

## ORIGINAL ARTICLE

# EFFICACY OF ZIRCONIA CROWNS: A 3 YEAR RETROSPECTIVE AND CLINICAL FOLLOW UP STUDY

Prashanth Shetty<sup>1</sup>, Pranav Verma<sup>2</sup>, Lokesh Chhapdia<sup>2</sup>, Anshul Sahu<sup>2</sup>, Narendra Singh Kushwaha<sup>2</sup>, Rahul Chaturvedi<sup>2</sup>, Suvashri Manna<sup>2</sup>

<sup>1</sup>Professor and Head, <sup>2</sup>Post graduate student, Department of Prosthodontics, Triveni Institute of Dental Sciences, Hospital and Research Centre, Bilaspur, Chhatisgarh


### ABSTRACT:

**Background:** All-ceramic crowns have become increasingly used also in the posterior regions, but there are only few studies documenting the clinical outcome of these restorations. The aim was therefore to present the 3-year outcome of zirconia single crowns. **Materials & Methods:** All patients treated with porcelain-veneered zirconia single crowns in prosthodontic department. The patient records were scrutinized for data on the restorations and the supporting teeth. Information was available for 152 patients and 260 crowns. At the 3-year recall appointments, a sample of 22 patients with 40 crowns was clinically examined and interviewed regarding patient satisfaction. **Results:** Most crowns (78%) were placed on premolars and molars. The clinical outcome of crowns was favourable. No zirconia core fractured and no caries was observed on the abutment teeth. Patient satisfaction with the zirconia crowns was in general high. **Conclusions:** The porcelain-veneered zirconia crowns showed good clinical results, were well accepted by the patients, and only few complications were reported over the 3-year follow-up period. Zirconia crowns can be alternative for metal –porcelain crowns in posterior teeth.

**Key Words:** Ceramic crowns, Metal –porcelain crowns, Zirconia

Corresponding Author: Dr. Prashanth Shetty, Professor and Head, Department of Prosthodontics, Triveni Institute of Dental Sciences, Hospital and Research Centre, Bilaspur, Chhatisgarh

This article may be cited as: Shetty P, Verma P, Chhapdia L, Sahu A, Kushwaha NS, Chaturvedi R, Manna S. Efficacy of zirconia crowns: A 3 year retrospective and clinical follow up study. J Adv Med Dent Scie Res 2016;4(4):96-100.

Access this article online	
<p>Quick Response Code</p> 	<p>Website: <a href="http://www.jamdsr.com">www.jamdsr.com</a></p>
	<p>DOI:</p> <p>10.21276/jamdsr.2016.4.4.21</p>

## INTRODUCTION

In the past decades, metal-ceramic and full metal crowns were widely used for restoration of teeth. Metal crowns were used for restorations for decayed, heavily repaired, fractured teeth. <sup>1</sup>Although the metal-ceramic crown was considered a “gold standard” for full coverage restoration, attempts have been made to replace the metal core with tooth color restorations due to increased patients’ demand for esthetics as well as

incidence of allergies to dental alloys components and high success rate.<sup>2</sup> For anterior teeth, the original porcelain jacket crown, fabricated of a feldspar ceramic can be used because chances of failure are less as compare to posterior teeth which requires more fracture resistant crowns.<sup>3</sup> Oxide ceramics based systems such as crystalline alumina and zirconia are superior to feldspathic ceramics with respect to mechanical properties, which have made them a

favourable choice for metal-free restorations also in the posterior region.<sup>4</sup>

Zirconium was introduced in dentistry in the early 1990s as zirconium oxide, which when stabilized with Yttrium generates a hard material. It is used for implants, veneers, crowns, and bridges.<sup>5</sup>

The mechanical properties of zirconia (zirconium dioxide, ZrO<sub>2</sub>) are the highest ever reported for any dental ceramic.

### PROPERTIES OF ZIRCONIA<sup>6</sup>

1. Low thermal conductivity.
2. Low corrosion potential.
3. Good radiographic contrast.
4. Good biologic compatibility.
5. Non-allergenicity.

Zirconia has been used clinically during the last few years but there are only few studies reporting the long-term results. Several studies of relatively few patients have reported promising results with zirconia fixed dental prostheses (FDP) with up to 100% survival but varying complication rates during 1–3 years in function.

The present study was done to evaluate the clinical outcome of zirconia based crown.

### MATERIALS & METHODS

This study was performed in department of prosthodontics in patients who were given zirconia based crowns . The number of patients was 152 with 260 zirconia crowns. It included 96 females and 56 males.

### PROSTHODONTIC PROCEDURES

The preparation of the teeth were performed with a deep chamfer and standardized as much as possible in accordance with the manufacturer's guidelines. A polyether was used for the impressions in a prefabricated tray. Temporary crowns were cemented with temporary zinc oxide eugenol (ZOE) cement. The plaster model of the prepared tooth was scanned and the zirconia core was designed using a computer-aided design (CAD). A computer-aided manufacturing (CAM) process of the crown was based on the digital information received and includes milling in aspressed zirconia. The zirconia copings were heated to 400 8C for binder burn-out and finally

sintered at 1500 8C. The CAD technique was used by the laboratory to design the zirconia cores with an anatomic form, with a minimum thickness of 0.5 mm to ensure the right thickness of the veneers according to the manufacturer. Feldspar porcelain, Vita Lumin (Vita Zahnfabrik, Bad Sackingen, Germany) or NobelRondo™ Zirconia (Nobel Biocare AB, Sweden) was fused to the cores by the laboratory. The veneering thickness layer was between 1.0 and 2.0 mm. The same dental laboratory produced all the crowns and one company manufactured all the zirconia cores.

The abutment teeth were cleaned with ultrasonic and 70% alcohol before cementation. Zinc phosphate cement was used for cementation of the 40 crowns and self-adhesive modified composite resin was used for the other 200 crowns.

Patients were recalled at one, two and three years. They were instructed to visit whenever they felt some problem.

Data was collected from the patient records regarding the following parameters: sex, age at crown delivery, number of crowns cemented, tooth position, veneering material, cement, occluding teeth in the opposite jaw, endodontic treatment before delivery, post material, loss of vitality, secondary caries and prosthodontic complications such as loss of retention and fractures. The treatment with Zirconia crowns was considered a failure when the abutment tooth was extracted or a remake of crown was performed because of the lost retention, not polishable veneer fracture or persistent pain. The following additional data were collected in the clinically examined patients: periodontal conditions (according to the CPITN<sup>22</sup>), periapical conditions (checking radiographs pre- and post-crown delivery), tooth mobility (classified: (1) <0.2mm in horizontal direction; (2) 0.2–1mm horizontally; (3) >1 mm horizontally; (4) mobility in vertical direction). The crowns were examined in accordance with the Californian Dental Association (CDA) system for quality evaluation for dental care.<sup>23</sup> The patients were interviewed regarding their satisfaction with their crowns using a visual analogue scale (VAS) of 100 mm with the endpoints extremely dissatisfied (0) and extremely satisfied (100). Results were subjected to statistical analysis.

**RESULTS**

Table I shows distribution of zirconia crowns. Out of 260 crowns, 140 were given in maxilla and 120 in mandible. The number of crowns in maxillary teeth was as follows, incisors-34, canine-16, premolar-48, molar 42. The number of crowns in mandibular teeth was as follows, incisors-26, canine-12, premolar-38, molar 44.

Table II shows that at after 1st year of crown placement, 12 were lost and 2 were failed. At 2<sup>nd</sup>

year, 16 were lost and 2 were failed. After 3 years, 10 were lost and 11 were failed.

Table III shows various complications of cemented zirconia crowns. Veneer chipping was seen in 2 anterior and 4 posterior teeth. Veneer fracture was seen in 2 posterior teeth. Loss of retention was seen in 2 anterior and 15 posterior teeth. Endo problem was seen in 16 posterior teeth. Extraction was done in 4 anterior and 6 posterior teeth either due to perio or endo lesion.

**Table I:** Distribution of Zirconia Crowns

ARCH	REGION				TOTAL
	INCISOR	CANINE	PREMOLAR	MOLAR	
MAXILLA	34	16	48	42	140
MANDIBLE	26	12	38	44	120
<b>TOTAL</b>	60	28	86	86	260

**Table II:** Life table analysis of placed zirconia crowns. cumulative survival rate (CSR)

Period	Examined crown	Lost	Failed	CSR
<b>Crown cementation</b>	240	0	0	100%
<b>1 year</b>	226	12	2	99.5
<b>2 year</b>	208	16	2	98.6
<b>3 year</b>	187	10	11	92.6
<b>Total</b>	187	38	15	92.6

**Table III:** Main complications of cemented zirconia crowns

	NUMBER OF CROWNS AT BASELINE AND NUMBER OF COMPLICATIONS				
	ANTERIOR	POSTERIOR	ENDO- TREATED	VITAL	TOTAL
No. at baseline	88	172	80	180	260
Veneer fracture(chipping)	2	4	1	5	6
Veneer fracture(adhesion)	0	2	0	2	2
Loss of retention	2	15	5	12	17
Endo problem	0	16	2	14	16
Extraction (perio/endo)	4	6	8	2	10

**Table IV:** Quality assessment according to CDA (%) of 40 zirconia crowns at 3-year follow-up

Parameter	Satisfactory		Not acceptable
	R	S	T/V
Surface and color	70	30	0
Anatomic form	100	0	0
Marginal integrity	90	10	0

R = range of excellence; S = range of acceptability; T = replace or correct for prevention; V = replace statim.

## DISCUSSION

Different types of zirconium are available for dental applications: yttrium cation-doped tetragonal zirconia polycrystals (Cercon Zirconia), glass-infiltrated zirconium toughened alumina (InCeram Zirconia), partially stabilized zirconium (Mg-PSZ), Cercon Base ZrO<sub>2</sub> sintered, shrinkage free ZrSiO<sub>4</sub> ceramic. Zirconia has demonstrated good results in short-term and up to 5-year follow-up studies.<sup>12–17</sup> In contrast to several reports on zirconia FDPs there are only few systematic studies of the clinical performance of zirconia crowns.<sup>7,8,9,10</sup>

The present study found favourable 3-year results of such crowns performed in a general dental practice. This study was done on 152 patients with 260 zirconia crowns. No caries was detected and no adverse soft tissue reactions around the crowns were observed. However, the periodontal conditions according to CPITN indicated a need for improved oral hygiene. In a review of complications in fixed prosthodontics, 22 studies of all-ceramic crowns were identified, none including zirconia restorations.<sup>11, 12</sup>

Veneer chipping was seen in 2 anterior and 4 posterior teeth. Veneer fracture was seen in 2 posterior teeth. Loss of retention was seen in 2 anterior and 15 posterior teeth. Endo problem was seen in 16 posterior teeth. Extraction was done in 4 anterior and 6 posterior teeth either due to perio or endo lesion. In the two only yet published controlled clinical studies of zirconia-based crowns, relatively low complication rates were found over a 2-year period.<sup>13,14</sup> The authors of both these studies concluded that the investigated all-ceramic crowns could sufficiently withstand functional load in the posterior zone. The present 3-year study corroborates these results.

Crown fracture was the most common cause for failure, strongly related to the location of the restoration. As there was no crown fracture in the present material it can be concluded that zirconia crowns behave differently from earlier all-ceramic restorations. The previous recommendation to avoid all ceramic restorations on posterior teeth does not seem relevant for zirconia crowns according to the available short-term results. Longer observation periods are necessary to secure such a statement.

The clinical quality of the crowns according to the CDA evaluation was all in the satisfactory range. Patient satisfaction with the crowns was high. Loss of retention and endodontic problems were higher in our study. This could be due to type of cement used or

improper tooth preparation. Similar complication rates have been reported for fixed prosthodontic restorations/crowns made of other materials.<sup>15</sup>

In our study, all endodontic problems and most loosening occurred in crowned teeth in the posterior region. One explanation might be that the molars and premolars had more severe loss of tooth substance than the anterior teeth before crown fabrication. Nevertheless, zirconia crowns appear to be able to withstand the functional loads also in the posterior region. Higher failure rate for root filled compared to vital abutment teeth has been demonstrated in several studies of metal–ceramic crowns<sup>16</sup>, findings, which concur with those in the present study.

## CONCLUSION

Author suggest that zirconia crowns can be alternative for metal –porcelain crowns in posterior teeth. However, long term studies are required to evaluate the results.

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**Source of support:** Nil

**Conflict of interest:** None declared

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