The tubed pedicle flap is a surgical procedure developed in the 1910’s that allows the movement of tissue from one part of the body to another in the reconstructive treatment of defects. It revolutionized the field of plastic surgery and led to the birth of procedures that are commonplace today. The development of the tubed pedicle flap, however, was not an anomaly. Rather it was the next step in a long history of progress towards autologous flaps that began 3000 years prior. The evolution that led to the tubed pedicle depended on several factors—a large volume of injuries from war and the industrial revolution, the development of medical and surgical knowledge, and the development of technology that stabilized trauma patients.
Progress, in this case, was dependent on the innovations of individual surgeons as well as the tide of medical knowledge that stretches into antiquity. Furthermore, the reaction by the public and medical community to this procedure in the early 20th century and the field that it birthed was overwhelmingly positive and allowed for its quick adoption.

As will be seen to be the case for reconstructive procedures in antiquity, the tubed pedicle flap was developed in parallel by two separate surgeons in different countries. Vladimir Petrovich Filatov, and ophthalmologist in Odessa, was presented with a patient in 1916 that suffered a malignant tumor of the right lower eyelid and would need a mass of tissue to replace the deficit caused by removing the cancer. After attempting a tube pedicle on a rabbit, Filatov raised the first human tube pedicle, raising a piece of skin and tissue into a cylinder. After twenty days he lengthened the tube then detached the lower end and flipped it into the hole left by the tumor in a third operation four days later. He published articles on his “round pedicle” in Russian, German and French between 1917 and 1927:

‘This is a matter of a new principle which guarantees nourishment of the transplanted flap, and, in describing my case it is not so much the plastic procedure of the eyelid that I am proposing as it is a method for the formation of a nutrient pedicle. This is irrespective of the type of plastic procedure and its location, provided there is an evident need for a long pedicle flap. It can be used in various plastic procedures of the eyelid, lips, nose, etc. If future observations confirm my hopes as to the stalklike round pedicle (and every reason supports this) then plastic operations (not only ophthalmological but also some surgical ones) will be considerably simplified. Although I do not wish to predetermine the type of condition to which the round stalklike pedicle can be applied, I can already see some additional usages and modifications in its applications.’ (Wallace)

Sir Harold Gillies independently invented the tubed pedicle on October 3, 1917 to treat a patient with a severe facial burn (Figure 1) and subsequently taught the technique to others in Europe and America:

‘This poor sailor was rendered hideously repulsive and well-nigh incapacitated by terrible burns received in the battle of Jutland. How a man can survive such an appalling burn is difficult to imagine, until one has met one of these survivors from fire, and realizes the unquenchable optimism which carries them through almost anything ... The process of thought on the problem led one to decide on a double pedicled chest flap, the pedicles to be tubed to prevent their being infected or exposed, to leave attached to these pedicles as large a chest flap as was deemed viable and then to place this large flap onto the face, excising the area covered by it ... In regard to the raw area of the chest no attempt at closure was made and the main line of treatment carried out for this area was the use of paraffin No. 7. At one stage hot fomentations were also applied to clean the surface. No grafting from the patient was attempted but three small grafts from another case were laid on the granulations, without success.’ (Gillies, 1920)

The first major period of time that sees the birth of an autologous flap starts in antiquity and stretches until the Industrial revolution in the middle of the 18th century. This period contained the growth of anatomic knowledge, modeled by the work of Galen in the third century CE, as well as early smaller procedures that developed the initial principles of the field of plastic surgery. As long ago as 800 BCE, the ayurvedic physician Sushruta of India described a local flap for the nose in Samhita, a procedure where a small patch of skin from the cheek was rotated in order to use for the reconstruction of a nose (Muley).

‘The portion of the nose to be covered should be first measured with a leaf. Then, a piece of skin of the required size should be dissected from the living skin of the cheek, and turned back to cover the nose, keeping a small pedicle attached to the cheek. The part of the nose to which the skin is to be attached should be made raw, by cutting the nasal stump with a knife. The physician then should place the skin on the nose
and stitch the two parts swiftly, keeping the skin properly elevated, by inserting two tubes of eranda (the castor-oil plant) in the position of the nostrils, so that the new nose has proper shape. The skin thus properly adjusted, it should then be sprinkled with a powder of liquorice, red sandal-wood, and barberry plant. Finally, it should be covered with cotton, and clean sesame oil should be continually applied. When the skin has united and granulated, if the nose is too short or too long, the middle of the flap should be divided, and an endeavor made to enlarge or shorten it.’ (Sushruta samhita)

An understanding of anatomy was also required for progression towards a tubed pedicle flap and facial reconstruction. Ancient Greek and Roman civilizations contributed to this knowledge with Herophilus of Chalcedon performing the first documented cadaveric dissections in Alexandria circa 250 BCE and Galen (131–221 CE) producing a study of muscular anatomy from his work on animals. The Romans Celsus and Oribasius documented pedicled flaps that allowed for the reconstruction of noses, ears, foreheads and lips in the 1st and 4th centuries, respectively. While each respective civilization contained the anatomic knowledge, trauma injuries from war, and technology innovations necessary for the progression of plastic surgery, the language and communication barrier between Indian and Greek/Roman civilizations led to the advancements to develop separately but in parallel and prevented collaboration or significant advancement. With the collapse of the Roman Empire and the beginning of the European Dark Ages, the frequent warfare provided numerous patients in need of reconstruction but the lack of knowledge and urban life led to a moratorium in the progression towards an autologous tubed pedicle flap and the development of plastic surgery.

War provided the majority of injuries requiring reconstruction prior to the industrial revolution. Injuries from gunshots led to significant morbidity and mortality on the battlefields beginning in the 15th century. Since hemorrhage and sepsis took priority over aesthetic and functional reconstruction, techniques in military trauma care had to develop prior to the principles of plastic surgery. The use of cautery and dressings (soaked in ephedra) to reduce hemorrhage and shock was documented by the Arabs, Greeks and Chinese as early as 900 CE (Cox).

Following the dark ages, early medieval Europe saw the rediscovery of plastic surgery principles described in early antiquity and a progression of anatomic knowledge. Without a significant increase in the body of knowledge regarding anatomy since Galen’s work in the 3rd century CE, the rebirth of progress found its home at the University of Bologna in the twelfth and thirteenth centuries. Ugo Borgognoni of Lucca and his son Theodoric performed cadaveric dissections on the executed of their time in a University that was separate from the Catholic Church. In addition to the basic anatomy that Borgognoni and his son discovered, Guglielmo da Saliceto (1210–1277 CE) documented the existence and location of motor nerves—a key component of pedicled flaps. Even more critical to allowing the tubed pedicles of Gillies, Mondino de Liuzzi (1270–1326 CE) injected colored dye into vessels and began mapping the circulatory system. This work would continue in the nineteenth and twentieth centuries in order to define the exact vessels that supplied tissue flaps, allowing for their movement to different locations in the body and subsequent reconstruction (Fang).

Ibn Abi Usaibia (1203-1270 BCE) of Damascus had translated the Sushruta samhita from Sanskrit to Arabic and it eventually was spread to Persia and Egypt. This eventually became the Cerrahiyet-ul Haniye (Imperial Surgery, 15th century) medical atlas in Europe and was picked up by Gustavo Branca of Italy who used Sushruta’s forehead flap technique for reconstruction of the nose (Rana). This spread of medical knowledge across civilizations was a crucial step in the progression towards an autologous tubed pedicle flap and the development of the principles of plastic surgery. Branca’s son Antonia reconstructed a nose using tissue from the inside of a patient’s upper arm in the 15th century, as did Heinrich von Pfolsprundt of Germany (1450 CE) and the Vianeo Brothers of Calabria. Bartholommeo Fazio writes:

‘Branca, the elder, was the inventor of an admirable and almost incredible thing. He conceived how he might repair and replace noses that had been mutilated and cut off, and developed his ideas into a marvelous art. And the son Antonius added not a little to his father’s wonderful discovery. For he conceived how mutilated lips and ears might be restored, as well as noses. Moreover, whereas his father had taken the flesh for the
repair from the mutilated man’s face, Antonius took it from the muscles of his arm, so that no distortion of the face should be caused.’

Rather than Branca and his son, it is Gaspare Tagliacozzi (1545-1599 CE) whose name is bestowed to the distant, autologous flap (Greco). A professor of surgery and anatomy at the University of Bologna, Tagliacozzi published a description of the surgical technique with the hopes of its promulgation but the flap was not well received at the time and the progression of reconstructive flaps and plastic surgery was halted (Figure 2).

Figure 2 The “Italian Method.” (Gnudi, 1976)

Trauma surgery progressed to tourniquets for hemostasis of the extremities following injury and during amputations during the 16th century but reconstruction of the extremities or salvage of body parts remained an infeasible goal given the lack of technology and priority of preventing hemorrhage. Despite the suspension of advancement in surgical techniques, the 16th century saw a significant contribution to anatomic knowledge with the work of Andreas Vesalius spread widely via the printing press. The musculature depictions of Leonardo da Vinci and Michelangelo during the Renaissance further contributed to the field, as did Charles Estienne publication De Dissectione Portium Corporis (1545) which contained mapped the superficial vascular and nervous system. In parallel with Vesalius was the work of Eustachius of Rome who, in the mid-16th century, produced accurate anatomic studies. With William Harvey’s mapping of arterial and venous flow through the extremities, the stage was set for translating anatomical and physiologic knowledge to autologous-tubed pedicle flaps.

The birth of the Industrial revolution (18th-19th centuries), in addition to its contribution of a new batch of extremity and body injuries, saw progress in anatomical knowledge, medical and surgical technology, and improved trauma care that would lead surgeons closer to tubed pedicle flap reconstruction. The new (upper) extremity injuries of the Industrial Revolution provided, for the first time, a large case volume of reconstructive patients. As opposed to the previous injuries of war where hemorrhage and stabilization were critical treatment, the loss of fingers and hands was less life threatening with the use of tourniquets and necessitated repairs (Loimer). In addition, the Industrial revolution saw a greater distribution of medical knowledge with increased printing press production and the consistent publication of medical journals to spread new techniques.

The technique of surgical debridement of a wound to allow for a healthy base of tissue to grow onto which a flap can be rotated or a skin graft to be provided was developed by the French Napoleonic surgeon Pierre Joseph Desault (1789) and was a crucial advancement that prepared for major reconstructive surgery (Helling). The technique was not widely spread, however, and surgeons from other countries continued with amputations to extremity wounds. The American Civil War saw excisional debridement performed in less than 3% of traumatic wounds with amputation performed in 75% of surgeries (USSGO). (Debridement would re-emerge during World War I with the work of Antoine Depage, a Belgian surgeon.) With Dominique Jean Larrey’s trauma triage during the Napoleonic Wars (1803-1816), stabilization of patients in mobile medical units close to the front line allowed for later reconstruction at a different site. The anesthesia of Crawford Long and William G. Morton in the 1840’s was also a critical step in allowing the long reconstructive procedures to be later performed in the 20th century. Sir Joseph Lister’s contribution of aseptic technique with carbolic acid (1867) and Ignaz Philip Semmelweis’ use of calcium chlorate (1847) were further necessary contributions on the path to reconstruction (Brunton). Progressing beyond the Industrial revolution, the development of sulfonamide antibiotics in the early 20th century and use of blood typing allowed soldiers to survive trauma longer and necessitated the development of reconstructive techniques including the tubed pedicle flap.

Along with trauma caused by machines and war of the industrial age, the period saw an increase in facial soft tissue lesions that were left after the removal of skin cancers. This subsequent work on closing these lesions led to a flurry of flap reconstructive concepts that were employed by the tubed pedicle. In France, Francois
Chopart (1743–1795) performed "advancement" flaps for reconstruction of the lips. This involves cutting and elevating a paddle of skin and tissue next to the lesion, maintaining care to preserve the nerves, arteries and veins connected to paddle, and stretching it beyond its original borders to a new position that covers the prior defect (Figure 3).

Figure 3 An advancement flap as used by Francois Chopart and still in use as a key technique in reconstructive surgery

The ancient Indian forehead flap was reintroduced to Europe and spread by Joseph C. Carpue (1764–1846). Over the next 100 years numerous other surgeons would experiment with small flaps that used axial circulation and vascularized tissues of the face including Johann Carl Georg Fricke, Léon Tripier, Karl August von Burow, Jakob August Estlander, Robert Abbe, and Johann Friedrich Dieffenbach.

With the historical contributions of a strong anatomical knowledge base, medical and surgical technology advancements, and sufficient trauma care to keep soldiers alive after their battlefield injuries, World War I saw the greatest growth in facial reconstructive surgery and the development of the tubed pedicle flap. Injuries from the war provided a plethora of patients in need. Harold Gillies, a New-Zealand born and London-trained otolaryngologist that would go on to revolutionize the field of Plastic Surgery, served as an army surgeon the Surgeon-General of the English Army to provide wards at the Cambridge Military Hospital in Aldershot specifically for facial surgery after witnessing the work of Hippolyte Morestin in Paris (Pound). These facilities proved insufficient after the first day of casualties in the Somme (July 1, 1916) and a dedicated facility with concentrated facial wounds would allow for advancement of the field and numerous opportunities to find unique surgical solutions was opened in June 1917. The Queen's Hospital was opened in place of Frognal House, an old mansion in Sidcup, Kent. Comprising over one thousand beds, dozens of surgeons were recruited from across the Empire to fill the new facility and provide care.

With the wealth of patients surrounding him, Gillies wrote that "it was more difficult to hide a bad case than to get a good one" in an institution like The Queen's Hospital (Gillies and Millard, 1957). While his was not the only location where surgeons specialized in facial surgery at the time, the concentration of patients at Sidcup and organization of the department led to the development of the premier teaching base in facial reconstruction. While surgeons Esser and Morestin served as pioneers in the field of facial surgery, the most difficult cases would be sent by to Sidcup by American surgeons stationed in France such as Kazanjian, Albee and Ivy. This led to the birth of numerous new techniques including the temporalis transfer, the tubed pedicle and arterial flaps that heralded the birth of modern Plastic Surgery (building upon the principles that have been previously outlined and developed over 3000 years. Gillies practiced alongside the leading facial surgeons of his time—he himself focused on nasal reconstruction. Pickerill, of New Zealand, specialized in upper lip work and Kelsey Fry developed numerous jaw reconstruction techniques (Bamji).

Throughout the First World War over 11,000 operations were performed on 5,000 men (Meikle). In each of those procedures a focus on both function and aesthetics emerged, differentiating the work of Gillies and his colleagues from the other surgeons of their time. Rehabilitation played a crucial role in post-operative recovery and a team of health practitioners was recruited to address these needs—one of Gillies' major contributions to the entire field of surgery. Surgery and post-operative recovery grew into a team-effort under his stewardship, a model that is followed today. In addition to rehabilitators, Gillies recruited dentists, physicians, radiologists, dental technicians, artists, sculptors and photographers to treat the whole patient and to assist in planning reconstructions, respectively (Bamji).

In addition to advancements in the fields of rehabilitation, surgical facial reconstruction and team-based medicine, Gillies and his colleagues learned and taught principles of plastic surgery that are continued today. These include the importance of treating infection, providing support with non-artificial materials, and restoring normal tissue to its proper position prior to grafting the remaining lesions (Bamji).
The specialization of facial reconstructive surgery that the development of the waltzing tubed pedicle flap and WWI created were quickly and well received among the masses during the time. In both Europe and America there was an acceptance of the new surgeries and appreciation for their development. As early as 1923, shortly after WWI, there was an acknowledgment in the English magazines of the time that war and trauma had been major contributors to the development of reconstructive surgery and the tubed pedicle flap. Writing in McClure’s magazine, Zoe Beckley outlines the view of Gillies’ work at the time:

'We all wonder sometimes—we of the conquering countries—what good things, if any, the Great War bestowed upon the world. Different people give different answers to the question. But all must agree—even the countries which didn’t win—that one magnificent benefit has been reaped from the red harvest of battlefields: the amazing progress achieved by surgery. In the anguish of 1914, unheard-of experiments were attempted in desperation, and out of desperation came the beginning of miracles.'

For decades after the development of the tubed-pedicle flap, discussion of Sir Harold Gillies and his contributions remained in the media and academic circles. He presented his waltzing tubed pedicle technique in Boston in 1934 to the College of Surgeons, describing his method of moving a "tube" of skin around the body over a period of time, allowing new vessels to feed the tissue in its new location before the end is cut and placed in a new position (The Sun). Stories of his contributions of Gillies to rehabilitation and team-based care were outlined in The Sun along with his patients’ view of their procedures:

'Sometimes these operations take many months, but there are expert psychologists at the hospitals to keep the patients smiling and happy. Then, too, they are taught new and interesting handicrafts and, when convalescent, play croquet or tennis in the extensive hospital grounds. They are never allowed to lie alone in bed in private rooms. None of the women and girls are shy or self-conscious about their injuries and no one suffers from self-pity. They even joke about their temporary disfigurements and many think their new faces will be better than their old ones.' (Littlefield)

Rather than being viewed as an abomination or an “unnatural” procedure, Sir Gillies' flaps were seen as a blessing of modern medicine that allowed for those who would have previously suffered to have normal lives. Even royalty were quick to adopt the new plastic surgery techniques—an article in the New York Times describes King Leopold of Belgium receiving surgical from Sir Gillies for facial scars suffered in the automobile crash that killed his wife Queen Astrid (NYT). An anecdote related by a former patient of Gillies, Captain J.K. Wilson, relates another’s experience with a flap:

‘A young married woman had suffered facial disfigurement in a car accident. Sir H was called in to see what he could do in restoring her pristine beauty. After having had a look at her he turned to the husband, saying: ‘Yes I think I can help, but it will need rather a large skin graft on her cheeks’ for which purpose he took skin from the husband’s bottom. The operation was more than successful. Some time after the young husband bumped into Sir H embracing him in a most affectionate manner saying ‘that he would never be able to thank him enough for what he had done’, adding that he would never regret giving his wife the necessary skin and particularly from that part of his anatomy from which it was taken ‘as whenever my mother-in-law spends the [weekend] with us and kisses my wife goodbye (sic) I always feel I'm getting my own back.’ (Bamji)

Dr. Gillies was endowed a knighthood in 1930 for his work during the war and contributions to the field of plastic surgery. While originally delayed, the honorary degrees and accolades would continue to pour in throughout his life until after his death (Pickrell). His contributions to the field of plastic surgery not only include the reconstructions on patients in both world wars but also the principles and techniques that remain in existence today. While advances in microsurgical technique and the development of high-powered microscope have led to the demise of his tubed-pedicle flap, the concepts of replacing what is normal to its original position and planning procedures in advance remain in place today.

While the tubed pedicle flap is viewed as a landmark procedure, the technique itself was the outcome of
thousands of years of medical advancement and its invention should not be viewed as a de novo innovation that led to the development of plastic surgery as a unique field. Without the injuries from war and the industrial age, the growth of medical and surgical knowledge and the development of technology that allowed trauma patients to survive their initial injuries, the tubed pedicle flap would not have emerged. The response to the development of the tubed pedicle and its reconstructive yields was positive and its adoption was widespread.

Bibliography


Gnudi, M: The Life and Times of Gaspare Tagliacozzi. Los Angeles, Zeitlin and Ver Brugge, 1976


Latest reviews:

- Medicine essays
- What is a contract?
- Comparison of 50MPa Powder-type and VMA-type Self-Compacting Concrete Mixes

Search for student essays:

Search ...

About EssaySauce, the student essay site:

EssaySauce.com is a free resource for students, providing thousands of example essays to help them complete their college and university coursework. Students can use our free essays as examples to write their own.
Latest student essays:

- Ocular disease
- HUMAN action recognition
- Analysing data production
- Desorption study
- Surfactants (surface active agents)
- Islamic Finance and Its Impact on Customer Satisfaction
- Persian gulf
- Feminist approach (Bhumika) (notes)
- What does it mean to be a Muslim woman in 21st century? (Shari’ah)
- Appellate Body’s analysis under section XIV(c)

Student essay categories:

- Accounting essays
- Architecture essays
- Business essays
Computer science essays
Criminology essays
Economics essays
Education essays
Engineering essays
English language essays
English literature essays
Environmental studies essays
Finance essays
Geography essays
Health essays
History essays
Hospitality and tourism essays
Human rights essays
Information technology essays
International Relations
Law essays
Leadership essays
Linguistics essays
Literature essays
Management essays
Marketing essays
Media essays
Medicine essays
Miscellaneous essays
Music Essays
Philosophy essays
Photography and arts essays
Politics essays
Project management essays
Psychology essays
Religious studies and Theology essays
Science essays
Social work essays
Sociology essays
Uncategorized
Zoology essays

Average review:

Overall rating: 0 out of 5 based on 0 reviews.
Q: Is EssaySauce.com free?

Yes! EssaySauce.com is a completely free resource for students. You can view our terms of use here.

Why use Essay Sauce?

The brightest students know that the best way to learn is by example! EssaySauce.com has thousands of great essay examples for students to use as inspiration when writing their own essays.

Is Essay Sauce completely free?

Yes! EssaySauce.com is a completely free resource for students. You can view our terms of use here.

Info:

About
Content policy
Essay removal request
Privacy
Terms of use