THE HISTORY OF NEUROLOGY

A short history of the reflex hammer

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There are several milestones in the early story of the reflex hammer: the discovery of percussion, the description of the clinical usefulness of muscle stretch reflexes, and the construction of the first devices.

PERCUSSION

Based on wine-growers' practice of thumping their wine casks to measure the level of the liquid, the Austrian physician Leopold Auenbrugger (1722–1809) described clinical percussion of the chest, back and abdomen in 1761 (Auenbrugger 1761). But this new technique only entered clinical practice in 1826, when the French physician Pierre Adolphe Piorry (1794–1879) invented the pleximeter – a resonator, struck with a finger when applied to the chest (Piorry 1828). In about 1828, inspired by the Swiss veterinary practice of percussing the skull of cattle to detect hydatid cysts (Swieten 1765), the Scottish physician Sir David Barry (1781–1836) fashioned a hammer to strike the pleximeter (Schiller 1967). But Piorry considered the hammer superfluous and it was only adopted in mainland Europe when the German clinician Max A.Wintrich (1812–1882) created the first popular percussion hammer in 1841, later modified in 1857 (Lanska 1988). In 1912, Ebstein produced a new model the 'reflex and sensibility tester' (Lanska 1988; Ebstein 1912), for striking tendons, with a pin in one of its tips. In the second half of the 19th century, a wide variety of percussion hammers were developed, each one known by the name of its developer, with an L- or T-shape, or resembling battle-axes or magic wands (Wilbur 1987), used with pleximeters for percussing the chest or the abdomen, or to elicit the reflexes. The heads of these hammers were made of wood, whalebone, ebony, brass or some other metal, while the handles were of wood, rubber, velvet-covered worsted, lead or brass (Wilbur 1987). By 1873, 32 years

Figure 1

Figure 2

after the creation of Wintrich's model, the profusion of percussion hammers was so big that Wintrich compared their number with obstetric forceps (there were about four hundred models of forceps at this time) (Lanska 1988). Some models were sold in a box containing a pleximeter as well as a percussion hammer (Fig. 1) and others used a system to make the hammer strike the pleximeter (Fig. 2).

MUSCLE STRETCH REFLEXES

In 1870 Whilhelm Heinrich Erb (1840–1921) was the first to recognize the diagnostic utility of the patellar or knee-jerk reflex, and the use of the percussion hammer to elicit it (Lanska 1988). When he was ready to submit his paper about the knee jerk to the German Archives of Psychiatry and Neurology, he discovered that the editor, Carl Friedrich Otto Westphal, had written a similar paper. Although they had different opinions on the reflex they agreed to make a simultaneous publication (Erb 1875; Westphal 1875). There were various preferences for eliciting the reflexes – using the fingers, the ulnar surface of the hand, or a percussion hammer. Erb, Westphal and even Gowers (1845–1915) used several methods but later neurologists like Charcot (1825–1932) and Babinski preferred to use the percussion hammer (Babinski 1912).

THE FIRST REFLEX HAMMERS

The first reflex hammer was conceived by John Madison Taylor (1855–1931), a neurologist from Philadelphia. It was manufactured by the Snowdon Brothers Surgical Instruments Company and demonstrated to the Philhadelphia Neurological Society on the 27 February 1888 (Lanska 1988). It had a triangular rubber head – the base was the same size as the striking surface of the ulnar side of the hand, and the rounded apex was designed to elicit the biceps jerk. The head was encircled by a metal band, which turned into the metal handle, finishing as an open loop (Fig. 3). Around 1920 this loop disappeared and the tip of the handle became solid and sharpened to allow the cutaneous reflexes to be tested. It had two major advantages: it was light (60–70 g) and its blow did not hurt the patient, or the doctor's fingers (Taylor 1888). Taylor's hammer was popularized by Silas Weir Mitchell (1829–1914; see Sharpe *et al.* 2003), who introduced the notations KN +, KN + + and KN- for the briskness of the knee jerks (McHenry 1969).

The second reflex hammer was designed by William Christopher Krauss (1863–1909), a neurologist from Buffalo, New York, also responsible for a neuro-topographical bust, an improved tape measure, a urethral electrode and a pedo-dynamometer (Krauss 1893). This hammer was made by the G. Tiemann Company, New York and was presented to the 20th meeting of the American Neurological Association in 1894 (Fig. 4). In Krauss's own words:

> 'The hammer is constructed after the French pattern (of percussion hammers) having a heavy metallic head fixed to a flattened oval handle 17 centimetres long. As a hammer it may be used to examine the

Figure 3

Figure 4

tendon and muscular reflexes, to percuss the head, spine, superficial nerves, etc. The handle (as in Fig. 4) being of hard rubber becomes warm on friction, while the head being of metal remains cold, thus offering the means of examining the sense of heat and the sense of cold, fulfilling the requirements of a thermo-aesthesiometer. The cap (C) when removed discloses a triangular spear head about one-half centimetre long, while at the other end of the hammer head is the rounded rubber point – the two ends furnishing therefore a sharp and a dull point for examining for anaesthesia or hyper-aesthesia. The spear is divisible into two portions, one securely fixed upon the hammer head, the other moveable upon a metallic slide upon which is engraved the metric and English scales. This arrangement furnishes an excellent aesthesiometer and is as accurate and convenient as any on the market. Replacing the cap (C) and removing the cap (E) a camel's hair brush is exposed, giving a soft surface, while the metallic cap (C) gives a hard surface.' Krauss 1894

Figure 5

The German school produced two different reflex hammers. Ernst L.O. Troemner (1868–1930), a neurologist at the Hospital de St Georg in Hamburg and Professor of the University of Hamburg, designed a model in 1910, manufactured by B.B. Cassel, Frankfurt (Fig. 5). According to Troemner (Troemner 1910),

'The hammer, which is all metal, weighs approximately 100 grams, is 22 centimetres long, lies comfortably in the hand, and has a head of 8 centimetres width, with knobs of rubber at both ends which can be easily exchanged. The large head is designed for use on the large tendons of the extensor surfaces (patellar, achilles, triceps reflexes) and especially for eliciting periosteal and joint reflexes which can be quite painful with the use of smaller hammers, especially in hyperalgetic patients. The smaller head is used for percussion of flexor tendons (biceps humeri, biceps femoris, and semitendinosus). The smooth handle of the hammer can be easily cleaned and at a pinch may be used as a tongue blade. Its sharpened edge, in addition, elicits cutaneous and vascular reflexes. The hammer is being fabricated by B.B. Cassel in Frankfurt (and Krauth and Company in Hamburg (Rooke, undated; Mulder & Sahs 1975), costs 8 marks, and contains two substitute rubber heads'

During his visit to Europe, Henry Woltman (1889–1964), associate professor of neurology at the Mayo Clinic, was so impressed with this hammer that he bought some of them. Since then the Troemner hammer has become a tradition at the Mayo (Lanska 1988; Rooke, undated; Mulder & Sahs 1975).

The other German model was conceived by Bernhardt Berliner (1910) (Berliner 1910), and manufactured by Louis & H. Lowenstein, Berlin (Fig. 6). Made of metal and nickel-plated, shaped like a hatchet, with an edge covered with rubber and the handle tapered at the end to elicit cutaneous reflexes, it was sufficiently heavy to test the Achilles tendon reflex 'in all instances' (Berliner 1910).

The French school created three different reflex hammers; two were by Joseph François Félix Babinski (1857–1932) who in 1912 wrote (Babinski 1912):

Figure 6

Figure 7

'Here I will describe the two which are the most frequently used. One is constructed of a nickel-plated steel handle which is 20–25 cm long, and fixed at the end is a disk which is made of the same substance and has around its circumference a groove filled with a rubber ring [Fig. 7]. In the second type, which has the advantage of being easier to fit into a pocket, the handle is basically the same as the first type of hammer but the disk is replaced by a rectangular plate in the same plane as the handle, and it is also provided with a rubber ring in its peripheral canal' [Lanska 1988; Babinski 1912].

During a dinner in Vienna, around 1920, Babinski offered his reflex hammer to the American neurologist Abraham Rabiner (1892–1986) who altered the hammer, screwing the head to the shank, allowing the use of the head parallel or perpendicular to the handle (Fig. 8).

Joseph Jules Déjerine (1849–1917) was the inventor of the other French model. With a blunt handle, the head was formed by a rubber cylinder encircled by metal (Fig. 9).

The Queen Square hammer is based on the Henry Vernon percussion hammer (1858) consisting 'of a slender tapering handle of whalebone, eight inches in length, surmounted by a sphere of bell-metal, weighing one ounce. The sphere of metal is grooved deeply in an equatorial direction, and a stout ring of caoutchouc (this is India Rubber, Editor) is let into the groove, as a cushion upon which to strike' (Lanska 1988; Vernon 1858) (Fig. 10). The Queen Square hammer (Fig. 11) is attributed to Miss Wintle who was nicknamed 'Sister Electrical' (Schiller 1967), although she was actually one head nurse at the National Hospital for Nervous Diseases, Queen Square, London. According to MacDonald Critchley, quoted by Schiller (Schiller 1967), around 1925, she 'hit upon the happy device of fitting a ring pessary to a solid brass wheel, and mounting this upon a stick of bamboo … For years she made these herself … and sold them.' The bamboo cane was flexible, approximately 8 inches long. On one end, a rubber ring was tightly fitted on a 1.5-inch diameter brass disk; the other end was sharpened to a point for use in eliciting plantar and abdominal responses.

The last basic model (Fig. 12) is the Buck reflex hammer. T-shaped, made of nickel-plated steel with an 18-cm handle, it had two different sized rubber tips mounted on the head. In the handle's upper end a pin was screwed and in the lower one a small hair brush.

Figure 8

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15

LATER EVOLUTION OF REFLEX HAMMERS

Reflex hammers can be compared in several ways: shape, colour, materials and inclusion of equipment to test different types of sensation. Not surprisingly the basic types evolved with many modifications. The handle tip of Taylor's early hammer lost its loop, becoming sharpened, allowing testing of cutaneous reflexes as noted earlier, and sometimes plastic replaced the nickel-plated steel. Sometimes the head was colourful, and some models incorporated a hairbrush, pin or tuning fork (Fig. 13). Like the Krauss model, the McGill model incorporated a two-point discriminator and pinwheel (Fig. 14). The Troemner prototype went through several transformations: the handle became more compact or shaped in a loop, heavy and light, in plastic with different colours and the head in different styles, quite like the Berliner model (Fig. 15). A gold-plated model was given to emeritus professors and visiting neurologists at the Mayo Clinic.

Babinski's model aquired a hinge proposed by Rabiner, a telescopic handle, and, in some models, a pin and a hairbrush, or a tuning fork. The Chinese model has the head parallel to the handle like the original Babinski models (Fig. 16). Déjerine's device gained a light handle, loop shape, and pin – the Hurst model. And plastic replaced the bamboo handle of the Queen Square hammer.

Buck's model has evolved to have different colours on the rubber tips, or to a more stylized head (Gima model, Italy), to telescopic models (Hong-Kong), and to another disposition of the hairbrush and the pin (Fig. 17). The sophisticated 'five in one' model had besides the hammer a pin, hairbrush, cog-wheel and tuning fork (Fig. 18). Another model was silver-plated.

Nowadays reflex hammer heads have new shapes – Polarit models for use in adults and children (Fig. 19) – or they have a brass tip that heats when rubbed to test hot and cold sensation like the Zenith model. The head of one modern paediatric hammer is even shaped like a giraffe, and has a fixation clip allowing safe transportation (Fig. 20)!

Figure 16

Figure 17

Figure 18

Figure 19

Figure 20

CONCLUSION

The medical use of percussion has a long history, since the second half of the 18th century, from primitive pleximeters to the present day reflex hammers. Even with modern imaging, neurological examination has not lost its importance and without eliciting the stretch reflexes – with a hammer – it is not complete. The reflex hammer is still a critical tool for the modern neurologist. And although the clinical examination is a science, it is also an art and each 'artist' must play with the reflex hammer that he or she thinks is the best. So even with globalization, there is no reflex hammer that is to everyones taste. Reflex hammers are still evolving, old models are rebuilt, and new ones created. We are still a long way from a world standard reflex hammer, or even a standard 'Eurohammer'.

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