

Into the Spine Metaverse: Reflections on a future *Metaspine* (Uni-)verse

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Among the five leading buzzwords of next generation spine care—with so called “Minimally Invasive spine surgery,” “Robotics,” “Virtual Reality”(VR), “machine learning,” (ML) and “Artificial Intelligence” (AI) leading the way—the latter three entities are all based on large-scale data gathering and processing endeavors aimed at enhancing spine care in an artificially created digital realm. The promise of these three abstract entities centers not around concrete goals of things like achieving better spinal decompression, alignment or fixation techniques, improving fusion quality, or even creating novel tissue regeneration options. Instead they aim for abstract achievements, like incrementally improved precision information gathering through pattern recognition and application (ML), enhanced nonhuman decision making (AI), as well as experiential educational and patient interaction options offered by a digitally enhanced version of our reality through virtual reality (VR). All three of these abstract entities are increasingly morphing from possibilities to feasibilities and even realities of medical care and we indeed might not be too far away from them becoming routine applications in our complex field of Spine care. It seems not farfetched to imagine that these three technological entities are not going to remain individual endpoints but may merge into a greater all-encompassing digital entity—a spine “metaverse” with an alternate “existence” of stakeholders in spine care actively participating within this new dimension.

The potential of a digital alternate “human” existence has been an enticing fantasy of the science fiction realm probably first introduced in the 1984 “Neuromancer” novel series of the Canadian-American writer William Gibson, who had his characters operate around a virtual reality space he called “Matrix.”¹ In 1992, the writer American Neal Stephenson coined the term “metaverse” in his novel “*Snow Crash*” as descriptive term of a parallel virtual universe with close intersections to the real world (in addition to his predicted cryptocurrencies and post nation state governance structures meted out by powerful entrepreneurs and corporations).² In what could be a case of truth being stranger than fiction, one of the leading social media corporations of our times announced its rebranding using the ancient Greek prefix “Meta Platforms

Inc” almost to the date 30 years after the publication of the first edition of “*Snow Crash*.”³ The choice of the prefix “meta” is interesting in itself as it connotes a variety of meanings, including “coming behind or beyond an event or focal object”; implying “change or transformation”; and “transcending or substituting” (to name a few options offered in the Merriam-Webster dictionary).⁴ In our medical world, we are well familiar with the applications of the prefix “Meta” in applications like “*Metacarpal*,” “*Metastasis*,” and “*Metanalysis*.” Some of the early concepts of this platform promise its users to be able to migrate throughout its various media formats in form of one’s own individually created and accessorized avatar. So far, the responses to this attempt at future proofing its business development have met with mixed market place responses; however, the foundation of a marketable digital parallel universe has now been laid down by one of the largest social media corporations of our era.^{5,6} In fact, significant real world market value investments have already been made in the alternate digital life space as seen in the \$1.2 million dollar real estate acquisition (using—of course—cryptocurrency) of a 52 parcel plot in a place called “Decentraland” by a Non-fungible Token (NFT) auction house in January 2022.⁷ That the parallel virtual world indeed has legs can be seen in the continued success in ventures like “Second Life,” which has been officially in existence since 2009 and reports 70+ million registered accounts and 11,800,000 visits over the 6 months preceding January 2021 including financial transactions for properties and personal modifications and even featuring a Reuters news agency bureau.⁸ For younger generations, alternate virtual lifestyles have become firmly established in game environments such as Minecraft and Fortnite. Whoever the eventual proprietors and whatever the eventual format or naming will be, a “metaverse” type digital sphere as a daily companion to human life seems to take shape more concretely and may become the successor to the present day more mundane “internet.” As these developments continue to unfold in real time, the 30th anniversary of the creation of the “metaverse” entity might be a suitable occasion to dream up some possible applications for a future Spine care in such an entity, a literal “Spine Metaverse” (or “Meta Spineverse”).



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Education: As the two year epochal COVID-19 pandemic continues to wind through its permutations of the Greek alphabet, the traditional medical conventions and meetings industry has yet to get back on its feet. Professional societies, exhibitors, and conventioners have become nervous about the future of large-scale in-person meetings as digital meeting platforms, such as “ZOOM” and “Teams,” and others have become a well-accepted highly convenient global gathering options. There are, of course, a number of limitations, such as hands-on training for surgeons on cadavers and lack of a “life-like” engagement. Increasingly, far less expensive virtual reality augmentation and holographic projections that do not make viewers sick stand to give in-person meetings a real run for their customer. For the device industry and professional societies, a sustained drop in meeting attendance will have serious consequences as their marketing concepts (and budgets) will have to be adapted to a more individualized end-user sphere, such as offered in a future digital realm. In this context the education sphere seems to be an ideal application of a future Spine Metaverse (Metaspine verse) or—to keep it clean and above board—a “Medical Life” version of “Second Life.” Imagine attending future “Global Spine Congress” events represented by your holographically projected avatar self as you migrate through the venues of such a space while interacting with your colleagues from around the world.

Patient education and consultations: The current educational value of the internet with its unregulated access options continues to be a bewildering experience for patients. The COVID-19 crisis has made virtual visits a common place encounter and will be here to stay at least as an alternate to conventional in-person visits. While the absence of meaningful physical examination remains a formidable obstacle to specialists like Spine surgeons, future delegated and digitally recorded surrogate standardized examinations may make such a deficiency obsolete. As a metaverse enhanced with dedicated digitized medical properties seemingly is becoming reality, it is not far-fetched that medical practices with big name caché will be interested in opening formal virtual representations as patient access points starting with information kiosks and later enhanced by direct avatar-based consultation and non-physical treatment resources. Instead of cumbersome internet navigations an interested patient could enter the Spine Metaverse and enter an integrated information and interactive care destination of their choice. It would not be too far-fetched to imagine future patient avatars loaded with their encrypted medical history and studies interacting with duly accredited avatar physicians of their choice for consultative advice and even noninterventional care. For us as spine surgeons, digitally rendered surgical planning images would also be a very feasible enhancement to current trigonometric alignment calculations.

Remote care: For chronic ailments like hypertension, adult-onset diabetes, morbid obesity and some mental health conditions, which are expensive and ineffective to manage with

conventional care delivery models, biometrically enhanced virtual care models with psychological group support programs, such as mindfulness and cognitive behavioral training, could offer enhanced near-term interaction options in a future medical metaverse. In fact, remote virtual nursing care, perhaps even enhanced by robotic end-user delivery units, has been touted as a potential remedy to alleviate the seemingly ubiquitous nursing personnel shortage. In a Spine Metaverse such implementations may become second nature to all involved due to the more life-like immersion offered by such a simulated care environment.⁹

Robotic surgery: While current iterations of robotic Spine surgery are limited to serving as glorified pedicle screw placement machines, other specialties have developed true remote surgery options, for instance in Urology with prostate surgery or endovascular Neurosurgery. These present-day applications feature haptic controls and offer a glimpse into a future where a spine surgeon sitting behind a remote monitor could perform precision decompression and instrumentation surgery. A Spine Metaverse could serve as a transactional space for such care delivery between a real-life patient in an actual hospital and a remote surgeon operating from their own home base, with the metaverse also serving as the third-party facilitator and accrediting body.

Research: A Spine Metaverse could be an ideal forum not only for lively information exchanges but also serve as a natural focal point for organically grown visual displays of large-scale data collections. Curating such efforts while avoid fraud and abuse, such as seen in the beginning of the Covid pandemic, would fall upon respected networked data clearing houses of the future, such initiated by the Global Burden of Disease projects fostered by the Bill and Melinda Gates Foundation.

Reality Check: While these surely are enticing future visions the actual reality on the ground in 2022 suffers from far more mundane problems that continue to hamper present day spine care delivery. For instance, as a profession, we still cannot agree on even basic spine terminologies and treatments, and one can argue pretty convincingly that we still do not actually really have a good handle on what “spine outcomes” actually should be to prove value of a care instance. From a technology application perspective, does a virtual reality guided robotically applied fixation system truly provide value added to large populations in the future, or are they more an expression of the vanities of patients, surgeons and the device industry? From a data analytics perspective, variations in care delivery remain frustratingly challenging. The true complexity of patient variables and expectations, which so far eludes mathematical modeling attempts, continues to flabbergast predictive analytics. (*Personal observation*) With this reality the growing gospel-like belief in a savior of artificial intelligence to guide us to better decision making about healthcare in the future actually lacks its most foundational basis.¹⁰ Perhaps most importantly, access to even basic spine care is globally significantly

hampered due to the general unaffordability of such advanced care and more recently due Covid induced shortages of nursing, hospital beds and nursing homes. A Spine Metaverse cannot be expected to somehow fix these fundamental infrastructural problems.

It will be compelling to see how technological advances and entrepreneurship actively engaged in the digital realm will change our world in general and our lives concretely. If the priorities of the real world—high quality spine care rendered in a timely, efficient and accountable fashion for an increasingly older and sicker world population—fail to be addressed, even the coolest digital parallel universe will remain nothing but a digital playground—a “Vaporware” (technical term for vague future software iterations).

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