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REVIEW PAPER

Langenbeck's legacy to the specialty of abdominal wall and hernias: father, Conrad Johan Martin L. and son, Maximilian Adolf L

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ABSTRACT

Background: The history of inguinal hernia surgery has gone through many stages of development, but none as intense as the radical cure stage. Of the founding fathers of the specialty, history has left out Conrad Johan Martin Langenbeck and forgotten his son, Maximilian Adolf.

Objective: Analyze the importance of the Langenbecks, Father and Son, in relation to the specialty of Abdominal Wall and Hernias.

Results: The contributions of the Langenbecks, father and son, to the anatomical and surgical science of hernias were remarkable and groundbreaking, especially in the challenging pre-antiseptic era. Their studies and experiences were fundamental to understanding current surgical practices for hernia repair. The research presented in this article demonstrates the individual legacy of the Langenbecks in both the anatomy and surgery of inguinal hernias.

Conclusions: The Langenbecks championed the role of the university-trained anatomical surgeon as essential for operating on hernias with low morbidity; they were pioneers in adapting personalized treatment and laid the groundwork for understanding the posterior approach and plug hernioplasty. History should recognize them as the founding fathers of the specialty.

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Langenbeck; Conrad Johan Martin; Maximilian Adolf; surgical history; inguinal hernia; hernia surgery; abdominal wall; radical cure of hernias

Introduction

The history of inguinal hernia surgery has gone through many stages of development, but none as intense as the era of radical anatomical advancements and cures. With the arrival of the nineteenth century, advances in the anatomical knowledge of the inguinal region, followed one after another, laying the theoretical foundations of the specialty, thanks to a quintet of internationally renowned figures: Camper (1801), Cooper (1804), Hesselbach (1806), Scarpa (1809), and Cloquet (1817) [1–4]. History has omitted Conrad Johan Martin Langenbeck (CJM) from this list and from the recognition he deserves, and has forgotten his son, Maximiliam Adolf (Max.). This fact could be partly explained by the predominance of French and English medical literature and the difficulty in obtaining German texts from that period [5].

The development of radical hernia surgery during the second half of the nineteenth century stemmed from the traditional technique of ligating the hernial sac, a practice carried out since antiquity, although until then associated with castration. Very few surgeons dared to operate on hernias due to their high mortality rate; Cooper and Scarpa were among them. Only CJM dared to perform it, becoming a link between the ancient history of hernia surgery and the modern era, ultimately driven by the advent of anesthesia and antisepsis. Despite this, CJM's contributions are not well known, nor are those of his son Max, and they are even confused in the literature, which uses only the surname Langenbeck without distinguishing between them [6–9]. Only by thorough comparison of the publication dates can we distinguish the individual legacy of each of them.

The objective of this study is to analyze the importance of the Langenbecks, Father and Son, in relation to the specialty of Abdominal Wall and Hernia Surgery.

Biographical Notes on Conrad Johan Martin, Langenbeck father (summarized in Table 1).

Formative stage

He was born in Horneburg on December 5th, 1776. He studied medicine at the University of Jena, with professors such as Justus Christian Loder (1753–1832), Wilhelm Karl Friedrich Suckow (1770–1848),

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Table 1. Chrono-biographical data of Conrad Johan Martin Langenbeck.

1776	Born in Horneburg (Bremen)
1794–98	University of Jena
1798	Doctoral Thesis
1799–1802	Royal Scholarship for training: Vienna and Würzburg
1802	Authorized by A.G. Richter, University of Göttingen
1804	Associate Professor of Anatomy
1807	Founded the 'Clinical Institute of Surgery and Ophthalmology'
1806–13, 1818–28	Publishes the journal 'Library of Surgery'
1808	Professor of Anatomy
1814	Professor of Anatomy and Clinical Surgery*
1815	Military Surgeon, Army of Hanover (Battle of Belle Alliance, Antwerp, and Brussels)
1816	Court Advisor (Royal House of Hanover)
1828	New Anatomical Theatre, Göttingen
1840	Senior Medical Advisor
1845	Member of the Royal Swedish Academy of Sciences Knight of the Royal Guelph Order
1848	Dismissed as Professor of Surgery and Director of the Surgical Clinic
1851	He died in Göttingen (succeeded by F.G.J. Henle)

*Last professor to hold the chairs of Anatomy and Surgery in Göttingen.

Christian Gottfried Gruner (1744–1815), Christoph Wilhelm Friedrich Hufeland (1762–1836), and Johann Christian Stark (1753–1811). After defending his thesis in 1802 (Über eine einfache und sichere Methode des Steinschnittes) to obtain his doctorate in medicine at the University of Jena, he moved to Vienna to continue his studies with Johann Peter Frank (1745–1821), Johann Lucas Boër (1751–1835), and Georg Joseph Beer (1763–1821) (6 months). Upon his return to Horneburg, he worked as a surgeon and ophthalmologist, gaining considerable social recognition. He was awarded a royal scholarship, which allowed him to undertake two additional periods of training: (1) in Würzburg, perfecting his anatomy and surgery with Karl Kaspar von Siebold (1736–1807) at Julius Hospital (two and a half years); and (2) back in Vienna, with Beer and Frank, modernizing his ophthalmology and practicing dissection in the mortuary chapel. Returning to Würzburg, he spent another six months with Franz Kaspar Hesselbach (1759–1816), training in anatomy and hernia surgery. Finally, he received his habilitation from August Gottlieb Richter (1742–1812) at the University of Göttingen (1802) and was hired as a private tutor and surgeon at the academic hospital (1802–1807). This university became his home, and he spent the rest of his life there. In 1803, he established his own lecture hall and began his teaching career with anatomical and surgical demonstrations. He was assigned the cadavers delivered to the anatomical operating room during the summer months, and as an invitation, he wrote a text 'On some important requirements for the training of the surgeon' [10,11].

Maturity stage

In 1804, he was hired as an associate professor of anatomy, and in his inaugural address, he again emphasized the need for surgeons to possess precise anatomical knowledge. In 1807, he founded his own Clinical Institute of Surgery and Ophthalmology, for which the university council granted him funding and the former residence of the school director. In 1809, it was expanded with several larger and better-ventilated wards, and a bright operating theater (1811). In 1821, new wards for private patients were added (total: 400 beds), and it was directly connected to his private residence. As a military surgeon in the Hanoverian army, he participated in the Battle of Belle-Alliance (near Waterloo, 1815), distinguishing himself by his precision and speed (the surgeon of the winged scalpel: he performed amputations in 4 min).

Alongside his work at the hospital, he continued Richter's (1771–97) work in the journal 'Library of Surgery', where he compiled the latest advances in European surgery (1818–28). He was promoted to the Chair of Anatomy after Wrisberg's death (1808), with the support of the House of Hanover, and reorganized the entire teaching program. He built a new Anatomical Theater and expanded the Museum of Dissection Specimens. To this end, he donated all his own works, purchased the private collection of Professor Gottlieb Leberecht Heyer (1747–1797), attracted private donations such as those from Johann Friedrich Blumenbach (1752–1840) and Caspar Ludwig Julius Mende (1779–1832), and contributed new specimens. His immense commitment garnered government support. In 1814, he was appointed Professor of Anatomy and Surgery, holding both chairs for over 30 years, until political changes forced him to relinquish the Surgery position (1848). Although he remained Professor of Anatomy until his death, he never overcame his resentment at being dismissed. His health gradually deteriorated until his death on January 24, 1851, and he was succeeded in the chair by Friedrich Gustav Jakob Henle (1851–1885) (Figure 1) [11–13].

Langenbeck son: Maximilian Adolf. (1818–1877)

He was born on January 11, 1818, in Göttingen. He studied at the Lyceum and the Karolinum in Braunschweig. From 1835 to 1840, he studied medicine in Göttingen, and later in Paris, Vienna, and Berlin. In 1842, he earned his doctorate with a dissertation on the famous hysterectomy performed by his father (first vaginal hysterectomy in 1813 on a woman with uterine cancer who survived the operation for 26 years, without anesthesia). In 1843, he was appointed university professor and began lecturing on anatomy, surgery, and ophthalmology—the same fields in which his father had excelled. In 1848, he resigned his teaching position, coinciding with his

Figure 1. A: Portrait of Conrad Johann Martin Langenbeck, the father (by Ludwig Emil Grimm). B: Portrait of Maximilian Adolf, the son (unknown artist, signature in the lower right third of the image, 1853; Collection of the Göttingen State and University Library). C: Portrait of Bernard, the nephew (or the cousin) (by August Hirschwald or H. Riffarth, 1888). Wellcome Historical Medical Museum. This last one is the one truly recognized by the history of surgery.

father's dismissal, and after his father's death, he moved to Hanover, where he practiced surgery from then on. This move was a consequence of the persecution he suffered for being, like his father, a supporter of the monarchy. In Göttingen, the 1848 revolution against absolutism was felt intensely in the university environment, the center of the unrest where the memory of the professors expelled in 1837 for defending the constitution served as a moral catalyst for the revolutionaries of 1848. This instability affected the Langenbeck family. In Hanover, a wound had already been open since 1837, when King Ernest Augustus I revoked the liberal constitution of 1833 upon ascending the throne. Discontent there was predominantly rural and forced the authoritarian monarch to appoint liberal ministers, restore freedom of the press, and democratize the Lutheran parishes.

From 1862 until his death, he devoted himself intensely to subcutaneous herniotomy and herniorrhaphy, operations he attempted to integrate into radical inguinal hernia surgery. In 1865, he was appointed to the Higher School of Medicine, but he resigned from this position. He died on May 2, 1877, in Hanover. His father's influence was always with him, but despite this, he developed his own intense and very diverse activity: in radical hernia surgery, in the control of compression aneurysms, in ophthalmology discovering the accommodative curvature of the lens (1847) before Hermann von Helmholtz (1821–1894) (he studied cataracts, eye inflammations, the Purkinje-Sanson light test, foreign bodies in the eye, etc.), in traumatology he was a pioneer in the correction of deviated knee joints under ether anesthesia (before his cousin Bernard) (1847), dislocations, healing of fractures, spinal deformity, contracture and ankylosis of the knee, etc., and a pioneer in the inoculation of medicines. Despite his commitment and enormous lifelong efforts, he did not achieve international recognition because his discoveries were quickly surpassed (in the inoculation of medicines by the widespread use of hypodermic injections; or in herniotomy by the arrival of antisepsis and the development of dissection surgery) (Table 2) [14,15].

The Langenbeck family and hernias

Anatomy of an inguinal hernia

The development of anatomical knowledge in Germany spread across the country from south to north, from Leipzig with J.C. Rosenmüller (1771–1820) and J.K. Wilhelm Walther (1796–1859), to Würzburg with the Hesselbachs, Frank Kaspar the father (1758–1816) and Adam Kaspar the son (1788–1856), and from Heidelberg with J.A. Nuhn (1814–1889), to Göttingen with the Langenbecks. Interest in hernias already existed in Göttingen thanks to Richter. When Conrad arrived at the University, he continued this line of research and deepened his knowledge alongside F.K. Hesselbach. He focused on the development of the peritoneal canal, the formation of the sac, and the migration of the testicle [16]. CJM's teaching method, of which his son was his most devoted student, was based on the premise that anatomy was the foundation of all medical knowledge. This approach is the common thread running through all of their works. They consistently emphasized the close connection between anatomy and surgery. They considered the practical application of anatomical knowledge an indispensable prerequisite for medical

Table 2. Publications of the Langenbecks, father (CJM) and son (Max.).

	Conrad Johan Martin Langenbeck (1776–1851)
1802	*Über eine einfache und sichere Methode des Steinschnittes* (On a simple and safe method for lithotomy or bladder surgery)
1803	*Tractatus anatomico-chirurgicus de nervis cerebri in dolore faciei consideratus* (Anatomical-surgical treatise on the cerebral nerves in facial pain considered)
1805	*Anatomisch-chirurgische Abhandlung über den Hirnnerv bei Gesichtsschmerzen* (Anatomical-Surgical Treatise on the Cerebri Nerve in Painful Face) *Anatomisches Handbuch* (Anatomical Handbook)
1806	*Anatomisches Handbuch* (Anatomical Handbook)
1806–13	*Bibliothek für Chirurgie und Augenheilkunde* (Library for Surgery and Ophthalmology, 4 vols.)
1815–18	*Neue Bibliothek für Chirurgie* (New Library for Surgery, 4 vols.)
1817	*Ein Kommentar zum Aufbau des Peritoneums, der Tunica testis und deren Abstieg vom Abdomen in den Hodensack zur Veranschaulichung der Natur von Hernien* (Commentarius de structura peritonaei, testiculorum tunicis, eorumque ex abdomine in scrotum descensu, ad illusstrandam herniarum indolem)
1818–28	*Neue Bibliothek für Chirurgie und Augenheilkunde* (New Library for Surgery and Ophthalmology, 4 vols.)
1821	*Abhandlung über Leisten- und Schenkelhernien* (Treatise on inguinal and femoral hernias)
1822–50	*Nosologie und Therapie chirurgischer Erkrankungen* (Nosology and Therapy of Surgical Diseases, 5 vols.)
1826–41	*Icones Anatomicae* (Anatomical Icons, 8 vol.)
1831–47	*Handbuch der Anatomie mit Bezug auf die Icones Anatomicae* (Handbook of Anatomy with Reference to the Icones Anatomicae)
1848–51	*Mikroskopisch-anatomische Illustrationen* (Microscopic-anatomical illustrations, 4 vols.)
	Maximilian Adolf Langenbeck (1818–1877)
1842	*Über die Ausstülpung der gesamten Gebärmutter mit Bronzetafeln* (De totius uteri extirpatione cum tabulis aeneis. Göttingen: Ex officina Dieterichiana)
1847	*Untersuchungen am Allantois* (Investigations on the Allantois. Göttingen: Printed and published by Dieterich's Bookstore)
1848	*Zur Effektivität der medizinischen Polizei* (On the effectiveness of medical police. Hanover: Vandenhoeck and Ruprecht)
1849–50	*Klinische Beiträge aus den Bereichen Chirurgie und Augenheilkunde* (Clinical contributions from the fields of surgery and ophthalmology. Göttingen: At Dieterich's Bookstore)
1851	*Die Mängel gängiger orthopädischer Behandlungsmethoden bei Wirbelsäulendeformitäten* (The shortcomings of common orthopedic treatment methods for spinal deformities)
1852	*Heilung von Kontrakturen und Steifheiten des Kniegelenks* (Healing of Contractures and Stiffnesses of the Knee Joint)
1856	*Die Impfung von Drogenkörpern, einschließlich einer Übersicht über einige meiner früheren Arbeiten* (The Inoculation of Drug Bodies, Including a Review of Some of My Earlier Works. Hanover: Carl Rümpler)
1858	*Die gestische Dehnung der Kniekontrakturen unter besonderer Berücksichtigung ihrer Gegensätze* (The gestural stretching of the knee contractures with special consideration of their opposites. Hanover: Schmorl & von Seefeld)
1859	*Sonnenstich der menschlichen Augen* (Sunstroke of the Human Eyes. Hanover: Schmorl & von Seefeld)
1861	*Beiträge zur Impfung mit Arzneimitteln* (Contributions to the inoculation of medicines. Memorabilia)
1864	*Trichinella-Prophylaxe. Allgemeine Wiener medizinische Zeitung* (Trichinella prophylaxis)
1868	*Gebärmutterentfernung bei vollständigem Gebärmuttervorfall* (Uterine excision in cases of complete prolapse. Memorabilia)
1870	*Akkommodationstheorie und ihre Störungen* (Accommodation theory and its disorders. Memorabilia)

and surgical practice and advocated for the academic training of surgeons. They left behind a veritable school of exceptionally skilled surgeons, among whom we highlight Louis Stromeyer (1804–1876) and his nephew Bernhard von Langenbeck (1810–1887), whose first students were Theodor Billroth (1829–1894) and Emil Theodor Kocher (1841–1917) [10–12].

Regarding the abdominal wall, his atlas, an exceptionally rare work due to its unique production (self-financed, avoiding commercial publishers), presents a detailed topographic study of the abdominal planes, highlighting the dissection of the transversus abdominis muscle, where he demonstrates its closing effect as an abdominal girdle or band, and its areas of weakness in the lumbar region, so important in current incisional hernia surgery (Figures 2 and 3) [20,21]. It is also noteworthy for: (1) the meticulous study of the inguinal region, hand-painting the vessels to alert surgeons to potential injury; (2) being a pioneer in including the preperitoneal and muscular course of the inguinal nerves; and (3) including surgical applications and anatomical variations to raise surgeons' awareness and prevent complications due to errors during surgery (Figures 4 and 5).

Max followed his father's anatomy (the peritoneal hernial sac theory) and expanded his training with other prominent figures such as Henle and Nuhn, whose main legacy in the field of hernias was the description of the fascial funnel theory. This theory proposes that the peritoneum and fasciae form a funnel-shaped structure, or 'processus vaginalis fasciae transversalis', which projects outward, facilitating the descent of the viscera in cases of weakness. The transversalis fascia invaginates into the internal inguinal ring, creating a funicular sheath that envelops the spermatic cord, an essential structure for

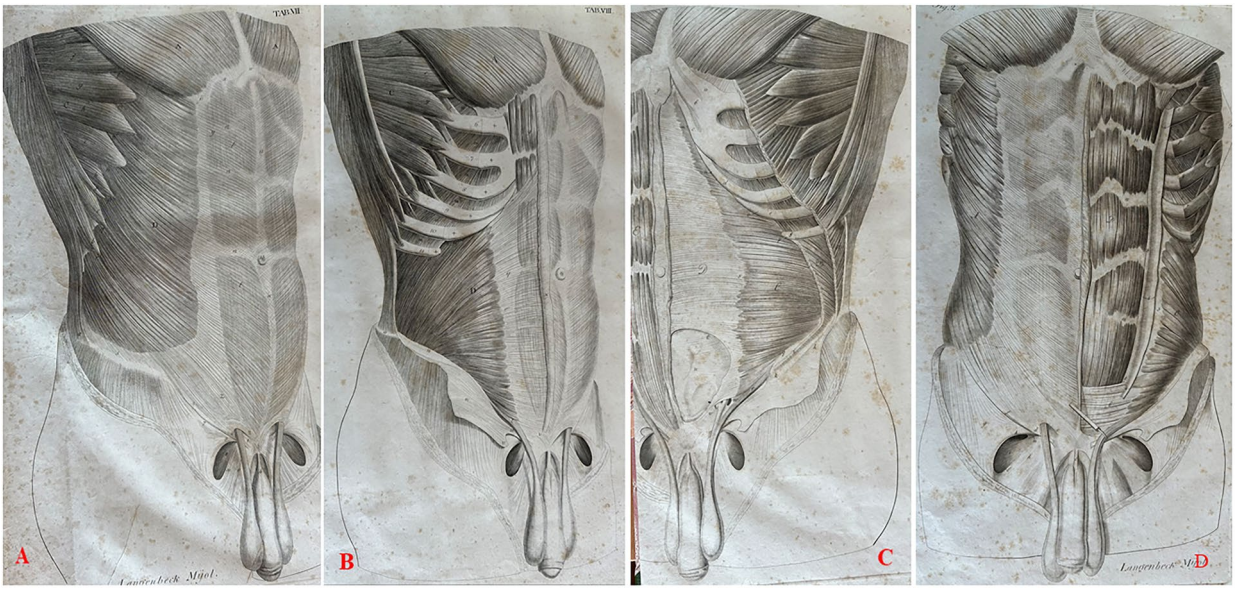

Figure 2. Topographic study of the abdominal wall and the musculoaponeurotic inguinal canal. A: External oblique plane. B: Internal oblique plane. C: Transversus abdominis plane. D: Study of the rectus abdominis and abdominal aponeuroses [17].

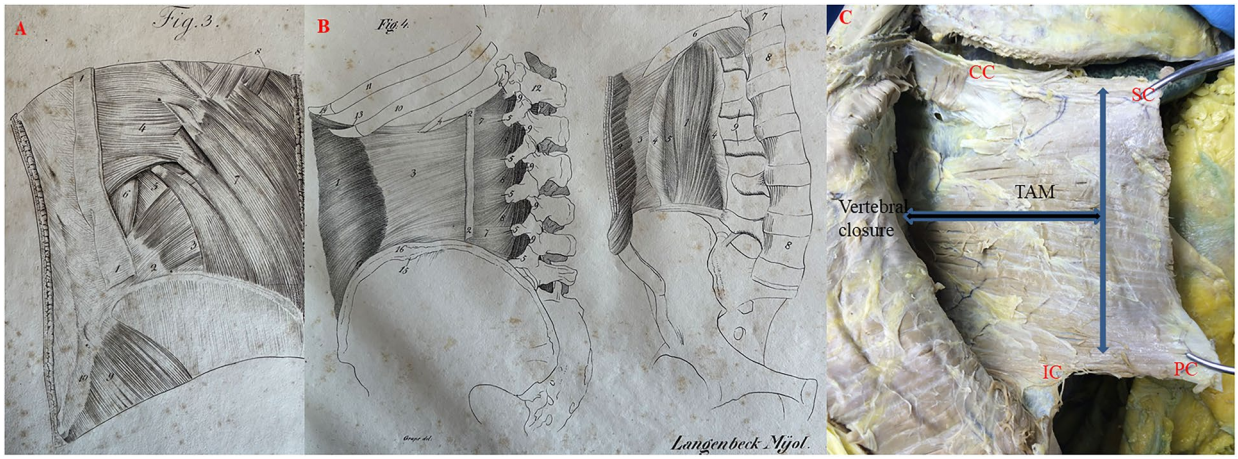

Figure 3. Study of the transversus abdominis muscle and lumbar region. A: shows the musculoaponeurotic insertions of the abdominal wall into the lumbar space (Grynfelt). B: details the abdominal closing effect of the transversus abdominis, providing protection and abdominal support with costal, vertebral, and iliac bone fixation [18]. C: current dissection by the author (TAM: transversus abdominis muscle; CC: costal closure; SC: sternal closure; IC; iliac closure; PC: pubic closure) [19].

understanding how the hernial sac slides through the inguinal canal and forms an indirect hernia. As we can see, the Langenbecks modified the understanding of hernia pathology, shifting the typical study from focusing on the anterior plane as the true inguinal canal (as described by Scarpa or Cloquet) to focusing on the posterior plane or preperitoneal space. This concept, viewed from a modern perspective, lays the foundation for accepting repair techniques *via* posterior or preperitoneal approaches (Figure 6) [17,18].

Radical hernia surgery

Conrad JM's experience in hernia surgery

Subcutaneous operation: occlusion and compression technique

CJM treats uncomplicated hernias, usually conservatively, using a combination of invagination and occlusion. First, he invaginates a small portion of the scrotal skin, then applies a compress to the external inguinal ring with firm pressure, and finally places a local compression bandage. According to CJM, both of these factors cause inflammation and supposedly lead to obliteration of the inguinal canal by fibrosis. These invagination methods, according to Thierry, cannot be considered effective, since their action only affects superficial and not deep layers. Therefore, if the hernia does not recur after the operation, it frequently will as soon as the patient stops using the bandage and begins working (Figure 7A) [7,22,25–27].

Dissection technique with ligation of the sac

CJM was one of the few surgeons who dared to perform open dissection on hernias in the pre-Lister era. After dividing the integument over the swelling, he cleans the hernial sac, reduces the prolapsed

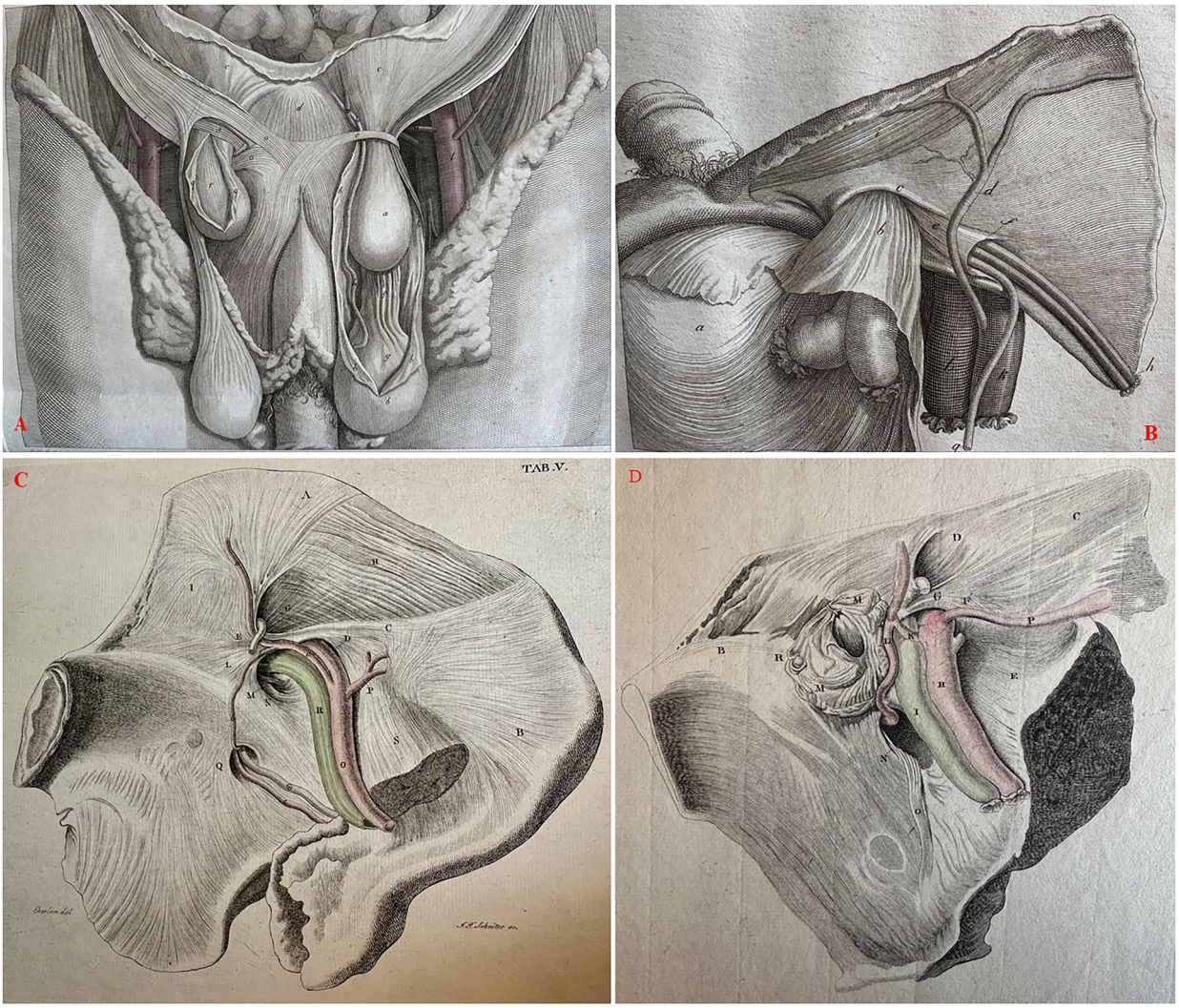

Figure 4. Study of the inguinal region, with hand-painted vessels to alert surgeons. Hesselbach's influence is evident; they even share the same illustrator in their later dissections (J.F. Schröter). A: Hernia study, anterior approach. B: Detail of the epigastric artery in an internal inguinal hernia, posterior approach. C: Normal vascular arrangement in the retroperitoneal space. D: Relationship of vessels in a double internal and external hernia, posterior approach [21].

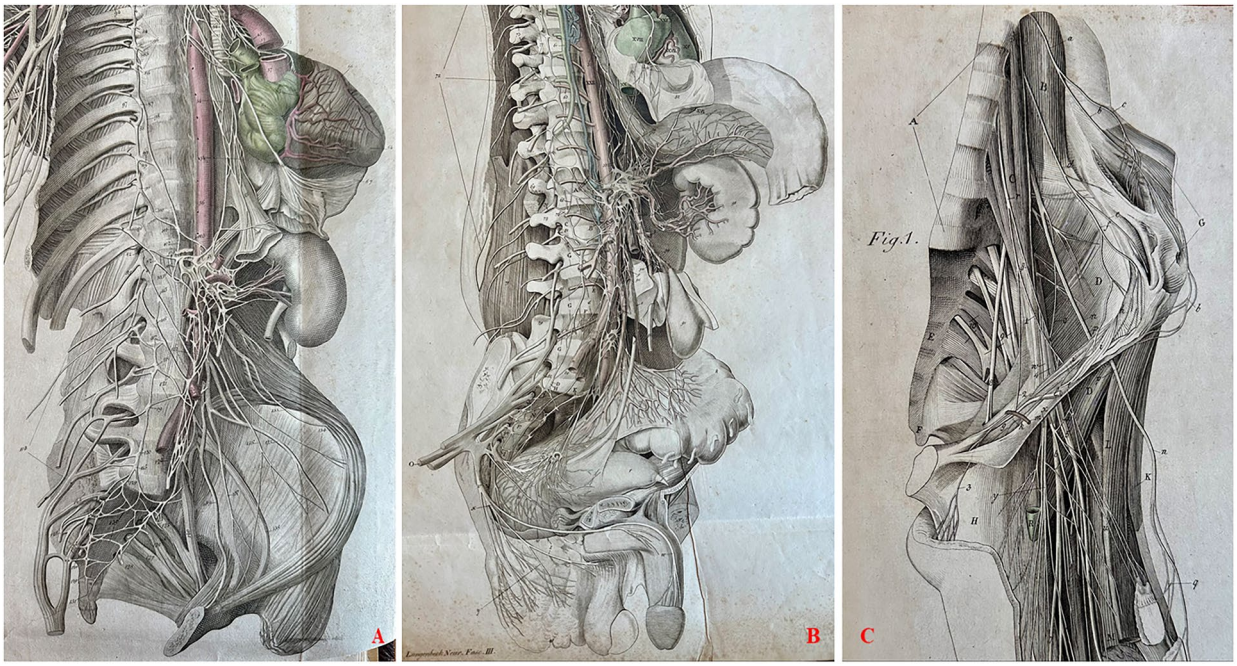

Figure 5. Neural study of the lumbar plexus. A: shows the retroperitoneal course. B: detail of the course of the inguinal nerves following the canal to the penis and scrotum. C: intermuscular and fascial course over the iliac crest [17].

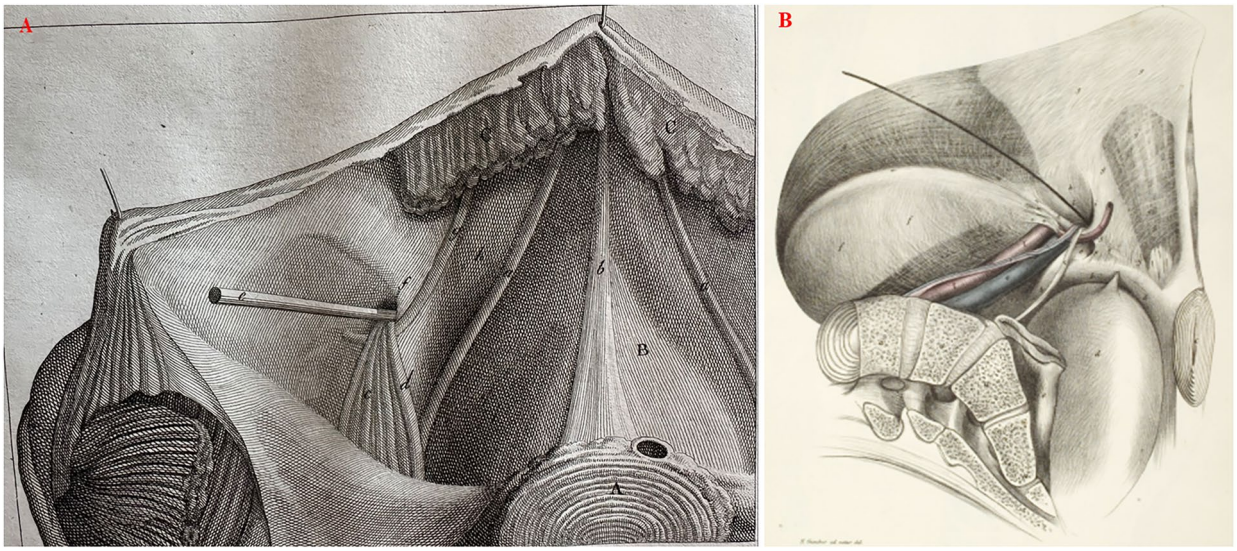

Figure 6. Posterior fascial funnel theory, in relation to the pathogenesis of inguinal hernias. A: study according to Conrad Langenbeck, starting from the peritoneal canal. B: study according to Nuhn, starting from the transversalis fascia [21,22].

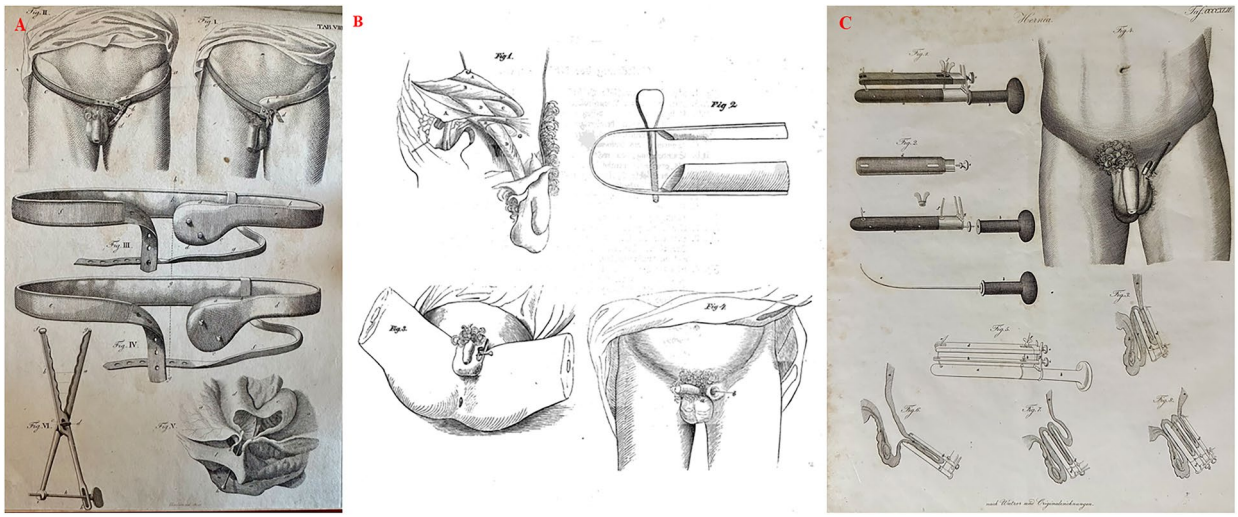

Figure 7. Hernia repair technique according to the Langenbecks. A: Containment trusses and clamp designed by Conrad JM [14]. B: Max technique. Figure 1. Shows the topographical features of the inguinal region. Figure 2. Hernia clamp designed by Max in its actual size. Figure 3. Shows how the hernia clamp is applied to the patient. The thicker arm is inserted completely into the abdominal ring. Figure 4. Shows the wound surface after removal of the instrument. a. Invagination of the scrotal skin at the level of the inguinal ring. b. Artificial opening created by the pressure of the clamp [23]. C: Wützer technique. The correct way to position the clamp is shown in Figure 4, and the incorrect way in Figures 5–7 [24].

portions, and places a high ligature at the neck of the sac, near the abdominal ring. He never opens the sac; he ligates it and leaves it. If it has completely separated from its connections, it collapses below the ligature. If, on the other hand, it has separated only enough to pass the ligature and remains connected to the scrotum, it becomes inflamed below, similar to what occurs after radical hydrocele surgery. Above, the ligature causes inflammation of the serosal surface, and the neck of the sac closes to the abdomen, as happens with a ligated portion of an artery. He advises against separating the entire sac from the scrotum and the tunica vaginalis proper of the testicle because it is traumatic. The ligature detaches between the 9th and 14th day [22,25,28–30].

Criticisms of the CJM technique

1. From a theoretical standpoint, the sac cannot be obliterated above the abdominal ring; therefore, a portion of the sac remains open, allowing for possible descent of the viscera. This criticism was not shared by its author, who strongly opposed this view.
2. The theory that the neck of the ligated sac obliterates along the canal to the internal opening, as a ligated artery would to its nearest branch, was unfounded. It has not been experimentally demonstrated.
3. The technique does not act on the rings; they remain intact, theoretically allowing for a possible future hernia protrusion [31].

Results

CJM acknowledges having performed this operation in 12 cases, across the three main types of hernia (indirect, direct, and femoral), with complete success. All patients were able to perform heavy work without bandages and were followed up for two years. The operation was advocated by Swedish colleagues such as Olof af Acrel (1717–1806), Englishmen such as William Sharp (1729–1810) and John Abernethy (1764–1831), and Frenchmen such as Jean-Louis Petit (1674–1750). However, although they also achieved numerous successes, they reported high mortality rates: Abernethy and Sharp reported two cases; Acrel and Petit, one case. Exposure of the peritoneum, manipulation of the spermatic cord, and strangulation of the sac exposed patients to peritonitis or testicular complications [31]. CJM's success depended on his extensive anatomical knowledge and meticulous dissection. The other key pillar of his success was prudence, a quality he learned from his mentor Richter [22].

Indications

CJM notes that surgery is easier in small, non-scrotal external hernias, in internal hernias because their sac is not closely connected to the spermatic cord, and in femoral hernias where the sac can be easily dissected and isolated.

(a) In uncomplicated hernias: surgery is not recommended, but scarification of the sac and placement of a band with a wool-lined rubber ball at the neck of the sac to create fibrosis are advisable, thus avoiding exposing a healthy person to the dangers of surgery.

(b) In incarcerated hernias, surgery is recommended, but the need for adequate anatomical knowledge to choose the correct time to perform it is emphasized. Early herniotomy by a knowledgeable hernia specialist is not a dangerous operation. If the patient dies, the operation is not to blame, but rather the delay in the decision, because the consequences can no longer be avoided by surgery. Precise knowledge of the planes and relationships of the sac is essential. Intestinal or vascular injuries must never be inflicted. The sac should be stretched, folded, and divided just below the fold; this maneuver avoids visceral injury. The operation can be performed successfully if the surgeon has anatomical knowledge of the arrangement and variations of the inferior epigastric artery [22,25].

Max's experience with radical hernia surgery

Complete closure technique of the hernial tract

For Max, the radical treatment of hernias had to guarantee two principles: safety and cure. No patient should undergo surgery if their life was in danger or if there was no hope of a cure. During his early years, he followed his father's conservative method and, having firsthand knowledge of the complications of open surgery, avoided it. While his father was an accomplished anatomist and skilled surgeon, Max was more of a surgeon than an anatomist, but arguably one of the best trained in hernia pathology. He preferred to follow Wützer's method, taking it to its extreme. The German surgeon Carl Wilhelm Würtzer (1789–1863) designed the subcutaneous invagination of the scrotal sac and part of the scrotal skin into the inguinal canal, blocking it. To fix it, he used a wooden cylinder with a curved needle that was passed through the tissues, causing inflammatory irritation that sealed the defect. It was widely used between 1840 and 1860 due to its relative simplicity but had a high recurrence rate. Max's goal was to achieve fusion of the walls of the of the hernial sac and the inguinal canal along their entire length through prolonged external pressure. To this end, he designed a new clamp with longer, straighter prongs, so that the compression applied over a greater length of the inguinal wall and canal [23].

Technique

In the pre-anesthetic and pre-antiseptic era, after invaginating the scrotal skin as deeply as possible into the inguinal canal, position the clamp and tighten the screw so that the external ends touch, with the thicker arm of the clamp inside the canal and the other over the external skin. In this way, both arms contain: (a) a portion of the inverted scrotal skin, (b) the anterior wall of the inguinal canal, and (c) the general coverings [23,32] (Figure 7B).

Applied anatomical basis

Max follows Nuhn's theory of the triangular arrangement of the inguinal region, denying the existence of a true canal. He assumes that the canal theory is incorrect and cannot be applied to the development of hernias. The spermatic cord lies between two laminae weakly connected by cellular tissue, in an irregularly triangular space. The anterior and posterior walls are formed by the aponeuroses of the external oblique and transversus abdominis muscles, which, being lax over one another, allow passage of the transversalis fascia sac containing the cord. The cord, without entering a canal, descends between the muscle laminae [33,34]. As a 21st-century surgeon, if we accept this theory and apply it to current hernioplasty, the result would be the prohibition of the use of plugs in hernia repair: if there is no canal, one cannot plug a space that does not exist; the repair involves the use of a flat mesh in the sliding parietal laminar space.

Proper use of the max clamp

Following the described topography, one arm of the clamp is inserted through the ring and positioned in the inguinal triangle (not the canal), where it can move freely inward and outward. The posterior surface of the arm, surrounded by the inverted scrotal skin, lies over or adjacent to the spermatic cord, and its rounded tip, enveloped by the tunica vaginalis, presses upward against the lower border of the internal oblique muscle or, if lowered, presses the transversus abdominis aponeurosis toward the abdominal cavity. Once the instrument is closed, it is left in place for 14–18 days, and gradually tightened until the arms touch. The patient should lie supine during this time. The clamp injures the soft tissues between the arms, inducing deep and circumferential inflammation that fixes the invaginated scrotal sac to the walls of the inguinal triangle. Upon removal of the clamp, the wound is cleaned of necrotic tissue, particularly tendon fibers of the external oblique aponeurosis. Granulation tissue is visible, and a slight movement of the spermatic cord can be felt within it when the scrotum is gently pulled. The wound is firmly packed with warm chamomile compresses for 3–4 weeks. Afterward, the patient can walk while wearing a jockstrap (not a truss) until final healing occurs [23].

Author's warnings

- For the operation to be successful, one arm of the forceps must penetrate the ring. If an invagination is performed without passing through the abdominal ring to the inner surface of the external oblique muscle, the cure will not be successful (Figure 7C).
- In the first few days, some numbness and pressure discomfort are noticeable, followed by local inflammation, burning and stinging, redness around the instrument, and a slight fever for about 10 days.
- These inflammatory symptoms, necessary for healing, are relieved with a low-fat diet, laxatives, and cool drinks [23]. The method required prolonged bed confinement and was too severe to be widely adopted. Despite Max's success, the demanding nature of the technique meant it did not gain many followers [35,36].

Plastic surgery technique: canal obturation using autoplastic flap

It was published by Horatio Gates (1778–1855) of Baltimore in 1829 for treating a femoral hernia using a tongue-shaped flap [26]. Max used it to treat both inguinal and femoral hernias in his later work, beginning in 1874. For inguinal hernias, without anesthesia and without asepsis, he created a one-inch-wide quadrilateral skin flap, the base of which was attached to the inguinal ring and the lower edge of which was located on the anterior thigh. He dissected it from bottom to top, inserted it into the inguinal canal, and sutured it to the edges of the defect. Max believed this method of obliteration was complete after three to six months. In femoral hernia repair, he dissected a lanceolate skin flap (unlike Jameson's lingual flap) from Scarpa's triangle, measuring two inches long and ten inches wide, with its adherent base corresponding to the superior base of the femoral ring. He inserted this flap into the femoral canal and secured it by suturing the wound edges together. He used this technique in two cases of femoral hernia, both of which were successful. He cautioned that this operation was only effective in small femoral hernias and was not adaptable to any other type [26,28]. From a historical perspective, we can state that Max performed one of the first hernioplasties with a plug or 'autoplastic plug' in Europe (with Jameson's permission), anticipating Lichtenstein (1974) and Gilbert (1992).

Conclusions

The Langenbecks, Father and Son:

- They championed the role of the university-trained anatomical surgeon as the ideal approach for hernia surgery, ensuring low morbidity and maximum safety. The father advocated for dissection surgery that preserved the integrity of the genitals. His approach allowed for more precise dissection of the hernial sac, laying the groundwork for subsequent anatomical repairs.
- Through their extensive experience and dedication, adapting techniques, designing instruments, bandages, and trusses, and performing autoplasty, they were pioneers in what is now known as personalized treatment for hernia patients.
- Through their anatomical studies on the peritoneum and the formation of the hernial sac (funnel theory), they laid the foundation for understanding the current posterior approach to hernias, from the same plane where the lesion occurs (TEP; TAP) [37,38]. Through their topographical dissections of the abdominal wall, its innervation and vascularization, and its anatomical courses and variations, highlighting the role of the transversus abdominis muscle, they anticipated incisional repairs that

respect the transversus abdominis as essential for visceral containment.

History has treated the Langenbecks unfairly: the father has not received the recognition of other contemporaries such as Cooper or Scarpa; and Max has not been recognized as the innovative surgeon he was, despite a lifetime dedicated to medical science. This work demonstrates, without a doubt, that the Langenbecks, father and son, should be considered the founding fathers of hernia surgery.

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