

Universitatea Titu Maiorescu din București
Școala Doctorală - Domeniul Medicină Dentară

Corelații între designul implanturilor dentare și prognosticul pe termen lung al acestora

TEZĂ DE DOCTORAT

Doctorand:

Alexandru Daniel REFERENDARU

Conducător științific:

Prof. Univ. Dr. EMILIAN HUTU

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Capitolul 1

Biomateriale utilizate în implantologie

Biomaterialele reprezintă totalitatea materialelor nemedicamentoase, folosite în medicină, pentru refacerea sau îmbunătățirea funcțiilor țesuturilor sau organelor [99].

Un material biocompatibil în implantologie trebuie să îndeplinească câteva proprietăți cum ar fi [103]:

1. Biocompatibilitate mare în raport cu corpul uman, mai bine spus să nu existe răspuns tisular de rejecție
2. Trebuie să prezinte o densitate cel puțin la fel ca osul
3. Rezistență mecanică mare
4. Rezistență la oboseală
5. Elasticitate mică
6. Rezistență la uzură
7. Rezistență la coroziune.

Materialele de adiție folosite în implantologie trebuie să fie biocompatibile. În anii 1990 biomaterialul era definit ca un material ce interacționează cu sistemele biologice pentru a ajuta un țesut, organ sau funcție sau pentru a îl înlocui [145].

Capitolul 2

Morfologia implanturilor dentare

La ora actuală există o multitudine de producători de implanturi dentare. Aceștia încearcă să aducă cât mai multe îmbunătățiri, atât la nivelul suprafeței de contact cu osul, cât și asupra formei implantului, numărului spirelor și distanței dintre acestea. De când Bränemark a ales forma cilindrică a primului său implant, în anii 70, aceasta nu a suferit în timp modificări importante [99].

Indiferent de forma corpului implantului (cilindric, conic sau hibrid), pe acesta se găsesc spire. Spirele implanturilor constituie poate cea mai importantă componentă a corpului implantului, ele prelungindu-se și în regiunea apexului, prezentând un pas identic sau nu, pe toată lungimea corpului, în funcție de producător.

În ceea ce privește distanța optimă dintre spire, nu putem spune că există la ora actuală un consens general. Pasul filetelor poate varia la nivelul corpului implantului între 0.6-1.25 mm [171].

Capitolul 3

Fiziologia formării și remodelării osoase și procesul de osteointegrare

Sistemul osos este un suport rigid, foarte specializat, al corpului, caracterizat prin duritatea și capacitatea de regenerare și vindecare. De-a lungul vieții, oasele suferă, în mod constant, un proces de

modelare (remodelare) pentru a se adapta la forțele biomecanice în schimbare și pentru a elimina osul vechi, deteriorat și a îl înlocui cu os nou, mai puternic din punct de vedere mecanic [287]. Osificarea membranoasă, de origine mezenchimală, este caracteristica principală a oaselor late, craniene, precum și a mandibulei, maxilei și claviculei. Acest tip de os se formează din țesut conjunctiv, mezenchimal și nu din cartilagiu ca la oasele de origine encondrală, precum oasele lungi.

Capitolul 4

Studii comparative privind distribuția presiunilor masticatorii în oasele maxilare în funcție de pasul spirelor implanturilor dentare

4.1 Introducere

Analizele cu elemente finite sunt utilizate în prezent pentru investigarea designului implanturilor dentare, comportamentului materialului din care este confecționată piesa protetică cu spijin implantar, precum și stabilității osului [307, 308] periimplantar.

4.2 Material și metodă

Pentru a studia comparativ comportamentul interfeței os-implant la solicitări mecanice în funcție de pasul spirelor implanturilor, am ales un caz complex, edentat total bimaxilar [316].

CBCT-ul pacientului a fost importat în Mimics Innovation Suite 17, ©Materialise NV și prelucrat [316]. Cele 3 implanturi frontale maxilare și cele 4 mandibulare au fost considerate inițial cu pasul mare între spire (**TIP B**) și ulterior cu pasul mic între spire (**TIP A**), pentru a decela eventuale diferențe la nivelul interfeței os-implant în funcție de designul implanturilor, respectiv pasul spirelor acestora [316].

4.4. Discuții

Unii cercetători [321] consideră că diametrul implantului este cel mai important factor ce dictează scăderea tensiunilor și deformațiilor în osul periimplantar, în timp ce alții [322] consideră că lungimea implantului are un impact mai mare asupra distribuției stresului în osul periimplantar. Pe de altă parte, s-a demonstrat că nici diametrul implantului, nici lungimea acestuia nu sunt la fel de importante ca tehnica chirurgicală de inserare, stabilitatea primară adecvată și igiena orală pre și postoperatorie. [323] Implanturile mai mari atât în diametru cât și în lungime s-a demonstrat că îmbunătățesc modelele de distribuție a tensiunilor și deformațiilor; cu toate acestea, în multe situații clinice, osul alveolar nu prezintă o grosime sau o înălțime suficiente pentru inserarea unor astfel de implanturi. [320]

4.5 Concluzii

1) Metoda elementului finit este o metodă matematică, de simulare a efectelor biomecanice ale diverselor tipuri de implanturi dentare, care sunt analizate ca structuri omogene, izotrope, cu comportament liniar, deformabile sub acțiunea diverselor forțe.

- 2) Zonele critice, în care au apărut valori extreme, au fost situate în osul din jurul colului și apexului implanturilor, indiferent de tipul de implant (**A sau B**) și de arcada analizată.
- 3) Tensiunile și deformațiile dezvoltate nu au prezentat valori care ar putea periclita osteointegrarea implanturilor, dar pe perioade mai mari de timp tensiunile cauzate de forțele masticatorii pot induce cedarea substratului osos în zonele critice.
- 4) Implanturile cu pasul mic între spire (**TIP A**) induc tensiuni și deformații mai reduse față de implanturile cu pasul mare între spire (**TIP B**), indiferent de arcada în care au fost inserate.

Capitolul 5

Studii de microscopie electronică asupra interfeței os-implant în cazul unor explanturi cu pasul diferit al spirelor

5.1 Introducere

Contactul biologic cu suprafața implanturilor dentare este definit de contactul os-dinte natural. [345] Osteointegrarea, contactul direct dintre os și implant, este privită ca o încapsulare a țesuturilor dure, o reacție imună de corp străin care izolează implantul [346]. Pentru a îmbunătăți activitatea celulelor osteogene în procesul de osteointegrare, caracteristicile fizice și chimice ale suprafeței implantului - inclusiv energia de suprafață și umectabilitatea - sunt modificate, deoarece nu este posibilă îmbunătățirea directă a suprafeței osoase [347-350].

5.2 Material și metodă

Scopul prezentului studiu a fost acela de a examina comparativ explanturi dentare, cu diferite designuri ale suprafeței, menținute pentru perioade diverse de timp în oasele maxilare, în vederea aprecierii modului în care pasul spirelor influențează procesul de osteointegrare. Materialul de studiu a fost reprezentat de un număr de 10 explanturi dentare din cazuistica *Clinicii de Reabilitare Orală Prof. Dr. Barbu*, de **TIP A** și **TIP B**, pe care le-am inserat cu caracter provizoriu, le-am explantat și apoi le-am examinat la microscopul electronic de scanning Phenom ProX, din dotarea centrului de cercetare BIOMAT din cadrul Universității Politehnica din București.

5.4 Discuții

În acest studiu am folosit două tipuri de implanturi și anume: un implant ce prezintă un corp cilindric (ușor conic spre apexul lui), cu pasul spirelor des (**TIP A**) și un implant conic, mai agresiv, cu pasul spirelor mai largi (**TIP B**). Cele două implanturi prezintă suprafețe diferit concepute și tratate. **Implantul TIP A** este realizat din titan de grad 5 și prezintă o suprafață care este realizată prin sablare cu particule de hidroxiapatită (HA), spălată apoi cu acid și cu apă distilată. **Implantul TIP B** prezintă o suprafață biocompatibilă și osteoconductoare. Este un implant autoforant, cu o formă conică, mai agresivă decât TIPUL A, cu filete duble. Prezintă o stabilitate primară foarte bună chiar și în osul de duritate D4.

5.5 Concluzii

- 1) Pe suprafața tuturor pieselor examinate este evidentă prezența țesutului osos de neoformație, indiferent de tipul de implant și de zona în care acestea au fost inserate.
- 2) Gradul de mineralizare al țesuturilor de pe suprafața explanturilor este dependent, în primul rând, de perioada de timp pentru care implantul a fost inserat în os.
- 3) Pe implanturile cu spire dese, există cantități mai mari de țesut de neoformație, mai aderent și cu un grad de mineralizare mai crescut.
- 4) Nanoporozitatea suprafeței implanturilor cu spire dese și tensiunile mai mici, induse local, stimulează într-o manieră mai „prietenosă” osteogeneza în comparație cu implanturile mai „agresive”, cu spire puține și spațiile dintre spire mari.

Capitolul 6

Studiu clinico-statistic privind prognosticul pe termen lung al tratamentului implanto-protetic în funcție de designul implanturilor dentare

6.1 Introducere

Restaurările cu agregare implantară oferă o serie de avantaje față de o proteză fixă convențională:

- 1) Rată mare de succes terapeutic (peste 97% la 10 ani)
- 2) Risc redus de carii și probleme endodontice la dinții adiacenți breșei edentate;
- 3) Contribuie la menținerea osului crestei edentate. [372]

Pacientul candidat la implant trebuie evaluat medical din faza de planificare a tratamentului pentru boli cardiovasculare sau tulburări endocrine decompensate, sarcină, tulburări de coagulare și afecțiuni osoase [373, 374]. De asemenea, evaluarea imagistică precisă și cuprinzătoare oferă toate informațiile necesare pentru etapa chirurgicală și protetică [372] de reabilitare orală complexă.

6.2 Material și metodă

Baza de studiu a fost reprezentată de situsurile implantare ale unui lot de pacienți care s-au adresat *Clinicii de Reabilitare Orală Prof. Dr. Barbu* în perioada 1 octombrie 2014 – 1 octombrie 2018, în vederea consultului și instituirii tratamentului de specialitate.

Lotul de studiu a fost constituit din 73 de pacienți de ambele sexe care erau vechi purtători de proteze adjuncte sau prezentau afecțiuni parodontale grave, avansate, care nu mai puteau fi tratate decât prin extracția tuturor unităților dentare restante pe arcade. La acest lot de pacienți s-au realizat 618 situsuri implantare.

6.4 Discuții

Prezentul studiu a confirmat interesul crescut al persoanelor de sex feminin față de aplicarea unor terapii dentare moderne în vederea refacerii funcțiilor aparatului dento-maxilar, lotul fiind compus preponderent din pacienți de sex feminin (61.64% din cazuri), similar altor studii recente [376-381]. La

lotul studiat au fost inserate 370 implanturi la arcadele maxilare și 248 implanturi la arcadele inferioare. Analizând distribuția numărului de implanturi inserate pe sexe, la femei au fost inserate 239 implanturi la maxilar și 134 implanturi la mandibulă, iar la bărbați s-au inserat 131 implanturi la maxilar și 114 implanturi la mandibulă. 55.81% din cazurile de eșec s-au produs la pacienți la care s-au efectuat diferite tipuri de adiții osoase. În funcție de tipul de adiție efectuat, procedura de elevare a sinusului maxilar prin abord extern a fost cel mai mult corelată cu cazurile de eșec implantar.

75.57% din implanturi au fost inserate drept, restul fiind inserate sub diferite unghiuri [389, 390], cuprinse între 10° și 65°. Câte 20% din cazurile de implanturi inserate sub un unghi de 55° sau 35° s-au soldat cu eșec și 7.49% din cazurile de implanturi inserate drept s-au soldat cu eșec. Cea mai redusă rată de eșec (4.76%) s-a înregistrat la lotul studiat la implanturile inserate cu o înclinare de 10°.

32 de pacienți erau fumători, dintre care 14 bărbați și 18 femei. 79 implanturi au fost încărcate imediat, 499 implanturi au fost încărcate tardiv și 40 implanturi au fost explantate imediat după inserare deoarece nu prezentau stabilitate primară satisfăcătoare.

6.5 Concluzii

- 1) Un procent mare de eșecuri în retenția implantelor (81.4%) s-a produs la maxilar, probabil datorită densității osoase mai reduse la acest nivel.
- 2) Prognosticul pe termen lung al implanturilor cu pasul mic între spire (**TIP A**) a fost mai bun față de cel al implanturilor de **TIP B**, cu pasul mare între spire (8 implanturi pierdute cu pasul mic între spire vs. 35 implanturi pierdute cu pasul mare între spire).
- 3) Cel mai bun prognostic pe termen lung l-au avut la lotul studiat implanturile cilindro-conice (**TIP A**), cu rată nulă de eșec, iar cel mai slab prognostic pe termen lung l-au avut implanturile zigomatice (12.5% rată de eșec).
- 4) Rata cea mai mare a cazurilor de eșec (55.81%) s-a produs la pacienții la care s-au efectuat și adiții osoase, în special sinus lift extern.
- 5) Cea mai mare rată de succes au avut-o implanturile inserate sub un unghi de 10° și cea mai mică rată de succes au avut-o implanturile inserate sub unghiuri de 35° și 55°.
- 6) Terapia implanto-protetică este o variantă fezabilă în majoritatea cazurilor de edentații la adulți, dar rata de stabilitate este dependentă de o multitudine de factori clinici și tehnici.

Capitolul 7

Elemente de originalitate ale studiilor și perspective pe care le deschide teza

Pe parcursul studiilor doctorale am abordat trei direcții de cercetare prin care am adus contribuții personale privind:

- Analiza cu elemente finite a modului de distribuție a presiunilor masticatorii în oasele maxilare prin intermediul unor implanturi dentare cu design diferit, respectiv cu pas mare sau mic între spire;
- Analiza prin microscopie electronică a interfeței os-implant în cazul unor explanturi cu pas diferit al spirelor (**TIP A și TIP B**), menținute în os pentru perioade de 12-24 luni;
- Prognosticul pe termen lung al tratamentului implanto-protetic în funcție de designul implanturilor dentare, analizat pe un lot de 618 situsuri implantare.

În viitor va fi necesară efectuarea unor noi studii clinice și paraclinice, atât pe loturi mai extinse de pacienți, cât și pe un număr mai mare de implanturi dentare cu design diferit, în vederea validării actualelor studii, dar și pentru a găsi noi soluții terapeutice care să contribuie la creșterea calității vieții pacienților edentați.

Concluzii generale

- 1) Zonele critice, analizate prin metoda FEM în care au apărut valori extreme, au fost situate în osul din jurul colului și apexului implanturilor, indiferent de tipul de implant și de arcada analizată.
- 2) Tensiunile și deformațiile dezvoltate nu au prezentat valori care ar putea periclita osteointegrarea implanturilor, dar pe perioade mai mari de timp tensiunile cauzate de forțele masticatorii pot induce cedarea substratului osos în zonele critice.
- 3) Implanturile cu pasul mic între spire (**TIP A**) induc tensiuni și deformații mai reduse față de implanturile cu pasul mare între spire (**TIP B**), indiferent de arcada în care au fost inserate.
- 4) Prognosticul pe termen lung al implanturilor cu pasul mic între spire a fost mai bun față de cel al implanturilor cu pasul mare între spire (8 implanturi pierdute cu pasul mic între spire vs. 35 implanturi pierdute cu pasul mare între spire).
- 5) Implanturile inserate sub un unghi de 10° au avut cea mai mare rată de succes.
- 6) Cel mai bun prognostic pe termen lung l-au avut implanturile cilindro-conice, cu rată nulă de eșec, iar cel mai slab prognostic pe termen lung l-au avut implanturile zigomatice (12.5% rată de eșec).
- 7) Un procent mare de eșecuri în retenția implantelor (81.4%) s-a produs la maxilar, probabil datorită densității osoase mai reduse la acest nivel.
- 8) Terapia implanto-protetică este o variantă fezabilă în majoritatea cazurilor de edentații la adulți, dar rata de stabilitate este dependentă de o multitudine de factori clinici (vârsta pacientului, starea generală de sănătate, igiena buco-dentară) și biomecanici (tipul implantului, distanța între spire, unghiul de inserare) și nu în ultimul rând acuratețea tehnicii chirurgicale.

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Anexe

Lista lucrărilor publicate *in extenso*, care se regăsesc citate în textul tezei

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