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Rehabilitation of commonly encountered anterior aesthetic challenges: A case series

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Abstract
In daily clinical practice, aesthetics of anterior teeth is a common presenting complaint of patients. This case series discusses the management of diastema and proclination of anterior teeth, asymmetric smile associated with unsatisfactory porcelain fused to metal restorations, missing anterior teeth with an unfavourable ridge relation, and missing single maxillary incisor tooth. The case report describes a clinical protocol using a variety of materials, ranging from pressed ceramics, zirconia, and conventional porcelain fused to metal. The treatment planning in all the cases was based on a diagnostic wax-up and cosmetic mock-up. After clinical and patient approvals were obtained, the patients was subjected to restorative treatment. Good planning enables satisfactory aesthetic results, and predictable functional success of anterior restorations.

Keywords: Aesthetic, smile, Diastema, faulty crowns, missing anterior teeth, anterior implant, laminates, Zirconia, pressed ceramics

1. Introduction
The demand for aesthetic dentistry has extensively increased; thus, treatment protocols for reestablishment of a smile have been proposed aiming at well-aligned and well-contoured teeth, setting the standard for beauty [1, 2]. In this sense, the beauty of smile is a correlation between teeth, gingiva, and lips [3]. In daily clinical practice, aesthetics of anterior teeth is a common presenting complaint of patients, which is affected by caries, malformation, anatomic alteration, discoloration/staining, and hypoplastic defects [2].
Aesthetic dentistry involves a harmonious integration of material selection and smile rehabilitation [4]. In relation to treatment of anterior teeth, the maxillary central incisors are the visual focal point for the smile, thus they should be symmetrical and dominant [4, 5]. The best approach to anterior teeth treatment has been widely discussed and a number of clinical protocols have been reported [2, 3, 4]. Among these, the all-ceramic or metal-ceramic crowns stand out due to their high biocompatibility, colour stability, high abrasion resistance, and clinical efficacy [6, 7].
This case series discusses

1. The management of a patient with a diastema in the anterior region, combined with proclined anterior teeth and open bite, and describes the clinical protocol for restoration using porcelain full crowns and porcelain laminate veneers;
2. The management of asymmetric smile associated with unsatisfactory restorations and replacement of the same with aesthetic Zirconia layered with emax crowns in harmony with the gingiva;
3. The management of missing incisor teeth with a class III ridge elation and open bite, with conventional porcelain fused to metal bridge, also aiming for pink aesthetics;
4. The management of single missing anterior tooth with implant and gingival recontouring for maximum aesthetic outcome.

2. Case report
2**.1 Case 1** (Figure 1 – Figure 5)
A 45 year old female patient presented with the desire to improve her unaesthetic facial appearance due to ‘gaps’ present between her front teeth. (Fig.1, Fig. 2) The patient was unhappy with the appearance of her teeth and restrained herself from smiling due to self-

consciousness. Complete dental and medical history of the patient along with preoperative photographs was taken. On clinical examination it was found that apart from anterior spacing, proclination of maxillary anterior teeth, with a slight open bite was also a concern. The patient exhibited a canine guided occlusion, bilaterally. Following a careful evaluation of the objective parameters of the patient's smile, all treatment options were discussed. As the patient was unwilling for long-term fixed orthodontic therapy, a conservative, aesthetic procedure using porcelain crowns and laminate veneers was selected. So, four maxillary anterior full ceramic crowns on the central incisors and canines, and two maxillary anterior veneers on lateral incisors were planned.

Treatment Protocol

Pre-prosthetics and initial appointment

Diagnostic impressions were made using irreversible hydrocolloid (Coltoprint, Coltene, India), poured with Type IV dental stone (Kalabhai, India). Shade was selected using Vitapan Classical shade guide (Vita Zahnfabrik, Germany).

Mock-up

One set of study models was used for wax up of the anterior teeth without any mock-preparation. On the second set of study casts, mock preparations were done, followed by wax up. 2 wax ups were prepared to choose the best for optimum aesthetic results. (Fig. 3)

Galip Gurel's preparation protocol

APR- (Aesthetic pre-recontouring). A silicone index according to this wax up was built and was tried on the teeth and was checked for passive fit. Due to the protruded position of the incisal third of the central incisors, APR was carried out.

APT- (Aesthetic pre-evaluative temporaries). In order to test the final outcome of the proposed smile design, the APTs were tested using Bisacryl composite material (Cooltemp, Coltene, India). Depth cutting burs (0.5 mm) were used to achieve the required depth and were marked with a pencil. A tapered diamond chamfer bur (Mani Burs) was used to create incisal reductions of approximately 1.5 to 2 mm and facial preparation was done until the pencil marks disappeared. Margins were placed. Central incisors and canines were prepared to receive full crowns, and lateral incisors to receive wrap-around laminates. Gingival displacement was done (#00 cord with AlCl3 solution) and two-stage final impression with addition polysiloxane was made (Aquasil, Dentsply Sirona).

Final prosthesis

Pressable ceramic, glass-ceramic lithium disilicate was used (IPSe. Max Press, Ivoclar Vivadent).

Bonding

Internal surfaces of the crowns and veneers were etched with 9.5% hydrofluoric acid (Ultra dent, Germany) for 20 s and were silanized with a silane coupling agent (Monobond Plus, Ivoclar Vivadent) before luting. Acid etching was done with 37% phosphoric acid (Total Etch, Ivoclar Vivadent) and the etchant was thoroughly rinsed off after a duration of 15 s. All the teeth surfaces and inner surface of veneers were coated with bonding agent in thin layer and light polymerized for 25–30 s. Dual cure composite luting agent (Variolink-II, Ivoclar) of appropriate shade was selected and placed in the inner surface of porcelain veneers. Initial polymerization was done for 5 s to remove excess luting agent and cured for 60 s on each tooth.

Instructions

The patient was advised to not use the front teeth to bite on hard foods. A nightguard was fabricated for the patient. Daily massaging of the gums in downward motion, daily gentle flossing, use of a mouthwash, and a 6-monthly follow-up was advised.

There was considerable improvement in overall appearance of the patients in terms of aesthetics as seen in post rehabilitation photographs.

Fig 1: Pre-operative smile- diastema

Fig 2: Pre-operative close-up- diastema

Fig 3: Post-operative smile- diastema closure

Fig 4: Post-operative close-up- diastema closed with lithium disilicate crowns and veneers

Fig 5: Galip Gurel's preparation technique utilizing APR-APT

2.2 Case 2 (Figure 6 – Figure 10)

A 35 year old female patient presented with the complaint of smile dissatisfaction relating to the bulky appearance of the

anterior teeth, hindered speech, and a conscious demeanour because of the appearance of her front teeth. (Figure). The clinical examination revealed bulky, bulbous, joint crowns on right central and lateral incisors with unsatisfactory colour, roughened texture, and inappropriate axial inclination. Following careful evaluation of the objective parameters of the patient's smile, removal of the crowns and space analysis was carried out. It was revealed that the available space for restoration was greater than that on the contralateral side. CAD designing was carried out and Zirconia layered with porcelain crowns were given.

Treatment Protocol

Pre-prosthetics and initial appointment

Existing restorations were removed using a tungsten carbide bur (Trihawk), and root canal treatment was found to be satisfactory. Diagnostic impressions were made using irreversible hydrocolloid (Coltoprint, Coltene, India), poured with Type IV dental stone (Kalabhai, India). Shade was selected using Vitapan Classical shade guide (Vita Zahnfabrik, Germany).

Mock-up

Wax up was carried out on the diagnostic cast after space analysis. As the space discrepancy between the right and left sides was significant, the wax up of the lateral incisor was done to increase the tilt and to slightly overlap the central incisor. Silicone index was made to serve as a preparation guide.

Preparation modification

The under-prepared teeth were modified, and sufficient incisal, labial, and palatal reduction was done in accordance with the silicone index. Radial shoulder finish lines were placed subgingivally. The incisors were discoloured. So, a careful bleaching was necessary. A combination of sodium perborate and distilled water was used, as it is less invasive [13]. After 2 times of bleaching, the attempt of the whitening in this case left a slightly persisting discoloration. This declined the indication of vitroceramic in favour of opaque ceramic hiding the coloration of the central incisor. Stump shade was selected. Two-stage impression was made after gingival displacement with addition polyvinylsiloxane material.

Final prosthesis

Y-TZP was manufactured through computer-aided design/computer-aided manufacturing (CAD/CAM) technology. Zirconia crowns, milled, layered with emax. Separate crowns.

Cementation

Resin-modified GIC was used (FujiCem, GC) Instructions: Flossing daily, additional use of a mouthwash, downward massage of the gums, and a 6-monthly follow-up was advised. There was considerable improvement in overall appearance of the patients in terms of aesthetics as seen in post rehabilitation photographs.

Fig 6: Pre-operative smile- unaesthetic, bulky, and asymmetrical anterior crowns

Fig 7: Post-operative smile- replacement with aesthetic crowns

Fig 8: CAD-CAM technology utilized for virtually designing and milling new zirconia crowns

Fig 9: Aesthetic Zirconia crowns layered with Lithium disilicate

Fig 10: Post-operative close-up- replacement with aesthetic layered Zirconia crowns

2.3 Case 3 (Figure 11 - Figure 15)

A 30 year old female patient presented with the complaint of multiple upper front missing teeth. She complained that she was ashamed of the way she looked, and talked. A past history of trauma due to fall, and subsequent neglect led to the ultimate decay, infection and extraction of maxillary incisor teeth. Her medical history was non-confirmatory. A detailed examination revealed that she had a gummy smile, incompetent lips, class III ridge relation, labial bone defect, and a lisp in her speech. Following careful evaluation of the objective parameters of the patient's smile, a diagnostic wax up was performed. After discussing all possible treatment plans, the patient rejected grafting and subsequent implant placement procedures owing to its invasive nature and high cost. Porcelain fused to metal conventional fixed bridge with additional gingival ceramic to mask the buccal defect was given to the patient.

Treatment Protocol

Pre-prosthetics and initial appointment

Diagnostic impressions were made using irreversible

hydrocolloid (Coltoprint, Coltene, India), poured with Type IV dental stone (Kalabhai, India). Shade was selected using Vitapan Classical shade guide (Vita Zahnfabrik, Germany) both for the teeth, and the gingiva.

Mock-up

Wax up was carried out on the diagnostic cast. The labial bony defect was covered with pink wax, while the teeth were done in white wax, maintaining the ideal zeniths in relation to the canines.

Tooth Preparation

CLP was planned and carried out on the canines. The canines were selected as the abutment teeth for the fixed partial prosthesis. Preparation was carried out carefully, maintaining parallelism. Chamfer finish lines were created using a round-ended tapered fissure bur, and were placed subgingivally following CLP and biologic width evaluation. Ovate pontic site preparation was unfruitful owing to the labial deficit, and patient's non-compliance to extensive invasive grafting procedures. Two-stage impression was made after gingival displacement with addition polyvinylsiloxane material. A temporary prosthesis fabricated on the basis of the wax up, reflected the final restorations which was utilized as a design pre-establishing the aesthetic outcome and guiding adjunctive treatment procedure.

Final Prosthesis

A conventional porcelain fused to metal 6 Unit Bridge with modified ridge-lap design for the pontics, and gingival ceramic making point contact with the surfaces to mask the defect and to achieve maximum aesthetics within the limitations of the case. All contact with the soft tissues was created in highly glazed ceramic, as it has the most favourable tissue response.

Cementation

The prosthesis was cemented with Type I (luting) GIC (GC).

Instructions

Patient was advised to floss daily, use adjuncts like mouthwash daily, and massage the gums in downward motion for stimulation. 6-monthly follow-up was advocated.

There was considerable improvement in overall appearance of the patients in terms of aesthetics as seen in post rehabilitation photographs.

Fig 11: Pre-operative smile- missing anterior teeth, gummy smile

Fig 12: Post-operative smile- replacement of missing anterior teeth and gummy smile with a very aesthetic conventional PFM bridge with gingival porcelain

Fig 13: Pre-operative intra-oral view- missing anterior teeth, class III ridge

Fig 14: Post-operative smile- replacement of missing anterior teeth with a conventional PFM bridge, and masking of gummy smile by addition of gingival ceramic

3. Discussion

The size, form and appearance of the maxillary anterior teeth are important not only to dental aesthetics but also to facial aesthetics. The goal is to restore the maxillary anterior teeth in harmony with the adjacent tissues as well as the facial appearance. However, there is little scientific data in the dental literature to use as a guide for defining the proper size and shape of anterior teeth or determining normal relationships for them and the adjacent tissue [8]. According to Young "it is apparent that beauty, harmony, naturalness, and individuality are major qualities" of aesthetics [9].

The etiology of diastema may be attributed to the following factors: (a) Hereditary- congenitally missing teeth, tooth and jaw size discrepancy, supernumerary teeth and frenum attachments; (b) Developmental problems- habits, periodontal disease, tooth loss, posterior bite collapse.[10] Treatment planning for diastema correction include orthodontic closure, restorative therapy, surgical correction or multidisciplinary approach depending upon the cause of diastema [10]. The restorative closure of diastema can be achieved by using any of the techniques mentioned; direct composite veneers, indirect composite veneers, porcelain laminate veneers, all ceramic crowns, metal ceramic crowns and composite crowns [10, 11]. Composite resin and porcelain are the most frequently used veneering material for diastema closure conservatively. It has become increasingly apparent that conservation of tooth structure is a major factor in determining the long term prognosis of any restorative procedure. One of the most important advantages of bonded porcelain restorations is that they are extremely conservative in terms of tooth reduction, and this rarely to pulpal involvement. The highly glazed surface of the porcelain

prevents plaque accumulation, considered important to attain a healthy periodontal response. Excellent aesthetics can also be achieved due to lifelike appearance of porcelain and scattering effect of the luting cement [12]. However, porcelain laminates have their own limitations too. They cannot be used when remaining enamel is inadequate to provide adequate retention [12]. For the same reason, full ceramic crowns were chosen for the central incisors and canines in Case 1. Galip Gurel's preparation technique [13] for minimally invasive porcelain laminate veneers are the gold standard in veneer preparation.

A study conducted by Walton *et al.* [14] concluded that secondary caries were the most frequent cause of failure accounting 24.3% of the units requiring replacement and periodontal diseases or mobility were the next most frequent oral diseases causing failure of single crowns or FPD. Whereas, the second most frequent reason for replacement was poor aesthetics as reported by patients themselves accounting for 6% units requiring replacement. Based on the aesthetic demands that increase the interest for non-metallic and biocompatible restorative materials and with the development of zirconia based prostheses, Yttrium-oxide partially stabilized zirconia (YTZP) became commonly used for anterior teeth when the abutments were discoloured, or for opaque teeth [15, 16]. The clinical techniques and aesthetic-driven sequence for an outcome-based protocol that enhances therapeutic cohesiveness in failed crowns, and ensures the sequential transfer of design objectives for the improvement of aesthetics must be understood. Zirconia based crowns are CAD-CAM manufactured, and are the most suitable prostheses to cover discoloured abutments. An opaque zirconia core overlaid by translucent enamel has a more natural appearance, and provides greater aesthetic results [17].

Dental aesthetics is not only based on "white component" of the restoration but also on the "pink component." [18] Many a times, the pink component or gingival tissue is lost due to extensive gingival and periodontal surgical procedures, trauma, ridge resorption, traumatic extraction, or trauma from occlusion [19]. The regenerative surgical procedure that can be employed includes soft-tissue grafts. Even after surgical procedures, in some cases, the results are unpredictable and unsatisfactory in terms of aesthetics and function. Many authors have suggested fixed prosthesis with gingival-coloured porcelain or removable gingival prosthesis as a replacement for the defect [20]. Historically, porcelain fused to metal ceramic restorations (PFMs) have been the "workhorse" of fixed restorative dentistry. It is possible to fabricate PFM restorations that rival all-ceramic restorations aesthetically with the use of proper use of new-generation porcelains and alloy systems. In such situations, a gingival-coloured prosthesis can be one of the options as a treatment to recover the hard- and soft-tissue defect.

4. Conclusion

Aesthetics is very subjective and necessitates excellent communication between the dentist, patient and ceramist. The case has to be carefully selected and treatment planned. The use of the mock-ups, followed by a wax-up, and silicone index for checking the preparation will not only allow the dentist to achieve the best aesthetic, phonetic and functional outcome, but also to communicate this to the patient, and to the laboratory.

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