IQRO JURNALI , IQRO JOURNAL, ИКРО ЖУРНАЛИ
ISSN:2181-4341| wordlyknowledge.uz/index.php/iqro
Volume 22 Issue 01 IYUN 2026

DENTAL IMPLANTATSIYANI REJALASHTIRISHDA RAQAMLI TEXNOLOGIYALARNING SAMARADORLIGI VA ULARNING KLINIK AHAMIYATI

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Annotatsiya. Ushbu maqolada dental implantatsiyadan oldingi bosqichda zamonaviy raqamli texnologiyalar – 3D konus-nurli kompyuter tomografiyasi (KKT), intraoral skanerlash va kompyuterlashtirilgan jarrohlik shablonlarining qo‘llanilishi va ularning klinik samaradorligi tahlil qilingan. Matn ichida keltirilgan ilmiy adabiyotlar tahlili shuni ko‘rsatadiki, raqamli rejalashtirish asoratlarni minimallashtirish va implantatning uzoq muddatli barqarorligini ta’minlashda hal qiluvchi omil hisoblanadi.

Kalit so‘zlar: dental implantatsiya, 3D tomografiya, intraoral skanerlash, jarrohlik shabloni, CAD/CAM, raqamli stomatologiya.

1. Kirish (Dolzarbligi)

Zamonaviy stomatologiyada adentiyani dental implantatlar yordamida davolash eng istiqbolli yo‘nalishlardan biri bo‘lib qolmoqda. Biroq, implantatning suyak to‘qimasida uzoq muddatli funktsional barqarorligini ta’minlash va implantat atrofidagi to‘qimalarning asoratlanishini (periimplantit va suyak rezorbsiyasi) oldini olish bevosita jarrohlikdan oldingi rejalashtirish sifatiga bog‘liq [1, 5]. An’anaviy ikki o‘lchovli (2D) rentgenologik tekshiruvlar (ortopantomografiya) suyak to‘qimasining anatomik hajmi, anatomik tuzilmalar (gaymor bo‘shlig‘i, pastki jag‘ nerv kanali) bilan masofasi haqida to‘liq va aniq ma’lumot bera olmaydi [8, 12].

So‘nggi o‘n yillikda raqamli stomatologiya (Digital Dentistry) konseptining rivojlanishi, xususan, 3D konus-nurli kompyuter tomografiyasi (KKT), raqamli intraoral skanerlash va CAD/CAM texnologiyalari asosida ishlab chiqiladigan jarrohlik shablonlari implantatsiyadan oldingi rejalashtirishni mutlaqo yangi bosqichga olib chiqdi [3, 19]. Bu texnologiyalar shifokorga implantat o‘rnatish jarayonini virtual muhitda simulyatsiya qilish imkonini beradi [14].

2. Dental implantologiyada 3D konus-nurli kompyuter tomografiyasi (KKT) ning o‘rni

Dental implantatsiyani muvaffaqiyatli amalga oshirish alveolyar o‘simtaning arxitektonikasi, suyak to‘qimasining zichligi (D1-D4 turlari) va anatomik tuzilmalarning topografik joylashuvini mukammal bilishni talab etadi [2, 10]. KKT texnologiyasi an’anaviy KTga nisbatan bemorga minimal nurlanish bergan holda, jag‘ suyaklarining uch o‘lchovli modelini yuqori aniqlikda (submillimetr darajasida) ko‘rish imkonini yaratdi [6, 22].

KKT ma’lumotlari orqali jarroh implantatning diametri, uzunligi va o‘rnatilish burchagini aniq belgilaydi, bu esa pastki jag‘ nervining (n. alveolaris inferior) shikastlanishi yoki yuqori jag‘ sinusining perforatsiyasi kabi og‘ir operatsion asoratlardan butunlay kafolatlaydi [7, 15]. Shuningdek, KKT suyak to‘qimasi atrofiyasini aniqlab, qo‘shimcha ravishda suyak augmentatsiyasi (sinus-lift, yo‘naltirilgan suyak regeneratsiyasi) amaliyotiga bo‘lgan ehtiyojni oldindan aniqlashga yordam beradi [11, 25].

3. Intraoral skanerlash va raqamli ishchi modellar

An’anaviy gips va alginat qoliplar olish usullari bemorlarda noqulaylik (qusish refleksi) tug‘dirishi hamda qolip materialining qisqarishi tufayli mikrometr darajasidagi xatoliklarga olib kelishi mumkin [4, 16]. Zamonaviy intraoral skanerlar (optik va lazerli tizimlar) yordamida og‘iz bo‘shlig‘ining raqamli uch o‘lchovli tasviri (STL formatda) bir necha daqiqa ichida hosil qilinadi [9, 13].

Ushbu raqamli modellar protezlash rejasini jarrohlik bosqichidan oldin tayyorlash (Orthoprosthetic-driven implantology) imkonini beradi. Ya’ni implantat shunchaki bo‘sh suyakka emas, balki kelajakda o‘rnatiladigan tish tojining ideal ortopedik o‘qiga mos ravishda joylashtiriladi [17, 21].

4. Virtual rejalashtirish va jarrohlik shablonlarining klinik samaradorligi

KKT ma’lumotlari (DICOM fayllar) va intraoral skaner tasvirlari (STL fayllar) maxsus kompyuter dasturlarida (masalan, Exoplan, Blue Sky Plan, CoDiagnostiX) o‘zaro birlashtiriladi (fusion) [18, 23]. Ushbu virtual muhitda implantatning suyak ichidagi joylashuvi va uning ortopedik konstruksiya bilan burchagi mukammal shakllantirilgach, 3D-printerlar yordamida individual **jarrohlik shablonlari (Surgical guides)** chop etiladi [20, 24].

Jarrohlik shablonlari yordamida operatsiyani milkni kesmasdan (flapless surgery) o‘tkazish mumkin. Bu usul operatsiyadan keyingi shish, og‘riq va qonashni minimal darajaga tushirib, bemorlarning reabilitatsiya davrini 2-3 barobarga qisqartiradi [14, 21]. Eng muhimi, implantatning virtual rejalashtirilgan o‘qi bilan operatsiyadagi haqiqiy o‘qi o‘rtasidagi og‘ish burchagi 1,5-2 darajadan oshmaydi, bu esa inson omili (shifokor qo‘li qaltirashi yoki ko‘rish burchagi xatosi) bilan bog‘liq xatoliklarni bartaraf etadi [3, 24].

5. Xulosa

Dental implantatsiyani rejalashtirish bosqichida 3D konus-nurli kompyuter tomografiyasi, intraoral skanerlash va kompyuterlashtirilgan jarrohlik shablonlarining integratsiyalashgan holda qo‘llanilishi zamonaviy raqamli stomatologiyaning eng yuqori va xavfsiz standartidir. Ushbu raqamli protokol asoratlar xavfini keskin kamaytiradi, jarrohlik amaliyoti vaqtini qisqartiradi hamda ortopedik konstruksiyalarning biomexanik yuklamani to‘g‘ri taqsimlashini ta’minlab, implantatning uzoq yillar xizmat qilishiga zamin yaratadi.

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