Effects of Dental Extraction on Cognitive Functions in the Elderly
Yaşlılarda Diş Çekiminin Kognitif Fonksiyonlar Üzerine Etkisi

Sara Samur-Erguven¹, Ayşe Hande Arpacı² Mustafa Arslan³ Berrin Isik³

¹ 75th Oral and Dental Health Hospital, Oral Surgery Clinic, Ankara, Turkey
² Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Ankara University, Ankara, Turkey
³ Department of Anesthesiology and Reanimation, Faculty of Medicine, Gazi University, Ankara, Turkey

ABSTRACT

Objective: Dental extraction can be a cause of short-term cognitive decline in elderly patients. In this research, we aimed to evaluate cognitive functions using the Mini-Mental State Examination before and after tooth extraction in elderly patients who have undergone dental extraction with local anesthesia.

Methods: A group of 40 randomly selected patients >65 years old who underwent dental extraction were included. Mini-Mental State Examinations were performed before and after dental extraction.

Results: The patients' total Mini-Mental State Examination scores after dental extraction were statistically significantly lower than the patients' scores before extraction (p < 0.0001).

Conclusion: The results of this study suggest that tooth extraction can be a cause of short-term cognitive decline in elderly patients. However, the possibility that loss of teeth is another contributing factor to long-term cognitive decline should be evaluated in further comprehensive clinical studies.

Key Words: Elderly, Tooth extraction, Cognitive functions

ÖZET

Amaç: Diş çekimi yaşlı hastalarda erken dönem kognitif yetersizlik nedeni olabilir. Bu çalışmada, lokal anestezi ile diş çekimi yapılan yaşlı hastalarda diş çekimi öncesi ve sonrasında Mini Mental Durum Değerlendirme testi ile kognitif fonksiyonların değerlendirilmesi amaçlanmıştır.

Yöntem: Rastlantısal olarak seçilmiş 65 yaş üstü, 40 adet diş çekim hastası bu çalışmaya dahil edilmiştir. Mini Mental Durum Değerlendirme Testi diş çekimi öncesi ve sonrası 40 adet diş çekim hastası bu çalışmaya dahil edilmiştir. Mini Mental Durum Değerlendirme Testi diş çekimi öncesi ve sonrası değerlendirilmiştir.

Bulgular: Hastaların diş çekimi sonrası Mini Mental Durum Değerlendirme test değerleri diş çekimi öncesi değerlerinden istatistiksel olarak anlamlı ölçüde düşük olarak saptanmıştır (p < 0.0001).

Sonuç: Bu çalışmanın sonuçları diş çekiminin yaşlı hastalarda erken dönem kognitif yetersizlik nedeni olabileceği ortaya koymaktadır. Bununla birlikte, diş kaybının uzun dönem kognitif yetersizliğine katkıda bulunabileceği bir faktör olma ihtimali daha kapsamlı klinik çalışmalarla değerlendirilmelidir.

Anahtar Sözcükler: Yaşlı; Diş çekimi; Kognitif fonksiyonlar

Received: 09.07.2018 Accepted: 11.14.2018

©Copyright 2020 by Gazi University Medical Faculty - Available on-line at web site http://medicaljournal.gazi.edu.tr/ doi:http://dx.doi.org/10.12996/gmj.2020.06
INTRODUCTION

Cognitive functions are defined as the mental processes of knowing and interpreting such as awareness, reasoning, and judgement. These functions are affected by several internal and external factors. Research into the nature and causes of cognitive impairment have focused on identifying factors that have the potential to decrease the risk of individuals experiencing cognitive decline (1).

Forms of cognitive decline, such as memory impairment or attention deficits, are associated with aging (2). Numerous neurobiological, psychological, and social factors may contribute to age-related cognitive impairments (1-4).

Tooth extraction is the removal of teeth from the dental alveolus in the alveolar bone, and extractions are performed for various reasons. In the elderly, teeth are commonly lost as a result of dental caries or inflammatory periodontal diseases that lead to periodontal tissue loss, both of which are caused by exposure to a bacterial biofilm.

Many studies have suggested that tooth loss can exacerbate cognitive impairment in the long term (4-6). In the present prospective clinical observational study, our aim was to evaluate the relationship between tooth extraction and cognitive functions in patients over 65 years old. For this purpose, cognitive functions were evaluated using the Mini-Mental State Examination (MMSE) (7) before (B) and after (A) a dental extraction procedure has been performed. Our clinical observational research suggests that tooth extraction promotes cognitive decline in elderly patients immediately after dental extraction. The proposed model provides a rationale for conducting further experimental and clinical studies.

MATERIALS and METHODS

This study was approved by the local Institutional Review Board and was conducted at two centers (Ankara University Faculty of Dentistry and Ankara 75.Inc. Hospital and Dental Health Hospital). The study was conducted in accordance with the Declaration of Helsinki guidelines and Good Medical Practice Guidelines. The study included 40 dental patients over 65 years old who were classified as American Society of Anesthesiologists (ASA) Physical Status I–II and who had undergone tooth extraction under local anesthesia. All patients were informed about the study protocol and dental extraction procedure. They were enrolled in the study after signing a written informed consent form. All patients had various indications for tooth extraction, including increased mobility, presence of deep caries, and attachment loss. Patients with a medical contraindication to minor oral surgery or neurological diseases were excluded. Gender, the level of education, the duration of the extraction procedure, presence of systemic diseases, and number of extracted tooth were recorded.

The MMSE was used to screen for possible cognitive impairment before and after performing tooth extraction. In the present study, the MMSE was used within a scale from 0 to 30, with 30 indicating the best level of cognitive function, as in the full version. Previous studies have suggested that changes of ≥2 and ≤3 points or ≤2–4 points indicated reliable change at a 90% confidence level (8,9). We therefore defined a decline of ≥3 in the MMSE scores between before extraction and after extraction to be suggestive of a possible decline in cognitive function.

Before extraction, the patients were seated in a dental unit, and MMSEs were administered to obtain baseline cognitive values [Before (B)]. Following local anesthesia (articaine) administration (Maxicaine fort® 2 ml, Vem İlaç, Ankara, Turkey), the extraction procedure was performed. After extraction, alveolar compression was applied, and the region was sutured with resorbable suture material (Pegelak 3/0, Doğsan, Trabzon, Turkey). In all patients, the procedures were successfully performed without any complications. For each patient, the entire procedure took <30 min. At 2 h postoperatively, cognitive functions were evaluated by the MMSE [After (A)], and cognitive values representing the postextraction time were obtained. After the completion of the procedure, the patients were discharged after postoperative instructions were provided. Extraction procedures and cognitive assessments were performed by the same researcher.

Statistical analyses were performed using version 20.0 of the SPSS program, and results are presented as mean ± SD, range (Min–Max), and number [n (%)]. A p-value of <0.05 was considered to indicate statistical significance. Scores before and after extraction were assessed using the paired t-test.

RESULTS

The data of all patients (n = 40) were included in this study. The patients’ characteristics are presented in Table 1 (Table 1. Age, gender, ASA physical status, number of extracted tooth, procedure time, side effects or complication variables of the patients [Mean±SD, (Min–Max), n (%)]).

| Variables                  | Mean±SD, (Min–Max) | n (%) |
|----------------------------|--------------------|-------|
| Age (year)                 | 70,25±5,40         | (65-87) |
| Gender (M/F)               | 30/10              | (75-25) |
| ASA physical status (I/II) | 10/30              | (25-75) |
| Number of the extracted tooth | 1,60±0,77        | (1–5) |
| Procedure time (minute)    | 11,38±4,38         | (5–30) |
| Side effect or complication (+/-) | 0/40         | (0/100) |

Table 1: Age, gender, ASA status, number of extracted tooth, procedure time, side effect or complication variables of the patients [Mean±SD, (Min–Max), n (%)].

| Variables                  | A               | P          | %95 (CI) |
|----------------------------|-----------------|------------|----------|
| Orientation                | 7,48±2,05*      | <0,0001    | 0,465-0,884 |
| Registration              | 2,93±0,27       | 1,00       | -0,007-0,007 |
| Attention                  | 1,55±0,31*      | 0,016      | 0,048-0,451 |
| Memory                     | 1,91±0,88*      | 0,047      | 0,004-0,545 |
| Language                   | 7,53±1,04*      | <0,0001    | 0,173-0,476 |
| Total                      | 21,48±4,60*     | <0,0001    | 1,177-1,872 |

*P ≤ 0.05 correspondence with before extraction variables

Figure 1. MMSE variables before and after dental extraction

The MMSE variables before and after dental extraction

*P ≤ 0.05 for the comparison with variables before extraction (Orientation, Attention, Memory, Language, Total)
DISCUSSION

Various factors have been proposed in relation to cognitive decline in the elderly, however, only some factors can be directly attributed to cognitive decline are known to be definitively involved. Cardiovascular disease, vascular risk factors, inflammation, sensory impairments including visual and auditory domains, decreased physical activity, and low education level have been shown to be strongly associated with cognitive decline (1,4,10-12).

The present clinical observational study suggests that dental extraction in elderly patients promotes cognitive decline immediately after dental extraction. In our patients, MMSE scores taken after dental extraction were lower than the scores before extraction, and it is important to note that MMSE scores will increase in repetitive applications as the subjects learn from the test (7).

The results from previous studies support a relationship between dental status and cognition (13-15). Research in humans has shown that chewing activates blood flow in many regions of the brain (16); on the other hand, multiple tooth loss and difficulty in chewing hard food has been shown to be linked with significantly high odds of cognitive impairment in the elderly (13). Onozuka et al. (17) reported that chewing causes regional increases in neuronal activity in the brain. Some of these changes have been found to be age-dependent. Sesay et al. (18) demonstrated a significant increase in regional cerebral blood flow during mastication in humans. These results support an association between chewing ability and cognitive impairment.

Among older Chinese adults, Luo et al. (14) concluded that having over 16 missing teeth was associated with severe cognitive impairment. Furthermore, sex, age, years of education, living alone, body mass index, cigarette smoking, alcohol drinking, anxiety, depression, heart disease, hypertension, diabetes, and APOE-ε4 are significantly associated with dementia. Li et al. (15) reported that cognitive decline and number of teeth remaining are interrelated among older adults. Similar to these studies, Peres et al. (19) found an association between tooth loss and severe cognitive impairment and observed that older adults seemed to be particularly vulnerable to causes that suppress cognitive functions.

To date, few distinguished studies have been conducted that have shown that tooth extraction in rodents can induce functional and structural changes in brain regions involved in cognitive functions (20-22). Recent research conducted by Avivi-Arber et al. (20) demonstrated that tooth loss in mice is associated with widespread structural magnetic resonance imaging-defined structural changes in the somatosensory, motor, and cognitive, and limbic regions of the brain. Another experimental study found that dental extraction in rats is associated with neuroplastic changes in the brain and that dental implant placement reverses extraction-induced changes (21).

Neuroplastic changes have also been demonstrated in animal and human studies in response to alterations in the environment induced by various factors, such as orthodontic tooth movement or nerve injury (23,24).

In the context of tooth extraction and cognitive function, another influential factor is age. Aged molar-less mice have shown a significantly reduced learning ability compared with that of age-matched control mice, whereas there was no difference between control and molar-less young adult mice (25).

In our study, we compared the MMSE scores before and after tooth extraction in the same patients. For each patient, we extracted a minimum of one and a maximum of five teeth, and we performed MMSE a second time 2 h after extraction. During this period, the local anesthetic effects of articaine were still ongoing, and no patients reported experiencing pain. No conflict of interest was declared by the authors.

ACKNOWLEDGEMENTS

Some of the findings of this study presented as oral presentation at the 51st National Congress of Turkish Association of Anesthesiology and Reanimation on 26 October 2017 in Antalya, Turkey

REFERENCES

1. Beyerlun MA, Beyerlun HA, Giamlaldo AA, Teel A, Zonderman AB, Wang Y. Epidemiologic studies of modifiable factors associated with cognition and dementia: systematic review and meta-analysis. BMC Public Health 2014; 14:643.
2. Crawford TJ, Smith ES, Berry DM. Eye Gaze and Aging: Selective and Combined Effects of Working Memory and Inhibitory Control. Front Hum Neurosci. 2017; 11:1563.
3. Alley DE, Crimmins EM, Karlamangla A, Hu P, Seeman TE. Inflammation and rate of cognitive change in high-functioning older adults. J Gerontol A Biol Sci Med Sci 2008; 63:50-5.
4. Bachkati KH, Mortensen EL, Brønnum-Hansen H, Holm-Pedersen P. Midlife cognitive ability, education, and tooth loss in older Danes. J Am Geriatr Soc 2017; 65:194-9.
5. Okamoto N, Merikawa M, Okamoto K, Habu N, Iwamoto J, Tomisaka K, et al. Relationship of tooth loss to mild memory impairment and cognitive impairment: Findings from the Fujisawa-kyo study. Behav Brain Funct 2010; 6:77.
6. Syrjälä AM, Ylöstalo P, Sulkava R, Knuttila M. Relationship between cognitive impairment and oral health: results of the Health 2000 Health Examination Survey in Finland. Acta Odontol Scand 2007; 65:303-8.
7. Folstein MF, Folstein SE, McHugh PR. “Mini-mental state”. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975; 12:189.
8. Stein J, Luppia M, Maier W, Wagner M, Wolfrugber S, Scherer M, et al. Assessing cognitive changes in the elderly: reliable change indices for the Mini-Mental State Examination. Acta Psychiatr Scand 2012; 126:208-18.
9. Hansel A, Angermeyer MC, Riedel-Heller SG. Measuring cognitive change in older and reliable change indices for the Mini-Mental State Examination. J Neurol Neurosurg Psychiatry 2007; 78:1298-303.
10. Valençin SA, van Boxtel MP, van Hooren SA, Bosma H, Bekkers H, Ponds RW, et al. Change in sensory functioning predicts change in cognitive functioning: results from a 6-year follow-up in the maasstricht aging study. J Am Geriatr Soc 2005; 53:374-80.
11. Stephan BCM, Harrison SL, Keage HAD, Babateen A, Robinson L, Siervo M. Cardiovascular disease, the nitric oxide pathway and risk of cognitive impairment and dementia. Curr Cardiol Rep 2017; 19:87.
12. Snyder HM, Corriuva RA, Craft S, Faber JE, Greenberg SM, Knopman D, et al. Vascular contributions to cognitive impairment and dementia including Alzheimer’s disease. Alzheimers Dement 2015; 11:710-7.
13. Lexomboon D, Trulsmon L, Währd J, Parker MG. Chewing ability and tooth loss: association with cognitive impairment in an elderly population study. J Am Geriatr Soc 2012; 60(10):1951-6. (PMID:23035667)
14. Luo J, Wu B, Zhao G, Guo G, Meng H, Yu L, et al. Association between tooth loss and cognitive function among 3063 Chinese elderly adults: a community-based study. PLoS One 2015; 10: e0120986.
15. Li J, Xu H, Pan W, Wu B. Association between tooth loss and cognitive decline: A 13-year longitudinal study of Chinese older adults. PLoS One 2017; 12:e0171404.
16. Momose T, Nishikawa J, Watanabe T, Sasaki Y, Senda M, Kubota K, et al. Effect of mastication on regional cerebral blood flow in humans examined by positron-emission tomography with 18F-labelled water and magnetic resonance imaging. Arch Oral Biol 1987; 42:57-61.
17. Onozuka M, Fujita M, Watanabe K, Hirano Y, Niwa M, Nishiyama K, et al. Age-related changes in brain regional activity during chewing: a functional magnetic resonance imaging study. J Dent Res 2003; 82:657-60.
18. Sesay M, Tanaka A, Ueno Y, Lecarcz P, De Beaufort GD. Assessment of regional cerebral blood flow by enhanced computed tomography during mastication in humans. Keio J Med 2000; 49:412-5.
19. Peres MA, Bastos JL, Watt RG, Xavier AJ, Barbato PR, D’Orsi E. Tooth loss is associated with severe cognitive impairment among older people: findings from a population-based study in Brazil. Aging Ment Health 2015; 19:876-84.
20. Avivi-Arber L, Seltzer Z, Friedel M, Larch JP, Moayedi M, Davis KD, et al. Widespread volumetric brain changes following tooth loss in female mice. Front Neurosci 2017; 10:121.
21. Avivi-Arber L, Lee JC, Sood M, Lakshchvita F, Fung M, Barashi-Gozal M, et al. Long-term neuroplasticity of the face primary motor cortex and adjacent somatosensory cortex induced by tooth loss can be reversed following dental implant replacement in rats. J Comp Neurol 2015; 523:2372-85.
22. Chen H, Linuma M, Onozuka M, Kubo KY. Chewing maintains hippocampus-dependent cognitive function. Int J Med Sci 2015; 12:502-9.
23. Sood M, Lee JC, Avivi-Arber L, Bhatt P, Sessle BJ. Neuroplastic changes in the sensorimotor cortex associated with orthodontic tooth movement in rats. J Comp Neurol 2015; 523:1548-68.
24. Yıldız S, Bademkiran F, Yıldız N, Aydoğdu I, Uludag B, Ertekin C. Facial motor cortex plasticity in patients with unilateral peripheral facial paralysis. Neurorehabilitation 2007; 22:133-40.
25. Onozuka M, Watanabe K, Nagasaki S, Jiang Y, Ozono S, Nishiyama K, et al. Impairment of spatial memory and changes in astroglial responsiveness following loss of molar teeth in aged SAMP8 mice. Behav Brain Res 2000; 108:145-55.