COMMUNICATION

# History of revascularization surgery: Robert Abbe's contribution

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The history of vascular anastomosis, replantation, and transplantation has been discussed in numerous sources. Many reviews, however, have overlooked or underemphasized Robert Abbe's contributions to the development of the ideas that led to revascularization surgery.

Early cases of reattachment surgery were stimulated by patients' natural need to regain the lost body part. Those procedures were not–and technically could not be–directed towards the restoration of vascular continuity, which is essential for achieving favorable functional results. The first vascular anatomy-based tissue relocation has been credited to the Italian surgeon Pietro Sabatini, who reported the labial artery flap in 1838. This procedure gained popularity only at the end of the 19th century, when the New York surgeon Robert Abbe described a similar flap in a widely-circulated journal [1]. Abbe should also be remembered for what is likely the earliest hypothesis of vascular anastomosis-based replantation and transplantation. In 1893, he reported a replantation experiment [2] that could also be regarded as a true vascular pedicle flap transfer. Abbe divided all tissues of a canine forelimb, except the brachial artery and vein, and then repaired the severed structures. The leg survived and regained function. Abbe concluded that even a completely amputated extremity would survive, if its blood supply was restored. Today this logic seems simple, but at that time little was known about transplant biology. Free tissue transfer was largely believed to be limited to only thin skin grafts [3]. Abbe [2] elaborated on his hypothesis with the following reasoning: "Where is the supply of limbs to come from" if grafts become possible? He further asked, "why not another man's blood as well as its owner's," if a bloodless extremity kept for hours under an Esmarch bandage revives after releasing the tourniquet? That is, why would it not be possible to restore circulation in a transplanted or replanted extremity?

In 1922, Halsted [4], from Johns Hopkins University in Baltimore, claimed to have performed an analogous experiment in 1887. His procedure involved leaving a dog's hind limb attached only by the main artery and transferring the leg to the contralateral side. Halstead probably failed to mention inclusion of a concomitant vein into the vascular leash, because the limb survived, seemingly without developing ruinous venostasis. Notably, similar procedures performed by his team around 1920 resulted in gangrene if the femoral vein was ligated [4].

Abbe's experiment was encouraged by a request of a bilateral hand amputee to be grafted with a convict's hand [2]. In 1906, this occurrence inspired a science fiction novelette, *Mortmain* [5], written by Abbe's friend Arthur Train [6]. With some touch of irony, apparently stemming from the contemporary ethical controversy of transplantation and animal experimentation, this story narrated in detail Abbe's experiment and hypothesis regarding limb grafting. Therefore, Train's writing can be considered a significant step in medical science fiction after its birth with Mary Shelley's *New Prometheus* or *Frankenstein* in 1816. Notably, Shelley may have been influenced by the rhinoplasty operations of 1814 and the galvanic experiments of 1803 performed by the London surgeon Joseph Constantine Carpue [7], a reviver of plastic surgery in Europe. In 1915, *Mortmain*, which also alluded to another medical theme, alien hand syndrome, was even made into a movie [8]. Interestingly, Alexis Carrel, a pioneer of transplantology, made the acquaintance of Train after reading his novelette [9].

Abbe's simulated of replantation was part of his project to develop a glass-tube vascular junction. His report appeared the year before Carrel, still a medical student, is said to have decided to take on the challenge of achieving effective vascular repair after witnessing the assassination of French President Sadi Carnot, who died on the operating table due to surgeons' inability to stop bleeding from the injured portal vein [10]. Carrel introduced his triangulation anastomosis in 1902 in Lyon [9], and by collaborating with Charles Claude Guthrie perfected it in 1905 in Chicago [9,10], which enabled them to replant a completely amputated canine limb in 1906 and to perform a number of experimental transplant procedures [9-12]. Their work was preceded by the German surgeon Edmund Höpfner's attempts of 1902 to reattach dogs' extremities, which involved triangulation of the lumens of the femoral vessels and their subsequent prosthetic tube anastomosis [13]. Also in 1902, the Vienna surgeon Emerich Ullmann reported kidney transplantation by stent anastomosis in a dog [9-12]. Clinical organ transplantation began in 1954 in Boston, with the first successful kidney transfer performed by Joseph Murray's team between identical twins [7]. The first reattachment of a human limb was also accomplished in Boston by Ronald A. Malt and Charles F. McKhann in 1962 [14], 60 years after the first experimental replantation. This lag is quite impressive, considering the evolution from biplanes to spacecraft and other advances in technology during this time.

## Notes

Conflict of interest
No potential conflict of interest relevant to this article was reported.

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## References

1. Santoni-Rugiu P, Sykes PJ. A history of plastic surgery. New York: Springer Verlag; 2007.
2. Abbe R. The surgery of the hand being the carpenter lectureship address before the New York Academy of Medicine. New York: New York Academy of Medicine; 1893.
3. Parham WS. Grafting in surgery. New Orleans Med Surg J 1892;20:163-81.
4. Halsted WS. Replantation of entire limbs without suture of vessels. Proc Natl Acad Sci U S A 1922;8:181-6.
5. Train AC. Mortmain. New York: D. Appleton; 1906.
6. Lederer SE. Flesh and blood: organ transplantation and blood transfusion in twentieth-century America. New York: Oxford University Press; 2008.
7. Hamilton D. A history of organ transplantation: ancient legends to modern practice. Pittsburgh: University of Pittsburgh Press; 2012.
8. Wlaschin K. Silent mystery and detective movies: a comprehensive filmography. Jefferson: McFarland & Company; 2009.
9. Hamilton D. The first transplant surgeon: the flawed genius of Nobel prize winner, Alexis Carrel. London: World Scientific; 2017.
10. McKellar S. Innovation in modern surgery: Alexis Carrel and blood vessel repair. In: Stapleton DH, editor. Creating a tradition of biomedical research: contributions to the history of the Rockefeller University. New York: The Rockefeller University Press; 2004. p.131-50.
11. Carrel A. The surgery of blood vessels, etc. Bull Johns Hopkins Hosp 1907;18:18-28.
12. Watts SH. The suture of blood vessels: implantation and transplantation of vessels and organs. An historical and experimental study. Bull Johns Hopkins Hosp 1907;18:153-79.
13. Höpfner E. Über Gefäßnaht, Gefäßtransplantationen und Replantation von amputirten Extremitäten. Arch Klin Chir 1903;70:417-71.
14. Morrison WA. The history of extremity replantation. In: Saylyapongse AN, Poore SO, Afifi AM, et al., editors. Extremity replantation: a comprehensive clinical guide. New York: Springer; 2015. p.1-8.