Neuroplasticity and the Edentulous Patient—Toward a Paradigm Shift in Oral Rehabilitation

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Western populations are aging and it is expected that in the future a higher proportion of populations in most countries will be middle-aged and elderly—age cohorts in which patients are likely to be edentulous and in whom most neurologic disorders will be evident. Complete tooth loss, like limb loss, is a stressful event that can produce emotional and psychologic distress—plus associated impaired sensory (eg, dysesthesia and pain) and motor (eg, reduced chewing efficiency) functions.

Oral rehabilitation aims to restore orofacial sensory and motor functions and improve a person's sense of well-being and quality of life. However, sensory-motor capabilities of edentulous patients rehabilitated with complete dentures, or even implant-supported prostheses, do not match those of dentate subjects. It is also unclear why some patients adapt quickly to losing their teeth or prosthetic replacements and relearn and regain lost sensory-motor skills or acquire new ones, whereas other patients adapt slowly, or not at all, and retain their sensory-motor deficits. Clinical and documented experiences indicate that technical emphasis on fabricating prostheses to manage edentulism does not guarantee automatic improvement of patients' sensory and motor functions. These maladaptive patients are all-too-often regarded as psychologically unfit to wear dentures and are dismissed as "problem patients."

It appears that orofacial somatosensory perception (including pain) and motor functions, as well as human executive functions such as thinking, memory, and emotions are controlled by distinct, yet reciprocally connected neuronal circuits in the brain. Somatosensory inputs from the orofacial region can project to and modulate brain regions involved in the generation and control of orofacial motor functions, as well as emotions and memory. Moreover, emotions and thoughts can in turn modulate somatosensory perception and motor functions.

Extensive neuroscience research on limb rehabilitation following peripheral or central injury (including limb amputation or stroke) has already provided insights into the remarkable neuroplastic capacity of the brain and the nervous system in general, plus its crucial role in sensory-motor adaptation processes during development through adulthood and following injury. Neural circuitry is continuously rewired through structural (eg, creating new synaptic connections or even new neurons) and functional (eg, changes in synaptic efficacy) changes in response to intrinsic or extrinsic influences. The clinical significance of these findings has dramatically influenced modern management of limb amputations and is strongly suggestive of the possibilities for understanding neurobiologic mechanisms that can be applied to the assessment and treatment of patients with orofacial sensory-motor impairments secondary to tooth loss and/or oral rehabilitation with dental prostheses.

Although limited, currently available clinical and basic-science evidence and everyday clinical practice suggest that principles of neuroplasticity and its features also may play a crucial role in adaptation and learning processes associated with tooth loss (or other intraoral alterations) and prosthodontic treatment interventions. Yet oral neurophysiology is regrettably only a minor component in the curriculum of most dental schools. This needs to change since dentists must realize that their rehabilitative interventions induce cortical neuroplasticity; and this can elicit adaptive changes as well as maladaptive ones. Biologically engaged dentists also must begin to understand the molecular and cellular mechanisms that determine how the brain adapts to alterations in the oral environment and thereby allows patients to recover (or not) their oral sensory-motor functions. These mechanisms are being studied in detail via invasive techniques in laboratory animals. However, it is hoped that the eventual improved understanding of neuroplastic mechanisms will enable researchers to develop therapeutic strategies that promote adaptive neuroplasticity in humans. This will enhance the objective of efficacious and effective prosthodontic treatment that also can prevent or reverse redundant neuroplastic changes. Enriching patients' quality of life remains the discipline's primary remit.

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