



# The use of technology for a technical analysis in tennis - A tribute to Gilles de Kermadec.

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## ABSTRACT

The storage capacity of a growing number of data and images, the ability to capture 1000 frames per second and the improved speed of editing mark a new stage in the technical analysis of sporting actions. Today, just type the word "tennis" in any search engine and browse the Internet to see the many results. Due to this, it seemed useful to us to have three tennis experts; a historian, a researcher in biomechanics and a National Technical Director, to reflect on the impact of technology in the development of technical analysis and teaching.

**Key words:** Technique, Technology, Anthropology, Biomechanics, Education.

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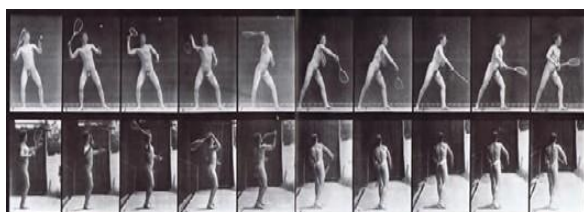
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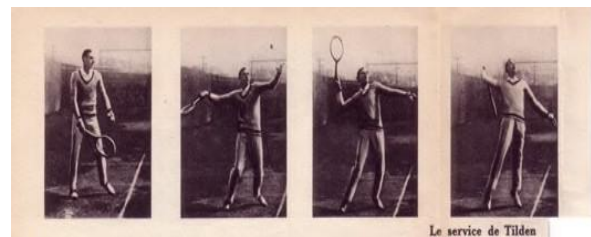
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## A CENTURY OF TECHNOLOGICAL INNOVATIONS

In the origins of the modern game, late nineteenth century, tennis champions could have easily avoided coaches and "coaches" were often considered as self-taught. At the beginning of the twentieth century, the invention of photography and Chronography transformed the way the act of playing tennis was represented. One early was of presenting the movements, experimented by Marey and Muybridge Demeny in 1882 and in 1887, was decomposing multiple sequences that could overlap and join each other. This allows using wide shots or angles of differing viewpoints, to isolate the details in order to better understand the effective movement of the top players (Beldam & Vaile 1905 Vaile, 1906; Paret, 1926, Lacoste, 1928).



**Figure 1. Plaque 294, electrophotographic phases in Animal Locomotion, Muybridge, 1887.**



**Figure 2. Kinograma from Tilden, Tennis, René Lacoste, 1928.**

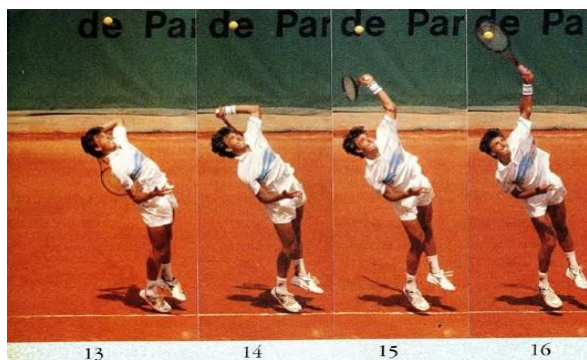
This is the same path that Gilles de Kermadec undertook from 1953 to 1998 as his "technical studies" appeared in 'Tennis de France'. This allows one to initially decompose the mechanical development of action image to image. Then gradually with these increasingly accurate cinematic procedures, it is possible to modify their technical analysis.

Thus, in 1956, with the service of Lewis Hoad, Gilles de Kermadec classically decomposed the act into six phases: Start, preparation, loop rotation, pause, impact, and arrows to analyze the path made by the racket. In the 60s, with the use of more sophisticated cameras, 25 fps, a better definition of the images was achieved and allowed the use of "zoom" to one or another area of the body in the service, which facilitates the decomposition of the forces involved in the "perfection of the act" (Kermadec, 1965).

In 1973, the first investigations of electronic image analysis with the invention of the VCR appeared but as Gilles de Kermadec stated, "It will take several years yet before it can be affordable to all and to all the clubs." One would have to wait for the beginning of 80s to have the first images of

biomechanic modeling studies obtained by computer calculations (Durey & Kermadec, 1984). "This is a long term project in which the computer participates ... the project will observe a single shot not only from front and side but also from above ... Meanwhile we will only have subjective approaches of the image that each player is performing ..." (Kermadec, 1986). From the 90s, the service action was analysed more commonly as a result of a cinematic chain with the summation of the different muscle groups starting from the feet to the final impact with forearm supination.

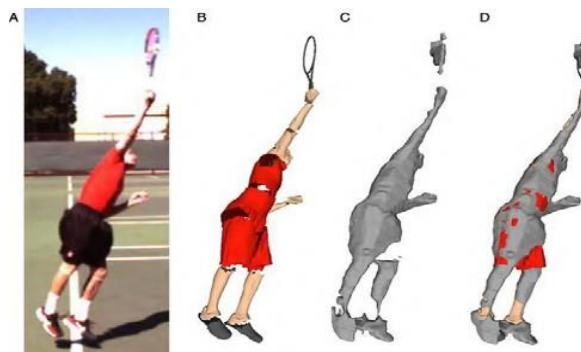
At the beginning of the third millennium we have definitely moved from a purely mechanical conception of the stroke to a biomechanical analysis (Solves, 2006; Elliot Reid & Crespo, 2006). In short, parallel to technological innovations in image processing, we observed a change in the perspective in the technical design of the movement.



**Figure 3. Extract from *Technicorama of Goran Ivasevic* by Gilles de Kermadec, 'Tennis de France' 460-92, 1991.**

#### CURRENT RESEARCH IN BIOMECHANICAL INVESTIGATION

Today optoelectronic systems are used, consisting of infrared cameras to capture a very high frequency (300 frames/s) and three-dimensional movements of the service of the players. The motion capture laboratory enables a biomechanical analysis by calculating the kinematic and dynamic variables relating to performance optimization and the understanding of the mechanisms in joint injuries. Along with measuring devices and analysis of muscle activity by EMG, combining these techniques allow observation and measurement from images to obtain additional data on muscle activity. They have the advantage of being able to eventually access efforts and "internal" system limitations and, therefore, investigate the parallel performance factors and also what is new and interesting in reference to the potential risk in injury. The timing of the rotation is best observed during the action of the serve, increasing the speed of the ball increases, and limitation of joint constraints experienced by the upper member (Martin, 2013). The investigations go even further to analyze the biomechanics of the serve from motion capture without placing body markers on the player (Sheets et al., 2011).



**Figure 4. The markerless motion capture: Images of a player performing a serve. A) Video image. B) Reproduced model. C) Partial rendering 3D Player. D) Final 3D image taken from Abrams et al. (2012).**

#### IMPLICATIONS FOR EDUCATION AND TRAINING

Today the problem is to provide for the coaches who favour scientific information dissemination. On the other hand, the educational philosophy developed by Gilles de Kermadec is more important than ever before, "look at the champions play, and try to identify common ground to establish the foundations of teaching tennis." The still photos and text captions are obvious to all and you do not need to be a ballistics expert to realize that the Nadal racket is facing the back fence of the court at the end of the preparation on his forehand.

One option to encourage knowledge sharing is to emphasize the relationship between laboratories engaged in sports science and the training services of the Federations. In France, there are currently research agreements with Nicolas Benguigui in Orsay, Caroline Martin in the ENS Cachan-Bretagne, with sports science laboratories of Caen, Poitiers & Lyon that led to publications in the Journal for coaches (Martin, 2012).

A second alternative is to mutualise data and encourage exchanges of information, not only with investigations but also to be interactive - critically - through various forms of remote experimentation. Indeed, ease of access to transmission of data over the Internet allows for discussion between the different stakeholders, track the performance of technical evolution thanks to the possibility of putting the videos online. Evolving, these collaborative platforms are undoubtedly a tool with a promising future and a valuable tool for the planification of coaches (Tennis Info, 2013).

#### CONCLUSION

Finally, the history of technology teaches us the importance of not only preparing future coaches to use these devices, but to learn how to be able to question their knowledge as new research (Pestre, 2009). The concept that we have of the

training or education can be excellent in a given era but become obsolete some decades later. Facilitating the exchange between theoretical knowledge and practical experience will be a necessary competence for future coaches.

Ultimately, the history of technology in the analysis of sports movement reveals not only the inventory of actions considered for effective performance at a particular time, but motivates us to be attentive to technology from an epistemological perspective and critique. What really matters is not the information obtained by research laboratories, but the interpretation of the truly useful and relevant information that can be applied to training and competition. This article is dedicated to the memory of Gilles de Kermadec who has managed to pass on to many generations of players and coaches the importance of image for understanding the technique of the tennis player.

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