

SURGICAL HISTORY

Mario Donati and the Vertical Mattress Suture of the Skin

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Abstract

Mario Donati (1879–1946) was one of the foremost European surgeons of the early 20th century. During an impressive career as surgeon, teacher, and innovator he authored more than 200 scientific works. Already as a young teacher he won the admiration of his colleagues: “His lectures were models of clarity and conviction, his originality and brilliance as a surgeon have well earned [him] a place among the most famous of the clinical masters of surgery of all eras” (Mario Donati. *J. Int. Coll. Surg.* 1946;9:739). The present review offers a brief biographical sketch of Donati’s life and career, presents an eyewitness account of the origin of the Donati stitch, and discusses a possible precursor of this suture technique in the Middle Ages. On the occasion of the 60th anniversary of the end of World War II, the authors would like to pay a special homage to Mario Donati, who due to his Jewish ancestry was removed from his office as Professor of Surgery at the University of Milan in 1938 and died shortly after his return from exile in Switzerland.

Mario Donati was born 24 February 1879 in Modena, Italy. After his medical studies in Modena, he worked as an assistant to Antonio Carle (1854–1927) at the Surgical Clinic of the University of Turin, where he received his doctor’s degree in 1901. In 1905, still an assistant, Donati presented the surgical results of his mentor Carle in a 385-page postdoctoral thesis entitled “Chirurgia dell’Ulcera Gastrica e dei Postumi della Medesima” [Gastric Ulcer Surgery and the Sequelae Thereof]. Donati’s thesis includes a description of Carle’s use of Murphy’s button in stomach surgery, especially gastroenterostomy performed for acute gastric ulcers and peptic stenosis of the pylorus.¹ The tradition of employing

this anastomosis technique continued at the Surgical Clinic in Turin under Ottorino Uffreduzzi (1885–1943) until 1934.^{2,3} On the basis of this thesis, Donati was awarded the position of Lecturer on Surgical Pathology at the University of Turin. In 1911 he qualified as a university Lecturer on Clinical Surgery and Operative Medicine.

From 1912 to 1913, Donati was Professor of Surgical Pathology in Cagliari (Sardinia). He moved to Modena in 1913, where he served as Professor of Clinical Surgery from 1916 to 1922. In 1920 he founded the “Langobard Society of Surgery.” From 1922 to 1938 he served in turn as Chair of Clinical Surgery at the universities in Padua (1922–1927) (a chair the renowned Italian surgeon Edoardo Bassini [1844–1924] had held from 1882 until 1919), Turin (1927–1932), and Milan (1932–1938). While in Milan he founded the “Archivio Italiano di Chirurgia.” In October 1938 he fell victim to the fascist racial laws and

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was removed from his office as Chair for Clinical Surgery at the University of Milan. He continued to work as a freelance surgeon until 1943, when, after the German invasion of Italy, he sought political asylum in Switzerland.^{4–8}

During his exile in Switzerland, Donati first stayed in Lugano as the guest of his friend F. Pedotti, Surgeon-in-Chief of the local Civic Hospital. In 1944 he moved, at the invitation of Swiss authorities, to Geneva, where he remained until July 1945.^{5–7} In Geneva, he was given the great honor of serving as a guest lecturer at the University of Geneva. He was also allowed to teach in a military internment camp for refugees on the University Campus. In 1944 Dr. L. S. Sillani compiled a 115-page record of eight of these lectures on clinical surgery for the “Fondo Europeo di Soccorso agli Studenti” (European Fund for the Support of Student Prisoners of War) (Donati, 1944; a typewritten copy is available at the University Library in Geneva). Each of the lectures presents a single case report on the topics “Carcinoma of the Hepatic Porta,” “Acute Abdomen Simulated by a Basilar Bronchial Pneumonia,” “Prostate Carcinoma,” “Tuberculosis of the Urinary Tract,” “Posttraumatic Tetanus,” “Recurrent Right-Sided Inguinal Hernia,” and “Gastric Surgery” (two lectures).⁹

During his long career, Mario Donati authored more than 200 scientific works.¹⁰ In addition to visceral surgery, the topics he dealt with included urology, hematology, and oncology. His “Trattato di chirurgia dell’addome” (1914) (Treatise on Abdominal Surgery) was highly regarded and widely known.

When World War II ended in 1945, Donati returned to his homeland and was reinstated as Professor at the University of Milan (Fig. 1). He died unexpectedly on 21 January 1946 at the age of 67.

Mario Donati was born into a Jewish family that had settled in Modena in northern Italy as early as the early 16th century.^{6,7} The Donati family still possesses a document dated 1505 in which the ruler of Modena grants permission to “the Jew Donati” to deal in grain and sell bread to the citizens of Modena. Around 1580 the Donatis founded a tannery in Modena. Mario Donati himself was raised without religion. In later life he converted to the Roman Catholic faith. Why he did so is not known. It may have been a private decision, or perhaps his Catholic wife was the impetus. It could well be that the fascist persecution of Jews at that time played a role in his conversion.¹⁰ He did not, however, change his surname, which is not surprising because he had already made a name for himself as a surgeon under the name Donati. Moreover, since the end of the 19th century it had been rare in Italy for converted Jews to change their names.¹²



Figure 1. Mario Donati (1879–1946) [From¹¹, with permission].

For Donati “[...] the belief in the omnipotence of science does not convey the magical sacredness of life [...]”.¹⁰ As a scientist he confronted religious questions head on.^{10,13} This balancing act in Donati’s life between science and faith parallels in a way the Kantian dualism between the “thing as appearance” and the “thing in itself,” or the dualism between an atheistic science and a living personal faith. The profound impact of this tension between science and faith on the individual and society was analyzed by the contemporary Swiss theologian Adolf Schlatter (1852–1938), Professor of Theology in Bern, Greifswald, Berlin, and Tübingen (Schlatter, 1905). Schlatter challenged science to reach beyond itself and proposed as a means “[...] the hidden metaphysics of scientific positivism [...]”. He cautioned against banning the metaphysical from the realm of science: “*In negotiation with Kantianism it has already been said quite clearly for a long time that dispensing with the idea of God is inevitably tantamount to dispensing with the idea of truth and is therefore destructive of science*”,¹⁴ p54. Donati put this consciousness of transcendentally grounded truth to good use in his clinical practice, where he assigned pri-

mary importance to the needs and welfare of the individual patient.

Donati was both passionate and pragmatic, he lived life to the fullest. Though he paid close attention to the smallest details, he never allowed himself to be bogged down by them: simplicity, precision, and minimal tissue trauma describe his surgical style.¹⁵ In its obituary for Donati, the International College of Surgeons described him as follows: “Because of his intelligence, energy, originality and brilliance, he became Italy’s leader in surgery; in the academic field his lectures were considered models of clarity and conviction. He has well earned a place among the most famous of the clinical masters of surgery of all eras”.¹⁶

THE ORIGIN OF THE DONATI SUTURE: AN EYEWITNESS ACCOUNT

Donati’s vertical mattress skin suture is still widely used in both plastic and general surgery. Like so much that is groundbreaking in medicine, its introduction was little noted at the time. Nevertheless, one of Donati’s assistants at the University Surgical Clinic in Modena, Antonio Biancheri, left an eyewitness account of its origin. In 1921 Biancheri was a Lecturer on Surgical Pathology in Modena.¹⁷ He later worked as a gynecologist and in the 1950s was named Chief Surgeon at the Ospedale S. Maria di Reggio Emilia.

Biancheri describes the origin of the Donati suture as follows: “[...] one morning as I assisted [Donati] in an operation on a case of ptosis of the right kidney and right colonic angle via a lumbotomy in accordance with a personal technique [of Donati’s], a vertical U-skin suture [was tried] which in an ideal manner enabled wound edges to be apposed in areas where the skin edges had a tendency to roll under. We had already determined that skin sutures in this area often did not leave the aesthetic scars he so highly valued. He made an attempt in one direction, then in another, then again in another. And there came into being, as a rough draft, that which he just described in a lecture on the occasion of the Enteroptosis Congress in Naples [XXVIII Congresso de la Societ  Italiana di Chirurgia, Napoli. 25–27.10.1921]. It is also true that—and this is said with no offense [intended]—that he neither had knowledge of old medical books nor did he spend any time studying them: he always strove to reach beyond them. Now, several years later, I found in a 17th century book on surgery a drawing of that same skin suture and showed it to him with the greatest sadness, not as an impertinent comparison, something he certainly does not deserve and

which would be incompatible with our relationship, which has always corresponded in the highest degree to a father–son relationship, but so that he could rejoice—as he also did—that he had had a very old and thus classic idea from an era when surgery had lived through tragic and heroic years. This is the history of this modest but useful technical detail, which some have smirked at and which represents but a fortuitous coincidence of ideas separated by centuries, as is the case for countless greater and more seminal discoveries in the history of progress [...],¹⁰ p96.

Mario Donati never published his innovation. Based on this eyewitness account, however, the year in which Donati first performed his eponymous skin suture technique can be set as 1921. Although the *proceedings* of the Enteroptosis Congress, held in Naples from 25 to 27 October 1921, are preserved in 20 pages of the *Riforma Medica*, they contain no mention of either the suture or the drawing cited above.^{18,19} It seems a brilliant idea was mentioned in passing without being recognized as such.

A “17TH CENTURY BOOK ON SURGERY”

The question is still open as to which 17th-century volume Biancheri was referring. The designation “17th century book on surgery” is very imprecise. Two hundred years after the discovery of printing, books on surgery were already widespread. Before that, the number of manuscript volumes was clearly lower. The search for the volume in question must focus therefore primarily on printed editions of classical handwritten manuscripts and secondarily on subsequent revised editions of the same texts supplemented with commentaries and addenda. The former usually had no illustrations or at best only sparse engravings. An interesting example of an early illustration of a suture is found in a manuscript from the 14th century containing a marginal sketch of a surgeon suturing a head cut. As was customary in the Middle Ages, the drawing does not highlight the technique and anatomy of the suture, but rather the interaction between surgeon and patient (Fig. 2). Although the 16th century renaissance of anatomy had advanced surgery from the philosophical plane toward the morphological, the centuries-old tradition of not illustrating surgical teachings still bore weight. Figures in today’s sense only arose much later. The exciting history and evolution of medical and surgical illustration will not be treated here; the reader is referred though to the unsurpassed works of Choulant (1852),²⁰ Sudhoff (1908),²¹ and MacKinney (1964).²²

The frequency with which itinerant surgeons performed wound sutures cannot be precisely determined. Early



Figure 2. Detail of a manuscript page from the early 14th century with a small pen drawing showing a surgeon kneeling beside a wounded man and suturing his head wound (Used with permission from the Wellcome Library, London.). As was usual in the Middle Ages, the drawing depicts the human dimension of the procedure and not merely the morphology of the suture technique.

surgical manuscripts generally recommended special ointments, bandages, and plasters to treat wounds, although some did provide descriptions of sutures. The topics “sutures” or “skin sutures” (in some texts also called “bloody sutures”) became part of academic surgical doctrine in the 18th and 19th centuries, as for example in Pierre Dionis’ “Cours D’Operations de Chirurgie” (1708; English translation, London, 1733: A course of chirurgical operations, demonstrated at the Royal Garden at Paris), the “Traité des Operations de Chirurgie” of Giovanni Ambroise Bertrandi (1769), or Samuel Cooper’s “Dictionary of Practical Surgery” (1809). It can be assumed, then, that until the beginning of the 19th century “state-of-the-art” wound treatment under academic surgeons consisted of medication with plasters, powders, ointments, or corrosive substances and, in some cases, with so-called *false* or *dry sutures*, which had been known since the Middle Ages (Fig. 3a,b,f). The term “dry suture” refers to “holding wound edges in apposition by means of an adhesive plaster”.²³ In the era before antiseptics, this type of wound treatment had the advantage of not always leading to wound suppuration and of allowing visual monitoring of the wound, as well as later tightening of the edges once swelling had subsided. Filippo Masiero (1702) from Padua described a similar method for bandaging linear wounds (Fig. 3e). Also known but rarely practiced were the *true sutures*, mainly the quilled suture (German: Zapfennaht or Schlingennaht;

Latin: *Sutura clavata*) (Fig. 3d), twisted or figure-of-eight suture (German: umschlungene Naht; Latin: *Sutura ferrea*) (Fig. 3c) and glover’s suture (German: Kürschner-naht; Latin: *Sutura pellionum*), although the latter designated more often intestinal sutures. The National Museum of German Art and Culture in Nuremberg has an animal skin dating from 1743 on which are *depicted* a few dozen sutures; they do not include, however, a vertical mattress suture.²⁴ Despite the often described suture techniques just mentioned, surgeons generally regarded skin sutures with scepticism due to the frequent suppuration (desirable white or *laudable* pus and the much feared fetid pus); so, like intestinal sutures, they were usually included in surgical manuals only for reasons of completeness.²⁵

A LIKELY CANDIDATE: PIERRE DIONIS’ “COURS D’OPERATIONS DE CHIRURGIE” (1708)

In the search for the illustration in the “17th century” volume mentioned by Biancheri, we have examined 47 surgical textbooks published between 1555 (Nicolai Marchetti) and 1821 (Samuel Cooper), including 20 volumes by Italian surgeons. An early attempt to depict a suture in its course was made in 1708 by the famous French anatomist and surgeon Pierre E. Dionis (1650–

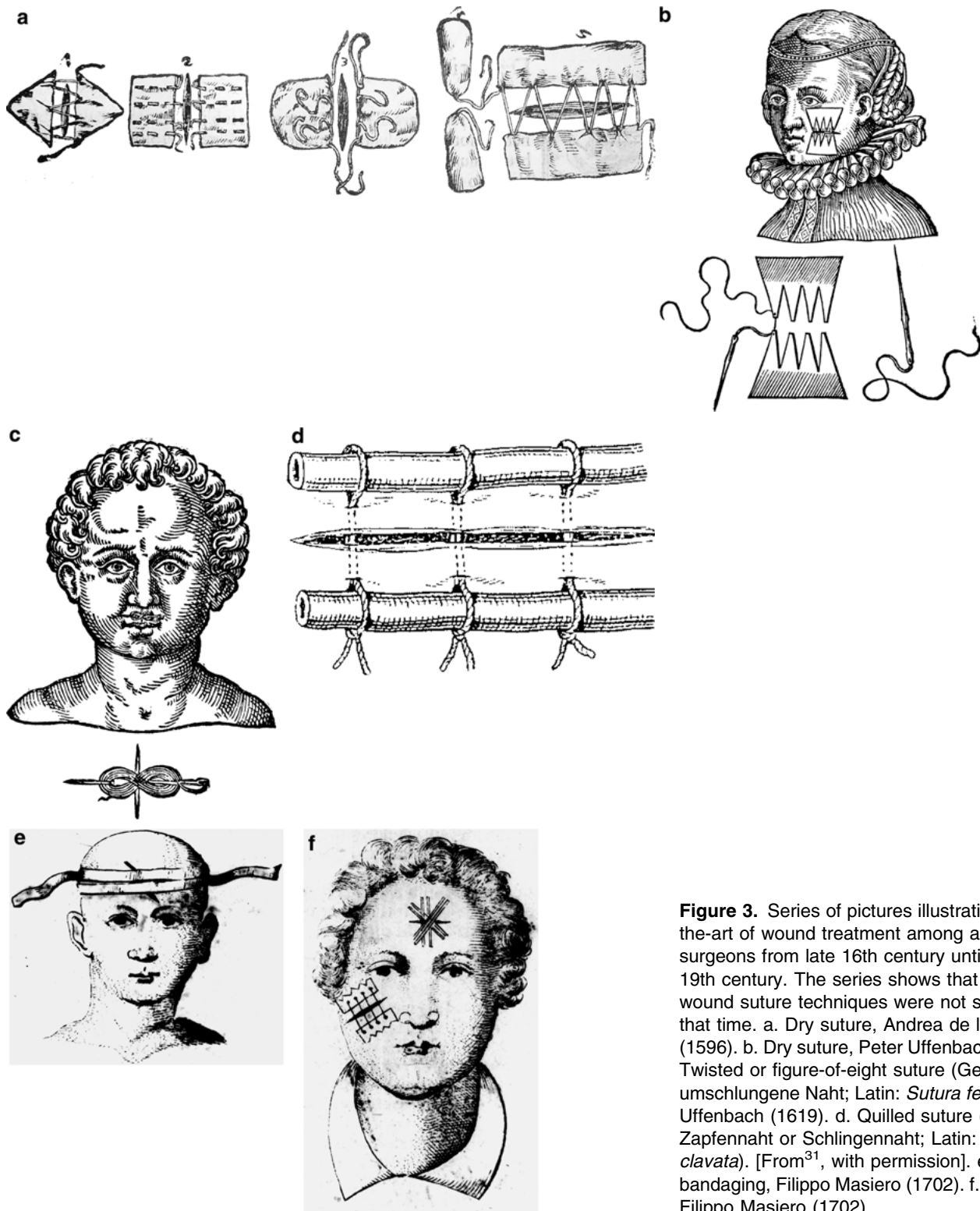


Figure 3. Series of pictures illustrating state-of-the-art of wound treatment among academic surgeons from late 16th century until the early 19th century. The series shows that today's wound suture techniques were not standard at that time. a. Dry suture, Andrea de la Croce (1596). b. Dry suture, Peter Uffenbach (1619). c. Twisted or figure-of-eight suture (German: umschlungene Naht; Latin: *Sutura ferrea*), Peter Uffenbach (1619). d. Quilled suture (German: Zapfennaht or Schlingennaht; Latin: *Sutura clavata*). [From³¹, with permission]. e. bandaging, Filippo Masiero (1702). f. Dry suture, Filippo Masiero (1702).

1718). Appointed personal physician to Louis XIV in 1680, Dionis's principal work on surgery was the "Cours d'Operations de Chirurgie, Demonstrées au Jardin Royal," which appeared in seven editions in French and

was translated into German, English, and Dutch. On page 59 (Brussels edition of 1708), in illustration "VIII. Figure *LES SUTURES*," the necessary instruments and materials for wound treatment are shown lying on a ta-

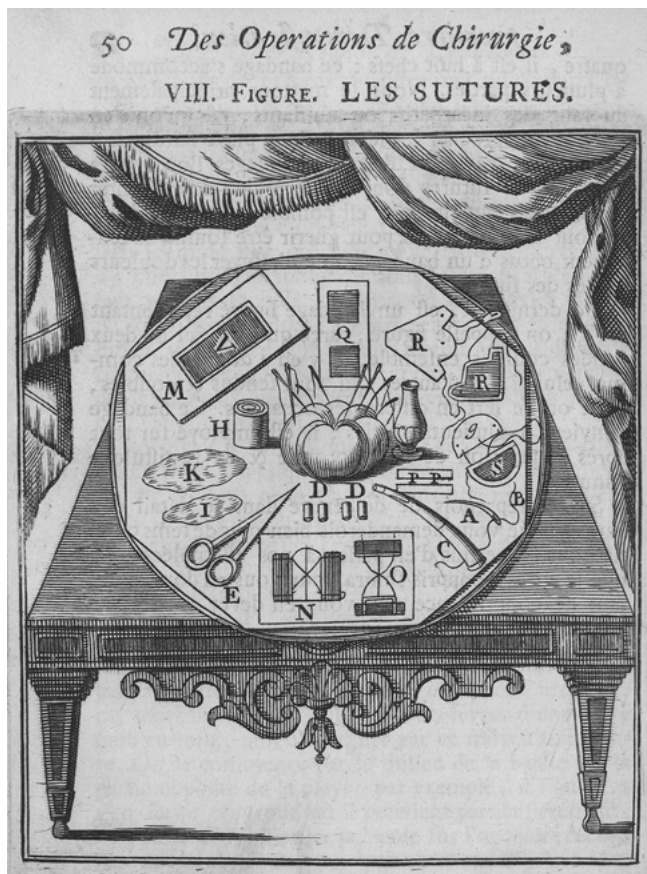


Figure 4. An early attempt to describe a vertical mattress suture of the skin (details “N” and “O”) disposed between surgical instruments and wound dressing materials on a surgeon’s table. Figure from Pierre Dionis’s “Cours D’Operations de Chirurgie” (1708).

ble. The accompanying text describes two types of wound suture, one to be performed with a double-needed thread, the other a kind of mattress suture resembling Donati’s suture (Fig. 4). It cannot, however, be said with certainty that this is the illustration Biancheri meant, although Dionis’s volume enjoyed wide distribution and respect. A definitive list of surgical books published between the 15th and 17th centuries would be an invaluable aid to any future search for this enigmatic illustration.

THE VERTICAL MATTRESS SUTURE TODAY: DONATI AND ALLGÖWER

Mario Donati was an intense personality. His impact on surgery began in his lifetime and continues to the present day. Almost 85 years after its introduction, the Donati suture’s place in the surgical repertoire is secure. It has the important advantages of allowing apposition of the

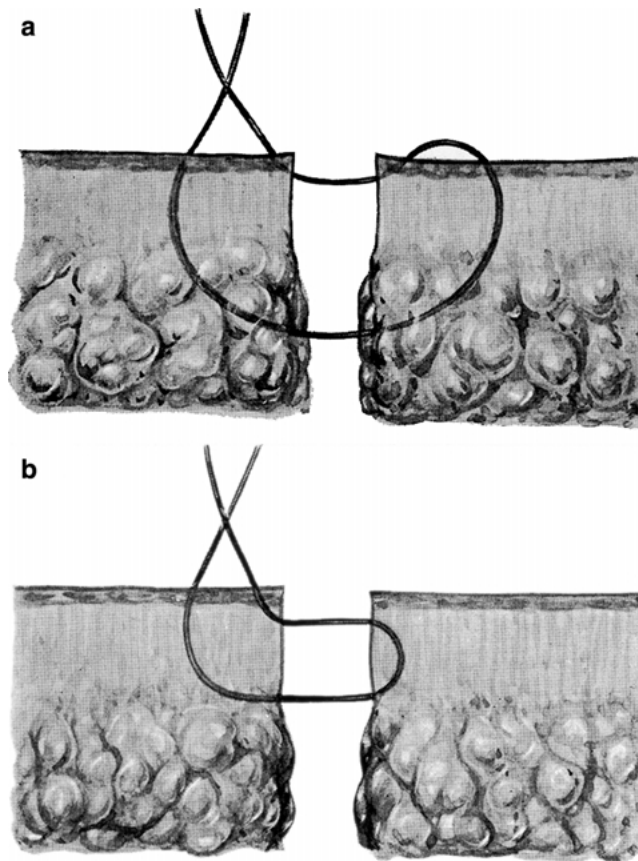


Figure 5. Vertical mattress sutures of the skin: a. The Donati suture (1921). b. The Allgöwer modification (1963) [From²⁸ with permission].

skin edges without inversion, simultaneous deep wound closure by adaptation of the individual layers (epidermis, dermis, and subcutaneous tissue), good hemostasis, and deflection of the tension laterally away from the scar line (Fig. 5a). According to one report, the suture can be performed even more quickly using a “near-near, far-far” technique.²⁶ Recent studies have confirmed the good cosmetic results of this suture technique.²⁷

The most important modification of the Donati suture is the Allgöwer suture. In 1963 Martin Allgöwer (born 1917), now Professor Emeritus of Surgery at the University of Basel, Switzerland, modified the Donati suture so as to cause even less trauma to the skin tissue of the lower leg during fracture surgery. He did this using an “intracutaneous” component to grasp only the dermis on one of the skin sides (Fig. 5b).²⁸

For reasons we have been unable to ascertain from the literature, the Donati suture—already in common use in the 1950s—is often termed the Blair-Donati suture. The “upside-down, continuous, subcuticular suture” described by Lyman C. Blair in 1964²⁹ is certainly not meant here and must be regarded as a modification of the run-

ning intracutaneous suture described by William S. Halsted in 1889.³⁰

The life and work of Mario Donati constitute a reminder to each of us that our scientific accomplishments (for Donati more than 200 published works) are but a small part of the general course of progress. They contribute to the accumulating store of knowledge; then, in a few short years, most are lost to memory. How different the fate of the occasional small, improbable but ingenious idea: though often not even honored with publication, such ideas bear the seed of legacy within themselves.

*Datta: what have we given?
My friend, blood shaking my heart
The awful daring of a moment's surrender
Which an age of prudence can never retract
By this, and this only, we have existed
Which is not to be found in our obituaries*
—T. S. Eliot, *The Waste Land*, 401–406

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REFERENCES

1. Donati M. *Chirurgia dell'ulcera gastrica e dei postumi della medesima*. Torino, Carlo-Clausen, 1905;1–348.
2. Dietz UA, Debus E-S, Hirt ALA, *et al.* Buttum zum Valtrac Ring: 100 Jahre auf der Suche nach einem Paradigma. *Zentralbl Chir* 1999;124:653–656.
3. Dietz UA, Debus ES, Weisser Ch. Vom Abenteuer der Darmnaht in der Antike zur Routine-Anastomose der Moderne. In Dietz UA, Debus ES, editors, *Resektions- und Rekonstruktions-verfahren in der Viszeralchirurgie*. Textbuch und Atlas der bio-fragmentierbaren Anastomose. Heidelberg, Kaden-Verlag, 2002;1–38.
4. Fischer I. *Biographisches Lexikon der hervorragenden Ärzte der letzten fünfzig Jahre*. Berlin, Urban & Schwarzenberg, 1932;I:326.
5. Fischer I, Voswinckel P. *Biographisches Lexikon der hervorragenden Ärzte der letzten fünfzig Jahre*. Nachträge und Ergänzungen. Hildesheim, Olms 2003;III:333.
6. *Dizionario Biografico degli Italiani*. Roma, 1992;41:51–53.
7. *Enciclopedia Modenese*. Modena, Nogarino, 1990;VII:75.
8. Natale L di. *Un maestro della chirurgia: Mario Donati*. Milano, Galileo, 1946;1–11.
9. Donati M. *Lezioni di clinica chirurgica*. Campo Universitario d'Internamento Militare, Università di Ginevra. *Fundo Europeo di Soccorso agli Studenti*, Ginevra, 1944;1–115.
10. Biancheri A. Mario Donati. *Arch Ital Chir* 1946;68:78–110.
11. *Scritti medici in onore del professore Mario Donati nel XXV anno di insegnamento*. *Arch Ital Chir Bologna*, Cappelli, 1938;Vol. I,1–755.
12. Staudacher AL (2002) *Jüdische Konvertiten in Wien 1782–1868*. Frankfurt/Main, Peter-Lang, 2002;I:460;II:1–732.
13. Biancheri A. Mario Donati e la mano del chirurgo. *Min Chir* 1946;1:380–382.
14. Schlatter A. *Atheistische Methoden in der Theologie*. *Beitr. Förderung Christl. Theol.* 1905;5:229–249. [English translation by Bauer D. Schlatter A. *Atheistic methods in theology*. *Asbury Theol J* 1996;51:45–57].
15. Ascoli R. Mario Donati (1879–1946). *Urologia* 1946;13:73–75.
16. Mario Donati. *J Int Coll Surg* 1946;9:739.
17. Biancheri A. *Lesione traumatiche della regione scapolare*. Libreria-Cappelli, Bologna, 1921;1–210.
18. Donati M, Parlavecchio G. *Patologia e clinica delle ptosi gastro-intestinali*. *Rif Med* 1921;37:1069–1071.
19. Donati M. *Terapia chirurgica in alcuni casi di splancnoptosi, con speciale riguardo alla terapia delle stenosi da posizione piloro-duodenali ed ileo-coliche*. *Rif Med* 1921;37:1074–1076.
20. Choulant JL. *History and bibliography of anatomic illustration*. New York, Hafner-Publishing, 1945;1–435. [English translation of: Choulant JL. *Geschichte und Bibliographie der Anatomischen Abbildung*. Leipzig, Rudolf-Weigel, 1858;1–203].
21. Sudhoff K. *Ein Beitrag zur Geschichte der Anatomie im Mittelalter*. Leipzig, Johann-Ambrosius-Barth, 1908;1–94, 24 figures.
22. MacKinney L. *Medical Illustrations in medieval manuscripts*. Wellcome-Historical-Medical-Library, London, 1965; 1–263.
23. Samuel Cooper. *Handbuch der Chirurgie*. Weimar, 1821;Vol. III, 218–224.
24. Nockemann PF. *Nahttechniken und Nahtmaterialien*. In: Hartel W, Keminger K, Rehner M, Reith HB, Schreiber HW, editors. *Viszeralchirurgie—Quellen*. Entwicklung. Status. Einhorn-Verlag, Reinbeck, 2001;125–236.
25. Dietz UA, Debus ES. *Intestinal anastomoses prior to 1882; a legacy of ingenuity, persistence, and research form a foundation for modern gastrointestinal surgery*. *World J Surg* 2005;29:396–401.

26. Snow SN, Goodmann MM, Lemke BN. The shorthand vertical mattress stitch—a rapid skin everting suture technique. *J Dermatol Surg Oncol* 1989;15:379–381.
27. Trimpos JB, Mouw R, Ranke G, *et al.* The Donati stitch revisited: favorable cosmetic results in a randomized clinical trial. *J Surg Res* 2002;107:131–134.
28. Allgöwer M. Besonderheiten der chirurgischen Weichteil-Technik bei Unterschenkelfrakturen. In Müller ME, Allgöwer M, Willenegger H, editors, *Technik der operativen Frakturenbehandlung*, Heidelberg, Springer-Verlag, 1963;111–114.
29. Blair LC. A new skin suture. *Med Rec Ann* 1964;57:418–420.
30. Halsted WS. The radical cure of groin hernia. *Johns Hopkins Hosp Bull* 1889;1:12–13.
31. Lexer E. *Lehrbuch der allgemeinen Chirurgie*. I Band. Stuttgart, Ferdinand-Enke, 1916;24–25.