



*Rethinking ferrule: A combination of orthodontic extrusion
and surgical crown lengthening – A case report*

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Abstract:

Post and core has been a popular treatment modality in patients with insufficient coronal tooth structure present. The success of post and core depends to a large extent on the ferrule effect. In the absence of a sound ferrule effect present around the tooth restoration of the tooth becomes biomechanically futile. Establishment of the ferrule effect then entail surgical crown lengthening procedure which may compromise on the esthetics due to disproportionate gingival zenith and also increase the effective crown to root ratio. The aforementioned problems can be solved by a combined approach of orthodontic extrusion followed by crown lengthening procedure. Orthodontic extrusion has to be accomplished in accordance with the resultant crown to root ratio which has to be calculated during treatment planning phase. The following case discusses the advantages and limitations of both the treatment modalities and the considerations when a combination of the two is opted.

Keywords: Post and core, crown lengthening procedure, Orthodontic extrusion, Ferrule effect.

I. Introduction:

Crown lengthening procedures are often necessary to successfully restore teeth that have been mutilated at or below the level of the bone crest. Such procedures are required to improve the resistance form of the future restoration. Crown lengthening is usually carried out by forced extrusion, surgical lengthening or a combination of both. These procedures have their respective advantages and limitations. Forced eruption is preferred to surgical removal of supporting alveolar bone, since forced eruption preserves the biological width, maintain esthetics, and at the same time exposes sound tooth structure for the placement of restorative margins. Following is a case of a maxillary central incisor with insufficient ferrule subjected to forced orthodontic extrusion followed by surgical crown lengthening.

II. Case Report:

A 28 year old male reported to the Department of Prosthodontics, GDCH Mumbai with a chief complaint of compromised esthetics due to fractured upper front tooth. His medical history did not reveal any significant abnormality. His dental history revealed root canal treatment with respect to upper front tooth followed by a crown 5 years ago which fractured 1 week ago. Extra-oral examination did not reveal any significant findings. Intraoral examination revealed fractured 11, the fracture line passing through the cervical aspect of the coronal structure with insufficient ferrule present for post and core restoration. The gingival zenith was 1 mm coronal to that of the adjacent teeth (Fig. 1)

Radiographic examination with an intraoral periapical radiograph revealed radio opacity in the canal portion of 11 indicative of an obturated canal. There was no periapical radiolucency present.

Surgical crown lengthening alone would have necessitated the same with all the maxillary anterior teeth due to esthetics and also altered the effective crown to root ratio. Hence a forced eruption of 11 followed by surgical crown lengthening was selected as the appropriate treatment modality.



Fig. 1: Fractured 11 with gingival zenith 1mm coronal to the zenith of 21.

Before initiation of forced eruption the restorability of the tooth after the orthodontic phase was considered. The following steps were followed:

1. Estimation of the length of the healthy root embedded in bone from the radiograph
2. Estimation of the space available for the clinical crown for which articulated casts were used as an aid.
3. Calculation of the amount of eruption necessary to restore the tooth (4mm sound structure coronal to the alveolar crest).
4. Calculation of the effective root length remaining after root extrusion and divide it by the clinical crown height as measured in step 2. If the result is 1 or more, then favourable conditions exist for completion of the restorative procedures. If the result is less than 1, then root extrusion will not provide the necessary basis for a properly constructed cast restoration. In this case the result was 1.3.

Post space preparation was carried out sequentially from #1 to #3 peeso reamer and #3 fibre post (SelfPost, Medicept) was luted with self adhesive resin cement (SelfCem, Medicept). A composite core (Ivoclar Vivadent, Liechenstein) was prepared on the post and impression of the same was made with putty wash technique using addition silicone (Honigum, DMG). A heat cure tooth coloured provisional crown was fabricated and luted on the core with glass ionomer cement. Orthodontic extrusion was carried out using Begg brackets and stainless steel orthodontic wires (Fig. 2). A force of 35g was applied using Dontrix gauge. The patient was recalled after every 15 days. The total extrusion was carried out in 2 months. The brackets were debonded and the heat cure temporary crown was sectioned and separated from the core. A putty wash impression was made and a cast was poured. The desired gingival zenith was drawn on the cast in accordance with that of 21 and wax mock up with respect to 11 was done on the cast. The cast was duplicated and an index of the altered gingival zenith was made using vacuum formed sheet.



Fig. 2: Orthodontic extrusion carried out applying a force of 25g on 11



Fig. 3: Wax mockup of 11

Surgical crown lengthening was performed with respect to 11 using the index prepared. The same index was then reapplied and a small bore of made on the palatal aspect of 11 on the index. Flowable composite was then allowed to flow inside the transparent index after which it was light cured (Fig. 4). The index was then removed. The gingiva was allowed to heal for 1 month during which patient was recalled weekly. The flowable composite crown was then sectioned and separated from the core following which a putty wash impression was made. A layered zirconia crown with a zirconia coping and lithium disilicate layering (IPS Emax) was fabricated and luted with self etch resin cement (Fig. 5). The patient was recalled after 24 hours, 1 week, 2 weeks, 1 month and thereafter every 6 months.



Fig. 4: Temporary flowable composite crown immediately following surgical crown lengthening.



Fig. 5: Layered zirconia crown luted with self etch resin cement

III. Discussion

Esthetic considerations have influenced the management of dental maladies in varying degrees for many years. Patient awareness and expectations have increased recently to the point that less than optimal esthetics are no longer an acceptable outcome¹. Therefore restoration of anterior teeth becomes a testimony to the excellence of treatment planning of the operator. An anterior tooth with a compromised clinical coronal height may be treated with different approaches, post and core being the most sought after amongst them. The 'ferrule effect' is important to long term success when a post is used.

A ferrule is defined as a vertical band of tooth structure at the gingival aspect of a crown preparation. It adds some retention but primarily provides resistance for^{2,3,4} and enhances longevity⁵. A ferrule with 1 mm of vertical height has been shown to double the resistance to fracture versus teeth restored without a ferrule⁴. Other studies have shown maximum beneficial effects from a ferrule with 1.5-2 mm of vertical tooth structure^{3,6,7,8,9}. In the absence of a ferrule effect two approaches can be used; the first approach being crown lengthening procedure and secondly orthodontic extrusion.

Crown lengthening procedure is subject to and limited by effective crown to root ratio, the difficulty in performing an osteotomy on a single anterior tooth without creating an esthetic deformity and in case of posterior teeth, the position of root furcation. If the gingival margin of the tooth to be restored is in harmony with adjacent teeth and at an acceptable level with regard to aesthetics, then crown lengthening would need to be performed on all of the adjacent anterior teeth, and this could adversely affect aesthetics. Removal of supporting bone from adjacent teeth to create a normal bony architecture may severely compromise the teeth. In such cases, forced eruption combined with localized fibrotomy and thorough root planning or limited crown lengthening may be indicated¹.

When a tooth is extruded, the resulting coronal-incisal height of the restoration that will be placed is less than if only a respective crown lengthening procedure were performed; consequently, the resulting crown-root ratio will be more favourable following extrusion than it would be with surgical crown lengthening alone¹⁰. Exposing adequate sound tooth structure by periodontal surgery alone will lead to a shortened clinical root and a larger clinical crown as the tissues are positioned apically. The crown to root ratio of the tooth following surgery alone will exceed the crown to root ratio of the tooth that is first orthodontically erupted.

Thus there is a relative improvement in the crown to root ratio of the tooth undergoing orthodontic eruption followed by periodontal therapy that does not occur after a surgical procedure alone¹¹. The orthodontic extrusion increases the width of the attached gingiva, and the mucogingival junction remains stable when the gingival margin migrated coronally¹². Hence an approach combining orthodontic extrusion and surgical crown lengthening is a preferable treatment modality from esthetic, biomechanical and periodontic standpoints.

IV. Conclusion:

Surgical crown lengthening alone is indicated when (i) The resultant crown to root ratio will remain less than 1, (ii) The gingival zenith of the tooth is coronally placed as compared to adjacent tooth, and (iii) The attached gingiva will be adequate post surgically. If any of the aforementioned criteria is not met, forced orthodontic extrusion followed by surgical crown lengthening is indicated. However the feasibility of orthodontic extrusion should be evaluated during treatment planning phase using the four steps mentioned earlier.

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