Lent
2024
Edition 15

young scientists' journal.

IN THIS EDITION

LENT

ISSUE 15

2024

The YSJ Team

Chief Editors:

Lily Porteous
Sonia Naidu

Editorial Team:

Hasan Khwaja
Laaiqah Yusuf
Muhammed Nasir
Daanyal Shaikh
Zara Rizvi
Isaac Chi

Contributions to this Issue:

We express our gratitude to all the contributors of articles in this edition of the YSJ, and extend special thanks to Mr. Reeves and Dr Griffin for their technical assistance with the journal.

Editors' Note

Young Scientists' Journal

LENT EDITION 2024

We are delighted to bring you the Lent 2024 edition of the LGS Young Scientists' Journal! The Young Scientists' Journal aims to foster a passion for the fields of science, technology, engineering and maths for all pupils across the school.

We provide a platform that allows students to showcase their passion and enthusiasm for STEM research and learning beyond the curriculum. This term's edition includes articles from an array of topics including: alien hand syndrome, postpartum depression, polio, astrophysics and many more. We are so delighted to have seen so many wonderful articles, and we would love to see even more students getting involved in the next edition. Happy reading!

Cover Images:

'Saturn' From NASA's James Webb Telescope

'Poliovirus' By Dr Microbe

'Zinnia floats in microgravity aboard the ISS' By NASA/Scott Kelly

'Neurons' By MedicalNewsToday

Key word definitions are from the Cambridge and Oxford English Dictionaries.

Contact us!

youngscientistsjournal@leicestergrammar.org.uk

@LGS_Senior

Young Scientists Journal

@YSJournal

LENT 2024

Releasing the Trigger

By Zara Rizvi

Key Words:

Flexor Tendon: a tendon that runs from the forearm across the wrist and palm and into the fingers, allowing you to bend your fingers.

Flexor Sheath: tissue that covers the flexor tendons and reduces friction during movement of the tendons.

Synovial Tissue: tissue that lines the flexor sheath and lubricates and nourishes joints by producing synovial fluid.

What is Trigger Finger?

Trigger finger is a condition caused by the tightening of a fibrous band in the palm and can affect all fingers. It is named "trigger finger" as the condition causes the finger to lock in full flexion, mimicking someone pulling the trigger of a gun. (Cleveland Clinic, n.d.) The finger can be 'unlocked' by forceful extension or using the other hand to 'snap' it open. The definitive treatments are through steroid injections or surgery.

What Causes Trigger Finger?

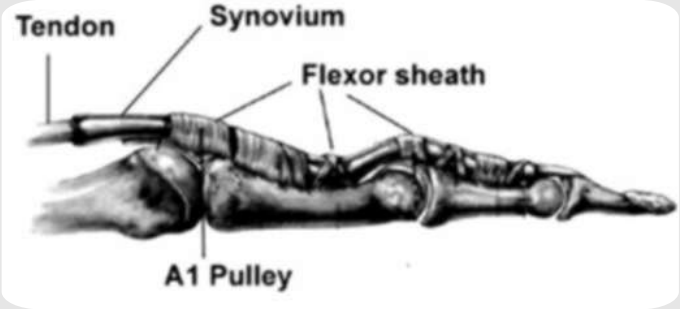


Figure 1: Anatomy of the Flexor Sheath (Myers,2021)

Tendons connect bones to muscles. Flexor tendons are an extension of the flexor digitorum profundus muscle which forms four tendons for the four fingers. The tendon for the thumb is derived from the plexor policis longus muscle. (Chaurasia and Garg, 2004) The flexor tendons are surrounded by a protective covering of flexor sheaths (Figure 1), the sheath holds the flexor tendons down to the bones underneath. Synovial tissue lines the tunnels of fibrous tissues. (Doyle, 1989) The synovial tissue produces a lubrication fluid for joints and tendon sheaths. Thickened areas of the sheaths are known as pulleys.

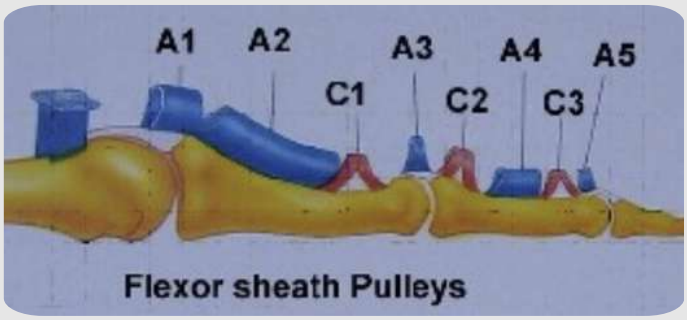


Figure 2: Positioning of the Pulleys (Myers,2021)

There are two forms of pulleys, annular pulleys, and cruciate pulleys. (Figure 2) There are five annular pulleys per finger and two for the thumb. They are called A1, A2, A3, A4 and A5 or just A1 and A2 for the thumb. The A1 pulley of each finger is opposite to the corresponding knuckle, while the A5 pulley is at the end of each finger. The cruciate pulleys are C1 (between A2 and A3), C2 (between A3 and A4) and C3 (between A4 and A5) and there are none for the thumb. The difference between the annular and cruciate pulleys is that the annular is reinforced by circular fibres and so are strong while the cruciate pulleys are reinforced by cruciform fibres so are more flexible. (teachmeanatomy.info, n.d.)

The inflammation of these sheaths/tendons along with the narrowing of the flexor pulleys leads to stenosing tenosynovitis, *trigger finger*. (Jeanmonod, Harberger and Waseem, 2021)

Risk factors

Repetitive motions of the hand including gripping, grasping, typing, or even playing an instrument can increase the chances of *trigger finger*. Other risk factors include age and gender. Women are more likely to get *trigger finger* and sometimes young children are unable to fully straighten their finger but, in most cases, treatment is not required. In terms of age, it is more common for people over 40 to be affected and having other medical conditions like rheumatoid arthritis and diabetes can also increase the likelihood of being affected. Sometimes, trauma to the finger can also cause trigger finger.

Key Words:

Annular Pulley: a thickened area of the tendon sheath which holds flexor tendons close to the bones of the fingers.

Cruciate Pulley: a set of crossing fibers that support the annular pulleys and flexor sheaths.

Cruciform Fibres: cross-shaped fibres.

Nodule of Heberden: a hard bony lump in the finger joint.

Symptoms and Signs

A list of symptoms includes (Cleveland Clinic, n.d.):

- A snapping or popping feeling when you move your fingers or thumb.
- Pain or stiffness when flexing your fingers or thumb.
- Soreness in the palm near the base of your fingers and thumbs.
- Swelling in the palm of your hand.
- Your finger locking in a flexed position.

When examining a patient with suspected trigger finger you will feel the thickening of the tendon/sheath at the A1 pulley. When the patient moves their finger, the thickening can be felt snapping in and out of the tendon sheath. (Browse et al., 2005)

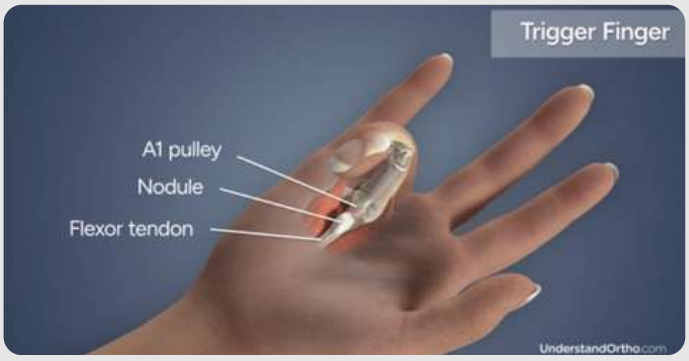


Figure 3: Nodule Trapped Near the A1 Pulley (UnderstandOrtho, n.d.)

This feeling may be attributed to a nodule (Figure 3), or a nodule of Heberden that forms on the tendon sheath. This hard bump, caused by the bunching of tendon fibres, near the A1 pulley causes the tendon to be stuck in the sheath.

Treatment

Common treatments for mild trigger finger include rest, splints, anti-inflammatory drugs (like ibuprofen) and steroid injections. The steroids most used are Depo-Medrone and Kenalog. Steroids work by reducing the inflammation around the fibrous sheath and calms the tendon down. It is effective in one week and can last up to a year. Patients are offered a second steroid injection followed by surgical release.

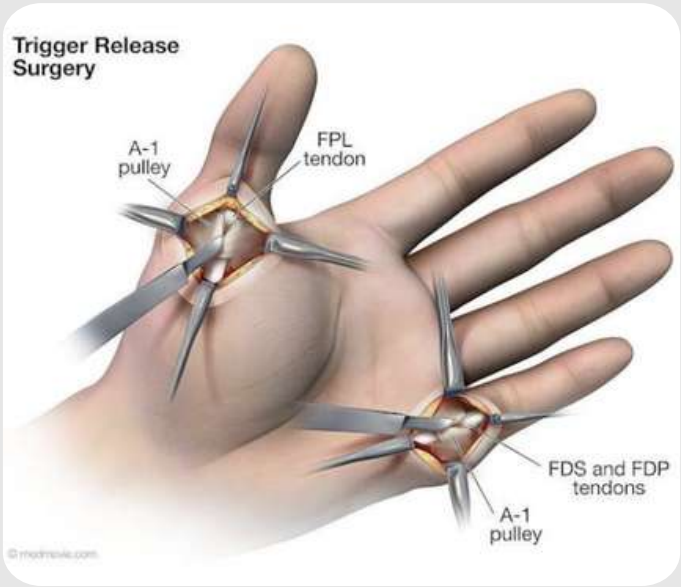


Figure 4: Diagram Showing Pulley Being Cut During Surgery (www.handtoshouldertexas, n.d.))

There are two types of surgical treatment. Dry needling is rarely used but the more commonly used technique is a minimally invasive procedure. The area over the fibrous sheath is made numb with an injection of local anaesthetic. A small 1cm incision is made horizontally over the fibrous sheath. The skin is divided with retractors and the fibrous sheath is identified. The A1 pulley is completely incised to free the tendon underneath (Figure 4). The tendon movement is checked to make sure the release is complete, with no residual triggering. The skin is closed with two stitches and bandaged. The patient can continue routine activities post-operation. However, any operation has risks and the risks associated with this operation are infection of the hand, injury to the digital nerves within proximity to the pulley and incomplete release.

Bibliography:

Browse, N., Black, J., Burnand, K. and Thomas, W. (2005). Browse's Introduction to the Symptoms & Signs of Surgical Disease 4th Edition. Crc Press. [Accessed 20 February 2024]

Chaurasia, B.D. and Garg, K. (2004). B.D. Chaurasia's human anatomy: regional and applied dissection and clinical. New Delhi: Cbs Publishers & Distributors. [Accessed 20 February 2024]

Cleveland Clinic. (n.d.). What Is Trigger Finger and How Is It Treated? [online] Available at: https://my.clevelandclinic.org/health/diseases/7080-trigger-finger. [Accessed 20 February 2024]

Doyle, J.R. (1989). Anatomy of the flexor tendon sheath and pulley system: A current review. The Journal of Hand Surgery, 14(2), pp.349-351. doi:https://doi.org/10.1016/0363-5023(89)90110-x. [Accessed 20 February 2024]

Jeanmonod, R., Harberger, S. and Waseem, M. (2021). Trigger Finger. [online] PubMed. Available at: https://www.ncbi.nlm.nih.gov/books/NBK459310/. [Accessed 20 February 2024]

Stuart Myers. (2021). Pulley Injuries. [Photograph] Available at: http://www.myhand.com.au/handouts/tendon/pulley-injuries [Accessed 21 February 2024]

teachmeanatomy.info. (n.d.). *The Flexor Pulley System of the Hand - Annular - Cruciate - Oblique - TeachMeAnatomy*. [online] Available at: https://teachmeanatomy.info/upper-limb/misc/flexor-system-hand/. [Accessed 20 February 2024]

UnderstandOrthoTM. (n.d.). *Trigger Finger Release*. [Photograph] Available at: https://www.understandortho.com/hand-wrist-elbow/trigger-finger-release/ [Accessed 21 February 2024].

www.handtoshouldertexas.com. (n.d.). *Trigger Finger Fort Worth, TX - The Hand to Shoulder Center*. [Photograph] Available at: https://www.handtoshouldertexas.com/trigger-finger. [Accessed 21 February 2024].

Key Words:

Hydroponics: the technique of growing plants using a water-based nutrient solution rather than soil.

Aeroponics: cultivating plants in an air or mist environment, which eliminates the need for soil.

LENT 2024

The Tomato Lost in Space

By Hannah Bukhari

In March 2023, NASA astronaut, Frank Rubio, had been working on off-Earth harvesting of produce on the International Space Station (ISS). He was the first to harvest tomatoes which he placed in a bag. However, without a trace, the tomato went missing. Rubio was continuously "blamed for eating the tomato" (Giraldo, 2023) by his colleagues, despite his refusal.

About 8 months later in early December of last year, the tomato reappeared. The "rogue" tomato was found with another, smaller tomato, shriveled up, "dehydrated and slightly squished" in the plastic bag, according to NASA. (Howell, 2023)

This fascinating space story opened many doors of research into the harvesting of fresh produce in space. First of all, if you imagine a tomato that has been left in a bag for 8 months on Earth, it would not look very appealing. However, the space tomato had not changed much - "Other than some discoloration, it had no visible microbial or fungal growth," - NASA wrote on the tomato's appearance (Howell, 2023).

This tomato mishap was part of the XROOTS (eXposed Root On-Orbit Test System) experiment, a process to test the possible methods of growing plants without soil or other growth substrates which could lead to sustainable produce for long-term space missions.

Figure 1 : An image of the Eight Month-old Tomatoes. (Howell, 2023)

The alternative growth methods used in XROOTS included hydroponics, using sand, gravel, or liquid media for growing plants; and aeroponics, where plant roots are suspended in the air while retaining nutrients via a fine mist. XROOTS hardware has been installed upon the ISS to carry out these plant-cultivation techniques which allows for an individual chamber for each plant and analyses through images and videos the different variations of aeroponic nutrient delivery to the plants to investigate the most efficient methods. (Macdonald, 2023)

Why is This Important for the Future?

The applications this new type of harvesting has brought about can help increase our chances of long-term survival in space. As space is void of any soil and natural sunlight, growing plant produce normally has proved to be incredibly difficult and unsustainable. But using and perfecting these new cultivation techniques that do not require the same ingredients needed for plant-growing on Earth, means that astronauts can grow produce in space and possibly even on another planet! This could happen without having to adapt to that planet's environment, terrain, or atmospheric composition. Growing produce in space can also lead to long lasting food sources. As we saw before, the two eight-month-old tomatoes didn't look all that bad. This means that these space-grown vegetables could last much longer than what humans are used to, providing a prolonged source of food on potential future space exploration. Additionally, taking new steps in growing plants in space provides us with more ways to gain oxygen when in space without relying on tanks that were brought from Earth. This is because plants need the carbon dioxide we produce, and we need the oxygen they produce. Furthermore, as NASA reported in a post on XROOTS research, the psychological benefit of gardening increases the quality of life of astronauts and acts as a relaxing activity to do while spending months at a time in space, isolated from the rest of the world.

All in all, growing plants in space is imperative for pushing the boundaries of space exploration and research for the future, and is one of the steps needed to take to plan for space travel projects in the near future. Plants are necessary for our survival here on Earth and no less important out there in space, providing we don't end up misplacing what we grow.

Figure 2: The hardware used in the XROOTS experiment. (Anon., 2023)

Bibliography:

Anon., 2023. eXposed Root On-Orbit Test System (XROOTS) Tech Demo. [Online] Available at: https://science.nasa.gov/biological-physical/investigations/xroots/ [Accessed 19 March 2024].

Giraldo, C., 2023. NASA: Let's Ketchup on International Space Station Tomato Research. [Online] Available at: https://www.nasa.gov/missions/station/nasa-lets-ketchup-on-international-space-station-tomato-research/ [Accessed 19 march 2024].

Howell, E., 2023. NASA reveals what 2 tomatoes look like after being lost in space for 8 months. [Online] Available at: https://www.space.com/nasa-international-space-station-lost-tomatoes-photo-video [Accessed 19 march 2024].

Howell, E., 2023. NASA reveals what 2 tomatoes look like after being lost in space for 8 months. [Online] Available at: https://www.space.com/nasa-international-space-station-lost-tomatoes-photo-video[Accessed 19 March 2024].

Macdonald, C., 2023. These tomatoes were lost on the International Space Station for almost a year. [Online] Available at: https://www.engadget.com/these-tomatoes-were-lost-on-the-international-space-station-for-almost-a-year-182601610.html?guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAF-8xi2-RFv999whUt_4bifjamEy06Xx-fDQUXero1BHAnmJ5gKxG81etQ7pbqRDlckbt [Accessed 19 March 2024].

LENT 2024

The Eras of Technology

By Aryan Gopal

Key Words:

VR (Virtual Reality): a set of images and sounds, produced by a computer, that represent a place or a situation that a person can take part in.

Blockchain: a system used to make a digital record of when cryptocurrency (a digital currency such as bitcoin) is bought or sold, and that grows as more blocks are added.

Over time we have witnessed many eras of technology, all the way from the 1800s to our advanced today. Here are some of the main eras that have shaped the world that we know today.

Early 1800s: The Industrial Revolution begins. The Industrial Revolution saw the introduction of machines and technology that allowed for mass production, leading to significant advancements in manufacturing, transportation, and communication.

1876: The telephone is invented. Alexander Graham's invention of the telephone revolutionized communication, making it possible to speak to people across far distances.

1901: The first radio transmission is sent. The ability to transmit signals wirelessly across great distances opened new possibilities for communication and paved the way for modern radio and television.

1939: The first computer is built. The development of computers in the 20th century allowed for automation, leading to breathtaking advancements in areas such as science, medicine, finance and much, much more.

1969: The first message is sent over the internet. The creation of the internet enabled rapid communication and information-sharing on a global scale, transforming the way we live and work.

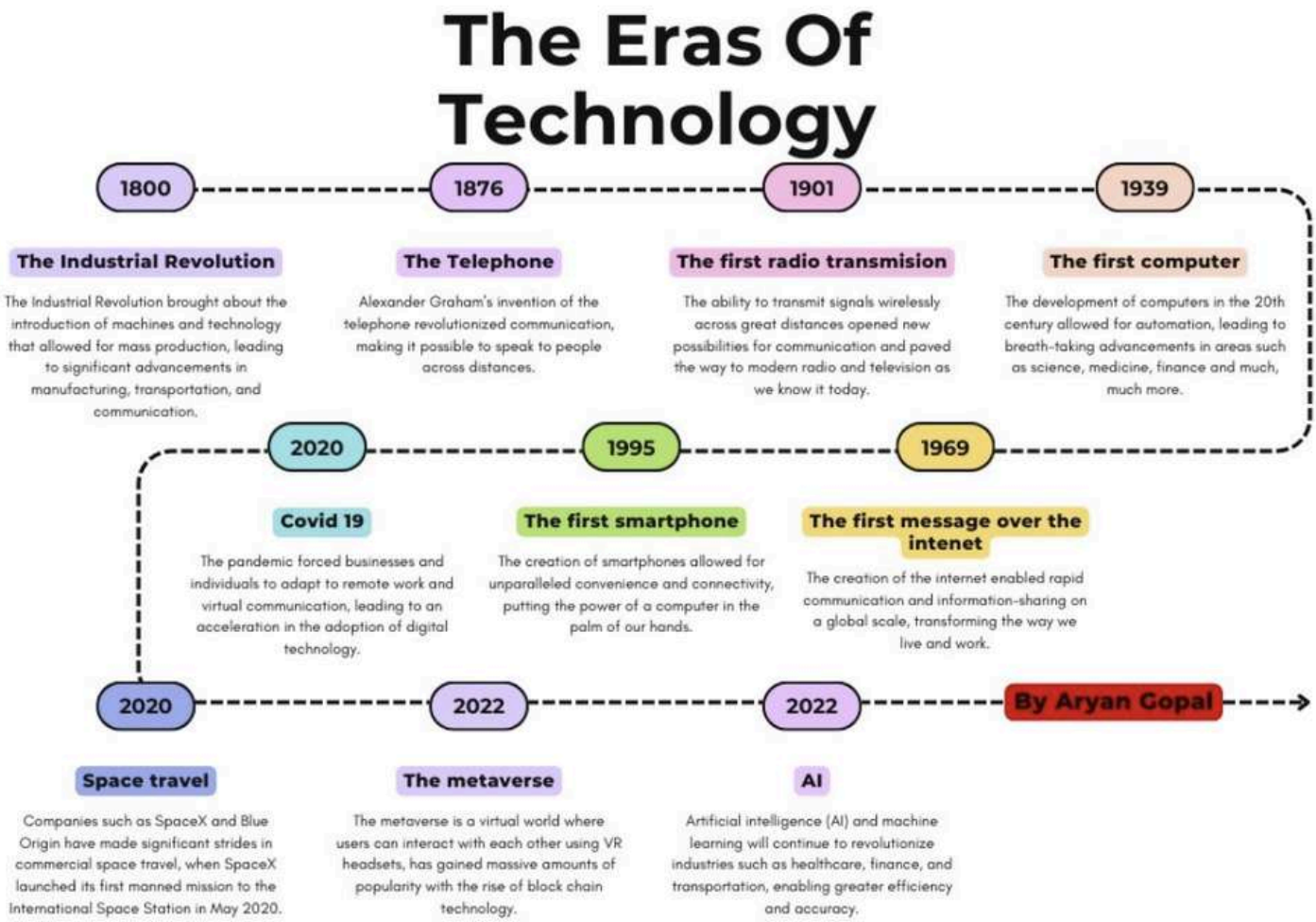
1995: The first smartphone is released. The creation of smartphones allowed for unparalleled convenience in time and connectivity, putting the power of a computer in the palm of our hands.

2020: The COVID-19 pandemic accelerates the development of technology. The pandemic forced businesses and individuals to adapt to remote work and virtual communication, leading to an acceleration in the adoption of digital technology.

2020: Commercial space travel becomes a reality. Companies such as SpaceX and Blue Origin have made significant strides in commercial space travel, such as when SpaceX launched its first manned mission to the International Space Station in May 2020.

2022: The Metaverse gains popularity: The Metaverse is a virtual world where users can interact with each other using VR headsets. Despite there being few brands that use this, it has gained massive amounts of popularity with the rise of block chain technology.

2022: Artificial intelligence (AI) and machine learning will continue to revolutionise industries such as healthcare, finance, and transportation, enabling greater efficiency and accuracy.



Bibliography:

Desjardins, J. (2019) *The history of technology: From the earliest tools to the modern age, Visual Capitalist*. Available at: https://www.visualcapitalist.com/history-of-technology-earliest-tools-modern-age/ (Accessed: 05 April 2024).

Edrea, A. (2023) What were the 'eras' of technological advancement in simple terms?, Medium. Available at: https://medium.com/@alaric.edrea/what-were-the-eras-of-technological-advancement-in-simple-terms-f39378d80a1e (Accessed: 05 April 2024)

Home (2024) CHM. Available at: https://computerhistory.org/?gad_source=1&gclid=CjwKCAjwwr6wBhBcEiwAfMEQsxYLVHbGTeSN3hPlNyrgkuUvD1-wxj4heFvzZ4lPuenhEu3TswT65xoCE4sQAvD_BwE (Accessed: 05 April 2024).

LENT 2024

Postpartum Depression

By Sonia Naidu

Key Words:

Stigma: a strong feeling of disapproval that most people in a society have about something, especially when this is unfair.

Intravenous Infusion: (IV infusion) a way to give fluids, medicine, nutrition, or blood directly into the blood stream through a vein.

Placebo: a substance that is not medicine, but is given to someone who is told that it is, used to test the effect of a drug or to please a patient

The birth of a child is often one of the most profound experiences a woman can go through, evoking maternal emotions of joy, elation and happiness upon seeing her newborn child. For most new mothers, the first few days after having a baby can be an emotional roller coaster. Thrilling moments of happiness and joy can be abruptly interrupted by depressive moments with symptoms including weeping, anxiety, anger and sadness. These 'baby blues' usually subside days after giving birth.

Except sometimes they don't go away...

What often goes unnoticed is the very sad reality for over 1 in 10 new mothers: postpartum depression (Yim et al., 2015). Postpartum depression, or PPD, is a medical condition that impacts over 10% of mothers according to NHS England. Unlike the transient nature of 'baby blues', PPD can tragically endure for months or even years (Cullen,2023). Some experts even believe that the rate of PPD could be at least twice as high as what current statistics reveal, due to many cases going undiagnosed (Beck, 2006).

The discrepancy between the positive emotions mothers believe they should feel, and the reality of experiencing a depressed and anxious mood can be perplexing and overwhelming. This, combined with societal stigmas and pressures placed on new mothers, can be incredibly damaging to the health of the mother as well as her child. This historically neglected disorder is described by Harvard Health as 'the worst kept secret'.

Symptoms of Postpartum Depression

Common symptoms of postpartum depression include: a persistent feeling of sadness or low mood, decreased enjoyment or interest in the wider world, feeling lethargic or sleepy and a tendency to withdraw from social interactions. Research also suggests that undiagnosed PPD can adversely affect the mother-infant relationship and lead to long-term problems for the child. This may manifest as delays in language development, difficulties in forming strong mother-child bonds, increased agitation, and an elevated risk of preschool obesity. Moreover, children of mothers with PPD may encounter difficulties in managing stress and adapting to social environments. What's perhaps most shocking, is that PPD can also drive some mothers to harm or even kill their child (Slomian et al., 2019). Lindsy Clandsy, 32, had been suffering with postpartum depression after the birth of her youngest son. On 5th May 2023, she was accused of strangling her three children, and eventually tried to commit suicide.

Causes of Postpartum Depression

Whilst the causes of postpartum depression are not entirely clear, certain factors are believed to heighten susceptibility. Hormonal fluctuations during and after pregnancy, particularly the rapid decrease in oestrogen and progesterone levels, are believed to contribute to the onset of PPD. Other factors include: a history of pre-existing mental health conditions (before, or during pregnancy), insufficient familial or social support, a strained relationship with one's partner, and recent stressful life events or experiences of physical or psychological trauma, such as domestic violence (NHS, 2022). Cultural factors, genetic predispositions, and adverse life events can also play significant roles.

Figure 1: Mother with Postpartum Depression Holding her Child (Harvard Health, 2017)

Treatment for Postpartum Depression

Despite the presence of counselling and antidepressant medications which serve as primary treatments for PPD, a significant number of women remain unresponsive to these approaches (Cleveland Clinic, 2024). In 2019, the FDA approved an intravenous infusion of brexanolone explicitly tailored for postpartum depression management (Salamon, 2023). It was the first drug of its kind to receive specific approval for postpartum depression. However, despite its promise, there remained many obstacles.

It requires a continuous 60-hr infusion, equivalent to approximately 2.5 days of treatment, and can sometimes be uncomfortable or painful (Mughal, 2022).

More recently, the introduction of Zuranolone (marketed as Zurzuvae) marked a significant breakthrough in the treatment landscape for postpartum depression. After placebo-controlled randomized trials, the FDA, on August 4, 2023, approved Zuranolone which stood out as a fast-acting medication, orally administered for just two weeks, unlike traditional antidepressants (Cullen,2023).

This new class of oral medication offers a ray of hope for individuals grappling with PPD, with some experiencing relief from symptoms in as little as three days. Dr Jefferey Iller, Medical Director of Behavioural Health at Gender Wellness OB/GYN, highlighted the potential of Zuranolone to revolutionise PPD treatment; expanding the availability of interventions to sufferers, 'hopefully allowing more individuals to receive effective and timely care'.

Zuranolone, categorised as a neuroactive steroid, contains a synthetic version of allopregnanolone, which is produced by progesterone - the pregnancy hormone. It operates by enhancing the activity of gamma-aminobutyric acid (GABA) in the brain, effectively reducing anxiety and chronic pain. By replenishing allopregnanolone levels, which normally decline sharply after childbirth, following a peak in the third trimester of pregnancy, Zuranolone restores hormonal balance and alleviates depressive symptoms. This unique mechanism of action holds promise for providing swift relief to individuals tackling PPD.

While Zuranolone presents a glimmer of hope for PPD sufferers, numerous uncertainties still linger about its future.

Key Words:

Socioeconomic: related to the differences between groups of people caused mainly by their financial situation.

Figure 2: Tablets (Healthcare, 2023)

After being on the drug, some women experienced suicidal thoughts and behaviour, and a small fraction reported concerns about doing potential harm to their child. Considering the study only included 151 women lasting just 45 days, it remains unclear how long the benefits beyond this period will last. Furthermore, questions arise about its prescription in conjunction with other medications, given that women in the study who were already taking different antidepressants were permitted to stay on it. The cost of Zuranolone and potential insurance restrictions also remain unknown. All things considered, Zuranolone isn't anticipated to be a miraculous 'wonder drug' that instantaneously resolves PPD. However, it may be a significant asset in aiding new mothers to regain their sense of well-being and sense of self (UT Southwestern, nd).

Difficulties for Women of Ethnic Minorities

The stigma surrounding postpartum depression (PPD) can be even more challenging for women of ethnic minorities due to various cultural, socioeconomic and language barriers.

In some cultures, there are strong expectations and pressures for women to embody the role of a 'perfect' mother, which can make it difficult for them, to admit they're struggling with PPD. There might also be additional stigma attached to mental health issues, leading to fear of judgement or ostracism. Moreover, many healthcare systems around the world are not sensitive to the unique experiences and needs of ethnic minority women, who, historically, have felt mistrust towards healthcare providers due to past experiences of discrimination and mistreatment. These communities may also face additional socioeconomic disparities, including limited access to healthcare resources, financial constraints, and inadequate insurance coverage (Shakeel et al.,2018). It's crucial to create a safe and supportive environment for ethnic minority mothers through cultural sensitivity training for healthcare providers, community outreach programmes tailored to specific cultural needs, and destigmatization campaigns within ethnic minority communities themselves.

Difficulties for Women of Low Economic Status

A case study was recently conducted by scientists involved individuals experiencing postpartum depression (PPD). In this study, researchers observed a cohort of women from diverse socioeconomic backgrounds who recently gave birth and exhibited symptoms of PPD. The study revealed a notable discrepancy in the prevalence and severity of PPD among women from lower socioeconomic status (SES) compared to more affluent women. Factors such as limited access to healthcare services, financial stressors, lack of social support networks, and heightened stigma surrounding mental health significantly impacted the experiences of poorer women with PPD.

These findings further highlight the urgent need for intervention and support systems that address the unique challenges faced by economically disadvantaged individuals tackling postpartum depression. By recognising and addressing the relationship between socioeconomic status and mental health, healthcare providers and policymakers can develop more effective strategies to mitigate the impact of PPD and improve outcomes for all individuals affected by this condition.

There are a lot of misconceptions surrounding the taboo of postpartum depression - for example, 'it is less severe than other types of depression', 'it will soon pass', 'it's just because women are hormonal after birth'. Childbirth is an incredibly difficult and exhausting process. A female goes through incredible hormonal, physical, emotional, and psychological changes throughout pregnancy. Tremendous shifts also occur in the mother's familial and interpersonal world (Mughal,2022). Whilst the causes of PPD are complex, it remains clear that it's a serious mental health condition that can severely hinder a mother's relationship with her newborn and those around her; it's not just a fleeting cloud of sadness (Cullen, 2023). While Zuranolone is a significant step forward in the right direction, it is vital to recognise that it's just one part of the broader conversation that needs to be had surrounding maternal mental health. We must break the stigma associated with PPD, especially for women of ethnic minorities where there persists a disparity.

Through raising awareness about its prevalence, ensuring women have access to adequate support and resources, and not feeling ashamed of addressing this pressing yet sad issue, we pave the way for mothers to reclaim not just their happiness, but their inherent strength and identity.

Figure 3: Mother Holding her Baby (Murray, 2018)

Bibliography:

Beck, CT. (2006) Postpartum depression: It isn't just the blues, [online], The American journal of nursing. Available at: https://pubmed.ncbi.nlm.nih.gov/16639243/ (Accessed: 07 April 2024).

Cleveland Clinic (2024) Cleveland Clinic unveils top 10 medical innovations for 2022, [online] Cleveland Clinic. Available at: https://newsroom.clevelandclinic.org/2022/02/16/cleveland-clinic-unveils-top-10-medical-innovations-for-2022 (Accessed: 25 March 2024).

Cullen, N. (2023) FDA approves new Postpartum Depression pill, [online] URMC Newsroom. Available at: https://www.urmc.rochester.edu/news/publications/health-matters/fda-approves-new-postpartum-depression-pill#:~:text=Postpartum%20depression%20is%20as%20devastating,for%20a%20couple%20of%20weeks. (Accessed: 25 March 2024).

First postpartum depression pill approved by FDA: What to know: Brain: Your pregnancy matters: UT southwestern medical center (no date) Brain | Your Pregnancy Matters | UT Southwestern Medical Center [online] Available at: https://utswmed.org/medblog/postpartum-depression-pill/#:~:text=Allopregnanolone%20increases%20during%20pregnancy%20and,function%20and%20improve%20depressive%20symptoms. (Accessed: 27 March 2024).

Healthcare, E. (2023) Which medications are you allowed to take into Dubai? [Photograph] Expatriate Group. Available at: https://www.expatriatehealthcare.com/which-medications-are-you-allowed-to-take-into-dubai/ (Accessed: 28 March 2024).

Mughal, S. (2022) Postpartum depression, StatPearls [online]. Available at: https://www.ncbi.nlm.nih.gov/books/NBK519070/ (Accessed: 25 March 2024).

Murray, L. (2018) Motherhood: Most empowering part of my life: Twin cities moms blog, Twin Cities Mom Collective [Photograph] Available at: https://twincitiesmom.com/motherhood-most-empowering-part-of-my-life/ (Accessed: 28 March 2024).

Post Partum Depression (n.d.) NHS choices [online]. Available at: https://www.nhs.uk/mental-health/conditions/post-natal-depression/overview/ (Accessed: 25 March 2024).

Post Partum Depression: The Worst Kept Secret (2017) Postpartum depression: The worst kept secret [Photograph], 2024 Harvard Health Publishing. Available at: https://www.health.harvard.edu/blog/postpartum-depression-worst-kept-secret-2017020811008 (Accessed: 27 March 2024).

Salamon, M. (2023) FDA approves first pill for postpartum depression, Harvard Health. [online]. Available at: https://www.health.harvard.edu/womens-health/fda-approves-first-pill-for-postpartumdepression#:~:text=The%20fast%2Dacting%20drug%2C%20zuranolone,a%20hospital%2Dbased%20intravenous%20infusion (Accessed: 27 March 2024).

Shakeel, N. et al. (2018) Prevalence of postpartum depressive symptoms in a multiethnic population and the role of ethnicity and integration [online], Journal of affective disorders. Available at: https://pubmed.ncbi.nlm.nih.gov/30096592/#:~:text=Results%3A%20The%20prevalence%20of%20PPDS,were%20other%20significant%20risk%20factors. (Accessed: 07 April 2024).

Slomian, J. et al. (2019) Consequences of maternal postpartum depression: A systematic review of maternal and infant outcomes, [online] Women's health (London, England). Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6492376/ (Accessed: 25 March 2024).

Yim, I.S. et al. (2015) Biological and psychosocial predictors of postpartum depression: Systematic review and call for Integration, [online], Annual review of clinical psychology. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5659274/ (Accessed: 27 March 2024).

LENT 2024

Polio and the Iron Lung

By Rushil Patel

Key Words:

RNA: a copy, or transcription of DNA

Capsid: the protein coat or shell of a virus particle, surrounding the nucleic acid.

Cell Lysis: where a cell bursts (here, further spreading the virus).

Virion: the complete, infective form of a virus outside a host cell, with a core of RNA and a capsid.

What is Polio?

Polio, also known as poliomyelitis, is an infectious disease caused by poliovirus. It is typically contracted by children aged 5 and under. It can result in muscle weakness, disability, or, in severe cases, death (JAMA Network, 2022). In modern times, poliovirus has been classified as eradicated. It is only present in two countries worldwide: Pakistan and Afghanistan.

There are three types of wild poliomyelitis: type one, type two, and type 3. All three consist of a single-stranded positive-sense RNA genome enclosed inside a protein capsid; however, the structure of the capsid is different for all three types (Burrill et al, 2013). The capsid is in an icosahedral shape and composed of four capsid proteins, VP1, VP2, VP3, and VP4, each having 60 copies to make up the capsid (Burrill et al, 2013). The surface is dominated by star-shaped, elevated areas surrounded by depressed canyon-like areas and propeller-shaped elevations surrounded by saddle-like depressions (Bubeck et al, 2005).

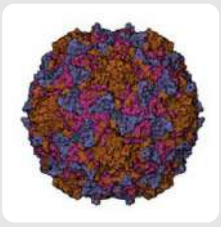


Figure 1: Type 1

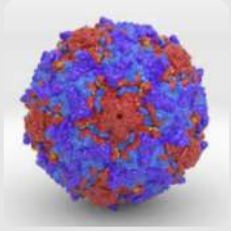


Figure 2: Type 2

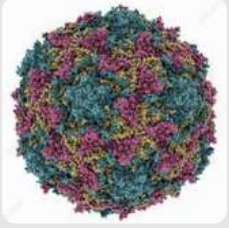


Figure 3: Type 3

(Grant et al., 1994)

Poliovirus replicates very quickly, with an estimated time of eight hours between infection and the first cell lysis. Each cell lysis can release up to 10,000 virions, making poliovirus extremely infective, and it spreads through the body extremely quickly. (Burrill et al, 2013).

Polio is a very infectious disease spread by person-to-person contact. It lives in an infected person's throat and intestines. It is present in a person's throat for about 1 to 2 weeks and is expelled in the faeces for about 3 to 6 weeks. This includes those who are asymptomatic (show no symptoms) (JAMA Network, 2022). It can also contaminate food and water in unsanitary conditions. It can only infect humans, so it is not transmitted via animal media. It spreads through the faecal matter of an infected person, or less commonly, through a sneeze or cough from an infected person. You can be infected if you have picked up a piece of faeces and you touch your mouth or put objects in your mouth that have been contaminated, such as food or water.

An infected person can spread poliovirus for up to two weeks after symptoms appear (CDC, 2022).

Polio is asymptomatic in 70% of cases. 25% experience mild symptoms such as fever, headache, sore throat, nausea, and vomiting. These are similar to flu symptoms. Between 1% and 5% of infected patients develop meningitis, an infection of the proactive membranes surrounding the spinal cord and brain (meninges). Meningitis results in symptoms such as fever, vomiting, dizziness, and, in some cases, seizures. (NHS, 2022) Rarely (approximately in 0.5% of patients), polio can cause the development of muscle weakness and paralysis. These can affect movement, breathing, speaking, and swallowing. (JAMA Network, 2022).

Key Words:

Attenuated Strand: part of a weakened virus.

Negative Pressure Ventilator: a machine outside of your body that helps you breathe by lowering the air pressure around part of your body.

Respiratory Paralysis: the loss of voluntary or involuntary control over the muscles (in this case the muscles involved in breathing).

How is Polio Currently Prevented?

Polio was successfully declared eradicated due to a vaccination system over a long period of time. In 1949, poliovirus was successfully cultivated in human tissue by John Enders, Thomas Weller, and Frederick Roberts at Boston's Children's Hospital. In the early 1950s, the first successful vaccine for polio was created by US physician Jonas Salk. This was mass-tested in Canada, Finland, and the USA, and it proved to be successful. Six pharmaceutical companies began to produce this on a large scale. This was inactivated poliovirus (IPV).

Albert Sabin then created a second type of vaccine, which was an attenuated strand of the virus (OPV). The USA rejected the testing of this vaccine because they already had a working vaccine; therefore, Sabin travelled to Russia. Here, alongside Mikhail P. Chumakov, they tested their vaccine in the Soviet Union in 1958 and in Czechoslovakia in 1959. This was an oral vaccine that could be administered by drops, which made it an ideal candidate for mass vaccination.

Following this, Czechoslovakia and Hungary became the first country in the world to eliminate polio.

This vaccination was a worldwide effort lasting for many years, there was a particular push in the 1990s and early 2000s. This resulted in many people in India and China being vaccinated, as well as eradication from the Americas in 1994. By the 2000s, polio had been eliminated from the Western Pacific. By 2003, polio was present in only 6 countries and by 2006 it was only present in 4 countries (WHO, 2024). Currently, only two out of 195 countries are not polio free.

What is the Iron Lung?

The iron lung is a negative pressure ventilator that came into major usage in the 1950s. It was created in 1927 by Philip Drinker and Louis Agassiz at Harvard University. This was to combat respiratory paralysis by pulling air into and out of the lungs using an electric motor connected to two vacuum cleaners (Johnna Rizzo, Pfizer, 2024). It was first used on an eight-year-old girl in 1928 who suffered from polio. She was treated using the iron lung at Boston's Children Hospital (OPENPediatrics, 2016).

Key Words:

Tracheostomy: a procedure to help air and oxygen reach the lungs by creating an opening into the trachea (windpipe) from outside the neck.

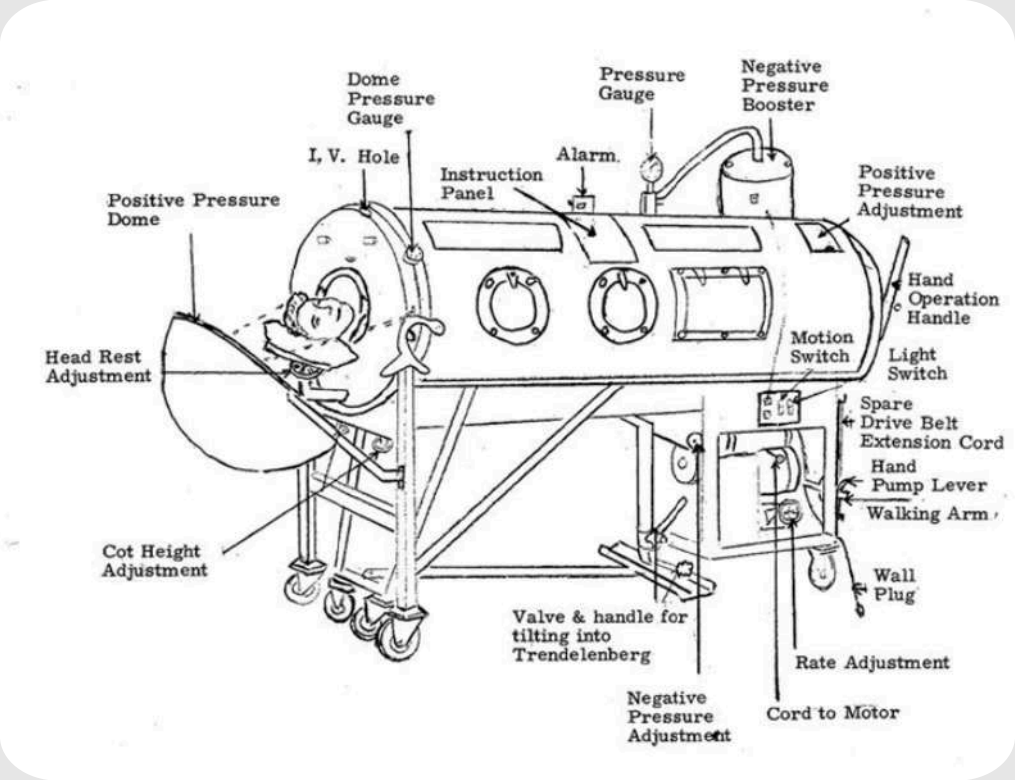


Figure 4: The Iron Lung (Grant et al., 1994)

How Does it Work?

The iron lung imitates the way the human respiratory system works. The iron lung is opened, and the patient lays on the bed. The device is closed and sealed using a special locking mechanism. A collar is secured around the patient's neck to form an airtight lock. A large diaphragm at the tail end of the ventilator would be rhythmically moved in and out. This could be done by a person or by a motor. When pulled out, volume increases and pressure decreases, thereby drawing air into the patient's lungs. When the diaphragm is released and pushed inward, volume decreases and pressure increases, which causes the subsequent movement of air out of the patient's lungs.

Typically, patients use the iron lung for a few weeks or months until they have recovered from polio; however, those with permanent paralysis of their respiratory muscles remain inside the iron lung for their whole lifetime (Emerson respirator or iron lung, 2024). Recently, Paul Alexander died after spending 72 years in the iron lung.

He was placed in the iron lung at age 6 following a battle with a very serious case of polio. He underwent an emergency tracheostomy operation and was unable to breathe without the iron lung following that. He spent the most time in the iron lung out of anyone else in history and passed away at age 78. (Snowdon, 2024).

Bibliography:

Bubeck, D. et al. (2005) 'The structure of the Poliovirus 135S cell entry intermediate at 10-angstrom resolution reveals the location of an externalized polypeptide that binds to membranes', Journal of virology, 79(12), pp. 7745-7755. doi: 10.1128/jvi.79.12.7745-7755.2005.

Burrill, C. P. et al. (2013) 'Global RNA structure analysis of Poliovirus identifies a conserved RNA structure involved in viral replication and infectivity', Journal of virology, 87(21), pp. 11670-11683. doi: 10.1128/jvi.01560-13.

CDC (2023) *What is polio?*, *Centers for Disease Control and Prevention*. Available at: https://www.cdc.gov/polio/what-is-polio/index.htm (Accessed: 20 March 2024).

Emerson respirator or iron lung (no date) *Osu.edu*. Available at: https://hsl.osu.edu/dept/medical-heritage-center/emerson-respirator-or-iron-lung (Accessed: 30 March 2024).

Flashback: Iron lung (n.d.) Pfizer.com. Available at: https://www.pfizer.com/news/articles/flashback_iron_lung (Accessed: 30 March 2024).

Grant, R.A., Hiremath, C.N., Filman, D.J., Syed, R., Andries, K. and Hogle, J.M. (1994). 'Structures of poliovirus complexes with anti-viral drugs: implications for viral stability and drug design.' Current Biology, 4(9), pp.784-797. doi: https://doi.org/10.1016/s0960-9822(00)00176-7.

Lung1 (2018) *HUB History*. Available at: https://www.hubhistory.com/episodes/the-iron-lung-episode-104/attachment/lung1-2/ (Accessed: 30 March 2024).

Meningitis (n.d.) *nhs.uk*. Available at: https://www.nhs.uk/conditions/meningitis/ (Accessed: 20 March 2024).

Nursing Procedures 1958-59, Respirator diagram and procedures (n.d.) Omeka.net. Available at: https://bcharchives.omeka.net/exhibits/show/polio/item/101 (Accessed: 30 March 2024).

OPENPediatrics (2016) *'the iron lung and polio' by Mark Rockoff, MD for OPENPediatrics*. Youtube. Available at: https://www.youtube.com/watch?v=cUCqsl6JROg (Accessed: 30 March 2024).

Snowdon, C. (2024) 'The man in the iron lung: How Paul Alexander lived life to the full', *BBC*, 24 March. Available at: https://www.bbc.co.uk/news/health-68627630 (Accessed: 30 March 2024).

The 'iron lung' (n.d.) *Omeka.net*. Available at: https://bcharchives.omeka.net/exhibits/show/polio/treatment/ironlung (Accessed: 30 March 2024).

Walter, K. and Malani, P. N. (2022) 'What is polio?', *JAMA: the journal of the American Medical Association*, 328(16), p. 1652. doi: 10.1001/jama.2022.17159.

Ourworldindata.org. (n.d.) Available at: https://ourworldindata.org/polio?trk=public_post_comment-text (Accessed: 20 March 2024).

Key Words:

Rage Quit: to angrily abandon an activity or pursuit that has become frustrating, especially the playing of a video game.

Hand-eye Coordination: the ability to do activities that require the simultaneous use of our hands and eyes.

LENT 2024

Video Games - Do They Cause More Harm Than Good?

By Gagan Kodivalasa

This question has been widely debated in society for the past couple of years. Are video games good or bad for your mental and physical health? Today I will be discussing the answer that lies behind this question.

Mental Effects

We all know how great we feel when we win a game online. For example, I am sure many of you play Fortnite, which we can all agree is excellent. It feels amazing when you win, but when you lose? Well, that is an entirely different story. Are you aware of the fits you can experience when you lose? Many people throw things around and punch people and objects.

Moreover, I have had mental breakdowns. Would you want that to happen? I would not! Gamers use a word called "Rage-quit", and I am very sure you know what it means. Stop and think, in any case. Would you want to "rage-quit" and end up being told off? Before you damage items, stop and think, is it worth destroying this? Have a brief pause and think.

Physical Effects

If you spent every single day playing video games, I do not think your bones would strengthen; they would weaken. What if they get actually more substantial from the hard work they have done. Do not take that personally. That was just a joke. Now, back to the point.

Figure 1: How much data does gaming use? (Anon., 2023)

Video games can injure your physical health, and you might not be as active and agile as you used to be. For example, your attainment and effort in PE might drop drastically. It may also harm your vision quite brutally, and the result could be dire. Your vision might be so poor that you need a prescription that has a 3-dimensional lens. Maybe your eyes could also improve with fast movements and hand-eye coordination.

Figure 2: (**MacDonald, 2022**)

If I had to add it all up, I would say that gaming can help you sometimes, but it is terrible for you in most instances. I am not saying you should avoid video games, but do not spend too long on them, not for the sake of it, but for the sake of your mental and physical health.

Think of it like this:

I have met a stranger; their name is Gregory. They are being nice to me. Oh no, now they are mean to me.

That is a video game in a nutshell.

You can play video games; stay safe and be careful with your mental and physical health.

Bibliography:

Collaboration (2019). Turning Your Passion For Gaming Into A Money-Maker. [online] TheXboxHub. Available at: https://www.thexboxhub.com/turning-your-passion-for-gaming-into-a-money-maker/ [Accessed 29 Mar. 2024].

MacDonald, H. (2022). Online Games: How Can You Keep Your Child Safe? | Nanny McPhee. [online] www.nannymcphee.co.uk. Available at: https://www.nannymcphee.co.uk/online-games-how-can-you-keep-your-child-safe/ [Accessed 29 Mar. 2024].

LENT 2024

Alien Hand Syndrome - Is It Real?

By Imaan Malik

Key Words:

Syndrome: a combination of medical problems that shows the existence of a particular disease or mental condition.

Neurodegenerative: involving the nerves gradually stopping working.

Idiopathic: a disease or medical condition that has no known cause.

You may be wondering if this is just a fantastical phenomenon - the answer is no. Although Alien Hand Syndrome (AHS) is rare, it is a real-life neurological condition which causes one's hand to act on its own free will (Cronkleton, 2018, online). The affected hand acts as if it has a mind of its own causing the person to lose control of their hand which can be incredibly dangerous as this hand can even harm the individual. Despite the condition being described as a syndrome, Anderson (2022, online) explains that it can last anywhere from 30 minutes to the rest of your life from the moment it begins!

What Triggers This?

As you can imagine, this phenomenon is caused by brain damage, a neurological condition leading to difficulties with movement and control. Anderson (2022, online) explains that like many conditions, there is not one universal cause of AHS. It is sometimes associated with "cancer, neurodegenerative diseases and brain aneurysms", whilst other people develop this condition after a stroke, trauma or tumor. In some cases, this condition is "idiopathic", so the exact cause remains unknown.

Cronkleton (2018, online) explains that it is also linked to brain surgeries; specifically, those which separate the two hemispheres of the brain. The corpus callosum (which divides these two hemispheres) allows for communication between the two sides.

So, when these 2 hemispheres are separated, a lack of communication results in the 'alien' hand being uncooperative.

What Can This 'Alien' Hand Do?

The hand can range from carrying out ordinary actions, sometimes repeatedly or compulsively, to harming the individual. It may "touch your face, button a shirt or pick an object". It can also levitate on its own (Parkinson's Resource Organisation, 2018, online). More scarily, the hand may also engage in self-oppositional actions such as closing a drawer that the other hand just opened, causing people with the condition to feel like this hand is foreign and it does not belong to them.

Symptoms and Signs

Since there are many different versions of AHS, there are a vast array of symptoms (Anderson, 2022, online). However, there can be substantial overlap between these versions, although "no one has ever reported any pain from the condition". In some cases, people have completely dissociated from their hand, and can no longer recognise it as their own.

Key Words:

Corpus Callosum: a wide strip of nerve fibres that connects the two halves of the brain.

Dissociate: to consider as separate and not related.

For example, the symptoms which are generally associated with the frontal lobe version of AHS include difficulty releasing objects, involuntary grasping and involuntary groping which can be incredibly disturbing.

How is it Treated?

Sadly, there is no medical treatment for AHS, but there are various techniques, addressing both the physical and psychological complications, that people have tried. Anderson (2022, online) lists several of these including; cognitive behavioural therapy, distracting the affected hand, coaching techniques, clonazepam and botulinum toxin injections. There are a few reported cases where some of these techniques have worked to some extent; for example, one 13-year-old girl whose right arm was affected by AHS took clonazepam. This drug led to a 70% reduction in her symptoms after 2 days, however, this caused some side effects. She then tried another method where she was injected with botulinum toxin in a few areas up and down this arm which showed an outstanding 80% reduction in her symptoms.

Although these techniques are mostly anecdotal, scientists are working on treatments to reduce symptoms. In some cases, the symptoms are so specific that people figure out the best way to handle their own situation, making this syndrome ever more difficult to treat.

Bibliography:

Anderson, A. (n.d.). What Is Alien Hand Syndrome? [online] WebMD. Available at: https://www.webmd.com/brain/what-is-alien-hand-syndrome#091e9c5e823c618e-2-6 [Accessed 23 Mar. 2024].

Cronkleton, E. (2018). Alien Hand Syndrome: Causes, Symptoms, Treatment. [online] Healthline. Available at: https://www.healthline.com/health/alien-hand-syndrome. [Accessed 23 Mar. 2024].

Parkinson's Resource Organization. (n.d.). WHAT IS ALIEN HAND SYNDROME? [online] Available at: https://www.parkinsonsresource.org/news/articles/what-is-alien-hand-syndrome/ [Accessed 23 Mar. 2024].

Key Words:

Asteroid: one of many large rocks that circle the sun.

Theory: an explanation of an aspect of the natural world and universe that has been constructed using the scientific method and can be repeatedly tested.

LENT 2024

The Influence of Jupiter

By Adhidev Ghosh

When asked to name three necessities of life, the average person might say food and drink. Greek philosopher Aristotle believed that happiness, or *eudaimonia*, as he called it, is the ultimate goal of life. Eleanor Roosevelt, who was once the First Lady of the United States, valued human rights and equality highly. American essayist Henry David Thoreau was a huge fan of simplicity. In Thoreau's book *"Walden"*, Thoreau advocated for minimalism and a connection to nature.

Frankly, there are many themes of life which possess their own importance, whether it be equality or simplicity. Another important aspect of life, whether it may seem peculiar or not, is Jupiter.

About five billion years ago, it is believed that a star in our galaxy exploded. The explosion resulted in a nearby cloud of dust and gas to form. This cloud collapsed and flattened into a disc. Most of the dust and gas condensed into a hot core, which became our sun. The remaining debris formed the other planetary bodies within our solar system. The majority of this debris came together to form what is the largest planet in the solar system: Jupiter. It is believed that Jupiter was the first planet to form out of the eight. This is just one theory regarding the formation of Jupiter – other competing theories with their own different evidence and conclusions. (BASF., n.d.)

Figure 1: The Formation of Jupiter (N.Tillman, 2021)

Excluding the Sun, Jupiter is the most dominant object in our Solar System, due to its atmosphere and colossal size – more than 1,300 Earths could fit into Jupiter! (Williams, N., 2010).

It is assumed that the asteroid belt consists of the remaining bits of debris that were not able to form planets, and instead lie in between Mars and Jupiter. Jupiter is largely responsible for not letting the debris interact with other planets. (Tillman, N., 2017)

Sixty-six million years ago, the dinosaurs perished. Their death has sparked lots of controversy and debates on how the dinosaurs actually died, but since the 1980s, scientists reckon that an asteroid the size of Mount Everest did the damage.

This asteroid, known as the *Chicxulub Impactor* made contact with the ground, causing a huge amount of dust to rise into the atmosphere, blocking out the sun for 15 years, resulting in a loss of light.

Figure 2: Where The Chicxulub Impactor was Thought to Have Done Its Damage (A. Remple, 2023)

About four billion years ago, Jupiter actually had the ability to swallow nearby planets, though this is not the case anymore. If planets like Jupiter remain distant from their stars, they are able to protect their fellow planets , since they can eat up any asteroid or comet that comes near, earning the nickname “vacuum cleaner of the solar system.” (BASF., n.d.)

Its gravitational field reduces the chances of asteroids combining with planets. Jupiter was unable to prevent the *Chicxulub Impactor* from colliding with Earth, but nowadays it is able to deflect thirty to one hundred asteroids per year. Had Jupiter not been present, these asteroids would have been very likely to crash into Earth, wiping out mankind.

To conclude, Jupiter is underappreciated in life, because without it, every known soul on the planet would not be alive. This goes to show how undervalued things are, and even the most unpopular of objects can go on to make a huge difference.

Bibliography:

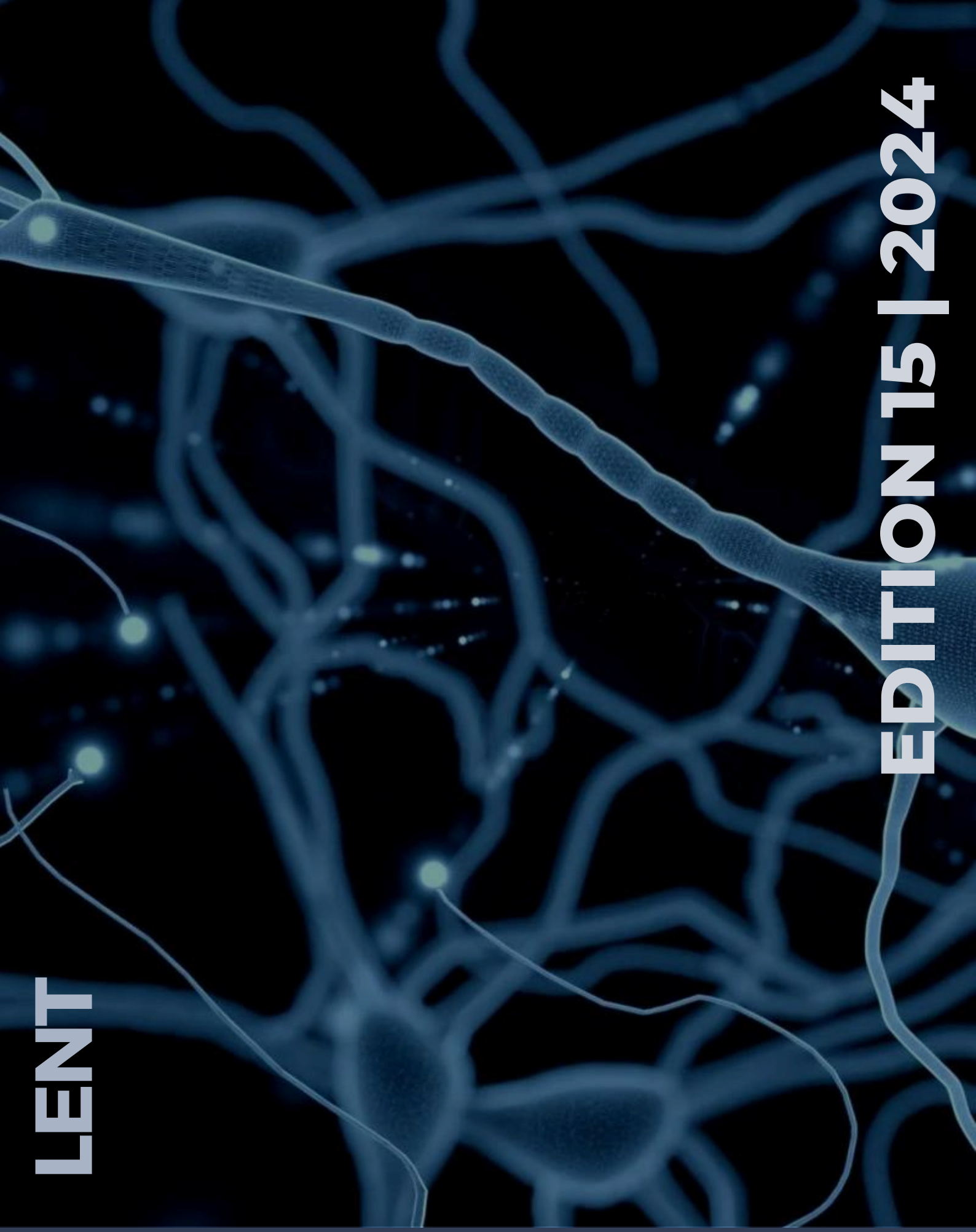
BASF. (n.d.). No sun, no life on earth. [online]. Available at: https://www.personal-care.basf.com/core-competencies/all-about-sun/sunlight/no-sun-no-life-on-earth#:~:text=Without%20the%20sun%20there%20would,and%20animals%20need%20to%20breathe.&text=The%20earth's%20position%20in%20the,for%20the%20development%20of%20life.

Mission Juno. (n.d.). Jupiter’s Influence. [online]. Available at: https://www.missionjuno.swri.edu/origin?show=hs_origin_story_jupiters-influence#:~:text=In%20our%20solar%20system%2C%20Jupiter,of%20the%20gas%20giant's%20influence.

Nola Taylor Tillman. (2017). Asteroid belt: Facts and Formation, Space.com. [online]. Available at: https://www.space.com/16105-asteroid-belt.html

Remple, A. (2023). How Big Was The Asteroid That Killed The Dinosaurs? [Photograph] WorldAtlas. Available at: https://www.worldatlas.com/space/how-big-was-the-asteroid-that-killed-the-dinosaurs.html.

Tillman, N. (2016). How Was Jupiter Formed? [Photograph] Space.com. Available at: https://www.space.com/18389-how-was-jupiter-formed.html.



LENT

EDITION 15 | 2024

Contact us!

youngscientistsjournal@leicestergrammar.org.uk