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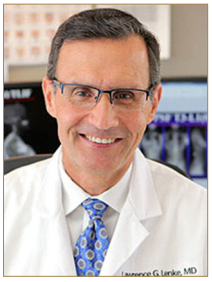
Editorial

Commentary: Artificial Intelligence for Adult Spinal Deformity



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See the article "Artificial Intelligence for Adult Spinal Deformity" via https://doi.org/10.14245/ns.1938414.207.

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This superb summary emphasizing that predictive modeling, analytics, and machine learning forming a foundation for artificial intelligence (AI) will play a critical role in the evaluation and treatment of adult spinal deformity (ASD) is quite logical.[1] ASD is one of the most complex medical problems seen as it involves not only evaluation of the entire spinal column from the upper cervical spine to the sacrum, but also the entire skeleton from the skull to the feet for radiographic completeness. It also has tremendous heterogeneity in its clinical presentations, extensive variability in current nonoperative and operative treatments prescribed with uncertain clinical outcomes, high complication rates and high costs associated with these treatments. There is no universally accepted ASD classification scheme, no accepted surgical algorithm for the most common types of pathologies seen, no accepted complication scheme to standardize the seriousness of adverse events nor their impact on recovery any required interventions or outcomes, and no definitive way to accurately predict who is going to do well with a major surgical intervention at a specific time in the patient's life. Thus, it seems logical that computational data analytics using AI would be quite helpful for the personalized treatment of the unique ASD patient that suffers from this often heavy disease burden.

So far, all of the work using predictive analytics and early AI for ASD has been done by a few individuals and study groups intimately involved in ASD surgical treatment. The ability of cluster AI algorithms to group these heterogenous ASD patients into specific categories of similar attributes seems logical and will be very helpful. Also, the ability to use various patient demographics to create a risk stratification based on the preoperative patient condition, the surgical invasiveness, and the treatment team has been done and will only improve over time. However, since this data generation is coming from only a few specific centers and surgeons, one of the unknowns is whether pooled data from purported centers of excellence in ASD care can be generalizable to all centers, surgeons and physicians evaluating and treating ASD patients around the world? Will this group data suffice or will more personalized data from individual centers and surgeons be required for the type of individualized health care that these unique patients require? Having travelled extensively to many spine centers both in North America and also to many countries around the world, I have had first-hand experience in the extreme variability that exists in the provision of nonoperative and operative care of ASD patients. Truthfully, the benefits of AI are obvious at face value, but the implementation of optimal care models may be much more difficult in the "real world" given the unique health care delivery models seen globally.

One other concern that we must always remind ourselves is that not only is every ASD patient truly unique, but so is every ASD spinal surgeon and spine center providing the care. So will optimal care pathways for the evaluation and treatment of ASD patients require input for both the patient and surgeon/center provider? Any spinal fellowship director knows that the spinal surgeons that are trained around the world finish their training with differ-

ent skill sets even with the same training program. The early data suggests that the complication profiles and ultimate patient outcomes from ASD surgery seem to correlate almost entirely from the patient demographic and psychosocial profile along with the surgical invasiveness, and not from the surgeon or center where the surgery was performed. However, this seems counterintuitive to almost all surgical disciplines where surgeons and centers with high volume performing the same procedure have lower complication rates and better outcomes. Why would ASD surgery be any different? If anything, because of the admitted high technical complexity, it would seem logical that the surgeon performing the operation and the facility caring for the patient following surgery would play an even more significant role in the early complication rates and outcomes.

So, there is no doubt that we are headed towards a new era of personalized medicine and ASD is the prototypical spine disease where AI and all of its computational benefits will provide truly revolutionary changes and improvements to our patients. My personal theory is that these types of efforts will need to be performed on a microscale and not a macroscale. So eventually, AI programming will be needed for both the patient presenting with ASD, but also the surgeon and center providing the care for the patient. This will mandate that those surgeons and centers taking care of these challenging patients with such complex procedures have the necessary computational resources to adjust the personalize care required to decide who to operate on, when the best time to perform the procedure (e.g., following a prescribed set of patient optimizing nutritional, therapeutic, psychosocial, and other requirements), the optimal procedure performed in the most standardized manner (e.g., use of robotic and navigational technologies among others), and a postoperative individualized protocol to ensure a safe and expedient recovery. This will certainly all be possible with AI technology and the future is certainly bright for all ASD patients and providers when these conditions have been met.

CONFLICT OF INTEREST

The author has a royalty and consulting relationship with Medtronic, and a consulting relationship with EOS Technologies, and Acuity Surgical.

REFERENCE

1. Joshi RS, Haddad AF, Lau D, Ames CP. Artificial intelligence for adult spinal deformity. Neurospine 2019;16:686-94.

Title: Ma Jolie
Artist: Pablo Picasso
Year: 1911-12
Ma jolie (My pretty girl) was the refrain of a popular song performed at a Parisian music hall Picasso frequented. The artist suggests this musical association by situating a treble clef and music staff near the bold, stenciled letters. *Ma jolie* was also Picasso's nickname for his lover Marcelle Humbert, whose figure he loosely built using the signature shifting planes of Analytic Cubism. This is far from a traditional portrait, but there are clues to its representational content. The central triangular mass subtly indicates the shape of a woman's head and torso, and a group of six vertical lines at the painting's lower center represent the strings of a guitar, which the woman strums. In Cubist works of this period, Picasso and Georges Braque employed multiple modes of representation simultaneously: here, Picasso combined language (in the black lettering), symbolic meaning (in the treble clef), and near abstraction (in the depiction of his subject).
More information: https://www.moma.org/collection/works/79051
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