The Precise Adjustment Techniques and Clinical Fitting Effects of the Artificial Teeth Arrangement Process in Complete Dentures

Guorui Li
Hainan Vocational University of Science and Technology, Haikou 571126, Hainan, China

Abstract: Complete denture restoration is the core method for patients with missing teeth to restore their oral chewing and speech functions, improve facial aesthetics, and enhance quality of life. The accuracy of the artificial tooth arrangement process directly determines the clinical fit and long-term usage effect of the denture. Traditional denture arrangement methods mostly rely on the clinical experience of dentists, which can easily lead to jaw position deviations and occlusal imbalance, resulting in poor denture retention and poor restoration results. The precise denture arrangement method is based on oral anatomical and physiological characteristics, integrating digital technology and personalized adjustment concepts. It integrates the principle of precision throughout the denture arrangement process to achieve a high degree of alignment between artificial teeth and the physiological structure and facial morphology of the oral maxillofacial region and facial appearance. This article reviews the core precise adjustment techniques in the arrangement of artificial teeth for complete dentures, such as jaw position relationship calibration, occlusal balance adjustment, tooth position arrangement control, and personalized adaptation adjustment. It analyzes the impact of precise adjustments on denture retention, functional recovery, facial aesthetics, and patient comfort, and summarizes the core points of clinical adaptation, providing theoretical and practical references for the standardized implementation of complete denture artificial tooth arrangement in clinical practice and improving the quality of restoration.

***Keywords*:** complete denture; artificial tooth arrangement; precise adjustment; clinical adaptation; oral restoration

1. Introduction

Missing teeth are a common degenerative disease in oral clinical practice, with a high incidence rate among the elderly population. The accelerating aging of the population has driven the continuous growth of the demand for complete denture restoration. Complete dentures rely on the bonding of the base and the oral mucosa for fixation, and complete denture restoration achieves physiological function reconstruction by replacing the missing natural teeth with artificial teeth. The restoration effect not only depends on the accuracy of base fabrication but is also closely related to the artificial tooth arrangement process. Traditional denture arrangement methods have operational difficulties, low data accuracy, and poor individual adaptability, which can easily cause poor denture retention, low chewing efficiency, and poor facial aesthetic results, increasing the frequency of patient follow-up visits. The precise denture arrangement method is an important achievement of the digital and standardized development of oral restoration technology. It is based on the patient's oral anatomy and jaw position relationship, combined with individual facial morphology, occlusal habits, etc., and through scientific adjustment techniques to achieve precise control of artificial tooth arrangement, effectively solving the clinical drawbacks of traditional denture arrangement. It has now become the mainstream technology for complete denture restoration. This article reviews the precise adjustment techniques and clinical adaptation effects in the arrangement of artificial teeth for complete dentures, providing references for clinical practice.

2. Core Precise Adjustment Techniques in Complete Denture Artificial Tooth Arrangement

Precise adjustment is based on the principle of "fitting physiology and adapting to individuals", running through the entire denture arrangement process. It focuses on four key aspects: jaw position relationship calibration, occlusal balance adjustment, tooth position arrangement control, and personalized adaptation adjustment. These aspects are interrelated and progressive, jointly ensuring the accuracy of denture arrangement.

2.1 Precise calibration of jaw position relationship

Jaw position relationship is the basis for denture arrangement. Precise calibration of the relative position of the upper and lower jaws is the prerequisite for ensuring occlusal balance and denture retention. The core goal is to accurately determine the centric relation position and vertical distance, avoiding jaw position deviations that cause occlusal disorders.

Multi-modal data acquisition technology provides important support for precise calibration. Through intraoral scanning, CBCT, and facial scanning, comprehensive acquisition of patient oral soft tissue, alveolar bone anatomical structure, and facial aesthetic data can be obtained, generating an integrated three-dimensional model, replacing the subjective experience judgment of traditional methods. In clinical practice, the wax tray method is still the core method for recording jaw position relationship. After recording, the upper and lower jaw wax models are fixed on the model and promptly placed on the full adjustable (occlusal) frame to ensure the model is aligned, the midline is aligned, the (occlusal) plane is parallel to the ground, and the (occlusal) frame is pressed with a heavy object for more than 5 hours to prevent the plaster from expanding and deforming due to heat, affecting accuracy. For patients with abnormal jaw positions such as habitual protrusion or lateral occlusion, the tongue-lift licking method, swallowing method, or finger guidance method can be used to help them restore and record the normal centric relation position, avoiding jaw position deviations from the source.

2.2 Precise adjustment of occlusal balance

Bite balance is the key for full-arch dentures to function normally in chewing. Precise adjustment can effectively avoid bite interference and reduce problems such as denture loosening and mucosal tenderness. The core is to achieve the balance and unity of centric, protrusive, and lateral bites. Centric bite adjustment requires that the cusps of the upper and lower artificial teeth have extensive and tight contact, with no gaps between adjacent teeth; protrusive bite needs to ensure that the incisors are completely in contact and in a cutting edge state when the mandible protrudes, with no bite interference from the posterior teeth; lateral bite requires that when the mandible moves to one side, the cusps of the posterior teeth on that side precisely contact, and there is no force interference on the posterior teeth on the opposite side. For bite deviations, clinical methods often use modifying the cusps of the artificial teeth and adjusting the angle of the tooth positions to correct, adhering to the principle of "prioritize modifying non-functional cusps and retain functional cusps" to ensure the integrity of the artificial teeth and not affect the chewing efficiency. The application of electronic (occlusal) jigs further improves the accuracy of adjustment by recording the movement trajectory of the mandible, accurately obtaining parameters such as the cutting guide slope, the lateral guide slope, etc., and achieving the transformation from "empirical adjustment" to "data-based adjustment".

2.3 Precise Control of Tooth Positioning

Tooth positioning follows the principles of "symmetry, coordination, and physiological fit". Precisely control the position, angle, and arc of each artificial tooth, taking into account both physiological functions and facial aesthetics. The tooth arrangement sequence is from the upper jaw to the lower jaw, and from the anterior teeth to the posterior teeth. The arrangement of the anterior teeth of the upper jaw is the core of facial aesthetic restoration, which needs to be adjusted according to the patient's facial shape, lip line height, and to adjust the arc and inclination angle to ensure that the anterior teeth are naturally coordinated with the facial contour, while maintaining a physiological range of 2-3mm of overbite and 1-2mm of overjet, avoiding unclear pronunciation and chewing disorders. The arrangement of posterior teeth is centered on the occlusal function and denture retention, adjusting the inclination angles in the mesial-distal and buccal-lingual directions based on the alveolar crest top line to ensure precise alignment of the posterior tooth cusps with the opposing teeth, and the harmonious and aesthetically pleasing occlusal curves; the posterior teeth of the mandible are first arranged with the first molar to determine the neutral occlusal relationship, and then the double premolars are arranged successively to ensure a high degree of fit with the alveolar crest and reduce uneven force leading to loosening and mucosal tenderness. In addition, before tooth arrangement, the finished teeth need to be pre-treated, removing the wax layer on the surface, and roughening the covering surface to enhance the bonding strength with the baseplate, ensuring the stability of tooth positioning.

2.4 Personalized Adaptation Adjustment

Precision tooth arrangement emphasizes, on the basis of standardized operations, personalized adjustment in combination with the patient's oral anatomy, facial morphology, bite habits, and previous restoration history to improve the adaptability and comfort of the denture. For patients with low alveolar ridges or defects, a biocompatible tissue adjustment agent is filled in the provisional denture base fitting surface, and multiple adaptation adjustments are made to compensate for alveolar bone defects, improving mucosal fit and retention force; patients with immediate tooth extraction and restoration need to wear transitional dentures promptly and adjust them regularly according to the healing of the wound to achieve dynamic adaptation between the denture and oral tissues. For patients with facial asymmetry or abnormal lip lines, optimize the arrangement position and angle of the artificial teeth to improve facial aesthetics and restore a natural contour; for patients with previous denture-wearing experience, adjust according to the characteristics of the original denture arrangement and the changes in oral tissues, reducing the adaptation period. At the same time, adjust the spacing and position of the anterior teeth to avoid unclear pronunciation and air leakage, achieving dual satisfaction of function and personalized needs.

3. Clinical Adaptation Effect of Precise Tooth Arrangement Adjustment for Full-arch Dentures

The precise adjustment techniques fundamentally improve the accuracy of tooth arrangement, significantly enhancing the clinical adaptation effect of dentures in terms of retention, physiological function recovery, facial aesthetics, and wearing comfort, while effectively reducing the risk of complications. In terms of denture retention, through jaw position calibration, tooth position and alveolar ridge fitting, and personalized adjustment, the retention of the denture is improved, reducing gaps, enhancing adhesion, and ensuring the stability of the denture during daily activities such as eating and speaking, significantly reducing the probability of loosening and detachment. In terms of physiological function recovery, the adjustment of occlusal balance ensures uniform occlusion and reasonable force distribution, enhancing chewing efficiency, while reducing occlusal interference and lowering the risk of temporomandibular joint disorders. Precise control and personalized adjustment of tooth positions effectively avoid speech disorders and achieve a good reconstruction of oral physiological functions such as chewing and speech. In terms of facial aesthetics and comfort, precise tooth arrangement realizes the coordination and unity of artificial teeth and facial morphology, improving facial depressions, corners of the mouth drooping, and other issues, and enhancing aesthetic satisfaction; personalized adaptation and adjustment fit the patient's oral anatomical characteristics, avoiding excessive extension of denture edges and improper positions of artificial teeth causing mucosal irritation, reducing the incidence of mucosal pain, ulcers and other complications, improving wearing comfort, and thereby increasing the overall satisfaction of patients with restoration, reducing the number of follow-up visits.

4. Key points for clinical adaptation of precise artificial tooth arrangement in complete denture prostheses

Clinical implementation of precise adaptation requires grasping the core adaptation points and integrating the precise concept throughout the entire restoration process. First, based on objective data, fully utilize digital scanning, three-dimensional modeling and other technologies to obtain precise data, replacing traditional empirical judgment, and improving the accuracy of tooth arrangement from the source; second, repeatedly calibrate the jaw position and occlusal relationship, check and adjust deviations during the tooth arrangement process multiple times to ensure stable occlusal balance; third, take into account both functional and aesthetic needs, optimize the arrangement of artificial teeth while ensuring the physiological functions of chewing and speech, achieving a natural coordination with facial morphology; fourth, strengthen post-restoration follow-up and dynamic adjustment, conduct regular follow-ups, and make fine-tuning of dentures based on changes in the patient's oral tissues and usage feedback to ensure long-term adaptability.

At the same time, clinical operations need to pay attention to detail control: avoid overly dense or sparse arrangement of artificial teeth, preventing interference with speech and chewing; when modifying artificial teeth, perform gentle actions to avoid excessive modification that damages the shape and affects the stability of occlusal; for special patients with severe alveolar ridge resorption and poor mucosal elasticity, combine traditional impression verification to improve the adaptability of dentures; strengthen the calibration and maintenance of digital equipment, improve the proficiency of physicians in digital design software and operation equipment, reduce technical errors, and ensure the clinical implementation effect of precise tooth arrangement.

5. Conclusions and Prospects

The precise adjustment of the artificial teeth arrangement in complete dentures is an important trend in the development of oral restoration technology. The comprehensive application of four core techniques - precise jaw position adjustment, precise adjustment of occlusion balance, precise control of tooth arrangement, and personalized adaptation adjustment - is the key to improving the clinical fitting effect of dentures. It can effectively enhance the retention force and chewing efficiency of the dentures, improve the aesthetic effect of the face, reduce the incidence of complications, and increase the patient's satisfaction with the restoration.

With the continuous development and integration of digital technology and biomaterial technology, the precise process of artificial tooth arrangement in complete dentures will be further improved. The in-depth application of technologies such as digital oral scanning, artificial intelligence-assisted design, and 3D printing will realize the full dataization and intelligent control of the tooth arrangement process, further improving the precision of tooth arrangement and the level of personalized adaptation. In the future, clinical practice needs to continuously promote the implementation of the precision concept, strengthen the training of physicians' digital technology operation capabilities, combine the precision adjustment techniques with advanced technologies, and provide more high-quality and personalized complete denture restoration services for

patients with missing teeth, promoting the development of the oral restoration discipline towards standardization, precision, and intelligence.

References

[1] Wei Ling, Zou Dong, Chen Hu, et al. Clinical Efficacy Evaluation of a Digital Complete Denture [J]. Journal of Peking University (Medicine Edition). 2020, (4). DOI: 10.19723/j.issn.1671-167X.2020.04.031.

[2] Wu Yiqun, Wang Feng. Implant Treatment for Patients with Congenital Missing Teeth [J]. Chinese Journal of Oral Implantology. 2024, 29(3). DOI: 10.12337/zgkqzzxzz.2024.06.003.

[3] Shu Lihong, Tang Zichun, Wang Haixia, et al. Clinical Phenotype Study of Non-syndromic Majority Permanent Tooth Congenital Absence [J]. West China Journal of Stomatology. 2024, 42(1). DOI: 10.7518/hxkq.2024.2023203.