2020

'OSTINATO': A Case Study of Repetitive Reactions to Medical Study

Alejandro Ramon Jarmel

THE FLORIDA STATE UNIVERSITY

COLLEGE OF ARTS & SCIENCES

‘OSTINATO’

A CASE STUDY OF REPETITIVE REACTIONS TO MEDICAL STUDY

By

ALEJANRO RAMON JARMEL

A Thesis submitted to the
Department of English
in partial fulfillment of the requirements for graduation with
Honors in the Major

Degree Award:
SPRING 2020

The members of the Defense Committee approve the thesis of Alejandro Jarmel defended on April 14th, 2020.

*_____

Dr. Candace Ward, Thesis Director

* _____

Dr. Yung Su, Outside Committee Member

*_____

Dr. Robin Goodman, Committee Member

*all signatures present in submitted and complete Defense Certificate Form.

Introduction

Conflict defines humanity's history. Whether that conflict finds itself as explicit as war and politics, or more subtle in nature and expression like discussions around cultural differences or ethical debates, contention and disagreement seem to permeate the story of humanity and its evolution to its current state. One could argue that one of the central areas of conflict that has come to both illustrate humanity's ability to grow and its capacity to lose sight of the mistakes of the past is the relationship between medical science and the prevailing social structure. In my work I would like to study the history of this consistent conflict between the realm of scientific progress and established social norms, using the fields of anatomical studies and stem cell research as case studies to explore how this conflict shapes our very understanding of medicine, morality, and reality.

In his work, The Structure of Scientific Revolutions, the philosopher and theorist, Thomas Kuhn, points to the idea of conflict defining human history through his construction of the term "paradigm shift". Kuhn explains how in his mission to understand the philosophy of science, he concluded that the growth of scientific knowledge was not a continuous and data driven process, as some conceived science's evolution as, but rather a violent, disruptive, and often, ideological exercise. Kuhn presents to his readers the idea that while science has a direct relationship to reality and seeks to understand it, ideology and culture defines many people's very conception of reality, in turn comes into conflict with the "anomalies" scientific discoveries indicate to society.

This means that throughout human history, science has at significant points been deeply unscientific and based in belief-centered falsehoods, because of the very nature of society's and culture's relationship with what becomes accepted and acknowledged as science or truth. Kuhn demonstrates that the conflict occurs here when what is thought to be the reality of the world is

contradicted by anomalies which generate a paradigm shift. The paradigm shift being, as Kuhn explains it, the establishment of a new operating hegemony in the world of scientific understanding[1].

However, Thomas Kuhn expresses that this establishment of a new comprehension of reality doesn't just simply occur with the acquisition of new information, but rather, the new information in many cases finds itself highly contested until the anomaly, and subsequent theory, are ratified. An example of Kuhn's breakdown of this process occurring relatively recently would have to be the evolution from Newtonian physics and Einsteinian physics. Newtonian physics were widely upheld by the scientific community as functional and indisputable laws until 1915, when Einstein, building on the foundation Newton created, explained, along with others he worked with, that the laws Newton had conceived were in fact relative to what we know of Earth's environment in his groundbreaking work, The Theory of General Relativity. Einstein explained that the very existence of gravity bends time and space relative to the mass of a planet/object, so much so that time will be experienced and understood differently depending on one's distance away from the planet. Much of the scientific establishment rejected Einstein's conceptions at first, Newton's understanding of gravity was seen as absolute, and Einstein's ideas were seen as radical. However, once Einstein's theories were tested utilizing a simple measurement of time relative to the space away from the surface of the Earth, the scientific community had to then shift its understanding of reality because of the anomaly pointed out by Einstein's theory.

[1] Kuhn, Thomas. The Structure of Scientific Revolutions. Illinois, United States: University of Chicago Press, 1962: 1-264.

It is important to note, however, that while Kuhn's theory mentions and holds the relationship between science and ideology to be important in the foundation of the idea of a paradigm shift, Kuhn's concept is more focused on the way science builds on and conflicts with internal scientific anomalies, rather than how these scientific anomalies and shifts affect humanity as a whole. Kuhn makes this distinction by explaining that the world of science before early paradigm shifts had elements of culture, ideology, and religion in its foundation because the very conception of what reality was thought to be found itself intertwined with "science" before humanity discovered and ratified anomalies which contrasted with preconceived notions of reality. Kuhn's theory of the paradigm shift therefore is rooted in the philosophy of science, a debate taking place between science versus science. The focus of this thesis however, is to explore the first assertion made by Kuhn in The Structure of Scientific Revolutions in conceiving that idea of the paradigm shift, that assertion being that science is fundamentally tied to the preclusions of the physical world accepted by society and the establishment which benefits and supports what is valued and necessitated scientific study. Then, through understanding why and how culture, ideology, and religion have affected the world of medical science especially, I would like to demonstrate how conflict both helps and limits us, as a means to answer the question, is history repeating itself?

The medical world, more specifically, the field of anatomy was chosen as the first historical case study for this work because the history of dissection and anatomical studies works as the prime example of the intense relationship between scientific progress and the ideological establishment. While examples given in Kuhn's work, like the Copernican Revolution and the transition from Newtonian to Einstein physics, also demonstrate the relationship between science and hegemony, such cases of conflict between science and religious/moral thought have much

less of a direct impact on the people of the world, and are more so grand scale debates about the metaphysical reality of the universe. Let it also be noted, that much like Kuhn's work, my case studies will be more so focused on this conflict as it takes place in the Western world (although much of what is discussed is highly affected by the West's interaction with our regions) as this allows for me cohesive comparison and continuity.

The field of anatomical studies, however, is an example of a conflict between science and ideological apprehension which does directly affect the health, well-being, and society of every person on Earth. Where one might speculate how much we might have advanced as a collective if we had understood the structure of the solar system or quantum physics earlier on, one could easily argue through a breakdown of history what would have been accomplished if the study of human anatomy was allowed sooner, and question how much medical science would have evolved in antiquity. This can be seen in strides attempted in specific instances through history, in which advancement of medicine would have progressed if ideologically based apprehension did not limit the very act of dissection. In ancient Greece, ancient Rome, the Late Medieval Period, the Italian Renaissance, and the eighteenth and nineteenth centuries, one can see clearly how close humanity was to progressing to a more complete and real understanding of the human form periodically, but was limited only by assumptions about the sanctity of the body. As my research has found, when limited dissection of human beings, animals, and an understanding of the necessity of anatomical studies were realized, medical science took leaps from previously established thought, and through these shifts, changes in moral and ethical comprehension both inside and outside the medical world advanced.

The second case study of this work, to be used comparatively to the first, is the modern-day debate surrounding stem cell and genetic research. This was chosen as a companion piece to

the conflict that historically took place around human dissection and anatomical studies, because of parallels between how the two medical-science conflicts have been opposed, debated, and justified through. Much like the study of human anatomy, stem cell research has been opposed on the basis of religious beliefs and societal apprehension, debated as a moral and ethical issue, and justified because of the advancement of medical science made possible by the research conducted in the two fields, and, therefore, validity and necessity of the findings found through said research. The limitations placed on the field of stem cell research however are still current, prevalent, and inhibiting, meaning that the overall benefits discovered are relatively small to what could be discovered without the wealth of religious and social outcry present in the modern day.

In this inhibition found in modern day stem cell research, one can see a clear parallel between this modern conflict and the medical and scientific debates of the past around human dissection. However, when modern society looks back on the debates around human dissection through a modern lens, the apprehension and taboos that were once commonplace from 300BC to as soon as 1910 appear heavily skewed and archaic. As time passed and discoveries about the human body were made which helped advance medical science and save lives, moral and ethical debates around the subject of anatomy shifted, and many concerns were invalidated, diminished, or simply faded away. In this, one might ask the question, will humanity look back on modern debates around stem cell research, in much of the same vein society today would reflect on the conversation around the ethics of human dissection, as close-minded, inhibiting, and short-sighted[2]?

[2] Porter, Roy. Blood & Guts. Great Britain: Penguin Books, 2002: 21-75 & 135-170.

A History of Cultural Conflict

Ancient Greece & Rome

In the minds of many who have studied and written about medical sociology, ancient Greece is often pointed out as a complex and perplexing time of medical science. As described in the work by Roy Porter, Blood & Guts, the ancient Greeks had a compound understanding of medical science which was deeply intertwined with their ethics and philosophical concepts. Porter describes in his book how while there were some very real divisions found in ancient Greek ethical thought surrounding the idea of the human body, especially its relationship to the mind and to the world around it, most philosophers, and moreover, the common Greek citizen, saw the human form as something divine and sacred. Because of this mode of thought, dissection and internal inspection of the human body was seen as sacrilegious, immoral, and improper. This attitude was maintained furthermore because the ancient Greeks believed that the very act of human dissection was an act of hubris, a violation of the sacred laws of their religion and the traditions founded over the course of their civilization's existence which determined the treatment of the corpse and skin (von Staden).

In the same vein as the ancient Egyptians, the ancient Greeks believed that the state of the human body upon burial or cremation would translate into the afterlife, and therefore, dissection of a corpse would violate the sacred nature of death. This viewpoint of the Greek afterlife was so commonly understood in their time that it was a central part in some of their most essential myths. For example, in Homer's Iliad (which most Greek citizens were taught to memorize at an early age), the Greek hero, Achilles states to his hated enemy, Hector, before killing him in a duel that he will not honor the proper funeral rituals considered the norm in the Hellinistic world. Achilles proclaims that after he kills Hector he will remove his eyes, ears, and tongue so that he

will wander the underworld “blind, deaf, and dumb”. This act on the part of Achilles is considered to be his most foul and heinous in the scope of the ten year war between the Greeks and Trojans, upsetting the Gods on both sides of the conflict and illustrating to Homer’s mainly Greek audience the depth of Achilles’ anger, pushing him to violate their most sacred laws[3].

However, unlike the Greeks, the Egyptians believed that instead, there was a relationship between the desiccation and decomposition of a corpse and its state in the afterlife, leading to the famous historical practice of mummification. During mummification, the organs are systematically removed from the corpse as a means to reduce the speed of decomposition, and because of this process, the ancient Egyptians developed a practical system of dissection which led to them gaining a comprehensive understanding of human anatomy. In the research study, Clinical anatomy as practiced by ancient Egyptians, by Loukas et al., it is detailed how because of the anatomical studies necessitated in undertaking the religious practice of mummification, the Egyptians were able to make serious strides in the realm of clinical medicine. This medicinal knowledge which was only achievable through the act of human dissection, would become translated through cross-cultural interaction to Greek physicians and led to sporadic cases of anatomical studies in Greece. As Loukas et al. writes,

> Several ancient papyri guide us through the Egyptians' exploration of the human body and how they applied anatomical knowledge to clinical medicine to the best of their knowledge. It is through records, such as the Edwin Smith, Ebers, and Kahun papyri and other literature detailing the work of the Egyptian embalmers, physicians, and Greek anatomists, that we are able to take a glimpse into the evolution of the anatomical

[3] Homerus, et al. Iliad. Harvard University Press, 2001.

> sciences from 3000 B.C. to 250 B.C. It is through the Egyptian embalmer that we were able to learn of some of the first interactions with human organs and their detailed observation. The Egyptian physician's knowledge, being transcribed into the Ebers and Edwin Smith papyri, enabled future physicians to seek reference to common ailments for diagnosing and treating a variety of conditions ranging from head injuries to procedures, such as trans-sphenoidal surgery.

In this example of early anatomical studies, one can see how with the human dissection the ancient Egyptians were able to undertake, they were able to diagnose and treat afflictions and understand organ systems far before any of their contemporaries who did not practice dissection. The information they gathered through their research then proved vital to the medical world outside of their civilization and became foundational parts of Greek and, later, Roman medical knowledge. The ancient Greeks, then given a glimpse into the practicality of anatomical studies, found themselves in an ethical quandary in respect to their views on the divine nature of the human body[4].

According to Heinrich von Staden, of Yale's Biomedical department, the ancient Greeks still maintained that the human body was sacred because of their funerary practices; however, Greek physicians did adapt and learn from the anatomical research conducted by the Egyptians and used the information as a secondary source to improve Greek medicine. For example, ancient Egyptian anatomists were one of the first early civilizations to establish a surgical understanding of midwifery (with their specialized teaching of female doctors) which they shared with the Greeks, and later the Romans, which led to a higher standard of birth-related

[4] Loukas, Marios, et al. "Clinical Anatomy as Practiced by ancient Egyptians." Clinical Anatomy (New York, N.Y.), U.S. National Library of Medicine, May 2011, www.ncbi.nlm.nih.gov/pubmed/21509810.

medical care. The Greeks also conducted limited dissection and anatomical study on the battlefield. This battlefield study became the primary source of anatomical information for the Hellenistic world until the rise of ancient Rome, aside from what was learned from the Egyptians[5]. Relics of this combat medicine can actually be seen in modern medical terminology, with many current terms for anatomical structure deriving from the Latinized Greek words for places which specific armor would be worn or a certain weapon would strike commonly, such as "thorax=breastplate, galea=helmet"[6].

Battlefields were not the only exception to the moral rules established in ancient Greece, however. In the beginning of the third century B.C, towards the tail-end of the height of ancient Greece and during the establishment of the Alexandrian Empire, two Greek scientists, Herophilus of Chalcedon/Alexandria and Erasistratus of Ceos were allowed to conduct a series of dissections on human cadavers. It's important to note that these corpses were not those of what would have been considered respected members of Greek society, rather, in The discovery of the body: human dissection and its cultural contexts in ancient Greece, von Staden explains that the bodies dissected by the two anatomists were in all likelihood those belonging to condemned criminals, which would have been considered unworthy of the funerary rights afforded to the average Greek citizen. In his work, von Staden explains that because of the amalgamation of cultural, political, and social construction found in early Alexandria, both Herophilus and Erasistratus were able to circumvent cultural and religious traditions and explore the inner workings of the human body. Yet, regardless of the clear evidence of knowledge and

[5] von Staden, Heinrich. "The Discovery of the Body: Human Dissection and Its Cultural Contexts in ancient Greece." The Yale Journal of Biology and Medicine, Yale Journal of Biology and Medicine, 1992, www.ncbi.nlm.nih.gov/pubmed/1285450/.

[6] Wulff, Henrik R. "The Language of Medicine." Journal of the Royal Society of Medicine, The Royal Society of Medicine, Apr. 2004, www.ncbi.nlm.nih.gov/pmc/articles/PMC1079361/.

practical applications discovered by the anatomists in both ancient Egypt and Greece, the study of human anatomy did not progress past the point established by Herophilus and Erasistratus until the second century A.D. with the work of Galen, and upon their deaths, the practice of anatomical studies remained unpracticed (or at least, unrecorded) in ancient Greece/Macedonia.

Galen studies are especially profound in the realm of this case study on the history of anatomical research, because his work serves as an example of how even basic dissection can lead to clear advancements in this realm of medical science, and conversely, how the limitations placed of the practice of anatomy because of ideological preclusions can twist information and restrict the scope of medical knowledge gained from medical study.

The ancient Roman Empire throughout its history generally forbade the dissection of human beings on much of the same grounds as the ancient Greeks, and when Christianity became the dominant religion of the empire, dissection was considered taboo on the basis of adapted Jewish conceptions on the sanctity of the human body. This meant that, in the second century A.D., one of the chief physicians of the Roman Empire, whose findings would be held as indisputable fact until the late Medieval period/early-Renaissance, Galen, was severely limited in his scientific scope. The constraints placed on Galen's studies led him to make many misplaced conjectures and comparisons about the physiology of the human being. Galen's overall breadth was the in-depth analysis of animal corpses, heavily restricted examination of convict cadavers, and older ancient Greek battlefield notes[7]. As a result, Galen's findings and assertions proved in many cases to be folly and error prone. The examples of Galen's false conclusions are numerous and confusing. Examples of Galen's perplexing ideas include ideas such as his belief that the

[7] Ghosh, Sanjib Kumar. "Human Cadaveric Dissection: a Historical Account from ancient Greece to the Modern Era." Anatomy & Cell Biology, Korean Association of Anatomists, Sept. 2015, www.ncbi.nlm.nih.gov/pmc/articles/PMC4582158/.

muscles that are attached to our bones (tendons) are the same structurally in humans and dogs, that blood was created in the liver, that blood was burned up and eviscerated as fuel for the muscles, that there were holes through the septum of the heart which allowed blood to flow from one side of the heart to the other, that the blood vessels of the brain matched those of a monkeys, and that the human jaw-bone and liver were constructed like those of dogs[8].

However, one might find it important to note that because of the dissection of animals and, more importantly, the limited dissection of criminals allowed, Galen did write some accurate information about the structure of the spinal cord and the nervous system which erupts from it. Galen accomplished this goal specifically through the dissection of pigs and monkeys (two animals taxonomically and physiologically similar to humans) and through inhibited comparison with his criminal corpses. In understanding these limitations, one can only ask how much more progress Galen and his contemporaries would have accomplished if they were allowed to investigate human anatomy more regularly, and how much sooner would medical science have advanced if not for religious and ideological conceptions invading the scientific sphere?

I believe that this argument is all the more poignant if one considers the advancements made during the time of the Roman Empire regardless of the disregard for the necessity of dissection. For instance, many developments in the application of first aid and the practice of surgery came about in ancient Rome because of what Roman society valued, such as gladiatorial bouts, war and conquest, and the art of midwifery and birthing techniques. Some of the most highly documented examples of first aid treatment are found in manuscripts describing the care

[8] BBC. "Roman Knowledge about the Body and Disease - Roman Medicine - GCSE History Revision - BBC Bitesize." BBC News, BBC, www.bbc.co.uk/bitesize/guides/zcyj9qt/revision/2

taken to maintain and heal gladiators after their participation in the cherished blood sports of the Empire. It was noted in "Roman Knowledge about the Body and Disease" from the BBC that the gladiators were not only given higher standards of living and physical care than the average slave or even Roman citizen, but also were afforded better medical and surgical care on the part of specialized experts of anatomical studies. Furthermore, the first record of a Caesarean section (as the name would imply) was discovered to be from ancient Rome, pointing to the necessity of advanced midwifery and surgical practices valued by the society of Rome. One can see in this complex history of Roman medical knowledge how unfortunately in the course of humanity's development, ideology and cultural values are inseparable from human advancement and conflict.

Both the successes and errors made by Galen, and those before him, would remain unrectified and unquestioned after the fall of Rome and into the Middle Ages. As Sanjib Kumar Ghosh writes in his work, Human cadaveric dissection: a historical account from ancient Greek to the modern era,

> Following widespread introduction of Christianity in Europe during the Middle Ages, the development of rational thought and investigation was paralysed by the church authorities and physicians could only repeat the works of the eminent figures from past such as Aristotle or Galen, without questioning their scientific validity. During this period, human dissection was considered to be blasphemous and so was prohibited. For hundreds of years, the European world valued the sanctity of the church more than scientific quest and it was not until early 14th century that human dissection was revived as a tool for teaching anatomy in Bologna, Italy after a hiatus of over 1,700 years.

Late Medieval Period & the Renaissance

It's important to note that the story of the revival of human dissection and anatomical studies in the Late Medieval Era and early Renaissance is directly tied to the relationship between church decries and the conception of the field of scientific study as a whole. As Ghosh explained, between the fall of Rome and the coming of the Italian Renaissance, there were 1,700 years of disregard for the field of anatomy. The reinstitution of anatomical studies was in part owed to the groundwork placed during the 12th and 13th centuries, with the establishment of clerical institutions across Europe. Ghosh writes,

> In Medieval Europe, considerable advances in the field of science could only be achieved during the 12th century and early 13th century, with the setting up of universities in Paris (1150), Bologna (1158), Oxford (1167), Montpellier (1181) and Padua (1222). From 12th century onwards, the church did not forbid human dissection in general; however, certain edicts were directed at specific practices. One of the significant proscriptions that Pope Alexander III enunciated at the Council of Tours in 1163 was the prohibition of clerics to involve themselves in the studies of physical nature and the canon (directive) was named as "Ecclesia abhorret a sanguine" meaning "The church abhors blood." This was misinterpreted as a ban which prevented clerics from practising surgery or studying anatomy. The Holy Roman emperor Frederick II (1194-1250) took significant measures towards the progress of science which reflected his free thinking outlook. In 1231, he issued a decree which mandated that a human body should be dissected at least once in every five years for anatomical studies and attendance was made compulsory for everyone who was to practice medicine or surgery. This initiative was a giant step towards revival of human dissection in the domain of anatomical sciences and towards

the later part of the thirteenth century, the realization that human anatomy could only be taught by the dissection of human body resulted in its legalisation in several European countries between 1283 and 1365.

However, this legalization did not prove to be consistent across Europe or in the overarching span of the late Medieval period. While the church and various institutions acknowledged the necessity of human dissection for anatomical instruction, relics of apprehension and taboos remained a subtle part of the churches process of delineation about what and who an anatomist was allowed to inspect. For example, generally, inspections of male or female genitally was prohibited on the basis of religious ideals and only persons who had committed grievous crimes or those without family to speak of were dissected, leading towards an increasingly divided standard of funerary respect between the rich and the poor. During the early 14th century in particular, direct church and religious restraints originally placed on the practice of human dissection became notably more relaxed than before, however, public opposition and condemnation rather became the "primary obstacle"[9].

The church, in fact, became the central voice in convincing the public about the social validity and religious grounds by which dissection was allowed. In the Italian states, namely Florence, Ghosh discovered documentation discussing the need for anatomical studies written by members of the Church. In these documents religious authorities presented rationale for the practice of anatomy, as well as the boundaries for study, as a means to decrease the peoples' protests, namely the importance for public health and the maintaining of governmental and

[9] Ghosh, Sanjib Kumar, and Ashutosh Kumar. "The Rich Heritage of Anatomical Texts during Renaissance and Thereafter: a Lead up to Henry Gray's Masterpiece." Anatomy & Cell Biology, Korean Association of Anatomists, Dec. 2019, www.ncbi.nlm.nih.gov/pubmed/31949973.

clerical stability. One might see how the public support anatomical studies on the part of the church and state during this period was correlated with the clear evidence of scientific information and advancement made available because of the field's growth, but an argument could also be made for two-fold invested interest which led to this uncharacteristic support. That invested interest, which my research found, was caused by the rediscovery of classical art and documents, which if left un-adapted and un-Christianized presented a threat to the power structure of Catholic Europe, and additionally the religious art commissioned by the church necessitated anatomical study.

In the rediscovery of classical texts and art which contained a wealth of anatomical information, the goal of the church in allowing the instruction of these texts and the practice of dissection was not to add to the foundations of anatomical knowledge, but rather to establish the specific texts the church deemed substantial and in line with Catholic thought. This was in turn complemented by the rising interest in anatomical studies as they related to the art of antiquity. In this, the earliest anatomists, physicians, and medical students were also trained and educated in the same vein as contemporary artists[10].

A prime example of the allowances made by the church for the study of anatomy as it relates to their interests in adapting old texts and creating religious art would be the work and study of Leonardo Da Vinci. As described by Walter Isaacson, Professor of History at Tulane and editor of Time magazine, painters and sculptors, like Da Vinci, found the increased availability of animal and human cadavers a must for the commissions of increasingly life-like religious art the church admired. Isaacson explains that one of the factors, besides raw talent,

[10] Isaacson, Walter. Leonardo Da Vinci. New York, NY: 2017: 23-105.

which allowed Da Vinci to rise as an artist and physical scientist, was his consistent study of human corpses, which he utilized to create advanced art. Two opposing examples of how anatomical studies improved Da Vinci's work include Tobias Walking with the Archangel, Raphael and The Vitruvian Man.


Tobias Walking with the Archangel, Raphael by Leonardo Da Vinci

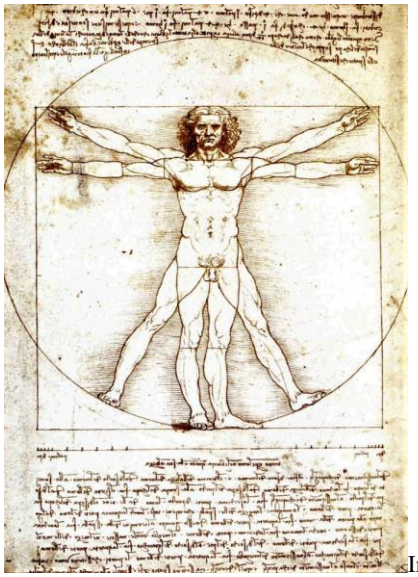
Image of the Vitruvian Man by Leonardo Da Vinci

I describe the images as opposing not just because of their imagery and subject matter were different, but because of the differences in their intended purposes. The painting of Tobias Walking with the Archangel, Raphael was created on commission by the church and serves as a

Renaissance reimagining and “Italianization” of a Biblical tale. The sketch of The Vitruvian Man, however, serves far more of a personal, note-taking purpose, to allow Da Vinci to maintain consistency and accuracy in his work. In both instances however, the practice of human dissection was vital to Da Vinci's ability to capture the reality and physiology of the human being. Isaacson writes in his biography of Da Vinci that Leonardo’s capacity to exemplify movement and humanity in the subjects he painted was directly correlated with the time he was allowed to study human cadavers during his instruction. In this example, one can see how the church’s investment in anatomical studies was not wholly altruistic and based in how dissection permitted artists and sculptors to produce a more honest portrayal of humanity.

The Eighteenth Century: Acceptance & Evolution

In exploring the eighteenth century, in the era some might call “The Age of Enlightenment”, one can see how the foundations established during the Renaissance period allowed for the practice of human dissection to become popularized as well as commodified by the ruling establishment. However, this period also serves as a moment of transition from the church being the source of authority when it came to the field of anatomy and what was declared as ethically sound to study, to a period where universities and scientific institutions worked instead to promote the validity of cadaveric dissection. In this timeframe, one might see a changing of the guard from one were strict adherence to religious doctrine was coupled with (or even overtaken by) the movement towards “enlightenment” as well as a great many internal divisions across Europe in the church, leading to the birth of regional Christian belief systems (not including the “Great Schism” after the fall of Rome) and centralizations of governmental power. This transition can be seen with the establishment of large anatomical theaters in the Universities of Padua and Bologna which established a trend across Europe making dissection

not only the norm, but a requirement for medical training, and change in what establishments had authority over the human body.

It's important to say, however, that there were a great many rules when it came to the subjects of dissection at this time. Much like the ancient Greeks and practitioners of anatomical studies in the Renaissance, it was more common for the subjects inspected either to be the bodies of criminals or women without families. This served as the fine line of morality delineated during the eighteenth century when it came to anatomical practices. Here we see an interesting balance point between the beliefs of the public in regard to Christianity and funerary practices that came with it, and the necessity of human dissection for the advancement of medicine.

One of the most profound examples of the new guard of eighteenth-century anatomical documentation is *Doctor Hunter's anatomical and chirurgic*al lectures. Between the years 1752 and 1781 Dr. Hunter provided his students with lengthy and highly detailed breakdowns of the human body structure. However, unlike the majority of inspections done during the Renaissance, which rarely had a present cadaver and mostly based it's teachings on previously documented dissections, Dr. Hunter would dissect his subjects with his students present outlining the functions and relationships between different organs in real time and in an institutional setting, establishing a new precedent (or at least, more consistently followed precedent) for medical instruction to follow. In the era before, it was rare to have consistent and live demonstrations of the human body being practically dissected with an audience. If it were to occur it would most likely be once every 5 years and would require church or governmental approval. However in this new era, with this acceptance of human dissection as a necessary part of medical training, the practice of live dissection became so common that it also became a period in which the "preparation", meaning the maintaining of a subject/cadaver, found itself a highly practiced and

artistic skill[11]. This practice of "preparation" became so vital that Dr. Hunter held its practice and skill to be just as important as the instruction of dissection itself.

Dr. Hunter describes that there were two characteristic means of maintaining a human corpse. First with "injections", which was the term to describe the process needed to maintain the "wet parts" of the body such as internal organs, and second, with "skeletons" leaving the process needed to preserve the "dry parts" such as the bones. Dr. Hunter was so resolute in this opinion that the skill of preparation was on par with knowing the inner workings of the human body that a note-taker in his class in 1768 wrote,

> It is well known that nothing has contributed more to the advancement of anatomy than the art of investigating the parts by injection [and] indeed so necessary it is, there is no making a good Practical Anatomist without being master of it.

One can see with the progression of the field of anatomy as a science, new technology and new methodology came about with it, as well as, understanding of the technicality and skill required to understand the human body. The progress also led to a shift in ethical understanding surrounding the human form[12]. Where in the past, the very idea of the "divinity" of the human body served to limit and, at worst, outright prevent the very act of dissection, Dr. Hunter and his contemporaries during this period of scientific enlightenment believed the opposite. As a result of the clear necessity and the wealth of knowledge gained through dissection, Dr. Hunter came to believe that his work, in fact, served the purpose of demonstrating the inner divinity of the

---

[11] Hunter, William. *Doctor Hunter's anatomical and chirurgical lectures, October, November & December,* 1768 MS Gen 769-772.

[12] MacLean, Robert. "Skeletons and Injections: William Hunter's Lectures on Anatomy and Aesthetics." University of Glasgow Library Blog, 5 Aug. 2015, universityofglasgowlibrary.wordpress.com/2015/08/05/skeletons-and-injections-william-hunters-lectures-on-anatomy-and-aesthetics/. Accessed: 6 Nov. 2019.

human form. Robert MacLean in his article “Skeletons and Injections: William Hunter's Lectures on Anatomy and Aesthetics” wrote,

> In bringing together anatomy and aesthetics in his lectures at the Royal Academy, then, Hunter had tremendous ambition: he sought not only to redefine Enlightenment standards by placing the utmost value on the exact replication of nature in art, but also to promote imaginative works that reflected the inner divinity of the human form. If his students blended anatomy with their artwork, Hunter believed, the results would change the course of world history: ‘Why should not posterity be able to say that the latter half of the eighteenth Century was the most distinguished period in the annals of human Genius?’ (MS Hunter H46, 5)

The final statement made by Dr. Hunter above I found substantial because in the latter half of the eighteenth century one can see a very real evolution of medical science which correlates with the availability and growth of anatomical studies. This was the very period in which surgery evolved into a respectable profession, as opposed to being relegated to the same level as a barber, as the practice was thought of in the past. An argument can be made that this is because human dissection was so heavily practiced and necessitated that the profession of surgeon could have and did become a practical and life-saving occupation, now having accurate information about the inner workings of the body.

This is evidenced in the work of Adrian Wilson in their novel The Making of Man-Midwifery: Childbirth in England, 1660-1770. In the work, it is outlined how with the development of accurate anatomical findings, the practice of male-midwifery was born from the institutional education of eighteenth-century England. Wilson explains how the value system in this Enlightenment era England was heavily focused on familial and individual health, which

shifted the original role of the midwife as the primary caregiver during birth to that of a doctor who would preside over the procedure. While this did lead to midwives playing secondary to doctors in medical practices, it did lead to a new prioritization of birthing and female care in the latter half of the eighteenth century, relative to the treatment known to have existed in the past[13].

This period however leads to an interesting complication in the idea of forward advancement one might believe to be clear when looking at the history of anatomical science. While Western society might have been improving their capacity for understanding the science of the human body and improving on the possible treatments for what might afflict it, there comes a subtle and immoral side to this growth. As noted before, much of the bodies utilized in classroom dissections came from those with no connections to society post-mortum, however, in many cases there were those actively being murdered for study or having their graves robbed for inspection. In the mid-eighteenth century, England in fact had to establish the "Murder Act of 1752" which forbade these unethical practices, regardless of their "value" to science. In this strange moment of immorality, one might instead see how advancement is rarely a linear, defined process, but a jagged and sometimes moral journey as Kuhn might describe.

The Nineteenth Century: No More Mystery

While the eighteenth century serves to illuminate the necessity of human dissection and fully establish it as a central facet of medical education, the nineteenth century demonstrates the ethical and social effects of the century before and how deeply intertwined medical science became with the psychosocial framework of society.

[13] Wilson, Adrian. The Making of Man-Midwifery: Childbirth in England, 1660-1770. Harvard University Press, June 16, 1995.

While viral, bacterial, and protozoan diseases would remain a mystery as to their origin and complexity until the beginning of the 20th century, much of what could be accomplished through surgical methods was highly improved by this point in history in relation to the century before. This is evidenced in the work of John South Warter, in his Observation in Medicine. In this documentation of an anatomical lecture hall dissertation, Warter transcribes his speech which outlines sections of the human body by organs and their grouping systems, illustrating the intimate details of the individual organs and how they work as a collective organ system, and in turn the methods used by physicians to treat and mend afflicted areas. I would argue that this presentation represents the importance of anatomical studies in the nineteenth century as Warter breaks down the functionality and structure of the human circulatory system explaining its complexity and relation to the human body as a whole. If human dissection continued to be a restricted practice, then in all likelihood Galen's highly flawed and potentially dangerous mistakes would still be commonplace. However, because of the overall shift in moral understanding developed concerning human dissection on the part of the public, Warter was able to base his work on more than just speculation and the incongruent research (animal dissection) of others, and provide a first-hand account of the construction of the human form which is now seen as a respectable and commendable undertaking in the nineteenth century[14].

The Brief History of Stem Cell Research

Attempting to break down the seemingly short history of stem cell research, at least in comparison to the history of anatomical studies, it's first important to know what a stem cell is. In short, a stem cell is a living cell of an indeterminate and unspecialized nature. This means that

[14] Warter, John Southey. Observation in Medicine. London, Great Britain: Longmans, Green, and Co., 1865: 11-20 & 23-40.

the cell can give rise, under the proper circumstances, to any specific, specialized cell the body needs. Most people are aware of embryonic stem cells which are derived from the inner mass of the blastocyst stage of an embryo which eventually differentiate to build a human infant. However, in adult human beings there are also somatic stem cells that lie dormant waiting to differentiate into cells of the tissue in which they reside. Theoretically stem cells could hold the basis for cures to many genetic and age associated diseases for which the medical community has been unable to find a way to combat as of yet, because of their morphology and malleability.

The history of stem cell research began in 1908; however the modern understanding stem cell research and the conception of treatments possible through stem cells weren't pioneered until 1989 when, scientist and researcher Sally Temple discovered the existence of multipotent self-renewing progenitor cells in the subventricular zone of the mouse brain. Upon this discovery, Brent Reynolds and Samuel Weiss in 1992 proceeded to isolated neural stem cells in adult human striatal tissue, which led to increased interest in the potential possibilities of stem cell research in the scientific community. Arguably, however, some of the most important findings when it comes to disease treatment and understanding were made the years 1997 and 1998 with John E. Dick discovering the existence of cancer stem cells and James Thompson discovering the existence of human embryonic stem cells respectively[15].

Since this discovery, the obtaining of germ cells (human reproductive cells: found in our reproductive organs, these cells contain half the number of a human body cell and during sexual reproduction these cells fuse with the germ cells of the opposite sex to form a gamete/new individual) and embryonic stem cells proved essential to the theoretical development of new

[15] Hongbao, Ma, et al. "The Discovery History of Stem Cell." Http://Www.sciencepub.net/Stem, 2013, www.sciencepub.net/stem/stem0401/002_1432stem0401_4_6.pdf.

treatments for unanswered medical quandaries. For example, in 2005 UC Irvine's Reeves / Irvine Research Center was able to partially restore mobility in paralyzed rats with induced spine damage using neural stem cells, and in 2006 Newcastle University in England differentiated umbilical cord blood stem cells into human liver cells. As recently as 2010, initial human clinical trials involving embryonic stem cells have continued and the production of stem cells from endangered species are being used to serve as a potential way to save species that are in danger of extinction. (For a further breakdown of the in depth, point-by-point history of stem cell research, please see the attachment of The Discovery History of Stem Cell, by Hongbao et al.)

It's important to note, however, that alongside the exponential progression found in a field of stem cell research, a vocal minority of specifically concerned religious communities has consistently inhibited and objected to it. Unfortunately, because of the association between stem cells and human embryos there has been a consistent conflation between the scientific and medical research of stem cells and abortion rights. This might be because the reality of stem cell research, its goals, and practice, is not commonly discussed that much of the research conducted around stem cells while it can be related to fetal gonadal tissue, mostly in modern settings involves pluripotent cells from other locations in the human body, such as human knee cartilage (which proved to be autologous mesenchymal adult stem cells) and muscle cells, and most significantly as long ago as 2008 researcher Robert Lanza invented a way to produce human embryonic stem cells that did not require the destruction of an embryo. As mentioned briefly above, in 2006, a Newcastle University in England, scientist developed a way to reorient the growth of umbilical cord stem cells into human liver cells, thus removing the need to harvest any stem cell from a human embryo, but rather just the umbilical cord.

Commonalities Between the History of Anatomical Studies and the Current Discussion Surrounding Stem Cell Research - Conclusions

This is where I believe these two case studies find serious parallels. In both fields of medical science, religious and ethical opposition has proven to not only be difficult to overcome and disregard, but has also been shown to be a constant battle against misconception and misinformation. In the 1,700 year history of anatomical studies one can see clear instances in which humanity had the opportunity and the resources to overcome their previous paradigms. However, because of religious opposition and misinformation disguised as ethical ideas about the sanctity of the human body, society for an egregious amount of time stayed blind to the physical reality human anatomy and the benefits of its inspection. In much of the same vein, one might question whether modern religious and ethical opposition towards stem cell research mirrors the same apprehensions held by the societies of the past around human dissection. The goal of this thesis, however, is not to simply critique our religious beliefs, but rather question how beliefs not based in the reality of the world affect and slow scientific and ethical development.

Much like modern computer science has grown at an exponential rate since its inception, stem cell research and its discoveries seem to progress at a far faster rate than the advancements made possible by anatomical studies. But unlike the case study of the history of anatomy, the public at-large appears to be mostly unaware of the advancements made possible through stem cell research. When it came to anatomy, the public outcry against human dissection was mixed with an equally strong interest in anatomical studies during the Renaissance, and especially the eighteenth and nineteenth centuries. Stem cell research seems to be thought of as more alien, distant, and divisionary issue than human dissection ever was.

In the research article, “Religion and the Public Ethics of Stem-Cell Research: Attitudes in Europe, Canada and the United States” by Allum et al., the researchers sought to gain an understanding of regional and moralistic differences concerning the debate around stem cell research in the western world. The article states,

> We draw upon representative sample surveys in Europe and North America, fielded in 2005 and find that the majority of people in Europe, Canada and the United States supported stem-cell research, providing it was tightly regulated, but that there were key differences between the geographical regions in the relative importance of different types of ethical position. In the U.S., moral acceptability was more influential as a driver of support for stem-cell research; in Europe the perceived benefit to society carried more weight; and in Canada the two were almost equally important. We also find that public opinion on stem-cell research was more strongly associated with religious convictions in the U.S. than in Canada and Europe, although many strongly religious citizens in all regions approved of stem-cell research. We conclude that if anything public opinion or ‘public ethics’ are likely to play an increasingly important role in framing policy and regulatory regimes for sensitive technologies in the future.

As evidenced by the article, the majority of the public approves of stem cell research and its goals, as long as it is tightly regulated and mediated by the government or ethical authority. It’s also important to note, that the article doesn’t note internal religious divisions as having any greater effect on opinions about stem cell research. I would argue that this further solidifies the parallel between the history of conflict surrounding human dissection and stem cell research, because, as it was demonstrated in the late Medieval period and Renaissance (even with a unified church), public concern about the morality of a field of scientific research usually stems from a

place of uncertainty about the ethics of the field of study and the amount of regulation placed on those researching in a specific field[16]. In the Renaissance, because of the church's relationship to artists, physicians, and anatomists who all benefited the church as well as the common people, the church stepped in to publicly defend the practice of human dissection, and complemented its defense with statements explaining the regulation and the necessity of dissection.

Understanding this clear parallel between the conflict between scientific studies and moral thinking is where the nuance of this comparison comes in. While in the past, the religious establishment supported the scientific field of anatomical studies, the modern debate surrounding stem cell research is commonly opposed by the religious establishment because of the association embryonic stem cells and the abortion debate. Instead of having a transition of authority between Church to the scientific community, like in the issue surrounding human dissection, the only authoritative support the field of stem cell research experiences is an internal one within the scientific community. In this, one can see a reflection of Thomas Kuhn's idea of the paradigm shift, where the discovery of stem cells works as a new anomaly which has shifted the possibilities of medical practice found within the community but finds itself in conflict with the fears and preconceptions belonging to the public-at-large. As stated in Allum et al. the issue might have less to do directly with the religious beliefs found in society than with the public framing and ethical concerns that might be based in religious ideals or simply as a want of regulation.

I would argue based on the parallels seen between the history of anatomical studies and the current debate surrounding stem cell research, we today are experiencing a similar slow shift

[16] Allum, Nick, et al. "Religion and the Public Ethics of Stem-Cell Research: Attitudes in Europe, Canada and the United States." PloS One, Public Library of Science, 20 Apr. 2017, www.ncbi.nlm.nih.gov/pmc/articles/PMC5398703/.

in attitudes around the ethical implications of stem cell technology. This shift is currently ongoing, a result of the strides made in the field, and the possible solutions for genetic disorders and diseases in much of the same way our moral conceptions about human dissection slowly changed in tandem with the knowledge and advancements that came with its acceptance and practice. I believe in understanding the errors of the past and the way the discovery of anomalies come to supersede our old taboos, human society's collective and consistent debate with itself will come to understand the aversions and concerns surrounding medical research as part of our evolutionary process in the pursuit of a better world. In time, with the advancement of stem cell research, one might see a society with an ethical code which has severely shifted in relation to the betterment of the technology available and our medical and sociological growth.

References

Allum, Nick, et al. “Religion and the Public Ethics of Stem-Cell Research: Attitudes in Europe, Canada and the United States.” PloS One, Public Library of Science, 20 Apr. 2017, www.ncbi.nlm.nih.gov/pmc/articles/PMC5398703/.

Cramer, Charles A. Abstraction and the Classical Ideal, 1760-1920. Cranbury, NJ: Associated University Presses, 2006.

Foucault, Michel. The History of Sexuality, Volume 1: An Introduction. Vintage Books, 1990.

Ghosh, Sanjib Kumar. “Human Cadaveric Dissection: a Historical Account from ancient Greece to the Modern Era.” Anatomy & Cell Biology, Korean Association of Anatomists, Sept. 2015, www.ncbi.nlm.nih.gov/pmc/articles/PMC4582158/.

Ghosh, Sanjib Kumar, and Ashutosh Kumar. “The Rich Heritage of Anatomical Texts during Renaissance and Thereafter: a Lead up to Henry Gray's Masterpiece.” Anatomy & Cell Biology, Korean Association of Anatomists, Dec. 2019, www.ncbi.nlm.nih.gov/pubmed/31949973.

Homerus, et al. Iliad. Harvard University Press, 2001.

Hongbao, Ma, et al. “The Discovery History of Stem Cell.” Http://Www.sciencepub.net/Stem, 2013, www.sciencepub.net/stem/stem0401/002_1432stem0401_4_6.pdf.

Hunter, William. *Doctor Hunter’s anatomical and chirurgical lectures, October, November &* December, 1768 MS Gen 769-772.

Isaacson, Walter. Leonardo Da Vinci. New York, NY: 2017: 23-105.

Jakobovits, Immanuel. “The Dissection of the Dead in Jewish Law. An Historical Study.” Harofe Haivri. The Hebrew Medical Journal, U.S. National Library of Medicine, 1960, www.ncbi.nlm.nih.gov/pubmed/13789238.

Jones, David Gareth. “Human Anatomy: A Review of the Science, Ethics and Culture of a Discipline in Transition.” IntechOpen, IntechOpen, 21 Nov. 2017, www.intechopen.com/books/human-anatomy-reviews-and-medical-advances/human-anatomy-a-review-of-the-science-ethics-and-culture-of-a-discipline-in-transition.

Kuhn, Thomas. The Structure of Scientific Revolutions. Illinois, United States: University of Chicago Press, 1962: 1-264.

Loukas, Marios, et al. “Clinical Anatomy as Practiced by ancient Egyptians.” Clinical Anatomy (New York, N.Y.), U.S. National Library of Medicine, May 2011, www.ncbi.nlm.nih.gov/pubmed/21509810.

Nicholson, John. “Reflections on the Ethics of Biomaterials Science.” School of Sport, Health & Applied *Science, St. Mary’s University College, Twickenham, Middlesex, TW1 oSX, UK* (2013): 1-18.

Notzer, Netta, et al. “Overcoming the Tension between Scientific and Religious Views in Teaching Anatomical Dissection: the Israeli Experience.” Clinical Anatomy (New York, N.Y.), U.S. National Library of Medicine, July 2006, www.ncbi.nlm.nih.gov/pubmed/16683239.

MacLean, Robert. “Skeletons and Injections: William Hunter's Lectures on Anatomy and Aesthetics.” University of Glasgow Library Blog, 5 Aug. 2015, universityofglasgowlibrary.wordpress.com/2015/08/05/skeletons-and-injections-william-hunters-lectures-on-anatomy-and-aesthetics/. Accessed: 6 Nov. 2019.

Percival, Dr. Thomas. Extracts from the Medical Ethics of Dr. Percival (Abridged Reprint). Philadelphia, United States: Clark & Raser, Printers, 1823: 1-24.

Porter, Roy. Blood & Guts. Great Britain: Penguin Books, 2002: 21-75 & 135-170.

Prioreschi, P. “Determinants of the Revival of Dissection of the Human Body in the Middle Ages.” Medical Hypotheses, U.S. National Library of Medicine, Feb. 2001, www.ncbi.nlm.nih.gov/pubmed/11425294.

BBC. “Roman Knowledge about the Body and Disease - Roman Medicine - GCSE History Revision - BBC Bitesize.” BBC News, BBC, www.bbc.co.uk/bitesize/guides/zcyj9qt/revision/2.

Sacco, Dr. Alexandra. Boosting muscle stem cells to treat muscular dystrophy and aging muscle. La Jolla, California: Sanford Burnham Prebys Medical Discovery Institute, April 17, 2019.

“Stem Cell Research Around the World.” Pew Research Center's Religion & Public Life Project, 31 Dec. 2019, www.pewforum.org/2008/07/17/stem-cell-research-around-the-world/.

von Staden, Heinrich. “The Discovery of the Body: Human Dissection and Its Cultural Contexts in ancient Greece.” The Yale Journal of Biology and Medicine, Yale Journal of Biology and Medicine, 1992, www.ncbi.nlm.nih.gov/pubmed/1285450/.

Warter, John Southey. Observation in Medicine. London, Great Britain: Longmans, Green, and Co., 1865: 11-20 & 23-40.

Wilson, Adrian. The Making of Man-Midwifery: Childbirth in England, 1660-1770. Harvard University Press, June 16, 1995.

Wulff, Henrik R. “The Language of Medicine.” Journal of the Royal Society of Medicine, The Royal Society of Medicine, Apr. 2004, www.ncbi.nlm.nih.gov/pmc/articles/PMC1079361/.

Hongbao et al. Extended History of Stem Cell Research:

• 1908: Alexander Alexandrowitsch Maximow (Russian) firstly proposed the term "Stem Cell" and the existence of haematopoietic stem cells.

• 1924: Alexander Alexandrowitsch Maximow identified the precursor cell within the mesenchyme that develops into mesenchymal stem cells.

• 1960s: Joseph Altman and Gopal Das showed the existence of neural stem cells. • 1963: James Edgar Till and Ernest McCulloch discovered the hematopoietic stem cells in mouse bone marrow that are self-renewing cells.

• 1968: A bone marrow transplant was successfully used. • 1978: Haematopoietic stem cells were discovered in human cord blood.

• 1981: Martin Evans and Matthew Kaufman extracted mice embryonic stem cells from mice blastocysts.

• 1989: Sally Temple discovered the existence of multipotent, self-renewing progenitor and stem cells in the subventricular zone of the mouse brain.

• 1992: Brent A. Reynolds and Samuel Weiss isolated neural stem cells from the adult striatal tissue.

• 1997: John E. Dick discovered the existence of cancer stem cells.

• 1998: James Thomson discovered the human embryonic stem cells.

• 1998: John Gearhart obtained the germ cells from fetal gonadal tissue before developing pluripotent stem cell lines.

• 2001: Advanced Cell Technology cloned early staged human embryos (at the stage of 4 to 6 cells)

• 2003: Songtao Shi discovered that the primary teeth of children can be used as a new source for extracting adult stem cells.

• 2004: Hwang Woo-Suk showed the creation of human embryonic stem cell lines from unfertilised human oocytes, but it was later shown that his work was fake.

• 2005: UC Irvine's Reeve-Irvine Research Centre partially restored mobility in paralysed rats with induced spine damage by using neural stem cells.

• 2006: University of Illinois at Chicago of USA identified cord blood-derived multipotent stem cells with pluripotent capacities.

• 2006: Shinya Yamanaka deriveed induced pluripotent stem cells from mice.

• 2006: Newcastle University in England differentiated umbilical cord blood stem cells into liver cells

• 2007: Anthony Atala discovered a amniotic fluid stem cells that are pluripotent in nature.

• 2007: Mario Capecchi, Martin Evans and Oliver Smithies got the Nobel prize for Physiology or Medicine with their work on mouse embryonic stem cells.

• 2007: Shinya Yamanaka created human induced pluripotent stem cells, and James Thomson obtained same achievement.

• 2008: Robert Lanza got the production of human embryonic stem cells that didn't require the destruction of an embryo.

• 2008: Human knee cartilage stem cell obtained, which was involved the use of autologous mesenchymal adult stem cells

•2008: Sabine Conrad created human pluripotent stem cells from spermatogonial cells of adult testis.

• 2008: Paolo Macchiarini transplanted the first human organ, fully grown from stem cells. It was a trachea which was transplanted on a Colombian female who had her own collapsed due to tuberculosis.

• 2010: The first human clinical trial involving embryonic stem cells started.

• 2011: Inbar Friedrich Ben-Nun produced stem cells from an endangered species, which has the potential to save the species that are in danger of extinction.

• 2012: Advance Cell Technology started.