The use of different platelet concentrates in socket augmentation following tooth extraction
(clinical and histomorphometric study)

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(وَمَا أُوتِيتُمْ مِنْ الْعِلْمِ إِلاَّ قَلِيلاً)

صدق الله العظيم

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DEDICATION:

I want to dedicate this thesis to my family my **Father (Dr Farahat)** and my **Mother (Soheir),** they believed in me, supported me, they gave me the hope to reach this point and beyond, I ask God to protect them and keep them for me ever. My great sisters **Shahenda, Yasmin and Ghada,** love you soo much, and special thanks and appreciation to my best friend **Al-Hassan Ahmed Abosarea.**

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Review of literature

Dentistry has entered an era in which patients no longer need to accept an edentulous or partially edentulous condition, or one in which their candidacy for tooth structure replacement (implants with subsequent restoration) must be dismissed because of insufficient alveolar bone volume, height, or width. The supporting bone can be preserved at the time of tooth extraction, or augmented at the time of case presentation, using a variety of available regenerative materials **(Keith et al., 2007).**

The main contraindications for immediate implant placement include: Acute symptomatic periapical infection, when good primary stability of an implant is not possible when placing it immediately into an extraction socket, patient driven factors, when there is loss of labial plate due to a draining apical infection or as is vertical root fracture. This is particularly the case in the aesthetic zone where stabilization of the soft tissue profile becomes even more critical, or in cases where there is limited bone height for subsequent implant placement (such as under a maxillary antrum or above the inferior dental nerve canal). In cases where immediate implant placement is contraindicated and delayed implant placement more appropriate, it is often worth contemplating socket grafting **(Danesh –Meyer et al., 2008).**

The ability to preserve marginal soft tissue contours is an important consideration in the aesthetic zone particularly in cases with thin labial plate of bone. Under normal circumstances, tooth extraction alone in these areas will result in loss of labial plate and soft tissue collapse into the extraction socket within a matter of weeks resulting in loss of bone volume and gingival contour **(Schropp et al., 2003).**

The key to successful site preservation is minimizing trauma to the hard and soft tissues around the tooth being extracted. In order to achieve this, it is necessary to adopt the appropriate technique and instrumentation. The use of a periotome and luxator is critical to achieving atraumatic tooth extractions. The surgical approach involves intrasalcular incisions around the tooth to be extracted **(Danesh et al., 2008).**

Site preservation ultimately provides stability of the hard and soft tissues at the level of the marginal gingiva post extraction by preventing soft tissue collapse. Support of the labial plate through the initial healing of the extraction socket also maintains the osseous ridge contour thereby simplifying subsequent implant placement. This is particularly important when treating the anterior aesthetic zone. Implant placement into a previously grafted extraction site should not proceed sooner than 4 months′ post extraction to allow for sufficient healing and consolidation of the bone through the grafted socket and ensure good initial stability of the implant at placement **(Danesh –Meyer et al., 2008).**

There appears to be consensus from the reviewed literature supporting ridge preservation techniques as a whole. Multiple studies demonstrated less ridge resorption occurring when alveolar ridge preservation procedures were used versus the placement of no graft material in fresh alveolar sockets. The analysis did not show any grafting materials demonstrating a clear benefit over any others or that a barrier membrane is necessary. The evidence is also too premature about whether socket preservation efforts require primary closure. In the emerging area of growth factors, there is no high-quality evidence to either support or refute their use **(Horowitz et al., 2012).**

Guided Bone Regeneration (GBR) procedures, employing non-vital bone grafting materials and membranes were developed to counteract the significant resorption of alveolar bone following tooth extraction. Although ridge dimensions were improved with these procedures, the amount of augmentation created at the time of GBR was not the amount of augmented bone present after several months of healing **(Simon et al., 2009).**

A number of techniques have been proposed to produce alveolar reconstruction before dental implant placement. However, when possible, preservation of the alveolar process is desirable. Many authors have evaluated techniques for preserving the alveolar process dimensions, varying from the usage of bone grafts associated with the guided tissue regeneration technique **(Lekovic et al. 1998; Smukler et al. 1999; Camargo et al. 2000)** to tissue engineering principles using stem cells **(De Kok et al., 2005).** Recent studies have speculated that an autologous bone marrow has stem cells that can differentiate into osteoblasts **(Lucarelli et al. 2004; De Kok et al. 2005; Smiler et al., 2008).** Therefore, the usage of these stem cells would yield an incremented osteogenic potential. Autologous bone marrow graft can contribute to alveolar bone repair after tooth extraction **(Pelegrine et al., 2010).**

Atwood divided factors affecting the rate of resorption into 4 categories: anatomic, metabolic, functional and prosthetic **(Atwood DA, 1957).**

Apparently, the healing of sockets in the maxilla progresses faster (because of the greater vascular supply) than those in the mandible, which could lead to a faster resorption pattern **(Johnson K, 1969).** Several recent studies have examined resorption patterns following single-tooth extraction. Using subtraction radiography, Schropp and others assessed, in a12-month prospective study, bone formation in the alveolus and changes in the contour of the alveolar process following single-tooth extraction. The width of the alveolar ridge decreased 50% (from 12 mm to 5.9 mm, on average), and two-thirds of the reduction occurred within the first 3 months. The percentage reduction was somewhat larger in the molar compared with the premolar region. Changes in bone height, however, were only slight (less than 1 mm). The level of bone regenerated in the extraction socket never reached the coronal level of bone attached to the tooth surfaces distal and mesial to the extraction site. The bone surface becomes "curved" apically **(Humphries S, 1989).**

A study done to monitor 6-month period the healing of human extraction sockets and include a semi quantitative analysis of tissues and cell populations involved in various stages of the processes of modeling/remodeling showed that Granulation tissue that was present in comparatively large amounts in the early healing phase of socket healing, was in the interval between the early and intermediate observation phase replaced with provisional matrix and woven bone. The density of vascular structures and macrophages slowly decreased from 2 to 4 weeks over time. The presence of osteoblasts peaked at 6–8 weeks and remained almost stable thereafter; a small number of osteoclasts were present in a few specimens at each observation interval **(Trombelli et al., 2008).**

Histology of the socket and Histomorphometric analysis:

Bone histomorphometry is a quantitative histological examination of an decalcified bone biopsy performed to obtain quantitative information on bone remodeling and structure **(Kulak et al., 2010).**

After extraction a blood clot filled the socket. After 7 days, the clot was replaced with granulation tissue. After 20 days, the granulation tissue was replaced by collagen, and bone began forming at the base and the periphery of the extraction socket. At 5 weeks, Amler estimated that on average two-thirds of the extraction socket had filled with bone (**Amler et al., 1960).** Epithelium was found to require a minimum of 24 days to completely cover the extraction socket, with some extraction sites requiring up to 35 days to completely covering the socket. The epithelium was found to grow progressively, enveloping islands of granulation tissue, debris, and bone splinters. Amler noted that all stages of bone regeneration progressed from the apex and periphery and proceeded finally to the center and crest of the extraction socket **(Pelegrine et al., 2010).**

While the article did not state which teeth were used for the study, the tissue biopsies indicated that the teeth were single-rooted **(Steiner et al 2008).**

After extraction no bone formation occurred for the first week. At 8 days, new bone formation was noted throughout the alveolar bone, particularly under the wall but not on the surface of the bone lining the extraction socket. At 10 days, bone formation was noted on the surface of the socket wall. At 12 days, new bone formation continued along the socket wall and in the trabecular spaces surrounding the extraction site **Devlin** and **Sloan** harvested healing extraction sockets 2 weeks after extraction. Immunostaining was used to identify new bone growth. In their histological samples, **Devlin** and **Sloan** noted woven bone trabecula at the periphery of the socket. Osteoprogenitor cells, preosteoblasts, and osteoblasts surrounded the trabecula. They also noted that the periodontal ligament was displaced to the center of the extraction socket and not attached to the socket wall **(Devlin et al., 2002).**

It was noted that bone fragments being exfoliated from the healing extraction socket **(Amler et al., 1960).** It was found that there was no bone growth for 1 week, and when bone growth was first noted, it appeared under the socket wall, not on the exposed surface **(Boyne PJ, 1966).** It was found the periodontal ligament displaced from the socket wall and residing in the center of the socket **(Devlin et al., 2002).**

These findings indicate that, in humans, the first phase of extraction-socket healing is most likely osteoclastic undermining and rejection of the original socket wall into the healing socket.

A study showed that histomorphometric analysis result in similar amounts of mineralized vital bone in both the control and the test groups, respectively. Which are close to those observed by others who have studied socket healing using histomorphometric analysis **(Smukler et al., 1999; Froum et al., 2002).**

Role of platelet concentrates in (Socket Augmentation):

The question that clinicians face is whether the use of bone replacement grafts and/or barrier membranes enhance their ability to provide for the future placement of a dental implant or to maximize ridge dimensions following the extraction of a tooth versus no additional treatments **(Horowitz et al., 2012).**

A systematic review done to show the effect of platelet concentrates on post extraction socket healing concluded that the heterogeneity in outcome variables of the different studies included, no meta-analysis could be performed. Based on the reports of the selected studies, the use of platelet concentrates may be beneficial for reducing postoperative pain and inflammation, thereby improving quality of life in the early period after extraction. No systematic acceleration of osseous healing at the extraction socket could be demonstrated, suggesting that platelet concentrates probably exert a negligible effect on bone regeneration **(Fabbro et al., 2011).**

Further randomized studies investigating the adjunctive effect of platelet concentrates in combination with socket preservation procedures should be made to gain more insight in the interaction between platelet growth factors and other regenerative techniques. The adoption of uniform procedures for both the platelet concentrate preparation and the assessment of outcome variables to evaluate socket healing are recommended for the standardization of future study design **(Fabbro et al.,2011).**