IMPLANTOLOGIYADA SUN'IY INTELLEKT

VA 3D RAQAMLI REJALASHTIRISH

KIUT Namangan Filiali Tibbiyot Fakulteti Stomatologiya Yonalishi DNT-N24UA guruh talabasi Valijonov Anasxon.

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Annotatsiya1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

2. The role of artificial intelligence in implant dentistry: a systematic review. International Journal of Oral and Maxillofacial Surgery. 2025;54(11):1098–1122. DOI: 10.1016/j.ijom.2025.04.005.

3. Accuracy in dental implant placement: A systematic review and meta-analysis comparing computer-assisted (static, dynamic, robotics) and noncomputer-assisted (freehand, conventional guide) approaches. The Journal of Prosthetic Dentistry. 2025. PubMed: https://pubmed.ncbi.nlm.nih.gov/40221370/

4. Elgarba B.M., Fontenele R.C., Tarce M., Jacobs R. Artificial intelligence serving pre-surgical digital implant planning: A scoping review. Journal of Dentistry. 2024;104862. DOI: 10.1016/j.jdent.2024.104862.

Ushbu maqolada zamonaviy stomatologik implantologiyada sun'iy intellekt (SI) va uch o'lchamli (3D) raqamli rejalashtirish texnologiyalarining ahamiyati yoritilgan. Implantatsiyadan oldingi diagnostikada konus-nurli kompyuter tomografiyasi (CBCT), intraoral skanerlash, virtual implant joylashtirish, kompyuter yordamida loyihalash va ishlab chiqarish (CAD/CAM), shuningdek, jarrohlik shablonlaridan foydalanish imkoniyatlari tahlil qilingan. Sun'iy intellekt

yordamida anatomik tuzilmalarni aniqlash, suyak hajmini baholash va davolash rejasini optimallashtirish imkoniyatlariga alohida e’tibor qaratilgan.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Kalit so‘zlar: stomatologik implantatsiya, sun’iy intellekt, 3D rejalashtirish, CBCT, intraoral skaner, CAD/CAM, raqamli stomatologiya, jarrohlik shabloni, implantatsiya aniqligi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Kirish1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Bugungi kunda stomatologiyada raqamli texnologiyalarning jadal rivojlanishi tish yo‘qotilishi bilan bog‘liq funksional va estetik muammolarni davolash imkoniyatlarini kengaytirmoqda. Dental implantatsiya yo‘qolgan tishlarni

tiklashning samarali usullaridan biri bo‘lib, uning muvaffaqiyati implantning to‘g‘ri joylashtirilishi, suyak to‘qimasining holati, yumshoq to‘qimalar xususiyatlari, okklyuzion munosabatlar va keyingi protezlash sifatiga bog‘liq.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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An’anaviy implantatsiya rejalashtirishida klinik tekshiruv, rentgenologik tasvirlar va shifokorning tajribasi muhim o‘rin tutadi. Biroq ikki o‘lchamli tasvirlar suyakning kengligi, balandligi va anatomik tuzilmalarning fazoviy joylashuvi haqida to‘liq ma’lumot bermasligi mumkin.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Maqolaning maqsadi — implantologiyada sun’iy intellekt va 3D raqamli rejalashtirish texnologiyalarining qo‘llanilishi, klinik afzalliklari, mavjud cheklovlari va istiqbollarini ilmiy adabiyotlar asosida tahlil qilish.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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serving pre-surgical digital implant planning: A scoping review. Journal of Dentistry. 2024;104862. DOI: 10.1016/j.jdent.2024.104862.

1. Implantologiyada 3D raqamli rejalashtirishning mohiyati1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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3D raqamli rejalashtirish — bemorning anatomik tuzilmalari va tish qatorining raqamli ma’lumotlari asosida implantning joylashuvi, yo‘nalishi, chuqurligi va o‘lchamlarini virtual muhitda oldindan belgilash jarayonidir. Ushbu yondashuv jarrohlik bosqichini protezlash maqsadlari bilan muvofiqlashtirishga imkon beradi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Raqamli rejalashtirishning asosiy tarkibiy qismlari quyidagilardan iborat:1.

Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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serving pre-surgical digital implant planning: A scoping review. Journal of Dentistry. 2024;104862. DOI: 10.1016/j.jdent.2024.104862.

1. Konus-nurli kompyuter tomografiyasi (CBCT). Ushbu tekshiruv alveolyar suyakning uch o‘lchamli tasvirini olish, suyak balandligi va kengligini baholash hamda mandibulyar kanal, mental teshik, maksillyar sinus kabi anatomik tuzilmalarni aniqlash uchun qo‘llaniladi. CBCT ma’lumotlari implantning xavfsiz joylashuvini rejalashtirishda muhim ahamiyatga ega.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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3. Raqamli ma’lumotlarni birlashtirish. CBCT tasvirlari va intraoral skanerlash ma’lumotlari maxsus dasturiy ta’minotda moslashtiriladi. Natijada suyak tuzilmalari, mavjud tishlar, yumshoq to‘qimalar konturlari va kelajakdagi ortopedik konstruksiyaning o‘zaro munosabati baholanadi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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[26.10.2026 20:27] □.: 4. Virtual implant joylashtirish. Shifokor implantning diametri, uzunligi, burchagi, chuqurligi va uch o‘lchamli holatini rejalashtiradi. Bunda anatomik xavfsizlik, protezning funksional talablari, estetik natija va suyak hajmi hisobga olinadi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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5. Jarrohlik shablonini ishlab chiqarish. Virtual reja asosida 3D printer yordamida jarrohlik shabloni tayyorlanishi mumkin. Shablon implantni rejalashtirilgan pozitsiyada joylashtirishga yo‘naltiradi.1. Alqutaibi A.Y., Algabri

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2. Sun’iy intellektning implantologiyadagi qo‘llanilishi1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Sun’iy intellekt — ma’lumotlarni tahlil qilish, ulardagi qonuniyatlarni aniqlash va muayyan vazifalarni bajarishga mo‘ljallangan algoritmlar majmuasidir. Implantologiyada, ayniqsa, mashinaviy o‘rganish va chuqur o‘rganish usullari tibbiy tasvirlarni qayta ishlashda muhim o‘rin egallaydi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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2.1. CBCT tasvirlarini avtomatik tahlil qilish1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Chuqur o‘rganish algoritmlari CBCT tasvirlarida jag‘ suyagi, tishlar, tishsiz sohalar va ayrim anatomik tuzilmalarni aniqlash hamda segmentatsiyalash uchun ishlatilishi mumkin. Segmentatsiya — tasvirdagi kerakli anatomik obyektlarni alohida ajratib ko‘rsatish jarayonidir.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Bunday texnologiyalar shifokorga suyakning o‘lchamlarini baholash, implant joylashtiriladigan hududni aniqlash va xavfli anatomik tuzilmalarga nisbatan masofani hisoblashda yordam beradi. 2025-yilda e’lon qilingan tizimli sharh va meta-tahlilda SI algoritmlarining tishsiz sohalarni aniqlashdagi umumlashtirilgan aniqligi pastki jag‘ uchun 96%, yuqori jag‘ uchun esa 83% deb qayd etilgan1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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SI asosidagi dasturiy vositalar anatomik ma’lumotlar, suyak hajmi va rejalashtirilgan protez shaklini hisobga olgan holda implant joylashuvining muqobil variantlarini taklif qilishi mumkin. Bu implantning protezga nisbatan qulay holatini tanlash va anatomik xavflarni oldindan baholashga yordam beradi..1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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- anatomik tuzilmalarni avtomatik aniqlash;
- suyak o‘lchamlarini dastlabki baholash;
- implant joylashtirish uchun muqobil pozitsiyalarni taqqoslash;
- rejalashtirish jarayonidagi takroriy o‘lchovlarni avtomatlashtirish;
- klinik ma’lumotlarni tizimlashtirish va ish jarayonini tezlashtirish.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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2025-yilda chop etilgan implantologiyada SI bo‘yicha tizimli sharhda ushbu texnologiyalar diagnostika, suyakni tasniflash, implantni rejalashtirish va prognozlash kabi turli yo‘nalishlarda o‘rganilgani ko‘rsatilgan [2]. Biroq algoritmning yuqori texnik aniqligi avtomatik ravishda bemor uchun yaxshiroq uzoq muddatli klinik natijani anglatmaydi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Raqamli rejalashtirishning muhim afzalliklaridan biri — implantni virtual rejaga muvofiq joylashtirishga yordam beradigan jarrohlik navigatsiyasi usullaridan foydalanish imkoniyatidir.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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[26.10.2026 20:27] □.: Robot-assistentli implantatsiya. Robotik tizimlar jarrohlik asbobining harakatini boshqarish yoki cheklash orqali rejalashtirilgan yo‘nalishga rioya qilishga yordam beradi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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2025-yilda chop etilgan 45 ta tadqiqotni qamrab olgan tizimli sharh va meta-tahlil kompyuter yordamidagi implantatsiya usullarini an’anaviy yondashuvlar bilan taqqoslagan. Natijalar kompyuter yordamidagi usullar implantning koronal va apikal nuqtalaridagi hamda burchak bo‘yicha og‘ishlarni kamaytirishi mumkinligini ko‘rsatgan .1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic

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Diagnostikaning aniqligi. Uch o‘lchamli tasvirlar suyakning anatomik xususiyatlarini turli tekisliklarda baholash imkonini beradi. SI esa ayrim o‘lchov va segmentatsiya vazifalarini avtomatlashtiradi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Uchinchidan, raqamli rejaning aniqligi faqat dasturiy ta’minotga emas, balki CBCT va intraoral skan ma’lumotlarining to‘g‘ri moslashtirilishiga, shablonning fiksatsiyasiga va operatsiya texnikasiga ham bog‘liq.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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To‘rtinchidan, uskunalar va dasturiy ta’minotning narxi, mutaxassislarni o‘qitish zarurati, bemor ma’lumotlarini himoya qilish va algoritmlar faoliyatining shaffofligi muhim masalalardir.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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2024-yilda e’lon qilingan ilmiy sharhda operatsiyadan oldingi implant rejalashtirishda SI vositalarining to‘liq avtomatlashtirilgan ishlashi hali yetarlicha

klinik tasdiqlanmagani ta’kidlangan [4]. Shu sababli SI mustaqil klinik qaror qabul qiluvchi vosita emas, balki mutaxassis faoliyatini qo‘llab-quvvatlovchi texnologiya sifatida ko‘rilishi kerak.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Ilmiy adabiyotlar tahlili sun’iy intellekt va 3D raqamli rejalashtirish implantologiyada diagnostik ma’lumotlarni qayta ishlash, anatomik tuzilmalarni aniqlash va jarrohlikni oldindan rejalashtirish imkoniyatlarini kengaytirayotganini ko‘rsatadi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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[26.10.2026 20:27] □.: Ayniqsa, CBCT va intraoral skanerlash ma’lumotlarini birlashtirish implantni kelajakdagi protezga mos ravishda

joylashtirishda muhim ahamiyatga ega.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Biroq texnologik aniqlik bilan klinik samaradorlikni farqlash zarur. Anatomik obyektni to‘g‘ri aniqlaydigan algoritm implantning uzoq muddatli saqlanishi, peri-implant to‘qimalarning salomatligi yoki bemorning hayot sifatini yaxshilashini o‘z-o‘zidan isbotlamaydi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Kelajakda turli populyatsiyalardan olingan sifatli ma’lumotlar bazalarini yaratish, algoritmlarni mustaqil klinik sharoitlarda tekshirish, xavfsizlik standartlarini takomillashtirish va stomatologlarning raqamli savodxonligini oshirish muhim vazifalar bo‘lib qoladi.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Implantologiyada sun’iy intellekt va 3D raqamli rejalashtirish zamonaviy diagnostika hamda jarrohlikni rejalashtirishning istiqbolli yo‘nalishlaridir.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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Sun’iy intellekt tasvirlarni avtomatik tahlil qilish, anatomik obyektlarni segmentatsiyalash va rejalashtirish jarayonini tezlashtirish imkoniyatiga ega. Shunga qaramay, algoritmlarning aniqligi, klinik qo‘llanishi va uzoq muddatli natijalarga ta’siri bo‘yicha qo‘shimcha tadqiqotlar zarur.1. Alqutaibi A.Y., Algabri R., Ibrahim W.I., Alhajj M.N., Elawady D. Dental implant planning using artificial intelligence: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025;134(5):1619–1629. DOI: 10.1016/j.prosdent.2024.03.032.

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