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THE EFFECT OF AGE AND PSYCHOLOGICAL STRESS ON THE EFFECTIVENESS OF OSSEOINTEGRATION: CLINICAL OBSERVATIONS

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Abstract: This article examines the effectiveness of the osseointegration process depending on age and psychological stress. Osseointegration is the phase in dental implantation that ensures the fusion between the bone and the implant. The success of this process is influenced by many factors, among which the patient's age and psychological state play a significant role. Based on clinical observations, it has been found that the metabolic activity of bone tissue in younger individuals and the impact of stress on the immune system directly affect the success of osseointegration. Higher effectiveness of osseointegration was observed in younger patients, while in older patients, the process was slower and had a higher rate of failure. Moreover, increased stress levels—especially long-term and high-intensity stress—can lead to negative outcomes in osseointegration. This article presents clinical findings on the impact of age and stress on the osseointegration process and provides recommendations aimed at improving treatment strategies by considering these factors.

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Keywords: Stress, Psychological condition, Age, Implant success, Osseointegration, Bone metabolism, Immune system, Dental implantation

Introduction

Osseointegration is a crucial biological process for the successful implementation of dental implantation, during which a strong connection is formed between the implant and the bone. The success of osseointegration primarily depends on the patient's overall health, age, immune system status, and psychological factors. Numerous scientific studies have shown that various factors—including the patient's age and stress levels—can influence the effectiveness of osseointegration. In younger individuals, bone tissue metabolism tends to be more active, whereas bone regeneration slows down with increasing age. Additionally, stress can negatively impact the success of osseointegration, as elevated stress levels weaken immune system function and reduce the body's ability to heal and combat trauma.

This study aims to investigate the effects of age and stress on the effectiveness of the osseointegration process based on clinical observations. The results of the research will demonstrate how age and stress levels affect the outcome of osseointegration and may contribute to improving treatment strategies by taking these factors into account. The analyzed data will provide opportunities to develop new approaches and recommendations for enhancing clinical success in osseointegration.

Literature Review

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The effectiveness of the osseointegration process has been the subject of extensive scientific research. Numerous studies have explored the factors influencing the success of this process, with age and stress being identified as key factors. As indicated in the literature, bone tissue metabolic activity, the condition of the immune system, and psychological factors all play a significant role in ensuring successful osseointegration.

Several studies have addressed the impact of age on osseointegration. For example, Schramm et al. (2016) reported that osseointegration success rates were higher in younger patients. Younger age is associated with accelerated bone regeneration processes, which facilitate a stronger bond between the implant and the bone. Conversely, in older patients, slower bone regeneration may contribute to osseointegration failure (Toth, 2018).

The influence of stress on the osseointegration process has also been widely studied. Stress can negatively affect the immune system, which in turn reduces the strength of the bond between the implant and the bone. Liu et al. (2017) investigated the impact of stress on bone regeneration and found a correlation between stress conditions and implant failure. They determined that long-term stress significantly contributes to negative outcomes in osseointegration.

Furthermore, the effects of psychological conditions on physiological changes in the body have also been studied. Psychological stress can alter hormone levels—particularly by increasing cortisol—which may reduce the effectiveness of osseointegration (Alaeddini et al., 2019). Therapies aimed at improving psychological well-being, such as stress-reduction techniques, may help enhance the osseointegration process.

In addition, psychosomatic factors may also influence osseointegration. Investigating the psychological state of patients after surgical procedures and implantation has shown a direct impact on the success of osseointegration (Tomasi et al., 2020). Thus, age and stress are identified as primary factors affecting the osseointegration process.
Other factors influencing the success of osseointegration—such as general health status, diabetes, smoking, and hormone levels—have also been discussed in the literature. However, the direct effects of age and stress have not always been clearly measured, which is why this study focuses on an in-depth investigation of these two factors in relation to osseointegration.

Methdology

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The aim of this study is to investigate the impact of age and psychological stress on the effectiveness of the osseointegration process. Clinical observations, statistical analysis, and experimental methods were applied in this research. The following methodological approaches were selected:

Study Design

The research was conducted in several stages. In the first stage, patients were divided into groups based on age and stress level. Clinical observations and assessments were then carried out to monitor the success of the osseointegration process. Control groups were also included in the study, comprising patients with minimal stress levels and matched ages. By comparing with the control group, the effects of age and stress were identified more precisely.

Participant Selection

The study involved 100 patients aged between 18 and 65 who had undergone dental implantation and were selected to assess the success of osseointegration. The participants were divided into two groups: a younger group (18–35 years) and an older group (50–65 years), each consisting of 50 patients. Stress levels were also measured for all participants.

Stress Level Assessment

Patients' stress levels were assessed using standardized psychological tests. The "Perceived Stress Scale" (PSS) was used to evaluate the extent to which individuals perceived their lives as stressful. The results of the test allowed for categorization of stress levels as low, moderate, or high.

Assessment of Osseointegration Effectiveness

The effectiveness of osseointegration was evaluated based on the stable integration of the implant with the bone. Implants were examined using radiographic imaging on the day of surgery, after 3 weeks, 3 months, and 6 months. Success was determined by the presence of new bone growth around the implant and the absence of implant mobility. Cases of significant implant failure were analyzed, and the degree of bone regeneration was also evaluated.

Discussion

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The findings of this study demonstrate that both age and psychological stress have a significant impact on the success of the osseointegration process. The faster and more efficient osseointegration observed in younger patients can be attributed to the higher metabolic activity of bone tissue in this age group. Conversely, the slower bone regeneration observed in older individuals appears to contribute to lower osseointegration efficiency.

Moreover, the negative influence of psychological stress on osseointegration was clearly identified. High stress levels may impair immune function, reduce bone regeneration capacity, and ultimately lead to implant failure. These outcomes highlight the importance of considering psychological health in the clinical management of dental implant procedures.

The study also suggests that implementing psychotherapeutic interventions aimed at reducing stress—such as breathing exercises and meditation—can enhance the effectiveness of osseointegration by improving patients' psychological states. These results support the notion that successful osseointegration relies not only on biological factors but also on psychological and psychosomatic elements.

Furthermore, the influence of age and stress on osseointegration underlines the need for individualized treatment planning in clinical practice. For older patients and those with high levels of psychological stress, integrating stress-reduction strategies and providing additional psychotherapeutic support may improve clinical outcomes.

Future research should explore the effects of age and stress on osseointegration in greater depth, evaluate the efficacy of psychotherapeutic approaches, and contribute to the development of optimized treatment protocols. Such advancements may enhance implant success rates and improve patients' overall health and well-being.

The statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) software. Correlation and regression analyses were conducted to evaluate the influence of stress levels and age on the osseointegration process. The results were analyzed to determine how these factors affect the success of osseointegration. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations and Data Protection

Informed written consent was obtained from all participants involved in the study. The study was fully approved from an ethical standpoint, and all personal data were collected in

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compliance with confidentiality protocols. Each participant was fully informed about the nature of the study and their health condition before inclusion.

Experimental Analysis

In the next stage of the research, experimental groups were formed to directly assess the impact of age and stress on the osseointegration process. Psychotherapeutic approaches aimed at stress reduction—such as meditation and breathing exercises—were implemented in these groups. The effect of these interventions on the success of osseointegration was then evaluated.

Results

The study yielded significant findings regarding the impact of age and psychological stress on the osseointegration process. The results obtained from the participants are summarized as follows:

Effect of Age

Patients in the younger age group (18–35 years) demonstrated higher efficiency in osseointegration. A strong bond between the implant and the bone was more frequently observed after three months, and bone regeneration occurred at a significantly faster rate. Radiographic evaluations showed a higher degree of bone-to-implant contact during follow-up periods. These results indicate that younger patients experience faster and more successful osseointegration.

Older Age Group

In contrast, patients in the older age group (50–65 years) exhibited a slower osseointegration process. Both bone regeneration and the integration between the implant and the surrounding bone tissue were lower after three months. In some cases, osseointegration failure was observed. Specifically, delayed bone regeneration and reduced implant stability were more common in older individuals, contributing to lower overall success rates.

Effect of Stress

Patients with higher stress levels experienced a slower osseointegration process. According to results from the Perceived Stress Scale (PSS), those with elevated stress levels showed reduced bone regeneration and weaker implant-to-bone integration. Increased cortisol

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levels and weakened immune responses associated with high stress were linked to implant failure. However, in patients who practiced stress-reduction techniques such as meditation and breathing exercises, osseointegration outcomes significantly improved.

Combined Effect of Age and Stress

The combination of age and stress was found to be a critical factor affecting the success of osseointegration. The highest success rates were observed in younger patients with low stress levels. Conversely, older patients with high stress levels exhibited increased implant failure rates and slower bone regeneration.

Conclusion

This study aimed to investigate the effect of age and psychological stress on the effectiveness of the osseointegration process. The results of the study indicated that both age and stress have a direct impact on osseointegration success.

Effect of Age:

Younger patients exhibited faster and more effective osseointegration, which is associated with higher bone regeneration activity. In contrast, older patients experienced slower osseointegration, and some cases of implant failure were observed.

Effect of Stress:

Higher levels of stress were associated with a slower osseointegration process. Increased stress levels lead to weakened immune function, elevated cortisol levels, and delayed bone regeneration. Psychotherapeutic approaches aimed at stress reduction were found to improve osseointegration effectiveness.

Combination of Age and Stress:

The combination of age and stress had a significant effect on osseointegration success. Younger patients with lower stress levels had the highest osseointegration success, whereas older patients with higher stress levels experienced implant failure and slower bone regeneration.

The findings highlight the necessity of considering both age and stress factors to improve osseointegration outcomes. Future research should focus on the use of psychotherapeutic approaches and stress reduction strategies to enhance osseointegration. Furthermore, age and

stress should be important factors when developing individualized treatment plans for patients.

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