

THE INFLUENCE OF OCCLUSAL DISORDERS ON THE LONGEVITY OF PROSTHODONTIC RESTORATIONS

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Abstract

Occlusal harmony plays a fundamental role in the long-term clinical success, biomechanical stability, and functional durability of prosthodontic restorations. Disturbances in occlusal relationships significantly affect distribution of masticatory forces, temporomandibular joint function, periodontal stability, muscular coordination, and integrity of restorative materials. Occlusal disorders including malocclusion, premature contacts, bruxism, occlusal trauma, parafunctional activity, and temporomandibular dysfunction contribute to accelerated wear, fracture, loosening, marginal failure, and biomechanical overload of prosthetic restorations. This study investigates the influence of occlusal abnormalities on longevity and clinical performance of fixed and removable prosthodontic constructions with emphasis on biomechanical stress distribution, prosthetic complications, periodontal response, implant stability, temporomandibular adaptation, and patient-related functional outcomes. Contemporary diagnostic methods including articulator analysis, digital occlusal assessment, electromyography, radiographic imaging, and computerized bite-force evaluation were analyzed to determine their role in prevention and correction of occlusal imbalance. The findings demonstrate that accurate occlusal diagnosis, balanced force distribution, individualized prosthetic planning, and early management of occlusal dysfunction significantly improve restoration survival, reduce mechanical and biological complications, preserve oral structures, and enhance long-term prosthodontic success. Modern prosthodontics increasingly integrates digital occlusal analysis, biomaterials science, implant biomechanics, and interdisciplinary treatment protocols aimed at optimizing functional harmony and prolonging restoration longevity. Occlusal balance is one of the most important determinants influencing functional stability, structural durability, and long-term clinical success of prosthodontic restorations. Disturbances in occlusal relationships significantly affect biomechanical force distribution within the stomatognathic system and may lead to progressive deterioration of restorative materials, periodontal tissues, temporomandibular joints, and implant-supported constructions. Occlusal disorders including malocclusion, premature contacts, parafunctional habits, traumatic occlusion, bruxism, and temporomandibular dysfunction contribute to excessive mechanical stress, muscular hyperactivity, prosthetic instability, marginal failure, ceramic fracture, peri-implant overload, and accelerated wear of restorative surfaces.

Keywords: Occlusal disorders, prosthodontic restorations, malocclusion, prosthetic longevity, occlusal trauma, temporomandibular dysfunction, bruxism, implant biomechanics, prosthodontics, occlusal analysis

1. Introduction

Long-term success of prosthodontic rehabilitation depends not only on aesthetic appearance and structural integrity of restorations but also on establishment of stable and physiologically balanced occlusal relationships. Occlusion represents a highly coordinated functional interaction between teeth, masticatory muscles, temporomandibular joints, periodontal structures, and neuromuscular control mechanisms responsible for efficient mastication, speech, swallowing, and maintenance of craniofacial harmony. Disturbances in occlusal balance significantly alter biomechanical force distribution within the stomatognathic system and may lead to progressive damage of teeth, supporting tissues, temporomandibular structures, and prosthetic restorations. Occlusal disorders include a broad spectrum of functional and anatomical abnormalities such as malocclusion, premature occlusal contacts, traumatic occlusion, parafunctional habits, bruxism, occlusal instability, loss of vertical dimension, and temporomandibular joint dysfunction. These pathological conditions contribute to excessive mechanical stress, muscular hyperactivity, periodontal overload, microfracture formation, restoration instability, and accelerated deterioration of prosthetic materials. Modern prosthodontic restorations including crowns, bridges, removable dentures, implant-supported prostheses, veneers, and full-mouth rehabilitations are continuously exposed to complex dynamic occlusal forces during mastication and parafunctional activity. Inadequate occlusal design or unresolved occlusal imbalance may therefore compromise structural durability, marginal adaptation, retention, and biological compatibility of prosthetic constructions. Bruxism and clenching habits represent particularly important risk factors because repetitive excessive loading produces fatigue failure, ceramic chipping, screw loosening, implant overload, periodontal trauma, and temporomandibular dysfunction. Occlusal discrepancies additionally influence neuromuscular coordination and may contribute to chronic pain, muscle fatigue, headaches, joint clicking, restricted mandibular movement, and decreased quality of life. Contemporary prosthodontics increasingly emphasizes comprehensive occlusal assessment prior to restorative treatment to ensure harmonious integration between prosthetic constructions and the functional biomechanics of the masticatory system. Modern diagnostic approaches include articulator-mounted study models, digital occlusal analysis systems, electromyographic evaluation, computerized bite-force assessment, cone-beam computed tomography, and temporomandibular joint imaging. Proper occlusal adjustment, balanced articulation, individualized prosthetic design, and management of parafunctional habits are critically important for prevention of restoration failure and preservation of oral health. Advances in digital dentistry, biomaterials science, implant biomechanics, and neuromuscular diagnostics continue to improve understanding of occlusal function and allow development of more durable and biologically compatible prosthodontic rehabilitation strategies. Contemporary oral rehabilitation therefore requires interdisciplinary integration of prosthodontics, orthodontics, periodontology, implantology, temporomandibular joint therapy, and digital occlusal technology to achieve optimal functional stability and long-term restoration survival. Successful prosthodontic rehabilitation requires not only restoration of missing dental structures and improvement of aesthetics but also establishment of stable, physiologically balanced, and biomechanically functional occlusion. Occlusion represents a highly coordinated interaction between teeth, periodontal tissues, masticatory muscles, temporomandibular joints, craniofacial skeletal structures, and neuromuscular control systems responsible for efficient mastication, speech, swallowing, and maintenance of oral functional harmony. Disturbances affecting occlusal relationships significantly alter biomechanical force transmission throughout the stomatognathic system and may result in progressive pathological changes involving teeth, supporting tissues, prosthetic restorations, and temporomandibular structures. Occlusal disorders include a broad spectrum of anatomical and functional abnormalities such as malocclusion, occlusal interference, premature contacts, traumatic occlusion, parafunctional activity, loss of vertical dimension, mandibular imbalance, and temporomandibular joint dysfunction. These pathological conditions frequently produce excessive loading forces, abnormal muscular contraction, periodontal stress, joint overloading, and mechanical fatigue of restorative materials. Contemporary prosthodontic restorations including crowns, fixed bridges, removable dentures, veneers, implant-supported prostheses, and full-mouth rehabilitations are continuously subjected to complex functional and parafunctional forces during mastication and neuromuscular activity. Improper occlusal relationships therefore significantly compromise prosthetic stability, marginal adaptation, retention, structural integrity, and long-term clinical survival of restorative constructions. Bruxism represents one of the most destructive occlusal disorders because repetitive clenching and

grinding generate excessive occlusal pressure capable of producing restoration fracture, ceramic chipping, implant overload, screw loosening, tooth wear, periodontal trauma, and temporomandibular dysfunction. Occlusal imbalance additionally affects muscular coordination and may contribute to chronic facial pain, headaches, mandibular restriction, muscle fatigue, joint sounds, and reduced quality of life. Modern prosthodontics increasingly emphasizes comprehensive functional diagnosis before restorative treatment to ensure harmonious integration between prosthetic constructions and dynamic biomechanics of the masticatory system. Contemporary diagnostic methods include digital occlusal analysis systems, articulator-mounted models, electromyography, computerized bite-force recording, cone-beam computed tomography, and temporomandibular imaging. Accurate occlusal adjustment, individualized articulation design, stabilization therapy, and management of parafunctional habits remain critically important for prevention of prosthetic complications and preservation of long-term oral rehabilitation success. Significant advancements in digital dentistry, implant biomechanics, restorative biomaterials, neuromuscular analysis, and computerized occlusal technology continue to improve understanding of functional occlusion and contribute to development of more durable, biologically compatible, and mechanically stable prosthodontic restorations. Contemporary oral rehabilitation therefore requires interdisciplinary integration of prosthodontics, orthodontics, implantology, periodontology, temporomandibular therapy, and digital functional diagnostics to optimize occlusal stability and improve long-term therapeutic outcomes.

2. Materials and Methods

This study was conducted using clinical, functional, and radiographic evaluation of patients with prosthodontic restorations affected by various occlusal disorders between 2020 and 2025. Comprehensive examination included assessment of occlusal relationships, masticatory function, temporomandibular joint condition, parafunctional activity, periodontal health, prosthetic stability, and muscular coordination. Diagnostic procedures included intraoral examination, articulator analysis, digital occlusal recording, electromyographic evaluation, panoramic radiography, cone-beam computed tomography, and computerized bite-force analysis. Patients with fixed prostheses, removable dentures, implant-supported restorations, and full-mouth rehabilitations were included in the study. Occlusal abnormalities including premature contacts, occlusal interference, bruxism, loss of vertical dimension, malocclusion, and temporomandibular dysfunction were evaluated clinically and functionally. Prosthetic complications such as restoration fracture, ceramic chipping, loosening, marginal leakage, implant overload, periodontal inflammation, and prosthetic instability were analyzed in relation to occlusal imbalance. Statistical analysis was performed to determine correlation between occlusal disorders and longevity of prosthodontic restorations.

3. Results

Comprehensive clinical evaluation demonstrated a significant association between occlusal disorders and reduced longevity of prosthodontic restorations. Patients presenting with bruxism, occlusal interference, premature contacts, and temporomandibular dysfunction exhibited increased incidence of prosthetic complications including ceramic fracture, crown loosening, marginal deterioration, implant overload, prosthetic instability, and accelerated restorative wear. Fixed prosthodontic restorations subjected to excessive occlusal stress demonstrated greater frequency of microcracks, chipping of veneering materials, and failure of cement retention compared with restorations functioning under balanced occlusal conditions. Implant-supported prostheses exposed to unfavorable occlusal loading demonstrated increased peri-implant bone stress, screw loosening, mechanical fatigue, and peri-implant inflammatory reactions. Removable prosthetic constructions in patients with occlusal instability showed decreased retention, mucosal irritation, uneven pressure distribution, and compromised chewing efficiency. Digital occlusal analysis systems effectively identified premature contacts, asymmetrical force distribution, and parafunctional loading patterns contributing to restoration failure. Electromyographic assessment demonstrated elevated muscular hyperactivity in patients with occlusal imbalance and bruxism, particularly within masseter and temporalis muscles. Occlusal adjustment procedures, stabilization splint therapy, correction of vertical dimension, and individualized prosthetic redesign significantly reduced mechanical complications and improved restoration stability and patient comfort. Patients receiving comprehensive occlusal

management demonstrated improved masticatory function, reduced temporomandibular symptoms, enhanced prosthetic durability, and increased overall satisfaction with oral rehabilitation outcomes. Comprehensive clinical and functional evaluation demonstrated a strong correlation between occlusal disorders and reduced longevity of prosthodontic restorations. Patients presenting with bruxism, premature contacts, occlusal interference, and temporomandibular dysfunction exhibited significantly higher incidence of restoration fracture, ceramic chipping, marginal deterioration, prosthetic instability, implant overload, periodontal inflammation, and accelerated occlusal wear. Fixed prosthodontic restorations subjected to excessive biomechanical stress demonstrated increased occurrence of microcracks, loss of retention, veneering material fracture, and structural fatigue compared with restorations functioning under balanced occlusal conditions. Implant-supported prostheses exposed to abnormal occlusal loading exhibited elevated peri-implant bone stress, screw loosening, prosthetic complications, and inflammatory changes within peri-implant tissues due to inadequate biomechanical force distribution. Removable prosthetic constructions in patients with unstable occlusion demonstrated decreased retention, uneven pressure transmission, mucosal irritation, reduced chewing efficiency, and increased patient discomfort during oral function. Digital occlusal analysis technologies effectively identified asymmetrical force distribution, hyperfunctional contacts, parafunctional loading patterns, and dynamic occlusal imbalance contributing to restoration failure. Electromyographic evaluation demonstrated increased activity within masticatory muscles, particularly masseter and temporalis muscles, among patients with bruxism and functional occlusal disorders. Occlusal correction procedures including selective grinding, stabilization splint therapy, restoration redesign, vertical dimension reconstruction, and individualized prosthetic adjustment significantly reduced biomechanical overload and improved restoration stability and functional adaptation. Patients receiving comprehensive occlusal management demonstrated enhanced masticatory performance, reduction of temporomandibular symptoms, decreased muscular fatigue, improved prosthetic durability, and greater overall satisfaction with oral rehabilitation results.

4. Discussion

The findings confirm that occlusal harmony represents one of the most critical determinants influencing long-term success and functional stability of prosthodontic restorations. Occlusal disorders generate abnormal biomechanical loading within the stomatognathic system and significantly increase risk of restorative failure, periodontal trauma, implant complications, and temporomandibular dysfunction. Balanced occlusal force distribution is essential for preservation of structural integrity of restorative materials and maintenance of healthy functional interaction between teeth, muscles, joints, and supporting tissues. Bruxism and parafunctional habits remain particularly destructive factors because repetitive excessive loading produces cumulative biomechanical fatigue, restoration fracture, ceramic chipping, screw loosening, and accelerated wear of prosthetic surfaces. The study additionally demonstrates that implant-supported prostheses are highly sensitive to occlusal overload due to absence of periodontal ligament proprioception and reduced physiological stress absorption compared with natural dentition. Proper occlusal design and careful force management are therefore critically important for prevention of peri-implant bone loss and mechanical complications in implant rehabilitation. Contemporary digital occlusal analysis systems significantly improve diagnostic precision by identifying premature contacts, asymmetrical loading patterns, and functional interference not easily detectable during conventional examination. Electromyographic evaluation additionally provides important information regarding muscular hyperactivity and neuromuscular imbalance associated with occlusal dysfunction. The findings emphasize that successful prosthodontic rehabilitation requires individualized occlusal planning based on anatomical characteristics, temporomandibular function, parafunctional risk factors, and biomechanical requirements of restorative materials. Despite major technological advancements in restorative dentistry, several clinical challenges continue to influence restoration longevity including inadequate occlusal assessment, improper articulation, progressive tooth wear, patient noncompliance, and untreated temporomandibular pathology. Future developments increasingly focus on digital occlusal simulation, artificial intelligence-assisted prosthetic planning, advanced biomaterials resistant to mechanical fatigue, robotic occlusal adjustment systems, and personalized neuromuscular rehabilitation aimed at improving long-term stability of prosthodontic restorations. Integration of prosthodontics, orthodontics, implantology, periodontology, temporomandibular therapy, and digital dentistry therefore remains essential for optimization of functional occlusion and

preservation of long-term oral rehabilitation outcomes. The findings confirm that functional occlusal harmony is one of the most critical factors influencing long-term clinical survival and biomechanical stability of prosthodontic restorations. Occlusal disorders create abnormal loading conditions within the stomatognathic system and substantially increase risk of restorative failure, periodontal trauma, implant complications, muscular dysfunction, and temporomandibular pathology. Physiological distribution of occlusal forces remains essential for preservation of structural integrity of restorative materials and maintenance of coordinated interaction between teeth, supporting tissues, joints, and neuromuscular components. Bruxism and parafunctional activity represent particularly significant destructive factors because repetitive excessive loading produces cumulative biomechanical fatigue leading to fracture of restorative materials, ceramic chipping, loosening of implant components, accelerated wear, and occlusal instability. Implant-supported prostheses are especially vulnerable to occlusal overload due to absence of periodontal ligament proprioception and reduced physiological shock absorption compared with natural teeth. Proper occlusal planning and biomechanical force control are therefore critically important for prevention of peri-implant bone loss and mechanical complications in implant rehabilitation. Contemporary digital occlusal analysis systems provide substantial diagnostic advantages through identification of premature contacts, force imbalance, hyperfunctional loading, and dynamic articulation disturbances not always detectable during conventional examination. Electromyographic analysis additionally allows evaluation of muscular hyperactivity and neuromuscular imbalance associated with functional occlusal disorders. The study further demonstrates that successful prosthodontic rehabilitation requires individualized treatment planning based on patient-specific anatomical characteristics, temporomandibular joint function, parafunctional habits, occlusal scheme, and biomechanical properties of restorative materials. Despite significant technological advancements in restorative dentistry, several clinical challenges continue to affect restoration longevity including inadequate occlusal diagnosis, progressive tooth wear, untreated temporomandibular dysfunction, patient noncompliance, and chronic parafunctional behavior. Future scientific development increasingly focuses on artificial intelligence-assisted occlusal simulation, digital functional analysis, advanced biomaterials resistant to mechanical fatigue, robotic occlusal adjustment systems, and personalized neuromuscular rehabilitation protocols aimed at improving long-term stability of prosthodontic restorations. Integration of prosthodontics, orthodontics, implantology, periodontology, temporomandibular medicine, and digital dentistry therefore remains essential for optimization of functional occlusion and preservation of durable oral rehabilitation outcomes.

5. Conclusion

Occlusal disorders significantly influence longevity, biomechanical stability, and clinical success of prosthodontic restorations through abnormal distribution of functional forces and increased mechanical stress within the stomatognathic system. Conditions including bruxism, premature contacts, malocclusion, temporomandibular dysfunction, and occlusal trauma contribute to restoration fracture, prosthetic instability, implant overload, periodontal complications, and accelerated wear of restorative materials. Comprehensive occlusal diagnosis, balanced articulation, individualized prosthetic planning, and early correction of functional abnormalities substantially improve restoration durability, peri-implant stability, masticatory performance, and patient satisfaction. Contemporary digital occlusal technologies and interdisciplinary treatment strategies provide important opportunities for optimization of prosthodontic rehabilitation and prevention of long-term complications. Continuous advancement in biomaterials science, digital dentistry, neuromuscular diagnostics, and implant biomechanics will further improve clinical outcomes and longevity of modern prosthodontic restorations. Occlusal disorders significantly influence durability, biomechanical stability, and long-term clinical success of prosthodontic restorations through abnormal distribution of functional forces and excessive mechanical stress within the stomatognathic system. Conditions including bruxism, premature contacts, malocclusion, occlusal trauma, and temporomandibular dysfunction contribute substantially to restoration fracture, prosthetic instability, implant overload, periodontal complications, and accelerated wear of restorative materials. Comprehensive functional diagnosis, balanced occlusal adjustment, individualized prosthetic planning, and early correction of occlusal abnormalities significantly improve restoration longevity, oral function, peri-implant stability, and patient satisfaction. Modern digital occlusal technologies and interdisciplinary therapeutic strategies provide important opportunities for optimization of

prosthodontic rehabilitation and prevention of long-term complications. Continuous advancement in biomaterials science, neuromuscular diagnostics, implant biomechanics, and digital dentistry will further improve clinical effectiveness and durability of contemporary prosthodontic restorations.

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