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Does Teeth Clenching Affect Dynamic Balance in Young Adults

Diş Sıkma Genç Erişkinlerde Dinamik Dengeyi Etkiler mi?

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Abstract

This study aimed to investigate the effect of teeth clenching on dynamic balance in healthy individuals. Volunteers aged 18-24 without balance issues, bruxism, or orthopedic conditions affecting balance were included. Recruitment was conducted via online announcements, and participants were assessed by a physiotherapist for eligibility. The HUR Smart Balance device was used for testing, which involves a platform, computer interface, and software to measure dynamic balance parameters. Participants performed two balance tests: one without clenching their teeth and another while clenching. The sequence of tests was randomized to prevent learning effects. During the test, participants swayed their bodies to maximum ranges in all directions without lifting toes or heels, and balance values were recorded in centimeters. Statistical analysis revealed no significant differences between the two conditions (p>0.05). These findings suggest that teeth clenching does not immediately affect dynamic balance in healthy individuals. Future research may explore this effect in populations with temporomandibular joint dysfunction or other musculoskeletal disorders.

Keywords: Balance, masseter, teeth clenching

Özet

Bu çalışma, diş sıkmanın sağlıklı bireylerde dinamik denge üzerindeki etkisini araştırmayı amaçlamıştır. Dengelerini etkileyen sorunları, bruksizmi veya ortopedik rahatsızlıkları bulunmayan 18-24 yaş arası gönüllüler çalışmaya dahil edilmiştir. Katılımcılar, çevrimiçi duyurular yoluyla davet edilmiş ve çalışmanın amacı, yöntemi ve riskleri hakkında bilgilendirilmiştir. Uygunluk değerlendirmesi, bir fizyoterapist tarafından gerçekleştirilmiştir. Dinamik denge ölçümleri için platform, bilgisayar arayüzü ve yazılım içeren HUR Smart Balance cihazı kullanılmıştır. Katılımcılar, biri dişlerini sıkmadan, diğeri ise sıkarken olmak üzere iki ayrı denge testi yapmıştır. Öğrenme etkisini önlemek için test sıralaması rastgele belirlenmiştir. Test sırasında katılımcılar, vücutlarını tüm yönlerde maksimum hareket aralıklarına kadar sallamış, parmak uçlarını veya topuklarını kaldırmadan denge değerleri santimetre cinsinden kaydedilmiştir. İstatistiksel analizler, iki koşul arasında anlamlı bir fark olmadığını göstermiştir (p>0,05). Bu bulgular, diş sıkmanın sağlıklı bireylerde dinamik dengeyi anlık olarak etkilemediğini önermektedir. Gelecekte, temporomandibular eklem disfonksiyonu veya diğer kas-iskelet sistemi rahatsızlıklarına sahip bireylerde bu etkinin araştırılması, daha kapsamlı sonuçlar sağlayabilir.

Anahtar Kelimeler: Denge, diş sıkma, masseter

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1. Introduction

The temporomandibular joint (TMJ) is the only movable joint of the skull, formed between the mandibular fossa and the articular tubercle of the temporal bone and the mandibular condyle. Because the mandible attaches to the skull with two condyles, it is considered a bicondylar joint. It is classified as a ginglymoarthrodial joint due to its ability to perform both rotational and translational movements (Fam et al., 2006). The TMJ plays a direct or indirect role in functions such as chewing, swallowing, sucking, vocalization, breathing, and the formation of facial expressions (Liem, 2002). The TMJ is a synovial ginglymoarthrodial joint (Hooks 2012; Hesse&Hansson 1988) The lateral and medial pterygoid, temporalis, and masseter muscles are responsible for jaw movements and chewing (Moore, 2018).

There is a close relationship between the structure and function of the TMJ and body posture. The center of gravity line is formed by the combination of all the forces that maintain the body in an upright position, passing through the cervical vertebra, sacrum, the midpoint of the hips, and the knees. Along with the TMJ, the skull also rests on this line. Therefore, any imbalance in the force distribution in the areas where the center of gravity passes through can significantly affect the TMJ (Liem, 2002; Tuncer et al., 2013).

Teeth clenching is voluntarily performed by the contraction of the muscles of the lower jaw (Brocard et al., 2008). In 2013, according to an international consensus, the repetitive jaw muscle activity characterized by clenching, grinding, supporting, or thrusting of the lower jaw was also defined as bruxism (Lobbezoo et al., 2013). Teeth grinding can lead to tooth wear, cracked teeth, hypertrophy of chewing muscles, exostoses, and prosthetic dental failures, all of which contribute to a general state of fatigue (Manfredini et al., 2011). Muscles, nerves, tendons, joints, and cartilage represent somatic balance points, reflecting the balance between muscle strength and fascial tension.

In a healthy body, the fascial system is free to move and transmit tension along the path, but if the fascial muscles become stiff, the structures and elements will not be in balance. This can lead to pain and likely injuries due to balance losses (Garofolini & Svanera, 2019). Isometric contraction of the chewing muscles can affect the body's static balance (Gangloff et al., 2000). Studies investigating the effect of teeth clenching on balance are limited in literature. Excessive muscle activations can disrupt muscular balance, potentially affecting both dynamic and static balance, which are crucial for individuals' daily activities. Teeth clenching in daily life may also contribute to balance disturbances. Therefore, this study aims to investigate changes in dynamic balance during teeth clenching.

2. Method

2.1. Aim

This study aims to investigate changes in dynamic balance during teeth clenching.

2.2. Research Hypothesis

Clenching teeth affect the balance activity being performed at that moment.

2.3. Universe and Sample of the Research

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Thirty-eight healthy individuals, aged between 18 and 24, were included in the study without gender discrimination. Exclusion criteria for the study: individuals with a history of teeth clenching or those diagnosed with bruxism, individuals experiencing jaw pain, those with increased tonus in the chewing muscles, individuals with balance problems, those with any orthopedic problems that may affect balance.

For sample selection, following the study conducted by (Ogasawara et al., 2022) (n=33), the parameter of body center of gravity oscillation was considered. Using G-power software (Heinrich Heine Universitat Dusseldorf) (Faul et al., 2009), the number of participants was calculated as 38.

2.4. Data Collection and Data Tools

The study investigated the effect of teeth clenching on balance in healthy individuals. Since individuals with a history of teeth clenching or diagnosed with bruxism may have higher muscle tonus compared to healthy individuals, which could affect the study results, the research was conducted only on healthy subjects. Additionally, individuals with pre-existing balance problems or orthopedic issues that could affect balance were excluded from the study to minimize any risks during the assessment using the balance device.

Before conducting the study, an online announcement was made to recruit volunteers. Respondents who showed interest in participating were provided with a detailed explanation of the study's purpose, methodology, potential risks, and eligibility criteria. Specific hours for the study sessions were determined, and those willing to participate arrived at the study location. A physiotherapist manually assessed each volunteer for any issues that could affect balance or excessive tonus in the jaw muscles. Based on these evaluations, suitable candidates were selected to participate in the study.

The balance test was conducted using the HUR Smart Balance (SME Inc, USA) (Siegrist et al., 2023) device. The equipment includes a platform, computer, balance support station, and HUR Smart Balance (SME Inc, USA) software (Figure 1).

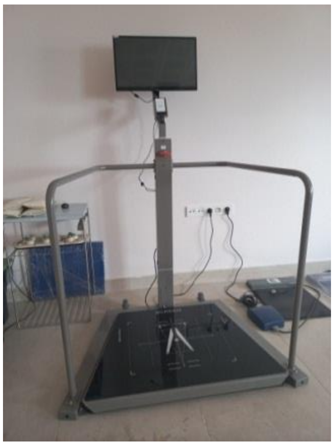

***Figure 1**. HUR Smart Balance Balance Device*

Participants were individually brought into the room where the test was conducted, and a quiet environment was ensured during the test. Before the start of the test, participants were briefed about the procedure. They were instructed to perform the test without raising their toes or heels, and they were

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informed that the test would end if they held onto the sidebars or in case of potential loss of balance. If a participant experienced a potential loss of balance, they were supported by the physiotherapist and encouraged to hold onto the sidebars. The test was conducted using the HUR Smart Balance device, which allows for various assessments and treatments related to balance. Dynamic balance testing was utilized to assess the effect of teeth clenching on balance. Before the test, participants' height, weight, and age were recorded, and the dynamic balance option was selected (Figure 2).

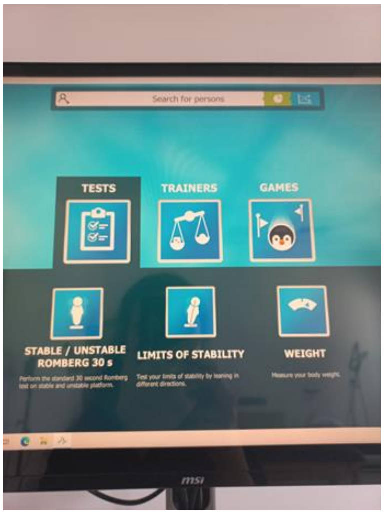

Figure 2. *Demographic Information and Selection of Dynamic Balance Option*

Before starting the test, there is an empty, colorless circle on the computer screen (Figure 3). There are 5-second rest intervals during the test, and the test duration is set to 8 seconds to maintain the position during the test.

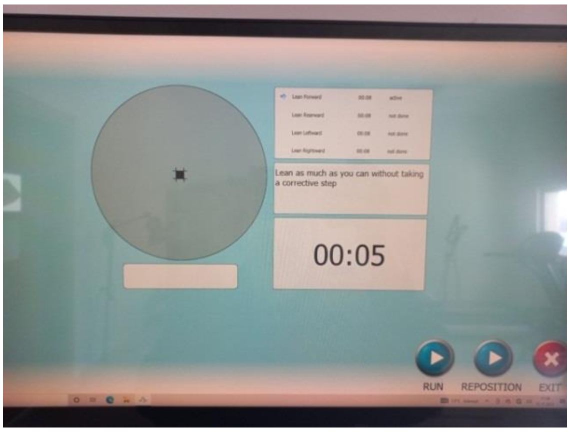

Figure 3. *Computer Screen During Balance Assessment*

The test was conducted twice. In one, participants were instructed to swing their bodies to the right, left, forward, and backward without clenching their teeth, allowing their bodies to reach the maximum range of motion. The test was performed with hands down by the sides, toes, and heels on the ground, without falling, and without holding onto the bars.

In the other test, participants were asked to clench their teeth before the test. The therapist checked for the presence of tonus by palpating whether the participant clenched their teeth or not. The only

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difference in the other test was that participants were instructed to continuously clench their teeth during the balance swing and also to reach the maximum range of motion. Commands were given to swing the body forward, backward, right, and left, and participants were instructed to maintain their balance without disrupting it until reaching the maximum range. During the test, teeth clenching was continuously monitored by the therapist.

To eliminate learning effect, half of the participants underwent the balance test with teeth clenching first, while the other half underwent the balance test with teeth clenching afterward (Figure 4).

Figure 4. *Evaluation of Balance with HUR Smart Balance*

At the end of the test, the maximum values of the balance at the furthest point reached in right, left, forward, and backward swings were recorded in centimeters. The device has its limit boundary. Values above this limit are shown in green, while values below the limit are shown in red (Figure 5).

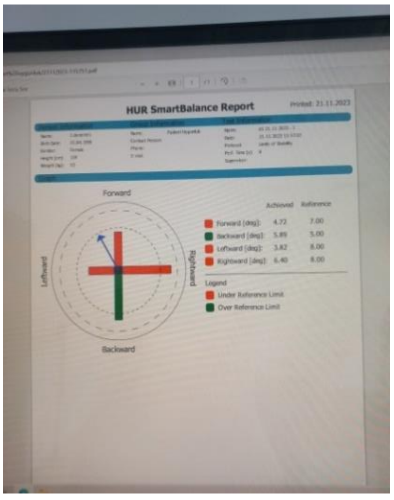

Figure 5. *Balance Measurement Results Screen with HUR Smart Balance*

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2.5. Ethical Aspects of the Research

The study was approved by the Scientific Research Ethics Committee of Gülhane University of Health Sciences (46418926-2023/410).

2.6. Limitations of the Study

Manual Muscle Activity Measurement: The tone of the masseter muscle was determined manually in the study. However, devices such as electromyography (EMG), which measure muscle activity more objectively, were not used. Technologies such as EMG could have allowed for a more precise assessment of muscle activation levels.

Limitation with a Healthy Population: Participants were selected only from healthy individuals. This situation limits the generalizability of the results to the general population or to individuals with bruxism or temporomandibular dysfunction (TMD). Working with individuals with bruxism or TMD could have provided a broader perspective on the effect of jaw clenching on dynamic balance.

Measurement Environment: The test environment was arranged in a quiet and controlled manner during the study. However, considering that individuals may encounter different environmental factors in daily life, the results of this study may not be directly reflected in real-life conditions. In particular, environments with distracting elements or different surfaces may affect dynamic balance.

Short-Term Measurement: The tests are based on short-term balance measurements of the participants. Long-term balance performance or the effects of repeated jaw clenching on balance were not examined. Balance measurements at different time periods could have provided more information about the long-term effects of jaw clenching.

Homogeneity of Participants: The age range of the participant group was kept narrow and consisted of healthy individuals between the ages of 18-24. The fact that individuals with different age groups or physiological characteristics were not included may limit the validity of the results for all age groups. Factors that may affect balance due to aging were also not taken into account.

2.7. Analysis and Evaluation of Data

The statistical analyses of the study were performed using the "Statistical Package for Social Sciences" (SPSS) version 21.0 (SPSS Inc., Chicago, IL, USA) software. Categorical variables were recorded in centimeters. The data were initially analyzed using the One-Sample Kolmogorov-Smirnov test. It was determined that the data followed a normal distribution, and thus, the Paired Samples Test was applied. The data were normally distributed. Statistical significance was defined as a p-value < 0.05.

3. Results

The study comprised 11 male participants (28.97%) and 27 female participants (71.06%). The age, height, weight, and body mass index (BMI) of the participants are presented in Table 1.

Table 1. Descriptive statistics of the participants

	Mean	SD ±
Age	22	1.91
Height(cm)	168.15	9.72
Weight	61.71	13.67
Body Mass Index	21.72	3.86

S= Standard Deviation

The mean results of dynamic balance measurements conducted with the balance device and the analysis results of the differences between pre and post-teeth clenching are presented in Table 2. There was no significant difference found between pre and post-teeth clenching in all directions ($p > 0.05$).

Table 2. Comparison of participants' dynamic balance values before and after teeth clenching

	Mean ± SD		Paired Samples Test
	Without CT	**With CT**	**p-value**
Forward Sway	5.24±1.13	5.11±1.24	0.36
Backwords Sway	5.19±1.09	5.21±1.22	0.83
Left Sway	5.09±1.07	5.08±1.18	0.96
Right Sway	5.93±1.27	5.78±1.40	0.33

SD=Standard Deviation, CT= Clenching Teeth

4. Discussion

This study investigated the impact of teeth clenching on balance. While there are studies evaluating different physical performance characteristics, research specifically examining the effect of teeth clenching on balance performance is limited. It is thought that teeth clenching may have negative effects on balance control, but the exact mechanism of this relationship has not been fully understood yet.

In a study conducted on healthy participants (Nakamura et al., 2017), the effect of teeth clenching on dynamic balance and jump-landing performance was examined. Masseter activity was measured using surface electromyography (EMG), and balance performance was assessed using a force platform. The results indicated an association between masseter muscle EMG activity and the change in the center of gravity, as well as differences in the change in the center of gravity between teeth clenchers and non-clenchers. These findings are not consistent with the results of the current study. However, there are methodological differences between the two studies. In that study, balance performance was evaluated through single-leg jump activities, whereas in this study, balance on two feet was assessed using a balance device. To ensure that participant-specific differences did not affect the results, measurements were taken from the same participants both with and without teeth clenching in the current study. The lack of difference may be attributed to the fact that participants were healthy individuals without any problems related to teeth clenching and balance.

Another study focused on the relationship between musculoskeletal disorders (MSDs) and bruxism investigating the association between bruxism and MSDs, as well as between bruxism and tooth wear (TW) (Mainjot et al., 2023). Both MSDs and bruxism have been linked to specific clinical conditions. Unlike the current study, balance measurements were not conducted in this study. In this research, the

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presence of MSDs increased fivefold in individuals diagnosed with bruxism. This indicates that the presence of bruxism indirectly affects the musculoskeletal system. Consequently, in the current study, it was also considered that this connection could affect balance. However, while individuals diagnosed with bruxism were considered in this study, the focus was on teeth clenching performance rather than bruxism itself. The difference in the included individuals may also influence the balance results.

Another study (Alghadir et al., 2022) examined the effects of different jaw positions on postural stability in visually impaired individuals and concluded that people with blindness behave in the same way as sighted subjects on firm and foam surfaces. However, changes in static and dynamic jaw positions do not affect postural stability among them. These results are also consistent with the current study, where jaw positions do not change balance scores in groups with no known balance loss.

In a pilot study examining the effects of masseter muscle activity on athletes' performance and balance (Nukaga et al., 2016), it was reported that there is a relationship between masseter muscle activity in athletes and sports performance as well as balance. The study involved short sprints (5 males), javelin throwing (4 males, 2 females), shot put (2 males, 2 females), long jump (5 males), and high jump. The WEB-7000 Multi-Channel Telemetry System (Nihon Kohden, Japan) was used to monitor muscle activity, and electromyograms of bilateral masseter muscles were measured during and after all activities. Balance measurements were taken by tracking deviations in activity position changes. Valid and reliable devices yielding accurate results were used in the study; however, in the current study, the masseter muscle was manually tested and not measured with EMG. This may have overlooked minimal changes in masseter muscle activity. In the current study, dynamic balance was measured along with the balance device. The differences in methods may have influenced the results based on the difficulty or ease of activities. There were also other muscles measured with EMG in the study, indicating that we should consider not only the masseter muscle but all muscles collectively affecting balance.

In a study investigating the effects of different jaw positions on dynamic balance using the Y balance test (Zafar et al., 2020), 80 healthy male participants aged 20-35 were included. Dynamic balance tests were measured in the relaxed, open, and clenching positions of the jaw. This study shares similarities with the current study in terms of its objective. Additionally, selecting only male participants in this study to avoid gender differences has strengthened the clarity of the results. No significant difference was found in the evaluation during teeth clenching, which aligns with similar findings in the current study. While various studies have demonstrated the direct or indirect effects of the jaw sensory-motor system on static postural control, the results of this study suggest a limited relationship with dynamic postural control in healthy individuals.

5. Conclusion

In the healthy population, no immediate effect of teeth clenching on balance was found. Future studies incorporating longer-term measurements, varied age groups, and participants with bruxism or temporomandibular dysfunction (TMD) could provide a broader understanding of the relationship between jaw muscle activity and dynamic balance. Expanding the scope of research to include different populations and more precise assessment methods may yield more definitive insights into this complex relationship.

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Authors Contributions

Selection of topic: ESA; Design: ESA, EDO; Planning: ESA,EDO; Data collection and analysis: ESA,EDO; Writing the article: ESA,EDO; Critical review: ESA**.**

Conflict of Interest

All authors report no conflict of interest.

References

Alghadir, A. H., Zafar, H., Ahmed Iqbal, Z., Anwer, S., & Iqbal, A. (2022). Effect of static and dynamic jaw positions on postural stability among people with blindness. Brain and behavior, 12(9), e2645. https://doi.org/10.1002/brb3.2645

Brocard, D., Laluque, J. F., & Knellesen, C. (2008). La gestion du bruxisme. Quintessence international.

Fam, A. G., Lawry, G. V., & Kreder, H. J. (2006). Musculoskeletal examination and joint injection techniques. Mosby.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behav Res Methods*, 41(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Garofolini, A., & Svanera, D. (2019). Fascial organisation of motor synergies: a hypothesis. *Eur J Transl Myol*, 29(3), 8313. https://doi.org/10.4081/ejtm.2019.8313

Gangloff, P., Louis, J. P., & Perrin, P. P. (2000). Dental occlusion modifies gaze and posture stabilization in human subjects. *Neurosci Lett*, 293(3), 203–206. https://doi.org/10.1016/s0304-3940(00)01528-7

Hesse, J. R., & Hansson, T. L. (1988). Factors influencing joint mobility in general and in particular respect of the craniomandibular articulation: a literature review. *J Orofac Pain*, 2(1), 19–28.

Hooks TR. (2012) Temporomandibular Joint, Editor(s): James R. Andrews, Gary L. Harrelson, Kevin E. Wilk, Physical Rehabilitation of the Injured Athlete (Fourth Edition). (Pages 282-305) W.B. Saunders.

Liem, T. (2002). The mandible and temporomandibular joınt. Editor: Liem T. Cranial Osteopathy (p 291-436) Churchill Livingstone.

Lobbezoo, F., Ahlberg, J., Glaros, A. G., Kato, T., Koyano, K., Lavigne, G. J., … Winocur, E. (2013). Bruxism defined and graded: an international consensus. *J Oral Rehabil*, 40(1), 2–4. https://doi.org/10.1111/joor.12011

Mainjot, A. K., Oudkerk, J., Bekaert, S., Dardenne, N., Streel, S., Koenig, V., … Bruyère, O. (2023). Bruxism as a new risk factor of musculo-skeletal disorders?. *J Dent*, 135, 104555. https://doi.org/10.1016/j.jdent.2023.104555

Manfredini, D., Fabbri, A., Peretta, R., Guarda-Nardini, L., & Lobbezoo, F. (2011). Influence of psychological symptoms on home-recorded sleep-time masticatory muscle activity in healthy subjects. *J Oral Rehabil*, 38(12), 902–911. https://doi.org/10.1111/j.1365-2842.2011.02226.x

Moore, K. L., & Dalley, A. F. (2018). Clinically Oriented Anatomy. Wolters Kluwer India Pvt Ltd.

Nakamura, T., Yoshida, Y., Churei, H., Aizawa, J., Hirohata, K., Ohmi, T., … Yagishita, K. (2017). The Effect of Teeth Clenching on Dynamic Balance at Jump-Landing: A Pilot Study. *J Appl Biomech*, 33(3), 211–215. https://doi.org/10.1123/jab.2016-0137

Nukaga, H., Takeda, T., Nakajima, K., Narimatsu, K., Ozawa, T., Ishigami, K., & Funato, K. (2016). Masseter Muscle Activity in Track and Field Athletes: A Pilot Study. *Open Dent J*, 10, 474–485. https://doi.org/10.2174/1874210601610010474

* Corresponding author: emreserdar.atalay@sbu.edu.tr

DOI: 10.56061/fbujohs.1552397
ORIGINAL ARTICLE

Ogasawara, Y., Yakabi, A., & Kubo, A. (2022). Effects of truncal taping on center of gravity sway: comparison of different trunk muscle masses. *J Phys Ther Sci*, 34(4), 252–256. https://doi.org/10.1589/jpts.34.252

Siegrist, M., Schaller, N., Weiß, M., Isaak, J., Schmid, V., Köppel, E., … Halle, M. (2023). Study protocol of a cluster-randomised controlled trial assessing a multimodal machine-based exercise training programme in senior care facilities over 6 months - the bestform study (best function of range of motion). *BMC Geriatr*, 23(1), 505. https://doi.org/10.1186/s12877-023-04176-7

Tuncer, A. B., Ergun, N., Tuncer, A. H., & Karahan, S. (2013). Effectiveness of manual therapy and home physical therapy in patients with temporomandibular disorders: A randomized controlled trial. *J Bodyw Mov Ther*, 17(3), 302–308. https://doi.org/10.1016/j.jbmt.2012.10.006

Zafar, H., Alghadir, A. H., Iqbal, Z. A., Iqbal, A., Anwer, S., & Alnahdi, A. H. (2020). Influence of different jaw positions on dynamic balance using Y-balance test. *Brain Behav,* 10(1), e01507. https://doi.org/10.1002/brb3.1507

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