SURFACE TREATED MINIIMPLANTS FOR ORTHODONTIC ANCHORAGE – A CASE REPORT

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Abstract

Orthodontic mini-implants surface treated with sandblasting followed by acid etching promotes partial osteointegration and improved stability to achieve the desired clinical outcome without witnessing failure of the mini-implants. The custom surface treated mini-implants were used in a class I bimaxillary protrusion case indicated for all first premolar extraction and absolute anchorage. These surface treated miniimplants remained stable for the entire retraction period and thereby helped to achieve significant retraction as witnessed by the significant improvement in the clinical and cephalometric soft tissue parameters.

Keywords: minimplants, surface treatment, osseointegration, secondary stability

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1. Introduction

Absolute anchorage with mini-implants has gained a lot of importance in the recent decade. The use of miniimplant driven biomechanics in orthodontic treatment avoids unwanted movement of the anchor teeth which happens with conventional tooth borne anchorage techniques [1], [2]. Though extraoral devices like headgear may provide anchorage effectively, the need for patient compliance limits the use of these devices [3]. Mini-implants can provide absolute anchorage system independent of patient compliance for a variety of tooth movements like enmasse retraction, anterior intrusion, molar distalization, mesialization, intrusion and mid palatal expansion. [4],[5],[6],[7],[8].

Skeletal anchorage systems in orthodontics has witnessed major change in the trend from use of larger conventional dental implants in the past to the use of smaller orthodontic mini-implants for enhanced anchorage in the present [9]. The materials used have also seen a significant change from use of vitalium to the current use of titanium minimplants in the present which are more biocompatible [10].

Primary and secondary stability of mini-implants is a critical factor affecting the success of implant supported anchorage systems. The prevalence of failure rate of orthodontic miniimplants is high varying from 13.5% to 16.4% [11]. Stability of an orthodontic mini-implant is dependent on numerous factors such as implant characteristics, hard tissue and soft tissue factors at the site of placement and placement technique [12]

Primary stability is the mechanical stability achieved due to the physical contact between miniimplant and bone and is responsible for withstanding initial loading forces. It is mostly affected by factors like miniimplant size, design, orientation to the cortical bone, cortical bone thickness, density and insertion torque [11][13]. Secondary stability is based on the bone remodelling around the implant and is responsible for the clinical stability of the implant throughout the orthodontic treatment. Osseointegration which is the direct structural and functional contact between the bone and the implant surface can result in improved secondary stability enabling the implant to withstand the dynamic and rotational orthodontic forces [1]

The residues of iron and nickel present in the surface of Titanium orthodontic mini-implants may prevent permeation of the osteoblasts and osseointegration [1]. Methods used in dental implants for improving osseointegration cannot be employed in orthodontic mini-implants as complete integration to the bone might make implant removal difficult or not possible at the end of orthodontic treatment. Surface treatment techniques on orthodontic appliances has been a welcome innovation in Orthodontics and have proved to provide numerous advantages[14]. Likewise, miniimplants has also been subjected to a few surface treatments for promoting partial osseointegration [15].Sandblasting with large grit alumina followed by acid etching have shown to promote partial osseointegration which results in improved stability during the treatment period without rendering the removal difficult at the end of orthodontic treatment [16].

This case report describes a clinical case in which surface treated orthodontic mini-implants were used for providing absolute anchorage for enmasse retraction.

Case Report

A 21 year old female patient reported to our postgraduate clinic with a chief compliant of protruded upper and lower front teeth. Clinical examination revealed a convex profile, an abnormal nasolabial angle, with a Class I skeletal pattern. The facial pattern was mesofacial, with an average mandibular plane angle (Figure 1).The molars had a bilateral Class I relationship, the upper and lower anterior teeth were proclined. The patient had an overjet of 2 mm, overbite of 3 mm and a Class I incisor relationship (Figure 2).

Cephalometric analysis indicated a class I skeletal with an orthognathic maxilla mandible. The lower anterior facial height was average with proclined upper and lower incisors (Table 1) (Figure 3) . Panoramic radiography demonstrated the presence of all permanent teeth, with normal alveolar bone levels and root morphologies. The TMJ space appeared optimal, with condylar heads of a normal size, shape, and position (Figure 4)

The treatment objectives were to achieve an ideal overjet and overbite, ideal inclination of the upper and lower anteriors, to maintain the Class I molar and canine relation and to achieve an ideal soft tissue profile. The recommended treatment plan was to extract all the four first premolars, and use of friction mechanics along with mini-implants aided anchorage for enmasse upper and lower anterior retraction. The surface treated mini-implants were used for anchorage for improved stability and to avoid forward movement of the permanent first molars as the case was indicated for an absolute anchorage clinically and cephalometrically.

The upper and lower first molars were banded and the both arches were bonded with 0.022 x 0.028 pre adjusted edgewise slot. 0.016" Niti archwires were used as initial aligning archwire in the upper and lower arch. Initial levelling and alignment was carried out over a period of 5 months. After completion of levelling , consolidation of the anteriors were done in both the upper and lower arches and 0.019 x 0.025 stainless steel archwires with soldered brass hooks were placed .

Surface treated Titanium Orthodontic miniimplants of dimensions 2.0mm x 8.0mm (A1 Bioray miniimplants) were placed in the interdental area between the second premolar and the first molar region in all the four quadrants under local anaesthesia (Figure 5). Literary evidence suggests that increased diameter of the minimplants seemed to reduce the stress in the surrounding bone when used for anterior retraction , the 2mm dimension implants was chosen in accordance to this [17].Retraction was initiated after a healing period of 4 months with 9mm Niti closed coil spring attached to the head of orthodontic mini-implant and the soldered brass hook after calibrating the force with a Dontrix gauge [18]. Retraction was carried out for a period of 6 months and the miniimplants were stable throughout the period until the space closure was complete. Finishing and detailing was carried out using 0.016" stainless steel wire after the completion of space closure for a period of 3 months The mini- implants were removed after completion of the retraction phase without any undue difficulty. After the settling was complete the fixed appliance was deboned and the patient was put in the retention phase with an upper Begg's retainer and lower fixed spiral wire retainer (Figure 6). Significant retraction of anteriors with improvement in profile, lip competence and facial balance was noted at the end of the treatment (Figure 7) (Figure 8) (Table 1). A good amount of root parallelism needed for the stability of the achieved results was witnessed in the post treatment orthopantomogram (Figure 9)

2. Discussion

This case report presents a case of bimaxillary protrusion indicated for a need of absolute anchorage with minimplants for extraction space closure. Retraction of incisors into the extraction space without any mesial movement of posteriors was indicated in this case as both upper and lips were severely protrusive and the ratio with which the lips follow the incisors vary from 2;1 to 1.5;1 for maxillary and mandibular arches respectively [19],[20].Literary evidence shows that there are an average 2-3mm mesial movement of anchors molars with the conventional mechanics when compared to that when miniimplant supported orthodontic mechanics during enmasse anterior retraction [21],[22].

Clinical stability of the miniimplants is one of the most important factors responsible for the success of miniimplants as anchorage devices. Previously the need for osseointegration for improving the clinical stability was dismissed and more emphasis was placed on factors affecting the primary stability [19] However the mechanical retention alone would not suffice to withstand the complex and dynamic orthodontic force systems especially in implant sites with poor bone quality [11], [23].

In the recent decade, the use of partial osseointegration by surface treating the orthodontic miniimplants with sandblasting and acid etching had gained popularity as a method to improve the clinical stability [14]. Various surface treatments of the miniimplants have been evaluated in the literature with animal studies and invitro studies [24],[25]. Clinical stability of orthodontic palatal implants and C implants have been reported to improve with surface treatment [1] [26].

The surface treatment with sandblasting with large grit alumina (250 – 500 µm) followed by acid etching with hydrochloricand sulphuric acid resulted in improved clinical stability of the mini-implants and thereby increased the clinical effectiveness in this patient . This prevented anchor loss and aided in complete closure of the extraction space by enmasse retraction of the anterior segment. This was evidenced clinically by a significant improvement in the profile and achievement of competent lips. Torque control is crucial in enmasse anterior retraction with miniimplant supported anchorage as the active anterior unit is bound to move to a greater distance compared to that of conventional mechanics [27]. A good torque control was achieved by doing retraction in 0.019 x 0.025 stainless steel arch-wires with compensatory bends and light continuous force calibrated to 150 gms and delivered with NiTi closed coil springs.

Miniimplants have revolutionised the field of Orthodontics by allowing the clinician to perform more complex tooth movements and thereby expanded the envelope of tooth movements that can be achieved non surgically .Techniques to improve the stability of these miniimplants in the period of time that they are placed in the mouth will allows us to achieve a variety of biomechanics without the fear of failure of the miniimplants.

Figure 1 Pre-treatment Extraoral photos

Figure 2 – Pre treatment Intraoral photos

Figure 3: Pre treatment Lateral Cephalogram

Figure 4 – Pre treatment Orthopantomogram

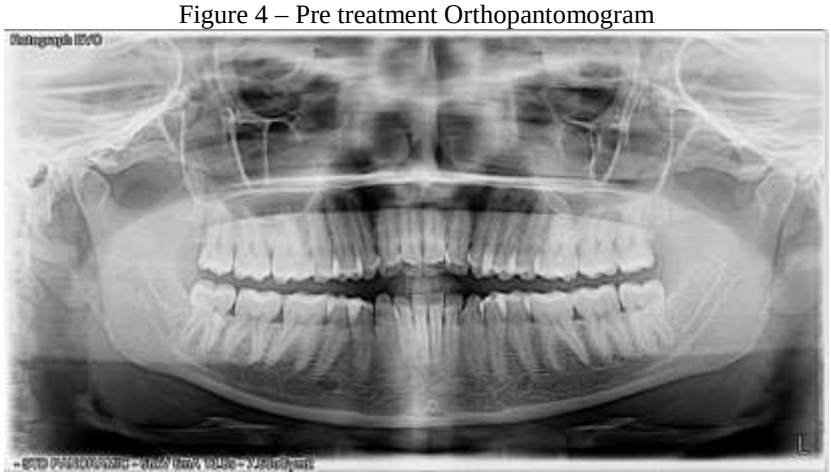

Figure 5: intra oral photographs showing retraction of anteriors with anchorage from surface treated miniimplants placed between second premolar and first molar

Figure 6: Post treatment intraoral photograph

Figure 7: Post treatment extraoral photograph

Figure 8: Post treatment lateral cephalogram

Figure 9: Post treatment Orthopantogram

Table 1: Cephalometric analysis (Pre and post)

ANGLES		NORMAL (RANGE)	PRE TREATMENT	POST TREATMENT
S	SNA	82°	81°	79°
K	SNB	80°	78°	78°
E	SND	78°	74°	70°
L	ANB	2°	3°	1°
E	Go Gn to SN	32°	30°	30°
T	PP-SN	7°	13°	11°
A	Occl. Pl to SN	14°	13°	16°
L	S line-upper		5 mm	- 2mm
	S line-lower		7 mm	0 mm
D	U1 to N-A(mm)	4mm	10 mm	4 mm
E	U1 to N-A (Angle)	22°	35°	23 °
N	L1 to N-B(mm)	4mm	10mm	4 mm
T	L1 to N-B(Angle)	25°	36°	22°
A	Int. Inc. Angle	131°	107°	140°
L	U1 to SN	102°	116°	115°

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