Historical Vignette

Celebrating the centennial (1894–1994): Leonardo Gigli and his wire saw

ANDREA BRUNORI, M.D., PATRIZIO BRUNI, M.D., ROMANO GRECO, M.D., RENATO GIUFFRÉ, M.D., AND FRANCESCO CHIAPPETTA, M.D.

Division of Neurosurgery, “G.M. Lancisi,” San Camillo Hospital; and Institute of Neurosurgery, “Tor Vergata,” University Medical School, Rome, Italy

In spite of the recent introduction of craniotomes in neurosurgical practice, the simple but brilliant wire saw invented by Leonardo Gigli still holds an important place in neurosurgical instrumentation. Born in Florence in 1863, Gigli was forced by circumstances to leave Italy soon after getting his medical degree. He first spent 2 years attending the most celebrated obstetrical clinics in Paris and London and then, in 1892, moved to Breslau where he worked with Fritsch and Mikulicz. During this successful and rewarding period, Gigli proposed the lateralized pubiotomy (Gigli’s operation) for safe delivery in cases of maternal pelvic deformities and, inspired by the sight of a jagged knife during a country banquet, conceived his wire saw to simplify the procedure. In 1894, at Professor Obalinski’s suggestion, he successfully tested a modified saw type with a whalebone guide for the preparation of osteoplastic cranial flaps. In spite of his great popularity and the high esteem in which he was held abroad, Gigli’s aims were systematically belittled in Italy, where he never qualified for a university teaching position. He died in 1908, at age 44.

Although the once celebrated Gigli’s operation has merely historical interest today, the favorable features of his wire saw make it a safe and efficient tool in the hands of twentieth-century neurosurgeons worldwide.

KEY WORDS • history of neurosurgery • Leonardo Gigli • wire saw • operative technique • craniotomy • historical vignette

As neurosurgeons, we are all greatly indebted to the Italian obstetrician Leonardo Gigli, the inventor of the wire saw. Everyone is familiar with this simple and efficient surgical tool, but very few are aware of Gigli’s life and medical career. Moreover, 1994 marks the centennial of his historic paper,11 which appeared in the Zentralblatt für Chirurgie of May 5, 1894 (Fig. 1).

In this paper we intend at once to celebrate the anniversary and to do justice to a man who significantly contributed to the development of modern neurosurgery.

Leonardo Gigli: His Life and Career

Leonardo Gigli was born near Florence on April 30, 1863 and received a fine education from his mother, a Tuscan woman of aristocratic descent and his father, a distinguished man of letters (Fig. 2).1,3,16,20 After graduating from Florence Medical School in 1889 he was initiated into obstetrics by Professor D. Chiarl. Because of the premature retirement of his patron, Gigli lost his position and was therefore forced to specialize abroad.1,20,21 In Paris, he attended the clinics of Tarnier, Budin, and Pinard, where he became interested in the problem of operative deliveries in cases of maternal pelvic deformities. He recognized the risks of symphysiotomy and envisioned the “lateralized pubiotomy,” a surgical procedure that would be named after him.1 After a short stay in London, Gigli moved to Breslau, Germany (now Wroclaw, Poland) where he stayed from November 1892 to June 1893.20

The German period was the most successful and rewarding of his entire life: soon he became the favorite pupil of Professor H. Fritsch, and here he conceived and realized the wire saw. The new tool was introduced and became popular in general surgery thanks especially to Professor J. Mikulicz.1,11 Gigli himself advised its use to simplify the lateralized pubiotomy.1,3,9,11,13 Therefore, not only did he propose a novel operative procedure, he also provided the appropriate instrument to perform it. Thanks to these innovative ideas, Leonardo Gigli gained fame and esteem all over Europe, as indicated by frequent invitations to speak at scientific congresses and to lecture in France and Germany. The choice of the German language and scientific journals for publication of his most significant papers is further evidence of Gigli’s affective and pro-

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On the other hand, Gigli was never accepted by the academic community in Italy because of the blind jealousy of his senior and more influential colleagues. In a letter to his friend Professor L. M. Bossi, dated November 11, 1906, Gigli wrote:

"... I am very satisfied with my short visit to Berlin. My operation is very popular here and the results are magnificent... I have been warmly received both by Olshausen and Professor Bumm. Olshausen insisted on having me for dinner at his house and he was thoughtful enough to invite the highest authorities on the faculty as well, Professor Bergmann and Professor Waldayer among them. However, I am in an awkward situation I must find a way out of: I feel deeply embarrassed at being constantly called "Professor Gigli," since I have no right to bear this title, and I am tired of explaining over and over again that I am not officially qualified for university teaching. As soon as I come back to Italy I will try to regularize my position."[1]

These touching words portray Leonardo Gigli as a deeply honest and noble minded man. Unfortunately, his claim to a title that was fully justified by his great merits was systematically denied and his candidacy ultimately rejected during the annual meeting of Italian obstetricians in Rome (1907), when the participants voted down a "solemn encomium" to the father of lateralized pubiotomy.[1,5,16]

Morally and physically devastated by this humiliating experience, Leonardo Gigli was struck by pneumonia and died at age 44, on April 4, 1908.[1,3,16,20,21]

Lateralized Pubiotomy (Gigli’s Operation) and the Birth of the Wire Saw

Difficult deliveries due to pelvic deformities were very frequent in Gigli’s time, the most common cause of deformity being rickets. Operative widening of the pelvis carried unacceptable morbidity and mortality rates for both mother and fetus, and Caesarean section was still considered too hazardous because of inadequate technical means. Other crude surgical procedures such as embryotomy were therefore routinely performed to save the mother by sacrificing the fetus.

Gigli thoroughly studied symphysiotomy, the operation originally proposed by Sigault in 1777.[1,4,7] While assisting in many cases during his time in Paris, he recognized the operation’s multiple drawbacks (fatal bleeding from venous plexuses; bladder, vaginal, and urethral lacerations; frequent infections). He realized that these complications could be overcome simply by avoiding the symphysis, and cutting on the pubic bone a few centimeters from the midline (Fig. 3).[1,4,6,8,16,21] Learning from the experiences of Aitken (1785), Champion de Bar le Duc (1832), and Stoltz-Lacour (1844), Gigli conceived the lateralized pubiotomy with the purpose of offering a surgical procedure feasible even in a domestic environment.[1,5,7,10,21] The goal was fully achieved with the realization of the wire saw, which, thanks to its features (technically simple, versatile, affordable) appeared to be the ideal tool for Gigli’s operation.[1] In fact, the first lateralized pubiotomy experience.
was performed successfully by Dr. B. Bonardi (a general practitioner) at the house of a poor mason in Lugano, on May 7, 1897.1,2

Briefly, the wire saw was guided behind the pubic bone by means of a saw carrier and then the bone was cut in less than 1 minute (Fig. 4). A retentive bandage and a 3-week bed rest were recommended after delivery.4,5,8,9,18

The operation was first presented in a paper published in 1894.10 Afterwards, Gigli dedicated to this subject 27 of his 41 publications.1,3,21

The enthusiasm for the novel technique grew rapidly: unanimous approval was expressed by the most celebrated obstetricians of the time; Bumm, Döderlein, and Fehling among others. In Rome in 1905, Gigli himself presented a critical review of the first 100 cases reported in the world literature.1,15,20,21 In spite of this, we remain ignorant of the reasons why Gigli waited as long as 8 years to perform his first pubiotomy on a living subject (1902).1,20

Curiously, while the once celebrated Gigli’s operation has merely historical interest today, the favorable features of the wire saw make it a safe and efficient tool in the hands of modern neurosurgeons worldwide.

Further Technical Improvements: The Introduction of the Wire Saw in Neurosurgery

Before Leonardo Gigli’s innovation, a wide variety of surgical saws was used to perform osteotomies. In the early days of neurosurgery, the skull was usually opened by means of a trephination enlarged either by bone forceps or mallet and chisel; the resulting defect served as a useful postoperative decompression. A major advance in operative neurosurgical technique was achieved by Wilhelm Wagner, who prepared the first osteoplastic cranial flap in a living subject on October 3, 1889. Aware that brain concussions resulted from the hammering necessary for chiselling, Wagner conceived the use of “... circular saws... set in motion similar to dentist’s drills...”24,25

In 1891, J. Toisson suggested that the calvaria between burr holes could be divided from within outward with a “chain saw.”22,23 As the name implies, the latter was composed of numerous links joined by strong rivets (similar to a modern bicycle chain), which had a handle attached to each extremity.5,23 Its most common application was in cutting long bones during amputations without injuring underlying soft tissue.6

Leonardo Gigli considered this instrument too sophisticated, easy to break, and moreover too expensive.11
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According to the legend, inspired by the sight of a jagged knife during a country banquet,1 he conceived a new saw type. With the technical advice of H. Härtele, a fine surgical instrument maker from Breslau, the new tool was quickly realized: it consisted of two toothed steel wires twisted together for a total diameter of 0.65 mm, which he named “Drahtsäge” (wire saw) (Fig. 5). In 1894 Gigli published in the prestigious Zentralblatt für Chirurgie a preliminary technical note in which he gave instructions for its correct use, determined indications, and warned against inferior imitations. As advertised in the last paragraph of the article, a dozen Gigli–Härtele saws in the original package cost 3 DM (40 pf for shipping), with a special discount and free samples for clinic directors.11

Soon the wire saw became a familiar surgical instrument for physicians practicing at any level; in the account of the first pубiotomy on a living subject, Dr. Bonardi2 states: “... I was aware of dangers hidden in the midline... therefore I chose lateralized pубiotomy instead of the classic symphysiотomy, as advised by Gigli himself. For this purpose I planned to use the special Gigli wire saw which I always carried in my obstetrical kit....” In a paper published in 1897 in the Zentralblatt, Professor A. Obalinski9 from Krakow pointed out the potential relevance of Gigli’s saw in cranial surgery. Gigli14 promptly responded to the invitation and the following year replied with his historic paper on cranial resection. To “... introduce the saw under the bone without exerting pressure and damaging the membranes of the brain.” he supplied the wire saw with a flexible whalebone guide and a grooved probe bent at one end at almost a right angle. Gigli proudly states that “... sometimes I was able to push the whalebone on the surface of cerebral hemispheres from the occipital bone as far as the upper edge of the orbit....” Then a silk thread was led under each one of the flap’s edges, with another continuous thread tracing the same path with the ends coming out of two adjacent burr holes. By pulling the latter, a complete detachment of the dura from the inner table was obtained; the former served to pull the wire saw under the edges of the flap. Then the flap was cut in the usual fashion12 (Fig. 6).

Although Gigli was an obstetrician and the procedure reported had been performed on a cadaver, he states “... I would have preferred to postpone this publication until after performing the operation on live subjects....” Although he did not carry out this wish, he certainly continued to study the problem of “Kranietomie,” introducing a new self-blocking trepan and modifying the saw's guides: clumsy whalebone was replaced by a flexible steel rod hooked at one end. To render the procedure easier Gigli invented an ingenious device made from two steel straws, parallel to each other and gently curved at one end. Threads were passed through the cavity of the straws. By spreading the points introduced into the narrow burr hole a loop of thread was presented, and this was easily grasped by means of the aforementioned hook.12

Conclusions

Neurosurgical instrumentation undergoes continuous updating thanks to technological advances and to the prolific ingenuity of some innovators. The case of Leonardo Gigli is a peculiar one, because the contribution comes from a physician devoted to a specialty unrelated to neurosurgery.

In spite of the growing use of air-driven cranietomies, the old wire saw hangs on to its place in operating rooms worldwide: no other instrument is as gentle to the dura mater, which is often tightly adherent to the inner table (as in the elderly and in meningiomas) and therefore easily ripped by the cranietome. Moreover, by increasing the angle between skull surface and the wire saw, beveled cuts are easily obtained; this prevents postoperative depression of the bone flap and possible cosmetic deformity.17 Such risks are undoubtedly harder to avoid using a cranietome. As originally pointed out by its inventor, the wire saw is still a simple and inexpensive surgical tool. Our only regret is that we will not be there to celebrate the bicentennial of Leonardo Gigli’s wire saw!

Acknowledgment

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References


Fig. 6. Illustrations from Gigli’s 1898 paper14 showing the final course of silk threads through burr holes (left) and sawing technique (right). For detailed description, see text.
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Address reprint requests to: Andrea Brunori, M.D., Division of Neurosurgery, “G.M. Lancisi,” San Camillo Hospital, Circonvalizzazione Gianicolense 87, 00152 Rome, Italy.