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# Clinical and Radiographical Evaluation of the Efficacy of Periotome during Tooth Extractions

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## Abstract

**Aims and objectives:** To evaluate the efficacy of periotome for atraumatic extractioms in single rooted teeth and to compare clinically and radiographically the efficacy of periotome in single rooted teeth extractions (Group p) with normal forceps extraction (Group c) in a sample of 30 patients.

**Patients and Methods:** Randomised prospective comparative clinical study was done in 30 patients 15 in each group (i.e. periotome and control group). Clinical parameters such as pain,buccal cortical plate fracture, gingival lacerations, soft tissue injury, teeth fracture,time taken for extraction,number and frequency of analgesics consumed and any post operative complications were evaluated. Radiographically crestal alveolar bone levels were measured by standardised IOPA using the grid in SOPRO imaging software, RVG at pre operative, 1st month and 3rd month intervals.

**Results:** Comparing group C and P, statistically significant (p value <0.05) amount of MCABL bone loss is seen from pre-operative to 3rd month and from 1st month to 3rd month in periotome group.Gingival lacerations are more of grade 1 in periotome group. Buccal cortical plate fractured in26%, 2 cases of teeth fracture, pain and analgesics consumption are more in control group.

**Conclusion:** Extraction of single rooted teeth can be done by periotome atraumatically which gives better ridge contours for future prostheticrehabilitations.

**Key words:** Extraction, periotome, crestal bone levels, soft tissue injury.

## Introduction

Nowadays rehabilitation of missing teeth with implants has gained importance. The prerequisite for the replacement of missing teeth with an implant is that there should be an adequate bulk of alveolar bone to surround the implant. Traumatic dental extractions can lead to wound healing complications and damage the crestal alveolar bone resulting in significant ridge deformities, thereby preclude dental implant placement or result in sub-pontic food traps beneath traditional fixed partial dentures. To avoid these complications atraumatic dental extraction techniques have gained importance. The

various newer systems and techniques evolved for atraumatic extraction are Periotomes, Physics forceps, Piezosurgery, Benex extractor, Easy X-Trac system. Of these, Physics forceps are based on gentle rotational force, only with wrist movement and based on class I lever mechanics making it maximum technique sensitive, high cost[30]. Easy X-Trac system and Benex extractor requires a lot of equipment (i.e. sectional impression trays, self tapping screws, matching diamond burs, putty impression material), no availability and increased operating time[28]. Disadvantages of piezosurgery include increased operating time, cannot be used on thick cortical plates and inaccessible areas and contraindicated in patients with cardiac pace makers[29]. Of the various tools available for atraumatic extraction, periotome was chosen in this study because of its easy availability, minimal technique sensitive, cost effective and easy to master the technique.

**Patients and Methods**

A randomised prospective comparative clinical study was designed of 30 patients 15 in each group to evaluate the efficacy of Periotome (HU-FRIEDY PT2 ANTERIOR PERIOTOME) in single rooted teeth extractions compared to forceps method of extraction both clinically and radiographically. The study obtained ethical committee clearance from the institution and consent forms were obtained from patients after explaining the details of the study. Normal healthy young adult patients requiring closed method of extractions of either maxillary or mandibular single rooted teeth and who are willing to participate were included in the study. Medically compromised, Syndromic and patients who are not willing to participate in the study were excluded. Armamentarium included Hu-Friedy PT2 anterior periotome, Molts mucoperiosteal elevator, Anterior forceps, LCP Rinn film holder, Custom made Guide stent. Pre operatively custom made stent was prepared from self cure acrylic material for serving as reference point for measuring bone levels. Mesial and distal crestal bone levels were measured radiographically in the IOPA with the LCP technique using the grid in SOPRO Imaging Software, RVG. All patients underwent extractions aseptically under local anaesthesia (2% lidocaine with 1:80,000 adrenaline).

Clinical parameters evaluated intra operatively were pain, buccal cortical plate fracture, gingival lacerations, soft tissue injury, teeth fracture and time taken for extraction in both the groups. Gingival lacerations were graded using the following scale:

| | Grade 1 | Grade 2 | Grade 3 | Grade 4 |
|---|---|---|---|---|
| Length | 0-5mm | 5-10mm | >1cm | Torn |
| Depth | Abrasion | Complete | Complete depth | |

All the patients were given post operative instructions and analgesics. One week post operatively patients were asked the number and frequency of analgesics consumed by telephone conversation. Patients of both the groups were recalled at 1st and 3rd month where Mesial and Distal crestal alveolar bone levels were measured radio graphically by the help of custom made stent.

Statistical analysis was done using SPSS version 21. Paired t-test was used for comparison of follow up's within the group and Independent t-test for comparing the two groups. Mann-Whitney U test is used for comparing intra operative pain between the Group P and Group C.

**Results and Discussion**

The mean values of MCABL in group P are 9.27, 9.87, and 10.53 for pre-operative, 1st month and 3rd month respectively. Comparisons between pre-operative to 1st month, 3rd month and 1st month to 3rd month are statistically highly significant i.e. (p value < 0.01). The

mean values of DCABL in group P are 8.60, 10.13, and 10.33 for pre-operative, 1st month and 3rd month respectively. Comparisons between pre-operative to 1st month, 3rd month are statistically highly significant i.e. (p value < 0.01) where as from 1st month to 3rd month it is statistically not significant (p value - 0.9). The mean values of MCABL in group C are 9.14, 9.50, and 9.57 for pre-operative, 1st month and 3rd month respectively. Comparisons between pre-operative to 1st month, 3rd month are statistically significant (p value < 0.05) where as from 1st month to 3rd month it is statistically not significant (p value - 0.72). The mean values of DCABL in group C are 9.29, 10.07, and 10.17 for pre-operative, 1st month and 3rd month respectively. Comparisons between pre-operative to 1st month, 3rd month are highly statistically significant (p value < 0.01) where as from 1st month to 3rd month it is statistically not significant (p value - 0.58). The comparison of MCABL loss in between group C and P from Pre-operative to 1st month, 3rd month and 1st month to 3rd month. The mean values of MCABL loss from pre-operative to 1st month, 3rd month and 1st month to 3rd month for Group C are 0.36, 0.43 and 0.07 respectively. The mean values of MCABL loss from pre-operative to 1st month, 3rd month and 1st month to 3rd month for Group P are 0.60, 1.27 and 0.67 respectively. Comparing between Group C and P, there is statistically significant (p value < 0.05) amount of bone loss is seen from pre-operative to 3rd month and from 1st month to 3rd month where as it is not statistically significant (p value - 0.39) from pre-operative to 1st month. The comparison of DCABL loss in between group C and P from Pre-operative to 1st month, 3rd month and 1st month to 3rd month. The mean values of DCABL loss from pre-operative to 1st month, 3rd month and 1st month to 3rd month for Group C are 0.79, 0.84 and 0.95 respectively. The mean values of DCABL loss from pre-operative to 1st month, 3rd month and 1st month to 3rd month for Group P are 1.53, 1.73 and 0.20 respectively. Comparing between Group C and Group P, there is highly statistically significant (p value < 0.01) amount of DCABL loss is seen from pre-operative to 3rd month where as it is not statistically significant from pre-operative to 1st month and from 1st month to 3rd month.

86% of the cases in group P are seen with grade 1 gingival lacerations while only 40% of the cases in group C. In Group C, 20% were grade 2, 26% were grade 3 and 13% were grade 4 gingival lacerations. The mean values of time taken for extraction for group P is 7.2 and for group C is 4.08 which is highly statistical significant (p<0.01). Buccal cortical plate fractured in 26% of cases with conventional method of extraction which is of statistically significant (p value < 0.05). In the control group, only 2 cases are seen with teeth fracture during teeth extraction while none of the cases are seen with teeth fracture in group C (p value - 0.48). The mean values of VAS score for Group P and Group C are 0.07 and 1.2 respectively (p value < 0.00). The mean values of analgesics consumption for Group P and Group C are 2.29 and 3.33 respectively (p value – 0.1). Soft tissue injury was neither observed in any case of Group P nor Group C.

Immediate rehabilitation of missing teeth with implantology has gained more importance in this modern era. Alan A. Quayle suggested that replacement of teeth with immediate implants following elective extraction requires preservation of alveolus with minimal surgical damage by atraumatic extraction[4]. Most commonly followed technique of extraction is the conventional method using forceps where resorption of bundle bone occurs because of destruction of periodontium which in turn increased by reflection of mucoperiosteum[42]. Elevation of mucoperiosteum may compromise the periosteal blood supply to the alveolus leading to marginal

alveolar bone loss even in relatively atraumatic extractions.Conventional method of extractions has complications such as pain, buccal cortical plate fracture, root fracture, dry socket, swelling, trismus, prolonged healing, loss of alveolar bone and sometimes leads to surgical method of extraction.

Any damage of bone tissue during tooth extraction result in sacrifice of alveolar bone leads to bone loss[7, 8] and difficulty in maintaining the socket integrity for immediate implant placement. Traumatic extractions result in soft and hard tissue damage leading to disturbed healing which can complicate or even jeopardise dental implant placement[9]. As well as disturbances in post extraction wound healing not only limited to localised symptoms but loss of days at work and decreased productivity from frequent hospital visits[9, 16]. For immediate rehabilitation of missing teeth with optimal aesthetic outcomes and for oral related health quality of life, an atraumatic dental extraction techniques has gained importance. Tools available for minimally invasive technique of tooth extraction are Periotomes, Easy X-Trac system, Physics forceps, Piezosurgery, Benex extractor.

In this study, HU-Friedy anterior PT2 periotome was used which is double ended instrument consisting of handle, shank and two working ends. Sneha D. Sharma et al[1] used Amron periotome with blade attachments. Alan A. Quayle used Friedrichsfeld GmbH, Mannheim, West Germany consisting of a handle and three detachable blades of different diameters, two of which are straight and the other angled[4]. Periotome technique of extraction was first described originally in German and subsequently in English literature by Schulte. The periotome was held in modified pen grasp technique and the long axis of the blade should be inserted at 20 degree angle to the long axis of the root surface, ensuring that the tip of the blade should be located within the crest of the alveolar bone. The gingival fibres at the cervical region of the tooth are severed first circumferentially and then pushed several mm into the periodontal ligament space inclining mesio-distally on the labial aspect of the tooth, tangential to the root surface and repeated in stages around the surface of the tooth. Once the access was obtained, the periotome was used to gradually advance until 2/3rd of root surface was reached using the same technique. Now, the tooth remains attached to the alveolus by only the most apical part of the periodontal ligament. Then tooth was extracted using extraction forceps without thrusting into the periodontal space exerting rotational force thus avoiding damage or distortion to the alveolar bone[4, 35].

Alan A. Quayle suggested that periotome is helpful in removing individual teeth or retained roots without damaging the adjacent alveolus[4]. Sneha D. Sharma et al[1] opinioned that periotome gives superior results compared to conventional method of extraction. Mohan kumar et al[17] found that periotome is more conservative in the maintenance of bony architecture and does not result in functional or aesthetic deformities in the anterior aesthetic zone. Lanning SK et al[18] and Gargiulo et al[19] proposed periotome in cases of deep sub-gingival carious lesions, sub-gingival root fractures and in cases where extensive osseous trephination are contraindicated. So, based on these studies, periotome was used as a means of atraumatic extraction of single rooted teeth in this study. As only few studies are in the literature, this study was undertaken to know the efficacy of periotome both clinically and radiographically (by measuring mesial and distal crestal bone levels) in extraction of single rooted teeth.

For rehabilitation of missing teeth with implants, marginal alveolar ridge protection is important in achieving

optimal functional and aesthetic prosthesis[42]. Crestal alveolar bone levels are a very important factor for the success of an implant and they are important for papilla preservation[32] and also to eliminate the apical migration of junctional epithelium which could disrupt the biological width[31]. Crestal bone loss can also lead to increased bacterial accumulation resulting in secondary peri-implantitis. Some possible aetiologies for early crestal bone loss around implants includes surgical trauma, reformation of biologic width, peri-implantitis, occlusal overload[34]. Resorption of alveolar ridge after tooth extraction is a natural physiologic phenomenon due to loss of mechanical demands[5] and it occurs more reduction in bucco-lingual width than loss of height[8]. Histologically, healing of an extraction socket involves a series of events including the formation of a coagulum that was replaced by provisional matrix, woven bone, lamellar bone and bone marrow. Cardaropoli G[10] et al done a experimental study in dogs to evaluate the healing of an extraction socket and noted the following events: a) blood clot formation during the first 3 days of healing which is replaced by provisional matrix after 7 days, b) first signs of mineralised bone on day 14 and on day 30 extraction socket was more or less entirely filled with bone (88%) and c) on day 60, 90, 120 and 180, a non-mineralised bone marrow was the dominating tissue and mineralised bone occupied only between 15% and 23% of the socket volume. In a study done by Melvin H. Amler[38] on the time sequence of tissue regeneration in human extraction wounds, clot formation was noted on same day of extraction, replacement of clot by granulation tissue and appearance of osteoid at base of socket after 7 days, replacement of granulation tissue by connective tissue after 20 days, trabeculae was found filling at least two thirds of socket after 38 days, and fusion of epithelium at 24-35 days after extraction. Philip J. Boyne[40] on his study on osseous repair of post extraction alveolus in man, observed a) clot formation on day 1, b) epithelial proliferation, fibroblasts invasion over the surface of the clot after 3 days, c) first evidence of new bone formation at the fundus of the socket after 5 days, d) new bone along the lateral aspects of the alveolus at 11 days, e) new bone had reached the crest of the alveolus at 19 days and f) 28 days post operatively alveolus had filled with new bone. The possible origins of osteoblasts in the human extraction socket were periodontal ligament fibroblasts, periosteum, marrow stem cells, pericytes and adipocytes[15]. During a 12 month period after a tooth extraction, alveolar walls loose buccal as well as vertical dimensions (0.7-1.8mm) buccal site more than lingual[5, 7, 41, and 42]. Residual ridge resorption occurs most rapidly in the first 6 months and continues throughout the life at a slower rate (0.5mm/year) [7, 6, 41]. In that within the first month following extraction maximum loss of tissue contour takes place[8]. Most of the alterations in the horizontal and vertical alveolar ridge dimensions will took place during the first 3 months of healing[7]. Lars Schropp et al[8] found that loss of crestal bone height mainly occurred within first 3-month period after extraction. So, based on above said studies, mesial and distal crestal bone levels were assessed radiographically at 1st and 3rd month post operative follow ups in this study. Techniques for taking Intra Oral Periapical films include paralleling and the bisecting angle techniques. In this study, IOPA with long cone paralleling technique was used to measure mesial and distal crestal bone levels because of its better dimensional accuracy. A Volchansky[23] recommended right-angle long-cone technique is a more reliable, accurate and reproducible method of radiographic examination as it minimises dimensional distortion. Similarly, Lars Schropp et al[8] achieved reproducible periapical images using paralleling

technique. Although intra-oral periapical radiographs were standardised, some degree of magnification is inevitable and measurements were approximated and not the real size[8]. In this study in order to provide reference line for measuring mesial and distal crestal bone level, a patient specific radio opaque stent was prepared which is in coherence to a study done by Michael S. Block et al[6]. Patient specific radio opaque stent was prepared using self cure acrylic material with a 18 gauze wire polymerised into the stent and positioned horizontally along the incisal or occlusal surfaces of two teeth on either side of the teeth going to be extracted. After the stent prepartion is done mesial and distal crestal bone levels were measured radiographically and comparisons were done from pre-operative to 1st month, 3rd month and 1st month to 3rd month.

In this study with the periotome method of extraction, it was found that mesial crestal alveolar bone loss is seen from pre-operative to the end of 3rd month, which is more in between 1st and 3rd month, where as distal crestal alveolar bone loss is seen in between pre-operative and 3rd month where as less bone loss is seen in between 1st and 3rd month. In this study with the conventional method of extraction, it was found that mesial and distal crestal alveolar bone loss is seen in between pre-operative and 3rd month where as less bone loss is seen in between 1st and 3rd month. In both periotome and control group, more of crestal alveolar bone loss is seen on the distal side than mesial side from pre-operative to 3rd month, which is more in between pre-operative to 1st month. In this study, when periotome is compared with conventional method of extraction using forceps more mesial crestal alveolar bone loss is seen in periotome group than forceps group from pre-operative to 3rd month and 1st month to 3rd month where as less bone loss is seen in between pre-operative and 1st month. Similarly, more amount of distal crestal alveolar bone loss is seen in periotome group than forceps extraction group from pre-operative to 3rd month not much in between pre-operative to 1st month and 3rd month. It can be concluded from the results of this study that the net result of radiographic assessment of mesial and distal crestal alveolar bone loss is seen more with periotome method than in conventional method of extraction.

Reasons for minimal amount of bone resorption in conventional method of extraction is may be due to presence of osteoblasts cells in the periodontal ligament. H. Devlin[15] et al investigated the pattern of osteoblast differentiation in the human extraction socket using Runx2 immuno-marker and found that osteoprogenitor cells in the residual periodontal ligament and bone marrow contributes to bone regeneration following tooth extraction. In addition to that Cardaropoli G[10] observed a large number of PDL cells close to the coagulam and suggested that PDL cells contributed not only to the formation of the provisional matrix but also to the hard tissue formation in the healing socket. Similar results were obtained by Lin[30] et al on their experiment on bone formation in extraction socket of rats.

In the same way reasons which can be attributed to more amount of crestal bone loss in periotome method of extraction can be be due to more damage of periodontal ligament during insertion of working end of periotome in to the periodontal ligament space during extraction. The possible origins of osteoblasts in the human extraction socket were periodontal ligament fibroblasts, periosteum, Marrow stem cells, pericytes and adipocytes[15]. When the periodontal ligament is traumatised, hyaluronidase (hyaluronate glycano hydrolase) is released which is an enzyme that catalyses the hydrolysis of the interstitial barrier, hyaluronan (hyaluronic acid) which is the cementing substance (extra

cellular matrix). Once chemical breakdown of the periodontal ligament by hyaluronidase occurs, the tooth is released from its attachment to the alveolus. It can also be attributed to periotome technique of extraction where the initial area of entry of working end of periotome is through the interproximal area of the tooth to be extracted thus damaging the periodontal ligament which is the possible source of origin of osteoblasts for bone regeneration.

In this study, clinical parameters such as buccal cortical plate fracture, time taken for extraction, gingival lacerations, soft tissue injury, teeth fracture, pain, analgesics consumption and any post operative complications were noted. In this study buccal cortical plate was fractured in 26.7% of cases and teeth fractured in 13.3% of cases in conventional method of extraction whereas none of them was reported in periotome method of extraction. In a study done by Waslu Lanre Adeyemo et al[11] to know the influence of trans-operative complications on socket healing, the authors reported that most frequently occurring trans-operative complications are root fractures (44.74%), crown fractures (34.21%) followed by alveolar bone fractures (2.63%). Al Khateeb et al[2] done a study to evaluate the pain experience after simple tooth extraction and reported pain as the most common complication in exodontias and majority of patients experienced mild pain (38.6%). Venkateshwar et al[12] found that teeth fracture, trismus, cortical plate fracture and dry socket were the most common complications and post operative pain the rare complication in exodontia. Marco cicciu et al[14] done an experimental in vivo study to evaluate the strength applied for teeth extraction and reported that complications of extraction is may be due to incorrect force application and strange root forms and not affected by amount of strength applied or quality of bone surrounding the tooth.The more the facial wall damage due to trauma, the bigger the deformation of the contours[42]. Excessive trauma results in delayed healing of extraction socket due to compression of bone lining the socket impairing vascular penetration and results in thrombosis of the vessels [25]. Raymond F. Huebsch[39] observed delayed healing in disturbed sockets and also noted necrosis of alveolar bone surface lining the socket initially followed by resorption of alveolar bone that is necrotic.

In this study soft tissue injury was not observed in any case of conventional or periotome method of extraction. Gingival lacerations are more of grade 1 type (86.7%) in periotome group suggesting less soft tissue injury resulting in good aesthetic outcome by prosthetic rehabilitation which is in coherence with the study done by Sneha D. Sharma et al[1]. In this study, the time taken for extraction of teeth is more with periotome method than with conventional method of extraction which is against the result of the study done by Sneha D. Sharma et al[1] where duration of procedure is significantly greater with conventional method of extraction than periotome method. Waslu L. Adeyemo et al., [11] observed increased number of complications and disturbances in wound healing in cases with increased extraction time which is not in coherence with this study, where no post operative complications were noted with periotome method of extraction where it took longer time to extract.

In this study there were no post operative complications due to extraction reported either in control or periotome group. Among many complications reported post operatively, dry socket is the most common complication reported[11]. Marcelo Carlos Bortoluzzi et al[3] done a study on 357 individuals with 473 teeth extracted and found that incidence of alveolar infection, dry socket and severe pain were very low (0.6%) for the routine extraction of erupted

teeth. Incidence of socket healing complications is minor but the problems created by disturbances in socket healing are not only limited to localised symptoms but also jeoparadises dental implant placement which is cumbersome to the patient as well for the clinician [9, 12,21.] In this study, pain was measured using VAS scale. Mathias Haefeli suggested that VAS and GRS are valuable instruments to assess pain intensity and changes due to therapy while NRS and VRS are not appropriate to detect changes over time[36, 37]. Polly E. Bijur et al[13] suggested that VAS is suffieciently reliable for assessing acute and chronic pain. In this study post operative pain is more in conventional method of extraction than periotome method which is in coherence with the study done by Sneha D. Sharma et al[1]. Maximum number of patients (81.8%) experienced pain of varying intensity at the evening of extraction after simple extractions[2]. Cheung et al[22] found that healing of simple uncomplicated extraction caused moderate to severe pain where as Adeyemo et al[9] found mild to moderate pain in 9.6% of cases up to the third day after extraction. Post operative pain is significantly related to the amount of surgical trauma done during extraction which can be attributed to the explanation given by Al-Khateeb et al[2]. Garcia Garcia A[24] reported that pain after simple extraction is less severe compared with extraction involving bone trephination. In this study analgesic consumption was more in conventional method of extraction than in periotome group which is in coherence to the study done by Sneha D. Sharma et al[1]. Reasons contributed to more amount of analgesic consumption in conventional method of extraction is may be due to more number of complications, increased grading of gingival lacerations and increased extraction time reported in conventional method of extraction. In this study, periotome helped in extracting grossly decayed tooth, fractured teeth, endodontically failured tooth, teeth with cervical caries without damaging the buccal and lingual cortical plates and soft tissue as well. Also the post operative pain, analgesics consumption was less improving oral-health related quality of life. Avoidance of excessive trauma and trans-operative complications, careful handling of tissues, use of controlled force, meticulous surgical technique will help reduce socket healing complications and also improved ridge contours for future prosthetic rehabilitation.

Limited number of studies are done regarding the efficacy of periotome in extractions where both clinical and radiographical evaluation of crestal bone levels were determined. Accurate method of measuring bone levels is by Cone Beam Computed Tomography but because of its lack of availability and high cost, it was not considered in this study. Less sample size was some of the draw backs present in this study. Further studies with a large sample size with advanced and accurate radiographical interpretation of crestal bone loss is required to know the radiographical efficacy of periotome over the conventional forceps extraction for single rooted teeth.

**Conclusion**

Even though a negligible more alveolar bone loss (radiographically) is seen with periotome than with forceps extraction for single rooted teeth, periotome offers an advantage of less soft tissue injury, no buccal cortical plate and tooth fracture during extraction, less post operative pain and uneventful healing. extraction of single rooted teeth can be done by periotome atraumatically which gives better ridge contours for future prosthetic rehabilitations.

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