

The Decline of Transplantation in Neurosurgery: Spinal Cord, Eye, Brain

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Abstract

A recent paper, "The Rise of Transplantation in Neurosurgery: Spinal Cord, Eye, Brain", suggests there will be a rise in neurosurgery transplants involving the spinal cord, eye, and brain. The present paper is written to evaluate whether transplants in neurosurgery involving the spinal cord, eye, and brain, may actually be increased in number, decreased in number, or even eliminated.

Keywords: *Spinal Cord Transplant; Eye Transplant; Brain Transplant; Omentum; Increased Blood Flow*

Spinal cord transplantation

A spinal cord transplant is a surgical procedure felt to be required when damaged or diseased tissue in the spinal cord is needed to be replaced by healthy tissue. The most common need for a transplant in spinal cord surgery results from a spinal cord injury. When a spinal cord injury occurs, a scar can develop within the spinal cord that could limit the progression of axons proximal to the spinal cord scar from advancing into the distal spinal cord. When a spinal cord scar is removed, a measurable gap in the spinal cord results. If the gap is small, it can be closed by the approximation of the proximal and distal cut edges of the spinal cord that results following the excision of the spinal cord scar. If the approximation of the cut edges of the divided spinal cord cannot be accomplished, even in the presence of a short spinal cord gap, the spinal cord gap can be shortened by a lumbar vertebrectomy that allows approximation of the divided ends of the proximal and distal cut edges at the spinal cord gap.

When a spinal cord scar is large, its removal results in a large gap in the spinal cord. This gap could be a site for a spinal cord transplant and its supporting blood supply. Even when this can be accomplished, the question arises as to whether axons descending from the proximal edge of the divided spinal cord will have sufficient biological energy to join with axons in the transplant to allow the axons in the spinal cord transplant to progress and make a neo-synaptic connection with appropriate distal spinal cord elements.

A simpler way to fill a gap in the spinal cord is with semi-liquid collagen (zyderm). The gap in the spinal cord, when filled with collagen, will allow axons to progress to distal positions in the spinal cord. Collagen is refrigerated at a temperature of four degrees Centigrade. As the temperature in the collagen rises because of the higher temperature in the subject receiving the collagen, the collagen forms a bridge that connects the proximal and distal edges of the divided spinal cord. The axons that progress through the collagen bridge have

their blood supply produced by an overlying omental pedicle, which supports the continuing progression of axons in the collagen bridge to advance into the distal spinal cord at the rate of 1 mm per day [4]. By three months, axons in the collagen bridge have been shown to progress for 90 mm down to connections in the distal spinal cord [5]. Animals that had undergone this collagen experiment later exhibited normal walking ability, which confirmed that axons had made appropriate connections with distal neurological elements. That axons had successfully progressed through a collagen bridge to distal neuronal tissue strongly suggests that the collagen bridge operation is simpler than the complexity of performing a spinal cord transplant [6].

The collagen bridge operation was successfully performed in animals, but it has also been accomplished in a single patient who had a spinal cord injury that was reported by an MRI to have shown complete anatomical transection of the spinal cord at the T6-T8 level (Figure 1). Five years after the patient's injury, the scar in the spinal cord was removed. The resection gap in the spinal cord, which measured 4 cm (1.6 inches), was totally filled with collagen. An MRI one year after surgery showed a large amount of soft tissue at the transection site (Figure 2). Subsequent yearly MRIs demonstrated the development of a longitudinal structure at the spinal cord transection site (Figure 3). A final MRI five years following surgery showed that the spinal cord had amazingly regenerated and had connected the previously divided proximal and distal cut surfaces in the spinal cord (Figure 4). Additionally, of interest was that the patient had regained some walking ability (See video) [7].



Figure 1: MRI at time of injury reported total transection at T6-T7 level.



Figure 2: One year after surgery, MRI showed a mass of soft tissue at SCI site.



Figure 3: MRI three years after surgery, soft tissue mass appears to be developing into a longitudinal structure at the SC transection site.

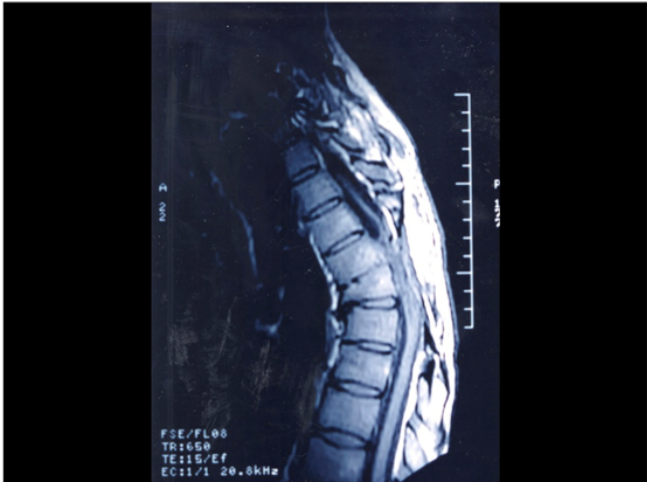


Figure 4: Final MRI five years after surgery shows regenerated SC connecting proximal and distal previously divided spinal cord segments.

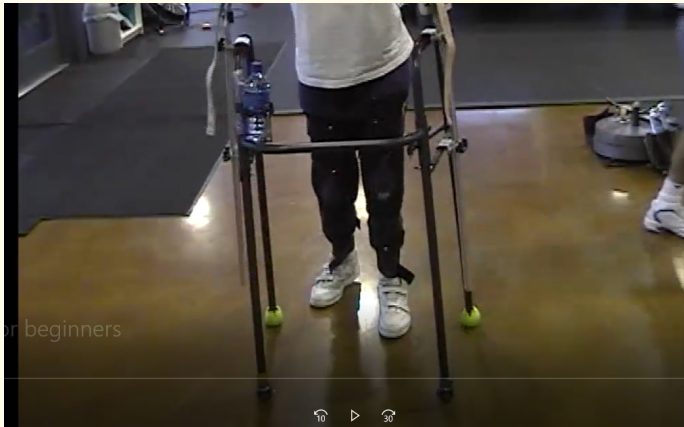


Figure 4: Final MRI five years after surgery shows regenerated SC connecting proximal and distal previously divided spinal cord segments.

Eye transplant

It has been suggested that there might be a place in the future for eye transplantation [1]. The main reason for performing an eye transplant is to increase vision, thereby lessening the potential for blindness. The problem is how to increase blood flow to the retina. A paper was published using dogs in the attempt to increase blood flow to the retina by applying the omentum to the eye [8]. The operation however was not successful, and even if it were successful, it would not have been appropriate for human application since the eye was surgically invaded. What is presently needed for a condition, such as macular degeneration, is a procedure that can allow increased blood flow to the retina without the need for a surgical invasion of the eye.

The late Dr. V.K. Agarwal, from India, apparently found a solution to this problem. He was a member of the American College of Surgeons, an experienced ophthalmologist, and the retired Dean of the prestigious El Mira Medical School in India [2]. He had a major interest in macular degeneration, in which there is decreased blood flow to blood vessels in the eye that supply blood to the macula, the central portion of the retina and to other blood vessels supplying the retina.

Dr. Agarwal's operation increases blood flow to the retina without invasion of the eye. His procedure has shown that blood flow can be increased to the eye suffering from decreased vision secondary to decreased vascularity without invading the intact eye itself. He has reported on 140 patients who suffered from decreased visual acuity. Patients who underwent the operation have experienced post-operative improvement [3].

Agarwal's operation involves the surgical mobilization of a piece of intact omentum, which is brought subcutaneously up the chest, neck, and behind the ear followed by the omentum being directed to the middle of the forehead. At this point, slips of omental tissue are placed on the back of both eyes. The length of the omentum required to reach the eye is comparable to the mobilization of the omentum to the brain for cerebral revascularization which has been reported in the literature [9].

When the intact omental tissue is placed on the back of the eye, omental capillaries do not penetrate into the eye but simply connect with posterior short ciliary arteries that are located just outside the eye. The blood flow from the omental capillaries enters into the ciliary arteries that penetrated into the eye and supplies blood flow to the choroidal artery that is inside the eye and located adjacent to the retina. The choroidal artery is the source of blood flow to the macula, the center of the retina, and to other retinal blood vessels. This all occurs without any invasion of the eye and any penetration by omental vessels into the eye.

A major problem throughout the world is a method to treat macular degeneration, a condition where less blood supply to the retina can result in decreased vision that can lead to eventual blindness. If Agarwal's operation can be confirmed, it would be tremendously important in helping the large numbers of people who suffer from vascular insufficiency to their eyes as in macular degeneration. It is hoped that researchers will quickly attempt to learn if Dr. Agarwal's operation is reproduceable since the placement of a piece of the omentum onto the back of an intact eye has the potential to remove the need in the future for an eye transplant.

Brain transplant

This paper addresses the importance for science of a brain transplant after a donor brain is placed in the skull of a recipient. Will it be possible for brain transplants to become a procedure of the future?

It is difficult to evaluate the importance of brain transplants for science and humanity based on an operation that is extremely controversial. The operation of brain transplantation will be very difficult to perform, and even if the first surgical operation can be accomplished, one wonders if it could lead to future neurosurgical transplants.

A question to be asked is what would be the cognitive state of a patient who has just undergone a brain transplant. Would his cognitive response justify the operation? Will the patient know his family? Just as important, will his family know him?

What would be the patient's thoughts? If the patient had greater cognitive ability prior to the operation than the donor patient, how would the brain recipient accept his or her new cognitive state? Will a brain transplant really be important to science and especially to a patient?

There are three reasons where one could expect that brain transplantation may not increase in the future [10]:

1. The logistics for brain transplantation are enormous. It has been stated that the operation will require the presence of 150 doctors and nurses to be at the operation which is expected to last for 36 hours; one and a half days.
2. The cost. It has been estimated that the cost of a brain transplant will be 11 million dollars. The cost includes the financial support for the personnel involved, the technology of the procedure, the cost of equipment, and the post-operative care of the patient.
3. The ethical challenge of the procedure is the major obstacle that may well prevent the continued application of brain transplantation. Many individuals at all levels continue to be highly resistant to brain transplantation. These include notable experts in bio-ethics.

Dr. Arthur Kaplan is one of the outstanding bio-ethicists in the United States who is strongly opposed to brain transplantation. Dr. Kaplan is the chairman of the Bio-Ethics Committee at the New York University Langone Medical Center in New York City and he has expressed his strong distaste for brain transplantation. Dr. Kaplan has written, "The brain would be completely confused. Not only would it be unethical, because we don't know the science, but it would be unethical to even think about it because of the significant risk of creating someone who would be insane, demented, or tortured".

Knowing the ethical arguments against brain transplantation, one would wonder how many of these operations could be performed throughout the world. The number would be expected to be extremely limited. The basic question is whether brain transplantation will be important to science.

Conclusion

It seems reasonable to expect that transplantation in neurosurgery in some situations may increase, but in the future, transplantation in neurosurgery will likely decrease.

Bibliography

1. Canavero S., *et al.* "The rise of transplantation neurosurgery: spinal cord, eye, brain". *Surgical Neurology International* 15 (2024): 478.
2. Agarwal VK. "Pedicle omental transplant to the eye". *Journal of the American College of Surgeons* 201.3 (2005): 486.
3. Agarwal VK., *et al.* "Functional recovery of vision in retinitis by omental transplant". *The Clinical Ophthalmologist Journal* 2 (2021): 1020.
4. de la Torre JC and Goldsmith HS. "Collagen-omental graft in experimental spinal cord transection". *Acta Neurochirurgica* 102 (1990): 152-163.
5. de la Torre JC and Goldsmith HS. "Supraspinal fiber outgrowth and apparent synaptic remodeling across transected-reconstructed feline spinal cord". *Acta Neurochirurgica* 114 (1992): 118-127.

6. Goldsmith HS and de la Torre JC. "Axonal regeneration after spinal cord transection and reconstruction". *Brain Research* 589.2 (1992): 217-224.
7. Goldsmith HS. "Prevention and excision of spinal cord scar following spinal cord injury results in motor function and spinal cord regeneration". *Clinical Surgery Journal* 1.5 (2020): 1-6.
8. Goldsmith HS., *et al.* "Intact omentum for ocular vascularization". *Investigative Ophthalmology* 14 (1975): 163-165.
9. Goldsmith HS. "Alzheimer's disease: a decreased cerebral blood flow to critical intraneuronal elements is the cause". *Journal of Alzheimer's Disease* 85.4 (2021): 1419-1422.
10. Whiteman H. "The first human head transplant: 'it will be a success'". *Medical News Today* (2015): 301073.

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