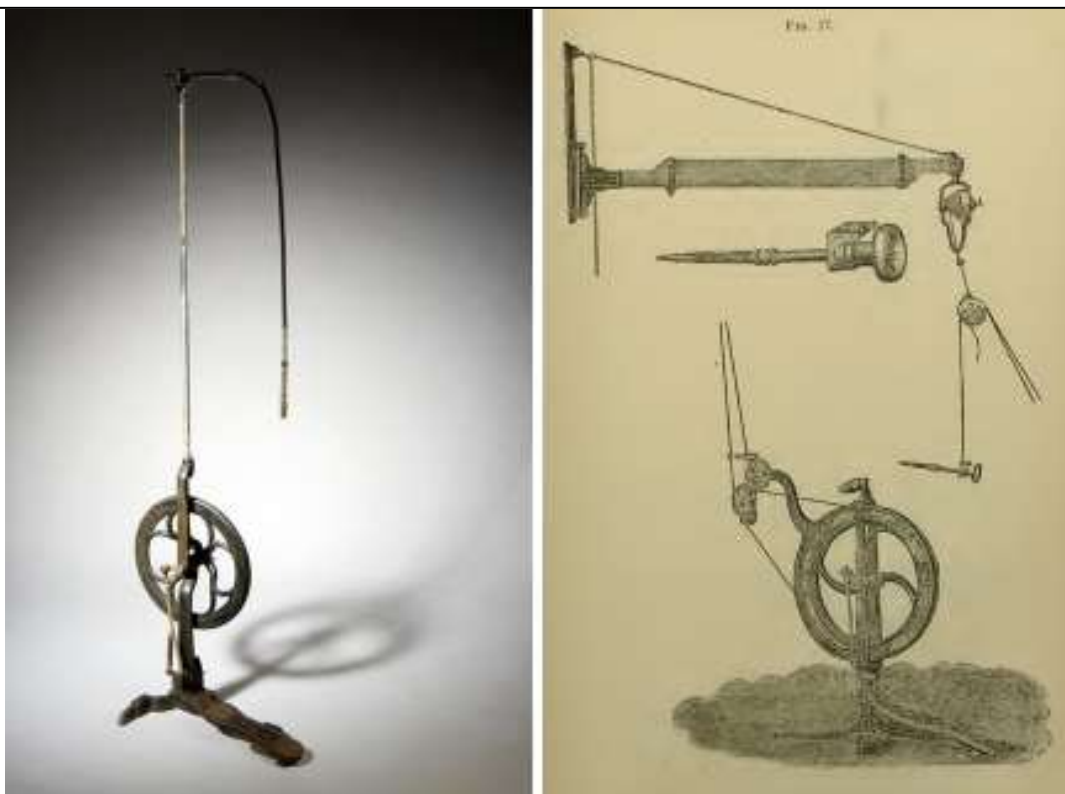


Figure 6. A foot-pedal operated dental drill. Early 20th Century

Figure 7. Ceiling-suspended dental drill. – 1883.