

ASSESSMENT OF PRIMARY AND SECONDARY IMPLANT STABILITY OF TWO DIFFERENT TYPES OF DENTAL IMPLANTS

ПРОЦЕНА НА ПРИМАРНАТА И СЕКУНДАРНАТА ИМПЛАНТНА СТАБИЛНОСТ КАЈ ДВА РАЗЛИЧНИ ТИПОВИ НА ДЕНТАЛНИ ИМПЛАНТИ

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Abstract

Implant stability plays a major role in the success of osteointegration. Taking into consideration this fact about the implant stability, the difference of the primary and secondary dental implant stability and their influence on the longevity of the implant therapy is the main aim of this study, which was established through the determination of the primary and secondary dental implant stability between patients with two different types of implants. This clinical study was performed in a private dental office called „Vita-Dent" in Tetovo, Republic of North Macedonia. The study incorporates two types of implants, MIS Seven implants with internal hexagonal shape and Straumann Standard plus Bone level implants from the ITI Academy with internal octagonal form. The stability of the implants was measured by analyzing the resonance frequency using the instrument Ostell IDX TM. Implant Stability Quotient (ISQ) is the measurement unit of this diagnostic tool and the measurement units range from 1 to 100. For all 308 implants, the ISQ values for primary implant stability vary in the range 61.85 ± 6.40 units. The ISQ values for secondary implant stability vary in the range 71.70 ± 11.67 units. Primary stability of Straumann dental implants is insignificantly greater than the primary stability of MIS dental implants, in comparison to the secondary stability of Straumann dental implants that is significantly greater than the secondary stability of MIS dental implants. **Keyword:** dental implants, implant stability, RFA, ISQ.

Апстракт

Стабилноста на имплантите игра голема улога во успехот на остеоинтеграцијата. Имајќи го предвид овој факт за стабилноста на имплантот, постоењето на примарна и секундарна стабилност и нивното влијание на долговечноста на имплантната терапија, е главната цел на оваа студија – преку утврдување на примарната и секундарната стабилност помеѓу пациентите со два различни видови импланти. Оваа клиничка студија беше спроведена во ПЗУ „Вита-Дент" во Тетово, Република Северна Македонија. Студијата опфати два различни типови на импланти, MIS Seven импланти со внатрешна хексагонална форма и Straumann Standard plus Bone level импланти од Академијата ITI со внатрешна октогонална форма. Стабилноста на имплантите се испитуваше преку анализата на резонантната фреквенција со помош на инструментот, наречен Ostell IDX TM. Кочичник на имплантна стабилност (ISQ) е единицата за мерење, на оваа дијагностичка алатка и мерните единици се движат од 1 до 100. За сите 308 импланти, ISQ вредностите за примарната стабилност на имплантите варираат во опсегот $61,85 \pm 6,40$ единици. Вредностите на ISQ за истиот број на дентални импланти за секундарна стабилност на имплантите варираат во опсегот од $71,70 \pm 11,67$ единици. Примарната стабилност на имплантите на Straumann имплантите е незначително поголема од примарната стабилност на MIS денталните импланти, за разлика од секундарната стабилност на Straumann дентални импланти што е сигнификантно поголема од секундарната стабилност на MIS имплантите. **Клучни зборови:** дентални импланти, имплантна стабилност, RFA, ISQ

Introduction

The number of patients treated with dental implants is increasing and continues to grow, and dentists accept the challenges, which these complex restorations carry with

them. Proper monitoring and maintenance of the implants in the patient's mouth is essential to ensure the longevity of the dental implant and its suprastructure through a combination of adequate control examinations, proper oral care and effective oral hygiene performed by the patient.

Implant stability plays a major role in the success of osteointegration. Primary stability is a mechanical phenomenon, which is related to the quality and quantity of the local bone, the type of implant and the surgical technique. Secondary stability is increased by bone formation and tissue remodeling on the implant - tissue interface and surrounding tissues. It has been proven that stability during implantation, as well as after a certain period of time, has major significance for the success of implant therapy¹.

The primary stability of a dental implant is related to the mechanical ratio and the contact of the implant with the surrounding alveolar bone, while bone regeneration and remodeling phenomena, affecting the alveolar bone, determine the secondary or biological stability of the implants. Secured and appropriate primary stability is in a positive correlation with the secondary stability².

The method we will use in this research is the analysis of the resonant frequency. Meredith, Sennerby and Meredith first proposed the RFA method as a highly efficient qualitative method that serves to assess the stability of dental implants^{3,4}.

Devices that perform a resonant frequency analysis, measure the resonance frequency through a transducer connected to the implant body, which is stimulated at different frequencies. The significance of these analyzes is enormous and according to a study by Sul et al., RFA is a reliable indicator of identifying the stability of the implant^{5, 6}.

In their research, Nordin et al. conclude that SLA Straumann implants positioned in the maxilla represent a reliable alternative treatment in fresh extraction wounds. Radiographic analysis after 2-3 years showed that there were no changes in the height of the bone either from the mesial or the distal side⁷.

Taking into consideration the facts about the implant stability, the difference of the primary and secondary dental implant stability, and their influence on the longevity of the implant therapy are the main aims of this study. Our goal is to determine the difference between primary and secondary dental implant stability, between patients with two different types of implants (MIS and Straumann dental implants) and we will determine the summary of primary and secondary stability of all dental implants in the study.

Material and methods

This clinical study was performed in a private dental office "Vita-Dent" in Tetovo, Republic of North Macedonia, carried out in the period from 2014-2019. Implants were placed in edentulous patients who needed

to restore one or more teeth. All of the patients were older than 18 years old. Patients with malignant, systemic diseases and patients with craniofacial anomalies (syndromes) were excluded from the study. The implants were surgically placed by one specialist - oral surgeon, and the stability of the implants was determined using a contemporary diagnostic instrument, which analyzes the resonant frequency.

The study incorporates two types of implants, MIS Seven implants with internal hexagonal shape and Straumann Standard plus and Bone level implants from the ITI Academy with internal octagonal form.

The stability of the implants was measured by analyzing the resonance frequency using the instrument Oststell IDX (Oststell AB, Gothenburg, Sweden). Implant Stability Quotient (ISQ) is the measurement unit of this diagnostic tool and the measurement units range from 1 to 100. In cases when higher values are displayed on the instrument, those implants have better stability. The results of the conducted analyzes will be appropriately recorded in the implantological and anamnestic charts for every subject, which were necessary for statistical analysis.

All implants were surgically placed according to the protocol of two-phase implantation, where the implant is surgically placed in the first phase. In this phase, the primary stability with the Osstell IDX RFA (Resonance Frequency Analyze) was determined. In the second phase after six months, appropriate x-rays were done to confirm the positioning of the implanted dental implants and to assess how close they are to the vital anatomical structures and whether sufficient bone tissue around the implant is formed. In this phase, adequate measurements were carried out to determine secondary stability and osteointegration.

The measurement technique is based on a small transducer screwed on the implant and tightened, according to the manufacturer's specifications, with a 10 N-cm torque. The wireless probe device was approached several millimeters to the transducer without touching it. The obtained ISQ values represent the resonance frequencies of the electromagnetic waves. Four measurements will be performed for every implant, on the mesial, distal, buccal and palatal/lingual side and they will be recorded in the instrument. The same data were registered on a computer connected with a USB cable to the Oststell IDX Data Manager.

Data obtained from the clinical investigation was appropriately and statistically processed. For statistical analysis, we used special software for statistical analysis of data- Statistica 7.1 for Windows and SPSS Statistics 17.0.

Results

This section of the paper will present the results obtained from the research related to the assessment of primary and secondary stability of implants performed in the period from 2014-2019 in the private dental office "Vita Dent" -Tetovo. The total number of participants was 100.

The clinical examination covered an equal number of respondents according to which implant they were given. From the total number of subjects, 48 (48 %) were female, while the remaining 52 (52 %) were male. The median age of patients varied in the interval of 54.18 ± 10.67 years (± 95.00 CI: 51.15-57.21).

1. Results for MIS Seven dental implants

Table 1. and Figure 1. present the descriptive statistics of the ISQ values of primary implant stability as well as the secondary stability of implants examined 6 months after implantation. In 185 implants, the ISQ values of primary implant stability vary in the range 61.66 ± 7.43 units (± 95.00 CI: 60.59-62.74), the minimum value is 41 units and the maximum value is 82 units. ISQ values of secondary implant stability vary in the range of 68.94 ± 9.91 units (± 95.00 CI: 67.50-70.37), the minimum value is 0.00 units and the maximum value is 88 units.

Table 1. Primary stability & Secondary stability/ISQ Values /Descriptive Statistics MIS. Seven dental implants.

Primary stability & Secondary stability	Number	Average	Confidence -95.00%	Confidence + 95.00%	Minimum	Maximum	Standard deviation
Primary stability	185	61.66	60.59	62.74	41.00	82.00	7.43
Secondary stability	185	68.94	67.50	70.37	0.00	88.00	9.91

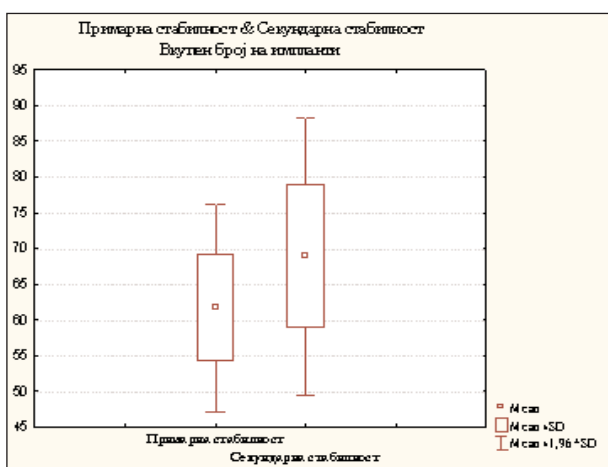


Figure 1. Primary stability & Secondary stability/ISQ Values/Descriptive Statistics MIS Seven dental implants

The results in Table 2. show the difference between the ISQ values of primary and secondary implant stability.

Six months after the implantation, the ISQ values for secondary implant stability for $Z = 11.02$ and $p < 0.001$ ($p = 0.000$) are significantly higher than the values of primary implant stability.

For $R = 0.87$ and $p < 0.05$ in the examined relationship between the ISQ values for primary and secondary implant stability, a very strong positive correlation was established.

2. Results for Straumann dental implants

Table 3. and Figure 2. present the descriptive statistics of the ISQ values of primary implant stability as well as the secondary implant stability examined 6 months after implantation of Straumann dental implants.

Of the total number of 123 implants, the ISQ values of primary implant stability vary in the range 62.14 ± 4.46 units (± 95.00 K: 61.34-62.93), the minimum value is 51 units and the maximum value is 79 units. Of the same 123 implants, the ISQ values of secondary implant stability vary in the range 75.86 ± 12.87 units (± 95.00 K: 73.56-78.16), the minimum value is 0.00 units and the maximum value is 89 units.

Table 2. Difference/Primary Stability & Secondary Stability

Implant stability	Valid	T	Z	p-level
Primary Stability & Secondary Stability	185	536.00	11.02	0.000

The results of Table 4. refer to the difference between the ISQ values of the primary and secondary implant stability.

Six months after the implantation, the ISQ values of the secondary implant stability for $Z = 8.70$ and $p < 0.001$ ($p = 0.000$) are significantly higher than the values of the primary implant stability.

Table 3. Primary Stability & Secondary Stability/ISQ Values/Descriptive Statistics Straumann dental implants

Primary stability & Secondary stability N	Number	Average	Confidence -95.00%	Confidence + 95.00%	Minimum	Maximum	Standard deviation
Primary stability	123	62.14	61.34	62.93	51.00	79.00	4.46
Secondary stability	123	75.86	73.56	78.16	0.00	89.00	12.87

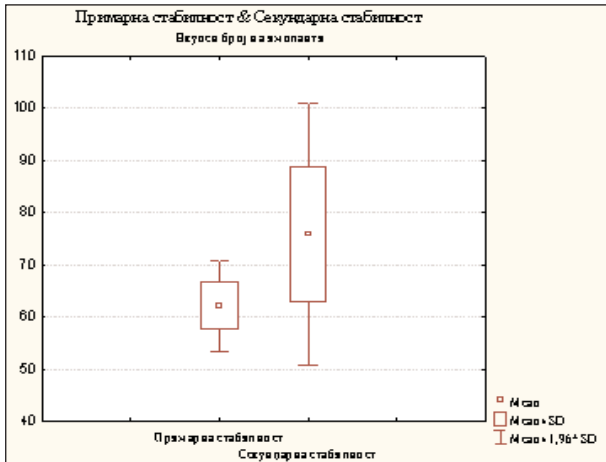


Figura 2. Primary Stability & Secondary Stability/ISQ Values/Descriptive Statistics Straumann dental implants

For $R = 0.49$ and $p < 0.05$ in the examined relationship between the ISQ values of primary and secondary implant stability, a mean strong positive correlation was discovered.

3. Both types of dental implants

Below are the results where a comparison of primary and secondary stability was made for both types of implants.

Table 4. Difference/Primary Stability & Secondary Stability

Implant stability	Valid	T	Z	p-level
Primary Stability & Secondary Stability	123	366.00	8.70	0.000

So, for $Z = -0.83$ and $p > 0.05$ ($p = 0.41$) the primary stability of Straumann dental implants ($x = 62.14$) is insignificantly greater than the primary stability of MIS dental implants ($x = 61, 66$) (Table 5).

For $Z = -8.29$ and $p < 0.001$ ($p = 0,000$), the secondary stability of Straumann dental implants ($x = 75.86$) is significantly greater than the secondary stability of MIS dental implants ($x = 68,94$) (Table 6.).

Table 7. and Figure 3. show descriptive statistics on the ISQ values of primary implant stability as well as secondary implant stability examined 6 months after implantation for all placed dental implants. For all 308 implants, the ISQ values for primary implant stability vary in the range 61.85 ± 6.40 units ($\pm 95.00CI: 61.14-62.57$), the minimum value is 41 units and the maximum value is 82 units. The ISQ values for the same number of dental implants for secondary implant stability vary in the range 71.70 ± 11.67 units ($\pm 95.00CI: 70.39-73.01$), the mini-

Table 5. Primary Stability/Difference/MIS dental implants & Straumann dental implants

	Rank Sum Mis	Rank Sum Straumann	U	Z	p-level	N Mis	N Straumann
Primary stability	27947.00	19639.00	10742.00	-0.83	0.41	185	123

Table 6. Secondary Stability / Distinction / MIS dental implants & Straumann dental implants

	Rank Sum Mis	Rank Sum Straumann	U	Z	p-level	N Mis	N Straumann
Primary stability	22239.50	25346.50	5034.50	-8.29	0.000	185	123