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Occlusal State and Physical Function of Junior Male Japan National Badminton Team Candidates

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Abstract

Purpose: The aim of this study was to clarify the differences in physical function due to the occlusal state of candidates for the U13, U16, and U19 junior male Japan national badminton team. Method: The participants were male badminton players (U13: 14 players, U16: 22 players, U19: 26 players) nominated as junior Japan representative candidates by the Nippon Badminton Association. Each participant group was divided into an occlusal stable group with a difference of less than 10% in left and right occlusal force and occlusal contact area, and an occlusal unstable group. Physical function was evaluated using sports tests; sit-ups, side steps, skipping rope, double jumps, and 100-m sprints. In each participant group, the differences in maximum occlusal force and scores on each sports test between the stable and unstable occlusal groups were compared using Student's t-test or Welch test. Results: The maximum occlusal pressure was significantly greater in the occlusal stable group than in the unstable group in the U16 and U19 ($P < 0.01$). In U16 and U19, the scores for side steps and double jumps were significantly higher in the occlusal stable group compared with the unstable group ($P < 0.01$), but no differences were observed between the two in other tests. Conclusion: The results of this study revealed that differences in physical function due to the occlusal condition of junior male Japanese national badminton team candidates were observed only in the scores of tests evaluating agility and dexterity, and that athletes with established molar occlusal contacts have better physical function.

Keywords

Badminton Competition, Occlusal Force, Occlusal Contact Area, Agility, Dexterity, Junior Japan National Team Candidate

1. Introduction

In many sports, skills tend to peak at a relatively young age. For this reason, there is a need to discover athletes with promising futures at an earlier stage. Specialized training from a young age enables athletes to succeed at an elite level, which in turn leads to the structural and progressive development of lifelong athletic ability (Balyi et al., 2013; Granacher & Borde, 2017). In Japan as well, various sports organizations are developing programs targeting junior athletes with the aim of developing elite-level athletes to compete in international competitions.

Occlusion affects the somatic sensation of postural control, and many studies have investigated the relationship between occlusal state and postural control (Bando, 2009; Bando et al., 2019; Marini et al., 2013; Takahashi & Bando, 2018, 2023a, 2023c, 2024). It has been shown that experimental occlusal interference increases center-of-gravity sway (Marini et al., 2013) and that using intraoral appliances to improve occlusal contact improves postural control (Takahashi et al., 2018, 2023a). Previous studies of the relationship between occlusion and physical or motor function have revealed that changes in occlusal state resulting from mouthguard use affect the flight time and landing position of trampoline gymnasts (Takahashi et al., 2023b, 2025), that handball players who wear a mouthguard have an advantage in jumping power and muscular strength (Takahashi et al., 2023c), and that the magnitude of occlusal force in junior athletes is related to agility (Bando et al., 2018). In addition, there have been various reports on the relationship between oral function and athletic ability in children, adults, and the elderly, and it has been shown that individuals with good sports performance exhibit better occlusal conditions (Bando, 2016, 2013; Hirao et al., 2015; Yasui, 2003).

The Nippon Badminton Association recruits candidates for the junior Japan national team in the following age groups: U13 (10 - 12 years old), U16 (13 - 15 years old), and U19 (16 - 18 years old). Players are selected based on a variety of factors, including their competitive performance, physical ability, and coach's evaluations (Nippon Badminton Association, 2025). Players in the U13 age group are in the mixed dentition period, which is characterized by different occlusal contact conditions compared with players in the U16 and U19 age groups.

The aim of this study was to clarify the differences in physical function due to the occlusal state of candidates for the U13, U16, and U19 junior male Japan national badminton team. The null hypothesis was that there are no differences in physical function due to the occlusal state of junior male badminton players.

2. Materials and Methods

2.1. Participants

The participants were male badminton players nominated as junior Japan representative candidates by the Nippon Badminton Association. There were 14 players in the U13 age group, 22 players in the U16 age group, and 26 players in the U19 age group.

This study was approved by the Ethics Committee of The Nippon Dental University School of Life Dentistry at Niigata (ECNG-R-326). The details of the study were explained in full to all participants and proxies, and their informed consent was obtained.

2.2. Measurement of Occlusal State

Occlusal state was measured using a pressure-sensitive film (Dental Prescale, 50H-R type; Fujifilm Co., Ltd. Tokyo, Japan), and evaluated using OCCLUZER (FPD-707; Fujifilm Co., Ltd.) (Bando et al., 2018, 2019; Takahashi et al., 2018, 2023a). The Dental Prescale was inserted into the participant's mouth, and they were instructed to clench with maximum force for 3 s in the intercuspal position (**Figure 1**). The Dental Prescale was removed from the mouth and analyzed using OCCLUZER. The occlusal contact area, average pressure, maximum pressure, and occlusal force as well as the overall, right-side, and left-side distributions, are shown in **Figure 2**. In this study, participants with a difference in occlusal contact area and occlusal force between the left and right sides of less than 10% were defined as the occlusal stable group, and the rest were defined as the occlusal unstable group (Takahashi et al., 2023b, 2024).

Figure 1. Occlusal measurement using pressure-sensitive film.

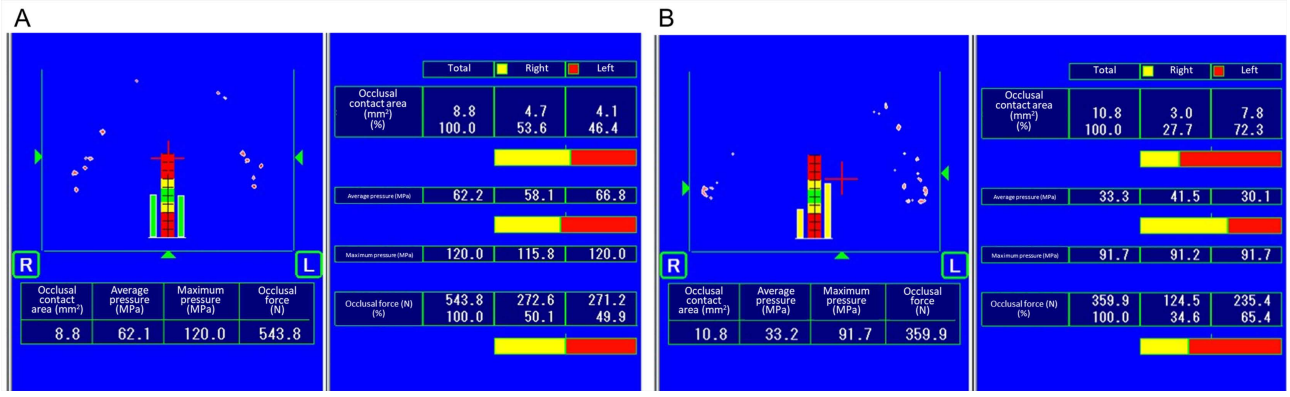

Figure 2. Analysis results of occlusal contact state, using OCCLUZER. A: Occlusal stable group, B: Occlusal unstable group.

2.3. Sports Tests

The following sports tests were conducted according to the rules of the Nippon Badminton Association: sit-ups, side steps, 10 min of skipping rope, 2 min of double jumps, and 100-m sprints (Bando, 2016; Nippon Badminton Association, 2025).

2.4. Statistical Analysis

Statistical analysis was performed in SPSS 17.0 software (SPSS Japan Inc., Tokyo, Japan). Significance was set at $P < 0.05$. The Shapiro-Wilk test was used to examine the normality of distribution and Levene's test was used for homogeneity of variance. Normality was observed in all age groups. Homodispersity was observed for all age groups except for maximum occlusal pressure and side steps in the U16 group.

The differences in maximum occlusal pressure and scores for each sports test were compared between the occlusal stable group and the occlusal unstable group for all three age groups. When the variances of each sample were equal, Student's *t*-test was used for analysis, and when the variances were not equal, Welch test was used.

3. Results

The difference in maximum occlusal pressure between the stable and unstable occlusal groups for each participant group is shown in Figure 3. In the U16 and U19 age groups, the maximum occlusal pressure was significantly greater in the stable group than in the unstable group ($P < 0.01$). No significant difference was observed between the two in the U13 age group.

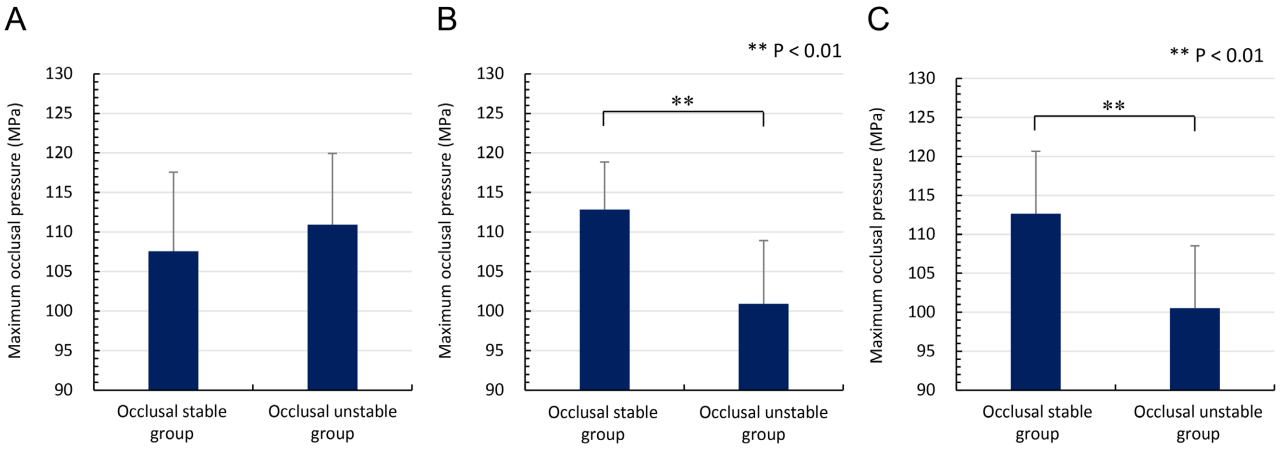

Figure 3. Comparison of maximum occlusal pressure among the U13 (A), U16 (B), and U19 (C) age groups.

Figure 4 shows the difference in scores between the occlusal stable group and the occlusal unstable group in each sports test for the U13 age group. No significant differences were found between the occlusal stable and unstable groups in any of the tests.

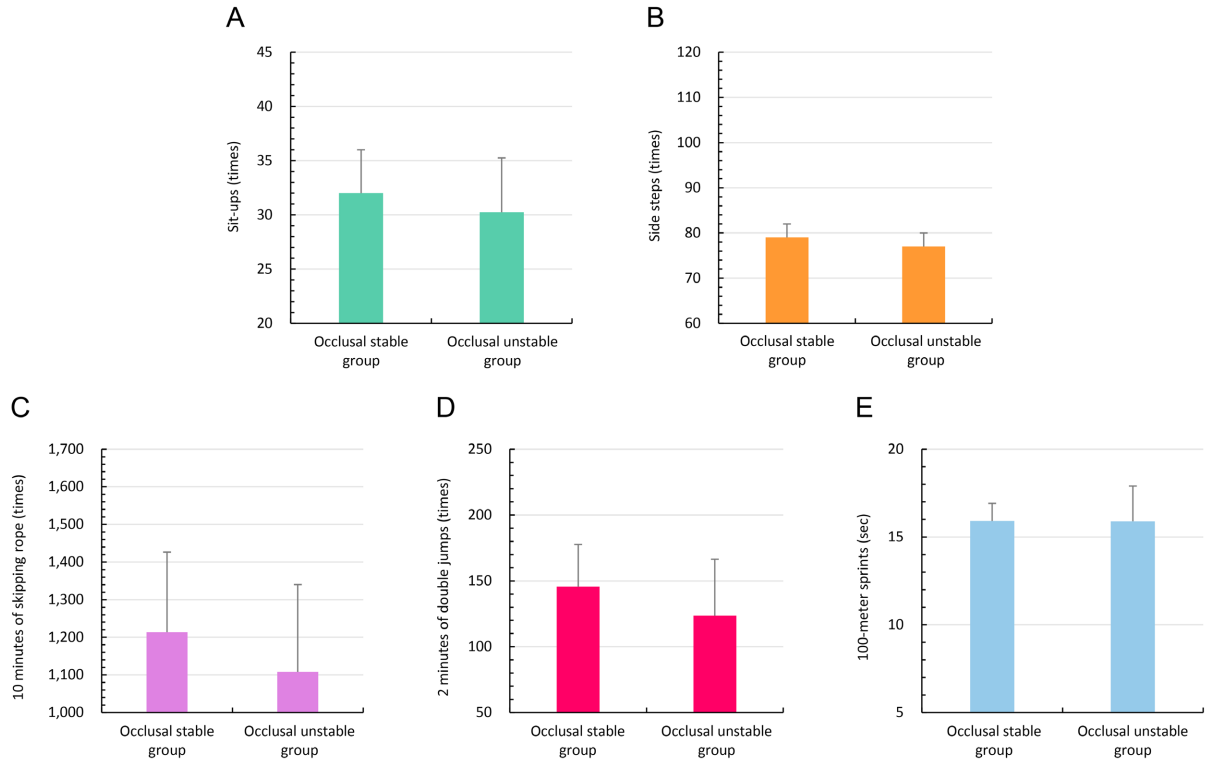

Figure 4. Differences in sports test scores depending on occlusal condition in the U13 age group. (A): Sit-ups. (B): Side steps. (C): 10 min of skipping rope. (D): 2 min of double jumps. (E): 100-m sprints.

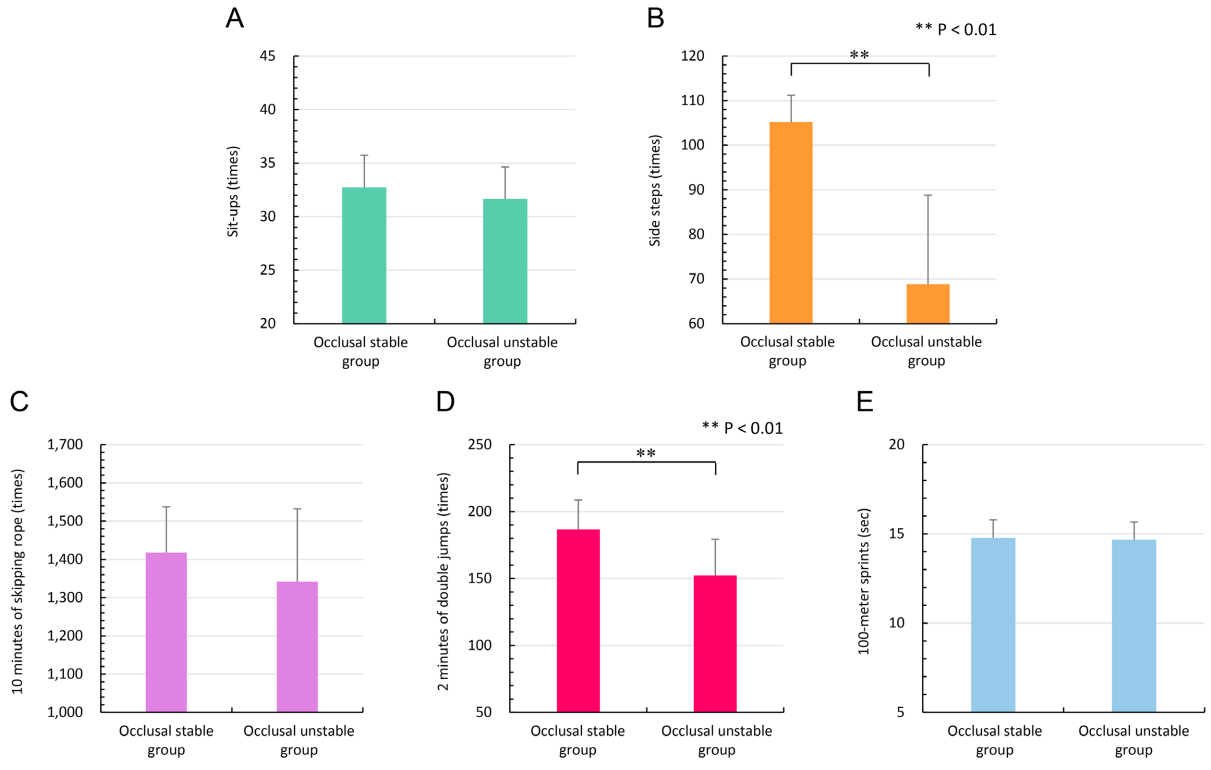

Figure 5. Differences in sports test scores depending on occlusal condition in the U16 age group. (A): Sit-ups. (B): Side steps. (C): 10 min of skipping rope. (D): 2 min of double jumps. (E): 100-m sprints.

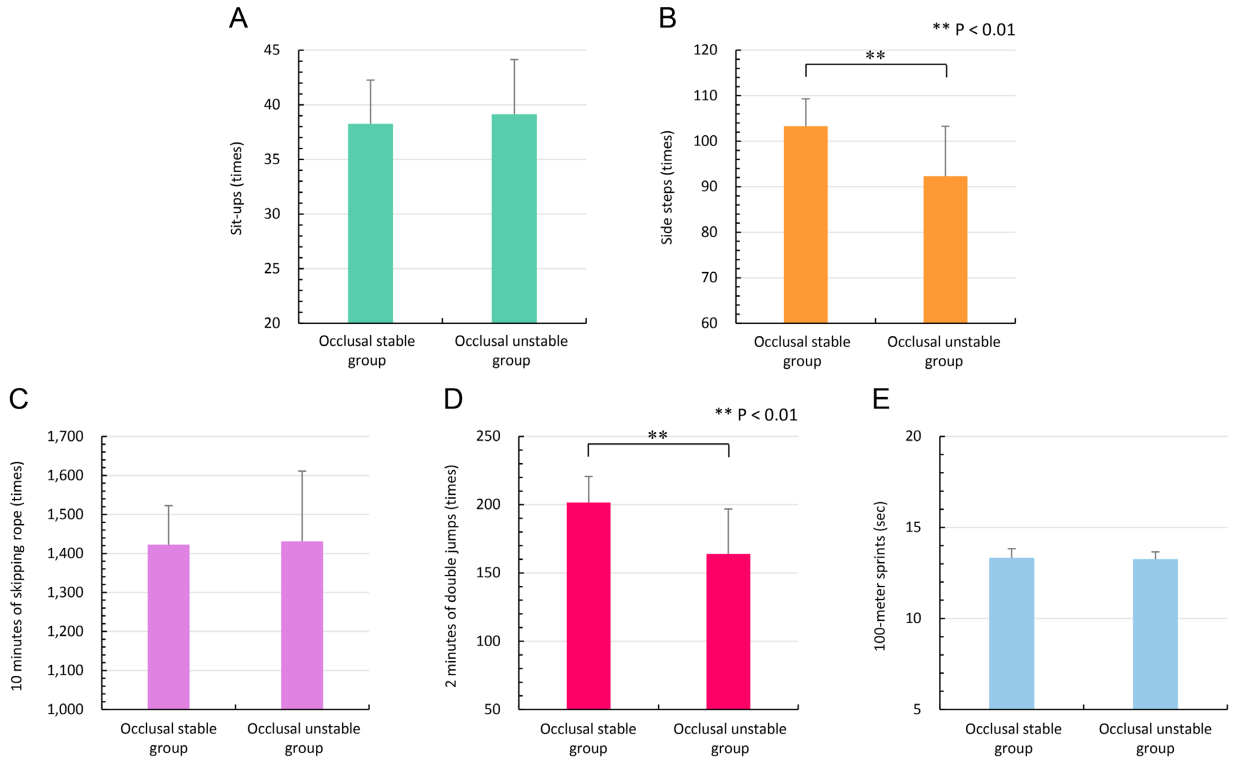

Figure 6. Differences in sports test scores depending on occlusal condition in the U19 age group. (A): Sit-ups. (B): Side steps. (C): 10 min of skipping rope. (D): 2 min of double jumps. (E): 100-m sprints.

The difference in scores between the stable and unstable occlusal groups in each sports test for the U16 age group are shown in **Figure 5**, and the results for the U19 age group are shown in **Figure 6**. The difference in test scores between the occlusal stable group and the occlusal unstable group showed a similar trend for the U16 and U19 age groups. The scores for side steps and 2-min double jumps were significantly higher in the occlusal stable group compared with the unstable group ($P < 0.01$). No significant differences were found in the scores for sit-ups, 10-min jump rope, or 100-m sprints in terms of occlusal condition.

4. Discussion

The results of this study showed that junior male badminton national team candidates with stable occlusion in the U16 and U19 age groups had better physical function than those with unstable occlusion. Therefore, the null hypothesis was rejected.

The reason that sports organizations are promoting the discovery of the next generation of athletes is to develop the athletes' potential from a young age by providing them with training to strengthen their sport-specific skills. Early and highly specialized training is essential to achieve the sports performance required to compete in international competitions (American Academy of Pediatrics, 2000). For this reason, sports scientists and coaches are constantly seeking new information to develop sport-specific training programs (Montgomery et al.,

2010; Vaeyens et al., 2008). Sports tests are one of the criteria for making this judgment. The test items are designed to evaluate various physical functions; for example, sit-ups are used to evaluate endurance, side steps are used to evaluate agility and instantaneous power, jump rope is used to evaluate endurance and dexterity, and the 100-m sprint is used to evaluate running ability. These represent physical functions that are particularly important in badminton competitions.

In this study, differences in maximum occlusal pressure were observed between the stable and unstable occlusal groups for the U16 and U19 age groups. One reason that no significant difference was observed in the U13 age group may be that occlusal contact or occlusal support of the molars has not been established because the participants in this group are still in the mixed dentition stage. Maximum occlusal force was greatest for the first molar, followed by the second molar, second premolar, and first premolar, suggesting that the state of occlusal contact between the upper and lower jaws may have influenced the maximum occlusal pressure. Furthermore, for the U16 and U19 age groups, it became clear that athletes with smaller left-right differences in occlusal contact were able to exert greater occlusal force.

In the side step and 2-min double jump tests, the scores of the occlusal stable group were better in the U16 and U19 age groups. In this study, occlusal intervention involving the use of an intraoral appliance was not performed, so this remains within the realm of possibility, but it is speculated that stabilization of the trunk using occlusal contact or muscles in the stomatognathic region may have had an influence. While playing sports, the posture changes repeatedly, and postural stability is maintained by engaging various postural muscles as well as postural reflexes (Takahashi et al., 2024). By using occlusion as one of the fixation sources, the skeletal muscles of the limbs are strengthened and the body orientation is stabilized (Boroojerdi et al., 2000). Therefore, it is predicted that motor functions affected by the occlusal state will be limited to tests that include movements that utilize trunk stability. Side steps is a movement in which the trunk changes direction repeatedly, while the double jump is a movement that makes skillful use of wrist snapping while stabilizing the trunk. For this reason, the occlusal stable group achieved higher scores in the side step and double jump tests. The main movement in sit-ups is trunk flexion, while the 10-min jump rope and 100-m sprint are evaluated in terms of endurance and running ability, respectively, and involve movements that involve relaxing the trunk. These tests did not involve trunk stability using occlusion, and thus no differences due to occlusal state were observed. In the U13 age group, no differences due to occlusal condition were observed in side steps and double jumps, and as with the maximum occlusal pressure, we speculate that the main reason is that the player is in the dentition stage, where using occlusion to stabilize the trunk cannot be performed due to the eruption status of the teeth.

The main limitations of this study are that it was limited to a cross-sectional survey and that the influence on actual play was not investigated. In addition, the

background of the study was not taken into consideration in the control of confounding factors such as past injuries and training load. In the future, it will be necessary to conduct longitudinal studies to clarify the relationship among the state of participant background, tooth eruption, and physical function as well as to examine the impact on competitive skill.

5. Conclusion

The results of this study revealed that differences in physical function due to the occlusal condition of junior male Japanese national badminton team candidates were observed only in the scores of tests evaluating agility and dexterity in the U16 and U19 age groups. This trend suggests that players with established occlusal contact of the molars and a stable balance between the left and right occlusal forces and occlusal contact areas have better physical function. Considering that occlusion is related to motor function, we would like to inform not only athletes but also those involved in sports and parents that oral care from a junior age can have a significant impact on future competitive skills, and we would like to apply the results of this study to raise awareness of regular dental checkups and early treatment.

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Conflicts of Interest

The authors have no conflicts of interest relevant to this article.

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