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Determination of Implant Primary Stability: A Comparison between the Surgeon's Tactile Sense and Objective Measurements

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Abstract

Background: Primary stability has been regarded as an essential factor for osseointegration, particularly when early or immediate loading protocols are considered as treatment modalities, also plays a significant role in the dental implants long-term success. Evaluation of primary stability could be achieved by several methods, including the resonance frequency analysis (RFA) and implant insertion torque (IT) values; the first representing the resistance to bending load and the second demonstrating the resistance to shear forces. It is eminent that osseointegration processes started with an initial rigid implant fixation into the bone; this early stability is a mechanical one, and it is mostly related to implant insertion torque values, bone quality, and implant properties. The need for sufficient primary stability, guaranteed by an adequate insertion torque and implant stability quotient values, increased its importance mainly in one stage implants or in immediate loading protocols.

Aims of the study: To find if there is any correlation between the peak insertion torque (PIT) required for final implant placement and ISQ values measured using Osstell device as two determinant factors for prediction of implant primary stability. Also to evaluate and compare whether an experienced clinician could precisely predict RFA values and, consequently, the primary stability of an implant on insertion procedure by means of his own tactile perception. In addition, to study the association between peak insertion torque, ISQ measurements and other factors affecting implant primary stability.

Materials and methods:A total of 60 Iraqi adult patients, 28 males and 32 females, age ranged 22-66 years old were enrolled in this clinical prospective study. Receiving a total of 160 dental implants (sandblasting with large grit and acid etching, endosseos, Superline and Implantium® fixtures) placed in both jaws, 45 of them in the anterior zone and 115 in the posterior zone .

The maximum torque value recorded on implant insertion using calibrated manual torque ratchet adopting three categories: low (10 to 30 N/cm), medium (>30 N/cm), and high insertion torque (>50 N/cm). Implant stability quotient changes were measured by Osstell ™ (Goteborg, Sweden, 4th generation) at surgery after they were completely inserted, the expert surgeon was asked to indicate the perceived ISQs values according to his perception of primary stability. Bone type was determined according to bone resistance to drilling according to a well-known classification proposed by Lekohlm and Zarb, (1985). A special case sheet form was used for data collection and results subjected to statistical analysis to observe their significant effects on the inserted implants stability.

Results: A total of 160 implants were inserted. The mean peak IT value was 49 ± 2.61 N/cm. The mean RFA was 71.7 ± 8.86 ISQ. Statistical analysis show a significant correlation between ISQ values and PIT values ($P<0.001$), between PIT values and bone types and between perceived primary stability and actual primary stability ($P<0.001$) .The statistical significance also reported between ISQ values and implant diameters, ISQ values and gender, PIT and gender and between bone types and age. The statistical insignificant correlations reported between ISQ values and bone types, ISQ values and implant lengths, PIT and implant dimensions, ISQ values and age, PIT and age and between bone types and gender.

Conclusions: The corresponding significant correlations between peak insertion torque, and ISQ values may help clinicians to predict primary stability on implant insertion that may be associated with implant survival and success rates. Data showed that only PIT is influenced by bone type, while only RFA is correlated to the diameter of implants used. Finally, the surgeon perception accuracy in determination of primary stability is not highly reliable to prevent mistakes; therefore, the systematic use of objective measurements is encouraged to have better recording for the primary stability.