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Rehabilitation of a case with hypodontia with implant placement using piezosurgical ridge split technique

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ABSTRACT

Hypodontia is a dental anomaly in which six or less than six teeth are congenitally missing in primary and /or permanent dentition. Irrespective of reason for tooth loss, missing teeth in the esthetic zone can be socially unpleasant to the individual. Also, congenitally missing teeth often present with agenesis of bone. These situations are a challenge to the dentist to rehabilitate because of inadequate bone height and width. To overcome such difficulties, bone manipulation techniques have been used. Ridge split is one such technique used when the available bone width is 3mm and more but less than 6mm.With the advent of newer technologies these procedures are possible with piezoelectric surgical devices. These devices used specially designed tips to split the bone with minimal invasion. The following article is a case report that describes the implant placement with ridge split using piezosurgical devices for a hypodontia case with inadequate bone width.

Keywords: Dental implant, Hypodontia, Minimally invasive procedures, Piezosurgery, Ridge split, Bone expansion, Autogenous bone graft, Esthetics.

INTRODUCTION

Hypodontia is a dentofacial malformation that can occur as a part of genetic syndrome or as a nonsyndromic isolated trait. The condition is characterized by congenitally missing six or less than six teeth in primary and/or permanent dentition [1]. Oral malformations commonly associated in hypodontia are atrophic ridge, microdontia, supernumerary tooth and least commonly associated are high arched palate, tongue tie, and taurodontism. In such cases, the atrophic ridge might require prosthetic rehabilitation with implant supported prosthesis along with bone regeneration. The augmentation procedures for horizontal bone defects are autogenous onlay bone grafts, guided bone regeneration (GBR), and split-ridge expansion/distraction techniques.

Bone manipulation with ridge expansion and ridge split are effective techniques to reconstruct horizontal ridge dimension. The advantages of these techniques are that they are minimally invasi7ve, have excellent esthetics, minimal discomfort, avoiding extensive grafting or barriers, decreased healing interval and patient acceptance [2]. Alveolar ridge split technique was introduced by Tatum (1986) with the aim of increasing the amount of bone in the maxilla [3], adapted by Summers in 1994 [4]. In 1992 Simion et al. used a longitudinal greenstick fracture in order to extend the socket, performed through osteotomies [5]. In 1994, Scipioni et al. described another variation i.e. a partial thickness flap created, followed by vertical intraosseous incisions and the simultaneous displacement of the buccal cortical plate, including a portion of cancellous bone, and the implant placement [6].

Traditionally, chisel and (hand) mallet were used for ridge split. The modern devices used for ridge expansion are motorized ridge expanders, expansion crest device, and piezoelectric device for ultrasonic bone surgery. The piezoelectric surgery systems are the newest crest expansion devices that work on the principle of piezoelectric effect, discovered 1880s [7]. In comparison to other alternatives for bone cutting procedures, the ultrasonic or the piezoelectric device are found to be the most effective. The piezosurgery ridge expansion teeth permits to obtain the expansion of the bone crest without excessive traumas or risk of ridge fracture. With this device, selective cutting of the bone without affecting the soft tissue (nerves and blood vessels) may be carried out [8]; further, an oscillating tip with an irrigating fluid provides a cleaner working area and greater visibility (cavitation effect) at the surgical site [9] without causing bone heating (compared to conventional devices).

This case report describes the management of a case with hypodontia by implant placement in atrophic ridge by ridge split using piezoelectric surgical system.

CASE REPORT:

A 24-year-old male patient reported to the outpatient department of the institution with chief complaint of poor social appearance due to loss of teeth in the lower front region of mouth since childhood. Dental history revealed missing teeth in 31,32,33,41,42,43 region since birth, traumatic avulsion of 21 for which a three-unit PFM FPD in 11,21,22 region was fabricated. Clinical examination revealed thin alveolar ridge in anterior region of mandible, faulty prosthesis with 11,21,22. Radiographic examination revealed no impacted teeth in mandibular anterior region so the diagnosis was non syndromic hypodontia. A computed tomography (CT) scan demonstrated inadequate ridge width in the anterior mandible with thin bone at crest that progresses apically expanding to thickness of 3 to 6 mm. The horizontal dimensions of the ridge in relation to 33 and 43 were 3 mm and 3.40 mm respectively after 3mm of crestotomy (Fig 1, 2). The treatment plan was to split the ridge for horizontal ridge augmentation and implant placement with relation to 33 and 43. The surgical procedure was explained to the patient and an informed consent was obtained for the same. Necessary lab investigations like CBC, BT, CT, PT-INR, HbsAg and ELISA were done.

A day prior to the surgery, loading dose of antibiotic was given. Local anesthetics (lignocaine with adrenaline) was administered. A mid-crestal incision was made from 33 to 43 region and crevicular incision was given to the adjacent teeth. A full thickness mucoperiosteal flap was raised. After the flap was reflected extremely thin bone was present at the crest as seen in CBCT scan (Fig 3). Crestotomy was performed 3-4 mm below the crest using LC 2 tip of piezoelectric unit (Fig 4). This bone was harvested to be used for interpositional grafting. After crestotomy, the bone width obtained was approximately 3mm. A horizontal bone incision was performed in the middle of the ridge with piezosurgical tip (CS 1, ACTEON®) to a depth of 9 mm, starting from 33 to 43 region (Fig 5). At two edges, two vertical releasing bone incisions were made in the vestibular bone with LC 2 piezotip such that it joins the horizontal cut given previously into the bone (Fig 6). The split ridge was expanded using CS 2, CS 3. The initial implant osteotomy was made with pilot drill upto 14 mm in 33 and 12.5 mm in 43 region. The osteotomy site was expanded using motorized expanders upto 3.75 × 13mm in 33 region and 3.75 × 11.5mm in 43 region. Ridge expanders were used sequentially with a 10 seconds interval to allow the bone to expand. Implants placed were of size 3.75 mm × 13mm in 33 region and 3.75 × 11.5 mm in 43 region (ADIN Dental Implant Systems LTD) within the splitted ridge. Both the implants were submerged for 1mm anticipatory crestal bone loss while bone remodeling. Post-operative radiographs were made to check the position and parallelism (Fig 7). The crestal bone harvested was used as the interpositional graft in the expanded bone. The cover screw was fixed over the implants and interrupted sutures were placed. Post-operative instructions were given to the patient. Analgesics and antibiotics were prescribed and patient was recalled after 10 days for suture removal.

The implants were allowed to osseointegrate for 4 months after which a stage II procedure was done to place the healing abutments to obtain the soft tissue contour around them. The gingival tissues were allowed to mature for 15 days and a final impression

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was made. Open tray impression coping was fixed to the implants and an open tray impression of poly vinyl siloxane impression material using putty and light body consistency (Photosil) was made. Shade selection was done. Customized abutments were fabricated over which a cement retained FP-3 type of prosthesis was fabricated (Fig 8). Abutment screw was torqued to 30Ncm and a four-unit PFM FPD was cemented onto the customized abutment using luting type of ZPC cement (Fig 9,10).

DISCUSSION:

The most prevalent anomaly in the Indian population is congenitally missing teeth i.e. 16.3% [10]. Missing teeth or loss of teeth causes might negatively affect both the esthetics and function. Patients with missing permanent teeth may suffer from complications such as malocclusion (which itself can lead to masticatory problems), periodontal damage, lack of alveolar bone growth, reduced chewing ability, inarticulate pronunciation, changes in skeletal relationships and an unfavorable appearance. It also affects the general health and quality of life of the patient therefore it is important to restore the lost tooth structure. In aforementioned case the patient was diagnosed with non-syndromic hypodontia in the mandibular anterior region that adversely affects the esthetics and function.

As there was agenesis of bone due to hypodontia of both, primary as well as permanent teeth, it was difficult to place implant due to inadequate amount of bone width. To increase the bone Volume various techniques were suggested like autogenous or artificial bone grafting procedures, distraction osteogenesis, guided bone regeneration, ridge split technique, etc.

Ridge split technique essentially reconstructs the alveolar bone by creating a green stick fracture which is a reliable and relatively non-invasive procedure. The alveolar ridge split technique with simultaneous implant placement is usually performed to shorten the total treatment time and to eliminate second surgical procedure morbidity [11]. Alveolar ridge splitting is classically performed by means of chisels and hammer, rotary burs, diamond disk, reciprocal saw. However, piezoelectric device are the modern devices that are being increasingly used for crest ridge expansion [12].

Piezoelectric bone surgery also called piezosurgery or ultrasonic osteotomy was used to minimize surgical trauma, preserve the cortices for support, and serve as a source of osteocytes for appropriate osseointegration of the implants. It is a procedure in which bone cutting is done using low frequency ultrasonic vibrations. The concept of ultrasonic osteotomy/piezo-surgery was introduced based on the reciprocal piezo effect [13]. A polarized piezo-ceramic receives a certain amount of voltage that causes deformation of piezoelectric crystals; creating alternate expansion and contraction of the material. This helps in selective cutting of bone without any damage to the soft tissue and other surrounding structures. It appears that the expander also condenses the trabecular bone [14]. Piezo-surgery has also been shown to be feasible in inferior alveolar nerve surgery as it favors smaller osteotomies and preserves the neurovascular bundle without any nerve injury. Piezosurgery devices consist of a titanium alloy tipped saw that oscillates with a vibration frequency in the 23–29 kHz range with a maximum 90 W power. Vibrational amplitude is 50 lm. Sterile water or saline irrigation is necessary to prevent thermally induced tissue necrosis. For a bone flap, a full thickness exposure of the osseous crest may be done for access but a partial or split thickness is then performed to expose the ridge while preserving the blood supply imparted by the periosteum. The bone flap is created by crestal, vertical, mesial, and distal cuts. The vertical, mesial and distal incisions are prepared 1 mm from natural teeth and 7–11 mm deep, as needed to release the facial cortex flap, mobilizing it but keeping it attached at the osseo-mucoperiosteal base. Motorized screw osteotomes of incrementally larger diameter were used on an electric drive motor. This mobilizes and gradually expands the bony flap, allowing access to the deep bone for osteotomy drilling. [15]

The ridge split procedure, in combination with immediate implant placement, has been previously reported by Scipioni and colleagues [6]. Santagata et al [16] reported the implant survival rate by 97% with ridge split technique. Sohn et al. [9] stated that the lateral ridge expansion technique is effective for horizontal augmentation in the severely atrophic posterior mandibular ridge. The delayed lateral ridge expansion technique can be used more safely and

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predictably in patients with high bone quality and thick cortex and a narrower ridge in the mandible.

When an interpositional bone graft is placed, the fate of the graft is often improved compared with onlay grafting techniques. Interpositional grafts have an improved prognosis as they have enhanced vascular bed in an osteogenic environment and are protected from masticatory function [17]. Studies comparing wound healing of piezoelectric bone cuts to those created with alternative methods have demonstrated reduced trauma and faster healing with the former and increased inflammation with the latter. [18,19] Danza et al. compared implant success rates in alveolar ridge split with piezoelectric surgical units to those where implants were placed into wide intact ridges found no difference in overall outcomes, although more failures did occur in the non-piezoelectric unsplit group.[20]

CONCLUSION:

Literature has demonstrated the predictability of a ridge split procedure in cases of narrow alveolar ridges that can be widened in preparation for an implant placement. Piezoelectric devices are the modern devices used for crest ridge expansion that are more suitable to prevent any trauma to the vulnerable structures like mucosa, nerves and blood vessels. Since there is less trauma to the bone, it results in faster healing and reduced morbidity, and no second surgical site for augmentation of the atrophic ridge. The success of piezoelectric devices is because of patient comfort during and after the surgery and lesser complications seen during or after surgery. Therefore, this technique can be used as a noble alternative to other difficult surgical procedures.

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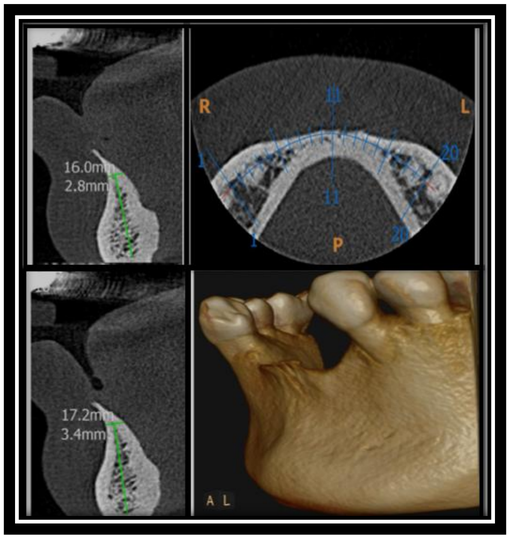

Figure 1: Pre- OP CBCT evaluation.

Fig. 2 Pre-OP (Frontal view)

Figure 3: Extremely thin crest of ridge.

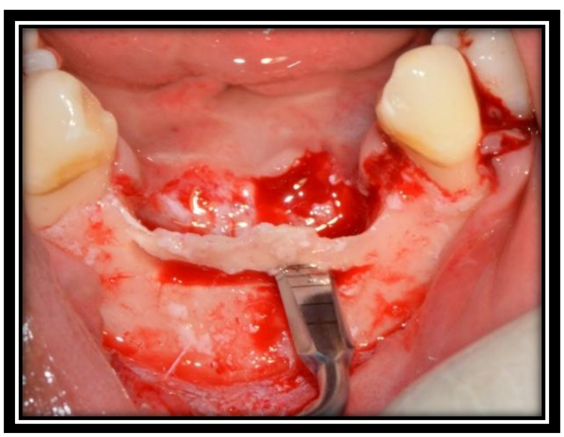

Figure 4: Crestotomy: 3-4 mm below the crest

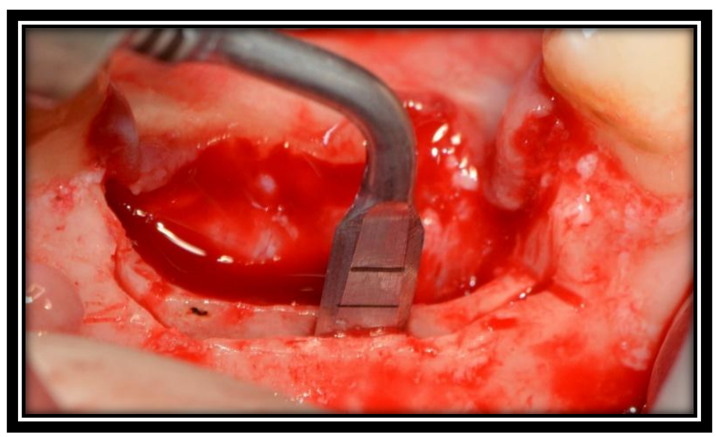

Fig. 5 Horizontal bone incision.

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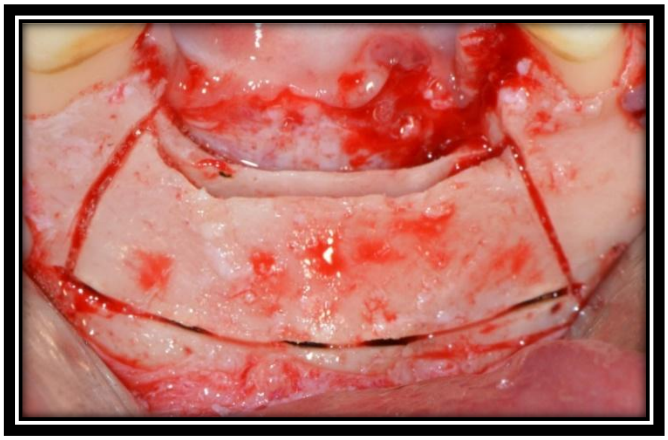

Figure 6: Two vertical bone incision.

Figure 7: Post OP X Ray

Figure 8: Customized abutment placed

Fig 9. Final FP-3 prosthesis

Figure 10: Pre-OP and Post-OP