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Table of Contents

5 Immediate Implant Placement with One Year Follow-up: A Case Report
Dr. Abdulgani Azzaldeen, Dr. Bajali Musa, Dr. Abu-Hussein Muhamad

13 Immediate Placement of Dental Implants in Molar Sites: A Case Series
Dr. Mohit B. Zamad, Dr. Aakanksha Zamad, Dr. Akshay Daga, Dr. Pankaj Ahare

23 Microleakage of Pit and Fissure Sealants Comparing Air Abrasion and Acid Etch Techniques – An in Vitro Study
Dr. Raman Deep Kaur, Neeraj Mahahjan

35 The Application of Extraoral Infraorbital Nerve Block Compared to the Intraoral Approach
Dr. Shady A. M. Negm
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Background: This case report describes extraction of a fractured left maxillary central incisor tooth, followed by immediate placement of a dental implant in the prepared socket and temporization by a bonded restoration.

Methods: The tooth was extracted with minimal hard and soft tissue trauma and without flap reflection. The socket was prepared to the required depth and a dental was inserted. An impression was made 4 months after implant insertion, and a definitive restoration was placed.

Results: The atraumatic operating technique and the immediate insertion of the implant resulted in the preservation of the hard and soft tissues at the extraction site. The patient exhibited no clinical or radiologic complications through 12 months of clinical monitoring after loading.

Conclusion: The dental implant and provisional restoration provided the patient with immediate esthetics, function, comfort and most importantly preservation of tissues.

KEY WORDS: Dental implant, immediate placement, temporization, prosthetics

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INTRODUCTION
Immediate implants are defined as the placement of implants in course of surgical extraction of the teeth to be replaced. The insertion of implants immediately after extraction is not new, and in the 1980s, the University of Tübingen advocated the procedure as the technique of choice for Tübingen and München ceramic implants.1,2 As a result of the success of the protocol designed by Brånemark and his team for their dental implant system, other procedures were largely relegated for many years. Initially, a healing period of 9-12 months was advised between tooth extraction and implant placement. Nevertheless, as a result of continued research, a number of the concepts contained in the Brånemark protocol and previously regarded as axiomatic; such as the submerged technique concept, delayed loading, machined titanium surface, etc.; have since been revised and improved upon even by actual creators of the procedure.2-4 Based on the time elapsed between extraction and implantation, the following classification has been established relating the receptor zone to the required therapeutic approach:

1. Immediate implantation, when the remnant bone suffices to ensure primary stability of the implant, which is inserted in the course of surgical extraction of the tooth to be replaced (primary immediate implants).

2. Recent implantation, when approximately 6-8 weeks have elapsed from extraction to implantation, a time during which the soft tissues heal, allowing adequate mucogingival covering of the alveolus (secondary immediate implants).

3. Delayed implantation, when the receptor zone is not optimum for either immediate or recent implantation. Bone promotion is first carried out with bone grafts and/or barrier membranes, followed approximately 6 months later by implant positioning (delayed implants).

4. Mature implantation, when over 9 months have elapsed from extraction to implantation. Mature bone is found in such situations.3-7

The most frequently cited reasons for underutilization of endosseous implant therapy are that treatment cost is perceived to be too high and treatment takes too long (Branemark’s original treatment protocols required up to a year or more to complete treatment) An obvious area of focus has been to decrease the amount of time necessary to complete implant therapy. Approaches to achieve this goal have dominated clinical research and practice: delayed/immediate implant loading, improving implant surface technology (promotion of quicker healing and better osseointegration), and immediate placement of an endosseous implant after extraction of a natural tooth.1 In this paper a case presentation supporting the last of these three approaches will be shown. The definition for an immediate endosseous implant is extraction of a natural tooth followed by immediate placement (within the same surgical procedure) of an endosseous dental implant. Immediate implants have become widely accepted despite controversial beginnings and the available literature consistently cites high levels of success ranging from 94-100% on average and immediate implants provide clinically recognizable benefits. Broadly speaking, these benefits include reduction of morbidity, reduction of alveolar
bone resorption. Controlled clinical studies have demonstrated an average of 4.4mm of horizontal and 1.2mm of vertical bone resorption six months after tooth extraction preservation of gingival tissues, preservation of the papilla in the esthetic zone, and reduction of treatment cost and time while the healing phase is shorter in general and there is a reduction in the number of procedures.\textsuperscript{1-5} With the extraction socket as a guide, the surgeon can also more easily determine the appropriate parallelism and alignment relative to the adjacent and opposing residual dentition. To maximize the advantage of these benefits and to minimize implant failure, case selection must be based on sound clinical and research criteria. Immediate placement and provisionalization for single tooth replacement allows for minimal disruption of the marginal soft tissues, providing immediate prosthetic support for the peri-implant tissues through the use of a carefully crafted provisional restoration. Primary implantation is fundamentally indicated for replacing teeth with pathologies not amenable to treatment, such as caries or fractures. Immediate implants are also indicated simultaneous to the removal of impacted canines.\textsuperscript{5,6} Immediate implantation can be carried out on extracting teeth with chronic apical lesions which are not likely to improve with endodontic treatment and
apical surgery. The surgical requirements for immediate implantation include extraction with the least trauma possible, preservation of the extraction socket walls and thorough alveolar curettage to eliminate all pathological material. Primary stability is an essential requirement, and is achieved with an implant exceeding the alveolar apex by 3-5 mm, or by placing an implant of greater diameter than the remnant alveolus. Esthetic emergence in the anterior zone is achieved by 1-3 mm sub-crestal implantation.

There are contraindications to immediate placement of dental implants. The existence of an acute periapical inflammatory process constitutes an absolute contraindication to immediate implantation. In the case of socket-implant diameter discrepancies in excess of 5 mm, which would leave most of the implant without bone contact, prior bone regeneration and delayed implantation may be considered. Avoid teeth with large or acute periapical infection; Teeth with labial bony dehiscence or fenestration defects; Insufficient bone apically to ensure primary
stability of the implant; Systemic factors that may impair healing (e.g. smoking); Large bulbous root morphology, Interproximal bone loss (aesthetic zone), active periodontitis.  

CASE REPORT

A 53-year-old male patient presented with a history of trauma and crown fracture at the cervical area of tooth 8 (figures 1-3) and requested an immediate solution. Clinical and radiological evaluation revealed adequate alveolar bone, absence of periapical pathology but fracture line was below the crest of alveolar bone and was limited to the tooth. So, it was decided to extract and place endosseous implant immediately and place a provisional restoration to avail the benefits like preservation of bone and emergence profile.

After administering appropriate antibiotic and analgesic, induction of local anesthesia was carried out using lignocaine with adrenaline. As preservation of alveolar bone is key to success of immediate implants, extraction of tooth has to be atraumatic, so using periotomes and small periosteal elevators the fragment was
luxated without excessive enlargement of the socket, and using an innovative method where endodontic file was used to engage the canal wall and tooth fragment was slowly luxated and removed from the socket using the file (figures 4, 5). The sockets were debrided with curettes and a dental implant (BioHorizons, Birmingham, Alabama, USA) of dimensions 4 x 12mm was planned. After checking for primary stability, which was achieved by wrenching the implant into the bone beyond the apex of the socket, xenograft (Bio-Oss, Geistlicht, Princeton, New Jersey, USA) was packed between the implant and labial socket wall. The cover screw was placed and interrupted sutures were placed. Intraoral photography was taken to see the implant placement (figures 6, 7). It was found to be satisfactory. Postoperative instructions were given to the patient and they were asked to report back after 1 week. The sutures were removed after 7 days and the patient received temporary acrylic crown bonded to the adjacent teeth with fiber-reinforced composite on the same day.

The patient was recalled after four months for the prosthetic procedures and was given porce-

CONCLUSION

The implant therapy must fulfill both functional and esthetic requirements to be considered a primary treatment modality. Aiming to reduce the process of alveolar bone resorption and treatment time, the immediate placement of endosseous implants into extraction sockets achieved high success rate of between 94-100%, compared to the delayed placement.

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Disclosure
The authors report no conflicts of interest with anything mentioned in this article.

References
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Commonly, immediate implants have been reserved for the single rooted anterior tooth and single or bi-rooted premolar tooth. Perhaps the most important aspect of any implant surgery in accordance with the successful procedure is implant stability and bone to implant contact (BIC). Immediate dental implant placement has been an acceptable procedure for at least the past two decades. Removal of molar teeth provides a challenging and intriguing dilemma due to multiple root morphology. In the case of extraction and immediate placement of dental implants preserving alveolar bone proper, particularly that of the labial and lingual plates of bone is essential in providing the optimal environment for maximizing BIC and implant stability. Also, the position of the final restoration must be considered, in relation to intra and inter arch position, occlusion, function and esthetics. Thus, minimal alveolar bone removal should be considered and attained to aid in the above factors in order to provide an acceptable surgical site for successful placement of the dental implant. Finally, and perhaps most importantly when considering immediate molar implant placement, removal of the intra-alveolar septum should be avoided to aid in increasing BIC and allowing the attainment of initial implant stability at the time of placement.

**KEY WORDS:** Dental implants, immediate placement, molars
INTRODUCTION

Immediate implant placement following tooth extraction in appropriately selected cases can be considered an optimal procedure for the following reasons: the natural healing process is mobilized to the maximum, no bone resorption, drilling is reduced, number of surgical stages are eliminated, design and construction of prosthesis is simplified, and positive psychological effect on the patient.\textsuperscript{1,2}

As per previous studies, immediate implant placement was carried out in single rooted teeth more successfully. The posterior mandible can be considered for implant placement because of the premature loss of molars and it is always a challenging task to place implant in multirooted teeth as there is discrepancy between size of implant and socket. However, their use is complicated by the anatomic obstacles of the inferior alveolar nerve and the presence of softer bone.\textsuperscript{3,4}

The implant diameter is often smaller than the diameter of the root of the extracted tooth. In cases where the distance between the implant and the extraction socket is less than 2mm, spontaneous bone healing can be expected without the necessity for additional grafting procedures.\textsuperscript{5,6,7} However, if the gap is more, then augmentation procedures are carried out by using synthetic bone graft followed by a non resorbable expanded Poly Tetra Fluoro Ethylene (ePTFE) membrane for soft tissue augmentation.\textsuperscript{8,9,10}
CASE REPORT 1

A 30 year old, non smoker visited the Department of Oral & Maxillofacial Surgery, VSPM Dental College & Research Centre, Nagpur. Tooth #30 was vertically fractured (Fig.1a) and was not associated with any infection. All the available treatment options were discussed with the patient which involves the hemisection of lower right 1st molar with extraction of the distal root and tooth segment and metal ceramic bridge fabrication; extraction of lower right 1st molar and fabrication of a metal ceramic bridge, extraction of lower right 1st molar, followed by a delayed implant placement, or an immediate implant placement. The patient opted for immediate implant placement for which the patient consented. All
the necessary blood investigations were carried out and radiological investigations were evaluated for the selection of implant size.

A crevicular incision extending to the adjacent teeth was made and a full thickness envelope flap was reflected. Lower right first molar was atraumatically extracted. The socket was curetted and irrigated with saline solution (Fig. 1b). The dimension of the socket was measured with a periodontal probe (UNC 15, Hu Friedy, Germany) after tooth extraction. The mesiodistal distance was 9 mm, buccolingual distance was 8 mm and the depth in the mesial side was 8 mm. A dental implant 4.2 mm wide, length 11.5 was placed into the interradicular bone. Pilot drill (2mm) was used for initial preparation. This was followed by sequential drilling along the implant axial line to allow the implant to have adequate bone contact and implant placement done.

Synthetic bone graft was used to cover the implant into the remaining socket and a non-resorbable ePTFE membrane was then secured over the socket for regeneration of soft tissues and bony augmentation (Fig. 1c). The patient was then prescribed an appropriate antibiotic and analgesic and chlorhexidine mouthwash. The membrane was removed 4 weeks after surgery. Healing cap was placed 6 months after surgery. After 2 weeks, healing cap was removed and implant was loaded with a single, ceramic crown (Figs. 1 d,e,f).

**CASE REPORT 2**

Another patient, a 17 year old female, reported in our department. This patient came with the complaint of overretained lower right deciduous (Fig. 2a,b) molar and wanted to replace it. All the treatment options as for Case 1 were given and patient opted for immediate implant placement. All the pre-operative investigations were within normal limits. The same surgical procedure was carried out for implant placement as in the previous case (Fig. 2c,d). In this case, no bone graft was required as the gap between implant the socket was wall was less than 2mm and the primary stability immediately after implant placement was good. Prosthesis for this patient was given after 3 months (Figs. 2 e, f, g).

**CASE REPORT 3**

A 23 year old male patient reported in our clinic for extraction of his carious tooth with lower right mandibular first molar. The patient opted for immediate implant placement. The same procedure was carried out and implant placement was done (Figs. 3 a, b).

**OBSERVATIONS**

Clinical evaluation was done at one, two and three months preloading, then at one, three and six months after loading including following parameters: Probing depth, bleeding index and gingival index, except for case 1 in which preloading follow up was 6 months as the primary stability was average. Radiographic evaluation was done for all cases at same follow up post loading periods using periapical and panoramic radiographs to assess marginal bone height and bone density mesial and distal to implant fixture. Postoperative follow up visits for all three patients were made every week during the first 4 weeks and then followed by
a maintenance program consisting of semi-annual follow up appointments for 2 years.

**RESULTS**

The results of these three cases are reported in Table 1. In the pre-loading clinical evaluation, all three patients were followed up at one, two and four months post operatively. At the first week postoperative, some discomfort was reported without any complaint of severe pain or edema. All wounds healed properly during follow up period.

The post-loading evaluation was done one, three and six months post-loading as implant mobility was tested using the Miller Mobility Index (MI) scores. Two of our cases showed no mobility during the follow up period. The remaining one case showed decline in mobility index scores through the follow up period.

Probing depth\(^1\) was measured for each implant for the four surfaces collectively (buccal, lingual, mesial and distal). There was gradual decrease in probing depth measurement during the study period.

Bleeding index\(^2\) were measured from the four surfaces collectively around the implant. At the three months follow-up period the bleeding index value showed a decline and a further decline was apparent at the six months follow-up period.

Gingival index\(^2\) scores were measured of the four surfaces collectively for all implant surfaces. At three months fol-

<table>
<thead>
<tr>
<th>Table 1: Results of the Study</th>
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<td><strong>Patient No.</strong></td>
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<td>1</td>
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<td>2</td>
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<td>3</td>
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Figure 2a: Preoperative intraoral radiograph showing retained primary molar.

Figure 2b: Preoperative clinical view showing retained primary molar.

Figure 2c: Extraction socket.

Figure 2d: Implant placement immediately after extraction.

low-up period a decline in the gingival index score was noticed. At six months follow up period, further decline in gingival index score was shown.

Both marginal bone height and bone density were evaluated for all cases throughout the post-loading follow up period. For the marginal bone height measurements, there
Figure 2e: Abutment at second stage.

Figure 2f: Implant supported prosthesis.

Figure 2g: Panoramic radiograph after prosthesis placement.
was decrease in the marginal bone height around all implants at the three months post-loading period and then increase in the six months post-loading period.

**DISCUSSION**

All the 3 patients were very pleased with the functional outcomes of their treatment. A main factor determining the success of immediate placement is the initial stability of the implant. The extraction site must be evaluated to see whether it is suitable for immediate implant placement. Micromovements between implant and surrounding bone should be avoided to allow successful healing to occur. In the present case reports, the interradicular septum of extraction socket was used to anchor the implant. Therefore, sufficient height and width of the interradicular septum should be considered serious selection criteria for this treatment modality. Further selection criteria include the following: absence of clinical signs of acute periodontal or endodontic abscess formation, establishment of healthy periodontal conditions before surgery; and patient compliance. It has been suggested that the implant should be placed into a minimum of 3 mm of solid bone apical to the extraction site.\(^13,14,15,16\)

The observation of a crestal gap between the implant shoulder and the socket wall is a common finding and in such cases augmentation procedures are indicated.\(^17\) All the 3 extraction sockets had intact socket walls after extraction. Following placement of the implants, primary stability of all cases were good except in the first case where primary stability was not achieved. All the cases had good soft tissue architecture preservation at one week post surgery with minimal edema and there were no complaints of pain nor discomfort during early post-operative healing period. All the implants achieved successful osseointegration after a healing period of between 3 and 6 months. The residual

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**Figure 3a:** Preoperative intraoral radiograph.

**Figure 3b:** Intraoral radiograph after implant placement.
peri implant socket spaces were found to be well healed exhibiting no implant thread exposure at the end of healing process.

In our study, two cases have showed no mobility through-out the post-loading follow-up period and one case showed gradual decline in the Mobility Index scores and decrease in Gingival bleeding indices as well as Probing depth during the follow-up period. This indicated healing of soft tissue attachment around the implant and absence of peri-implant disease due to extensive oral hygiene instructed to the patients. This is in agreement with Linkow et al, who stated that periodontal indices were not directly related to the success or failure of osseointegration of implants. They are used for monitoring peri-implant soft tissue.

**CONCLUSION**

The above findings suggest that in cases of immediate implant placement in molar region, a sufficient interradicular bone width can be utilised for primary retention of immediate implant successfully. The long term stability of immediate implant placement in the molar region has been demonstrated previously; however, the existing data is not sufficient for determination of treatment guidelines. More extensive and long term study is further motivated.

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**Disclosure**

The author reports no conflicts of interest with anything mentioned in this article.

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Aim: To investigate the degree of dye penetration as an estimation of marginal adaptation of pit and fissure sealants after preparation with air abrasion and acid etching techniques.

Method: Sixty freshly extracted human premolars were taken and divided into three groups of twenty teeth each. Fissures of samples of Group I were opened using Air abrasion. Samples of Group II were prepared using combination of Air abrasion and Acid Etching while that of Group III were prepared by Conventional Bur preparation and Acid Etching. To all the prepared samples single layer of bonding agent was applied and then the fissures were closed using light cured pit and fissure sealant. Specimens were then subjected to thermocycling and dye penetration in Silver Nitrate solution. Finally the teeth were sectioned buccolingually. The sectioned samples were then assessed under stereomicroscope to measure the extent of dye penetration. The measured scores were analyzed statistically.

Results: All the three groups (Air abrasion, Air abrasion + Acid Etching, Bur preparation + Acid Etching) tested showed microleakage at tooth sealant interface. The degree of microleakage among the three groups was greatest for Air Abrasion. Least degree of microleakage was found in procedure done with air abrasion and acid etching.

Conclusion: This study suggests that the Air abrasive technique in combination with Acid etching can be considered as a method of choice for dental enamel priming before sealant placement.

KEY WORDS: Air abrasion, acid etching, microleakage, sealants

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INTRODUCTION
In 1895, Greene Vardiman Black introduced revolutionary concepts of restorative treatment, turning the empirical dentistry at that time into a scientifically based science. Extension of preparations was incorporated to prevent marginal and recurrent caries. Mechanical retention was required to secure the restorative material. In the past few years, the emerging techniques of operative dentistry dedicated to minimal invasion and minimal sacrifice of sound tooth structure have been explored and documented, and they have become part of mainstream dentistry. Microdentistry, the dental science of diagnosing, intercepting, and treating dental decay on the microscopic level, is now emerging as an operative tool in science-based microdentistry, and thus a new term “Prevention of Extension” is introduced.

Pit and fissure caries has the highest prevalence of all dental caries. The pits and fissures which are actually the grooves and the fossa with non-coalesced enamel provides an excellent mechanical shelter for microorganisms. The dental battle against decay in pits and fissures has a long and creative past that includes such preventive innovations as early physical blocking of fissures with Zinc phosphate cement, mechanical fissure eradication, and chemical treatment with silver nitrate. An invasive operative procedure, the prophylactic odontotomies introduced in the 1920s, remained the treatment of choice for many clinicians well into the 1970s. But with Buonocore’s visionary procedure came the ability, as he predicted in 1955, to successfully prevent caries by sealing pits and fissures with a bonded resin material.

The prevention of pit and fissure caries through the use of occlusal sealants continues to be focus in pediatric population. The morphological configuration of occlusal pits and fissures (narrow, ‘deep gaps) facilitates retention of bacteria, nutrients and debris. If the fissures are sealed completely and microleakage is prevented, they act as a physical barrier to external carious agents, thus preventing the onset of caries.

Marginal microleakage following sealant placement allows bacteria and bacterial byproducts to penetrate beneath the sealant, potentially initiating and perpetuating the caries formation process. Removal of enamel surface contaminants and obtaining a properly acid etched surface prior to sealant placement are important factors for successful retention and caries prevention. Etching produces a wettable surface and a retentive pattern. Acid etching is however a technique sensitive process involving several time consuming steps. Therefore, several methods of preparing fissures such as enameloplasty, an air polishing system or laser treatment have been advocated by researchers for sealant retention. Bonding techniques developed by Buonocore (1951), Bowen (1970) and others provide an alternative to mechanical retention.

The course towards enamel conservation has prompted a second look at air-abrasive cavity preparation. Air abrasion was first introduced in dentistry in 1943, when Dr Robert Black patented the micro-sandblaster for dental applications. The kinetic
cavity preparation technique was pioneered in 1940s and was integrated into some dental practices in the mid – 1950s, only to be supplanted by the widespread adoption of the air rotor high speed hand piece.

Air abrasive technology has been reported to prepare enamel and dentin for bonding in a similar way to acid etching.17,18 With the improved restorative materials available today, a more conservative cavity preparation is acceptable, making air abrasion a potential alternative to conventional handpieces.25 Air abrasion works by spraying a particular area of the tooth with a thin stream of air and a fine abrasive powder made of alumina, avoiding the odors, noises, vibrations, microcracks and, in most cases, the apprehension associated with the drill. It is designed to provide patient –friendly care, which is especially important for the treatment of children’s dental problems. Some authors have also stated that air abrasion may serve as an alternative to acid etching of enamel, coining the phrase “air – abrasion etching.”35 A number of studies have examined the influence of tooth preparation on microleakage of pit and fissure sealants. There have been very few studies directly comparing the degree of microleakage of sealants following preparation of pits and fissures with bur preparation, acid etching and air abrasion. Hence, this study was done to investigate the degree of dye penetration as an estimation of marginal adaptation of pit and fissure sealants after preparation with air abrasion and acid etching techniques.

MATERIALS AND METHODS
Sixty noncarious human premolars extracted for orthodontic purpose were collected. After extraction the teeth were cleaned of the debris and blood clots in running water and were examined by transillumination to exclude teeth exhibiting enamel fractures as these might allow dye penetration. The teeth were stored in distilled water at room temperature. The teeth were randomly divided into three equal groups. In Group I (Air Abrasion Group) the occlusal surfaces were prepared with the hand piece of Air Abrasive system (Prep Start, Danville), using 27 micron diameter Aluminum oxide particles through 0.015” nozzle opening at 80 psi pressure. The nozzle tip was held at 2 mm from tooth surface and slightly offset from perpendicular. A quick, steady, sweeping motion was used along the surface to achieve a uniform, frosty appearance. The excess particles were then removed with a moisture – free air stream, and the surface was not rinsed. In Group II (Air abrasion + Acid etch group), the occlusal surfaces were again prepared with Air Abrasive system. The prepared surfaces were then etched using 37% Phosphoric acid gel (Actino Etchant Gel) for 15 seconds. The specimens were then rinsed with water for 15 seconds, ensuring that all the etchant has been removed. Each specimen was dried with oil free compressed air until a chalky white appearance was obtained. In Group III (Bur preparation + Acid etch Group), the occlusal surfaces were prepared using a round diamond bur at high speed with air–water spray.
After surface preparations of all the specimens of Group I, Group II and Group III, a uniform layer of single component bonding system (Prime and Bond, Dentsply), was applied, air thinned and light cured for 30 seconds using a visible light curing unit (3M ESPE, Curing Light 2500, 3 M Dental Products). A light cure pit and fissure sealant (Clinpro, 3 M Dental Products), was applied to all the conditioned surfaces and light cured for 20 seconds using visible light curing unit. The samples were then stored in distilled water at room temperature for future use.

The restored teeth were subjected to thermocycling regimen (Perkin Almer Thermocycling Machine Model No. 9700 (Perkin Almer Biocare Systems, United Kingdom) in distilled water at 5°C and 55°C for 500 cycles, with a dwell time of 10 seconds. All the specimens were then immersed in 50 % Silver Nitrate dye solution for 2 hours in a dark environment. After staining these teeth were individually rinsed with distilled water for one minute and were placed in photo developing solution under fluorescent light for 8 hours to precipitate the Silver Nitrate.

After removal from the developing solution, the teeth were washed in distilled water to remove the excess surface dye. Finally the teeth were sectioned longitudinally in a buccolingual direction at low speed with a water cooled diamond disk held in straight hand piece. Microscopic evaluation of each sectioned sample was examined using a Stereomicroscope (Olympus SZ – PT, Japan) under 10 x magnification. The extent of dye penetration was determined at buccal and lingual / palatal wall from the occlusal portion of the restoration to base of the cavity along the tooth restoration interface. All the measurements were taken from the junction of tooth sealant interface to the first point of termination. The scoring method as described by Ovenbo and Raadal (1990) was used:

<table>
<thead>
<tr>
<th>Group</th>
<th>0.00</th>
<th>1.00</th>
<th>2.00</th>
<th>3.00</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>5</td>
<td>11</td>
<td>2</td>
<td>2</td>
<td>20</td>
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<tr>
<td>II</td>
<td>17</td>
<td>3</td>
<td></td>
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<td>20</td>
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<tr>
<td>III</td>
<td>13</td>
<td>4</td>
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<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>18</td>
<td>5</td>
<td>2</td>
<td>60</td>
</tr>
</tbody>
</table>
Score 0 = No microleakage (no dye penetration).
Score 1 = Microleakage less than half the distance of the sealant border (dye penetration less than half the distance of one side of the fissure sealant and enamel border).
Score 2 = Microleakage one half the distance of the sealant border.
Score 3 = Microleakage along the whole sealant / enamel border.

Figure 1:
- Score 0 = No microleakage.
- Score 1 = Microleakage less than half the distance of the sealant border.
- Score 2 = Microleakage one half the distance of the sealant border.
- Score 3 = Microleakage along the whole sealant / enamel border.

The data collected was subjected to Statistical Analysis with Kruskal Wallis, ANOVA test and Mann – Whitney U tests.

RESULTS
The degree of dye penetration in the occlusal cavity walls was assessed separately under a Stereomicroscope at 10X magnification. The extent of dye penetration was determined at buccal and lingual / palatal wall from the occlusal portion of the restoration to base of the cavity along the tooth restoration interface. Microleakage along the buccal and lingual walls was measured on an Ordinal scale with scores 0 to 3 in increasing order of
Table 2: Comparison of Techniques

<table>
<thead>
<tr>
<th>Group</th>
<th>Buccal</th>
<th>Lingual</th>
<th>Overall</th>
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<tbody>
<tr>
<td>I Air Abrasion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.9500</td>
<td>.7000</td>
<td>1.0500</td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.8870</td>
<td>.6569</td>
<td>.8870</td>
</tr>
<tr>
<td>Range</td>
<td>0-3</td>
<td>0-2</td>
<td>0-3</td>
</tr>
<tr>
<td>Std Error of Mean</td>
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<td>.1469</td>
<td>.1983</td>
</tr>
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<td>II Air Abrasion + Acid Etching</td>
<td></td>
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<tr>
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<td>.1500</td>
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<tr>
<td>N</td>
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<tr>
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<td>.2236</td>
<td>.3663</td>
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penetration of dye. It was found that microleakage in buccal and lingual / palatal walls of all the twenty samples prepared with Air abrasion (Group I) values range from minimum zero to maximum three. In Group II Microleakage scores range from minimum score of 0 to maximum 2. In Group III microleakage scores of the samples prepared by conventional bur and Acid Etching ranges from 0 to 2.

The overall mean dye penetration for Group I (Air abrasion) is 1.0500 ± 0.8870. For Group II (Air abrasion + Acid etching) the mean dye penetration value is 0.1500 ± 0.3663. For Group III (Bur preparation + Acid etching) it is 0.5000 ± 0.7609.

The results showed statistically significant difference (p < 0.05) in the microleakage scores among the samples of Group I (Air abrasion) and Group II (Air abrasion + Acid etching). Intergroup comparison between group I (Air abrasion) and Group III (Bur preparation + Acid etching) also showed the statistically significant difference (p < 0.05) among the microleakage scores. The comparison between Group II (Air abrasion + Acid etching) and Group III (Bur preparation + Acid etching) showed statistically insignificant difference (p > 0.05) among the microleakage scores.

So the results showed the maximum dye penetration for the samples of Group I (Air abrasion) is higher compared to other groups, indicating that Air abrasion alone may not be sufficient to achieve adequate bond strength and prevent microleakage.

Figure 2:
GROUP I : Air Abrasion
GROUP II : Air Abrasion + Acid Etching
GROUP III : Bur preparation + Acid Etching

From the above graph its clear that Group I exhibits maximum value of mean dye penetration (1.05 + .8870), while the least values of mean dye penetration are shown by Group II (0.15 + 0.3663).
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<table>
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Kruskal Wallis analysis to show the comparison of microleakage among Group I (Air abrasion), Group II (Air abrasion + Acid etching), Group III (Bur preparation + Acid etching).
Figure 3: The above figure represents the statistically significant difference (p < 0.05) in microleakage scores along the buccal walls (0.003), lingual walls (0.00) and the total (0.001) microleakage scores among the three preparation groups. From the above graph its clear that Group I exhibits maximum value of mean dye penetration (1.05 + .8870), while the least values of mean dye penetration are shown by Group II (0.15 + 0.3663).

abrasion) with statistically significant difference with the Group II and Group III, while the least dye penetration is seen among the specimens of Group II (Air abrasion + Acid etching) though statistically insignificant difference was observed among Group II and Group III. Hence, the degree of microleakage among the three groups can be ranked in following order:

Air abrasion > Bur preparation + acid etching > Air abrasion + acid etching

DISCUSSION
The focus of this study was chiefly the preparation of enamel before applying the pit and fissure sealant. Pit and fissure sealants have become the most effective treatment to prevent or arrest caries. While the authors had previously attempted to find conservative ways of treating occlusal pits and fissures such as Wilson who used Zinc Phosphate cement, Bodecker who proposed enamel fissure eradication and Kline and Knutson who used ammonical silver nitrate to treat pits and fissures, none achieved any great measure of success.41

An invasive operative procedure, prophylactic odontotomy introduced in the 1920’s remained the treatment of choice for many clinicians well into the 1970’s. Buonocore introduced the acid etch technique to alter
the existing enamel in order to improve the retention of acrylic restorative materials.

Alternative methods such as bur preparation, laser and air abrasion have been proposed to better clean pits and fissures of debris. Air abrasion has also been suggested as a pretreatment method to mechanically roughen enamel in a conservative and time efficient manner and remove residual organic material in the fissures to aid in sealant bonding. However marginal leakage studies have shown that air abrasion alone is not as effective as air abrasion coupled with acid etching in preventing microleakage. So, this study was done to compare the air abrasion and acid etching techniques for enamel preparation before the placement of fissure sealants using the dye penetration method.

The results of this study showed that Air abrasion alone exhibited maximum microleakage value as compared to other groups (1.0500 ± 0.8870). Tooth preparation by air abrasion is reported to offer improved comfort by eliminating the vibration, pressure and noise associated with rotational methods. Air abrasion creates a roughened enamel surface which make it more conducive to bonding. Some studies have suggested that this may eliminate the need for acid etching when applying pit and fissure sealants.45

Laurell et al found that air abrasion of the surface revealed a uniform roughness of the enamel and that the enamel prisms and dentinal tubules were not identifiable. In addition enamel rod prisms are not evident after air abrasion.25

The combination of air abrasion and acid etching exhibited the least mean value of dye penetration (0.1500 ± 0.3663). The recommended use of phosphoric acid is 30 – 50 %. Thirty seven percent percent phosphoric acid was used in this study as found by Silverstone, that the application of 30% to 40% phosphoric acid resulted in very retentive enamel surfaces. 37% phosphoric acid results in the formation of monocalcium phosphate monohydrate precipitate than can be rinsed off.

Ellis et al. reported that the enamel surfaces conditioned with a combination of air abrasion and acid etch revealed a more detailed pattern than surfaces treated with either treatment alone.25 Its believed that air abrasion may induce a more retentive pattern and enhance etchant penetration to deep fissures, as this system widens the pits and fissures, eliminates organic material and exposes more reactive tooth enamel.

The mean dye penetration for conventional bur preparation and acid etching was 0.500 ± 0.7609. For Opening the fissures with a round diamond bur is a conventional method of fissure preparation. Etching with phosphoric acid removes the enamel prisms, thus creating the micromechanical retention for the sealant by the formation of resin tags.

In the present study the conventional bur preparation and acid etching technique led to significantly less microleakage than the air abrasion technique alone from the microleakage point of view (p < 0.05). This finding suggested that removing the debris was not sufficient to produce good mechanical retention of the sealant material and further treatment of enamel was needed.45 However, found no statisti-
cal significant difference in microleakage between acid etched and air abraded teeth prior to sealant or composite placements

Eakle et al. found that air abrasion produced a roughened surface but lacked the seal obtained with acid etching; Brown and Barkmeier, Ellis et al. showed that air abrasion alone was not sufficient in promoting high bond strength of a sealant to enamel. A study by Ferdianakis and Guirguis et al. produced similar results. A clinical study showed that sealants placed on occlusal surfaces had similar retention rates after six months for acid etched and air abraded surfaces, but that sealants failed when placed on buccal and distolingual surfaces prepared by air abrasion alone. Therefore from the literature, it appears that the etching technique is still considered to be the treatment of choice over air abrasion alone.

The use of burs, however, has been controversial and acid etching is always recommended after ameloplasty performed with a bur. In our study the occlusal surfaces of the Group III have been prepared by round diamond bur followed by acid etching. Various studies have compared the microleakage produced by surfaces prepared with burs with that of surfaces prepared by acid etching or air abrasion techniques. Hatibovic - Kofman et al., found them to be superior, others found them to be no superior, still others found them to be no different or even worse.

The results of this present study found that air abrasion followed by acid etching produced superior bonding surfaces than those produced by air abrasion alone.

The lowest microleakage values of intact enamel surfaces were achieved using air abrasion with aluminum oxide followed by acid conditioning with phosphoric acid.

The results of our study coincides with that of A. Mentes and N. Gescoglu who found that air abrasion of enamel followed by acid etching produced the lowest microleakage scores, which however were not significantly lower than those produced by the conventional method of acid etching. Borsatto demonstrated that the application of an aluminum oxide jet in association with acid etching conditioning of enamel presented shear bond strength resistance values statistically similar to those obtained by acid conditioning.

Such findings suggest that the acid etching step cannot be omitted if air abrasion technology is chosen to promote bonding of pit and fissure sealants. Thus the results of the present study indicate that the combination of air abrasion and acid etching technique can be considered as a method of choice for enamel preparation before the sealant placement.

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The Application of Extraoral Infraorbital Nerve Block Compared to the Intraoral Approach

Dr. Shady A. M. Negm¹

Abstract

Background: The application of infraorbital nerve block is often to accomplish regional anesthesia of the face. The procedure offers several advantages over local tissue infiltration. A nerve block often achieves anesthesia with a smaller amount of medication than is required for local infiltration. In addition, unlike local tissue infiltration, blocks can provide anesthesia without causing tissue distortion. In this article I will discuss the structure of anesthesia, approach of the technique, indication, contraindication and others. The aim of this study was to describe a technique for extraoral infraorbital nerve block using several anatomical points for reference, simplifying the procedure and enabling greater success and a more rapid learning curve. Effective pain control in Dentistry may be achieved by local anesthetic techniques. The success of the anesthetic technique for nerve block in anterior region depends on the proximity of the needle tip to the infraorbital foramen at the moment of anesthetic injection into it. Two techniques are available to reach the infraorbital nerve, namely extraoral and intraoral; these techniques differ in the place where we should start.

Methods: The application of extraoral infraorbital nerve block in implant for anterior region has a superior effect rather than the intraoral approach. A nerve block often achieves anesthesia with a smaller amount of medication than is required for local infiltration. In addition, unlike local tissue infiltration, blocks can provide anesthesia without causing tissue distortion. And as we mention before that successful infraorbital nerve block provides anesthesia for the area between the lower eyelid and the upper lip including the anterior part of the alveolar ridge at the side of innervation so we can perform the implant surgery effectively with more comfort to the patients. You should pay attention while using this technique because the needle is in very close proximity to the facial artery. So that, avoid adding vasoconstrictors to the anesthetic agent.

Results: The obtained data showed 100% success rate of anesthesia injection for all cases we treated.

Conclusions: This method is potentially effective for extraoral infraorbital nerve block, especially in Geriatric Dentistry.

KEY WORDS: Extraoral infraorbital nerve block, intraoral infraorbital nerve block, local anesthesia

¹. Dentist at Ministry of Health, Fellow of Alexandria Oral Implantology Association (A.O.I.A), Fellow of Egyptian Society of Oral Implantology (E.S.O.I)
INTRODUCTION

In general, regional anesthesia is ideal when the area of interest is innervated by a single superficial nerve. The infraorbital nerve supplies sensory innervation to the lower eyelid, the side and ala of the nose, and the upper lip. Since the infraorbital nerve provides a considerably large area of sensory innervation, it is a prime candidate for a regional nerve block. A successful infraorbital nerve block provides anesthesia for the area between the lower eyelid and the upper lip including the anterior part of the alveolar ridge at the side of innervation.

The cranial nerve V (trigeminal nerve), provides sensory innervation to the face. The second division, the maxillary nerve (V2), exits the skull from the foramen rotundum. After giving off numerous branches, the maxillary nerve eventually enters the face through the infraorbital canal, where it ends as the infraorbital nerve. The infraorbital nerve supplies sensory branches to the lower eyelid, the side of the nose, and the upper lip including the anterior part of the alveolar ridge at the side of innervation.

Indications for infraorbital nerve blocks include wound closure, pain relief, and anesthesia for debridement. Contraindications for infraorbital nerve block include any allergy or sensitivity to the anesthetic agent, evidence of infection at the infection site, distortion of anatomical landmarks, and uncooperative patients. The disadvantage of the infraorbital nerve block is that it is performed by blind palpation of the infraorbital foramen.

Technique for extraoral infraorbital nerve block

During the extraoral technique, the needle is in very close proximity to the facial artery. Because of this proximity, avoid adding vasoconstrictors to the anesthetic agent. Use the landmarks to locate the infraorbital foramen. Prepare the skin overlying the infraorbital foramen with povidone iodine (Betadine) and sterile gauze. Using sterile technique, insert the needle through the skin, the subcutaneous tissue, and the muscle. Aspi-
rate to ensure the needle is not within a vessel. The facial artery and vein are very close to the needle in this position. Inject the anesthetic solution. The infiltrated tissue appears swollen. Firmly massage this area for 10-15 seconds. Complications that may occur from the extraoral infraorbital injection technique include bleeding, hematoma, allergic or systemic reaction to the anesthetic agent, infection, unintentional injection into artery or vein, failure to anesthetize, nerve damage, and swelling of the eye lid.

**CASE PRESENTATION**

These two Egyptian female patients came to my clinic seeking for implant to restore the missing teeth in anterior segment of the alveolar ridge. I decided to use the extraoral infraorbital nerve block rather than infiltration intraorally. The technique as I mention before is painless and less traumatic. The anesthesia was very effective and I complete the surgery without any problems. The following figures showing the application of the anesthesia: Figure [2] showing the first patient with right extraoral infraorbital injection; Figure [3] showing the first patient with left extraoral infraorbital injection; Figure [4] showing the second patient with left extraoral infraorbital injection; Figure [5] showing the upper anterior region of first patient in where surgery was performed during the implant surgical procedure; Figure [6] showing the upper left anterior region of second patient in where surgery was performed during the implant surgical procedure.

**DISCUSSION**

The majority of local anesthetic agents share the same basic chemical structure, which consists of an aromatic ring, linked to an intermediate chain (The intermediate chain between the aromatic and hydrophilic segments is either an ester or an amide), linked to a hydrophilic amine segment as seen in Figure 1. The chemical structure of this intermediate group classifies the agent into the amide group or the ester group. This structural difference determines
the pathway by which the agent is metabolized and its allergic potential. The toxicities associated with local anesthetics are cardiovascular and neurologic. Methemoglobinemia can occur with use of these agents, though it is rarely clinically significant. An infraorbital nerve block requires 1-3 mL of the chosen anesthetic agent. Lidocaine (Xylocaine) is the most commonly used agent. The onset of action for lidocaine is approximately 4-6 minutes. The duration of effect is approximately 75 minutes, which is sufficient enough to complete the implant surgery without needs of giving anesthesia again.

**Figure 4:** The second patient with left extraoral infraorbital injection.

**Figure 5:** The upper anterior region of first patient in where surgery was performed during the implant surgical procedure.

**Figure 6:** The upper left anterior region of second patient in where surgery was performed during the implant surgical procedure.

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**References**