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Analysis of the Effect of Zirconia Restorations on Oral Restoration and Their Impact on Patients' Chewing Ability

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Abstract: *Objective:* To evaluate the effectiveness of zirconia restorations in patients undergoing oral restoration. *Method:* A randomized controlled trial was conducted on 90 patients who met the criteria for oral restoration from January 2024 to December 2024. The study included an observation group (45 patients with zirconia restorations) and a control group (45 patients with cobalt chromium alloy restorations) to compare the degree of pain and oral health impact, bite and chewing ability, and incidence of complications. *Result:* The study group showed significant improvements in various indicators, especially in bite and chewing abilities, compared to the control group ($p < 0.05$). *Conclusion:* Zirconia restorations have practical value in improving the biting and chewing abilities of oral restoration patients, reducing the incidence of complications, and other aspects.

Keywords: Oral restoration; Zirconia restorations; Cobalt chromium alloy restoration; Chewing ability; Occlusal ability

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1. Introduction

With the continuous advancement of oral restoration technology, innovative oral restoration materials play an important role in improving patients' quality of life [1].

Although traditional metal restorations (such as nickel chromium alloys and cobalt chromium alloys) perform well in mechanical properties, their defects are becoming increasingly apparent, such as insufficient aesthetics, gum gray lines, the risk of metal allergies, and long-term use that can be easily corroded by saliva and gingival crevicular fluid, leading to discoloration and fracture of the restoration [2]. In addition, the thermal conductivity of metal materials may stimulate dental pulp, and the release of metal ions may even trigger systemic toxic reactions, thereby affecting long-term safety [3].

With the increasing demand for oral aesthetics and functionality among patients, there is an urgent need for a restorative material that combines high strength, good biocompatibility, and natural aesthetics. Zirconia, as a new type of all ceramic material, has gradually become a research focus in the field of oral restoration due to its excellent performance. In order to investigate the effectiveness of zirconia restorations in oral restoration, this study selected 90 patients who met the conditions for oral restoration.

2. General information

2.1. Basic information

Select 90 patients who meet the criteria for oral restoration from January 2024 to December 2024, and design a randomized controlled trial. The basic information of the patients is shown in **Table 1**.

Table 1. Basic information

Group	n	Gender (Example)		Age (years)
		Male	Female	
Research group	45	21	24	47.26 ± 3.15
Control group	45	19	26	47.37 ± 3.22
χ^2/t		0.180	0.164	
p		0.671	0.870	

2.2. Research methods

(1) Pre repair treatment

A series of treatment measures such as teeth cleaning, extraction, filling, and orthodontic treatment should be carried out first.

(2) Precise preparation of teeth

Scientific and reasonable grinding of remaining teeth lays the foundation for precise restoration of the restoration.

(3) Impression and model making

First, take out an accurate impression, and then pour gypsum to make the model. On this basis, carefully make the restoration according to the design requirements. Selecting different materials for restorations, research group: Zirconia restorations; Control group: Cobalt chromium alloy restoration,

(4) Fine technical processing

Fine technical processing is carried out by comparing gypsum models, striving to minimize deformation.

(5) Trial wearing and functional adjustment

Place the pre made restoration on the oral defect site, comprehensively check its adaptability and bite function, and make necessary adjustments according to the actual situation.

(6) Stable bonding of restoration

After adjustment, firmly bond the restoration to the target tooth to ensure its stability and functionality.

2.3. Observation indicators

(1) Bite and chewing ability

Use a bite force tester (such as T-Scan system) to measure the maximum bite force. The subjective chewing ability score consists of 5 items, ranging from 0 to 5 points, with higher scores indicating better chewing ability.

(2) Incidence of complications

Fracture of restorations, gingival discoloration, secondary caries, gingivitis and sensitivity, bite and functional issues.

(3) The oral health impact profile (OHIP-14)

Consists of 14 items with scores ranging from 0 to 56. The higher the score, the more severe the impact of oral health on quality of life. VAS score (0–10 points), the higher the score, the more severe the pain.

2.4. Statistical processing

SPSS statistical software, version number SPSS 26.0, was used for data analysis. If $p < 0.05$, the difference was considered

statistically significant. Statistical measures such as mean, standard deviation ($\bar{x} \pm s$), and percentage were used to describe the difference. Independent sample *t*-test and chi square χ^2 test were used for inter group comparison.

3. Results

3.1. Biting and chewing ability

According to the data in **Table 2**, compared with the control group, the study group showed an improvement in bite force ($p < 0.05$) and an improvement in chewing ability score ($p < 0.05$).

Table 2. Occlusion and chewing abilities ($\bar{x} \pm s$)

Group	n	Occlusal ability (N)		Chewing ability score (points)	
		Before treatment	After treatment	Before treatment	After treatment
Research group	45	68.28 ± 10.02	82.33 ± 5.63	1.23 ± 0.37	4.18 ± 0.66
Control group	45	68.59 ± 9.59	75.26 ± 5.95	1.25 ± 0.41	2.68 ± 0.15
t		0.126	5.357	0.236	5.439
p		0.899	0.000	0.689	0.000

3.2. Incidence of complications

According to the data analysis in **Table 3**, the incidence of complications in the study group was lower ($p < 0.05$).

Table 3. Incidence of complications (n%)

Group	n	Repair fracture	Gingival discoloration	Secondary caries	Gingivitis and sensitivity	Occlusion and functional issues	Overall incidence rate
Research group	45	0 (0%)	1 (2.22%)	0 (0%)	1 (2.22%)	0 (0%)	2 (4.44%)
Control group	45	2 (4.44%)	2 (4.44%)	2 (4.44%)	2 (4.44%)	2 (4.44%)	10 (22.22%)
χ^2		--	--	--	--	--	6.154
p		--	--	--	--	--	0.019

3.3. Oral health

According to the data analysis in **Table 4**, the OHIP-14 and VAS scores of the study group decreased ($p < 0.05$).

Table 4. Oral health ($\bar{x} \pm s$)

Group	n	VAS score (points)		OHIP-14 (min)	
		Before treatment	After treatment	Before treatment	After treatment
Research group	45	4.42 ± 1.03	1.29 ± 0.37	32.36 ± 5.56	12.26 ± 3.66
Control group	45	4.45 ± 1.03	2.08 ± 0.62	32.56 ± 5.71	28.44 ± 4.12
t		0.118	6.286	0.126	5.357
p		0.906	0.000	0.899	0.000

4. Discussion

Oral restoration treatment, as one of the core areas of dentistry, mainly solves problems such as tooth defects, missing teeth, and oral and maxillofacial defects [4]. In modern medical technology, oral restoration not only effectively restores the chewing function of teeth, but also improves personal aesthetics and enhances self-confidence. The main problems solved by oral restoration include:

(1) Dental defects

Hard tissue damage caused by dental caries, trauma, wear, etc., which not only affects aesthetics but may also cause discomfort such as tooth sensitivity and pain.

(2) Dental arch defect

The loss of some teeth in the dental arch, commonly seen in patients with dental caries, periodontal disease, trauma, etc., can lead to decreased chewing function, disrupted bite relationships, and other problems.

(3) Dental loss

The absence of all teeth in the oral cavity seriously affects the patient's chewing, pronunciation, and facial appearance, mainly caused by dental caries and periodontal disease.

Oral restorations include:

(1) Fixed restorations

Including inlays, veneers, crowns, and fixed bridges, which are tightly connected to natural teeth or implants through adhesives or fixation devices, with high stability and comfortable use.

(2) Removable restorations

Including removable partial dentures, full dentures, overlay dentures, and immediate dentures, composed of artificial teeth, abutments, and retainers, which patients can remove and wear on their own for easy cleaning and maintenance.

(3) Implanted dentures

Artificial implants are implanted into the jawbone through surgery, and after fusion with the jawbone, dental crowns or dentures are installed. Having the stability of fixed restorations while avoiding damage to adjacent teeth, it has become the preferred technique for modern oral restoration.

In recent years, breakthrough progress has been made in the field of antibacterial technology for oral restoration materials, which not only significantly improves the aesthetic effect of oral restoration, but also maximizes the restoration of the original function of oral tissues. Research has found that various oral tissue repair materials perform excellently in repairing dental tissue defects and functional deficiencies. However, the issue of anisotropy between materials and damaged oral tissue structures also needs attention to prevent potential oral diseases. Common oral restoration materials include:

(1) Silver amalgam

As a traditional dental filling material, silver amalgam is known for its high strength and wear resistance, especially suitable for repairing posterior dental caries, and can withstand large bite forces. But it is slightly lacking in aesthetics, with a significant difference in metallic color compared to natural teeth. In addition, the presence of mercury has also raised concerns about safety among some people.

(2) Composite resin

Composite resin is favored for its color close to natural teeth and good aesthetics. It can tightly bond with tooth tissue and exhibit a certain degree of adhesion. However, its strength is relatively low and it is prone to wear and tear, so patients need to pay attention to protection during use.

(3) Ceramic materials

Ceramic materials exhibit excellent beauty and biocompatibility, with a color highly similar to natural teeth, high hardness, good wear resistance, and the ability to withstand significant chewing pressure. Among them, zirconia, as a representative of all ceramic materials, is known for its extremely high durability and is not prone to cracking.

At the same time, it is widely used in the fields of beauty and repairing missing teeth, enabling continuous crown restoration of multiple teeth.

Cobalt chromium alloy occupies a place in the field of oral restoration due to its high melting point, high hardness, and low ductility. Its excellent corrosion resistance, biological safety, and affordable price make it a commonly used material for making dental metal porcelain base crowns and bridges. Clinical practice has proven that cobalt chromium alloy restorations exhibit excellent performance in dealing with various types of tooth defects, especially large-scale defects and heavily worn teeth. Their high strength, wear resistance, and adaptability are widely recognized [5]. However, cobalt chromium alloy restorations are not perfect. Its darker color may have an impact on the aesthetics of the restoration, especially in front tooth restorations where the metallic color may penetrate the porcelain layer and affect the overall aesthetic effect. In addition, cobalt chromium alloys may cause irritation to the gums, leading to gum recession or inflammation, which may be related to the precipitation of metal ions in the alloy. Furthermore, despite its high hardness, it may exhibit relative brittleness under stress, posing a risk of cracking. This study compared the clinical effects of zirconia restorations and cobalt chromium alloy restorations. The results showed that the research group using zirconia restorations showed significant improvements in bite force and chewing ability scores. At the same time, the OHIP-14, VAS score, and complication rate of this group were all reduced. The flexural strength of zirconia exceeds 1000 MPa, far higher than the traditional cobalt chromium alloy's strength of about 650 MPa, and close to the strength of natural dental enamel (300–400 MPa) [6]. This characteristic enables it to effectively disperse occlusal stress, reduce the risk of fracture of the restoration, thereby effectively restoring chewing function and reducing wear on the teeth. In terms of aesthetics, the translucency of zirconia and multi-layer staining technology can simulate the color and layering of natural teeth, significantly improving the aesthetics of restorations, especially suitable for anterior tooth restoration. In addition, zirconia has almost no allergenicity and can reduce gum inflammation and probing bleeding, improving periodontal health. Multiple clinical studies have confirmed that zirconia restorations are significantly superior to traditional metal restorations in terms of restoring bite force, improving chewing efficiency, and patient satisfaction. Although the hardness of zirconia (1200 HV) differs from that of natural dental enamel (340 HV), its surface polishing technique can significantly reduce the wear rate on dental teeth [7]. The bite force results showed that the restored bite force of the zirconia restoration was close to that of natural teeth, indicating better mechanical adaptability and more efficient transmission of chewing load, thereby improving chewing efficiency. The multi-layer dyeing technology of zirconia solves the appearance problem of "dead white" caused by the color blocking layer of metal porcelain crowns, improves aesthetics, and may indirectly enhance patients' confidence in using the restoration, reduce chewing avoidance behavior caused by psychological rejection, and further promote chewing function recovery. In addition, the chemical inertness of zirconia avoids the problem of ion dissociation in metal restorations, and its surface smoothness ($Ra < 0.2$ μm) can reduce plaque adhesion and lower the risk of gingivitis. A study compared the effects of zirconia restorations and cobalt chromium alloy restorations. The results showed that the zirconia group exhibited superior performance in terms of restoration effect, chewing function, tooth index, and inflammatory factor levels [8]. In recent years, a large amount of experimental and clinical data has confirmed that zirconia is non-toxic to bone tissue and soft tissue cells, and there have been no reports of users experiencing allergic reactions, demonstrating its excellent performance in terms of biosafety. In addition, the adhesive properties of zirconia ceramic restorations have also been extensively studied. The clinical bonding performance and durability of zirconia restorations can be effectively improved through physical sandblasting and primer treatment agents containing 10 methacryloyloxydecylphosphate. Zirconia restorations have become an ideal choice in the field of oral restoration due to their high strength, biomimetic aesthetic effects, and low risk of complications.

Based on comprehensive analysis, zirconia restorations have practical value in improving the biting and chewing abilities of oral restoration patients, reducing the incidence of complications, and other aspects.

About the author

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Disclosure statement

The author declares no conflict of interest.

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