

A study of the shock absorbing qualities of the plastron or 'dō' in *kendō* armour

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Abstract:

Purpose

The purpose of this research was to conduct a detailed investigation into the shock absorbing qualities of the *kendō* plastron (*dō*) according to varying degrees of force, in order to improve the overall standard and safety of this piece of equipment.

Methodology

1. Materials:

a total of seven plastrons were used in this experiment, constructed from four different types of materials – traditionally made bamboo *dō* covered in leather, fibre (compressed fibre composite), impact resistant nylon resin, and ABS resin.

2. Measurements:

1) Striking device – In order to ensure a constant measure of force on impact, and thus enhance the reproducibility and accuracy of this experiment, a machine was developed to rotate and strike the target plastron in a horizontal direction.

Powered by an electric motor, a crank rotates horizontally to push a lever with a *shinai* (bamboo sword) fixed in place.

This movement was initiated as the crank separated from the lever and activated a spring to swing the *shinai* towards

the target. The force of the swing was measured by two settings – low force (approximately 100kgf) and high force

(approximately 190kgf). With consideration given to the reproducibility of this experiment, the *shinai* used was made of

carbon-fibre. The impact area on the *shinai* was measured at approximately 25cm from the tip, and each plastron was

struck ten times.

2) Force measurement device – An existing system for the measurement of force was employed. The mechanism

holding the plastron was suspended by a rope, and the right-side target area was adjusted to the height of the impact

sensor. The detection and measurement of striking force utilised the same methods that have been used in previous

studies. The measurement of the force of a *dō* strike also had to consider the presence of the *tare-obi* belt worn under

the plastron. For this reason, a strip of hand-stitched material (stitch width of 1-*bu* 5-*rin*, or 3.3mm) was positioned at

the striking head unit.

3) Test conditions; (1) Control: no plastron, directly striking the material positioned at the striking head unit. (2)

Condition 1: the plastron and the material covered striking head unit were touching when struck. (3) Condition 2: the

plastron and the material covered striking head unit were separated by approximately 2cm when struck.

Conclusions

1. While there was a difference in shock absorbing qualities between each type of plastron, simply wearing a plastron was found to reduce impact on the body (3 directional components of force) in both the low and high force settings by 30-50% - exhibiting the high shock absorbing qualities of this piece of equipment.

2. Plastrons made from the chemical compound of ABS resin, impact resistant nylon resin and compressed fibre composite, displayed extremely good shock absorbing qualities against the low force setting.

3. The traditional plastron made of leather bound bamboo showed a better level of shock absorbing qualities against the high force setting than plastrons made from chemical compounds.