

The forecasting implant stability quotient (isq) coefficient of dental implants in different types of jaw bone

Shevela T. L.¹, Kuznetsov Y. O.²

¹Belarusian State Medical University, Minsk, Republic of Belarus

²Health Care Institution «5th City Clinical polyclinic», Minsk, Republic of Belarus

Summary. We studied the efficiency stability rate of dental implants in different types of bone tissue. 48 patients were examined in clinic and determined the state of the jaw bone tissue with the help of cone-beam computed tomography (CBCT) in «Planmeca Romexis» software. The density of jaw bone tissue evaluated using Hounsfield index to quantify the scale of radiographic bone density. During dental implants placement and 6 months after, prior to orthopedic treatment, implants primary stability ratio was determined using the MEGA-ISQ device (South Korea). Based on studies in 48 patients tested in the field of dental implants installed I type of bone was in 14 patients, Hounsfield value of the index correspond to 1300 units. ($M \pm m$), the implant stability coefficient after 6 months was as high as possible and amounted to 94.0 U. II type of bones noted in 12 patients, Hounsfield value of the index corresponds to 850 units. ($M \pm m$), the coefficient of implant stability after 6 months was 84.0 U. Type III was diagnosed in 12 patients, the value of the Hounsfield index corresponded to 500 units. ($M \pm m$), the coefficient of implant stability after 6 months was 80.0 U. 10 patients were with IV type of bone tissue, the Hounsfield index corresponded to 380 units. ($M \pm m$), the stability ratio of the implant during the operation after 6 months amounted to 63.0 U. Measuring the implant stability factor (ISF) gives clinician the opportunity to accurately assess each specific clinical situation as accurately as possible.

Keywords: bone, implant, prediction, prosthetics, stability.

Introduction. The rapidly progressing atrophy of the alveolar processes, which is observed after tooth extraction, significantly complicates the orthopedic treatment using intraosseous dental implants. [4]. It should be taken in account that in clinical practice a comprehensive examination of patients seeking dental care and planning rehabilitation using orthopedic structures based on dental implants is relatively rare. Assessment of the initial state of bone tissue is important not only for the dental implantation in accordance with the chosen treatment plan, but also for predicting the results of their osseointegration. In this connection, the determination of bone mineral density and primary stability of dental implants determines the strategy of use this type of rehabilitation measures in dentistry [1].

Implant stability is crucially important for successful prosthetics. Manual control of implant stability cannot be objective considered immediately after installation. As implant osseointegration becomes more difficult to obtain reliable data using tests to determine the force on the implant, moreover, this method significantly increases the risk of impaired healing [2].

The aim –To determine the effectiveness of the stability coefficient of dental implants for different types of bone tissue.

Objects and methods. 48 patients are examined in the clinic by computed tomography (CBCT) in (Planmeca Romexis) to determine the state of their jaw bone. The bone density of jaws was estimated using the Hounsfield index on a quantitative bone x-ray density scale: less than 500 units. — low bone density, from 500–1000 units. — average bone density, more than 1000 units. — high bone density [3]. The data obtained during the study was subjected to statistical processing using «Statistica 10.0».

The primary stability coefficient of dental implants was determined using the MEGA-ISQ device (South Korea) during dental implants placement and 6 months before the orthopedic treatment (figure 1). The method limits of the values of the stability coefficient (from 60 to 100 Units), excluding the type of bone tissue in the area of the installed implants.

The operations of delayed two-stage dental implantation were conducted to patients using implants AnyOne, MegaGEN system (South Korea) (figures 2,3). The primary stability coefficient was determined immediately after the installation of dental implants (figure 4).



Figure 1 — A device for determining the implant stability factor



Figure 2 — Dental implantation in position 4.6



Figure 3 — Dental implantation in jaw bone at 0.5 mm depth



Figure 4 — Determination of the dental implant’s primary stability coefficient

The stability coefficient was determined 6 months after the operation in order to compare with previous values and conclude that the successful osseointegration of dental implants (figures 5, 6).



Figure 5 — Magnetic pin screwed into the implant shaft (SmartPeg)



Figure 6 — The «MEGA-ISQ» sensor brought to the magnetic pin and the number of value is reflected in the display

Results and discussion. Type I bone tissue was found in 14 patients, type II bone in 12 patients, type III was diagnosed in 12 patients and 10 patients were of type IV bone tissue based on the studies conducted in 48 examined patients in the area of installed dental implants. A comparative assessment of the implant stability coefficient and the Hounsfield index on a quantitative scale of bone x-ray density based on CBCT data are presented in table 1.

Table 1 — Results of comparison implant stability factor and the index of Hounsfield on bone type

Bone type	Diagnostic methods of research and their rate		
	Dental implant’s stability coefficient (normal range 60–100 units)		Cone beam computed tomography. Hounsfield Index
I type (n = 14)	During operation	After 6 months	1300 units (0,05 M±m)
	96,0 (92,0–96,0)	94 (92,0–94,0)	
II type (n = 12)	90,0 (89,0–90,0)	84 (81,0–84,0)	850 units (0,05 M±m)
III type (n = 12)	85 (81,0–85,0)	80 (78,0–80,0)	500 units (0,01M±m)
IV type (n = 10)	69 (67,0–70,0)	63 (60,0–63,0)	380 units (0,01 M±m)

14 patients with dense cortical tissue had the Hounsfield index corresponded to 1300 units. (M ± m), the implant stability coefficient during surgery was 96.0 units, after 6 months it was as high as possible and amounted to 94.0 units.

12 patients had a Hounsfield index value of 850 units. ($M \pm m$) had the presence of a uniform cortical plate and cancellous bone, the stability coefficient of the implant during surgery is 90.0 Units. and after 6 months it amounted to 84.0 units.

12 patients with a well-developed cancellous bone layer had the Hounsfield index corresponded to 500 units. ($M \pm m$), the implant stability coefficient during surgery is 85.0 Units. and after 6 months it amounted to 80.0 units.

Patients (10 people) who were diagnosed with the absence of a cortical plate and loose spongy bone Hounsfield index corresponded to 380 units. ($M \pm m$), had the implant stability coefficient during surgery is 69.0 Units. and after 6 months amounted to 63.0 units.

A non-invasive study is important for the diagnosis of implant stability. The method of determining the implant stability coefficient using the apparatus is convenient with a minimal risk of disruption of the osseointegration process. The obtained coefficient values during dental implantation allow the surgeon to solve the problem of implant's diameter or to predict the timing of the second stage of the operation in advance.

CT scan technique does not guarantee the fact of the effective functioning of bone tissue and dental implant contact. Pathological rearrangement and its resorption often occur under physiological stress on a bone with a different type of architectonics [4], which confirms the results obtained with a decrease in the implant stability coefficient 6 months after surgery.

Conclusion. Measurement of the implant stability coefficient (ISC) gives the doctor an opportunity to accurately assess each specific clinical situation. Comparison of the primary and secondary stability of the implant provides clinically relevant information about the features of the healing process and osseointegration. This approach guarantees the success of implantation even among patients of high risk group. In this turn it is the basis for improving the well-known tests and their new developing to predicting the processes of osseointegration.

References

1. Динамика минерализации большеберцовой кости по шкале Хаунсфильда при лечении ложных суставов методом чрескостного компрессионного остеосинтеза с использованием биологической стимуляции регенерации / Ю. А. Барабаш [и др.] // Бюлл. ВСНЦ СО РАМН. — 2011. — Т. 80, № 4. — С. 20–23.
2. Добровольская, О. В. Критерии эффективности в дентальной имплантации / О. В. Добровольская, В. В. Рубаненко // Вісник Української мед.стом. академії. — 2006 — Т. 6, вып. 4. — С. 13–15.
3. Колдырин, С. В. Оценка минеральной плотности альвеолярных отделов челюстей методом ультразвуковой остеометрии / С. В. Колдырин, М. А. Белоусова, С. Н. Ермольев // Рос. стоматология. — 2014. — № 7(1). — С. 16–19.
4. Sensitivity and specificity of radiographic methods for predicting insertion torque of dental implants / A. R. Cortes [et al.] // J. Periodontol. — 2015. — Vol. 86, № 15. — P. 646–655.

Эффективность прогнозирования коэффициента стабильности дентальных имплантатов при разных типах костной ткани

Шевела Т. Л., Кузнецов Я. О.

*Учреждение образования «Белорусский государственный медицинский университет»,
г. Минск, Республика Беларусь;*

*Учреждение здравоохранения «5-я городская клиническая поликлиника»,
г. Минск, Республика Беларусь*

Реферат. Цель исследования включала определение коэффициента стабильности дентальных имплантатов при разных типах костной ткани. В клинике обследовано 48 пациентов, у которых определяли состояние костной ткани челюстей на основании данных конусно-лучевой компьютерной

томографии (КЛКТ) в программе «Planmeca Romexis». Плотность костной ткани челюстей оценивали при помощи индекса Хаунсфилда по количественной шкале рентгенологической плотности кости. Во время операции при установке дентальных имплантатов и через 6 месяцев перед проведением ортопедического лечения определяли коэффициент первичной стабильности дентальных имплантатов аппаратом «MEGA-ISQ» (Южная Корея). Измерение коэффициента стабильности имплантата (КСИ) дает клиницисту возможность максимально точно оценить каждую конкретную клиническую ситуацию.

Ключевые слова: прогнозирование, стабильность, имплантат, протезирование, кость.

Поступила 23.11.2020