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Assessment of Osseointegration around Immediate Implants after Atraumatic Extraction Using Physics Forceps Device

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ABSTRACT

Background: Clinical techniques and biomaterials have facilitated a great expansion in the indications for dental extraction and implant treatment options, which have proven successful.The aim of the present study was to assess the osseointegration around immediate implants after atraumatic extraction using physics forceps device. **Patients and methods**: The present study was conducted on sixteen cases with diseased teeth in the upper jaw of the premolars and anterior teeth that are not repairable and they do not have any diseases that interfere with performing the surgery. The cases were divided into two groups, each group consisting of eight cases, one of which is extracted using the physical forceps and the other with the convintional forceps. A clinical and radiological study was conducted before and immediately after the surgery and follow up after six month, the evaluation of bone formation was done. **Results:** The superiority of the physical forceps in increasing the stability and bone density around the implant compared to the regular forceps. **Conclusion:** Physics forceps are innovative extraction instruments and by using them it is possible to perform difficult extractions with predictable results and without need to reflect a flap.

Keywords: Atraumatic Extraction; Osseointegration ; Immediate Implants ; Physics Forceps

Introduction

Teeth replacement using dental implants has proven to be successful and predictable treatment procedure. The principles of biomechanics are the basis for the development of the Physics Forceps. This instrument was developed by Golden in 2004 and has been modified with the help of several doctors. Implementation of a first-class lever, creep, and the type of force provides the mechanical advantages necessary to make this dental extraction device more efficient. Moment of force in physics represents the magnitude of force applied to a rotational system at a distance from the axis of rotation **(1,2)**.

The Physics Forceps is really a dental extractor rather than a forceps (as its name implies), and uses first-class lever mechanics. One handle of the device is connected to a "bumper" which acts as a fulcrum during the extraction. The beak of the extractor is positioned most often on the lingual or palatal root of the tooth and into the gingival sulcus. The bumper is most often placed on the facial aspect of the dental alveolus, typically at the mucogingival

junction, no squeezing pressure is applied to the handles or to the tooth. Instead,the handles (once in position) are rotated as one unit for a few degrees, and then the action is stopped for approximately 1 minute. No force is required to be placed on the beak, which is only on the lingual aspect of the tooth root. Therefore, the tooth does not split, crush or fracture **(3,4)**.

A phenomenon termed "creep" occurs when a material changes shape over time while being subjected to a continuous load. In a tooth extraction, creep may occur in bone and the periodontal ligament, this process allows the tooth socket to expand and permits the tooth to exit the socket. Once creep has expanded and weakened the periodontal ligament and bone, the handle of the extraction device may be slowly rotated another few degrees for 10 to 30 seconds. This action contributes to the creep rupture of the ligament and usually elevates the tooth a few millimeters from the socket. At this point the tooth is loose and ready to be removed from the socket using any pincer-like device. This is important to note,since further rotational force on the tooth may fracture the facial plate of bone **(5)**.

The first dental implant protocol presented by Branemark Included a two-stage surgical procedure, separated by a period of Osseointegration of six months as minimum, prior to the prosthetic loading of the implant at the mandible. The period of wound healing and post extraction bone formation, was invariably associated with aesthetics periodontal alterations due to the localized bone resorption observed at the extraction area, caused by the absence of the stimulus to the periodontal ligament, as well as the remodeling of the soft tissues, despite the clinical success demonstrated in many cases **(6,7)**.

Residual bone volume could be reduced significantly because of the alveolar bone resorption associated with tooth extraction, compromising the subsequent implant treatment, and hindering the implant placement in a favorable position. The immediate implant placement in extraction site is a treatment with a well-accepted and defined protocol. It leads to the preservation of aesthetics, the maintenance of the alveolar walls, a better positioning of the implant, and a reduction in the overall surgery treatment **(8,9)**.

Grafts can provide scaffolding for bone regeneration and augmentation for bone defects resulting from trauma, pathology or surgery. They can also be used to restore bone loss resulting from dental disease to fill extraction sites and to reserve the height and width of alveolar ridge through augmentation and reconstruction **(10)**.

Osteogenesis, osteoinduction, and osteoconduction are considered the main Mechanisms of bone regeneration and augmentation. Osteogenesis is the formation and development of bone. Osteoinduction is the process of stimulating osteogenesis. Osteoconduction provides a physical matrix or scaffold suitable for of new bone deposition **(11)**.

Three primary types of bone graft material are being in current use. Autogenous bone, allografts, and alloplasts of which commercially available xenografts are generally considered a subgroup **(12,13)**.

Therefore, the aim of the present study was to evaluate the osseointegration around immediate implants after atraumatic extraction using physics forceps device

PATIENTS AND METHODS

The study was done on healthy patients classified as ASA (American Society of Anesthesiology classified patients according to their physical state) class I and class II as the following:

ASA class I: patient is a completely healthy fit patient.

ASA class II: Patient has mild systemic disease.

This study included sixteen patients of both sexes selected from the outpatient clinic of Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Suez Canal University. All patients were evaluated by digital radiograph and CBCT preoperatively and 6 months postoperatively. They were evaluated for implant stability immediately after implant placement and 6 months postoperatively.

Inclusion criteria:

Patients with badly decayed teeth in the anterior region up to the second premolar of the upper jaw. Patients aged from 20-40 years. Patients with good oral hygiene. Patients with adequate apical bone volume (at least 4 mm from the apex) to achieve primary stability of the immediate implant. Patients with adequate inter-occlusal space at the implant site (at least 8-10 mm) to accommodate the fixed prosthesis following immediate implant placement.

The sixteen patients were divided randomly in two equal groups (Group A and group B) :
- **Group A** (study group): consists of eight patients who were treated by extraction of badly decayed tooth by physics forceps followed by immediate implant placement.
- **Group B** (control group): consists of eight patients who were treated by extraction of badly decayed tooth by traditional forceps and elevators following the use of periotomes then immediate implant placement was carried out.

Ethical Consideration:

Patients were fully informed about the treatment procedures and follow up protocol. Appropriate institutional ethical clearance and written informed consent were obtained.

Preoperative clinical assessment:

Medical history was taken from patients preoperatively. Oral hygiene of the patients was assessed and referred to Perio department to undergo scaling and polishing when needed. The following criteria were checked preoperatively: presence or absence of periapical radiolucency / infection, the amount of available bone above the apices of the teeth, the integrity and thickness of labial / buccal and palatal plates of bone, root inclination within the sockets, measurement of labio/bucco palatal width of the tooth, measurement of labio/bucco palatal width of the socket, and measurement of length of the root.

Surgical procedure:

All the surgical procedures were performed by the same surgeon using standardized technique under aseptic conditions. All patients were operated under local anesthesia using Articaine hydrochloride 4% (Artinibsa,Inibsa dental S.L.U,Spain) with 1:100.000 epinephrine. Patients were anesthetized by infiltration technique labially or buccally and palatally. All patients received Neobiotech implants.

I. Group A (Study group):

Atraumatic extraction were performed using physics forceps. Currettage and graduated preidontal probe applied labially/buccally and palatally to measure the distance between marginal gingiva and height of labial/buccal and palatal plates. Implant osteotomy was done under standardized protocol. Neobiotech implant with suitable size and length was placed. Healing abutment placed after surgery completed **(Figure 1)**.

II. Group B (Control group):

Extraction of badly decayed tooth was done by periotomes followed by traditional elevators and forceps. Currettage and graduated preidontal probe applied labially/buccally and palatally to measure the distance between marginal gingiva and height of labial/buccal and palatal plates. Implant osteotomy was done followed by immediate implant placement **(Figure 2)**.

Postoperative medications:

All patients in both groups were subjected to the following drugs after the surgery:

A- Amoxicillin with Clavulanic acid (Ex. Augmentin 1g) tablets every 12 hours for 7 days.

B- Metronidazole (Ex. Flagyl 500 mg) tablets every 8 hours for 7 days.

C- Ibuprofen (Ex.Brufen 600 mg) tablets as an analgesic in case of pain.

D- Povidone-iodine antiseptic mouth wash (Ex. Betadine m.w. 1%*) available as 125 ml three times daily for 7 days post-operatively.

All patients were informed to expect some redness, blood ooze or swelling. To minimize swelling ice backs were kept over the cheek at the area of surgery for 10 minute every an hour for 12 hours after surgery. Soft diet should be eaten at the day of surgery with no hot food and drinks. Avoid rinsing and spitting for 24 hours after surgery. The patients were instructed to act accordingly.

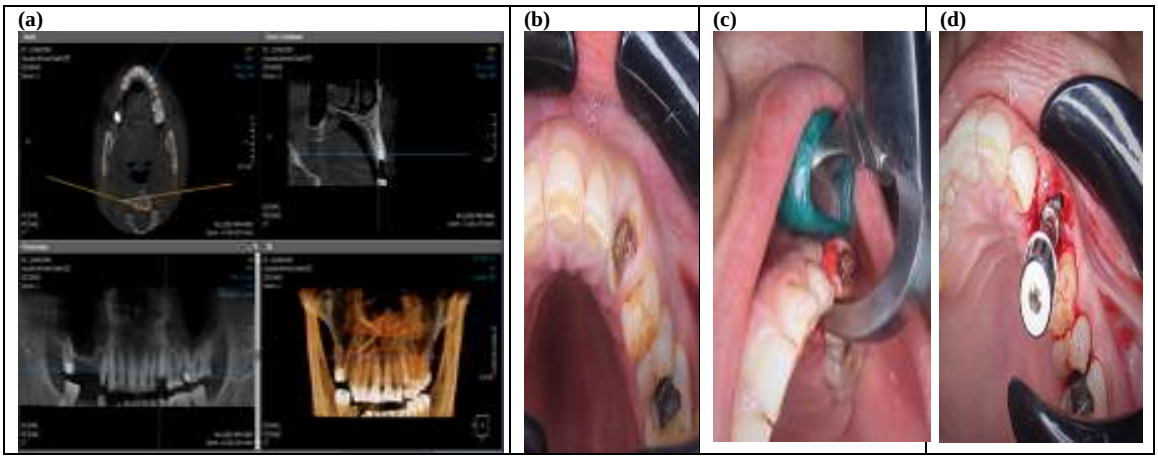

Figure (1): Photographs showing (a) CBCT to detect bone width and length at the interested area; (b) preoperative condition in incisal view; (c) R.R. extraction; and (d) implant insertion.

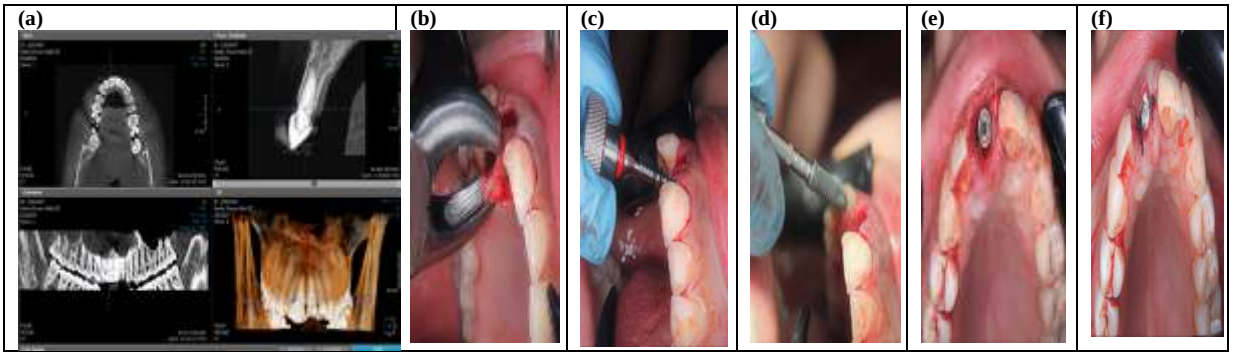

Figure (2): Photographs showing (a) CBCT to detect bone width and length at the interested area; (b) RR extraction; (c) implant osteotomy preparation; (d) implant insertion; (e) final implant position at the socket; (f) healing abutment placement and final postoperative suturing to aid soft tissue healing

Postoperative assessment:

1) Implant stability measurement: Initial stability was measured before placement of healing cap and final stability was measured after 6 months of the surgery using Implant Sability Quotient (ISQ) scale to compare changes in stability.

2) Digital Radiography Assessment: Periapical digital radiograph was taken for each patient postoperatively to assess the surgical procedure . Each patient returned for follow up and periapical x-ray after six months. CBCT was used for assessment of bone density around the implants after 6 months

3) Bone Density Assessment: The idea of using virtual implant was to fix the area measured whereas the area drawn manually can't be fixed in both initial and final CBCT. The virtual implant was chosen with the same dimension and design of the used implant placed over the real implant in the pre and final CBCT and adjusted in both axial and cross sectional view. Using OnDemand3D CBCT analyzing system the density of 2mm thickness of bone around the implant was measured and converted to Housefield unit**.**

Statistical analysis:

Data analyzed using Microsoft Excel software then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD. Differences between quantitative independent multiple by ANOVA. P value was set at <0.05 for significant results &<0.001 for high significant result.

Results

The present study was conducted on 16 cases and they divided and randomly. According to gender, group A about 37.5 % males and 62.5% females with mean average from 20 to 40 years old. While group B about 25 % males and 75% females with same mean average **(Figure 3)**.

Regards to changing by time, the stability values were increased significantly with increasing period for group A with (30.29%) and group B with (42.99%) , and there was statistically significant change in the mean of (stability) within the same group after 6 months compared with the baseline for both groups (P<0.001) using independent samples T-test. There was highly statistically significant difference between groups for stability at the baseline and after 6 months using independent sample T-test at P<0.05 (P<0.001and P=0.001). The high mean values was recorded in group A (56.23±0.72) immediate post operatively and (73.26±0.1.39) after 6 month compared with group B (49.10 ±0.94) at base line and (70.21±1.56) after 6 month **(Table 1)**.

The bone density values were increased significantly with increasing period for group A as 61.22 and group B as 31.84%, and there was statistically significant change in the mean of (bone density) within the same group after 6 months compared with the baseline for both groups (P<0.001) using independent samples T-test. There was highly statistically significant difference between groups for bone density at the baseline and after 6 months using independent sample T-test at P<0.05 (P<0.001). At the baseline, the high mean values was recorded in group B (1068.39±4.99) compared with group A (989.45 ±3.58) while after 6 months the high mean values was recorded in group A (1595.19±5.04) compared with group B (1408.61 ±4.38) **(Table 2)**.

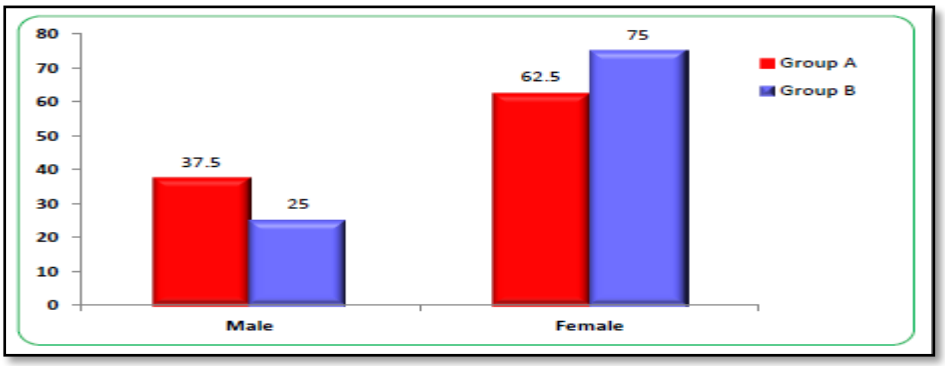

Figure 3: Descriptive statistical for 16 cases under study.

Table 1: Comparison between groups for stability at different time

	Baseline		6 month		% change	95% Confidence Interval of the Differenc		Paired. T test	P value
	Mean	SD	Mean	SD		Lower	Upper		
Group A	**56.23**	0.72	**73.26**	1.39	30.29	-18.3	-15.7	***31.02***	***<0.001*****
Group B	**49.10**	0.94	**70.21**	1.56	42.99	-19.6	-33.495	***33.49***	***<0.001*****
Indep. T test	***16.98***		***4.13***						
P value	***<0.001*****		***0.0010*****						

*** means significant difference at P<0.05*

Table 2: comparison between groups for bone density at different time

	Baseline		6 month		% change	95% Confidence Interval of the Differenc		Indep. T test	P value
	Mean	**SD**	**Mean**	**SD**		**Lower**	**Upper**		
Group A	**989.45**	**3.58**	**1595.19**	**5.04**	**61.22**	**-611.8**	**-599.7**	***236.52***	***<0.001*****
Group B	**1068.39**	**4.99**	**1408.61**	**4.38**	**31.84**	**-345.4**	**-335.1**	***155.93***	***<0.001*****
Indep. T test	**36.35**		**78.99**						
P value	***<0.001*****		***<0.001*****						

*** means significant difference at P<0.05*

DISCUSSION:

The way was paved for superior immediate implant technique to replace the traditional delayed one by studies that suggest the possibility of placing an immediate implant in a socket as most of the unrestorable teeth that need replacement. This allowed utilizing immediate implant advantages which include preservation of bone plates, better soft tissue contour, easier placement of implant with proper position, less number of visits, less treatment duration with less cost and better final esthetic outcome **(14,15)**.

Another obstacle facing the immediate implant procedure is the limited blood supply of the labial/buccal bone. The buccal bone sole blood supply from the periodontal ligament is cut after the extraction leading to its eventual resorption. The decrease in labial/buccal bone height and width endanger the success of immediate implant technique as metal display and gingival recession will result in bad esthetics and short duration of the implant. Jose Viña-Almuni, Et al. in 2018 found that immediate implant technique did not stop the decrease in buccal bone height and width. He suggested that the use of smaller implant diameter with at least 2mm buccal gap between the implant and buccal bone and the use of ridge preservation technique may help preserve the buccal bone height and width **(16)**.

The success of Osseointegration is related to many factors, including the quality of the bone, the biocompatibility and surface characteristics of the implant material, surface treatment material enhancing Osseointegration, the surgical technique, and functional loading. Osseointegration of dental implants is important, and includes the circumferential tissue response that includes inflammation, neoangiogenesis, osteoinduction, and osteoconduction, followed by a remodeling phase **(17-20)**.

The surgical requirements for immediate implants include atraumatic extraction and thorough alveolar curettage to eliminate any possible pathological material. Primary implant stability is also an essential requirement and is achieved either by the extension of implants that exceed the tooth apex by 3–5 mm or by placing a dental implant with a greater diameter than the alveolar socket.

Physics forceps are the most innovative oral surgery instruments in recent years, completely changing the physics behind dental extractions; hence it is named as physics forceps. They were developed by Dr. Richard Golden in 2004 and have been modified with the help of several doctors. It reduces trauma to the adjacent bone and preserves buccal plate of bone intact during tooth extraction, which is essential for immediate implantation **(22-23)**.

The main advantage of physics forceps over conventional forceps is related to their unique design that can deliver a powerful mechanical advantage by employing an efficient first-class lever. The extraction technique differs from any other extraction technique in that the buccal portion of the forceps is not a beak, but rather a plastic-covered bumper which is placed apically in the vestibule, creating a more efficient class I lever system in addition to supporting the labial/buccal plate of bone. By combining the biomechanical advantages of a first-class lever with the biochemical reaction, extraction of the teeth became easier with physics forceps than conventional type with less incidence of crown and root fracture **(3)**.

When the periodontal ligament was traumatized with forceps or elevators, hyaluronidase was released. Once this chemical breakdown of the periodontal ligament by hyaluronic acid was sufficient, the tooth was released from its attachment to the alveolus and could be removed. This explains why the physics forceps with its steady trauma to the periodontal ligament quantitatively creates a greater release of hyaluronidase than traditional forceps or

elevator extractions because the trauma from those techniques was intermittent. This is what makes the physics forceps more efficient, and causes less crown and root fracture **(3,4)**.

In the current research a study group of eight patients had their teeth extracted using the maxillary anterior physics forceps while in the control group extraction was performed using the maxillary anterior and premolar conventional forceps. Clinical evaluation was done postoperatively until 6 months.

The results were in agreement with the study of **Choi et al. (76)** who used physics forceps to extract teeth for intentional replantation (IR) and they concluded that, physics forceps could be considered as a reliable extraction method for safe and successful IR.

In addition, the beak of the physics forceps is designed to apply control pressure parallel to the long axis of the root, and the bumper acts as a simple fulcrum or pivot point, so there were no squeezing forces applied to the beak of the physics forceps; because of that the tooth does not split, crush or fracture. Traditional forceps grasp, squeeze, twist, and exert crushing forces on the crown leading to increase in the incidence of crown fracture in conventional forceps group. These results were concomitant with the study of **Misch and Perez (3)** who concluded that the handles of conventional forceps allow the operator to grasp the tooth but do not assist in the mechanical advantage to remove it.

On the other hand The physics forceps applies a constant and steady pressure with the wrist only, as this technique requires a minimal amount of strength and a maximum amount of patience, that helping to decrease the incidence of buccal bone fracture. In addition the bumper applies a compressive force at the buccal bone as it was positioned on the buccal alveolar ridge, resulting in holding and supporting the bone in its place. This result was in agreement with the result of **Kosinski (25)** who stated that the buccal movement applied by physics forceps was slow and generally insufficient to fracture the buccal bone plate which if happend can affect negativly the stability and Osseointegration around the dental implant.

However, the use of physics forceps needs a presence of exposed palatal shelf of the tooth to the beak of the forseps to rest on. If this is not the case we can creat such fulcrum point by reflicting the palatal gingiva to expose the needed palatal aspect of the root or even using contra to remove bone in case of fully coverd root to creat such point. In the present study, mild gingival lacerations resulted during extraction in some patients of the study group at the mucogingival margin where the bumper of the physics forceps rested. Similar result was obtained by **Yehea et al. (26)** in their evaluation study of the extraction using physics forceps.

Radiographic evaluations were done immediately postoperatively and after 6 months. Results revealed that there were statistically significant results obtained in each group separately throughout the evaluation period. There was also statistically significant difference between the two groups according to the mean values of both the bone density and implant stability in favor to the study group immediately postoperatively and after 6 month.

Regarding the implant stability quotient values, the study group showed higher significance values both at the baseline and after 6 month postoperativly. This would obviously suggest that the physics forceps extraction yields better osseointegration results, however the literature lakes similar substantial evidence to support or contradict such finding.

Finally, It is suggested from this study that the physics forceps and its associated beak and bumper technique is clinically valuable in atraumatic tooth removal and in preserving the labial/buccal bone plate, which is mainly critical prerequisite for implant stability and bone osseointegration process around the implant.

Conclusion:

Physics forceps are innovative extraction instruments and by using them it is possible to perform difficult extractions with predictable results and without need to reflect a flap.

Physics forceps can be regarded as a reliable technique for atraumatic tooth extraction, leading to good immediate implant initial stability and bone integrity surrounding the placed implant which increase the final osseoitegration outcome.

Physics forceps are newer instruments that should be introduced in the teaching of dental graduates. Further trials with bigger samples are required, particularly in other population age groups.

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Author contribution: Authors contributed equally in the study.

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