DEVELOPMENT OF A TABLE TENNIS MACHINE TO COUNTER THE "CHIQUITA" SPIN

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After Beijing Olympics, leading athletes began to use a stroke known as the "Chiquita" spin frequently. Thus, the Japan national table tennis team at the time undertook countermeasures against the Chiquita spin including some plans. However, these did not produce significant results. Therefore, we developed a table tennis training machine for the team in activities supporting the Japan national table tennis team. The machine has 3 rotors to shoot a ball stably. Also, these rotors are twisted to make a "gyro rotation" of the ball. This machine was introduced into the Japan national table tennis team to take measures for London 2012 Olympic.

KEY WORDS: Table tennis, machine, spin.

INTRODUCTION: Around the time of the Beijing Olympics, leading athletes began to use a stroke known as the "Chiquita" spin frequently. The Chiquita spin is a way of hitting the ball in which the ball is struck over the table with a side spin using a backhand flick. The main point of the technique is to increase the ball's spin rather than its speed by means of a small movement. At the time, detailed ball behavior and the like in the use of this stroke were unclear. Moreover, because there were few athletes using the Chiquita spin when the Japan National Team's manager and coach were actively competing, there was no one inside Japan capable of hitting a Chiquita spin equivalent to that of the leading foreign athletes. Thus, the National Team at the time undertook countermeasures against the Chiquita spin including plans to visit China as well as inviting Chinese athletes. However, this did not produce significant results, either because they were unable to get much training time focusing on the Chiquita spin, or possibly because they were unable to obtain top athletes through their invitations. Under these circumstances, we undertook research into the development of a machine that could faithfully reproduce the Chiquita spin that is being unleashed by top foreign athletes.

METHODS: Before making the table tennis machine, we interviewed the National Team staff regarding what kinds of specifications should be incorporated into the machine. In addition to the Chiquita countermeasure, they made requests for various features such as the ability to shoot balls with various other spin directions and to reproduce ball behavior more realistically unlike existing table tennis robots. Thus, in collaboration with the Japan Table Tennis Association's medical science staff and the Japan Institute of Sports Science (JISS), we collected data such as ball speed, ball rotational speed, and rotational axis direction of balls in various stroke techniques used by top foreign athletes. Further, we cooperated with companies with proven track records in the development of baseball pitching machines, specialists in fluid dynamics, and the like to investigate the specifications of a machine that would be capable of shooting balls that reproduce no less than the behavior observed in the balls hit by top foreign athletes. Our top priorities for the machine in development were the ability to shoot the ball in a diverse variety of ways, the ability to shoot continuously at a steady pace, and the reproduction of more realistic ball behavior. We therefore built the firing mechanism with a three-rotor construction in which each rotor would be turned left and right

dozens of times independently (Figure.1). Moreover, through the use of a large-output motor, we designed the rotors with the ability to spin in reverse for short periods, handling a variety of table tennis shots (Table.1). After a development period of about six months, we added improvements based on the opinions of the National Team staff, and ultimately the machine was adopted for use as a piece of training equipment by the men's National Team. After the machine was adopted, we continued to make improvements and update the program to meet training protocol.

(a) (b)
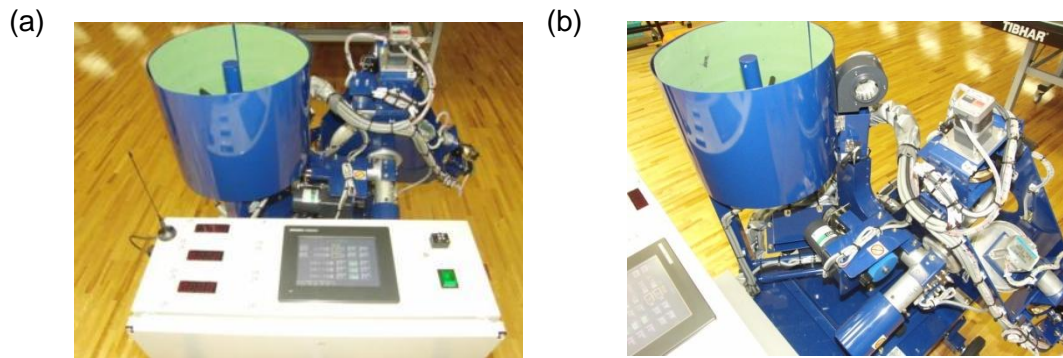
Figure 1: A control panel (a) and rotors (b) of the table tennis machine.

Table 1
Main spec of the table tennis machine

1. maximum spin rate of rotors	83.3rps
2. maximum spin rate of the ball	200rps
3. maximum ball speed	90km
4. the range of twisting angle of rotors	±30°
5. available ball spin	Any direction

DISCCUSION: The machine was utilized in the National Team's training until just before the London Olympics. Moreover, we obtained favorable ratings for the machine from managers and coaches in reports on activities within the association after the London Olympics as well. We therefore believe that the table tennis machine development project achieved a certain degree of success.

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