In Memoriam:
My Story with Charles J Burstone

My struggle with studying Orthodontics with an engineering background, initially in Brazil, where I went to Dental School, was to try to find an appropriate scientific, physical approach. I've only started to find this approach when reading the work of Charles J. Burstone. In 2001, I translated one of his books, "*Modern Edgewise Mechanics and the Segmented Arch Technique*", into Portuguese. Without much hope of a response, I contacted Dr. Burstone with some questions about the book. Dr. Burstone not only replied to all my questions, but that was the beginning of a mutually stimulating intellectual discussion that has lasted until last February of 2015. He started as my mentor, and passed away as one of my best friends. There was no teacher that I admired more.

Fig. 1: Dr. CJ Burstone at Sun Valley in 1990.

Dr. Burstone was the first mentor of my academic life. It started when I once asked him how we could predict tooth movement based on force systems if we didn't have any papers about the relationship between the force we applied on the tooth and how that translated to cellular reaction and bone modeling in the PDL. He said that basically there was no scientific evidence for it, and we just assumed that the tooth would respond linearly to the force system. I was surprised by this, because predictability of tooth movement depends on this hypothesis. Our conversation gave me motivation to pursue research to investigate this. He said I should go to Indiana to study under Dr. Eugene Roberts. I had no motivation to go anywhere else and study anything other than biomechanics, so I followed his advice. Moreover, our discussions and some issues I found with the T-loops in the book led to the publication of my first paper "*Self-corrective T-loop for differential space closure*".

When I finished my PhD, my original idea for research that originated from my conversations with Dr. Burstone, combined with the genetics input from Dr. Eugene Roberts and his collaborators, won

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the Milo Hellman Award, being recognized as the best graduate research in North America. I immediately started my academic career as an Assistant Professor at NYU after graduating from residency.

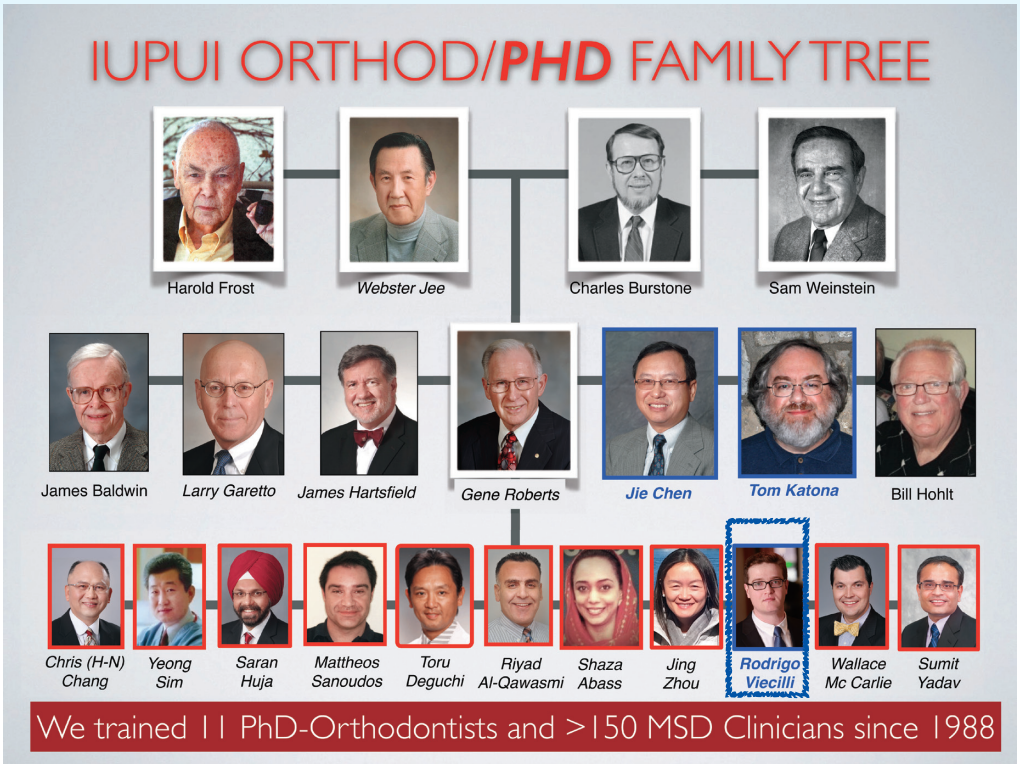
I once took Dr. Burstone to see the Episode III of the Star Wars series, when we were lecturing together at a national meeting in Brazil. He had never seen any of the Star Wars movies, but after watching it, he started to incorporate the theme in his lectures. He liked to say that we, the biomechanical scientists of Orthodontists, should be the Jedi of the profession, and fight against the dark side (*the gurus and technique prophets*). He convinced me that people like us have an ethical mission in the Profession to keep things factual and scientific.

Fig. 2:
Portrait of (from left to right) Drs. Chris Chang, Charles Burstone, Eugene Roberts, James Baldwin (oil painting) and bust of C. Burstone (center left). Permanent collection in the Department of Orthodontics and Oral Facial Genetics at Indiana University School of Dentistry.

In my opinion, there are only two minds that were truly genius in Orthodontics: Calvin Case and Charles Burstone. I will explain why. In the beginning of the 20th century, Calvin Case defended extractions in selected cases to improve the profile, and proposed customized force systems to achieve specific movements. In his book, he described the first scientific attempt to define a primitive center of resistance. Calvin Case defended that specific objectives for positions of teeth should be established and the decision on extractions depended on those. On the other hand, Edward Angle, who ended up being more famous and recognized, designed and helped sell pre-fabricated appliances. Long discussions in ***Dental Cosmos*** depicted Angle using divine images and religious arguments against Case to suggest his thoughts as heretic. Unfortunately, Case was ahead of his time and was ostracized by the Orthodontic community after being continuously attacked by Angle, and killed himself. When I first discussed this story with Dr. Burstone, and the difficulty in making the Orthodontic community study and accept a more scientific approach to mechanics, in lieu of simply focusing on brackets and devices, he surprised me. He said Calvin Case was his greatest inspiration,

Fig. 3:
Bust of Calvin Case. Permanent collection in the Beethoven Orthodontic Center.

Fig. 3:
Two of Dr. Burstone's closest professional colleagues and personal friends (Rodrigo and Michael Marcotte), and Chris Chang at the Burstone Memorial Symposium in Indianapolis in 2015.



and the concepts of goal-oriented treatment and the occlusogram that he invented were basically a sophisticated version of Case's ideas. The genius of Dr. Burstone is that he was able to take Case's ideas to a more practical level. Even though he was a tough scientist somewhat opposing the way things were generally done in orthodontics, his lectures were always packed and he was admired and loved by most, if not all.

The difference between Charles J. Burstone and other great legends of Orthodontics is that he did not teach a technique (*although some labeled it as such*). He was not a guru or a clinician. He was a scientist and the concepts revealed by his research are universal. Anytime he analyzed a mechanical system or appliance, he would look at the data, and rejected even his own original versions of appliances when necessary. His conclusions about mechanical design and tooth movement were based on data, not on what he anedoctally saw in his office, or what worked in his hands. To compare the legacy of Dr. Burstone in Orthodontic mechanics to any others is simply unfair, because nobody can match establishing the scientific foundations of orthodontic mechanics. I feel extremely privileged to have the opportunity to directly work with him in the last few years and ask and learn from him while we worked on projects. It is my responsibility as a scientist to give continuity to his work.

Fig. 4: Drs. Charles Burstone and James Baldwin.

I had the privilege to work together with Dr. Burstone in his last two contributions to orthodontics. The first was the proof that the center of resistance could not be defined in 3D as a point, and the proof that axes of resistance could. This study was published in the AJO-DO and has since been validated by other groups. This study revealed that there can be expected variation of 1-2mm in the location of the projected center of resistance in different planes, and that the Cres is very sensitive to root and bone asymmetries. Hence, continuous clinical feedback and adjustment are necessary as the tooth moves.

The last thing we worked on together is called SmartArch (*Fig. 5*) (*http://www.smartarchortho.com*). It is an alignment wire with stiffness prescriptions for each inter-bracket distance in an arch. It was conceptualized jointly by us while we discussed what would be the best possible alignment archwire. Basically, the SmartArch was developed to be the only necessary alignment archwire for first and second order corrections. Our calculations determined that for optimum sliding during alignment we should not use a wire larger than 0.016 to starts a case. Then, laser was used to process the wire in each interbracket distance so that each tooth would get an optimum force value for its available root support. The SmartArch is the first wire in orthodontics that has data showing that both root support and interbracket distances are taken into account to obtain the optimum force for tooth alignment. Our data shows that alignment with this archwire works best with self-ligating brackets or

Fig. 5:
SmileArch designed by Drs. Charles Burstone and Rodrigo F. Viecilli.

a slightly loose metallic ligature. Dr. Burstone and I spent over a year and worked on this on the phone and weekend-long meetings during that period.

Dr. Burstone, even with his advanced age, was extremely sharp and had a very witty sense of humor. We had just talked on the phone about some challenges regarding the SmartArch right before he travelled to Korea to give his last series of lectures. I was sad and stunned to be woken up with the news that he had passed away. But, in the serenity that I learned to have from him, I was comforted by the fact that he passed away still performing at his best, with honor, and doing what he loved. That's the way of the scientist, and the Jedi.

The picture below was taken in 2003, when I was 26 and was finishing my residency in Orthodontics. Dr. Burstone had visited Brazil to give a course, and met my family (*which is also of orthodontists*) to revise the translation of his book.

Fig. 6: Drs. Charles Burstone, Rodrigo and his family, 2003.