

# THE WEIGHT OF PERMANENT TEETH: AN EXPLORATORY STUDY ON A TOTAL OF 190 TEETH

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## ABSTRACT

**Aim:** Human dentin matrix can be considered an excellent alternative to autologous or heterologous bone graft. Autologous tooth graft has been proposed since 1967 when the osteoinductive properties of autogenous demineralized dentin matrix were discovered. The preparation technique to transform autologous teeth in suitable grafting material still represents the fundamental step of the whole procedure. The aim of the present study was to evaluate the weight and the volume of teeth from Italian population in order to understand what would be the quantity of material that can be obtained.

**Methods:** a total of 205 extracted teeth were analyzed using a professional digital mini scale to evaluate the weight and the volume using a millimeter-level syringe. The length of the teeth is evaluated using a digital caliper.

**Results:** Considering different tooth type, the average weight ranged from 0,68gr to 1,88gr and the average volume resulted to be from 0,38cc to 0,96cc, but the variability is very high. The minimum weight was 0,4gr and the maximum weight was 3gr, the minimum volume is 0,2cc and the maximum volume is 2cc.

**Conclusions:** The results showed that the material that could be derived from tooth could be sufficient to be adopted as bone grafting material. Anyway, the different grinding from the different devices could change the volume usable for regeneration.

**Keywords:** teeth, weight, volume, regeneration

## INTRODUCTION

In recent years, the use of tooth dentin as a material for alveolar bone regeneration has attracted great interest. Grafting materials have been widely used for bone augmentation procedures for more than 35 years, in order to allow implant placement. The most common graft materials are from animal origin, synthetic or human. For years, Autogenous bone graft has been considered the “gold standard” for the repair of alveolar bone defects, but its use could be associated with donor complications and morbidity and also suffers from a limited supply. The use of permanent teeth material as bone substitute have been proposed firstly in 1967, when one study showed the regenerative properties of autogenous demineralized dentin matrix (1). The idea to use autogenous tooth as bone substitute in grafting procedure comes from the similar chemical composition between bone and dentin. Both of them consist, on average, of, 70% inorganic portion (Calcium: Bone: 42% - Dentin:  $16.01 \pm 6.12$ , Carbonate: Bone: 9.6% - Dentin:  $26.21 \pm 4.35$ , Phosphate: Bone: 17% - Dentin:  $26.21 \pm 2.67$ , Sodium 0.7%, Magnesium 0.5%, Potassium: Bone: 0.2% - Dentin:  $7.93 \pm 0.49$ ), and 30% organic portion (70% collagen, 22% proteins and 8% of fluids). Both tooth and alveolar bone derive from embryonal neural crest cells and are made of the same type of collagen.

Many studies evaluated the use of such bone substitute of autogenous origin. In 1991, Bessho and coworkers (2) demonstrated the presence of bone morphogenetic proteins (BMPs) in human dentin matrix. Therefore, both bone and dentin matrix could be a repository for growth factors, such as bone morphogenetic proteins (BMPs) and basic fibroblast growth factor. In 2006 other authors (3), used autogenous demineralized dentin matrix on dental socket wound healing process in humans and they reported that dentin matrix gradually disappeared from the dental socket during the course of the repair process. In 2014 (4), one study hypothesized that autogenous tooth bone graft could be considered as a good alternative to a heterologous bone graft when extraction is necessary prior to the surgery.

Two years later, in 2016, a case series was published showing that the cortico-cancellous bone that had formed using autogenous tooth bone graft material had been maintained successfully with an average follow-up of 5 years (5).

It was also reported that the demineralized human dentin matrix was able to induce bone and cartilage formation in mouse muscles with the concomitant presence of bone-forming cells (osteoblasts) (6). The consistent number of recent studies (7, 8) testifies the scientific increasing interest about this possibility for grafting procedures.

The demineralized dentin matrix should represent an efficient carrier of BMPs because highly soluble BMPs did not show osteoinductive effects when used alone. Bioactive growth factors (GFs), such as transforming growth factor-B (TGF-B) and bone morphogenetic proteins (BMPs), which are known to be present in and released from dentinal material, are involved in bone repairing processes (9).

The preparation technique to transform autologous teeth in suitable grafting material represent the key step of the whole procedure. It is fundamental to preserve the organic autologous components to stimulate bone progenitor cells, remove any contaminants to avoid inflammatory or infective reactions, and prepare the inorganic part to be easily colonized by osteoblasts. The demineralization process is required for freeing the various growth factors and proteins, since the release of the growth factors is sometimes blocked by the presence of hydroxyapatite crystals (10). Through the reduction of the mineral phase, demineralization supports the release of such growth factors from the tooth

matrix (11). There are some devices, on the market, that allow to grind the tooth of the patient to produce dentin granules.

The present paper aims to analyze the dimension, the weight and the volume of whole teeth, after the extraction and before the grind, in order to estimate, on average, the amount of potential bone substitute could be obtained.

## MATERIALS AND METHODS

Teeth that were extracted for periodontal reasons, without root canal fillings or prosthetic / conservative reconstructions, were, after the extraction, carefully cleaned and placed in a surgical envelop. A professional scale (Professional Digital Mini Scale 1479V, Tanita, Arlington Heights, IL, USA) was used to evaluate the weight of each single tooth. The scale has an electrostatic capacitance load cell for feather-touch sensitivity and 0.1 g graduation. (Figure 1).

A digital caliper was used to measure the dimensions of the tooth with a precision of 0.01 mm (Figure 1). The measure was taken between the most coronal extent of cuspids and the tip of the longer root.

The volume was measured using a millimeter-level syringe. All measures were taken twice and mean values were recorded.

## RESULTS

A total of 190 teeth were analyzed to evaluate the length, weight and volume.

6.3% were canines, 20.5% were incisors, 53.7% were molars, and 19.5% premolars. Table 1 presents the means and standard deviations of the weight, volume and length measurements, according to each group of teeth.

The average weight ranged from 0.68gr to 1.88gr and the average volume is from 0.38cc to 0.96cc, depending on tooth type. The minimum weight was 0.4 g and the maximum weight was 3.0 g and the minimum volume was 0.2 cc and the maximum volume is 2 cc (Figure 2-4).

The length of the teeth is associated to the teeth weight (Person correlation coefficient = 0.83).

## DISCUSSION

The present study reported mean values of width, weight, and of length of permanent extracted teeth. The reported values showed a significant heterogeneity in general and a correlation between the length and the weight. Interestingly, the length of teeth appeared to be a good estimator of the weight and this aspect could be important when evaluating the use of grinded tooth as bone substitute, since length could be estimable by one periapical radiograph.

The results of the study should be read in consideration of the limitations of the protocol. Firstly, the limited sample size and the fact that all teeth belonged to one cohort of Caucasians limited importantly the possibility to generalize the results. Then, we had not the possibility to discriminate the different materials constituting the tooth; therefore, the authors were not allowed to speculate about the proportion of enamel, dentin, and cementum, contributing to determine weight and volume. Finally, we didn't make an analysis of the results evaluating between-subject and intra-subject variability in density of the teeth extracted.

In general, the results of the study about the size and the volume of extracted teeth were coherent with what was previously published in literature (12-14).

Adequate bone volume of the alveolar ridge is essential to achieve ideal functional and aesthetical results after implant treatment. It is necessary to have a sufficient volume of graft material to be able to regenerate the missing bone. The quantity of bone loss is different in each case, so we need to use different quantities of graft material. While using a common graft material if we need more material we can always open another box of graft material.

In order to consider teeth as bone substitute material in cases requiring bone regeneration we should consider the significant heterogeneity in volume and weight measurements. The volume of molar teeth is more than twice the volume of one mandibular incisor.

Interestingly, we found a positive correlation between the height of one tooth and its volume. This observation could justify the use of periapical radiographs to estimate the volume of the tooth that has to be extracted.

More studies with a higher sample size are fundamental to increase the knowledge about weight, volume and size in general of human teeth.

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