Use of Hard Stainless Steel "Office" Pin as Improvised Post in the Management of Ellis Class III Fracture of Anterior Teeth in a Resource Poor and Challenging Environment: Case Reports

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ABSTRACT

Objective: Traumatic dental injury is considered as the damage to the teeth and/or other hard and soft tissues within and around the oral cavity caused by the collision of the individual with a moving or stationary object. Traumatic dental injury to the anterior teeth can result in varying degree of injuries ranging from various types of fracture of teeth to avulsed teeth. Ellis class III fracture of anterior teeth following trauma, is a common presentation to the dental clinic and may result in pain and discomfort, aesthetic challenge and impaired quality of life. The treatment of Ellis class III fracture of anterior teeth involves a combination of treatment of the pulp injury and the un-aesthetic crown fracture, usually by endodontic treatment and Aesthetic Restorative Materials (ARM). This article reviewed the use of ARM in the management of Ellis class III fracture of anterior teeth and reported our experience in Stella Obasanjo Hospital, Benin City, Nigeria on Ellis class III fracture of anterior teeth managed with hard stainless steel "office" pin retained composite restoration.

Results: Composite restoration retained with hard stainless steel pin meets the patients' expectations of aesthetics; strength and retention of restorative material after the fractured teeth have been treated with RCT.

Conclusion: Hard stainless steel "office" pin retained composite restoration facilitates the retention of the aesthetic material (composite) which results in morale boost, improved patients' comfort and improved quality of life of patients. Authors hereby suggest the use of hard stainless steel "office" pin as an acceptable improvised post in a resource poor environment rather than risk failure of restoration.

Keywords: Ellis Class III Fracture, hard stainless steel pin, composite restoration, anterior teeth.

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INTRODUCTION

Traumatic injury to the orofacial region, in general, can result in damage to face, mouth and/or teeth. Dental trauma is an impact injury to the teeth and other hard and soft tissues within and around the vicinity of the oral cavity.[1] Dental trauma most commonly affects the maxillary central incisor.[2] It occurs more in males than females.[3-4] Dental trauma occurs frequently in children and young adults, comprising 5% of all injuries [6]. The greatest risk age of dental injuries in children is 7-12 years old.[7] This is due to children increased physical activities. Twenty-five per cent of all school children experience dental trauma and 33% of adults have experienced trauma to the permanent dentition, with the majority of the injuries occurring before age 19.[6] Orodental injuries are fourth most common area of bodily injuries among 7-30-year-old.[8] Tumen et al.[9] reported a prevalence of 4.6% of traumatic dental injuries to the permanent anterior teeth among school children within the ages of 8-to- 12- years in Diyarbakir, Turkey.

Dental trauma has been classified according to a variety of factors, such as aetiology, anatomy, pathology or therapeutic considerations. Ellis and Davey (1970) [10], classified traumatic dental injury to the dentition as;

Class I: Enamel fracture

Class II: Enamel and dentine fracture not involving the pulp

Class III: Enamel and dentine fracture with pulpal exposure

Class VI: A traumatized tooth that has become non-vital with or without loss of crown structure

Class V: Teeth loss due to trauma (Avulsion)

Class VI: Root fracture with or without the loss of crown structure

Class VII: Displacement of the tooth with neither root or crown fracture

Class VIII: Fracture of crown en masse or Complete Crown fracture and its replacement

Class IX: Traumatic injuries of primary tooth.

Most cases of traumatic dental Injury are caused by activities not intended to cause harm including sports. Some cases are due to violent incidences such as fights, assaults or physical abuse. Accidents such as Road Traffic Accidents (RTA), falls and seizures have also been reported as causes of traumatic dental injury.[10] Whereas falls account for most injuries in the primary dentition, sporting activities account for majority of the injuries in the permanent dentition [11]. The patient's home, schools, sporting arena, club houses, playground and roads are some of the identified locations for sustaining traumatic dental injuries [11].

Traumatic dental injury (TDI) should be considered a public health concern. This is because it is common, significantly affects the individual and is preventable.[12] It causes aesthetic, psychological, social and functional problems [13]. The initial awareness of dental trauma may be pain or discomfort on mastication which may be followed by spontaneous, unprovoked pain. The unsightly appearance of the fractured tooth is the aesthetic challenge associated with dental trauma. Children with TDI are often teased by their peers which causes them distress and affects their self-image.[14] Moreover, TDI can negatively affect children's academic performance.[15] The problems associated with TDI can be resolved only if appropriate treatment is rendered.

The treatment of TDI involves a combination of treatment of the pulp injury and the un-aesthetic crown fracture, usually by endodontic treatment of the pulpal exposure and Aesthetic Restorative Materials (ARM). Although Traumatic dental injury to the anterior teeth can result in varying degree of injuries ranging from various types of fracture of teeth to avulsed teeth; however, these case reports were limited to Ellis class III fracture of anterior teeth. Literature review did not reveal any report of Ellis class III fracture of anterior teeth managed with hard stainless steel "office" pin retained composite restoration which is a type of ARM. This article reported our experience in Stella Obasanjo Hospital, Benin City, Nigeria on Ellis class III fracture of anterior teeth managed with hard stainless steel "office" pin retained composite restoration.

Treatment of dental trauma

The treatment of dental trauma resulting in Ellis class III fractures involves endodontic treatment of the pulpal exposure and Aesthetic Restorative Materials (ARM).[10] ARM is not a substitute for endodontic treatment as adverse events may follow the untreated pulpal exposure which may become non vital.[16] The treatment of the pulpal exposure usually involves non surgical and surgical endodontic treatment but sometimes may be limited to non surgical endodontic treatment.[10] Root canal treatment is indicated in matured permanent teeth where there is complete root development with closure of the root apex. Where there is incomplete root development with open root apex as in young permanent teeth, apexogenesis or apexification is required depending on whether the pulp is vital or

non vital.[17] Root canal treatment is typically delayed until completion of root end closure through apexification. The speed of barrier formation at the root apex with apexification varies from 3-24 months, depending on the material used for the procedure [17, 18, 19]. Surgical endodontic treatment is carried for cases of persisting or emerging diseases following failed root canal treatment where retreatment is inappropriate or impossible or cases of impossible root canal treatment.[20] An amazing variety of Aesthetic Restorative Materials (ARM), including filled resins (composite), silicate cement, unfilled resins (Acrylic), Glass ionomer cement, ceramics and porcelain crowns; is available to the dentist to meet the patient demand for aesthetics.[21,22] The treatment of the exposed pulp and conventional use of ARM is usually enough to relieve pain and discomfort, re-establish function and aesthetics. However, auxiliary retentive features such as slots, grooves, pits, proximal box, pins, post (and core in the case of a crown) is needed in cases where there is an inadequate amount of sound tooth tissue remaining following fracture where retention of the ARM may be a challenge. A post is, however, mostly indicated when other forms of retention is inadequate. This is in addition to the endodontic treatment and ARM [23]. When a post is to be used, the post space is prepared and the post of choice is placed before use of the final ARM.[24] However, in our centre, a prefabricated hard stainless steel "office" pin was used as an improvised post to retain composite restoration after endodontic treatment, due to unavailability of the conventional post on account of the resource poor and challenging environment of practice.

Use of post with ARM

A Post is a restorative dental material placed within the root canal of a structurally damaged tooth to provide adequate retention for a coronal restoration.[23] A post is indicated when the coronal tooth structure is inadequate for the retention of the restoration and when there is sufficient root length to accommodate the post while maintaining an adequate apical seal.[23] Where teeth with extensive loss of crown structure requires a coronal restoration, a post is used to retain the restoration and this should be firmly fixed in the root canal, strong enough not to fail under load and be able to achieve optimal stress distribution in the root.

When a post is to be used, a post space has to be prepared. The post space is prepared by removal of gutta percha with the aid of a heated endodontic plugger or with rotary instruments such as gates glidden drills or even chemicals. The root canal is thereafter enlarged with a peso reamer or a low speed drill to remove undercuts and prepare the canal to receive an appropriately sized post without excessively enlarging the canal. The enlargement should not be greater than one-third the diameter of the root at the cementoenamel junction and there should be a minimum thickness of 1.0mm of tooth structure around the post at the mid-root and beyond. Thereafter, the prefabricated post is actively screwed in with specific screw-keys or properly cemented into the post space with the appropriate luting agent for the threaded post or smooth-surfaced posts respectively.[25] The custom made post can be cast from a direct pattern using acrylic resin or using the indirect procedure with an accurate impression with any elastomeric material and the fabrication carried out in the dental laboratory. The post is then cemented into the post space as for prefabricated post.[26]

The factors to consider while placing a post in a canal are the post length, post diameter and post design. A post length of about $3/4^{th}$ of the root canal system and 3mm minimum apical seal is desirable. Three to six millimeters of the obturating material e.g. gutta percha retained at the root apex to maintain apical seal is advised [24].

Classification of post

1. Post can be classified as metallic (stainless steel, titanium, titanium alloy, gold plated alloy) and non-metallic (ceramic, carbon fibre, glass reinforced).[27]
2. Post can be classified as prefabricated post and Custom made post [27].
3. Post can be classified according to the design as serrated, roughened, threaded or smooth post.[24]
4. Post can be classified as parallel or tapered [24].
5. Post can be classified as active or passive. Active post engages the walls of the canal whereas passive post is retained strictly by the luting agent.[27] The choice of post design to be used is largely dependent on the dentist and the tooth to be restored.

The diameter of the post is dictated by the root canal anatomy.[28] However, a study reported that posts diameter variations are of little relevance in providing retention.[27] A minimum dentin thickness of 1mm around the post is however advised.[28]

Case Reports

Case # 1:

A 17-year-old female student who is a Christian and Benin by tribe presented with a complaint of fractured upper right lateral incisor (12) following Road Traffic Accident of about one week duration. A history of loss of consciousness, bruises on her face and loss of some of her teeth was obtained. Patient was hospitalized in a private clinic where she was resuscitated and stabilized. She was however discharged after two days and referred to us for further management.

On examination, the following missing teeth were noted: upper right central incisor (11), lower left lateral incisor (32), lower right central incisor (41) and crown fracture of upper right lateral incisor (12). There was grade 2 mobility of the following teeth upper right lateral incisor (12), upper left central incisor (21), and upper left lateral incisor (22). Retained roots of lower left central incisor (31) and lower right lateral incisor (42) were also noted. Periapical radiograph revealed crown fracture of upper right lateral incisor (12) communicating with the pulp. An impression of Ellis Class III fracture of right lateral incisor (12), grade 2 mobility of the following teeth upper right lateral incisor (12), upper left central incisor (21), and upper left lateral incisor (22) following trauma and retained roots of lower left central incisor (31) and lower right lateral incisor (42) incisor was made. Treatment carried out, was forceps extraction of the retained roots of lower left central incisor (31) and lower right lateral incisor (42); root canal treatment and post-retained composite restoration using a hard stainless steel "office" pin as improvised post for the of upper right lateral incisor (12). Hard stainless steel "office" pin as improvised post was used after obtaining patient's consent. Its use was clearly explained so that the patient understood that it was an alternative to established types of intra-canal post, on account of their unavailability. The hard stainless steel "office" pin (improvised post)-retained composite restoration was carried out following a post space preparation. The post space was prepared by removal of gutta percha with a heated small head condenser, up to 2/3rd of the root canal. The root canal was thereafter enlarged with a size 30 reamer to remove undercuts and prepare the canal. Thereafter, the sterilized prefabricated hard stainless steel "office" pin as improvised post was carried into the post space with precision tweezers and cemented with zinc oxide eugenol luting material. Composite reinforced with 0.5 mm hard stainless steel splint extending from the upper right first premolar (14) to the upper left right first premolar (24) for the mobile upper right lateral incisor (12), upper left central incisor (21), and upper left lateral incisor (22) was also placed to reduce the mobile teeth (Figure1). Oral hygiene instruction was given and patient was placed on Amoxicillin 500mg 8 hourly for 5 days, Metronidazole 400mg 8 hourly for 5 days and Ibuprofen 400mg 12 hourly for 3 days.

At 3 months postoperative review, mobility has reduced, the post retained composite restoration was intact with no complaints of pain, discomfort or swelling with radiographic picture of alveolar bone and tooth appearing grossly normal

Figure 1: Stainless steel 'office' pin retained composite restoration of Ellis class II fracture of 12 and composite reinforced with 0.5 mm hard stainless steel wire splint of upper arch

Case # 2:
A 36-year old female trader who is a Christian and Ijaw by tribe presented with a complaint of tooth ache of the upper left lateral incisor (22) of about 3 days duration. The pain was spontaneous, disturbed patient's sleep at night, aggravated by intake of cold fluids and relieved by analgesics. The toothache was as a result of caries in the tooth which started some 6 years ago but had compromised the tooth substance with consequent Ellis class III fracture of the tooth during chewing about 3 days prior to presentation.
On examination reveals, Ellis class III fracture of caries undermined upper left lateral incisor (22), retained root of upper left first premolar (24), poor oral hygiene were noted. Periapical radiograph revealed crown fracture of upper left lateral incisor (22) communicating with the pulp. An impression of irreversible pulpitis associated with Ellis Class III fracture of a carious upper left lateral incisor (22) and retained root of upper left first premolar (24) was made.
Treatment carried out was forceps extraction of the retained root of upper left first premolar (24) as well as root canal treatment and post-retained composite restoration using a hard stainless steel "office" pin as an improvised post for the Ellis class III fracture upper left lateral incisor (22). Hard stainless steel "office" pin as improvised post was used after obtaining patient's consent. Its use was clearly explained so that the patient understood that it was an alternative to established types of intra-canal post, on account of their unavailability. The hard stainless steel "office" pin (improvised post)-retained composite restoration was carried out following a post space preparation. The post space was prepared by removal of gutta percha with a heated small head condenser, up to 2/3rd of the root canal. The root canal was thereafter enlarged with a size 25 reamer to remove undercuts and prepare the canal. Thereafter, the sterilized prefabricated hard stainless steel "office" pin as improvised post was carried into the post space with precision tweezers and cemented into the post space with zinc oxide eugenol luting material (Figure 2). Patient was placed on Amoxicillin 500mg 8 hourly for 5 days, Metronidazole 400mg 8 hourly for 5 days and Ibuprofen 400mg 12 hourly for 3 days.
At 3 months postoperative review, there was no fresh complaint and the post retained composite restoration was intact

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Figure 2: Stainless steel 'office' pin retained composite restoration of Ellis class III fracture of a carious 22

Case #3:
A 43-year old male driver who is a Christian and Igbo by tribe presented with a complaint of broken tooth on the upper right central incisor (11), while he was eating of about 1 week duration. There was no history of trauma or caries in the affected tooth but history of associated pain which was spontaneous and disturbed patient's daily activities, was obtained.
On examination Ellis class III fracture of the upper right central incisors (11), cervical abrasion of upper left central incisor (21), upper left lateral incisor (22), upper left canine (23), upper left first premolar (24) and upper left second premolar (25) were noted. Periapical radiograph revealed crown fracture of upper right central incisor (11) communicating with the pulp. An impression of Ellis class III fracture of the upper right central incisors (11), cervical abrasion of upper left central incisor (21) and upper left lateral incisor (22), upper left canine (23), upper left first premolar (24) and upper left second premolar (25) was made. Treatment done was root canal treatment and post-retained composite restoration using a hard stainless steel "office" pin as an improvised post for

the Ellis class III fracture upper right central incisor (11). Hard stainless steel "office" pin as improvised post was used after obtaining patient's consent. Its use was clearly explained so that the patient understood that it was an alternative to established types of intra-canal post, on account of their unavailability. The hard stainless steel "office" pin (improvised post)-retained composite restoration was carried out following a post space preparation. The post space was prepared by removal of gutta percha with a heated small head condenser, up to 2/3rd of the root canal. The root canal was thereafter enlarged with a size 45 reamer to remove undercuts and prepare the canal. Thereafter, the sterilized prefabricated hard stainless steel "office" pin as improvised post was carried into the post space with precision tweezers and cemented into the post space with zinc oxide eugenol luting material (Figure 3). Other lesions were yet to be treated due to financial constraint.

At 3 months postoperative review, the post retained composite restoration was intact with no complaints of pain, discomfort or swelling with radiographic picture of alveolar bone and tooth appearing grossly normal

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Figure 3: Stainless steel 'office' pin retained composite restoration of Ellis class II fracture of 11 and Radiograph shows root filled 11

Case #4:

A 25-year old female civil servant presented with complaints of broken tooth on the upper left lateral incisor (22) while eating. There was history of previous restoration of the tooth but no history of associated pain or swelling was obtained.

On examination dental caries in upper right central incisor (11), upper right lateral incisor (12), and upper left canine (23) were noted. Ellis class III fracture of failed filled upper left lateral incisor (22) was also noted. An impression of Ellis class III fracture of upper left lateral incisor (22) secondary to failed filling, Black's class III dental caries in upper right central incisor (11), Black's class V dental caries in upper right lateral incisor (12), and Black's class III dental caries in upper left canine (23) was made

Treatment done was root canal treatment and post-retained composite restoration using a hard stainless steel "office" pin as improvised post for the Ellis class III fracture upper left lateral incisor (22). Hard stainless steel "office" pin as improvised post was used after obtaining patient's consent. Its use was clearly explained so that the patient understood that it was an alternative to established types of intra-canal post, on account of their unavailability. The hard stainless steel "office" pin (improvised post)-retained composite restoration was carried out following a post space preparation. The post space was prepared by removal of gutta percha with a heated small head condenser, up to 2/3rd of the root canal. The root canal was thereafter enlarged with a size 25 reamer to remove undercuts and prepare the canal. Thereafter, the sterilized prefabricated hard stainless steel "office" pin as improvised post was carried into the post space with precision tweezers and cemented into the post space with zinc oxide eugenol luting material (Figure 4). Other lesions were yet to be treated due to financial constraint. At 3 months and 6 months postoperative review, the post retained composite restoration was intact with no complaints of pain, discomfort or swelling with radiographic picture of alveolar bone and tooth appearing grossly normal

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Figure 4: Stainless steel 'office' pin retained composite restoration of Ellis class II fracture of 22

DISCUSSION

Dental trauma may arise in different patients from different causes [10, 11]. Dental caries is an important predisposing factor for tooth fracture, from trauma. The resultant cavities from dental caries may undermine the integrity of tooth substance and make even the slightest of trauma to result in tooth fracture.[29] Other predisposing factors include occlusal traumatism, parafunctional habits as in bruxism, and heavy dental restorations [30]. In these case reports, case #2 had caries while case #4 had a previous restoration. Where an anterior tooth with extensive loss of crown structure requires a coronal restoration; a post is used to retain the restoration. Mismanagement using composite restoration alone, without consideration for post as a retentive feature often results in loss of restoration after a while. In the cases reported, hard stainless steel "office" pin was used as an improvised post, due to unavailability of the conventional pre-fabricated or custom made post. When a post is being considered, adequate knowledge and technique of placement is advised so that the post does not fail under functional stress.[23, 24]. It is therefore crucial to raise clinicians' awareness in the appropriate use and placement of post. In the cases reported, the prefabricated hard stainless steel "office" pin as improvised post was cemented into the post space with zinc oxide eugenol luting material. This is because the hard stainless steel "office" pin is smooth surface and sufficient post space has been prepared to receive the pin. A post should be firmly fixed in the root canal and strong enough to withstand load. In the cases reported, the prefabricated hard stainless steel "office" pin used as improvised post is made of nickel plated high carbon steel. It is smooth, strong, durable and corrosion resistant. The hard stainless steel "office" pin improvised post has high tensile strength hence it can withstand forces of mastication and still retain ARM [31, 32]. A loose and thin post often breaks under functional stress making the restoration to fail. In all the cases reported, the improvised posts were firmly fixed in the canal. Case #3 had 2 hard stainless steel "office" pins. This is because use of only one pin in its post space resulted in a loose pin with more than 1mm residual space remaining. A post should not be difficult to retrieve from the intra canal position in the event of failure. In the cases reported, consideration was given for safe retrieval of the hard stainless steel "office" pins in the event of failure by the extension of the pin to the coronal portion of the tooth, up to 3mm, before being embedded in the composite restoration (Figure 5).

Figure 5: Radiograph shows extension of hard stainless steel 'office' pin to the coronal portion of the tooth before being embedded in the composite restoration

The fact that the hard stainless steel "office" pins-improvised post is retained strictly by the luting agent also aids its easy removal in the event of failure. Dental examination and intra-oral radiographs are usually helpful in determining the length, number and size of post to be placed. In this report, root canal treatment and post-retained composite restoration using a hard stainless steel "office" pin as an improvised post for the Ellis class III fracture resulted in a good clinical outcome. Review of the literature did not reveal any similar or dissimilar improvisions for replacements for posts or other corono-radicular stabilizers.

The patients were followed up and the improvised post (Stainless steel "office" pin) retained composite restorations were intact and without complaints from the patients.

CONCLUSION

Post retained ARM is a well-accepted integral part of the holistic treatment of tooth fracture which results in morale boost and improved quality of life of the patients. Post-retained composite restoration using a hard stainless steel "office" pin as an improvised post may be used to restore the patient's tooth after they have been treated with root canal therapy. Authors hereby suggest the use of hard stainless steel "office" pin as an acceptable improvised post in a resource poor environment rather than risk failure of restoration.

Source of Support

Nil.

Conflict of Interest

None declared

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