

## Brains, Craniums, and Heads, Oh My!

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“I’d while away the hours, conferrin’ with the flowers...if I only had a brain!”

Most of us instantly recognize the lyrics of that song as sung by the Scarecrow in the 1939 MGM production, *The Wizard of Oz*. By the end of that wonderful film we do know that the Scarecrow did indeed get his brain and all it took was a diploma. If it were only that easy...just a diploma. But wait! According to some of our favorite SF films it just may *be* that easy so read on gentle readers.

### Anatomy 101

But first, we need a little time for some introductory brain and head anatomy. Not much, just enough to get an overall understanding of what is really there between our ears (unlike the 3 Stooges where Moe looks into Curly’s ear and sees Larry on the other side!). Typically, our brains are around 3 lbs of tissue. Not really that much when you get down to it so this is a nice example of compactness in a small space. And that is a key element to our brains, its compactness.

Our brains are composed of several major areas. The bulk of the brain is called the neocortex and what most think of as the actual brain is composed of four lobes, the frontal lobe (the front), the parietal lobe (the middle), the occipital lobe (back), and the temporal lobes (the sides). The frontal lobe is where planning, language, and speech expression occur. Taste and touch are controlled in the parietal lobe whereas vision is controlled by the occipital lobe. The temporal lobes control language and reception. Right and left-handedness play a role in brain development as well as whether one is right brain dominated (artistic) or left brain dominated (analytical). (For me personally, my left brain isn’t right and my right brain has left!) The cerebral cortex is the wrinkled outer layer of the front parts of the brain and its functions include the perception of sensations, learning, reasoning and memory.

Another major area of the brain is the cerebellum (underneath the occipital lobe) and this coordinates the movement of muscles. The diencephalon is composed of the thalamus (the cerebral cortex relay center) and the hypothalamus (controls the autonomic nervous system and serves as an overall integration center). Buried in the cerebellum is the epithalamus, more commonly known as the pineal gland or the “third eye” and this controls the body’s various rhythms (the pineal gland played a key plot point in the film *THE LEECH WOMAN*). The limbic system is composed of the olfactory (smell), amygdala (regulates heart beat), and the hippocampus (controls memories). Lastly is the brain stem and is

composed of the mid brain (controls body posture, blood pressure, body temperature, and regulates appetite), the pons (controls respiration, chewing, and taste), and the medulla. The medulla is considered the life-sustaining control center and controls the heart, respiratory, cough/gag/swallow reflexes, and digestion. Emanating from the brain and brain stem are the 10 cranial nerves that coordinate the entire body. Most of these 10 cranial nerves come from the brain stem which is the body's main highway connecting all of the body's nerves and spinal cord with the brain.

### Head trauma

Congresswoman, Gabrielle Giffords and the head trauma she suffered with a bullet through the brain is a current example of how other areas of the brain can take over functions and relearn actions. And this is a key point to emphasize. Our brains have multiple redundancies that take over when one area is no longer functioning as it should. When this does occur it often takes long periods of rehabilitation for new areas of the brain to relearn simple tasks. And this should also give you a bit of an understanding that when things go wrong, or the wrong brain function takes over, then mental disorders can result, some worse than others. What this means is that great care must be taken for brain surgery. And to underscore how difficult this is in reality, while brain surgery is inherently difficult, no successful human brain transplant has ever been performed. The brain is the last major organ that has not been successfully transplanted. There are too many vital nerve connections that need to be immediately made and this technology is not available. At some time in the future brain transplants may be feasible but the recovery and rehabilitation time will be substantial and full recovery may not be possible.

Now that we are experts on brain anatomy what does it all mean when things go wrong with our favorite monsters? So, if there is damage to the frontal lobe then there could be memory defects, poor concentration, behavioral disorders, depression, and other psychotic disorders. If the parietal lobe is damaged then the monster will suffer motor issues (difficulty using coordinated muscles), have time and speed disorders, have inabilities to properly read, draw, and write (so you know, the left parietal lobe contains Broca's speech area). Those with occipital lobe damage will have a difficulty receiving visual input and ability to interpret visual images (problems with sight). Those with damage to the temporal lobe will suffer from hearing loss, visual memory, are easily agitated, are irritable, and have short attention spans. Those with cerebellum damage suffer from improper muscle coordination, have a difficulty with balance (walking), swallowing, talking, and eye-hand coordination. Those with thalamus damage have altered consciousness and perceptual losses and those with hypothalamus damage have hormone imbalances and the inability to control body temperatures. Epithalamus problems result in hypertension, epilepsy, and depression. Damage to the limbic system can result in loss of smell (olfactory), loss of emotional control (amygdala), sleep problems, loss of appetite, and memory (hippocampus). Those with damage to the brain stem suffer from a loss

of consciousness (mid brain damage), can be in a semi-coma (pons damage), or can be comatose with abnormal breathing (medulla damage).

So, as you can now readily tell, when things go wrong in our brains, either slight or significant, major alterations to these normal brain functions can occur. Trauma, either biological or physical, to any anatomic region of the brain or peripheral nervous system can result in homeostatic imbalance. It doesn't really take much to significantly alter behavior and function in our favorite monsters. Just a little "oops" from our annoyed scientists can dramatically change the course of events. And I am quite sure that many of the "problems" our favorite monsters have can be easily traced to some sort of brain trauma from somewhere in or on their brain.

## BRAIN TRANSPLANTS

Before we discuss some of our favorite brain and head films we should clarify what a brain transplant really means. Much of society identifies "brain surgery" as the ultimate in medical knowledge and technique and that a "brain surgeon" must be a certifiable genius. Though that all may be true it is certainly not the entire story. Truth be told, though brain surgery is a delicate and precise discipline, it is in reality no more difficult than most other delicate surgeries. Most brain surgeries last no longer than 6-8 hours, similar to a heart transplant. Something like a hand transplant is far more delicate, can typically take between 12-18 hours, and is done by a team of surgeons each with their own specialty so these are far more complex than brain surgery. It is the mystique of the brain that is so compelling to make us all think so highly of this profession.

Since human brains are as complex as they are a complete recovery after a transplantation would be difficult. Connecting the myriad of nerves from the spinal column to the brain stem is a daunting task indeed. All the nerve connections for sight, smell, heart, lung, and muscle movement need to be properly connected for normal functions. If the brain tissue is rejected then the monster will of course not survive and it is back to the drawing board for our mad scientist.

Yes, there are other brain transplant films but they mostly cover the same ground so we will limit ourselves to the more interesting ones.

### The Frankenbrain

The granddaddy of all brain transplant films is, of course, FRANKENSTEIN (1931) where the monster gets the "abnormal" brain because Fritz accidentally dropped the normal brain he was attempting to steal. It's this abnormal brain that is the root of all the mayhem that happens in this film and the sequels. (Just so you know, such a brain on display in a teaching hospital like the one Fritz stole would be immersed in formaldehyde, a solution that preserves tissues. As a result of this preservation the tissues would not be functional and therefore quite dead so no amount of electricity would revive tissues preserved in

formaldehyde.) During Dr. Waldman's anatomy lecture at the Goldstadt Medical College he refers to two jars with formaldehyde preserved brains. Jar #1 is clearly labeled with a capital type font, "CEREBRUM" on one label and the words, "NORMAL BRAIN", also clearly labeled with a capital type font on the second slightly overlapping label. Jar #2 is labeled somewhat differently with the words, also in type font capitals, "DYSFUNCTION" on one line and underneath it is the word, "CEREBRI", which is an odd label for a 'dysfunctional cerebrum'. During his lecture Waldman points out, "the distinct degeneration of the middle frontal lobe" on the abnormal brain that signifies a man "whose life was one of brutality, violence, and murder". Later, when Fritz enters the lecture room to steal a brain he initially takes the jar with the label, "NORMAL BRAIN". However, this label is clearly hand written and is therefore different (we will call this jar #3) from the one Dr. Waldman referred to as normal during his earlier lecture. After dropping this one Fritz then takes the next one that is labeled, "ABNORMAL BRAIN" and we can clearly see that this too is hand labeled making it distinct (we will call this jar #4) from that also shown earlier by Waldman which had a printed label. Each word on the hand written labels is underlined adding to their distinction. Did a lab assistant switch jars after Waldman's lecture and before Fritz enters the lecture room? If so, then maybe the brain in jar#4 could indeed be the brain of a super psychotic criminal, worse than that in jar #2, and it is this brain in jar #4 that ended up in the skull of the monster.

Shortly after the monster was brought to life both Frankenstein and Waldman are having a casual conversation and Frankenstein comments that the "brain must be given time to develop". This is an interesting statement to make and shows that the good doctor does indeed know what he is talking about in that after any surgery the body needs to recover and allowing the brain time to develop (I see this as total nerve re-connection which would take time) is necessary for this. In other words, to convert dead tissue to fully living tissue via electricity and transplant will need time to develop and Frankenstein acknowledged this.

A few days after the monster is alive he is brought out from a back room and into the lab. In just a few moments we learn much about the monster's cognitive abilities. The Monster hears, understands, and responds to voice commands ("sit down") showing much muscle coordination. When Frankenstein opens a skylight the monster looks up and responds indicating that his sight is functional. Then the monster emotes with his face and hand gestures clearly indicating that all brain function and nerve impulses are working properly. The monster also responds vehemently when Fritz approaches with a torch indicating sophisticated flight and fight brain functions. Apparently, just a few days is enough for the monster's brain to be given time to fully develop.

In GHOST OF FRANKENSTEIN (1942) things took a dramatic turn when originally, Dr. Kettering's brain (whom the monster killed earlier) was going to be transplanted into the monster's body but Igor (superbly played by Bela Lugosi) and Dr. Bohmer (played by Lionel Atwill) conspire and put Igor's brain into the

monster instead. Seeing the Lon Chaney monster mouth words with the voice of Bela Lugosi's Igor near the end of the film is a wonderful moment. (In reality, it is the vocal cords that determine vocal tone and quality and not the brain so spoken words would be the same as before, irrespective of how many brains were transplanted into the monster's skull. Nevertheless, the desired results are effective and do succinctly make their point. Igor is now in charge.) Shortly after the brain transplant the monster goes blind, the reason being, as noted by Dr. Ludwig Frankenstein, tissue rejection resulting in the loss of sight. An interesting development and suggests the optic nerves were not properly connected to allow appropriate sight. Dr. Frankenstein implied that Kettering's brain was a transplant match with the monster's body whereas Igor's brain was not a match and was therefore being rejected with eyesight being the first to go. In the end, it is the monster's immune response that ultimately won out by rejecting the brain transplant.

In *HOUSE OF FRANKENSTEIN* (1944) Dr. Nieman (played by Boris Karloff) "tried to give a human brain to a dog" and was kicked out of Visaria University as a result (if I was on the Visaria University human subjects committee to evaluate the work of Dr. Nieman I would have kicked him out too!). Transplanting a human brain into the skull of a dog would be career suicide and there is no way to defend it. Even the largest dogs do not have the cranial capacity to effectively house a human brain.

As demented as putting a human brain into a dog may be we still have some distance yet to go. As revenge, Dr Nieman performed the trifecta of brain transplants by transplanting Herr Ullman's brain into the Frankenstein's monster, Herr Strauss' brain into that of the Wolf Man, and also says, "Talbot's body is the perfect home for the Monster's brain...which I will add to and subtract from in my experiments." A trifecta triple brain transplant! What is interesting is the brain surgery was done in a refrigerated cold room (with windows!) suggesting that cryo-surgery is an important element of brain transplants. I wonder how many hours it took to do three brain transplants?

Human brains into apes

*THE MONSTER AND THE GIRL* (1940). A man framed for a murder he did not commit was executed and his brain was transplanted into the body of a gorilla. This gorilla-man then kills those who framed him. The major problem in transplanting human tissues, in this case a brain, into an ape would be severe and immediate tissue rejection. The transplantation of any tissues into a different species is called xenotransplantation and the host's immune response (the ape's) will reject the transplant (the human brain). Even though apes and humans have a 98.5% similarity in their DNA it is not enough to allow complete acceptance of a tissue graft. As a result, neither the ape nor the human brain would survive. Having a fully cognitive human brain working an ape's body would be impossible. Also, the shape of an ape's cranium is different from that of

a human so the fit would not be a tight one allowing the brain to slosh around, even while walking, causing many mental problems.

Other examples

THE COLOSSUS OF NEW YORK (1958). In this film a brain surgeon transplants his dead son's brain into an unfeeling mechanical body. The resulting sensory deprivation shows that for a human brain to properly function then nerves need to be connected to flesh and not mechanics. Prior to the transplantation the surgeon kept the brain on life support in a tank ala Donovan's Brain. The concepts of this film were quite ahead of their time, which makes for appropriate science fiction and sort of represents a pre-TERMINATOR cyborg. Cyborg limbs and mechanical bodies are becoming a reality and will be very much a part of our future.

BRAIN OF BLOOD (1971). Though there is really nothing particularly new in this film in the way of brain transplants it does get a mention because in this film a deranged brain is transplanted into a politician. The only problem is there was no discernable difference!! Apparently there was no tissue rejection since the deranged brain was readily accepted by the politician's body (which is an interesting comment on political life).

#### HEAD TRANSPLANTS

Head transplants have been a staple in SF films for decades. The idea itself is simple and easy for anyone to imagine. However, in reality a head transplant would be too complex to ensure success and any physician attempting such a procedure would immediately lose his license, ala Dr. Nieman.

Anatomically, the head and neck are the most complicated in the entire human body with the numerous delicate muscles and many connective tissues. As punishment for many first year medical students learning anatomy the professor typically has pop quizzes on head & neck anatomy that can be quite frustrating. You gentle readers do not need any more frustrations in your lives so we will simply just skip all this and move on. Suffice it to say that for our purposes any surgery involving the head and neck will be very complicated indeed.

FRANKENSTEIN'S DAUGHTER (1958). For an interesting twist on the Frankenstein monster theme this outing resulted in the transplanting of a female human head onto a stitched together male body. (The mind reels at all the transgender possibilities...but I digress.) As Oliver Frank states, "It's a head I need. Everything is ready except for the brain." Here, he is confusing a brain with an intact head and perhaps he sees the two as synonymous instead of two separate items. Then later, he says, "We have to graft this head onto the other body." Transplanting female tissues into a male or vice versa is not especially problematical so this is really not a limitation of the plot. General tissue rejection

is still the major issue to overcome. The monster does take and execute commands so he/she/it has high level cognitive abilities from the head transplant.

#### THE INCREDIBLE TWO-HEADED TRANSPLANT (1971)

Your typical mad scientist transplants a criminal head (are there no other choices?) on to the shoulder of big John Bloom. Needless to say, this two-headed beastie runs amok and this film is enjoyable with a bowl of popcorn. The major problem with transplanting a head onto the shoulder of a body is making sure all the nerves are appropriately connected since there is some distance between the shoulder and the spinal column. Some connections may be made but not all of them so the transplanted head would have some deficiencies. To speak the grafted head would need the lungs of big John so there could be some competition for breathing.

#### KEEPING A HEAD ALIVE

Above, we discussed some of our favorite brain transplant films so it seems only appropriate that our next stop be keeping the entire head alive. So, what would it really take to keep a head alive? Before we, ahem, head into our favorite scare films let us take a look at something that may interest you and brings some real world flavor to the discussion. United States patent # 4,666,425 is disingenuously titled, "Device for perfusing an animal head". In simple terms, its keeping a head alive by tube feeding, which is what the word perfusion means. Sound familiar? Yes, this patent does exist and can easily be looked up at the US Patent and Trademark Office website. This patent describes a device referred to as a "cabinet" that provides both physical and biochemical support for an animal's head (read: human) that has been "discorporated" (in simple terms, as Mord the executioner from TOWER OF LONDON would say, "severed from its body"). The cabinet has a collar that supports the head and the tubes would supply oxygenated blood and other nutrients that would enter the neck and deoxygenated blood would return to the cabinet via additional tubes. In the cabinet a series of steps would be performed that would remove carbon dioxide, various waste products, and re-oxygenate the blood that would then be returned along with new nutrients in a continuous cycle. With all those tubes in place it would be easy to add other drugs and nutrients via the tubing to achieve certain effects (as in TBTWD, see below). All in all, a simple set up that in principle should work. To get this patent issued by the US Government the inventor had to provide evidence of a working model and most likely this was an actual animal.

In a case of life imitating art, this patent was filed on December 17, 1985. This was years after our "head films" were released so the idea itself was obviously not novel. However, having a science fictional idea produced by Hollywood is nowhere near the reality of creating such a device that actually works. There was no legal precedent established in the film industry that can be applied to the real world. In other words, thinking up such an idea is not sufficient to file a patent. After all, if this were true then think of all those ideas in SF novels that

have covered virtually everything and all those ideas would be patented. (Do you think Cthulhu and his ilk would want to be patented?) The critical component of a patent is you must provide a working model (in legal terms they call this, “reduce to practice”) and demonstrate that it actually works. This is intended by the patent office to keep all the crackpot ideas out (such as a perpetual motion machine). So, what this all means is that, indeed, keeping a head alive is a real possibility that has been officially recognized as such by the US Patent Office. Keeping a head alive is far more likely than a brain or head transplant. And this makes our favorite keeping-a-head-alive films much more interesting because there is a kernel of truth there. And I will leave it up to you gentle readers to decide if having the numbers, “666”, the sign of the beast, in this patent has any meaning.

Not meant to be an exhaustive list here are some of my favorite SF films that have gone to the head of the class.

THE MAN WITHOUT A BODY (1957). Wealthy Mr. Brussard was diagnosed with a brain tumor so he decides he needs a new brain. The head of Nostradamus, the early 16<sup>th</sup> Century prognosticator, was found more or less intact (!) that was initially kept alive in a jar and subsequently transplanted onto an appropriate body. [Early in this film is a scene of a supposedly disembodied monkey head that is kept alive with pumps and various tubes. An artificial heart and artificial lung, each in a separate container, provide blood and oxygen to the disembodied monkey head. The monkey had been dead for 6 years when Dr. Merritt (played by Robert Hutton) revitalized the tissues. Since he transplanted a monkey brain into another monkey he has the necessary experience with primates.] Brussard had the head of Nostradamus stolen from his grave then wrapped it up and encased it in plaster to avoid customs. It was noted that the head was severed “professionally” so the larynx (voice box) and other delicate neck tissues were intact. Nostradamus’ head was revitalized by immersing it in a jar of liquid that had many tubes connected for life support, similar to TBTWD. Nostradamus’ head was eventually transplanted onto the body of Merritt’s assistant Brussard had just killed. The transplant surgery apparently worked well since the new embodied Nostradamus easily walked around, could hear, etc., (all senses appeared to work) so all nerves and tissues were appropriately connected and the head could effectively control the body.

THE HEAD (1959). Dr. Abel is a transplantation specialist and invents a robotic operating table (similar in principle to present day DaVinci robotic operating machines; once again, science fiction predicts real science). After Abel dies of a heart attack his assistant, Dr. Uud, uses the robotic operating table and removes Abel’s head and keeps it alive. Abel’s head was kept alive for self-serving purposes by Uud. The feeding tube setup seen in this film is more convincing than that shown in the similar TBTWD. With a nod to some sort of realism we see air being pumped through a tube to push air over Abel’s larynx (vocal cords



or voice box) for speech. With no air going over the larynx, as typically provided by our lungs, there can be no speech.

THE BRAIN THAT WOULDN'T DIE (1962). The lengths one will go to for love. Dr. Cortner's fiancé accidentally loses her head in a car accident and the doctor takes the severed head to his home lab and connects it to various life support systems to keep it alive while he searches for a body to graft the head onto. Though the ultimate goal is a head transplant the plot never gets that far and all is ablaze at the end. A head that was traumatically decapitated, probably not cleanly, as a result of a car accident would be different from a clinically removed head as seen in TMWAB or TH. The decapitated head in TBTWD could be missing critical neck tissues such as a larynx, jugular veins, neck vertebrae and nerves, tendons, and other delicate muscles whereas Abel's surgically removed head would have all of these tissues intact. Lastly, the disembodied head in TBTWD developed the ability to telepathically communicate with the closet monster, a trait similar to that seen in the Donovan's brain films.

MADMEN OF MANDORAS (1963; aka, THEY SAVED HITLER'S BRAIN). Hitler's disembodied head is kept alive in the South American country of Mandoras. For an interesting twist in the keeping a disembodied head alive sub-genre, Hitler's head, complete with trademark moustache, is housed in a glass dome. Even so, the head still gives out orders. As ludicrous as all this sounds it is best enjoyed with friends, popcorn, and beverages. Initially, the head-in-jar is resting on top of some sort of control cabinet but later the jar is simply lifted off the cabinet and with no visible means of life support the head continues to emote and act. This immediately brings into question what the purpose of the control cabinet really was.

RE-ANIMATOR (1984). Dr. West's re-animator fluid not only revitalized tissues it also preserves them too so this is a double benefit. Though a fantasy this reanimation fluid is fun to discuss. After two injections into the severed head of Dr. Hill it comes alive and entertains the audience in a number of interesting ways. The other keeping-a-severed-head-alive films have at least a resemblance to reality unlike this film that is pure fantasy. Nevertheless, this film is entertaining and well done. The "head" scenes are enjoyable to watch.

#### Donovan's Brain films

The Donovan's Brain films deserve special mention because of the unique nature of simply keeping a brain alive with no transplant intentions involved. Our brains have two major metabolic demands of oxygen and nutrients. With the appropriate perfusion system (tube feeding) this could work but I do have my serious doubts. To monitor brain function these brains are hooked up to an EEG machine (electroencephalograph) and traditional alpha waves appear on the chart paper. It is difficult to know if these chart waves represent pain, pleasure, passive thought, or uninterested boredom.

For these Donovan Brain films the disembodied head had obtained extrasensory perception and able to communicate telepathically (similar to TBTWD). This could be an interesting side effect (and benefit?) of having no body. You suddenly get the ability to telepathically communicate and control others, even at some distance. (Is this dubious benefit worth the risks? To become telepathic you need to lose your body?)

DONOVAN'S BRAIN (1953). Though there are a few versions of this film this one is the superior one (all based on the Curt Siodmak's story of the same name, 'Donovan's Brain'). In general brain alpha waves signify a resting state with minimal activity so the brain waves are in synchronization and this can easily be measured on an EEG machine. When the brain is active beta waves result that are not in synchronization showing that mental activity is occurring. Well, the brain of Mr. Donovan is anything but resting and is quite active particularly when trying to transmit telepathic thoughts over distances. Some of this is visibly seen when the EEG chart pens start rapidly moving suggesting active thought.

The brain seen in this film is shown inside a fish tank like container and only about half of the brain appears to be immersed in liquid. In our heads our brains are essentially encased in a fluid sack so being totally immersed in liquid is a natural state for our brains. The portion of the brain not immersed in fluid could dry out and not be totally functional. If true, then other parts of the brain could be trained to take over which may explain the telepathic abilities. One possibility is new re-trained thought pathways in the brain could result in telepathic tendencies.

THE BRAIN (1962). This film's plot is essentially that of Donovan's Brain in which a man's brain, a Mr. Holt, was kept alive in a tank (based on the same Curt Siodmak story). To me, the setup of the brain-in-a-tank seems more convincing than that shown in DB. The surrounding life-support system is more appropriate for the work at hand and, to me, adds much to the enjoyment of this film.

THE MAN WITH TWO BRAINS (1983). In this entertaining comedy Steve Martin is Dr. Hfuhruhurr who falls in love with a woman's disembodied brain he keeps in his lab, ala Donovan's brain. This just goes to show that a man can love a woman for her mind.

### Summary

In terms of difficulty I would rate them as follows. For surgery versus transplants the easiest is brain surgery in which the brain remains in the cranium and the surgeon does what is necessary. In the real world, this type of brain surgery is actually quite common and is mostly done on trauma and brain cancer patients. Several orders of magnitude more complicated would be brain transplants in which all of the various nerves need to be appropriately connected for normal function. Most complicated of them all is a head transplant. In addition to connecting the brain stem (!) there are all those tendons, muscles, larynx, blood

vessels (the jugular being the most critical), and neck vertebrae bones that need to be connected too. A daunting task indeed.

So, now to the next level. What is more difficult, a brain transplant or keeping a head alive? To have a transplanted brain function normally all of the nerves as mentioned would have to be properly connected and working. A mighty tall order. For a head transplant just the spinal column needs to be attached (also a tall order), not to mention the rest of the blood vessels (like the jugular), tissues, tendons, and muscles. Of the two a head transplant would be technically easier though only our favorite mad scientists would perform such an endeavor. Stay tuned for future headlines because sooner or later someone will actually try this. Just don't do it in your secret lab you keep in your home.

Thanks for reading. It's back to the lab for me. Stay healthy and eat right.