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A Multidisciplinary Practicable Approach for Rehabilitation of Grossly Mutilated Premolars - Original Case Series

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Abstract

Extensive loss of tooth structure due to caries, trauma, previous restoration failures, or even procedures related to endodontic treatment can sometimes pose difficulty in fabrication and retention of full coverage restorations. The substantial loss and weakening of remaining tooth structure often necessitates the placement of post and core to salvage an existing tooth and helps to anchor a dental crown on it. This article describes a series of 3 clinical case reports with interdisciplinary approach combining periodontal, endodontic and prosthetic treatment for the rehabilitation of grossly mutilated/decayed teeth to achieve long term success of therapy. The interdisciplinary treatment plan for esthetic and functional rehabilitation of severely broken down teeth requires crown lengthening procedures (CLP) followed by post and core and full coverage restorations. The crown lengthening procedure is commonly done when an inadequate clinical crown structure is available for the retention of indirect restoration and re-establishment of biologic width space. The cases discussed here have been treated with both electrosurgical and surgical means to avoid any violation of Biologic Width (BW) which in turn leads to chronic gingival inflammation, pain, clinical attachment loss and bone loss.

Keywords: *Crown Lengthening Procedure; Electrosurgery; Interdisciplinary Approach; Post and Core; Biologic Width*

Abbreviations

CLP, ES, BW

Introduction

The esthetic and functional success of a dental treatment depends on accurate diagnosis, precise treatment plan, skillful clinical and laboratory procedures. Formulation of a comprehensive treatment plan and its execution is the most challenging task and holds important role in clinical practice. Esthetically and functionally driven treatment plan should include structured and interdisciplinary approach [1,2]. With every patient being unique and representing a special blend of clinical characteristics, our knowledge of interdisciplinary concepts can open a whole range of treatment options and outcomes for the patient [2]. Every dentist must have a thorough knowledge of periodontal, endodontic and restorative parameters in achieving esthetic and functional success in badly mutilated teeth, with the most conservative and biologically sound interdisciplinary treatment plan [3].

The amount of remaining tooth structure is the most important predictor for the long-term success of a dental restoration. Successful esthetic and restorative outcomes can be best accomplished in a tooth surrounded with healthy and stable tissues. But in cases with severe loss of tooth structure due to subgingival caries, trauma/fractures and previous restorations, gingival overgrowth is a condition that commonly develops. These teeth will almost always end up with extraction as they lack the optimum crown root ratio and inadequate ferrule effect would compromise the predictability of the restorative treatment. When there has been sufficient loss of tooth structure, consideration should be given for crown lengthening procedures and placement of post and core for retention of the final crown [4]. According to Wenjia., *et al.* (2020) [5], it was found that the higher the ferrule height, the greater the fracture resistance of the tooth. Teeth with ferrule thickness of > 1.5 mm can achieve higher fracture resistance and have a better long-term prognosis. Various treatment options are documented in the literature for altering gingival tissue levels. One of the most frequently advocated is crown lengthening procedures. DW Cohen [6] gave the concept of crown lengthening procedure in the year 1962. Crown lengthening is a surgical procedure designed to remove periodontal tissue in order to expose the sound tooth structure [7]. It can be performed by the use of scalpel, electrocautery and lasers (Kalsi, Hussain, and Darbar, 2015; Allen, Wagenberg, Bashetty, McGuire, and Lagdive, 1993). Based on the esthetic functional and economic requirement of each patient, best treatment option has to be formulated [8,9].

The present case reports were designed to assess the clinical effectiveness of traditional surgical versus electrosurgical method for crown lengthening procedures and to weigh the outcomes of both techniques in achieving excellent esthetic and functional result for the patient.

Case Reports

Case 1

A 32-year-old female patient referred to the Department of Conservative Dentistry and Endodontics at Panineeya Institute of Dental Sciences and Research Centre, Hyderabad with a chief complaint of food lodgement in the upper right back tooth region since 1 month with no associated pain or discomfort. The medical history was non-contributory. A review of the patient's dental history revealed that patient had undergone root canal treatment 1 year back in relation to tooth 14, 15. Clinical examination revealed mild calculus, short clinical crown in relation to 15 with increased periodontal probing depth of about 5mm on the distal aspect of the tooth. Further examination revealed overgrowth of gingiva into the carious lesion and interproximal between 15 and 16 which was reddish pink in colour with slightly soft and edematous interdental papilla. The teeth were non tender to percussion, palpation and biting and no mobility was detected. Radiographically there was no bone loss evident, adequate obturation with no periapical changes detected with both 14 and 15. The tooth was diagnosed as root canal treated with dislodged post endo restoration and secondary caries in relation to 15. Before the commencement of treatment, possible treatment interventions were explained to the patient which includes

- Extraction of the tooth 15 followed by FPD.
- Extraction followed by implant supported prosthesis,
- Crown lengthening followed by post and core build up and full coverage restoration.

After explaining the success and failure possibilities of various treatment options, patient requested to save the tooth and opted to have an interdisciplinary approach. Informed written consent was obtained from the patient and complete oral prophylaxis was performed before the start of the treatment and necessary oral hygiene instructions were given to the patient for proper maintenance of oral hygiene. Thereafter CLP was performed in relation to 15 under local anesthesia (2% lignocaine with 1: 80000 adrenaline) by using electrocautery with single wire electrode tip. Then post space preparation was done in relation to15 with the help of peeso-reamers (Mani,

Japan) #1 - 4, retaining approximately 5-6mm of gutta-percha apically. Fiber post (Self post, Italy) of the suitable size was cemented by variolink resin cement (Ivoclar vivadent, India) and core build up of adequate height was done by resin based composite (Ivoclar vivadent, India) in relation to 15 followed by tooth preparation and cementation of metal ceramic prosthesis in relation to teeth 14 and 15 by using Cention® N (Ivoclar vivadent, India). The patient was recalled after 1 week and observed that patient was asymptomatic with good dental health and radiographically no abnormality detected. Further follow ups for the patient were scheduled after 1 month, 3 months, 6 months, 9 months and periodically at 3 month intervals up to 2 years. Oral hygiene instructions were reinforced throughout the treatment and patient was placed on oral hygiene maintenance therapy.

Case 2

A 28-year-old female patient reported to the Department of Conservative Dentistry and Endodontics at Panineeya Institute of Dental Sciences and Research Centre, Hyderabad with a chief complaint of food lodgement and pain in the upper left back tooth region since 2 months. Dental examination revealed presence of heavy stains and calculus. On clinical examination it was observed that there was grossly decayed tooth in relation with 24 and periodontal probing depth of about 6mm on the mesial aspect of the tooth. The tooth was tender to percussion, palpation and no mobility detected. Radiographically there was no bone loss and no periapical changes detected. Past medical and dental history revealed nothing significant. The diagnosis of the tooth was symptomatic irreversible pulpitis in relation to 24. Antibiotics and analgesics were prescribed for 5 days and oral prophylaxis was performed. After explaining the treatment plan, informed written consent was obtained from the patient and access opening was done in relation to 24 followed by endodontic build-up by using glass ionomer cement (GC gold label II, Japan) in relation to 24 and margins of the gingiva was cauterized by using an electrocautery. After the completion of CLP, remaining root canal treatment was performed. Biomechanical preparation was done in a crown down manner by using protaper universal rotary files (Dentsply, India) up to ISO # 25 (6%). Then obturation was done by using Gutta percha cones (Dentsply, India) followed by post space preparation by using peeso-reamers (Mani, Japan) of size # 1 - 3 in palatal canal in relation to 24. The post (Self post, Italy) of the suitable size was selected and cemented and core build-up was performed by using resin based composite (Ivoclar vivadent, India). Thereafter tooth preparation was done in relation to tooth 24 and patients upper and lower arch impressions were made in poly vinyl siloxane impression material followed by metal ceramic crown cementation in relation to 24. The patient was recalled after 1 month, 3 months and followed up to a period of $1^{1/2}$ years. On clinical and radiographic examination, it was observed that the tooth was asymptomatic and functional.

Case 3

A 33-year-old female patient was referred to the Department of Conservative Dentistry and Endodontics at Panineeya Institute of Dental Sciences and Research Centre, Hyderabad with a chief complaint of pain and food lodgement in the upper left back tooth region since 10 days. On clinical examination, there were mild stains and calculus with no mobility detected. The tooth was tender to percussion with deep dental caries, periodontal probing depth of 4mm, adequate width of keratinized gingiva in relation to 24. Radiographic examination showed no bone loss and no periapical changes detected. The tooth was diagnosed as symptomatic irreversible pulpitis in relation to 24. Informed written consent was obtained from the patient after explaining treatment plan and root canal treatment was performed. After the completion of root canal treatment, post space preparation was done in the palatal canal by using peeso-reamers (Mani, Japan) #1 - 4 in relation to 24 followed by post placement and core build-up. Crown lengthening procedure was then performed in relation to 24 under local anesthesia by using scalpel and Bard parker blade (no.15). Tooth preparation was done in relation to 24 and metal ceramic crown was fabricated and cemented in the next appointment. The patient was recalled after 1 month, 6 months, 9 months and followed up to $1^{1/2}$ years and no abnormality detected on clinical and radiographic examination.

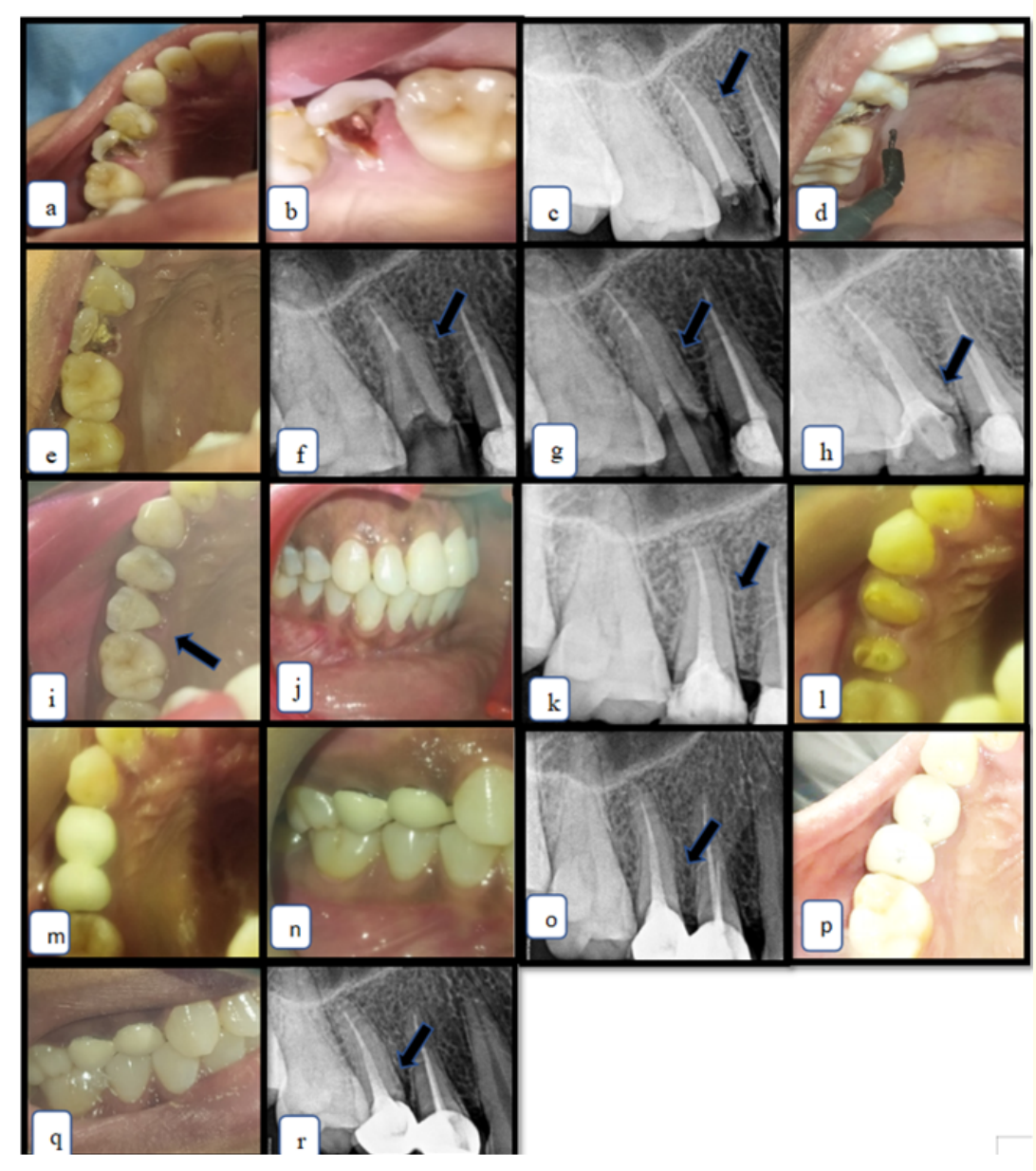

Figure 1: *(a) and (b) pre-operative image (c) pre-op radiograph (d) image showing crown lengthening with electrosurgery irt 15 (e) immediately after crown lengthening (f) post space preparation irt 15 (g)post placement (h)post cementation irt 15 (i) radiograph after core build up irt 15 (j) and (k) image after core build up irt 15 (l) crown preparation irt 14,15 (m) and (n) image showing crown placement irt 14,15 (o) radiograph after crown cementation (p) and (q) intraoral image of 3 month follow up (r) radiograph after 3 month follow up.*

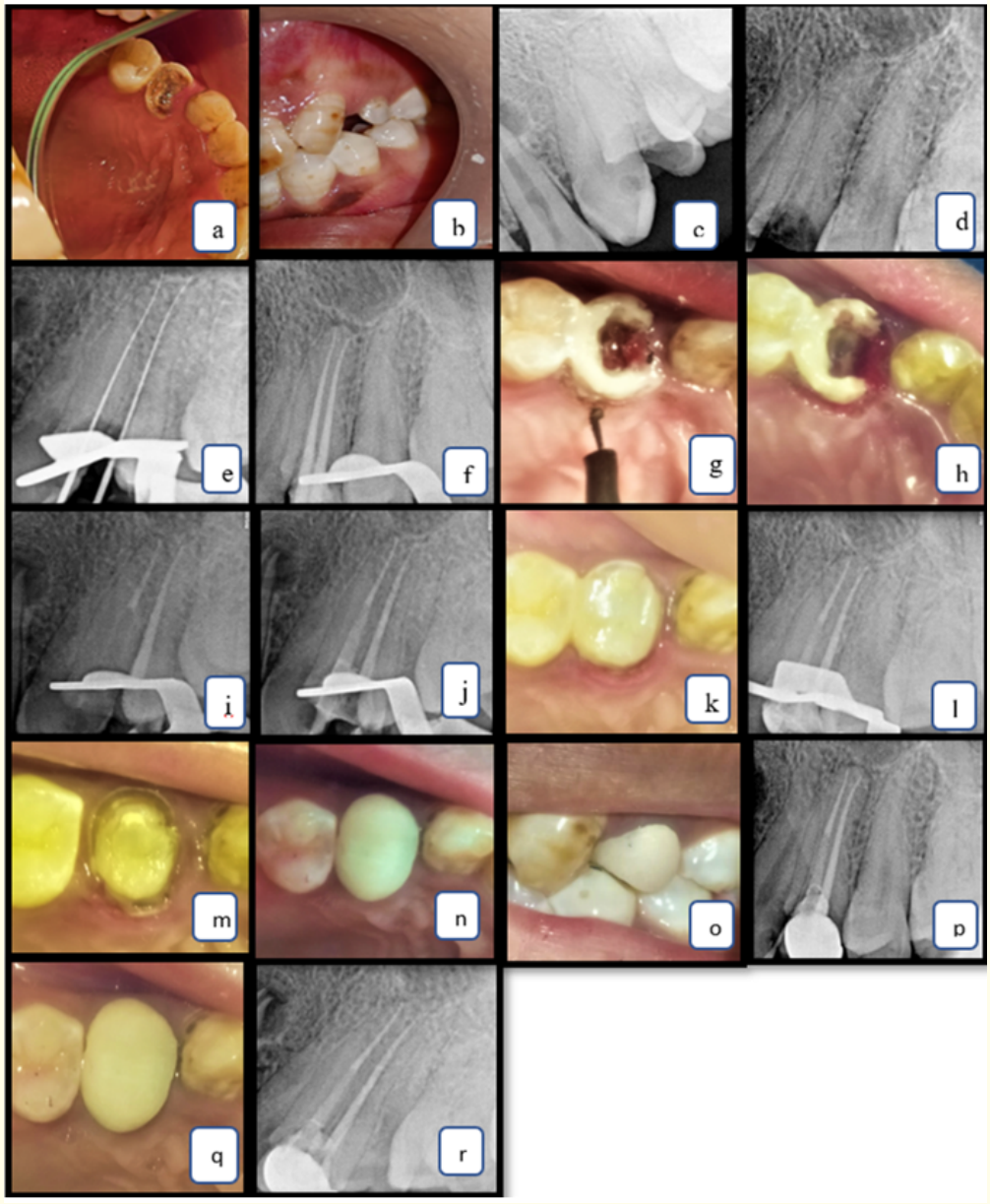

Figure 2: *(a) and (b) pre-operative image (c) and (d) pre-op radiograph (e) working length radiograph irt 24 (f) image showing crown lengthening with electrosurgery irt 24 (g) immediately after crown lengthening (h) radiograph showing obturation irt 24 (i) radiograph showing post preparation (j) radiograph after post cementation (k) image after core build up irt 24 (l) radiograph after core build up irt 24 (m) image after tooth preparation irt 24 (n) annd (o) image after crown cementation irt 24 (p) radiograph after crown cementation irt 24 (q) radiograph after 1month follow up irt 24 (r) image after1 month follow up irt 24.*

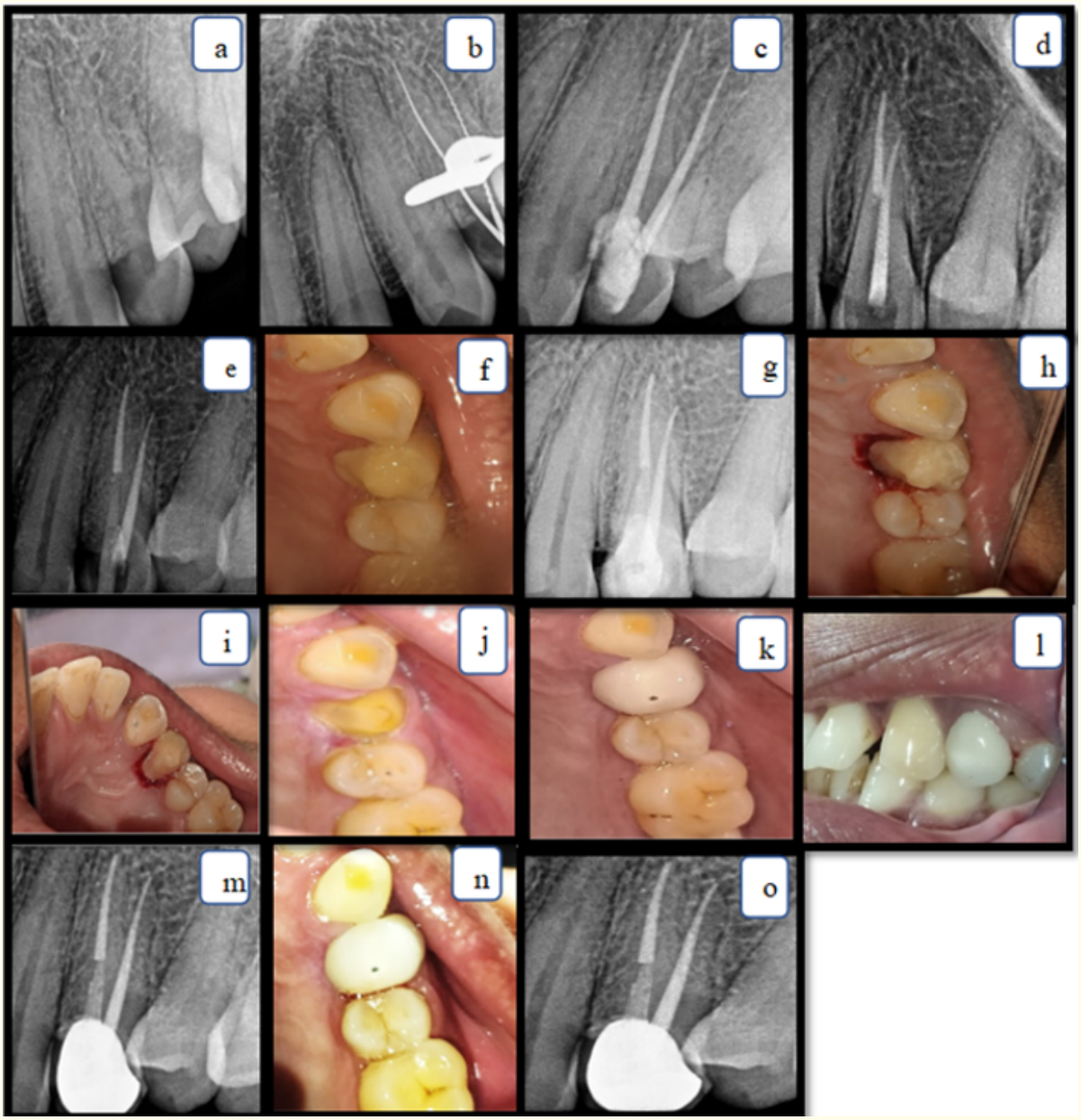

Figure 3: *(a) pre-operative radiograph irt 24 (b) radiograph showing working length irt 24 (c) radiograph after obturation irt 24 (d) radiograph showing post space preparation irt 24 (e) radiograph showing post placement irt 24 (f) image after core build up irt 24 (g) radiograph after core build up irt 24 (h) and (i) image after crown lengthening with scalpel (j) image after crown preparation irt 24 (k) and (l) image after crown placement irt 24 (m) radiograph after crown placement irt 24 (n) image after 3 month follow up (o) radiograph after 3 month follow up.*

Discussion

Decision-making processes of a tooth as having a good, questionable, or hopeless prognosis are based on the periodontal, endodontic, and restorative parameters**.** In order to best address the biological, functional, and esthetic requirements of each particular case, careful diagnosis and accurate treatment plan is mandatory for every dentist. The cases in this paper presented were not having sufficient coronal tooth structure to provide retention for crown. Decision was made to save the tooth rather than to extract it by following interdisciplinary treatment approach. According to Moghaddam AS (2014) [10], the long-term survival rate of multidisciplinary-treated teeth (combined endodontic, periodontal, and prosthodontic treatment) was 83% - 98%, for 245 teeth followed for at least 3 years to more than 10 years (3 - 5 years 98%, 5 - 10 years 96%, and ≥ 10 years 83%).

The periodontal health was considered and crown lengthening procedure was performed to achieve margins on sound tooth structure, for maintenance of the biologic width, to provide access for impression techniques and for esthetic purpose [11].

According to the definition of the American Academy of Periodontology, Crown lengthening is a surgical procedure designed to increase the extent of the supragingival tooth structure for restorative or esthetic purposes by apically positioning the gingival margin, removing supporting bone or both [12]. According to Ashnagar (2019) [13], the long-term survival of CLP treated structurally-compromised teeth has been found to be quite acceptable at 78.4% at 10 years of service. The cumulative success rate of such teeth is found to be 68% for teeth/patients followed for ≥ 15 years. When crown lengthening is planned to increase the height of the remaining tooth structure, the biologic width needs to be considered. The violation of biologic width may result in severe periodontal breakdown [14,15]. Before performing crown lengthening procedure the amount of attached gingiva needs to be assessed. It has well known that, to maintain periodontal health, there should be minimum of 2 - 3 mm of attached gingiva [16,17].

The concept of BW is widely utilized as a clinical guideline during the evaluation of periodontal restorative inter-relationships. Biologic width is also called as "PERIODONTAL ATTACHMENT LAMINA". Term satisfies not only exclusivity of the tissue to the periodontium, but also gives a sense of its functional importance in interdisciplinary treatment approaches. It was first described by Sicher (1959) and later by Gargiulo [18] and colleagues in 1961 [19].

The Biologic Width is defined as the dimension of soft tissue that is attached to the portion of the tooth coronal to the crest of the alveolar bone. Nevins and Skurow (1984) [15] defined biologic width as the sum of the combined supra-crestal fibers, the junctional epithelium, and the sulcus. The biologic width consists of junctional epithelium and the connective tissue attachment. The BW dimension appears to constitute a constant feature in the human periodontium, and can be considered an immutable therapeutic parameter.

According to early investigators, the average dimension of the epithelial attachment was 0.97 mm and the average dimension of the connective tissue attachment was measured at 1.07 mm yielding the combined dimension of 2.04 mm (1.77 to 2.43mm). It has been theorized that violation of the BW by the placement of restorative margins within its zone may result in gingival inflammation, pocket formation, clinical attachment loss and bone loss [6,20]. Clinical observation indicates that biologic width impingement will result in attempts by the gingival tissue to re-establish its original dimension through chronic gingival inflammation and bone resorption [16].

There are various methods for performing crown lengthening procedure in dentistry. They are scalpel, electrosurgery and more recently by the use of lasers [21]. Traditional surgery is performed by using a scalpel and BP blade. Soft tissue cutting with the scalpel is the conventional and most commonly used technique. It's advantages includes ease of use, low cost, and exhibits relatively fast and uneventful healing. However excessive blood flow leading to the obstruction of the operative field, producing irregular margins and tissue tags is a common and unavoidable drawback of the conventional technique [22].

Electrosurgery (ES) had been occasionally used in various branches of medicine as well as in dentistry since 1914. Electrosurgery is defined as intentional passage of high-frequency waveforms or currents, through the tissues of the body to achieve a controllable surgical effect. Electrosurgical unit provides four possible tissue effects i.e, cutting, coagulation, desiccation, and fulguration. Achieving these effects depends on current density, size of the electrode, time of contact with the tissue, and tissue conductivity. Ideally, the electrode should be held slightly away from the tissue to create a spark gap or steam envelope (which results from heating up the atmosphere between electrode and the tissue) through which the current arcs to the tissue [23]. As the electrode contacts the patient's oral soft tissue the heat is produced and controlled cutting is achieved. Electrosurgical electrodes are found in various sizes and shapes, smaller electrodes provide a higher current density and result in a concentrated heating effect at the site of tissue contact. The advantages of ES includes minimal bleeding, low cost, very little post operative pain and discomfort. When applied according to its principles, predictable and good wound healing can be achieved. However, heat generation and current speed can cause irreversible damage to the alveolar crest leading to recession and exposure of the restorative margins [21,22].

With the advent of Lasers, the use of electrosurgery has moderately declined [21]. Precision, sterilization, bloodless surgical field, accelerated healing time, minimal (or) no need for sutures, less pain and swelling and better prognosis are advantages of lasers over traditional crown lengthening procedures [24]. However, the disadvantages associated with lasers are high cost, longer learning curve and its abrading nature. Careful clinical assessment and identifying the right technique is essential for successful crown lengthening procedure. ES can never completely replace scalpel. Although electrosurgery requires more knowledge and skill, advantages outnumber and outweigh its disadvantages. In a study by Praveen Kumar (2015) [25], both laser and electrosurgical units work well for simple cutting of oral soft tissues and it was found that both laser and electrosurgery are equivalent and good haemostasis is achieved with both devices. In the present study, patients opted for electrosurgery considering its low cost, less post operative discomfort and minimal bleeding. An electrosurgical unit costs only a small fraction of price of laser unit and can be used to perform many of the soft tissue surgical procedures, being carried out with lasers [26,27].

Gingival regrowth following CLP has been well documented in the literature. Deas., *et al*. (2004) [28] reported a significant soft tissue rebound following crown lengthening surgery, that continued after 6 months. Perez., *et al*. (2007) [29] observed that the pre-operative dimensions of the supra-crestal gingiva had not fully recurred 6 months after crown lengthening surgery. Pontoriero and Carnevale (2001) [30] reported that during a 1-year period of healing following surgical crown lengthening, the gingival margins exhibited a tendency to grow in a direction coronal from the level established at the time of surgery. The causes for gingival regrowth following CLP are multifactorial. The amount of tissue rebound depends on the surgical approach, gingival tissue biotype and site location may also play a role, as Pontoriero., *et al.* in his study reported a more pronounced tendency of gingival re-growth in patients exhibiting a thick tissue biotype, with a larger amount observed in interproximal regions. The gingival tissue regrowth following CLP is the result of efforts by the body to re-establish its predetermined gingival complex dimension during healing and maturation period [31].

In the present case reports endodontic consideration was given for the placement of subsequent restoration and necessity for the post. Posts are most often required in premolars compared to molars as they have less tooth structure and smaller pulp chambers to retain a core. The primary purpose of a post is to retain a core in a tooth [32]. Although cast post was used until recently, but there have been various drawbacks associated with cast post systems such as loss of retention, root fractures, corrosion, necessity of removal of extensive root structure, stress concentration and shadowing of the soft tissues adjacent to the root surface. These drawbacks resulted in introduction of various types of fiber post systems. Fiber post plays an important role to achieve an esthetically favourable restorative outcome. Fiber posts systems have lower elasticity modulus (between 1 and 4 x 106 psi) closer to that of dentin (2 x 106 psi), which makes their behaviour similar to dentine and similar stress patterns under external impacts [33]. In a study by (Guldener K A 2016) [34] The overall tooth survival rate was 89.6% after a mean observation time of 8.8 ± 2.3 years. The survival rate of teeth with a fiber post amounted to 94.3%, and for teeth without a post, it was 76.3%.

The success of endodontic treatment depends not only on root canal treatment but also on proper prosthetic rehabilitation of a tooth. The interface between dental restorations and the surrounding soft tissue is of critical importance for success of a restoration. A clinician has three options for margin placement i.e supragingival, equigingival and subgingival margins. Silness (1980) [35] found that margins of fixed prosthodontics significantly compromise the gingival health, if placed below the gingival margin. In a study [36] it was found that subgingival margins demonstrated increased probing depths and higher plaque and gingival index scores. According to Nevins (1984) [15] subgingivally placed restoration margins retains cement on its margins which may predispose to plaque accumulation, resulting in an inflammatory response. It is well documented in the literature that supragingival margins creates more favourable condition to allow periodontal health [37]. There are additional benefits of ease of impression making, cleansing and detection of secondary caries [38,39].

Limited tooth structure in these cases has posed challenges to prosthetic rehabilitation. The longevity of the restored endodontically treated tooth is related to the adequate height (1.5 - 2 mm) of sound tooth structure, or ferrule, between the core and the crown margin. The ferrule is a band that encircles the external dimensions of residual tooth structure and provides a bracing action to protect the integrity of the root. It has been shown to significantly reduce the incidence of fracture in the endodontically treated teeth.

Thus, exposure of 1.5 - 2 mm of tooth structure in these three treated clinical cases has successfully provided 2 mm ferrule height which is considered adequate to promote good periodontal health and facilitate fabrication of a post-retained crown. Furthermore, meticulous care is to be exercised when confronted with challenging cases where endodontically treated teeth are accompanied by hard tissue loss with extensive magnitude.

These case reports demonstrates that retaining a tooth with a poor prognosis is possible when the treatment follows a structured and interdisciplinary approach. Basic requirements leading to the decision to save rather than extract the tooth were the good oral hygiene and compliance of the patient as well as the restorability of the tooth. Crown lengthening is a common periodontal surgery in routine dental practice and can be a viable option for facilitating restorative therapy or improving esthetic appearance. The success rate of the treatment is high if appropriate case selection is considered.

Prognosis after CLP is dependent on anatomical and technical factors. The post surgical maturation and healing after CLP resulted in increase in crown length and changes in the periodontal soft tissues such as regrowth, recession and stability. However, that increased length was found to be significantly reduced at the follow-up visits and soft tissue stability was gained at about 3 - 6 months. This results were consistent with systemic review conducted by Mugri., *et al.* (2021) [40] and data obtained by Lanning., *et al.* (2003) [41] who did not observe major changes in the gingival margin position over 6 months. The histological effect of ES varies depending on the power output and frequency of ES unit, the waveform selected and size and shape of electrode. A study comparing electrosurgical and surgical techniques states that healing of electrosurgical wounds was delayed with more inflammatory response and more tissue destruction. But in both kinds of wounds the viability of osteoblasts was the same, and there was no increase in the osteoclasts which would indicate that no bone resorption had occurred [42].

The cases discussed here have been treated with electrosurgery and traditional surgical techniques. Both electrosurgery and traditional surgical techniques resulted in sufficient removal of the gingival tissue with adequate exposure of the tooth structure which is similar to the study done by Ashwini., *et al.* (2018) [26]. On the contrary, our study didn't show any clinically significant difference when wound healing between electrosurgery and traditional surgical methods were assessed which was in accordance with the study done by Glickman and Imber [43].

Conclusion

A simple, systematic and organized approach is essential for rehabilitation of aesthetically and functionally compromised teeth. In the present case series, patients were recalled periodically to assess the long-term survival of the teeth and favourable outcomes of the

therapy both clinically and radiographically were observed throughout the recall visits. Within the limitations of this study, it can be concluded that when performed judiciously both electrosurgical and traditional surgical techniques of crown lengthening procedures shows promising results both from a biomechanical and esthetic point of view when combined with conservative and intellectually planned interdisciplinary approach.

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Volume 21 Issue 5 May 2022