COMPARISON OF THE KINETIC FRICTIONAL FORCE BETWEEN CONVENTIONAL PLASTIC BRACKETS WITH THERMOPLASTIC LOW-FRICTION MODULE LIGATION AND SELF-LIGATING BRACKETS

Aim: To compare the kinetic frictional force of a conventional plastic preadjusted bracket with thermoplastic low-friction module ligation and a self-ligating bracket. Materials and Methods: The testing model consisted of four 0.022-inch conventional plastic preadjusted brackets; four 0.022-inch self-ligating brackets for the first premolar, canine, and lateral and central incisors; and a 0.014-inch superelastic nickel-titanium and a 0.019 × 0.025-inch stainless steel wire. The brackets were either aligned for both wires or out of line by 0.5, 1.0, 1.5, and 2.0 mm for only the 0.014-inch superelastic wire. The wires were pulled for 3.0 mm at a speed of 0.1 mm per second. Unpaired t tests were used to compare the mean differences of the measurements between the two bracket systems with both wires. Results: No significant difference in the kinetic frictional force between the two bracket systems and the two wires were found for the 0.014-inch superelastic wire at 0-mm deflection. Conclusion: Both bracket systems demonstrate low friction, which is beneficial for effective orthodontic tooth movement with light forces. World J Orthod 2009;10:220–223.

Key words: conventional plastic brackets, low friction, self-ligating brackets

Esthetic brackets are preferred by orthodontic patients, particularly adults. However, the frictional properties of ceramic brackets are significantly higher than those of stainless steel brackets.1–3 Ceramic brackets also have a significantly higher friction compared with plastic brackets or plastic brackets with metal sleeves.4 Plastic brackets can deform due to the compression force of ligation, which increases their frictional resistance compared to stainless steel brackets.5 Thus, deformation of plastic brackets with excessive ligation forces must be avoided. There are two ways to accomplish this. One is to use self-ligating brackets,6–8 while the other is to use low-friction ligatures.9,10 Very low friction with self-ligating brackets has been clearly demonstrated by several researchers.6–8 Remarkably reduced friction is also a feature of thermoplastic low-friction modules (Clear-snap, Dentsply-Sankin) (Fig 1).

Because thermoplastic low-friction modules cover the bracket slot, they convert a bracket into a tube-like structure. These modules have an excellent esthetic appearance because of the material from which they are constructed.

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Low friction and high esthetics make thermoplastic low-friction modules very beneficial for adult patients. Moreover, currently available self-ligating brackets are more expensive than most good quality conventional brackets. Thus, cost savings also speak in favor of conventional plastic brackets with thermoplastic low-friction module ligation. However, there are few reports about how much thermoplastic low-friction modules reduce frictional resistance compared to self-ligating brackets. This study compares the kinetic frictional force in plastic brackets/thermoplastic low-friction modules with that of self-ligating brackets.

MATERIALS AND METHODS

The materials consisted of four 0.022-inch conventional plastic preadjusted brackets (Clear-bracket, Dentsply-Sankin) and four 0.022-inch self-ligating brackets (Damon 3, Ormco) for the first premolar, canine, and lateral and central incisor, which were bonded on posts (Table 1). They were adjusted in two units: one was made up of the central incisor and the canine and the other of the lateral incisor and the first premolar. These units could be moved in opposite directions, so that the adjacent brackets were misaligned by 0.5-mm increments. The interbracket distance was 4.5 mm because that is the average clinical interbracket distance.

Test wires were a 0.014-inch superelastic nickel-titanium wire (Tynilloy wire, Dentsply-Sankin) and a 0.019 × 0.025-inch stainless steel wire (SUS wire, Dentsply-Sankin). These wires were held in place with thermoplastic low-friction modules (conventional plastic preadjusted brackets) or by the locking system of the self-ligating brackets.

To mimic the clinical situation of initial misalignment, the two bracket units were tested with a misalignment up to 2.0 mm, but only in the superelastic wire (Fig 2). The perfect alignment for the 0.019 × 0.025-inch stainless steel wire was chosen to imitate a situation at the final stage of treatment.

For the kinetic frictional force measurement, a strain gauge, micrometer, and pulse-controller were used (Fig 3). The wire sections were pulled 3.0 mm at a speed of 0.1 mm per second as measured.
by a micrometer (Mitutoyo) and driven by a pulse-controller (Keyence). All tests were performed under dry conditions at room temperature (24°C ± 2°C). The kinetic frictional forces were measured at a displacement of 1.0, 1.5, 2.0, and 2.5 mm and averaged for arithmetic means. The entire measurements were conducted 10 times using new wires and modules every time. Unpaired t tests were used to compare the mean differences between the conventional plastic preadjusted brackets ligated with thermoplastic low-friction modules and the self-ligating brackets. The level of significance was set at $P < .05$.

### RESULTS

The mean values and standard deviations of the kinetic frictional forces for both bracket systems and wires are shown in Figs 4 and 5. There was no significant difference between bracket systems except for the 0 mm deflection of the 0.014-inch superelastic wire (0.3 cN for the conventional plastic preadjusted brackets with thermoplastic low-friction modules as compared to 0.2 cN for the self-ligating brackets) (Fig 4).
DISCUSSION

Extremely low friction with self-ligating brackets has been reported.13,14 In this study, there was no significant difference between the conventional plastic preadjusted brackets with thermoplastic low-friction modules and the self-ligating brackets for the two wires, with the exception of the superelastic wire at 0-mm deflection. However, this difference was only 1 cN, which does not indicate any clinical significance. The low friction value of the self-ligating brackets is no surprise because the locking mechanism opens and closes vertically and creates a passive cover over the slot. Conventional plastic preadjusted brackets with thermoplastic low-friction modules have a similar feature because the slot has four passive walls. Overall, the low friction property can be a substantial advantage for orthodontists who use sliding mechanics.

CONCLUSIONS

The kinetic frictional force of conventional plastic preadjusted brackets with thermoplastic low-friction modules was compared to that of self-ligating brackets. There was no clinically significant difference between them. Conventional plastic preadjusted brackets with thermoplastic low-friction modules, as well as self-ligating brackets, provide low friction, which is beneficial for effective orthodontic tooth movements using light forces.

REFERENCES