History of Medicine

Reshaping the nose: a historical journey through the paramedian forehead flap

Ernest Chan, BSc, MD[1]
Justin Paletz, MD, FRCSC[1]
1. Department of Medicine, Faculty of Medicine, Dalhousie University, Halifax, NS

Correspondence to
Dr. Ernest Chan;
Ernest.Chan@dal.ca

Forehead flap nasal reconstruction is one of the oldest forms of reconstructive surgery. Its evolution throughout history has undergone significant changes before becoming one of the gold standards of soft tissue reconstruction in modern medicine. This historical review traces the origins of nasal reconstruction from ancient India to the Italian Renaissance, which laid the foundation for modern techniques. It also examines future directions in nasal reconstruction, particularly the surgical considerations for patients from various ethnic backgrounds with differing craniofacial anatomy. The nose is central to the "triangle of fixation," an area bordered by the eyes and nose that guides visual attention to the face. This attentional bias toward the nose highlights the importance of nasal reconstruction in improving quality of life and aesthetic outcomes for patients throughout history.

Introduction

Forehead flap nasal reconstruction is considered one of the oldest categories of reconstructive surgeries in the history of medicine. Paramedian flap nasal reconstructive surgery is typically referred to as "the gold standard of nasal soft tissue reconstruction" and involves freeing a portion of skin from the forehead, isolating its blood supply, and rotating it to the area where the nasal defect is seen.[1] In recent decades, advancements in surgical techniques have revolutionized the treatment for nasal defects elicited by aggressive skin cancers, traumatic injuries, and congenital deformities to achieve the best aesthetic outcome.[1] The prominence of nasal reconstruction innovation correlates with the nose's importance within what is colloquially known as the "central triangle of fixation". The triangle of fixation, an imaginary triangle encompassing the eyes and tip of the nose, is considered central to how people perceive and focus on someone's face; therefore, this area is crucial for aesthetic considerations pertaining to nasal reconstruction.[2] To further understand the complex history of forehead flap nasal reconstruction, we will begin by discussing pertinent anatomical landmarks that surgeons from different time periods have utilized to develop the standard procedures that we use today.

Pertinent Anatomical Considerations

The forehead is a major flap site in nasal reconstruction due to its large surface area of tissue, along with a complex vascular network allowing for a strong blood supply to the pedicle.[1] Paramedian forehead flaps are harvested from the medial border of the eyebrow, above the superior orbital rim, further extending to the forehead.[3] The incorporation of specific blood vessels within the longitudinal axis of a flap to the area of the defect is denoted as an "axial flap pattern".[4] The paramedian forehead flap is a type of axial flap that integrates the supratrochlear artery, which allows for a continuous blood supply upon forehead flap rotation to the nose.[4] In most cases, the flap is taken from the ipsilateral side of the nasal defect as this requires less tissue and can be more easily rotated toward the nasal defect as opposed to contralateral flaps.[3] However, it is important to note that ipsilateral flaps can result in "kinking" of the pedicle, which would be a significant issue in the vitality of the flap itself. In some patients the typical anatomical considerations/landmarks are not sufficient for a healthy paramedian forehead flap procedure.[4] Therefore, further extension of the flap into the hair-bearing scalp and ~1.5 cm below the orbital rim can be considered if required.[4] The anatomical considerations of flap procedures for nasal reconstruction have differed throughout history, thus it is important to understand the techniques that have shaped and remain the foundation of the gold standard procedures of modern medicine.

Ancient India: The Beginning of Nasal Reconstruction

The origins of nasal reconstruction can be traced back to ancient India ~800 BCE, where cultural beliefs emphasized the nose as a vital element of one's appearance, symbolizing dignity and integrity.[5] As a result, nose amputations were commonly used as a form of punishment

during this period. This cultural significance laid the groundwork for the development of early nasal reconstruction techniques. Sushruta, an ancient Indian physician, is globally known as the "Father of Plastic Surgery".[6] His revolutionary encyclopedia of surgical procedures, known as Sushruta Samhita, introduced the technique of rhinoplasty.[7] Although Sushruta's knowledge of facial anatomy was not as robust as what we know today, his surgical approach had many similarities and a profound influence on how plastic surgeons repair nasal defects in modern times.[5] The Sushruta Samhita described the origins of nasal reconstruction as placing a leaf on the nasal defect to approximate the amount of tissue needed for the flap.[7] In the early phases of Sushruta's nasal reconstruction procedures, flaps were taken from the ipsilateral cheek, where the leaf was used as a template for skin dissection. Further modifications by Sushruta utilized a rotation flap from the forehead as depicted in Figure 1.[8] Once the flap was rotated onto the nasal defect, Sushruta's technique emphasized placing castor-oil plants inside the nostrils to elevate the flap for proper nasal contour.[7] Ancient Indian care post-rhinoplasty paralleled many of the concepts modern medicine has adopted. Sushruta described the need to keep the surgical site clean and moist. This was done by covering the nose in sesame oil and protecting the site with a layer of cotton after treatment.[7] Sushruta's medical teachings in India cultivated his version of nasal reconstruction for centuries following its inception. The rhinoplasty technique was passed down to multiple generations of physicians in India following Sushruta's death in 700 BCE.[6] Sushruta's technique eventually made its way to Europe in the 1700s, after British surgeons began working with the East Indian Company.[9] When the Mysore War broke out in 1792, many British soldiers had their noses mutilated by the ongoing conflict between the British and the soldiers of Tipu Sultan, the South Indian ruler.[9] After British soldiers underwent the same procedure Sushruta had founded centuries before them, British surgeons Thomas Cruso and James Findlay returned home with diagrams and descriptions of their findings, publicizing what would come to be known as the "Indian Flap" (Figure 2).[10]

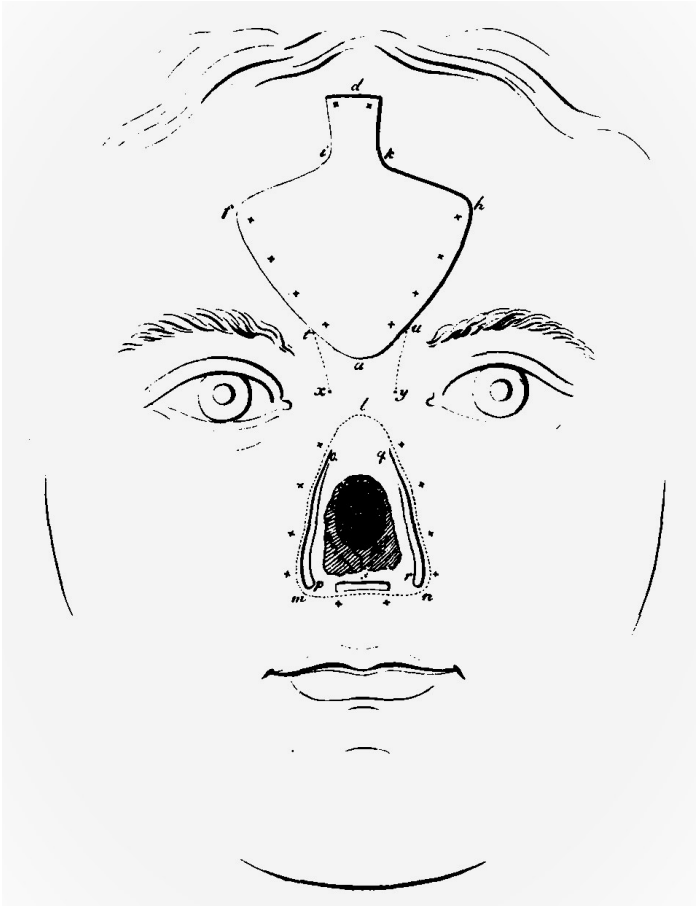


Figure 1 | Sketch depicting Sushruta's technique for nasal reconstruction.[8]

The Legacy of Carpue and Gillies in the Evolution of Nasal Reconstruction

Depictions of the "Indian Flap" (Figure 2) saw a pivotal transformation in the 19th century when Joseph



Figure 2 | The Gentleman's Magazine of London depicting nasal reconstruction via "The Indian Flap".[10]

Constantine Carpue, an English surgeon, introduced Sushruta's techniques into medical practice in England.[11] In 1816, Carpue published his monograph, An Account of Two Successful Operations for Restoring a Lost Nose. His work detailed two cases of nasal reconstruction: one involving a patient who had lost his nose to syphilitic ulceration and another who had been disfigured by traumatic injuries. Carpue closely followed Sushruta's principles while incorporating advancements in contemporary medical knowledge.[12] He was among the first to highlight the psychological impact of facial restoration and advocate for cross-cultural exchange in medicine, encouraging the broader adoption of nasal reconstruction across Europe.[13] Furthermore, Carpue's monograph included descriptive illustrations, patient outcomes, as well as anatomical depictions to ensure that the techniques used could be further replicated and improved on across Europe.[12]

Modern Techniques of Paramedian Forehead Flap Surgery & Future Advancement

Nasal reconstruction continued to develop through the 1800s, and techniques began to spread to North America by American plastic surgeon J.M. Warren, who later became the first person to perform a rhinoplasty in the United States.[1] In the 1930s, Dr. Varaztad Kazanjian, an American plastic surgeon, was the first to describe the supratrochlear and supraorbital arteries that supplied the median forehead flap.[1] Kazanjian popularized the use of median forehead flap surgery as the standard for nasal reconstruction due to the proximity of the flap to the nasal defect and similarity in skin texture and colour.[17] With further knowledge of the blood supply and facial anatomy, further innovative designs were implemented in practice by Dr. Ralph Millard; this in turn created the inception of the paramedian forehead flap position in the 1960s.[1] The revolutionary paramedian forehead flap altered several complications that were common in the classic median forehead flap procedure. Millard's paramedian forehead flap position eliminated the use of glabellar skin (the skin located between the eyebrow and above the nose) in the flap, which decreased partial and complete flap loss post-operatively.[1,18] Glabellar skin also contained a less robust vascular network, meaning that removing this from the paramedian flap isolated the supratrochlear artery to supply the flap completely.[1] Further refinement by Dr. F. J. Menick in the 1990s extended the lateral incisions below the orbital rim and narrowed the base of the pedicle. This allowed for additional rotation with less tension to properly reach the nasal defect with better aesthetic outcomes.[17] In the present day, there are more aesthetic considerations for craniofacial anatomy of different ethnic origins, specifically patients of East Asian origin. Current literature highlights new approaches to creating the most natural look for East Asian patients following paramedian forehead flap nasal reconstruction. For instance, tissue expansion is beginning to be utilized for different patient ethnicities to accommodate wider nasal bases when a paramedian flap is performed.[19] However, little has been investigated regarding patient outcomes and satisfaction. As the plastic surgery field continues to refine and document these methods, future advancements will emerge to incorporate developing technologies, tissue engineering, microsurgery, and regenerative medicine to gain the best aesthetic results for all patients.

Conclusion

The development of paramedian forehead flaps for nasal reconstruction can be traced back several millennia to its primitive techniques. Its significance in different countries throughout history to aid otherwise detrimental nasal defects have completely altered the quality of life for patients from the period of Sushruta's practice to modern medicine. Nasal reconstruction will continue to evolve to further echo the profound impact these advancements have had, incorporating new technologies and techniques to achieve even more natural and functional results.

1. Correa, B.J., Weathers, W.M., Wolfswinkel, E.M., Thornton, J.F. The forehead flap: the gold standard of nasal soft tissue reconstruction. Semin Plast Surg. 2013;**27**(2):96-103. doi:10.1055/s-0033-1351231
2. Park, S.S. Fundamental principles in aesthetic rhinoplasty. Clin Exp Otorhinolaryngol. 2011;**4**(2):55-66. doi:10.3342/ceo.2011.4.2.55
3. Park, S.S. Forehead flaps. Medscape. July 2023. Available at: https://emedicine.medscape.com/article/880171-overview?form=fpf. Accessed July 28, 2024.
4. Paramedian Forehead Flap. Iowa Head and Neck Protocols. Available at: https://medicine.uiowa.edu/iowaprotocols/paramedian-forehead-flap. Accessed September 1, 2024
5. Sorta-Bilajac, I., Muzur, A. The nose between ethics and aesthetics: Sushruta's legacy. Otolaryngol Head Neck Surg. 2007;**137**(5):707-710. doi:10.1016/j.otohns.2007.07.029
6. Kansupada, K.B., Sassani, J.W. Sushruta: the father of Indian surgery and ophthalmology. Doc Ophthalmol. 1997;**93**(1-2):159-167. doi:10.1007/BF02569056
7. Saraf, S. Sushruta: rhinoplasty in 600 B.C. Internet J Plast Surg. 2006;3(2). Available at: https://print.ispub.com/api/0/ispub-article/7662. Accessed September 1, 2024.
8. Graefe, C.F. Rhinoplastik oder die Kunst den Verlust der Nase organisch zu ersetzen. In: ihren früheren Verhältnissen erforscht und durch neue Verfahrungsweisen zur höheren Volkommenheit gefördert. Berlin: Realschulbuchhandlung; 1818. Available at: https://archive.org/stream/rhinoplastikoder00grae?ref=ol#page/n3/mode/2up. Accessed July 1, 2024. Public Domain.
9. Saini, A. Physicians of colonial India (1757-1900). J Family Med Prim Care. 2016;**5**(3):528-532. doi:10.4103/2249-4863.197257
10. B. L. Hindu rhinoplasty. The Gentleman's Magazine. 1794;**64**(pt 2):891-892, 1 plate (p.883). Licensing: https://creativecommons.org/licenses/by-sa/4.0/deed.en
11. Freshwater, M.F. Joseph Constantine Carpue and the Bicentennial of the Birth of Modern Plastic Surgery. Aesthet Surg J. 2015;**35**(6):748-758. doi:10.1093/asj/sju157
12. Marinozzi, S., et al. The art of rhinoplasty: researching technical and cultural foundations of Western world rhinosurgery, from the Middle Ages to the Renaissance. Aesthet Plast Surg. 2021;**45**(6):2886-2895. doi:10.1007/s00266-021-02247-x
13. An Account of Two Successful Operations for Restoring a Lost Nose (Lost Noses) from the Integuments of the Forehead, in the Cases of Two Officers in His Majesty's Army: To Which Are Affixed, Historical and Physiological Remarks on the Nasal Operation; Including Descriptions of the Indian and Italian Methods. Med Chir J Rev. 1817;**4**(23):376-387.
14. Loh, M., Heewa, A., Gribbon, M., Hampton, N. Reconstruction of the Nose using the Paramedian Forehead Flap – an interesting history. Mor Bay Med J. 2022;**9**(2):38-40.
15. Piccinini, P.S., et al. History of plastic surgery: Sir Harold Gillies, a pioneer of reconstructive plastic surgery. Revista Brasileira de Cirurgia Plástica (RBCP) – Brazilian Journal of Plastic Sugery. 2017;**32**(4):608
16. Solish, M.J., Roller, J.M., Zhong, T. Sir Harold Gillies: The Modern Father of Plastic Surgery. Plastic & Reconstructive Surgery. 2023
17. Marck, K.W., Palyvoda, R., Bamji, A., van Wingerden, J.J. The tubed pedicle flap centennial: its concept, origin, rise and fall. Eur J Plast Surg. 2017;**40**(5):473-8.
18. Menick, F.J. Nasal reconstruction with a forehead flap. Clin Plast Surg. 2009;**36**(3):443-459. doi:10.1016/j.cps.2009.02.015
19. Boyd, C.M., et al. The forehead flap for nasal reconstruction. Arch Dermatol. 2000;**136**(11):1365-1370. doi:10.1001/archderm.136.11.1365
20. Wei, M., et al. Expanded forehead flap in Asian nasal reconstruction. Sci Rep. 2023;**13**(1). doi:10.1038/s41598-023-30245-3