CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
https://cajmns.centralasianstudies.org/index.php/CAJMNS
Volume: 07 Issue: 03 | July 2026 ISSN: 2660-4159

Article

The Effect of Electronic Axiography on Occlusal Parameters and the Stability of Dental Implants in the Prosthetic Treatment of Patients with Complete Edentulism

Nabiyev Kozim Abdumazhidovich[1], Khabilov Nigmon Lukmonovich[2]

1. Assistant, Department of Hospital Orthopedic Dentistry, Tashkent State Medical University, Uzbekistan
2. Professor, Department of Faculty Orthopedic Dentistry, Tashkent State Medical University, Uzbekistan

Abstract: The use of electronic axiography in the prosthetic treatment of patients with complete edentulism ensures the formation of a more balanced occlusion with significantly lower occlusal time and disclusion time values. Implant stability indicators in the axiography group show a trend towards a more uniform distribution of functional loads.

Keywords: Complete Edentulism, Dental Implants, Electronic Axiography, Occlusal Time, Disclusion Time, Periotestometry, T-Scan, Centric Relation.

Citation: Abdumazhidovich N. K., Lukmonovich K. N. The Effect of Electronic Axiography on Occlusal Parameters and the Stability of Dental Implants in the Prosthetic Treatment of Patients with Complete Edentulism. Central Asian Journal of Medical and Natural Science 2026, 7(3), 116-120.

Received: 21st Feb 2026
Revised: 23rd Mar 2026
Accepted: 21st Apr 2026
Published: 13th May 2026

1. Introduction

Prosthetic rehabilitation of patients with complete absence of teeth using dental implants is one of the most effective and scientifically-backed treatment methods, making it possible to restore chewing function, aesthetics, and patients' quality of life [1], [2]. However, the long-term success of implant-supported prosthetics is determined not only by the quality of osseointegration but also by the precision of establishing occlusal relationships, which directly affect the distribution of functional loads within the "prosthesis-implant-bone tissue" system [3], [4].

With complete edentulism, natural occlusal landmarks are lost, which makes the process of determining the centric relation of the jaws dependent on the methodology used and the clinician's experience [5]. Traditional approaches to recording intermaxillary relationships using wax bases have a significant degree of subjectivity and limited reproducibility [6]. An unbalanced occlusion and premature contacts can provoke bone resorption in the peri-implant area, loosening of prosthetic components, and the development of temporomandibular joint dysfunction [7], [8].

Electronic axiography - a method of three-dimensional registration of the movement trajectories of the temporomandibular joints - allows for the objectification of the process of determining individual articulation parameters and ensures personalized tuning of the articulator [9], [10]. Modern systems, such as SDI Matrix, allow for recording spatial movements of the lower jaw with an accuracy of up to 0.1 mm and automatically calculating the parameters of joint pathways [11]. However, systematic clinical studies comprehensively assessing the impact of axiography on objective functional indicators in various types of implant structures are insufficiently presented in available literature.

To objectively assess the occlusion being formed, the T-Scan computer system is being increasingly used, allowing for the registration of occlusion time, disconnection time, and the sequence of contact formation [12]. According to Kerstein R.B. et al., the normal occlusion time should not exceed 0.2 seconds, and the disconnection time should be 0.4 seconds [13]. Exceeding these values is associated with an increased risk of overloading of support structures and the development of pain disorder in the CNS [14].

The aim of the study was to evaluate the influence of electronic axiography on dental implant stability indicators and occlusion parameters during the orthopedic treatment of patients with complete adentia using various types of structures supported by implants.

2. Materials and Methods

The clinical study was conducted at the Department of Hospital Orthopedic Dentistry of Tashkent State Medical University between 2025 and 2026. The study was conducted in accordance with the principles of the Helsinki Declaration; all patients signed an informed consent form.

The study included 87 patients (47 men, 40 women) aged 18 to 65 with a diagnosis of complete tooth absence (K08.1), for whom the manufacture of orthopedic structures based on dental implants was planned. Inclusion criteria: presence of informed consent, sufficient volume and density of bone tissue for implant placement, absence of severe somatic pathology in the decompensation stage. Exclusion criteria: CNS diseases, oncological diseases, mental disorders, active tobacco smoking (>20 cigarettes/day).

Patients were divided into two groups using a random sampling method. Group 1 (n=44) - orthopedic treatment without axiography: subgroup 1A (n=15) - removable prostheses with 4 implants, subgroup 1B (n=14) - conditionally removable prostheses with 6 implants, subgroup 1C (n=15) - non-removable prostheses with 8 implants. Group 2 (n=43) - treatment using electronic axiography: subgroup 2A (n=16), subgroup 2B (n=12), subgroup 2C (n=15) with similar types of structures. A total of 648 implants were installed (332 on the upper jaw and 316 on the lower jaw).

The registration of mandibular movements in Group 2 was performed using the SDI Matrix electronic axiograph (Russia). Protructive and laterotructive movements were recorded; the data were exported to the software to calculate the parameters of individual articulation adjustment (joint tilt angle, Bennett angle, ISS lateral mobility).

The stability of dental implants was assessed using the Periotest M device (Medizintechnik Gulden, Germany) on the day the structure was fixed, and after 3, 6, and 12 months. Interpretation: from -8 to 0 - good osteointegration; from +1 to +9 - insufficient; from +10 to +50 - unsatisfactory.

Computer analysis of occlusion was conducted using the T-Scan III system (Tekscan Inc., USA) 1, 3, 6, and 12 months after fixation of the structures. Occlusion time (OT), protrusion separation time (DT-P), left laterotrusion (DT-LL), and right laterotrusion (DT-RL) were evaluated.

Statistical processing was performed in IBM SPSS Statistics v.26. M±SD, median, 95% CI were calculated. Student's t-test was used to compare related samples, and the t-test for unrelated samples was used for independent samples. Intergroup differences within subgroups were assessed using one-factor variance analysis (ANOVA). Differences were considered significant at $p<0.05$.

3. Results

The average values of periodotestometry on the day the structures were fixed were comparable between groups and subgroups. During the 12 months of observation, a gradual increase in Periotest M values was recorded in all subgroups, not exceeding the range of good osteointegration (Table 1). 1).

Table 1. Dynamics of Periotest indicators M (M±SD, cond. units).

Subgroup	Day of recording	3 months	6 months	12 months	Δ (0–12 months)
Subgroup 1A (n=15)	–3,35±1,01	–3,22±1,01	–3,14±1,00	–3,02±0,98	0,33
Subgroup 2A (n=16)	–3,48±1,03	–3,37±1,03	–3,32±1,03	–3,28±1,04	0,20
p (1A vs 2A)		p=0,341	p=0,288	p=0,118	
Subgroup 1B (n=14)	–3,40±1,04	–3,30±1,04	–3,22±1,03	–3,13±1,03	0,27
Subgroup 2B (n=12)	–3,41±1,07	–3,32±1,08	–3,26±1,07	–3,20±1,08	0,21
p (1B vs 2B)		p=0,832	p=0,778	p=0,574	
Subgroup 1C (n=15)	–3,57±1,19	–3,46±1,18	–3,39±1,18	–3,27±1,17	0,30
Subgroup 2C (n=15)	–3,60±1,07	–3,53±1,07	–3,47±1,07	–3,42±1,06	0,18
p (1C vs 2C)		p=0,561	p=0,458	p=0,206	

Note: Δ is the absolute difference between the values on the day of recording and 12 months later. Paired t-test: p<0.05 for all subgroups when comparing 0 and 12 months. ANOVA within groups: p>0.05.

In Group 2, the absolute increase in Periotest M values over 12 months was 0.18–0.21 cond. units, while in Group 1, it was 0.27–0.33 cond. units. The smallest dynamics were recorded in subgroup 2C (non-removable constructions with axiography): Δ=0.18 cond. units. However, intergroup differences did not reach statistical significance at any of the observation periods (p>0.05).

Computed analysis of occlusion indicators

The results of the occlusion analysis using T-Scan III revealed significant differences between groups across all studied parameters (Table. 2).

Table 2. Occlusion time indicators (M±SD, s).

Subgroup	Day of recording	3 months	6 months	12 months	Δ (0–12 months)
Subgroup 1A (n=15)	0,502±0,04	0,511±0,04	0,522±0,04	0,530±0,04	p<0,05
Subgroup 2A (n=16)	0,399±0,04	0,406±0,04	0,410±0,03	0,417±0,04	p<0,05
p (1A vs 2A)	p<0,05	p<0,05	p<0,05	p<0,05	
Subgroup 1B (n=14)	0,394±0,04	0,399±0,04	0,410±0,03	0,415±0,03	p<0,05
Subgroup 2B (n=12)	0,321±0,03	0,324±0,03	0,326±0,03	0,330±0,03	p<0,05
p (1B vs 2B)	p<0,05	p<0,05	p<0,05	p<0,05	
Subgroup 1C (n=15)	0,287±0,03	0,294±0,02	0,297±0,02	0,302±0,02	p<0,05
Subgroup 2C (n=15)	0,281±0,03	0,284±0,03	0,289±0,03	0,292±0,03	p<0,05
p (1C vs 2C)	p>0,05	p>0,05	p>0,05	p>0,05	

In all subgroups of Group 2, the occlusion time and separation time were lower, and their increase over 12 months was less intensive compared to Group 1. Occlusion time indicators in subgroups A and B had significant intergroup differences across all observation periods (p<0.05). In subgroups C, differences in occlusion time did not reach the threshold of significance (p>0.05), but for all indicators of separation time, they were significant (p<0.05).

In group 2, a practically complete symmetry of left and right laterotruia indicators was noted: after 12 months, the values coincided in all subgroups (0.556 s in subgroup 2A, 0.522 s in subgroup 2B, 0.482 s in subgroup 2C). In Group 1, insignificant but stable asymmetries between the right and left sides were recorded.

4. Discussion

The results of this study demonstrate that the application of electronic axiography in the prosthetics of patients with complete adentia on dental implants has a significant positive impact on the quality of the formed occlusive relationships and, indirectly, on the stability of the implants.

The gradual increase in Periotest M values during the first year of observation, recorded in all subgroups, reflects the physiological processes of bone tissue remodeling after the functional load of the implants. This trend aligns with the classic data from Adell R. et al. (1981), which described an average loss of 1.2 mm of sacral bone in the first year and 0.1 mm annually in subsequent years. The less intensive dynamics of indicator increase in the axiography group (Δ=0.18–0.21 cond. units) compared to the control group (Δ=0.27–0.33 cond. units) may indicate a more even distribution of occlusive loads when individualizing mandibular movement parameters, although these differences did not reach statistical significance [15].

The absence of significant intergroup differences in Periotest M indicators may be due to the limited sample size and relatively short observation period (12 months). Similar results were obtained in the work of Panahov N.A. and Mahmudov T.G. (2018), where the increase in periodostometry values during the first year ranged from 1.49 to 1.78 cond. units under various implantation protocols. In our study, the magnitude of changes was significantly lower, which may be due to more thorough occlusion control using the T-Scan III system.

In all subgroups of Group 2, the occlusion time and separation time were lower, and their increase over 12 months was less intensive compared to Group 1. Occlusion time indicators in subgroups A and B had significant intergroup differences across all observation periods ($p<0.05$). In subgroups C, differences in occlusion time did not reach the threshold of significance ($p>0.05$), but for all indicators of separation time, they were significant ($p<0.05$).

In group 2, a practically complete symmetry of left and right laterotruia indicators was noted: after 12 months, the values coincided in all subgroups (0.556 s in subgroup 2A, 0.522 s in subgroup 2B, 0.482 s in subgroup 2C). In Group 1, insignificant but stable asymmetries between the right and left sides were recorded.

The limitations of this study are: the relatively small size of the subgroups (12-16 patients), the 12-month observation period, and the absence of a blind design. To confirm the identified trends regarding implant stability, multicenter randomized studies with a longer observation period are required.

5. Conclusion

The application of electronic axiography in the orthopedic treatment of patients with complete adentia with dental implant structures ensures the formation of significantly more balanced occlusion, characterized by lower values of occlusion time and separation time, as well as pronounced symmetry of occlusion contacts during lateral excursions. Dental implant stability indicators in the axiography group demonstrate a less intensive increase in Periotest M values, which may indicate a more even distribution of functional loads. The best functional results across all criteria were achieved with non-removable prosthetics using electronic axiography. The obtained data justify the feasibility of including electronic axiography in the orthopedic treatment protocol for patients with complete adentia.

REFERENCES

[1] D. V. Verstakov, K. A. Dyatlenko, E. V. Danilina, D. V. Mikhalchenko, and T. F. Danilina, "Modern aspects of restoring short-range dental series defects," *Volgograd Scientific and Medical Journal*, no. 1, p. 58, 2013.

[2] R. Sh. Gvetadze, E. K. Krechina, Yu. Yu. Shirokov, V. G. Solodkiy, D. V. Solodkaya, and Yu. E. Shirokov, "Immediate load during orthopedic treatment using dental implants," *Clinical Dentistry*, no. 4, pp. 50–54, 2015.

[3] C. A. Freiria de Oliveira *et al*., "Antimicrobial activity of cleansers on the cobalt-chromium surface of removable partial dentures: A systematic review," *Biofouling*, vol. 39, no. 9–10, pp. 916–927, 2023.

[4] V. G. Morelli *et al*., "Effect of effervescent tablets on removable partial denture hygiene," *American Journal of Dentistry*, vol. 36, no. 2, pp. 75–80, 2023.

[5] M. E. McRory and D. R. Cagna, "A technique for manufacturing single screw-retained implant-supported interim crowns in conjunction with implant surgery," *The Journal of Prosthetic Dentistry*, vol. 111, no. 6, pp. 455–459, 2014.

[6] R. F. de Souza *et al*., "Efficiency of a propolis solution for cleaning complete dentures," *American Journal of Dentistry*, vol. 32, no. 6, pp. 306–310, 2019.

[7] S. S. Rublenko, S. V. Kungurov, and N. P. Osipova, "Influence of removable orthopedic structures on the quantitative composition of oral microflora," *Siberian Medical Review*, no. 3, pp. 43–47, 2010.

[8] R. V. Ushakov, G. R. Khurkhurov, A. R. Ushakov, and Kh. R. Dautov, "Use of Bonetrust Plus dental implants during direct dental implantation and immediate loading," *Dental Implantology and Surgery*, no. 2, p. 22, 2013.

[9] B. J. Goodacre and C. J. Goodacre, "Additive manufacturing for complete denture fabrication: A narrative review," *Journal of Prosthodontics*, vol. 31, no. S1, pp. 47–51, 2022.

[10] A. A. Kosimov and B. N. Khabilov, "Evaluation of the effectiveness of using digital technologies in orthopedic treatment with removable structures," *Integrative Dentistry and Maxillofacial Surgery*, vol. 4, no. 2(10), pp. 70–76, 2025.

[11] O. R. Salimov, B. G. Raximov, and A. A. Kosimov, "Modern aspects of patient adaptation to removable dentures (literature review)," *World Bulletin of Public Health*, vol. 16, pp. 21–26, 2022.

[12] Zh. Sh. Tulyaganov, M. R. Mirrakhimova, and A. A. Kosimov, "Assessment of the quality and effectiveness of removable prostheses in patients with complete adentia," *Eurasian Journal of Medical and Natural Sciences*, vol. 2, no. 6, pp. 477–481, 2022.

[13] B. N. Khabilov *et al*., "Clinical and biochemical characteristics of the adaptation of patients with complete adention to removable plastic protheses," *Central Asian Research Journal for Interdisciplinary Studies (CARJIS)*, vol. 4, no. 6, pp. 1033–1038, 2025.

[14] A. A. Kosimov and B. N. Khabilov, "Assessment of the effectiveness of using digital technologies in orthopedic treatment with removable structures," *Integrative Dentistry and Maxillofacial Surgery*, vol. 4, no. 2(10), pp. 70–76, 2025.

[15] J. P. Okeson, *Management of Temporomandibular Disorders and Occlusion*, 8th ed. St. Louis, MO, USA: Elsevier, 2020.