“CAROL DAVILA” UNIVERSITY OF MEDICINE AND PHARMACY

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CORRELATIONS BETWEEN ORAL CAVITY HEALTH AND POSTURAL CONTROL

PhD THESIS ABSTRACT

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2. **Cezar Ioniță,** Alexandru Eugen Petre, Alexandra Velicu, Adriana Sarah Nica. Comparative Evaluation of Temporomandibular Disorders and Dental Wear in Video Game Players. J Clin Med. 2024 Dec 25;14(1):31. .IF:3 https://doi.org/10.3390/jcm14010031. CHAPTER 4, p. 46-73;

3. **Cezar Ioniță**, Stefan Tiron, Summer Abdallah, Silvia-Andreea Gheorghe-Simionesie, Dorin Simionesie, Brindusa Ilinca Mitoiu, Oana Belei, Ileana Enatescu, Felix Bratosin, and Adriana Sarah Nica. Evaluating Plantar Correction Strategies in Pediatric Growing Pains: A Postural and Pain Analysis in 647 Children. J Med Life. 2025 May; 18(5). https://doi.org/10.25122/jml-2025-0084. CHAPTER 5, p.75-97.

Human posture is the outcome of a continuous dialogue among the sensory systems—visual, vestibular, proprioceptive, and trigeminal—and the motor networks that modulate axial tone to keep the center of gravity safely within the base of support. The stomatognathic system, consisting of teeth, periodontium, masticatory muscles, and the temporomandibular joint, constantly sends high-fidelity signals to the brain stem through dedicated trigeminal fibers. When occlusal contacts become uneven, even on a scale of microns, this afferent flow is altered and the brain recalibrates postural responses, redistributing cervical muscle contractions and shifting center-of-pressure pathways. Under conditions of visual fatigue, vestibular disorders, or cognitive load, the weight of trigeminal signals increases further, which is why occlusion becomes decisive for balance. This mechanism explains why people with the same dental deviation respond differently: sensory re-weighting is dynamic, shaped by context and individual history.

Modern imaging demonstrates a biomechanical continuum between the mandible and cervical spine. Mandibular advancement surgery in skeletal Class II cases triggers an anterior cranial rotation and a flexion of a few degrees at the atlanto-occipital level, changes that persist six months post-op. Subtle condylar repositioning unloads the sub-occipital extensors, and electromyography confirms reduced activity in the posterior chain. Over time, tension redistribution propagates down the thoracolumbar region, altering lordosis and even pelvic tilt. The phenomenon is reversible: when occlusion deteriorates through tooth loss or high restorations, the body produces the same adaptations in reverse, paving the way for cervicodorsal pain and headache. Thus occlusal integrity is not limited to the dental arch but forms part of a structural ensemble that runs from the cranial vault to the interphalangeal joints.

The functional bridge between masticatory muscles and balance control becomes obvious on force platforms: interposing thin cotton rolls between arches can enlarge sway area by 20–30 % within seconds. The increase is accentuated when eyes are closed, showing that once visual support is removed the brain assigns greater weight to trigeminal feedback. Within three or four minutes the nervous system partially compensates, confirming circuit plasticity. Conversely, placing the mandible in centric relation via well-adjusted splints lowers sway velocity and shrink balance area, especially in older adults or vestibular-deficit patients. Hence reversible dental devices hold therapeutic potential in balance disorders, provided they are embedded in neuromuscular retraining and monitored objectively.

Beyond the lab, the link between occlusion and motor performance is confirmed in precision sports. Pistol shooting, track cycling, and artistic gymnastics all show measurable changes when athletes wear appliances that slightly alter condylar position. In shooting, millimetric center-of-pressure shifts translate into point differences large enough to lose a final. In cycling, mandibular position influences neck muscle tone and alters aerodynamics via changes in the cranio-thoracic angle. In gymnastics, fine segmental control relies on anticipatory postural adjustments in which the trigeminal nerve supplies extra cues about head and jaw position. All these observations converge on the idea that balance optimization cannot ignore dental structure, at least at elite levels where milliseconds and millimeters decide outcomes.

Modern lifestyles add a behavioral variable: prolonged video gaming. Dedicated gamers often exceed four hours daily on screen, during which the head moves forward and the mandible slides postero-superiorly. In this configuration joint pressure rises, discs displace, and subclinical synovitis develops. Competition-induced arousal triggers reflex clenching, overloading canines and molars. University samples show an average 2 mm increase in vertical mandibular mobility, masseter hyperalgesia prevalence above 45 %, and unilateral canine wear correlated with controller hand dominance. The relationship is dose-response: each extra gaming hour heightens temporomandibular symptoms and wear. Recommended interventions blend active breaks, short aerobic bouts, and mouth guards that absorb occlusal shock without impeding the voice chat central to online play.

Splints could add a new level of control. Embedding EMG or pressure sensors in thermoplastic material enables live monitoring of clench force and data transmission to a phone app. Users receive vibrotactile alerts when a preset threshold is exceeded, precisely at peak game tension. Real-time feedback creates a new motor habit; the brain learns to relax masseters automatically, similar to mastering a correct golf swing. Long term, TMJ load falls, enamel wear diminishes, and musculoskeletal balance is restored. This dental biofeedback concept matches the broader performance and rehab trend of replacing subjective feel with objective data, turning prevention into a measurable process.

At the pediatric pole, growing pains spotlight the foot as a postural receptor. About 90 % of children aged 3–14 present posterior plantar load distribution, yet only half experience pain. The phenomenon suggests an individual tolerance threshold to periosteal traction shaped by age, sleep, and psychosocial factors. Custom orthoses redistribute pressure forward to the metatarsal zone, easing tension on the Achilles tendon. Children wearing these devices more than eight hours daily report pain intensity drops in over 80 % of cases and an objective 3.5 cm increase in step length. Single-leg stance time also rises, signaling better dynamic stability. Supplementary hamstring stretching and gluteal strengthening maximize benefit, proving the need for multimodal programs.

When plantar therapy fails, causes are often proximal. Hamstring tightness, hip-abductor weakness, or lumbar hyper-lordosis can sabotage load redistribution by altering joint moments at knee and hip. Physiotherapy therefore complements orthoses, restoring vertical muscle chain balance. Orthotic adaptation can provoke transient discomfort—medial arch soreness, plantar blisters, calf fatigue—but these reactions usually vanish after a three-day break-in period. Electronic temperature logging inside the orthosis quantifies actual wear time and correlates it with symptom evolution, a valuable tool for both clinician and researcher.

Postural-analysis technologies advance rapidly. Raster-stereography, an optical 3-D method, reconstructs the back with sub-millimetric accuracy, revealing curvature deviations that escape conventional X-ray. Combined with cranio-facial CBCT, it yields a full map of the cranio-cervico-thoraco-lumbar chain. Software merges the data into intuitive reports—changes in cranio-cervical angle, vertebral rotations, plantar-arch height—that double as patient education, boosting adherence. In the future, AI algorithms could predict, from a single scan, the probability that a Class II child will develop hyper-lordosis or that a young gamer will present TMD, enabling early intervention.

Cumulative results show that clinical success depends on addressing all involved captors simultaneously: oral cavity, foot, visual system, even cervical proprioceptors. A perfect splint in a body with marked plantar weakness will yield limited effects, and an ideal orthosis can be undermined by a premature occlusal contact. Modern posture management follows a collaborative triangle: the dentist balances occlusion and controls parafunction; the physiotherapist optimizes muscle chains and sensory integration; the optometrist adjusts oculomotor anomalies that disturb spatial orientation. When these fields communicate, the patient benefits from a coherent compensation network and relapse rates fall.

Economic relevance of preventive strategies emerges from cost-benefit comparisons: a custom splint plus orthoses costs less than six months of analgesics and three specialist visits for chronic pain. Early intervention lowers the risk of TMJ degeneration, progressive scoliosis, or recurrent low-back pain—conditions requiring far more expensive care. Insurance programs could therefore view postural evaluation and preventive devices as investments, not expenses. The e-sports industry, aware of health’s impact on performance, may become a powerful vector, sponsoring screenings and equipment for digital athletes.

Research methodology shows most current studies focus on static posture, although daily life involves movement. Introducing dynamic tests—treadmill walking, controlled jumps, unexpected perturbations—reveals hidden deficits. Adding cognitive tasks like backward counting to stabilometry exposes the interplay between executive center and postural control. A future paradigm should employ portable inertial sensors to measure sway while subjects engage in real activities: playing basketball, strolling downtown, or gaming. Recording data in natural environments will reduce bias and provide an authentic picture of occlusal and plantar links with everyday posture.

Central sensitization is a convergence point among bruxism, growing pains, and postural disorders. Repeated nociceptor discharges—periodontal or periosteal—lower activation thresholds in dorsal horn neurons and the spinal trigeminal nucleus. Consequently, otherwise innocuous stimuli, such as light plantar pressure or moderate jaw opening, may be perceived as painful. Awareness of this dynamic justifies integrating desensitization techniques—manual therapy, low-level laser, mindfulness—into mechanically centered treatment plans. Dual mechanical-neuropsychological approaches raise chances of durable remission.

In children, plantar posterior distribution is not just about foot anatomy but also CNS maturation. Young kids with immature proprioception rely on heel input for stability, hence heel-biased load. As vestibular and parietal cortices mature, load should migrate forward. When that shift fails, tension concentrates on proximal tibial structures, triggering nocturnal pain. Orthoses act as a sensorimotor guide, gradually teaching children to use the full plantar surface.

During adolescence, growth spurts can outpace connective-tissue adaptation. Microfissures appear in the periosteum and local inflammation rises, increasing pain sensitivity. Data show adolescents benefit from orthoses but need longer adjustment periods and extra flexibility exercises. Hamstring stretching and triceps surae strengthening accelerate adaptation, shortening the soreness phase. Psychological counseling can reduce anxiety about night pain, lowering perceived intensity.

The integrated database combining CBCT, baropodometric maps, and EMG enables clustering algorithms for patient classification. Resulting groups show patterns; for instance, the "hypermobile gamer" cluster features mandibular mobility >55 mm, unilateral canine wear, and gaming time >5 h/day, whereas the "pediatric heel-loader" cluster includes children with FPD < 45 %, moderate growing pains, and high hamstring tone. This taxonomy guides clinicians in personalizing treatment, suggesting immediately whether priority is splint, orthosis, or behavioral therapy.

Real-time data exploitation opens telemedicine opportunities. Smart splints and orthoses can transmit daily reports on occlusal pressure and plantar distribution, allowing clinicians to adjust parameters remotely. This reduces in-person visits, boosts adherence, and permits quick interventions when deviations arise. For professional gamers at international tournaments, tele-monitoring becomes essential because access to their base clinic is limited.

Education remains the foundation of any preventive program. School modules on postural hygiene can explain that balance starts in the mouth and ends in the feet. Active-break exercises—tip-toe rises, neck rotations, gymnastics—can be integrated every 45 minutes of class or tablet play. In e-sports clubs, coaches can introduce mandibular warm-ups and cervical stretching just as basketball uses ankle warm-ups.

Longitudinal surveillance is essential to confirm sustainability of results. Future randomized studies must follow participants for at least 12 months to see whether splint and orthosis benefits persist after continuous wear stops. Researchers will also test whether early intervention prevents late degenerations like TMJ osteoarthritis or flatfoot. Cost-effectiveness data will inform health policy, showing that investing in devices at young ages brings significant savings in adulthood.

Technologically, 3D printing with gradient-rigidity materials allows ultra-light orthoses and splints with zonal shock absorption. In dentistry, this means guards that transfer force only to canines. In orthopedics, insoles can include air cells in unloading zones while maintaining minimal thickness for footwear. Integrating NFC chips simplifies wear-time reading with a phone tap, no extra battery required.

Legally and ethically, collecting sensitive biomechanical data demands strong safeguards. Anonymization, end-to-end encryption, and detailed informed consent are mandatory. For minors, parents must receive clear explanations about data types collected and withdrawal rights. Ethical guidelines also recommend limiting data storage duration and using it only for initial purposes. Collaboration with cybersecurity experts is essential to prevent breaches compromising confidentiality.

Professional training must evolve with scientific progress. Medical curricula can include AI modules applied to musculoskeletal health, so the dentist of the future reads center-of-pressure charts as fluently as radiographs. Physiotherapists will understand occlusion, and optometrists will consider the plantar-cervical chain when prescribing prisms. Such cross-competence reduces fragmented care, speeds diagnosis, and optimizes outcomes.

In both clinic and research, the ultimate indicator is patient quality of life. Pain reduction, improved mastication, increased gait safety, and lower performance anxiety define real success. Measuring these outcomes may use validated questionnaires (OHIP-14, PedsQL) but also objective metrics—daily step counts, e-sports scores, sports performance. Correlating biological gains with psychosocial improvements will prove global impact and strengthen the case for wide adoption.

From a statistical perspective, this thesis employed methods tailored to each study design. In the systematic review, a standardized tool was used to assess methodological quality, enabling comparability across heterogeneous studies. The observational comparative study applied Student’s t-tests, Mann–Whitney U, Kruskal–Wallis, and chi-squared tests with Yates’ correction, with effect sizes expressed as Cohen’s d and Cramer’s V. In the pediatric study, data were managed in REDCap, with multiple imputation applied for variables with >5% missing data and analysis performed using paired t-tests, McNemar tests, and ANCOVA models adjusted for baseline values and age. Clinical significance was assessed using MCID thresholds.

The studies forming the foundation of this doctoral thesis were conducted in strict accordance with the ethical principles outlined in the Declaration of Helsinki. Each research project received prior approval from a competent ethics committee: the Ethics Committee of the “Carol Davila” University of Medicine and Pharmacy in Bucharest and the local ethics committee of the medical institution where the study was conducted.

In summary, the link between the oral cavity and postural control is not a mere academic curiosity but a fundamental principle of human function. Teeth, feet, and sensory systems converge in an adaptive network that maintains balance, guides gaze, and supports movement. Disrupting any link reflects across the others; restoring harmony demands integrated, personalized strategies. Advances from 3-D scanning to AI create the premise for early diagnostics and precise therapies. Implemented in an interdisciplinary framework, these insights make it possible not only to treat symptoms but to prevent dysfunction, optimize performance, and sustainably enhance quality of life.

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