

Insights from the cutting edge: an interview on corneal neurotization and ophthalmic surgical innovation

Nathan Lee-Wing, BSc[†]

Abstract

This article explores the field of ophthalmic surgical innovation through an in-depth interview on corneal neurotization, a groundbreaking procedure aimed at restoring corneal sensation in patients suffering from neurotrophic keratopathy. The discussion offers insights into the technical details and challenges of performing this novel surgery, which is being conducted for the first time in Manitoba. By speaking with a ophthalmic surgeon at the forefront of this technique, the article examines the goals, surgical steps, and expected outcomes of corneal neurotization. The interview also delves into the surgeon's reflections on preparing for and executing novel procedures, highlighting the emotional and intellectual preparations required, the collaborative efforts with the plastic surgery team, and the adaptations made in response to intraoperative challenges. The conversation provides a unique perspective on the importance of lifelong learning, adaptability, and continuous innovation in surgical practice, offering valuable lessons for medical students, trainees, and professionals eager to embrace novel challenges in their careers.

Keywords: Corneal Neurotization, Ophthalmology, Surgical Innovation

Conflict of Interest Statement: None to declare.

Preamble

Clerkship is a time in a medical trainee's career that is filled with new experiences and coinciding reflection. For myself, this period has elicited a great respect for the knowledge and skills possessed by my mentors and other healthcare professionals who surround me daily. This experience has cultivated an appreciation akin to the Dunning-Kruger curve; an understanding of the extensive learning and experience that is required to achieve a remotely similar level of proficiency.¹ Although this experience was daunting at first, a new revelation has brought me comfort by knowing that those whom I admire around me have also traversed this rite of passage. They were once medical students and learners who diligently honed their skills, bridging the chasm of knowledge and experience they had encountered. Through these shared experiences we are bound by a common thread in the medical community.

Clinical experience has also provided insight into another lesson that learning does not end upon graduation from medical school. The physician's pledge is an oath made upon the inauguration of a medical trainee to signify their commitment to practicing medicine.²

Moreover, it establishes an understanding that learning and curiosity are continually pursued throughout a physician's lifetime. In the context of clinical medicine, this translates to a physician's dedication to continually better oneself through evolving and adapting medical knowledge and skills.

Perhaps no medical field illustrates the perpetual quest for knowledge and mastery of skills better than surgery, where practitioners must constantly evolve to offer care that is to the highest standard of medical treatment. In this ever-advancing field, the breakthrough of novel surgical techniques has created massive changes in regard to patient care.³

Ophthalmology is one such surgical specialty in which innovation is at the forefront of patient care. Over the past few decades, the specialty has seen massive advances, such as in the treatment of retinal diseases and cataract surgery, which now can be performed in minutes. The pioneering of novel surgical techniques and technology such as phacoemulsification has had a significant impact on reducing wait times and accelerating visual recovery for patients undergoing ophthalmic surgery which ultimately illustrates how innovation profoundly enhances care.⁴

Oculoplastics, a subspecialty of ophthalmology, has

*Correspondence to: leewingn@myumanitoba.ca

[†]Max Rady College of Medicine, University of Manitoba

also seen radical advancement. Of recent developments, a novel procedure called corneal neurotization has become revolutionary for treating corneal anesthesia. I had the unique opportunity to speak with a surgeon at the cutting edge of this innovative procedure, set to perform Manitoba's first corneal neurotization surgery. Our following conversation explores not only the technical details and challenges of performing the groundbreaking surgery but also offers a personal glimpse into valuable lessons on adapting and embracing novel situations in medicine.

The following interview was conducted on April 15, 2024. It has been lightly edited for clarity and length.

Interview Part One:

Thank you so much for taking the time to speak with us today. To start, could you please describe what the goals of corneal neurotization are?

"It is a pleasure to speak to you today. Corneal neurotization is a procedure aimed at restoring corneal sensation in patients with corneal ulcers due to lack of sensation. This is called neurotrophic keratopathy and it can be from various etiologies such as herpetic keratitis, surgical trauma, diabetes, or congenital insensitivity.⁵ In each of these pathologies, the corneal nerve becomes nonfunctional. For the patient tomorrow the most likely etiology is HSV but there could be various factors at play. When corneal sensation is lost this can cause a lot of problems. Similar to how a diabetic foot loses sensation - a very protective mechanism is lost. The loss of corneal sensitivity is not just a matter of diminished sensation; the nerves are also important to the cornea because they provide nutritional support by releasing paracrine neurotrophic factors.⁵ Without this support you can have recurrent corneal erosions and ulcers, poor wound healing, and vision-threatening complications (figure 1, 2). With this procedure, our goal is to reestablish the sensation to the cornea, which also promotes natural processes. The sensation will hopefully recover because the infraorbital nerve provides new nerve growth into the patient's eye via the nerve graft."

Could you please give a brief description of what the surgery entails?

"There are several steps to this surgery.⁶ We start by harvesting an autologous nerve graft (figure 3). For tomorrow's surgery, we're planning on using the sural nerve which runs down the back of the calf and the ankle. The sural nerve is the most commonly used graft for nerve reconstruction and is chosen because it is easily accessible and most patients are not bothered by the resultant minor sensory deficits on the distal lower leg and dorsum of the foot. We'll isolate this and remove a piece (figure 4). We'll use this nerve piece to be the new nerve conduit to the cornea. While the sural nerve graft is being harvested, I'll dissect into the inferior orbital space to isolate the infraorbital nerve,

taking off a small piece of bone from the orbital floor to expose the nerve. The nerve graft will be tunneled from the inferior orbit into the superficial layers of the eye (figure 5). We'll then create an anastomosis with sutures to connect one end of the graft to the infraorbital nerve and the other end to the eye. After the graft is securely connected to the infraorbital nerve, the final portion of the surgery is to separate the other end of the graft into fascicles and attach them to the corneal limbus (figure 6). The nerve fascicles are then covered with conjunctiva."

How long after surgery would you expect sensation and healing to return to the cornea?

"The healing phase will take time. The nerves have to recover, and I expect this to take at least 6 months.⁷ I'll see the patient in my office and monitor for signs of nerve regeneration and improvement of corneal sensation."

What specific steps do you take the night before surgery to make sure you're mentally and physically prepared?

"The evening before a surgery, I like to make sure I'm mentally and physically prepared. First, I make sure to get a good night's sleep; it helps for maintaining focus during surgery. I also think it's important to review the surgery steps, especially if it involves anatomy I haven't worked with for a while. I find that mentally visualizing the entire process helps with preparation. I also review any notes I may have written in pre-op and earlier clinics regarding the patient. There's often long wait times for surgery so there can be a significant gap between my initial consultation with the patient and the day of the procedure. Refreshing my memory on their specific case makes surprises less likely when we're in the operating room."

I find the OR environment to be intense at times. Are there any routines you do in the OR to alleviate stress?

"I have a couple of things that I like to do to stay relaxed. Playing music I enjoy helps me stay calm. Having familiar, relaxing tunes can help to ground yourself. I prefer something relaxing and fun to create a calm atmosphere without being too loud or fast. If I anticipate a long surgery ahead, I'll take time to stretch beforehand to prevent cramping. I'll be in the OR beforehand as well doing small things like adjusting the temperature for comfort if anesthesia allows. Also ensuring all equipment, like the microscope, loops, and headlight, are set to my preferences and review all the equipment that I'll need with the nurses. I try to minimize in-surgery adjustments as much as I can. I also try to position myself to be ergonomically comfortable during surgery and to avoid awkward body positions, especially for longer cases."

How do you counsel or prepare a patient who is nervous on the day of performing a novel surgery?

"It's important to be honest with patients. Even though this is my first time performing this surgery, these are steps that I am familiar with and parts I've done before in other surgeries. I've found that a patient's nervousness often stems from uncertainty about what to expect. I take the time to walk them through the process: explaining the surgery in detail, its duration, what sensations they might experience afterward, including any discomfort, and the expected timeline for discharge from the hospital. Acknowledging that the patient's anxiety before surgery is natural is also important. I assure them that our OR team will make their experience as comfortable as possible. Sometimes we provide medication to help ease their anxiety ahead of the procedure."

What emotions and feelings do you have before doing a surgery/procedure for the first time?

"Facing a surgery for the first time always brings a complex mix of emotions. Tomorrow's procedure is different because I'll be working with a plastic surgeon which is different from my usual solo surgeries. She'll handle the leg part to harvest the graft and also anastomose the graft to the infraorbital nerve, and I'll focus on the eye. There's a sense of excitement since this will be the first time this procedure is performed in Manitoba with collaboration between two specialties – Ophthalmology and Plastic Surgery. I'm eager to see the results, especially in terms of restoring sensation and healing. There's still some anxiety due to the novelty of the procedure. It's important to strike a balance between humility and confidence. While the new experience introduces some nervousness, my confidence is rooted in the skills I've developed over years in surgery. This gives me a solid foundation to lean on."

Interview Part Two:

Six weeks after the surgery, I had the opportunity to speak with the surgeon again, this time focusing on the lessons he'd learned and his reflections on the case.

"I am very pleased with how it went. I expected a learning curve, but I thought it went well, considering it was the first time we performed this procedure. With the help of the Plastic Surgery team, we completed the case successfully and without any problems. Post-operatively, everything seems to be progressing as expected; the corneal ulcer has healed, and it looks very promising for the return of corneal sensation (figure 7). Overall, the eye appears much healthier compared to before the surgery. The patient is also very happy. When I last saw her, she mentioned feeling some improvement in how the eye felt. She stated that there was some tingling on her left cheek and I reassured her that this will improve with time. We still need to wait a few months—six months or more—to know the

final results and see if corneal sensation has markedly improved."

Were there any unexpected challenges or surprises during the surgery? If so, how did you address this?

"Initially, I was hesitant about exposing the infraorbital nerve, particularly about exposing the nerve to the necessary degree without causing excessive bleeding or damage that could result in lasting facial sensation impairment. Fortunately, that part ultimately turned out well but did require extra caution. Suturing the sural nerve graft to the infraorbital nerve was another area of concern, but it went smoothly with the assistance of the Plastic Surgery team (figure 8). It was immensely helpful to have a nerve plastic surgeon accustomed to this type of work, and I enjoyed the teamwork as this is not something I often get to do."

What modifications to your technique or approach would you make when performing this surgery again in the future?

"I thought the length of the sural nerve graft was very long, and we didn't actually need the entirety of it. Because it was the first time we did it, we decided to err on the side of caution rather than risk not having enough. In terms of technique, instead of making a conjunctival incision close to the limbus, I would make the incision further back and tunnel the graft further under the conjunctiva so that the nerve fascicles lay closer to the cornea and were well-covered."

Reflecting on the process of learning this new procedure, what advice would you give to medical students and young doctors about embracing new challenges and evolving their practice?

"I would advise them to learn the basics first before learning new techniques. It's essential to master your fundamental skills before moving on to advanced procedures. I would not suggest learning too many new procedures at the start of one's career. Once these foundational skills are mastered, you can then branch out, focus on improving, and evolve new skills. You can do this by being curious and proactive: attend meetings, read journals and textbooks, watch surgical videos online, and talk to other surgeons. Asking to observe new techniques is also a great way to learn. Through this approach, you will build new techniques upon the solid base of fundamentals you've already established."

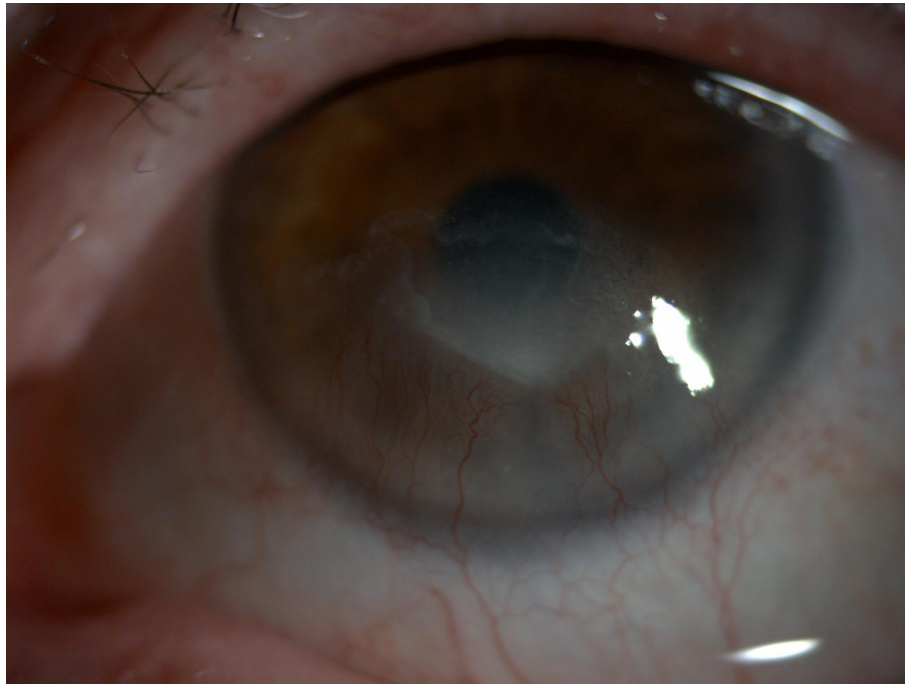


Figure 1. Chronic non-healing corneal ulcer of the candidate patient imaged with slit lamp microscopy. Adequate corneal sensation is required for healing of the ulcer.



Figure 2. Non-healing chronic neurotrophic corneal ulcer stained with fluorescein dye.



Figure 3. Exposure of the sural nerve on the posterior-lateral leg.

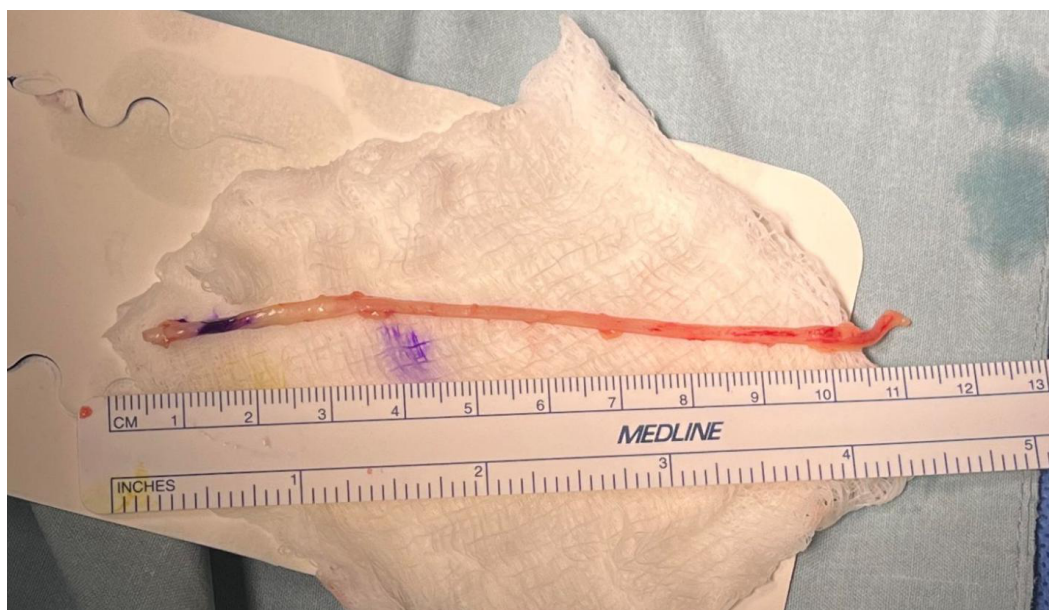


Figure 4. Isolated sural nerve graft.

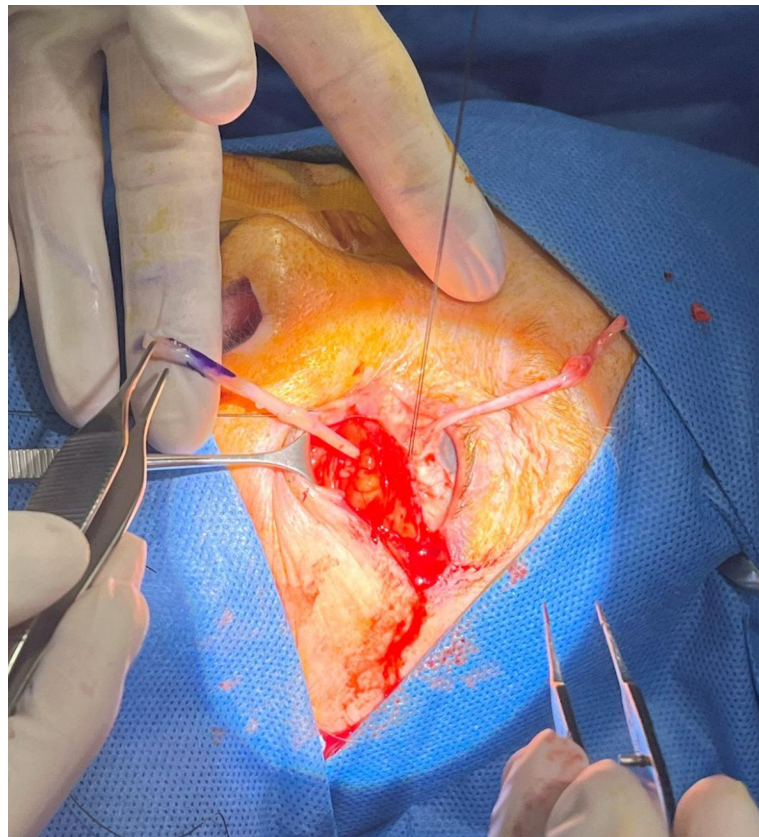


Figure 5. Sural nerve graft tunneled subconjunctivally from the inferior orbital space into the subconjunctival space of the patient's eye.

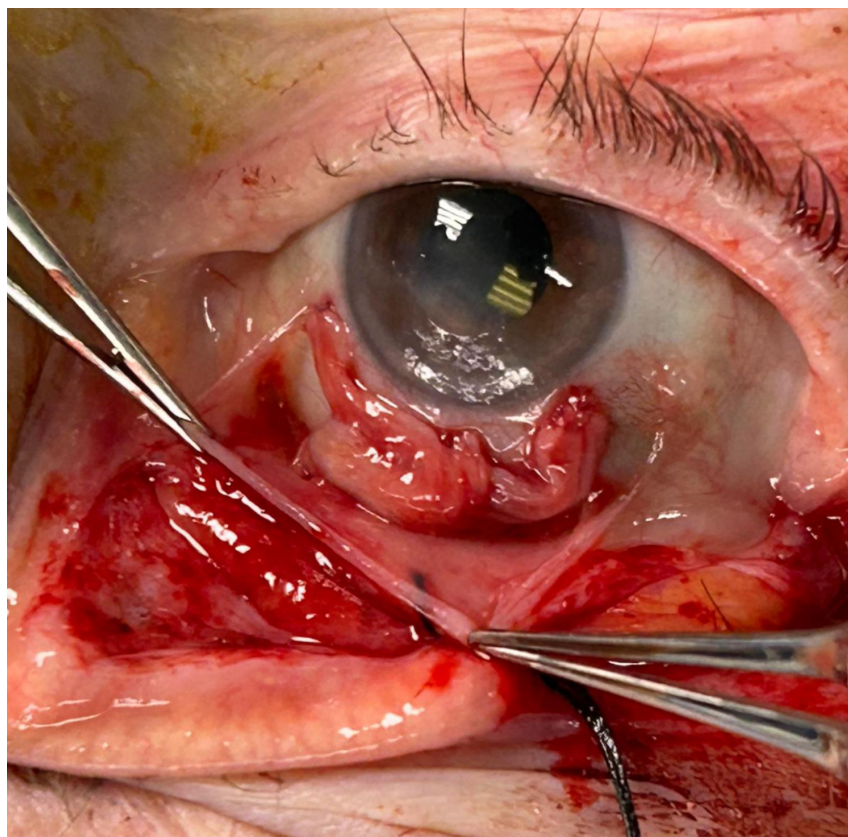


Figure 6. Graft separated into three nerve fascicles and attached to the subconjunctival limbus area of the eye with sutures. The other end of the graft is attached to the infraorbital nerve.

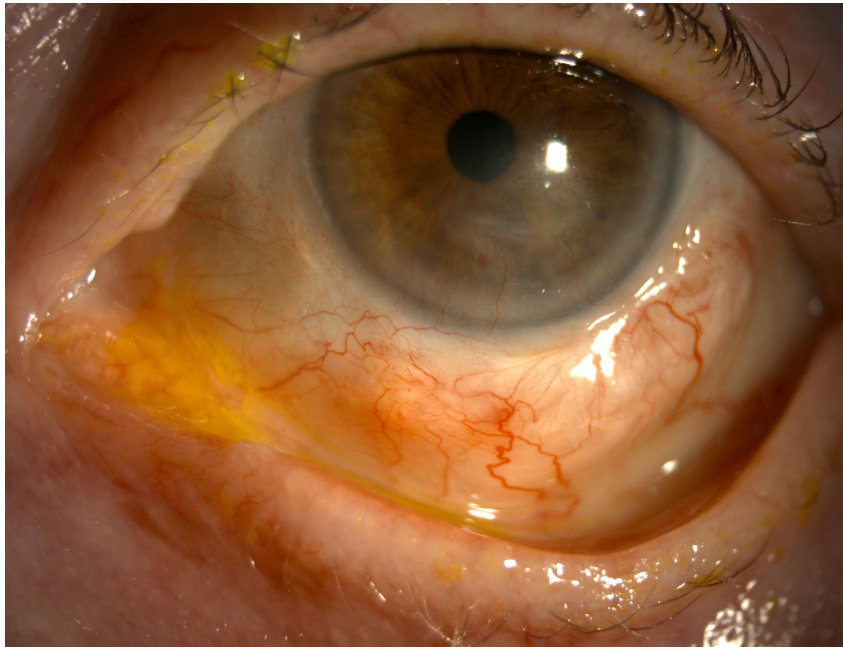


Figure 7. Slit lamp microscopy six weeks postoperatively shows a healed corneal ulcer and subconjunctival nerve graft inferiorly.



Figure 8. Two surgical teams perform corneal neurotization surgery. The Ophthalmology team at the patient's head isolates and exposes the infraorbital nerve while the Plastic Surgery team harvests the sural nerve graft.

References

- [1] Kruger J, Dunning D. Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*. 1999;77(6):1121.
- [2] Anonymous. World Medical Association Declaration of Geneva. *African Health Sciences*. 2017;17(4):1203.
- [3] Jonczyk MM, Jean J, Graham R, Chatterjee A. Surgical trends in breast cancer: a rise in novel operative treatment options over a 12 year analysis. In: *Breast Cancer Research and Treatment*. vol. 173. Springer Science and Business Media LLC; 2018. p. 267-74.
- [4] Davis G. The Evolution of Cataract Surgery. *Missouri Medicine*. 2016;113(1):58-62.
- [5] Wells J, Michelson M. Diagnosing and treating neurotrophic keratopathy. *American Academy of Ophthalmology*; 2016. Accessed: 14 May 2024. Available from: <https://www.aao.org/eyenet/article/diagnosing-treating-neurotrophic-keratopathy#:~:text=Clinical%20Causes,neuralgia%20surgery%20and%20acoustic%20neuroma>.
- [6] Wolkow N, Habib LA, Yoon MK, Freitag SK. Corneal Neurotization: Review of a New Surgical Approach and Its Developments. *Seminars in Ophthalmology*. 2019;34(7-8):473-87.
- [7] Rathi A, Bothra N, Priyadarshini SR, Achanta DSR, Fernandes M, Murthy SI, et al. Neurotization of the human cornea - A comprehensive review and an interim report. *Indian Journal of Ophthalmology*. 2022;70(6):1905-17.