The use of Piezotome (Piezo Ultrasonic Surgery) in the Treatment of Surgical Crown Lengthening –Case Series & Review

Dr. Akanksha Singh
Associate Professor, Department Of Peridontics, Institute Of Dental Sciences, Bareilly, Uttar Pradesh – 243006.
Dr. Rika Singh
Professor ,Department Of Periodontics, Institute Of Dental Sciences, Bareilly, Uttar Pradesh – 243006.
Corresponding author: Dr. Rika Singh

Abstract: Severely worn teeth, or teeth that are badly broken down, with little tooth structure remaining, can provide a significant challenge for restoration. Crown lengthening assisted with the proper maintenance of biologic width, can help ensure that the marginal placement of restorations remains supra or equigingival, thereby not causing problems for the health of the marginal gingiva. Piezo-electrical surgery is a relatively new surgical technique and offers considerable advantages over conventional methods of bone surgery. Therefore this case series is an attempt to describe the beneficial effects of peizo surgery in the crown lengthening procedure.

Keywords: Biologic Width, Crown Lengthening, Peizosurgery

Introduction:

The concept of crown lengthening was first introduced by D. W. Cohen (1962) [(1)] and is presently a procedure that often employs combination of tissue reduction or removal, osseous surgery, and/or orthodontics for tooth exposure.

Indications For Crown Lengthening [(2)]

Restorative/ functional crown lengthening

- To access to subgingival caries
- To increase the clinical crown height reduced by the tooth wear , caries or a fracture extending subgingivally.
- To assist in creating “ferrule” effect.
- Correcting the position of the restorative margin when there has been invasion of biological width.
- Access to superficial root perforations (e.g. following pin placement)
- Aesthetic Crown Lengthening
- Correction of short clinical crowns due to the wear or altered passive eruption.
- Creating gingival symmetry in the smile line.
- Creating irregular/uneven gingival margins
- Correcting for excessive gingival “Gummy smile” or hyperplastic tissue growth.

The amount of tooth structure exposed coronal to the osseous crest (about 4 mm) must be enough to provide for a stable Dentogingival complex and biologic width to permit proper tooth preparation and account for an adequate marginal placement, thus ensuring a good marginal seal with retention for both provisional and final restorations [(3)].

Soft tissue recontouring (Gingivectomy), this technique is indicated in cases where there is excess gingival tissue. It consists of a gingivectomy procedure where a collar of marginal gingiva is removed to expose more of the crown of the tooth. As such, this is only indicated where the CEJ is more than 2mm apical to the free gingival margin. A gingivectomy should only be undertaken where there is adequate attached gingival tissues. If tissue is removed to the level of the bone, soft tissue rebound will be likely as the gingival tissues heal. This is a result of the re-establishment of the biologic width during wound healing. Soft tissue re – contouring can be undertaken using conventional surgery with a scalpel using either an external bevel incision or internal bevel (also sometimes referred to as an internal bevel gingivectomy). Electorsurgery can also be used although extreme caution needs to be exercised when using this around the tooth roots. The use of electrosurgery for crown lengthening has largely been super ceded by dental lasers. A simple diode laser can be a very useful instrument for performing an external bevel gingivectomy. The main advantages of using a dental laser over conventional surgery include minimal or no bleeding, detailed control of tissue removal, rapid wound healing and minimal post-operative discomfort.

Ultrasonic bone-cutting surgery has been recently introduced as a feasible alternative to conventional tools for cranio - maxillofacial surgery, due to its technical characteristics of precision and safety [(4,5)].

Piezo- surgery® ((Satellac Acteon Group Piezotome Unit: F57310) is a new and innovative method that uses piezoelectric ultrasonic vibrations to perform precise and safe osteotomies [(6)]. It was first invented by Tomaso Vercelotti to overcome the limitations of traditional instruments in oral bone surgery, and first reported for preprosthetic surgery, alveolar crest expansion and sinus grafting [(7)].

The equipment consists of a piezoelectric handpiece and a foot switch connected to a main unit that supplies power, and has holders for the handpiece and irrigation fluids. It contains a peristaltic pump for cooling with a jet of solution that is discharged from the inserts with an adequate flow of 0 to 60ml/min and removes detritus from the cutting area [(6)]. Piezoelectric surgery uses a specifically engineered surgical instrument characterised by a surgical power that is three times higher than normal ultrasonic instruments [(8)]. The device used is unique in that the cutting action occurs when the tool is used on mineralised tissues, but stops on soft tissues [(4)]. Nerves, vessels and soft tissue are not injured by the microvibrations (60 to 200mm/sec), which are adjusted to target only mineralised tissue [(9)]. It has variable modulations of frequency (25.25 to 30 kHz) that give inserts a specific vibration that allows the cut to keep clean of bone splinters. The elevation of membrane from the sinus floor is performed using both piezo- electric elevators and due to the force of a physiological solution subjected to piezoelectric cavitation. Piezosurgery resulted in more favourable osseous repair and remodelling in comparison with carbide and diamond burs. In addition, the force necessary to obtain a cut by the operator is much less compared with a rotational bur. Patients perceived greater comfort with this instrument in osseous surgery as it eliminates the noise of the high-speed handpiece [(10)].

Biologic Width Considerations

One of the most difficult concepts that need to be grasped in relation to surgical crown lengthening is that of biologic width. In basic terms, it refers to the dimension between the crestal bone height and the free gingival margin. Studies have shown that the average dimensions for the biologic width is around 2.75-3.00mm [(11)]. This allows for the establishment of a stable dentogingival complex, which consists of the sulcus depth, epithelial and connective tissue attachments to the tooth root surface coronal to the crest of the bone. A restorative margin should never be placed within less than 3mm from the crestal bone height; otherwise the margin will invade the space occupied by the biologic width. Violation of the biologic width can result in chronic inflammation/irritation of the marginal gingiva which can be uncomfortable for the patient, lead to bleeding,

poor aesthetics and ultimately periodontal breakdown [12]. There are some variations on the recommendations of ideal biologic width dimensions within the literature and it is important to remember that it is likely that individual variations may play a role in this variability. Lanning et al., found that the biologic width dimension on a particular individual would re - establish itself to the same proportion as it was prior to surgery, but with the dentogingival complex, more apically following the surgical crown lengthening [13].

"Crown lengthening can be beneficial in enhancing the aesthetics of a case as well as facilitating the predictable restoration of heavily worn or broken down teeth. It can improve the ability of the restorative dentist to provide a well-retained fixed restoration with improved longevity..."

Case Report:

Three female patients aged 33 year old, 35 years old and 21 years old referred from Department of Endodontics to the Department of Periodontics at Institute of Dental Sciences , Bareilly for the surgical crown lengthening procedure in maxillary right posterior tooth region and mandibular left posterior teeth region and maxillary left posterior teeth region respectively which was previously treated endodontically.

After examining the patient it was diagnosed as having insufficient crown length to place a prosthesis as depicted in Fig 1, 1A, 1B the patients were explained the available treatment options and informed consent was obtained from the patients and it was decided that the surgical crown lengthening would be done by piezosurgery unit (Satellac Acteon Group Piezotome Unit: F57310).

Surgery was performed in relation to 17, 46, 26 in case 1, case 2 & case 3 respectively, under local anaesthesia which consisted of lignox 2 % solution.

Surgical procedure consisted of internal bevel incision Fig 2, 2A , 2B and then full thickness flap was elevated, the excess soft tissue was removed with the help of curretes, followed by osteotomy with the help of the piezosurgery unit Fig 3, 3A, 3B. The extreme care was taken to meet the requirements of biologic width.

At the completion of the procedure re – evaluation was done and the flap was closed with the help of 3-0 silk suture (**Ethicon / Johnson & JohnsonSilk suture 3-0, FS-2 needle, 45 cm black filament**) using the interrupted suturing technique. Then the periodontal dressing was placed and patient was recalled after 1 week Fig 4, 4A, 4B. Post – Operative Instructions were given and pateints were prescribed antibiotics containing Amoxicillin 500 mg t.i.d for 5 days, anti – inflammatory drugs along with 10ml of 0.2% chlorhexidine mouth rinses for 14 days. On recall visits the patient healing was satisfactory and they were placed on long term maintainence. Case 3 was followed upto 3 months Fig. No.: 5B. Finally the patients were referred to department of endodontics for next phase of treatment.

CASE 1

Fig. 1: Pre – Operative (Right Lateral View)

Fig. 2: Placement Of Internal Bevel Incision

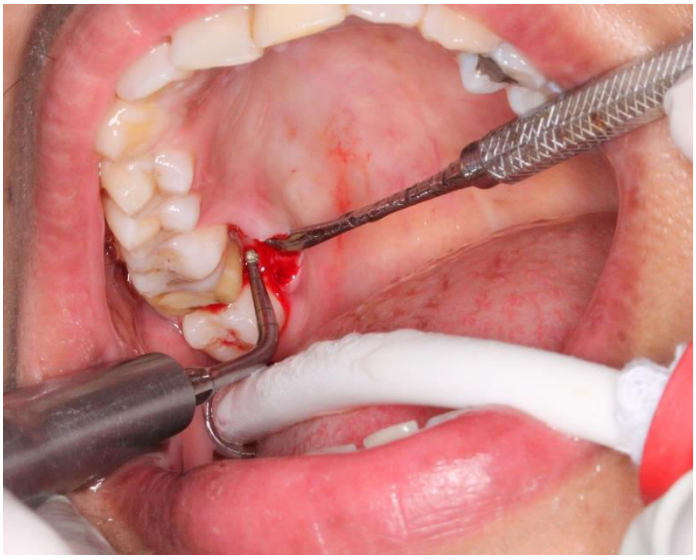

Fig. 3: Osseous Recontouring By Peizosurgery

Fig. 4: 1 Week Post – Operative (Right Lateral View)

CASE 2

Fig. 1A: Pre – Operative (Right Lateral View)

Fig. 2A: Placement Of Internal Bevel Incision

Fig. 3A: Osseous Recontouring By Peizosurgery

Fig. 4A: 1 Week Post – Operative (Right Lateral View)

CASE 3

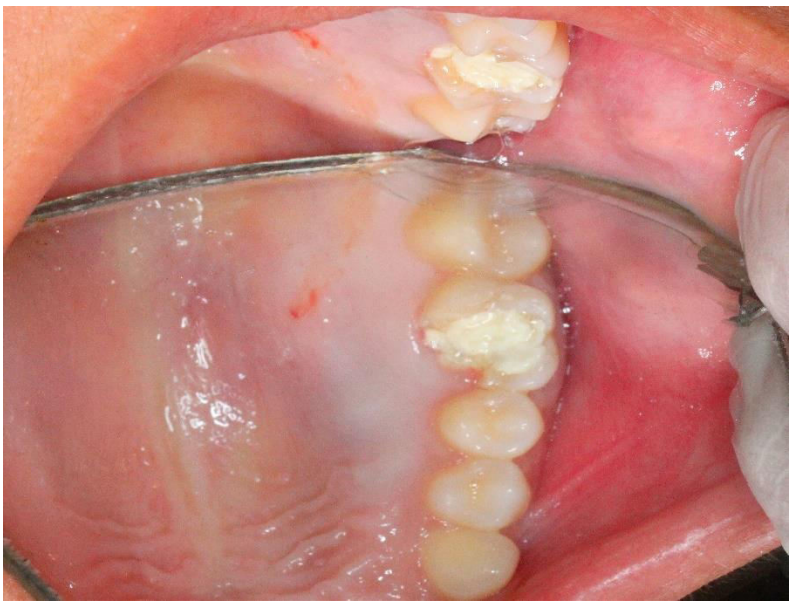

Fig. 1B: Pre – Operative (Palatal View)

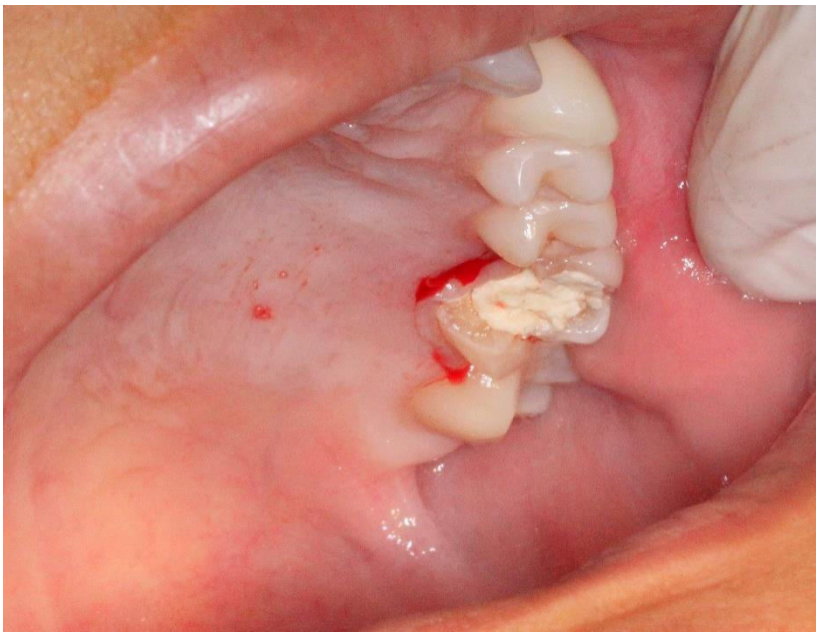

Fig. No: 2B Placement Of Internal Bevel Incision

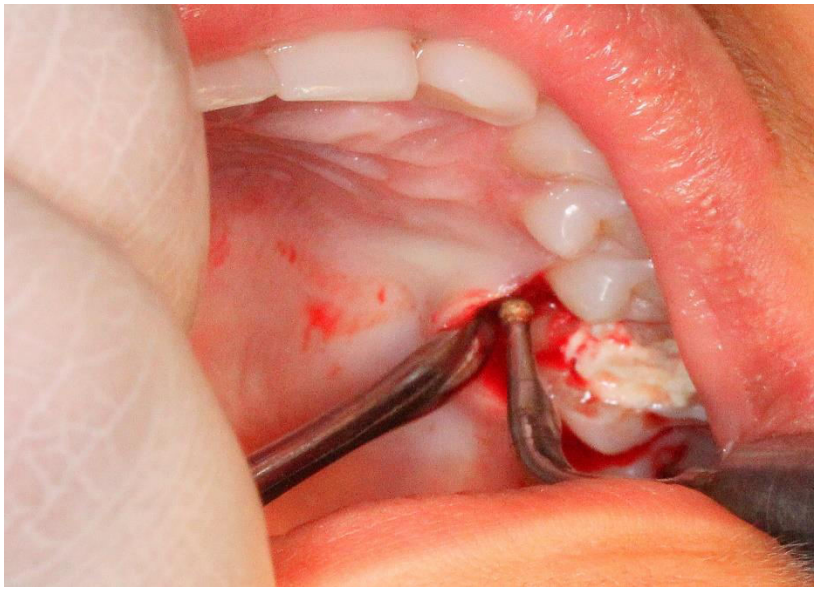

Fig. No: 3B Osseous Recontouring By Peizosurgery

Fig. No.: 4B 1 Week Post – Operative (Palatal View)

Fig. No: 5B 3 Month Post – Operative

Discussion:-

The placement of a restoration margin seems to be of importance for periodontal health (Kois 1996) [(14)]. In addition to the influence of several risk factors (Kinane et al. 2006) [(15)], the position of the restoration margin may affect the initiation and progression of periodontal diseases (Matthews and Tabesh 2004) [(16)]. Interactions between dental crowns and periodontal tissues were recently evaluated in a systematic review (Kosyfaki et al. 2010) [(17)]. The results of this study indicated that a crown margin with a supragingival location was the most beneficial restoration type in terms of periodontal health. In contrast, restorations with equigingival and subgingival margin terminations resulted in increased plaque accumulation, potentially leading to more severe gingival inflammation followed by periodontal destruction with increased pocket depths, loss of attachment, and gingival recessions (Lang et al. 1983 [(18)], Sch€atzle et al. 2001[(19)], Reitemeier et al. 2002 [(20)]). These inflammatory processes seem to be associated with a breach of the biologic width. Therefore the maintenance of adequate biologic width is of utmost importance. Conventionally the osseous re - contouring was done with the help of rotary instruments, which caused undue trauma to the bone and due to excessive heating may lead to the necrosis of the bone. Therefore the use of ultrasonic devices (Peizosurgery) gained importance in the osseous surgeries. The results of a histologic comparison of the effect of a standard ultrasonic insert to a rotary bur and a surgical chisel were published in 1975 [(21)]. The ultrasonic insert, like the surgical chisel, was found to cut and not burnish bone. While the rotary bur was observed to produce the smoothest surface of bone, the rate of bone healing proceeded best when bone was removed by surgical chisel or ultrasonic insert. In a follow-up study of clinical and histologic observations using ultrasonic instruments in the surgical removal of teeth and osseous surgery, ultrasonic inserts were found to remove bone with ease and preciseness. There was no evidence of detrimental histologic changes [(22)]. In addition, patient discomfort appeared to be reduced, resulting in higher acceptance. Patients perceive greater comfort when this instrument is substituted for conventional instruments for osseous surgery. First, it can be used for root planing, elimi- nating the noise in manual instrumentation while producing a smooth surface. The second advantage is elimination of the noise of the high-speed hand piece. Thus, patient response is significantly improved versus traditional instrumentation. Overall, piezosurgery resulted in more favourable osseous repair and remodeling in comparison with carbide and diamond burs, and its use in ostectomy and osteoplasty procedures may prove a promising addition to the clinician's armamentarium.

Definitive restoration following crown lengthening:-

The rate of healing following surgical crown lengthening will drive the timing of the restoration of the case. As a general rule, the longer you can leave the tissues to mature post-surgery, the more stable the gingival margin will become. When crown lengthening involves both soft tissue and osseous reduction, the gingival margin can take up to 20 weeks to stabilize. Thus, the preparation of the definitive margin and final impression should be deferred. However, it is common practice to proceed with some preparation and temporary crown placement 2-4 weeks post-surgery and to leave these until tissue maturation is com- plete. This is particularly relevant in the aesthetic zone but not as critical posteriorly where the definitive restoration can normally be undertaken 8-10 weeks later. Also, when a gingivectomy has been undertaken (i.e. no osseous reduction), healing times are also generally on the shorter side as the gingival margin will stabilize more quickly, allowing the definitive restoration to commence at 8-10 weeks.

Conclusion:-

Crown lengthening can be beneficial in enhancing the aesthetics as well as facilitating the predictable restoration of heavily worn or broken down teeth. It can improve the ability of the restorative dentist to provide a well-retained fixed restoration with improved longevity. Perhaps the most significant advancement in performing surgical crown lengthening in the past decade has been the introduction of the dental laser. Although laser assisted crown lengthening involving osseous resection is technically demanding, this new surgical tool does provide very precise surgical control for the operator and is generally more patient-friendly than conventional surgery.

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