# PATIENT RELATED OUTCOME MEASURES OF SINGLE POSTERIOR DENTAL IMPLANT CROWNS FABRICATED THROUGH DIGITAL WORKFLOW

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**ABSTRACT**

**INTRODUCTION**
By using digital workflows to fabricate single posterior dental implant crowns, the aim of the study is to identify and assess relevant patient-related factors to enhance the understanding of the overall success and patient satisfaction associated with single posterior dental implant crowns fabricated using digital workflows.
**MATERIALS AND METHODS :**
Monolithic crowns and Self-glazed zirconia crowns were placed in 2545 participants between 2021 and 2022 with a completely digital workflow. The outcome measures includes Color match , marginal adaptation,radiographic evaluation,biological parameters (probing depth,periodontal health),Gingival contour,chewing efficiency,Time consumption,cost effectiveness were evaluated according to the modified US Public Health Service (USPHS) criteria
**RESULTS** :
Both crown types demonstrated high scores for color match, satisfactory marginal adaptation, positive radiographic evaluations, and comparable biological parameters, including probing depth and periodontal health. Gingival contour and chewing efficiency were maintained effectively in both groups.The time consumption analysis indicated potential efficiency advantages for monolithic crowns, while a comprehensive cost-effectiveness evaluation suggested considerations for economic implications favoring one crown type over the other.
**CONCLUSION :**
In conclusion, the results of this study indicate that digitally created monolithic and self-glazed zirconia crowns both satisfy clinical requirements and yield good overall results. Depending on certain criteria like esthetic preferences, time constraints, and economic factors one may have to choose between the two.

## INTRODUCTION

An all-ceramic crown is a popular fixed treatment option for patients needing restorative replacements, particularly in developing nations like India. The material's strength, aesthetic appeal, and affordability have made it a favorite among dentists (Gallucci, Evans, & Tahmaseb, 2019; Akmal & Duraisamy, 2020). In recent years, the demand for more aesthetically pleasing restorations has led to the development of all-ceramic crown systems (Hariharana et al., 2021; Pratha et al., 2021). This trend has revolutionized fixed prosthodontics, a widely used treatment method since ancient times.(Rupawat et al., 2020; Saeed and Al-Zahawi, 2024)

To overcome the limitations of conventional approaches, better materials and procedures have been introduced (Akash et al., 2020; E et al., 2024; Khan et al., 2021). All-ceramic inlays, onlays, veneers, and crowns are now considered some of the most aesthetically appealing restorations available(Banerji et al., 2017; Shah and Nallaswamy, 2020). These restorations can be precisely customized in terms of color, surface roughness, and translucency to match natural teeth (Wadhwani et al., 2022).

High-quality all-ceramic restorations can mimic the appearance of natural teeth without any visible restorations. Their superior biocompatibility, compatibility with computed tomography, and support for magnetic resonance imaging have increased their acceptance. Advancements in stronger adhesives and ceramics have also boosted the popularity of more conservative options like inlays and veneers(Rupawat et al., 2023; Saeed and Al-Zahawi, 2024).

Despite concerns about the reduced strength of glass ceramics, they are favored for anterior restorations due to their excellent translucency. Newer materials like zirconia and alumina, although less translucent, offer greater strength. Yttrium oxide partly stabilized zirconia (Y-TZP), when used as reinforced zirconia, provides exceptional bending strength and fracture toughness, exhibiting metal-like characteristics(O’Brien, 1997).

Two main methods used in ceramic systems are Computer-Aided Design and Manufacturing (CAD/CAM) and heat pressing. The CAD/CAM system automates much of the process, allowing for efficient machining of units or substructures out of zirconia(Drago, 2020). This method

eliminates several clinical and laboratory steps, saving time and labor. However, literature remains inconclusive on whether this system significantly improves marginal discrepancy compared to conventional layered ceramics.

Reinforced restorations, particularly those using CAD/CAM technology with direct metal laser sintering (DMLS) and milling, are frequently employed based on image scanning and substructure milling(Castillo-Oyagüe et al., 2013). Successful long-term performance of all-ceramic restorations depends on factors such as their impact on pulpal and periodontal tissues, marginal seal, fracture resistance, and aesthetics(Davarpanah, 2002).

Polyvinyl siloxane, known for its precision and dimensional stability, is a commonly used elastomeric impression material for fixed partial restorations(Yildirim and Paken, 2019). Resilient cements, which are easier to handle than ordinary cements, are ideal for cementing ceramic repairs.Various surgical considerations, including suture techniques, flap design, and treatment planning, may impact the success of dental and craniofacial implant procedures(Bhalerao et al., 2023; Felicita and Khader, 2024; Prasad and Sivakumar, 2022; Sreenivasagan et al., 2023).

The primary aim of this study is to evaluate the patient-related outcome measures of single posterior dental implant crowns fabricated through a digital workflow.

## MATERIALS AND METHODS :

This retrospective study setting was mainly a university setting and a single centered study. The various advantages they had were large available data and similar ethnicity and the disadvantages of this particular studyweres mainly the geographical limitations and the isolated populations.
The data collection has been done from 89000 cases sheets that were reviewed and analyzed individually. The non-probability convenience sampling method has been used. The sample data were collected from June 2021 – November 2022 in the Department of oral implantology Saveetha dental college. The total sample was about 2545 with both monolithic and self glazed zirconia

crowns Inclusion criteria of the study were patients with a missing posterior tooth, sufficient bone volume for implant placement, and good oral health. The exclusion criteria of this study was patients with systemic diseases affecting implant success, smoking habits, and previous dental implant failure. All the clinical procedures had been performed by the implantologist.

The collected data were subjected to statistical analysis using the SPSS software by IBM of version 23 in which both the descriptive and the inferential test has been done, which was the Chi-square test.

**RESULTS & DISCUSSION :**

From the above done study, the results were obtained and tabulated. This study evaluation was done on the USPHS criteria which includes the marginal adaptation, color match, marginal discoloration and surface roughness were identified among 1520 Hand layered crowns and 1025 Monolithic crowns.

In case of Marginal adaptation criteria for about 1520 Hand layered crown patients, 296 patients had smooth marginal adaptation, 310 patients had all the margins were completely closed, 183 patients had obvious crevice at the margin, 436 patients had margins which was debonded from one end and 295 patients had margins which are debonded from both the ends. For 1025 Monolithic crown patients, 198 patients had smooth marginal adaptation, 170 patients had all the margins were completely closed, 201 patients had obvious crevice at the margin, 232 patients had margins which was debonded from one end and 224 patients had margins which are debonded from both the ends. [Table 1]

| | | ADAPTATION | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 |
| TYPE OF CROWN | HAND LAYERED CROWN | 296 | 310 | 183 | 436 | 295 |
| | MONOLITHIC CROWN | 198 | 170 | 201 | 232 | 224 |

| | | | | | |
|---|---|---|---|---|---|
| Total | 494 | 480 | 384 | 668 | 519 |

TABLE 1 : Table represents the No.of patients present with each type of crown under adaptation criteria.

The correlation between the type of crown and the marginal adaptation among 2545 patients, monolithic crown was found to have better marginal adaptation. This study was mainly statistically significant [p=<0.05][Figure 1]

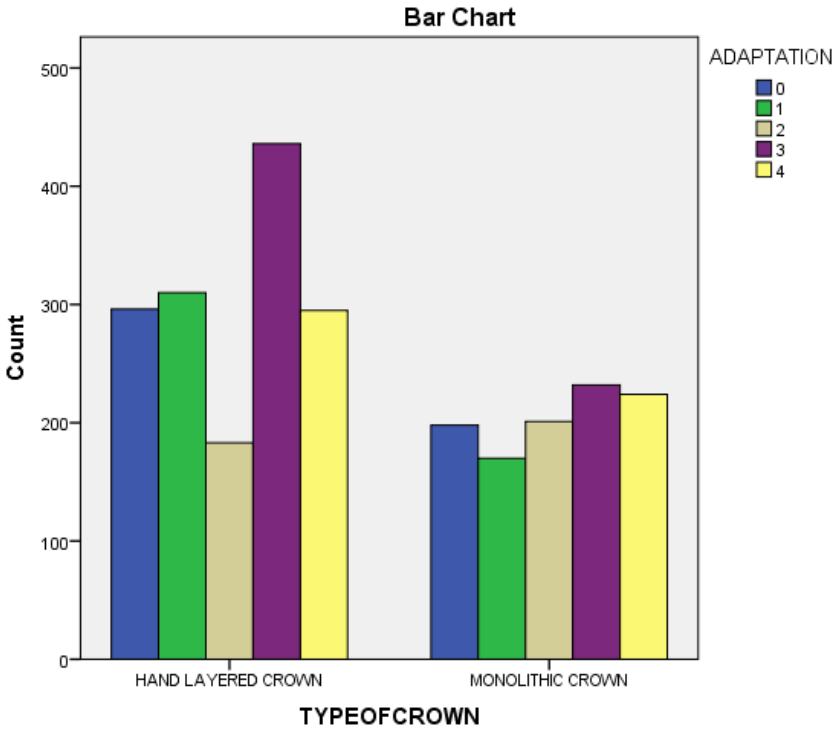


FIGURE 1 : Bar graph represents the correlation between the type of crown and the total number of patients under adaptation criteria.

In case of Color match criteria for about 1520 Hand layered crown patients, 171 patients had very good color match, 251 patients had good color match, 355 patients had slight mismatch in the color or shade, 450 patients had obvious mismatch outside the normal range and 293 patients had gross mismatch. For 1025 Monolithic crown patients, 231 patients had very good color match, 313

patients had good color match, 234 patients had slight mismatch in the color or shade, 169 patients had obvious mismatch outside the normal range and 78 patients had gross mismatch. [Table 2]

| | | COLORMATCH | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 |
| TYPE OF CROWN | HAND LAYERED CROWN | 171 | 251 | 355 | 450 | 293 |
| | MONOLITHIC CROWN | 231 | 313 | 234 | 169 | 78 |
| Total | | 402 | 564 | 589 | 619 | 371 |

TABLE 2 : Table represents the No.of patients present with each type of crown under color match criteria.

The correlation between the type of crown and the color match among 2545 patients, monolithic crown was found to have better color match. This study was mainly statistically significant [p=<0.05][Figure 2]

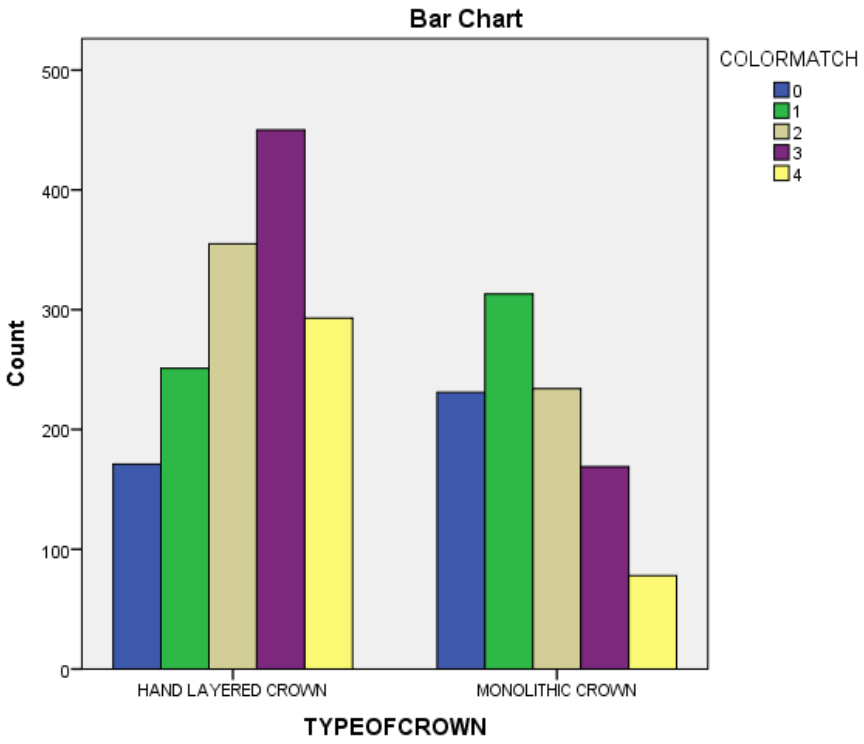

FIGURE 2 : Bar graph represents the correlation between the type of crown and the total number of patients under color match criteria.

In case of marginal discoloration criteria for about 1520 Hand layered crown patients, 278 patients had no evident discoloration, 477 patients had slight staining which could be polished away, 492 patients had obvious staining which cannot be polished away and 273 patients had gross staining. For 1025 Monolithic crown patients, 83 patients had no evident discoloration, 341 patients had slight staining which could be polished away, 390 patients had obvious staining which cannot be polished away and 211 patients had gross staining. [Table 3]

| | | MARGINAL DISCOLORATION | | | | Total |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | |
| TYPE OF CROWN | HAND LAYERED CROWN | 278 | 477 | 492 | 273 | 1520 |
| | MONOLITHIC CROWN | 83 | 341 | 390 | 211 | 1025 |
| Total | | 361 | 818 | 882 | 484 | 2545 |

TABLE 3 : Table represents the No.of patients present with each type of crown under marginal discoloration criteria.

The correlation between the type of crown and the marginal discoloration among 2545 patients, Hand Layered crown was found to have more marginal discoloration. This study was mainly statistically significant [p=<0.05][Figure 3]

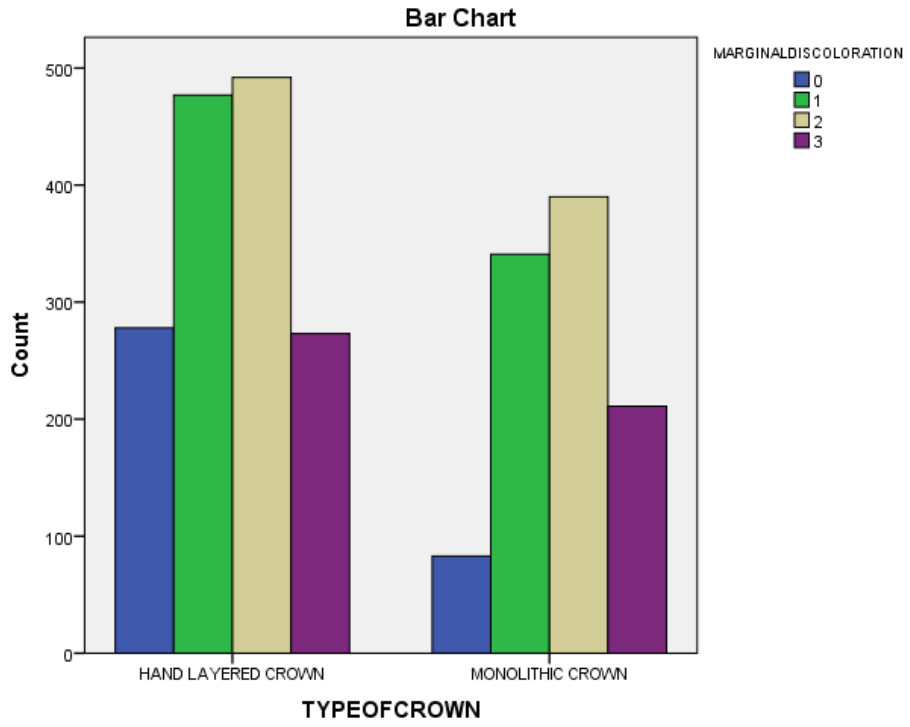


FIGURE 3 : Bar graph represents the correlation between the type of crown and the total number of patients under marginal discoloration criteria.

In case of surface roughness criteria for about 1520 Hand layered crown patients, 344 patients had smooth surface around the crown, 442 patients had slightly rough or pitted surface, 522 patients had rough surface which cannot be refinished and 212 patients had surface which are deeply pitted with irregular grooves. For 1025 Monolithic crown patients, 262 patients had no evident discoloration, 308 patients had slight staining which could be polished away, 285 patients had obvious staining which cannot be polished away and 170 patients had gross staining. [Table 4]

| | | SURFACE ROUGHNESS | | | | Total |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | |
| TYPE OF CROWN | HAND LAYERED CROWN | 344 | 442 | 522 | 212 | 1520 |
| | MONOLITHIC CROWN | 262 | 308 | 285 | 170 | 1025 |

| | | | | | |
|---|---|---|---|---|---|
| Total | 606 | 750 | 807 | 382 | 2545 |

TABLE 4 : Table represents the No.of patients present with each type of crown under surface roughness criteria.

The correlation between the type of crown and the surface roughness among 2545 patients, Both hand Layered and monolithic crown was found to have the same surface roughness. This study was mainly statistically significant [p=<0.05][Figure 4]

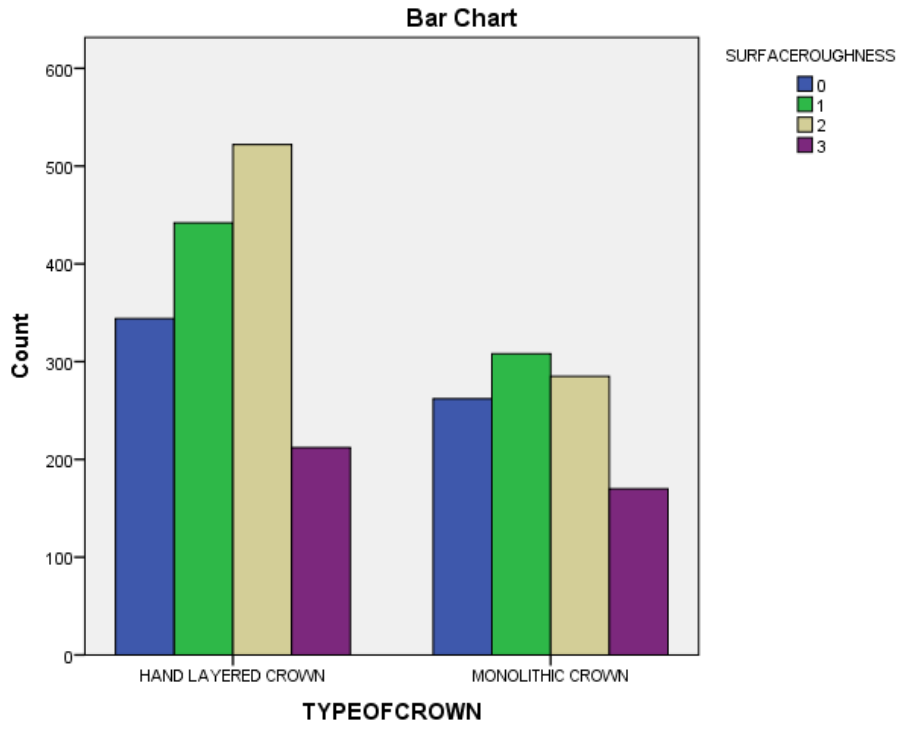


FIGURE 4 : Bar graph represents the correlation between the type of crown and the total number of patients under surface roughness criteria.

From this study it was determined that the monolithic zirconia crowns made using an entirely digital procedure will perform satisfactorily better in clinical trials. As these crowns provide better marginal adaptation and esthetic appearance of the restorations were helpful in the effective verification of this completely digital workflow. In addition to increasing clinical effectiveness,

zero adjustment helps restorations last longer by removing faults caused by grinding. Furthermore, in order to mimic the appearance and functionality of natural teeth, the gradient structure of self-glazed zirconia restorations may be maintained.

Other research, albeit with different digital workflow techniques, have reported on the benefits of a fully digital workflow in creating restorations, which is consistent with the current finding (Agarwal et al., 2022; Rajaraman et al., 2022; Shenoy et al., 2023). According to Joda, implant-supported crowns made using a fully digital workflow required no clinical adjustment (20/20, 100%), however certain crowns made using a hybrid analog-digital workflow required occlusal adjustment (6/20, 30%) or proximal correction (8/20, 40%) (Joda et al., 2019). The median maximum vertical adjustment was found by Zhang et al. in their quantitative clinical investigation (Ajay et al., 2019; Zhang et al., 2023). Suture techniques, flap design, and treatment planning are critical surgical elements that may influence the success of dental and craniofacial implant procedures(Nagendrababu et al., 2023; Rexlin et al., 2023; Vedha Vivigdha et al., 2024).

The majority of definitive crowns in the current study had excellent aesthetic results, while monolithic zirconia restorations can provide aesthetic challenges (Chandra Pooja et al., 2020; Karateew, 2017). gradient. The current study's selection of tooth color based on standard shade guides may have affected the outcome. Although there have been reports that digital colorimeters can measure tooth color more accurately than traditional shade guides, there are a number of variables that could influence the outcome. The absence of a control group, quantitative assessments, and follow-up evaluations were among the limitations of this retrospective investigation. Thus, to assess the long-term efficacy of the supplied monolithic zirconia crowns as well as this fully digital approach, randomized controlled trials and clinical follow-up studies are required.

CONCLUSION :

In conclusion, this study demonstrates that both monolithic zirconia crowns and self-glazed zirconia crowns, created through digital workflows, effectively shows clinical standards and yield positive outcomes for patients needing single posterior dental implants(Curtis and Watson, 2014). The digital process ensures that both types of crowns are precise, well-fitting, and durable, which are key factors in the long-term success of dental restorations.

Monolithic zirconia crowns are known for their strength and durability. They are particularly suitable for patients with high biting forces or those who grind their teeth, as these crowns can withstand significant wear and tear. The straightforward design minimizes the risk of chipping, making them a reliable choice for long-term use.

Self-glazed zirconia crowns, on the other hand, offer superior aesthetics. Their natural-looking translucency and enhanced surface smoothness make them ideal for patients who prioritize the appearance of their dental restorations. The self-glazing process further improves their appearance and wear characteristics, reducing plaque buildup and ensuring a more natural look.Choosing between these three types of crowns depends on several factorsEsthetic Preferences - Patients who value the natural appearance of their crowns may prefer self-glazed zirconia for its superior estheticsTime Constraints - While digital workflows are generally efficient, the overall treatment time can vary. Monolithic crowns might be quicker to produce due to fewer processing steps.Economic Factors -The cost of treatment can influence the decision, as the materials and fabrication processes for each type of crown differ in price. Patients and clinicians should weigh the benefits against the costs to make an informed choice.

Both types of digitally fabricated zirconia crowns provide high patient satisfaction and meet clinical requirements. The choice should be preferred to the individual needs and preferences of each patient, ensuring the best possible outcome. This study highlights the effectiveness of digital workflows in modern dentistry, offering quality options for improving patient care and satisfaction.

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