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MECHANICAL COMPLICATIONS OF DENTAL IMPLANTS WITH BRUXER PATIENTS IN THE POSTERIOR MANDIBULAR AREA

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დავით ხიტირი, მარიამ ხიტირი, ვლადიმერ მარგველაშვილი

ქვედა ყბის უკანა მიდამოში დენტალური იმპლანტების მექანიკური გართულებები ბრუქსიზმით დაავადებულ პაციენტებში

ივანე ჯავახიშვილის თბილისის სახელმწიფო უნივერსიტეტი, თბილისი, საქართველო

რეზიუმე

ბრუქსიზმით დაავადებულ პაციენტებში, ქვედა ყბის უკანა მიდამოს კბილები (განსაკუთრებით მოლარები) განიცდიან ჭარბ ვერტიკალურ და გვერდით დატვირთვას ღეჭვის დროს. აღნიშნულ კბილებს უმნიშვნელოვანესი როლი ენიჭებათ ღეჭვის პროცესში ძალების სწორად გადანაწილებაში. ქვედა ყბის უკანა ნაწილში ძვლის სიმკვრივე შედარებით მეტია, ვიდრე ზედა ყბის ანალოგიურ ნაწილში, თუმცა ხშირად სწორედ ქვედა ყბის უკანა მიდამოს კბილები გახლავთ დაზიანების სამიზნე ბრუქსიზმით დაავადებულ ადამიანებში. ჩვენს მიერ საკუთარ პაციენტებზე წარმოებულმა კვლევამ, რომელიც 6 წლის განმავლობაში მიმდინარეობდა, აჩვენა, რომ ბრუქსიზმის მქონე პაციენტებში დენტალური იმპლანტაციის შემდეგ მექანიკური გართულებები მნიშვნელოვნად მეტია, ვიდრე იმ პაციენტებში, რომლებიც ამ პრობლემას არ განიცდიან. გართულებები მოიცავდა კერამიკის ფრაგმენტაციას, პროთეზების შესუსტებას, ფიქსაციის წერტილების დაზიანებას და იმპლანტის სხვადასხვა ნაწილების მწყობრიდან გამოსვლას. მიუხედავად ამისა, ბრუქსიზმი არ წარმოადგენს დენტალური იმპლანტაციის უკუჩვენებას, თუმცა ყურადღება უნდა გამახვილდეს იმპლანტების სწორ რაოდენობასა და პოზიციონირებაზე, ასევე კონსტრუქციების სწორად შერჩევასა და კონსოლების თავიდან არიდებაზე.

Introduction: Bruxism involves the grinding and clenching of teeth, which can lead to increase stress on the dental structures. It is typically more common and severe during sleep, but can also occur during daytime. Exacerbations is sometimes related to stressfull events [1,2,3]. In patients with bruxism, posterior mandibular teeth in dental arches, specifically molars, are under the influence of excessive vertical and lateral forces. These posterior mandibular teeth (molars, premolars) have important role in occlusion and force distribution during mastication [4,5]. In bruxers, these teeth experience higher occlusal forces. The posterior portion of the mandible has more alveolar bone density than the same part of the maxilla, but it can still be affected by extra forces. Posterior mandibular region is so close to critical structures such as the inferior alveolar nerve, which requires careful planning during implant placement. Dental implants have multiple complications, that may be divided into two main subgroups: mechanical and biological. During the our own research we studied mechanical complications after dental implantation in bruxer patients in the posterior mandibular region [2-4].

Research goal and Methods: Study Type was Prospective observational study with a 6-year follow-up period. A total of 72 patients (40 females, 32 males) who were diagnosed with bruxism (51 with night bruxism and 21 with both day and night bruxism). All patients had defects in the 3rd and 4th quadrants of the posterior mandibular region. The study also included a control group consisting of 30 non-bruxer patients who had similar defects in the posterior mandibular region.

Inclusion Criteria:

1. Patients with bruxism (night and/or day).
2. Patients requiring dental implants for defects in the posterior mandibular region.
3. No prior bone augmentation or other significant dental procedures that could affect implant placement.

Exclusion Criteria:

1. Severe systemic conditions contraindicating dental implantation.
2. Insufficient bone volume requiring bone grafting.

Orthopedic Construction. The prosthetic restorations were non-removable, fixed with metal structures, and covered with zirconium dioxide crowns or bridges. The number of implants placed per patient varied: 1 Implant: 36 cases; 2 Implants: 82 cases; 3 Implants: 132 cases; 4 Implants: 68 cases. Bone augmentation procedures (e.g., bone grafting, sinus lifts) were not performed in any of the patients.

Implant Placement. Grade 4 titanium implants (diameter: 3.75–4.1 mm; length: 8–11.5 cm) were used in all patients. A two-step surgery was performed: First stage was Incision and flap formation for implant placement and the Second stage was itself Implant placement. The orthopedic constructions were divided into several groups based on their configuration and support:

1. Single Crown: One implant supporting a single crown.
2. Connected Crowns: Multiple crowns connected to one another.
3. Bridges without Cantilevers: Fixed bridges supported by implants without the use of any cantilevered elements (no distal or medial extensions).
4. Bridges with Distal Cantilevers: Fixed bridges with distal cantilever extensions (extensions from the last implant).
5. Bridges with Medial Cantilevers: Fixed bridges with cantilever extensions at the middle (medial) of the bridge.

Observation and Follow-up. Patients were monitored for 6 years after implant placement. All patients underwent regular follow-up examinations in every 3-4 months. This included Clinical Examination - Physical assessments to check for signs of implant mobility, peri-implantitis, or any other clinical issues. Also Radiographic Evaluation: X-ray imaging was performed regularly to evaluate bone status, implant positioning, and the condition of the surrounding tissues. Data about mechanical complications were collected and statistically studied.

Mechanical Complications after dental implantation:

- Ceramic Fracture - This refers to the fracture of the ceramic material used for the crowns or bridges, which may occur due to excessive occlusal forces, improper loading, or material losing over time [7].
- Prosthetic Relaxation: This can be referred to as prosthetic loosening or settling. It indicates a loss of retention or tension in the connection between the implant abutment and the prosthetic restoration (crown or bridge), leading to instability or misalignment of the prosthesis [15-18].
- Damage to Retention Points: This is the failure of the fixation elements or retention screws securing the prosthetic to the implant. This may include screw loosening, fracture, or wear at the interface between the abutment and the prosthetic restoration [19].
- Implant Neck Fracture: This refers to the fracture of the implant neck, which is the portion of the implant that connects to the abutment. This may occur due to excessive mechanical loading, poor implant positioning, or fatigue over time [20].

- Implant Body Fracture: This indicates a fracture or rupture of the main body of the implant itself. It can result from overloading, material defects, or the progressive breakdown of the implant due to bruxism or excessive occlusal forces.

Study Results. During the study we observed multiple mechanical complications:

1. Ceramic Fracture: A total of 59 cases of ceramic fracture were observed during the follow-up period. The fractures primarily affected the zirconium dioxide-based restorations. Zirconium dioxide constructions are generally more resistant to fracture; however, when fractures did occur, they were typically manageable with simple cleaning and repair procedures.
2. Prosthetic Fractures (Bridge or Crown): 13 cases of crown or bridge fractures were recorded, with fractures occurring typically between 6 months and 2 years post-implantation. In these instances, the affected prosthetic elements were replaced, as they could not be repaired effectively. In 8 cases, the number of implants was increased to enhance the stability and retention points, especially in the case of distal cantilevered bridges, and this strategy was found to be effective in preventing further complications.
3. Prosthetic Loosening (Softening): 43 cases of prosthetic softening were reported throughout the study. This refers to loosening or settling of the crowns or bridges, which was observed during routine visits. The patients underwent frequent follow-up visits (3-4 per month), allowing early detection and management of these issues. In most cases, the loosening was corrected by tightening the retention screws or minor adjustments to the prosthesis.
4. Fixation Screw Damage: 17 cases of damage to fixation screws were observed, typically occurring after 2 years of implant placement. The damage included screw loosening, fracture, or wear, primarily due to excessive occlusal forces and repetitive loading. This complication necessitated replacement of the damaged screws and adjustments to the prosthetic components.
5. Implant Neck Fracture: An implant neck fracture was reported in 8 cases. The primary cause of this complication was delayed referral to the clinic, where signs of implant failure or instability were not addressed in a timely manner. Among these cases, 4 occurred in patients with single implants, and 4 cases were associated with two-implant restorations with distal cantilevers, where the fracture was confined to the distal implant. These complications typically arose after 3-4 years of function and required implant replacement along with the construction of a new prosthesis without cantilever extensions.
6. Implant Body Fracture: A rare implant body fracture occurred in 1 case. This was attributed to an imbalance in the implant-abutment ratio, where the implant length (8 mm) was insufficient for the required prosthetic height (13 mm). The low bone height also contributed to an inadequate foundation for the implant, resulting in excessive stress on the implant body. This complication emerged 3 years post-implantation and required implant replacement and the fabrication of a new, properly sized prosthesis.

The rate of mechanical complications was significantly higher in bruxer patients compared to non-bruxer control patients, indicating that bruxism is a significant risk factor for implant and prosthetic failure. The complications observed in bruxer patients and the corresponding incidence in non-bruxers are as follows: Ceramic Fracture: 18.5% in bruxers vs. 7% in non-bruxers. Bruxism-induced para-functional movements lead to increased wear and fracture risk in ceramic materials. Crown or Bridge Fracture: 4% in bruxers vs. 2% in non-bruxers. The increased masticatory forces in bruxer patients result in higher mechanical stress on prosthetic components, leading to an elevated fracture rate.

Prosthetic Loosening (Softening of Bridge or Crown): 13.5% in bruxers vs. 6.2% in non-bruxers. Repetitive occlusal loading in bruxers contributes to the loosening of retention screws and the settling of prostheses. Screw Damage: 5.3% in bruxers vs. 1.8% in non-bruxers. Bruxism leads to excessive forces on the fixation screws, causing loosening, fracture, or wear, which is less common in non-bruxer patients. Implant Neck Fracture: 2.5% in bruxers vs. 0.5% in non-bruxers. The delayed referral in bruxer patients often results in unaddressed implant instability, leading to fractures at the implant neck, especially in cases with distal cantilevered prostheses. Implant Body Fracture: 0.3% in bruxers vs. 0.3% in non-bruxers. Though rare, implant body fractures were observed equally in both groups, with the underlying causes being implant-abutment ratio issues and inadequate bone support, particularly in cases with high prosthetic heights.

Result Analysis. One of the primary causes of mechanical complications was the non-vertical insertion of implants, particularly in relation to Wilson's line, which is perpendicular to the occlusal plane. Incorrect implant angulation can lead to increased stress on the implants and prosthetic components, especially in multi-implant restorations, where implant alignment plays a critical role in the distribution of occlusal forces.

Incorrect positioning was especially problematic in two-implant restorations supporting three-tooth bridges with medial or distal cantilevers. These restorations are more susceptible to mechanical failure if the implants are not placed in an optimal position, as this can lead to uneven force distribution and increased stress concentration on the cantilevered components.

The fixation of a single crown on an independent implant was another factor that contributed to complications. Joined crowns (i.e., crowns connected to one another) proved to be more resistant to occlusal stresses in bruxer patients, likely due to their ability to distribute forces more evenly across multiple implants, as compared to single crowns which may experience localized stress.

The presence of oblique surfaces on the vestibular tubercles may also have contributed to the increased stress on the implant-restoration system. These surfaces can potentially increase resistance to occlusal forces, leading to a higher likelihood of mechanical failure over time.

Conclusion. Bruxism, while associated with an increased risk of mechanical complications, is not a contraindication for dental implant placement. In bruxer patients, careful attention to implant positioning, prosthetic design, and occlusal forces is essential to reduce the risk of complications. Based on the findings of this study, the following recommendations are made for optimal implant and prosthetic outcomes:

1. Implant Number and Placement: It is advisable to place an equal number of implants to match the number of defects, ensuring adequate distribution of occlusal forces. This approach provides better support and minimizes the risk of overloading individual implants.
2. Connected Prosthetic Constructions: Connected prosthetic constructions (e.g., multiple crowns joined together) are preferred over individual crowns, as they demonstrate greater resistance to the stresses encountered in bruxer patients. Joined crowns help in force distribution, reducing the likelihood of material fracture and loosening.
3. Avoidance of Cantilevered Prostheses: Prosthetic constructions without cantilevers are recommended, as the presence of distal or medial cantilevers can increase stress on the supporting implants, leading to higher complication rates. This approach enhances the stability and longevity of the prosthetic restoration.
4. Molars and Tubercle Considerations: The use of molars with less prominent vestibular tubercles is recommended, as these features provide increased resistance to occlusal forces and may reduce the risk of implant failure or fracture. By adhering to these principles, it is possible to achieve long-term success with

dental implants in bruxer patients, minimizing the risk of mechanical complications and improving overall treatment outcomes.

References:

1. F.Lobbezoo. J.E.I.G. Brouwers, M.S. Cune, M.Naeije. Dental implants in patients with bruxing habits. J Oral Rehabil. 2006 Feb; 33(2): 152-159. https://doi.org/10.1111/j1365-2842.2006.01542.x.
2. Lobbezoo F, Brouwers JE, Cune MS, Naeije M. Tandheelkundige implantaten bij bruxisten [Dental implants in tooth grinders]. Ned Tijdschr Tandheelkd. 2004 Mar;111(3):85-90. Dutch. PMID: 15058243.
3. Misch CE. The effect of bruxism on treatment planning for dental implants. Dent Today. 2002 Sep;21(9):76-81. PMID: 12271847.
4. Misch, Carl E. Consideration of biomechanical stress in treatment with dental implants. Dent Today. 2006 May; 25(5): 80, 82, 84-5. Quiz 85.
5. U. Brägger, S. Aeschlimann, W. Bürgin, C.H. Hämmerle, N.P. Lang. Biological and technical complications and failures with fixed partial dentures (FPD) on implants and teeth alter four to five years of function. "Clinical Onal Implants Res", 2001; 12:26-34.
6. A. Ekfeld, L.A. Johansson, S. Isaksson. Implant – supported overdenture therapy: a retrospective study "Int J. Prosthodont, 1997; 10:366-374.
7. A.Ekfeldt. U. Christiansson, T. Eriksson, U. Linden, S. Lundqvist, T. Runderants, et.al. A retrospective analysis of factors associated with multiple implant failures in maxillae. "Clin Oral Implants Res", 2001; 12: 462-467.
8. De Boever AL, Keersmaekers K, Vanmaele G, Kerschbaum T, et al.. Prosthetic complications in fixed endosseous implant-borne reconstructions after an observations period of at least 40 months. J Oral Rehabil. 2006 Nov;33(11):833-9. doi: 10.1111/j.1365-2842.2006.01638.x. PMID: 17002743.
9. Fichev A. Raiv R. Preclinics of prosthetic dentistry. Sofia, 2007: 7-16.
10. Bakke M. Halen B, Jensen Lietal. Unilateral isometric bite force in eght 68-year-old women and men retected to occlusal factors. Scand J. Dent Res. 1990:98:149-158.
11. Osbome J.W. Mao J. A. thin bite force transducer with three – dimensional capabilities. Archives of Oral Biology 1993:38:139-144.
12. Ortuġ G. A new device for measuring mastication force. Ann Anat 2002: 184:393-396.
13. Van Aken AA. De Baat C, Van Rossum G.M. et al. Prosthetic condition and satistacfaction with dentures. Ned. Tijdcher 1995:102:1:12-14.
14. K.Nishigawa, E. Bando, M.Nakano (Quantitive study of bite force during sleep associated bruxism) – Archives of Oral Biology. 2001. 20 december. 115:40-51.
15. Papi, P., DiCarlo, S. Meneio, F. Rosella, D. De Angelis, F. and Pompa G. (2017) Dental implants placed in patients with mechanical risk factors: A long – term follou-up retrospective study. Journal of International Society of Preventive and Community Dentistry, 7 (1): S48-51.
16. Chatopulos, G. Sand Wolff, L.F (2017) Symptoms of temporomandibular disorder, self reported bruxism, and risk of implant failure: A retrospective analysis. CRANIO 38(1): 50-57.
17. Coltro, M.P.L. OzKomur. A., Villarinho, E.A., Teixeira, E.R., Vigo, A., and ShinKai R.S. (2018). Risk factor model of mechanical complications in implant – supported fixed complete dentures: a prospective cohort study. Clinical Oral Implants Research, 20(9): 915-921.
18. Mangano, F.G., Shibli, J.A., Sammons, R.L., laculli, F., Piattelli A., and Mangano, C. (2014). Short (8mm) locking – taper implants supporting single crowns in posterior region: a prospective clinical study with 1- to 10-years of follou- up. Clinical Oral LaPlant Rescearch, 25(8): 933–940.
19. Tawil, G., Aboujaoude, N., and Younan, R. (2006) Influence of prostatic parameters on the survival and complication rates of short implants. International Journal of Oral and Maxilotacial Implants, 21(2): 275-282.

20. De Angelis F., Dapi P., Mencio F., Rosiella D., Di Carlo S., Pompa G (2017). Impant survival and success rates in patients with risk factors: results from a long – term retrospective study with a 10 to 18 years follow-up. "European Reviw for Medical and Pharmacological Science", 21(3): 433-437.
21. Chreanovic, B.R. Kish, J.Albrekrsson, T, Wennerberg, A. (2017). Bruxism and dental implant treatment complications: a retrospective comparative study of 98 bruxer patients and a matched group. Clinical oral implants research, 28(7): el-e9.
22. Azouzi I., Gassara Y, Nasri S., et al. (2023). Implant Supported Fixed Prostheses and Bruxism: An Overview. Scholars Journal of Dental Sciences. 10(11): 275-283.

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SUMMARY

In patients with bruxism, posterior mandibular teeth in dental arches, specifically molars, are under the influence of excessive vertical and lateral forces. These posterior mandibular teeth (molars, premolars) have important role in occlusion and force distribution during mastication. In bruxers, these teeth experience higher occlusal forces. The posterior portion of the mandible has more alveolar bone density than the same part of the maxilla, but it can still be affected by extra forces. Posterior mandibular region is so close to critical structures such as the inferior alveolar nerve, which requires careful planning during implant placement. Dental implants have multiple complications, that may be divided into two main subgroups: mechanical and biological. During the our own research we studied mechanical complications after dental implantation in bruxer patients in the posterior mandibular region. Bruxism, while associated with an increased risk of mechanical complications, is not a contraindication for dental implant placement. In bruxer patients, careful attention to implant positioning, prosthetic design, and occlusal forces is essential to reduce the risk of complications.

Keywords: dental implants, bruxer, posterior, mandibular, mechanical complications