

Cuneo Tendinous Suture – the Story of One Publication

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Abstract

In Russia and in post-Soviet countries tendon Cuneo suture is still widely known and is applied in clinical practice because of its strength and simplicity. One can find its sketch along with the sketches of Rozov and Kozakov sutures in most Russian handbooks on operative surgery. In foreign literature, however, this term is never used, and the authorship of the technique is attributed to S. Bunnell. According to the original source, the tendon suture technique suggested by S. Bunnell is different from that of B. Cuneo. Likewise, Cuneo tendon suture cannot be applied with the use of tendon forceps, as suggested by S. Bunnell. Besides, to confirm proper use of B. Cuneo's name in the case of the tendon suture in question, we cite an adapted translation of a certain paper by B. Cuneo and A. Tailhefer, devoted to a case study where the authors used suture of flexor tendon of little finger. We also provide historical background, concerning some interesting facts and people relevant to the topic.

Keywords: hand surgery, tendon suture, damage to flexor tendons of fingers, *fexor tendon repair*, *tendon suture*, *flexor tendon leasure*.


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We thank E.T. Samitova for translating the article „Cuneo B., Tailhefer. Surun cas de suture secondaire des tendons flechisseurs ducinquieme doigt“.

One can hardly find a surgeon in Russia who is not familiar, at least schematically, with the Cuneo¹ tendon suture technique. All Russian textbooks on operative surgery, inclusive of those published during the Soviet Union times, provide the image of this joining technique, usu. next to that by Rogov [1, 2]. Even now, many Russian surgeons choose the Cuneo for its simplicity and the repair strength. Interestingly, we failed to trace either the original article by B. Cuneo or any reference to it. This fact, which is not unfamiliar to other researchers, made some scholars doubt the existence of the original article explaining the technique, and thus the authorship of Bernard Cuneo [3].

¹ *Bernard Joseph Cuneo* (1873–1944), a prominent French surgeon and anatomist. In France, he is more famous for his seminal papers in anatomy [4]. While working at his biography, we chanced to come across only one of his publications (apart from that discussed in this study) related to the hand – it dwells on the physiology of the wrist joints [5]. At the time of the clinical observation described, he was the head of the department at Hôpital Lariboisière in Paris.

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There is an opinion that this tendon suture was first proposed by the American surgeon Sterling Bunnell². Sometimes, both last names (the Bunnell — Cuneo suture technique) are used, although not exclusively in order to put the historical record straight, but simplify the matters to the reader. This hot-button issue made us turn to the primary source literature.



Professor B. Cuneo

It should be noted that the method of tendon repair using a tendon clip, as it was described by S. Bunnell in his first article and the *in vitro* picture of which was first given there [6], is not similar in appearance to what is traditionally called the Cuneo in our textbooks. In this description, the needle is firstly put transversally through the tendon, then the longitudinal component of the suture is placed obliquely to let the needle out of the tendon and through one of the gaps of the tendon clip (which looks like a claw clip); then an arc link on the tendon surface is made by transferring the needle transversally to the original puncture side, with the whole procedure repeated to finally pull the needle through the cut end of the tendon. The second end of the strand of the suture is used similarly. Then the whole design is repeated on the other tendon to finally knot the four ends of the two strands pairwise. The repair in Figure 1a exactly follows the description made by S. Bunnell and is similar to that in the picture published by him himself [6].

In his next article on tendon plastic surgery S. Bunnell explains that while pulling the strand through the tendon clip it could be enough to grasp just a certain amount of tendon tissue [7]. Both of these descriptions imply a method which is different

from the familiar Cuneo technique. The latter exhibits some evident pros, as the strand is put through the thickness of the tendon, which reduces adhesion and minimizes the damage to the intrastem blood supply of the tendon (Fig. 1b). But theoretically, the strength of this tendon repair should be lower in comparison with the Bunnell, as there are no locking loops, the importance of which was to be

theorized much later [8].

We posit that the name of S. Bunnell was mistakenly attributed to this type of repair on account of the similarity between the way the strands are drawn through the ends of the tendon in his another method of a removable wire tendon suture and the technique in question [9]. Apart from that, in his first two articles, Dr. Bunnell does not provide us with a schematic image of the repair, and gives a verbal description of the technique supported by the photos of the repair *in vitro*, which yielded little information.

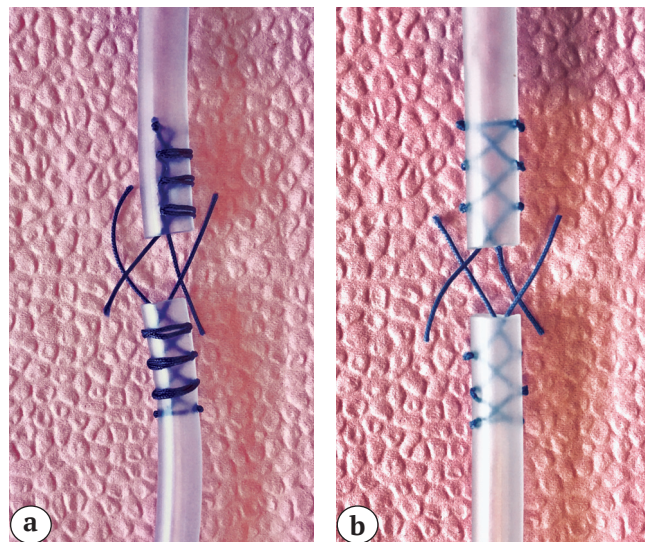


Fig. 1. Tendon sutures of Bunnell (a) and Kuneo (b) on the layouts *in vitro*

² Sterling Bunnell (1882–1957), a famous American surgeon. He was the one to popularize hand surgery as a freestanding discipline. He is also considered one of the founding fathers of the American Society for Surgery of the Hand (ASSH) – the parent organization of the International Federation of Societies for Surgery of the Hand (IFSSH).

An easy-to-understand image of the repair was firstly published in S. Bunnell's book (1944), and that explained the aforementioned removable wire tendon suture technique. But by that time, the term Cuneo repair with its familiar pattern had already been widely used, at least in the Soviet Union. Thus, we have come to believe that the Bunnell repair was falsely attributed in the literature. At the same time though, we also failed to confirm B. Cuneo's authorship.

The primary source of this misattribution of the technique to B. Cuneo, where the very repair was mentioned for the first time, is a rarely cited article describing a clinical case of a tendon repair co-authored by B. Cuneo and E. Teilhefer³. In this article, no scheme, description, or photo of the repair is given. There

is only one simile to characterize the repair: "boot-lacing". Besides, this description fits the actual Bunnell repair much better.

In his study to follow, E. Teilhefer not only shares the views of S. Bunnell, preferring tendon plastic surgery to suture [10], but also, as it was noted by his science advisor A. Mouchet [11], uses a device similar to that described in S. Bunnell's article⁴.

B. Cuneo himself pointed out that a detailed description of this tendon repair could be found in the dissertation of his apprentice Ph. de La Marnierre⁵. We chanced to come across an accurate explanation of the Cuneo tendon repair performed by Dr. Maurice Cazin [12]. Here is the procedure he suggested: the tendon is pierced frontally with one strand of suture 1.5 cm



Staff members and interns of St. Louis Hospital: second from the left in the second row is A. Tailhefer

³ In the original text, Tailhefer's first name does not appear either in the article body or on its title page; however, the article review, which followed, implied that he was Dr. A. Mouchet's (1869–1963) assistant. At that time, Dr. Mouchet ran the pediatric surgery department of the Hôpital Saint-Louis in Paris, he is also reputed to have described two syndromes named after him: Mouchet I and Mouchet II. Later, he and Tailhefer co-authored a monograph on traumatology. Three years later, Emile Marie André Tailhefer (1896–1963) wrote a thesis on the flexor and extensor digitorum repair techniques, and also became prominent for his input in surgical oncology. Interestingly, he was both the co-author of the article, and the patient of the case described in it.

⁴ It should be said in all fairness that later in his work Tailhefer quoted the Bunnell technique as it was described in Marc Iselin's (1898 – 1987) paper. It would look strange if there appeared no name of M. Iselin in this article, who is considered both an ardent partisan of the ideas propagated by S. Bunnell, and a hand surgery pioneer in France. But it is also noteworthy to say that at the time of the observation described in the article he was an intern.

⁵ Dr. Daniel-Robert Phelippes de La Marnierre presented a thesis on the restoration of the flexor digitorum in 1924, he was a resident at L'hôpital Lariboisière in Paris.

away from the tendon end. Then, either needle is inserted near its exit into the tendon placing the longitudinal component obliquely, so that the needle could exit 5 mm distal of the other half of the strand, which, in its turn, is also placed similarly, in an oblique manner, to let it exit on the opposite side of the tendon. The routine is repeated once again to finally let both needles out through the tendon cut. The other tendon end undergoes the same procedure, after which the ends of the strands are tightened and knotted together. Bearing in mind that this description of the technique fitted the framework of discussion of then contemporary methods of tendon repair and was witnessed by B. Cuneo's opponents and his co-author E. Teilhefer, one may consider it authentic, and thus the authorship of B. Cuneo was a fact accepted by his surrounding. This description matches the familiar image of the repair fairly well.

The image of the Cuneo proper caught our eye only in several articles of Russian-speaking scholars, (which include the contributions to non-Russian periodicals), e. g. the article by A. M. Dychno⁶ published in *Lyon Chirurgical* in 1937 (Fig. 2) [13].

Following this instruction, we performed this repair on a mock tendon (see Picture 1b) in order to compare it with the Bunnell, and with the pattern familiar to Russian-speaking surgeons. It is worth mentioning that B. Cuneo's article is of interest not only because it confirms the existence of the Cuneo repair and his authorship — it also gives a very detailed account of the method he used, and explains that, with the operation performed accurately and rehabilitation to follow, one can achieve a very good result in the primary tendon repair of the finger flexor. The mat-

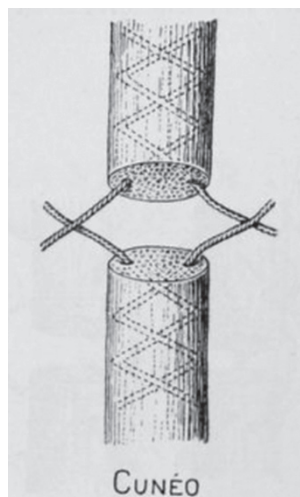


Fig. 2. Cuneo tendon suture (from the article of A. Dychno) [13]

ter is that such high-profile surgeons of the time as S. Bunnell, M. Iselin, and M.L. Mason [7, 14, 15] propagated a more delicate approach with their preference for the secondary tendon repair with the help of a transplant.

The variant readings of the term Cuneo repair, and the popularity of other terms associated with the procedure in Russia, as well as certain dif-

ficulties we and our colleagues encountered at reference retrieval have determined our decision to provide the Russian reader with the possibility to find out more about the original article. Here you may find an adapted translation of it [16].

Notes on a Case of Secondary Tendon Suture of the Fifth Finger Flexor Digtorum⁷

B. Cuneo, E. Teilhefer

The message which our young colleague Mr. Teilhefer and I have the honour to direct to you concerns a case of tendon section in the human hand. Here is our observation:

OBSERVATION. — The accident took place on February 14, 1925. A shiver of glass crosscuts the ulnar border of the left hand at the lower palmar crease. The wound practically reaches the dorsal part of the hand on the one side, and on the other, it extends to the palm proper till the axis of the forth finger. A dissection of both flexor tendons of the little finger is diagnosed. Two hours after the accident, under regional anesthesia of the cubital tunnel and local anesthe-

⁶ *Aleksandr M. Dykhno* was then a teaching assistant at the Department of Surgery of the Rostov School of Medicine. In 1935, he presented a thesis on the arterial blood supply of the arm, hand and finger tendons and tendon sheaths.

⁷ An adapted translation of the original article: Cuneo B. & Teilhefer. Sur un cas de suture secondaire des tendons flechisseurs ducinquieme doigt // Bulletin set memoires de la societe de chirurgie. 1925. Vol. 51. P. 959-963. Translated by E. T. Samitova, sci. ed. by D. G. Nakonechny.

sia of the hand, followed by wound toilet, there was performed a classical tendon suture technique with a support thread and knots. The metacarpophalangeal joint, which had been cut open, was sutured, and the hypothenar muscles were reconstructed. But with this first intervention, the surgeon found only the central end of the flexor digitorum profundus, which was held by the corresponding lumbrical of the hand, and sutured it with the peripheral ends of the flexor profundus and flexor superficialis.

The finger was immobilized in its flexed position, a wick provided drainage for the wound for 46 hours. For two days there was a slight fluid oozing from the wound with 38.5°, then everything stabilized.

On the 17th day, the patient attempted to move the finger and the phalanges, and also performed finger extensions. In the following days, the 3rd phalanx could flex slightly, but later no motion was possible. One month later the situation did not improve; passive mobilization is possible, there is no joint rigidity, the extension is limited to 100°, an active flexion of only the first phalanx is obtained. The electro-stimulation performed in March, 20 in Salpêtrière⁸ by Dr. Bourguignon⁹ diagnosed the atrophy of the flexor longus digitorum.

It was then that this case was referred to Prof. Cunèo; the scar was fibrous, inhibiting the extension, with no sensitivity along the superficial branch of the cubital nerve. Any contact with the scar area was extremely unpleasant and provoked painful tingling, which made one think of the existence of a small neuroma. Apart from that, there were some trophic problems in this area: the skin was thin, shiny, dry and redder than around. A surgical intervention was considered necessary but was postponed by one month or so to improve the skin condition with massage and ion therapy, which brought splendid results after 25 treatment sessions.

The operation was performed under general ether anesthesia by Prof. Cunèo on 26 May, 1925. After the resection of the skin and scar tissue, it was found that the flexor tendon profundus had restored, and that the peripheral end of the flexor tendon superficialis had adhered to the suture of the flexor profundus in the way this tendon had been repaired during the first operation. The adhered tendons were released, and after a long and tiresome procedure the flexor profundus was literally sculptured from the fibrous tissue. The incision of the extensor retinaculum al-

lowed to find the central end of the flexor digitorum superficialis, which was let out through the wound on the palm via the catheterized carpal tunnel. Then the flexor tendon superficialis was sutured with a linen thread following the “boot-lacing” technique, which had already been described by Prof. Cunèo in the thesis by Dr. de La Marnière; the tendons were isolated with artificial sheaths made from animal membranes after Rolland. By that moment Dr. Bourguignon had performed an electric test to verify the optimal length of the sutured tendons: the sutured flexor superficialis functioned normally and with its maximum effect, while the length of the flexor profundus turned to be excessive. But, as this tendon had cicatrized after the first operation, it was left intact in hope for its functional adaptation in the future. Then the neuroma of the superficial branch of the cubital nerve was partly excised, and the discovered peripheral end of the nerve collateral of the fifth finger was implanted to the base of it, though not sure of its exact identification. Finally, the palmar defect was covered with the Indian flap tailored from the dorsal surface of the hand along the ulnar margin. The region of the hand where the flap was retrieved from would soon recover. The hand was immobilized in a semi-flexed position. The surgical intervention continued for 95 minutes, which was certainly an important factor for the success — any surgery should be extremely meticulous.

The mobilization commenced on the 6th day, the spontaneous movements of the first two phalanges were perfect, as per the third phalanx, its movement was hardly noticeable, but the range of movement increased with each day. Active mobilization exercises were made for two hours every day, followed by massages and a one-week course of ion therapy. One month after the intervention, the restored movements were sufficient to allow the patient to play the violin, which required much accentuated flexion from the fifth finger. On June 22, the distal part of the transplant that formed a disgraceful flap was resected under local anesthesia. On July 3, the dorsal scar in the donor area was excised, and the zone was restored by the neighbouring skin and the Thiersch graft. At the same time, the extensor tendon was freed from adhesions. The movements resumed the same day and were more effortless.

In August, three months after the suture, the movements of the phalanges are so smooth that it is

⁸ L'Hôpital de la Salpêtrière is an ancient hospital in Paris, now the premises of a university clinical complex.

⁹ D.G. Bourguignon was a French neurophysiologist. In his monograph [17] on electric stimulation, he dwells on a similar case. However, this observation is dated earlier than that described in this study. Presumably, the before-mentioned collaboration of D. G. Bourguignon and B. Cuneo in tendon surgery was a continuous process..

possible to talk about the full recovery of their amplitude and the movements of the finger. The sensitivity started appearing a month and a half after the suture. At present, the sensitivity stretches beyond the half of the distal phalanx, with only the anesthesia of the finger pulp remaining. A full recovery of the sensitivity is a matter of a few weeks.

If we dare to believe that this observation, humble at first sight, may draw your attention for some time, this is only because we retain the memory of the pessimism about the discussion on the finger flexor suture held two or three years ago. As a result of this discussion, it seemed that the suture of the finger flexor tendon, particularly in the introsynovial area, was doomed to failure.

I should confess that at that time I shared this pessimistic view, but since I started suturing tendons rigorously following the technique in every detail, I have always achieved success even in the cases which originally looked absolutely hopeless.

Without going into details of this technique, which was described in the thesis by my follower de La Marnière, I would like to put an emphasis on the following:

First and foremost, it is necessary to have the skin which covers the suture area in as good condition as possible, for there may frequently be necessary to resort to tentative or immediate autoplasties.

On the other hand, it is important to fully reconstruct the normal anatomical disposition. The synergy of finger flexor tendons is so subtle and delicate that the reconstruction of tendons by means of approximate procedures will definitely be doomed to failure. In this particular case, the suture of the peripheral ends of both tendons and the central end of the flexor profundus a priori would not have yielded any positive result. In effect, the length of the flexor tendons is accurate to the millimetre. It is related rigorously to the contractile part of the muscle, and is individual for each flexor. It is impossible to replace a tendon without correcting its length, the importance of which we still underestimate.

Based on our experience, we may speak of the importance of finding the right length of the tendon: in one of our patients, the retention of a newly formed fragment of the central end, which extended the tendon by only 2 mm, was enough to cause the impairment of the sutured tendon. After placing a temporary suture in the course of operation, it is necessary to cause the contraction of the muscle in order to fit the length of the tendon. If the patient is operated on under regional anesthesia, one can resort to voluntary contractions. As I use general anesthesia in many cas-

es, I reach out to my friend Dr. Bourguignon to cause with due circumspection the contraction of different muscles via electric stimulation.

In my opinion, the suture of choice is the "boot-lacing" technique. I prefer either silk or finest and ultra-strong flax suture strands, lubricated with oil. Straight or slightly curved needles can be used. When choosing the latter, I prefer those used in ophthalmology. The "boot-lacing" technique ensures perfect coaptation and strong connection of the ends; it stands in traction and causes no bulging in the suture area.

Every time it is possible, the synovial sheath should be reconstructed without narrowing it down. If it is impossible, I create an artificial synovial sheath by wrapping the suture with the intestinal membrane after Rolland, prepared by Lemeland. A number of tests have proven that such membranes inhibit adhesion of the tendon, allowing the latter to move smoothly. The edges of the artificial synovial sheath are to be attached to the neighbouring areas to avoid its crimping similar to that of an accordion when the tendon is in motion.

Among the technical details concerning tendon sutures, I think, a couple of words should also be said about suturing the nerve fibers that are probably a part of the medial collateral nerve of the fifth finger with the central end containing a neuroma. Unlike in classical approaches, I do not resect a neuroma while suturing nerve fibres. I am content with dissecting it from the end side where the ball is. I preserve that part of the central end where the rectilinear fibers and the peripheral membranes concentrate, and at the distal end of which I place a suture, which allows the suture to be located at a distance from the place where both ends meet. I attribute a relatively rapid restoration of sensitivity to this technique in particular.

The skin suture should be made with extreme attention, and any drainage should be avoided if possible. Total immobilization is mandatory for one week; at the same time, I deem it useless to put the hand in plaster.

I do not think it is necessary to talk about the considerable importance of after-treatment. Massages, passive and active movements, diathermy, ion treatment, all other known means should be used in order to restore the flexibility of the operated organ as soon as possible.

Now we can see the crucial role which is played by intelligence, courage and patience in the surgical operations of this kind. As in arthroplasty, the success is 50 per cent dependent on these criteria — and there is not much to be added.

The splendid result which you were told about, and which you can judge about by yourselves, can oppose

the defeatist attitude toward the suture of the flexor tendon digitorum, the attitude which is now still shared by so many!

In the literature on flexor tendon repair of the time, many scholars preferred a tendoplasty of the flexor digitorum profundus in order to minimize the damage to the carpal canal and to avoid adhesions. To some extent, B. Cuneo puts this observation up against other popular approaches. But as time and our efforts to retrieve the original article have shown, his words fell on deaf ears and got lost among other publications and reports which expanded the indications for tendoplasty. Even B. Cuneo's co-author and patient E. Teilhefer, who successfully underwent the surgery and got inspired by tendon repair practices, was carried away by S. Bunnell's "modern" approach, propagated in France by M. Iselin. In effect, this method reflected the general tendency to increase treatment cases by means of choosing tendon plastic surgery (i. e., a replacement of a dysfunctional organ) in favour of anatomical reconstruction (i. e., tendon suture repair), despite the loss of natural biomechanics and proprioception. On the contrary, Professor Cuneo's approach implied a meticulous reconstruction of the anatomy of the organ, as well as strict postoperative management protocols, exercise and physical therapy, and revision operations if necessary. In this particular case, two revision surgeries were necessary, but they allowed the patient not only to play the violin but also build a career as a surgeon. The primary tendon suture technique would start flourishing only twenty years after, with C. Verdan's report [18] and the discovery of penicillin.

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