Bacterial Contamination Levels of Autogenous Bone Particles Collected by 3 Different Techniques for Harvesting Intraoral Bone Grafts

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Purpose: The aim of this study was to compare levels of bacterial contamination of autogenous bone collected when using low-speed drilling, a back-action chisel, and a bone filter.

Materials and Methods: Bone tissue samples were taken from 31 patients who underwent surgical extraction of their third lower molars. Before surgical removal of the molar, bone particles were collected by a low-speed drill or a back-action chisel. Then, a stringent aspiration protocol was applied during the ostectomy to collect particulate bone by a bone filter. Processing of samples commenced immediately by incubation in an anaerobic or a CO_2-rich atmosphere. The number of colony-forming units (CFUs) was determined at 48 hours of culture.

Results: No significant difference in the number of CFUs per milliliter was observed between the low-speed drilling group and the back-action chisel group in the anaerobic or CO_2-rich condition ($P = .34$). However, significantly more micro-organisms were found in the bone filter group than in the low-speed drilling group or the back-action chisel group in the anaerobic and CO_2-rich conditions ($P < .001$).

Conclusions: Particulate bone harvested with low-speed drilling or a back-action chisel is safer for use as an autograft than are bone particles collected with a bone filter. These results suggest that bone obtained from low-speed drilling is safe and straightforward to harvest and could be the method of choice for collecting particulate bone. Further research is needed to lower the bacterial contamination levels of autogenous bone particles used as graft material.

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The number of dental implants used in recent years to replace missing teeth in the dental arch has increased exponentially, particularly in the past decade. The predictability of implant procedures and the long-term maintenance of implant stability are directly related to the quality and quantity of bone tissue available for implant placement.[1]

Bone grafts are widely and routinely used to reconstruct defects, especially in dental implantology. The most frequent cause of bone tissue deficit is alveolar

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resorption after tooth loss, which can limit the angle of implant placement.[2] Guided bone regeneration techniques and bone grafts are used to fill adjacent bone defects and thereby allow implants to be placed in the optimal position. The simultaneous augmentation approach has been previously described,[3] and collected bone debris has been used in this technique[4] and in the staged augmentation technique.[5]

The use of autologous bone remains the gold standard for bone augmentation, because it contains proteins, such as bone morphogenetic proteins, minerals, and vital bone cells, unlike other types of bone grafts, such as allografts or xenografts. Block or particulate autologous bone grafts are used alone or in combination,[6,7] and numerous extraoral and intraoral donor sites have been proposed.

In daily implantology practice, only a relatively small volume of bone is usually needed to correct small osseous defects, such as fenestrations and dehiscences, and a sufficient amount can generally be obtained by a simultaneous technique. This possibility and the morbidity associated with the creation of a second surgical field as a donor area have led to the harvesting of bone from areas adjacent to the implant site, thus taking advantage of the same surgical field. Various techniques have been used for this purpose, including the aspiration of bone fragments through a bone filter during the ostectomy,[8] the use of a back-action chisel to obtain small bone fragments or shavings, and the harvesting of bone shavings trapped in implant drills using low-speed drilling with no irrigation.[9] The authors' research group previously reported that low-speed drilling is one of the best techniques for gathering bone for grafts in terms of cell viability and osteogenic potential.[10]

Bone particles harvested from areas adjacent to the implant site are especially susceptible to bacterial contamination because of the large amount of microorganisms that make up the oral flora,[8] thus increasing the risk of contamination and consequent failure of the graft. The objective of this study was to compare the degree of bacterial contamination in bone particles harvested by 3 different techniques for intraoral bone grafts and to test whether low-speed drilling is a safe technique against bacterial contamination.

Materials and Methods

PATIENT SELECTION

Ninety-three bone biopsy specimens were obtained from 31 healthy volunteers (13 men, 18 women; 20 to 25 yr old) during mandibular surgery (3 biopsy specimens per volunteer); they were students of the School of Dentistry, University of Granada (Granada, Spain) undergoing scheduled surgical extraction of impacted third molars at the school clinic. All participants signed their informed consent to participate in the study, which was approved by the ethical committee of the University of Granada (reference number 721). This study followed the guidelines of the Declaration of Helsinki. Participants were selected at random from among volunteers meeting study eligibility criteria. Study exclusion criteria were the history or presence of systemic disease, an immunocompromised state, pregnancy, clinical or radiographic evidence of active oral disease, semi-erupted third molars, receipt of any medication that could interfere with the surgical procedure or postoperative wound healing, or receipt of antibiotic therapy in the month before the study.

SURGICAL PROTOCOL

The surgeon and assistant scrubbed and wore sterile gowns and gloves. Patients were fully covered with sterile drapes, and their lips and perioral facial skin were disinfected with 10% povidone iodine (PI; Corsodyl, SmithKline Beecham, Brendford, UK). Immediately before the surgery, patients rinsed their mouths for 2 minutes with 0.12% chlorhexidine mouth rinse 10 mL (Perio-Aid, Dentaid SL, Barcelona, Spain), which was delivered using sterile injectors. Surgical sites were isolated by placing sterile gauze swabs on the upper vestibular and buccal sulcus to prevent saliva flow from reaching the Stensen duct and on the lingual aspect of the surgical site, extending sublingually. All surgical procedures were performed by the same experienced surgeon (F.J.H.-B.) under local anesthesia using 4% articaine with 1:100,000 epinephrine (Ultracain, Normon SA, Madrid, Spain).

Three sample types were obtained from each patient during the third molar extraction. A releasing incision was made from the distal aspect of the second molar to its buccal sulcus, and a full-thickness flap was elevated to display the molar and adjacent bone. The first sample was taken from the area adjacent to the extraction site using a low-speed (20 to 80 rpm) drilling technique, with no irrigation (Fig 1). The second sample was taken from the area adjacent to the ostectomy with a back-action bone chisel (Hu-Friedy Manufacturing Company, Rotterdam, Netherlands; Fig 2). The third sample was collected using a sterile disposable suction tip (Proclinic SA, Barcelona, Spain) directly connected to the bone filter (Quirurgical Bontempi SL, Barcelona, Spain), consisting of a 2-part grade 2 titanium housing with an internal disposable sieve (246 slots with a width of 0.3 mm and lengths ranging from 0.5 to 5.3 mm; Fig 3); this was carefully localized within the surgical site and strictly limited to the collection of cortical bone from the anterior border of the ramus, irrigant (sterile saline), and blood during bone removal with a bur. Continuous salivary control was obtained with a sterilized metal suction tip (similar to that used in the initial soft tissue surgery).