UNIVERSIDADE DE SÃO PAULO
FACULDADE DE ODONTOLOGIA DE BAURU

MATHEUS HERREIRA FERREIRA

Somatosensory alterations and neuropathic pain symptoms after single-unit implant immediate loading: a 1-year follow-up study

Alterações somatossensoriais e sintomas de dor neuropática após implante unitário com carga imediata: estudo com 1 ano de *follow-up*

BAURU
2023

MATHEUS HERREIRA FERREIRA

Somatosensory alterations and neuropathic pain symptoms after single-unit implant immediate loading: a 1-year follow-up study

Alterações somatossensoriais e sintomas de dor neuropática após implante unitário com carga imediata: estudo com 1 ano de *follow-up*

Dissertação constituída por artigo apresentada à Faculdade de Odontologia de Bauru da Universidade de São Paulo para obtenção do título de Mestre em Ciências no Programa de Ciências Odontológicas Aplicadas, na área de concentração Biologia Oral.

Orientador: Prof. Dr. Leonardo Rigoldi Bonjardim

BAURU

2023

Herreira-Ferreira, Matheus

Somatosensory alterations and neuropathic pain symptoms after single-unit implant immediate loading: a 1-year follow-up study/ Matheus Herreira Ferreira. -- Bauru, 2023.

43 p. : il. ; 31 cm.

Dissertação (mestrado) -- Faculdade de Odontologia de Bauru, Universidade de São Paulo, 2023.

Orientador: Prof. Dr. Leonardo Rigoldi Bonjardim

Comitê de Ética da FOB-USP

Protocolo nº: 50811015.0.0000.5417

FOLHA DE APROVAÇÃO

Dissertação apresentada e defendida por
MATHEUS HERREIRA FERREIRA
e aprovada pela Comissão Julgadora
em 24 de março de 2023.

Prof. Dr. **YURI MARTINS COSTA**
FOP-Unicamp

Prof. Dr. **RAFAEL DOS SANTOS SILVA**
UEM

Prof. Dr. **ESTEVAM AUGUSTO BONFANTE**
FOB-USP

Prof. Dr. **LEONARDO RIGOLDI BONJARDIM**
Presidente da Banca
FOB - USP

Prof. Dr. Marco Antonio Hungaro Duarte
Presidente da Comissão de Pós-Graduação
FOB-USP

DEDICATÓRIA

Dedico este trabalho à Deus e a minha família, bases do meu caráter e alicerces da minha vida profissional.

AGRADECIMENTOS

Agradeço a Deus, por me abençoar, me guiar e me fazer capaz de chegar aonde cheguei.

Agradeço a minha mãe, Cristina, por me apoiar e me amar incondicionalmente. Seu amor e carinho, assim como seu zelo me fizeram voar mais longe. Obrigado por ser esse exemplo na minha vida.

Agradeço ao meu padrasto, Rosley, pelo apoio e por toda ajuda na profissão. Obrigado pelos incontáveis conselhos e incentivos, que já fazem parte da minha história.

Agradeço a minha irmã, Fernanda, por ser luz nos meus dias. Que você continue sendo a diferença na minha vida. Contribuiu imensamente para ser o homem que hoje sou.

A toda minha família, eu agradeço o suporte e os incentivos. Sem vocês nada valeria a pena.

Ao meu orientador Prof. Dr. Leonardo Rigoldi Bonjardim, a minha imensa gratidão. Tive o prazer de ser orientado por um profissional ímpar, e mais importante, umas das melhores pessoas que eu já tive o prazer de conviver. Que o senhor continue sempre com o seu alto astral e sua educação invejável. Tenho-o como exemplo na profissão.

Agradeço ao Prof. Dr. Estevam Augusto Bonfante, pela parceria, confiança e orientação também neste incrível trabalho, fico honrado de ter trabalhado ao seu lado.

Agradeço também ao Prof. Dr. Yuri Martins Costa, pelo apoio e supervisão do trabalho. Sinto honrado de hoje poder trabalhar com o senhor, que teve sua base de formação na mesma instituição que estudei, e hoje sigo seus passos na FOB também. Tenho grande admiração pela sua trajetória.

A professora Carolina Ortigosa e ao professor Paulo Conti, pelos ensinamentos essenciais a minha formação na área. Tenho um carinho e respeito muito grande pelos dois, e honra de ser aluno de vocês.

Ao Prof. Dr. Rafael dos Santos Silva, gostaria de agradecer por ter me introduzido nesta área que tanto amo. Obrigado pelas orientações e portas abertas que o senhor sempre proporcionou. Vou guardar sempre na lembrança.

Aos amigos que fiz em Bauru, muito obrigado por tudo. Sem vocês, minha estadia por aqui não seria a mesma. Aprendi muito com vocês ao meu lado, me dando todo suporte e apoio

do mundo. Quem tem amigos tem tudo, e que bom que pude conhecer todos vocês! Que seja amizade para a vida toda.

A Dalva, da secretaria da Biologia Oral, muito obrigado por tudo. Pelas inúmeras ajudas com dúvidas recorrentes. Sua paciência e empatia com os alunos da pós-graduação é invejável e fez toda a diferença na minha formação.

Aos funcionários da FOB, agradeço a cada um, que à sua maneira, contribuíram muito a minha caminhada por aqui. Meu sincero obrigado.

Agradeço a Faculdade de Odontologia de Bauru - FOB, representada pela diretora Marilia Afonso Rabelo Buzalaf com todo seu zelo a instituição, que hoje faz parte da minha jornada.

O presente trabalho foi realizado com o apoio da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Código de Financiamento 001 e Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP: 2015/26920-4).

RESUMO

O objetivo do presente estudo foi avaliar a incidência de anormalidades somatossensoriais e sintomas de dor neuropática, assim como seu impacto na qualidade de vida relacionada a saúde bucal em pacientes reabilitados com implantes unitários com carga imediata. Ao todo, 33 pacientes com perdas dentárias unitárias na região posterior de maxila ou mandíbula foram avaliados em 8 tempos distintos (basal; 3 dias; 7 dias; 15 dias; 1 mês; 3 meses; 6 meses e 1 ano). Os questionários DN4 e OHIP-14 foram aplicados para rastreio de dor neuropática e qualidade de vida relacionada a saúde bucal, respectivamente. Além destes, os testes quantitativos sensoriais (QST) térmicos e qualitativos sensoriais (QualST) foram realizados nas regiões contralateral e ipsilateral à cirurgia, tanto extraoral como intraoral. Para os resultados do DN4, uma estatística descritiva foi reportada e o teste ANOVA de Medidas Repetidas usado para as informações do OHIP-14. O teste ANOVA de Medidas Repetidas de Duas Vias e o teste Tukey *post hoc* foram utilizados para os valores do QST e o teste Q de Cochran para os valores do QualST. As informações oriundas do DN4 sugeriram que dores neuropáticas não foram detectadas após 1 mês de acompanhamento. No lado operado, o limiar de dor ao frio (CPT) geral (extraoral: $p=0,030$), limiar de detecção de frio (CDT) e CPT (intraoral: $p<0,001$) diminuiu ao longo do tempo. Na região contralateral, o CDT da maxila (extraoral: $p=0,024$; intraoral: $p=0,031$), limiar de detecção de calor (WDT) (extraoral: $p=0,026$; intraoral: $p=0,047$) e o CPT geral (extraoral e intraoral: $p<0,001$) também diminuíram. O QualST mostrou anormalidades ao longo do tempo para os estímulos de picada extraoral ($p=0,032$) e intraoral ($p=0,000$), frio ($p=0,000$) e toque ($p=0,002$). Os valores de OHIP-14 mostraram um aumento significativo ($p<0,001$). Mesmo com pequenas anormalidades somatossensoriais encontradas, estas não representaram mudanças clínicas relevantes, confirmando que a cirurgia de implantes unitários imediatos é um procedimento de baixo risco e com impacto positivo na qualidade de vida relacionada à saúde bucal dos pacientes.

Palavras-chave: implantes dentários; carga imediata em implante dentário; distúrbios somatossensoriais; qualidade de vida; neuralgia.

ABSTRACT

Somatosensory alterations and neuropathic pain symptoms after single-unit implant immediate loading: a 1-year follow-up study

The aim of the present study was to evaluate the incidence of somatosensory abnormalities and neuropathic pain symptoms and its impact on oral health quality of life on patients rehabilitated with single immediate implant loading. 33 patients with single-tooth loss on the posterior region of maxilla or mandible were evaluated at 8 different times (baseline; 3 days; 7 days; 15 days; 1 month; 3 months; 6 months; and 1 year). DN4 and OHIP-14 questionnaires were applied for tracking neuropathic pain and oral health quality of life, respectively. Also, thermal QST and QualST were performed at the contralateral and ipsilateral region to the surgery, extra- and intraorally. Descriptive statistic was reported for DN4 results as the Repeated Measures ANOVA test on OHIP-14 data. The Two-Way Repeated Measures ANOVA test and *post hoc* Tukey test were used on QST values and Cochran Q test on QualST. DN4 data suggesting neuropathic pain were not seen after 1 month follow-up. At the operated side, overall CPT (extraoral: $p=0.030$), CDT and CPT (intraoral: $p<0.001$) decreased over time. In the contralateral region, maxilla CDT (extraoral: $p=0.024$; intraoral: $p=0.031$), WDT (extraoral: $p=0.026$; intraoral: $p=0.047$) and overall CPT (extraoral and intraoral: $p<0.001$) also decreased. QualST showed extraoral pinprick stimuli ($p=0.032$) and intraoral pinprick ($p=0.000$), cold ($p=0.000$) and touch ($p=0.002$) stimuli abnormalities over time. The OHIP-14 values showed a significant improvement ($p<0.001$). Although minor somatosensory abnormalities were found, those did not represent clinical relevant changes, confirming single-tooth immediate loading surgery as a low risk procedure and with a positive impact on the oral health-related quality of life.

Keywords: dental implants, single-tooth; immediate dental implant loading; somatosensory disorders; health-related quality of life; neuropathic pain.

LISTA DE ABREVIATURA E SIGLAS

DN4	*Douleur Neuropathique en 4 Questions*
IASP	Associação Internacional de Estudo da Dor
OHIP	Perfil de Impacto da Saúde Bucal
QualST	Teste Qualitativo Sensorial
QST	Teste Quantitativo Sensorial

SUMÁRIO

1. INTRODUÇÃO

A qualidade de vida de um indivíduo pode ser influenciada por diversos fatores biológicos e psicossociais. Sabe-se que a saúde bucal é um dos fatores que podem influenciar na qualidade de vida (GENNAI et al., 2021; MARTINS et al., 2021). Funções nobres como comunicar e se alimentar são essenciais, e tem no sistema estomatognático sua base de funcionamento (GERRITSEN et al., 2010; VAN LIERDE et al., 2012). Além disso, a região orofacial tem seus estímulos fortemente percebidos no córtex primário sensorial (SCHOTT, 1993) e pode ser considerada a região mais sensível do corpo humano (MAGERL et al., 2010).

Doenças crônicas como caries dentárias ainda são altamente prevalentes na população adulta, o que torna o risco de perda dentária alto em faixas etárias mais avançadas (GERRITSEN et al., 2010). Estas perdas, podem gerar impactos negativos na qualidade de vida de um indivíduo (GERRITSEN et al., 2010; NICKENIG et al., 2016; RAES et al., 2012, 2017), e mesmo quando unitárias, tem capacidade de gerar disfunções mastigatórias e estéticas, além de serem vistas como algo negativo na sociedade, o que pode afetar a parte psicossocial do indivíduo, aumentando sua procura por reabilitações protéticas (FARZADMOGHADAM et al., 2020; GERRITSEN et al., 2010). Devido à baixa adesão e dificuldade alta de adaptação das próteses removíveis, a procura se torna, principalmente, pelas próteses implantossuportadas (MENASSA et al., 2016). Sabe-se que os tratamentos implantossuportados com carga imediata trazem benefícios para o paciente, através de uma rápida reabilitação e boa aceitação final (HATTINGH; DE BRUYN; VANDEWEGHE, 2019; MENASSA et al., 2016; RAES et al., 2012, 2017; VAN LIERDE et al., 2012).

Embora não habitual, em alguns casos, pacientes podem apresentar relatos de dor após a cirurgia com controle desafiador. Em seu último consenso, a Associação Internacional de Estudo da Dor (IASP, sigla em inglês) define dor em: “uma experiência sensorial e emocional desagradável associada, ou semelhante àquela associada, a uma lesão tecidual real ou potencial” (RAJA et al., 2020), e desta maneira, devido a manipulação e injúria tecidual provocada (lesão tecidual real) durante o procedimento, um processo inflamatório irá se instalar na região, e quando não controlado devidamente, o paciente pode ser exposto a estímulos nociceptivos em excesso (AL-SABBAGH et al., 2015a; COSTIGAN; SCHOLZ; WOOLF, 2009; SELVIDO et al., 2021). Esses estímulos nociceptivos, quando em proporções normais, funcionam como um alarme mediados pelas fibras C e Aδ, que conduzem os impulsos nervosos para o sistema nervoso central (COSTIGAN; SCHOLZ; WOOLF, 2009). Por isso, na dor de origem nociceptiva, os sintomas tendem a melhorar de acordo com o reparo tecidual. Porém, em casos

de injúrias mais extensas a tecidos nervosos, esta condição pode progredir para uma condição de dor neuropática, com envolvimento de ambos mecanismos centrais e periféricos (CONTI et al., 2021; COSTIGAN; SCHOLZ; WOOLF, 2009). Nestas situações, o nervo alveolar inferior costuma ser o mais afetado na região orofacial (HILLERUP, 2007; SELVIDO et al., 2021; VÁZQUEZ-DELGADO et al., 2018). A dor neuropática pode estar associada a perda de função e comprometer atividades diárias como se alimentar, falar e socializar, reduzindo drasticamente a qualidade de vida do indivíduo (AL-SABBAGH et al., 2015b). Algumas ferramentas fornecem informações para rastreio de dores neuropáticas e podem ser encontradas na literatura. Por exemplo, o *Douleur Neuropathique en 4 Questions* (DN4, sigla em francês), é uma ferramenta com alta acurácia para detecção deste tipo de condição (BOUHASSIRA et al., 2005; VANDENKERKHOF et al., 2018). Porém, nenhum estudo ainda foi publicado com o uso desta ferramenta relacionada a cirurgia de implantes.

Quando voltadas a avaliação de alterações somatossensoriais, ferramentas como os testes quantitativos (QST, sigla em inglês) e qualitativos (QualST, sigla em inglês) sensoriais, já são descritos na literatura como opções confiáveis e acuradas (AGBAJE et al., 2017; BAAD-HANSEN et al., 2013; PIGG et al., 2010; ROLKE et al., 2006a, 2006b; VAN DER CRUYSSEN et al., 2020). Alguns estudos utilizaram estes testes como ferramentas para avaliar possíveis alterações após cirurgias maxilofaciais (PILLAI et al., 2020; SAID-YEKTA et al., 2012; SAID YEKTA et al., 2010), incluindo implantes dentários (HARTMANN et al., 2017a, 2017b; KIM; KIM, 2019; PORPORATTI et al., 2017). Porém, em relação aos implantes dentários, os resultados dos estudos ainda se divergem entre perda sensorial (KIM; KIM, 2019) e nenhuma alteração encontrada (HARTMANN et al., 2017b; PORPORATTI et al., 2017).

Como a qualidade de vida de um indivíduo pode ser alterada após reabilitação com implantes dentários, vários autores também buscaram quantificar essas possíveis alterações psicossociais através de algumas ferramentas como Questionário de Perfil de Impacto da Saúde Bucal (OHIP, sigla em inglês) com 14 (HATTINGH; DE BRUYN; VANDEWEGHE, 2019; PAUL S et al., 2018; RAES et al., 2012, 2017; VAN EEKEREN et al., 2016), 20 e 21 questões (MENASSA et al., 2016; NICKENIG et al., 2016). Todos encontraram uma melhora significativa na qualidade de vida dos pacientes submetidos a reabilitações com implantes dentários.

Portanto, o presente estudo objetivou avaliar a incidência de anormalidades sensoriais e o impacto na qualidade de vida relacionada à saúde bucal após a instalação de implantes unitários com carga imediata em região posterior em um acompanhamento de um ano.

2. ARTIGO

O artigo apresentado nesta dissertação foi escrito de acordo com as normas de submissão da revista "Clinical Implant Dentistry And Related Research".

Somatosensory alterations and neuropathic pain symptoms after single-unit implant immediate loading: a 1-year follow-up study

Authors:

Matheus Herreira-Ferreira

DDS, Master's Student, Department of Biological Sciences, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil.

Estevam Augusto Bonfante

DDS, MSc, PhD, Professor, Department of Prosthodontics and Periodontology, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil.

Paulo César Rodrigues Conti

DDS, MSc, PhD, Professor, Department of Prosthodontics and Periodontology, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil.

Everardo Napoleão Santana de Araújo-Júnior

DDS, MSc, PhD, Department of Prosthodontics and Periodontology, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil.

Camila Moreira Machado

DDS, MSc, PhD, Department of Prosthodontics and Periodontology, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil.

Patrick Henry Machado Alves

DDS, MSc, PhD, Department of Prosthodontics and Periodontology, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil.

Yuri Martins Costa

DDS, MSc, PhD, Professor, Department of Biosciences, Piracicaba Dental School, University of Campinas, Piracicaba, Brazil.

Leonardo Rigoldi Bonjardim

DDS, MSc, PhD, Professor, Department of Biological Sciences, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil.

ABSTRACT

Objective: The aim of the present study was to evaluate the incidence of somatosensory abnormalities and neuropathic pain symptoms and its impact on oral health quality of life on patients rehabilitated with single immediate implant loading. **Material and Methods:** 33 patients with single-tooth loss on the posterior region of maxilla or mandible were evaluated at 8 different times (baseline; 3 days; 7 days; 15 days; 1 month; 3 months; 6 months; and 1 year). DN4 and OHIP-14 questionnaires were applied for tracking neuropathic pain and oral health quality of life, respectively. Also, thermal QST and QualST were performed at the contralateral and ipsilateral region to the surgery, extra- and intraorally. Descriptive statistic was reported for DN4 results as the Repeated Measures ANOVA test on OHIP-14 data. The Two-Way Repeated Measures ANOVA test and *post hoc* Tukey test were used on QST values and Cochran Q test on QualST. **Results:** DN4 data suggesting neuropathic pain were not seen after 1 month follow-up. At the operated side, overall CPT (extraoral: $p=0.030$), CDT and CPT (intraoral: $p<0.001$) decreased over time. In the contralateral region, maxilla CDT (extraoral: $p=0.024$; intraoral: $p=0.031$), WDT (extraoral: $p=0.026$; intraoral: $p=0.047$) and overall CPT (extraoral and intraoral: $p<0.001$) also decreased. QualST showed extraoral pinprick stimuli ($p=0.032$) and intraoral pinprick ($p=0.000$), cold ($p=0.000$) and touch ($p=0.002$) stimuli abnormalities over time. The OHIP-14 values showed a significant improvement ($p<0.001$). **Conclusion:** Although minor somatosensory abnormalities were found, those did not represent clinical relevant changes, confirming single-tooth immediate loading surgery as a low risk procedure.

Keywords: Dental Implants, Single-Tooth, Immediate Dental Implant Loading, Somatosensory Disorders, Health-Related Quality Of Life, Neuropathic Pain

INTRODUCTION

A single tooth loss can have negative impact on the individual's quality of life [1–4]. This loss can generate masticatory and aesthetic dysfunctions increasing the demand, mainly for implant-supported rehabilitations [4,5] largely due to the difficulty of adapting to removable prostheses [6]. Thus, immediate implant loading can bring benefits to the patient through fast rehabilitation, with good acceptance and satisfaction [2,3,6–8].

Unfortunately, some patients can report pain after surgery with challenging control. The IASP (International Association for the Study of Pain) defines pain as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" [9]. Due to manipulation and injury of peripheral tissues (actual tissue damage) during the implant placement procedure, an inflammatory process is installed in the region, and if not well controlled, the patient may be exposed to unnecessary and excessive nociceptive stimuli [10–12]. This nociceptive type of pain tends to improve as healing of the injured tissue progresses, although neuropathic pain can develop in a few cases with involvement of both peripheral and central mechanisms [12,13], where the inferior alveolar nerve is the most affected in the orofacial region [11,14,15]. This painful situation can compromise daily activities such as eating, drinking, talking and socializing, drastically reducing the affected subject's quality of life [16].

Post-operative pain related to probable damage and sensitization of neuronal tissues are often related to gain and loss of function, which are common symptoms of neuropathic disorders [12,13,17]. Thus, tracking the onset of these sensory impairments and its behavior in patients going through dental implant surgery becomes important to understand and control such cases. The absent of well-controlled studies evaluating and describing the gain and loss of function and presence of persistent post-operative pain associated with other neuronal and psychosocial effects with longer follow-up, drives to a need for well performed analysis, leading a better overall comprehension.

That being said, the present study evaluated the incidence of somatosensory abnormalities as well as symptoms of neuropathic pain and the impact on oral health related quality of life after a single-unit immediate implant loading in the posterior region in a one year follow up. The null hypothesis is that thermal and mechanical thresholds will probably decrease, with no reports of neuropathic pain.

MATERIAL AND METHODS

This prospective study was supported by The Sao Paulo Research Foundation – FAPESP (2015/26920-4). There was no conflict of interest. This study was conducted in accordance with the Declaration of Helsinki, the STROBE (The Strengthening the Reporting of Observational Studies in Epidemiology)[18] guidelines for cohort studies and was approved by the local ethics committee (CAAE: 50811015.0.0000.5417). An informed consent was obtained from all participants.

Sample Selection

All participants were recruited at the University of São Paulo, Brazil, from January to July 2016. Patients over 18 years old, with single tooth loss sites, a minimum height and thickness of 8.5mmx5mm, respectively, without any systemic conditions and local changes were included in the sample. In addition, alcoholic, smokers, bruxers, grafted areas and insertion torque lower than 32 N.cm. were excluded.

Surgery details

An internal conical connection implant (Unitite, S.I.N., São Paulo, São Paulo, Brazil) was placed in the posterior region (maxilla or mandible), for each participant. For implant planning and bone volume analysis, Cone-beam Computed Tomography (CBCT) scans were performed for all patients. The selection of implants length and diameter was conducted through virtual planning (Invivo5 3D, Kavo, Biberach, Germany). Implants with diameters of 3.5, 4.3 or 5.0 mm and lengths of 8.5, 10, 11.5 or 13 mm were used, according to the bone availability.

All implants were installed by the same professional (P.H.M.A), experienced in the surgical field, under local anesthesia with an anesthetic solution based on 2% mepivacaine hydrochloride with epinephrine at 1:100000 (Mepiadre 2%, Nova DFL, Rio de Janeiro, RJ, Brazil). A total flap incision with tissue dissection was performed. For the osteotomy, the sequence of drills suggested by the manufacturer was followed, aided by a surgical guide. All implants were installed 1.0mm to 2.0mm below bone level, with a minimum insertion torque of 32 N.cm, being indicated for immediate loading [19–22]. The flap was sutured with Vicryl 5.0 suture thread (Vicryl, Ethicon J&J International, St-Stevens-Woluwe, Belgium). Impressions with putty and light body polyvinylsiloxane were made (Express, 3M Oral Care, St. Paul, MN, USA) and sent to the dental laboratory. Healing abutments were installed in the meantime. As postoperative medication, antibiotics (Amoxicillin 500mg) were prescribed for seven days and non-steroidal anti-inflammatory drugs (NSAIDs) (Ibuprofen 600mg) for five days. Prosthetic

loading was performed 4 days after implant placement, where crowns were occlusally adjusted to maintain contacts in maximal intercuspal position.

Outcomes

Neuropathic and nociceptive pain screening

The DN4 questionnaire (Douleur Neuropathique en 4 Questions) was used to screen and differentiate neuropathic pain from nociceptive pain after implant placement [23]. This questionnaire consists of 4 groups of questions including evaluation of seven sensory signals and three signals related to a sensory examination. The questionnaire validated in Portuguese [24] was applied to the patients. On the questionnaire, a score of 1 is given to each positive item and a score of 0 to each negative item. The total score is calculated as the sum of the 10 items and the cut-off value for the diagnosis of neuropathic pain is a total score of 4/10.

Quantitative Sensory Testing (QST)

Cold detection threshold (CDT), cold pain threshold (CPT), warm detection threshold (WDT) and heat pain thresholds (HPT), from the QST (Quantitative Sensory Testing) battery according to German protocol of the German Research Network on Neuropathic Pain (DFNS) [25], were assessed at the extraoral (infraorbital skin and mental skin) and intraoral region (buccal gingiva adjacent to the implant), ipsilateral and contralateral to the implant site, being first applied in the contralateral region. The tests were performed using the Thermosensory Analyzer (TSA-II) (MEDOC, Israel), with a contact area of 0.81 cm2 and 2.56 cm2 (intraoral and extraoral, respectively), and good reproducibility at the trigeminal area [26,27]. The average threshold temperature of three consecutive trials was calculated to determine each threshold considering the following settings: baseline temperature of 32°C (extraoral) and 37°C (intraoral), 1°C/s stimulus ramp, and cut-off temperatures of 0°C and 50°C [25,27].

Qualitative Sensory Testing (QualST)

Touch, cold and prick stimuli sensibility were evaluated in the implant site adjacent mucosa and correspondent skin dermatome. Stimuli were applied to the contralateral side first, followed by the ipsilateral side. This protocol was performed according to Baad-Hansen et al. (2013) [28]. The touch stimulus was applied with a cotton swab in a single stroke over 1 to 2 cm of the area. The cold stimulus was applied with a stainless-steel dental spatula (kept cool in ice water, ~0˚c) for 1 to 2 seconds. The pinprick stimulus was applied with a dental examination probe with moderate force (a force that was painful but would not penetrate the gingival

surface) on the gingiva for ~1 second. Patients were asked to report hypersensitivity, hyposensitivity, or normal sensitivity on the implant site compared with the contralateral site.

Oral Health Related Quality of Life (OHRQoL)

For the evaluation of oral health related quality of life (OHRQoL), the Oral Health Impact Profile-14 (OHIP-14) was applied in the validated Portuguese version [29]. The OHIP-14 aims to assess the social impact of problems that can compromise oral health, through 14 questions, where the answers range from 0 (never) to 4 (always). In this case, the higher the score, the lower the OHRQoL [29,30].

Study design

This prospective study was conducted at 8 different timepoints: baseline; 3 days; 7 days; 15 days; 1 month; 3 months; 6 months; and 1 year. The DN4 questionnaire (Douleur Neuropathique en 4 Questions), the QST (Quantitavive Sensory Testing) and the QualST (Qualitative Sensory Testing) were applied and performed at all times. The Oral Health Impact Profile-14 (OHIP-14) was applied at baseline prior to the surgery, and at 6 months after surgery (Figure 1).

Statistical Analysis

Statistical analyses were conducted using the IBM SPSS Statistics version 20 (SPSS Inc., USA), with a significance level of 5%. After Shapiro-Wilk test, a non-normal distribution was detected only on QST variables, which the logarithmic transformation was performed. To analyze the DN4 data, a descriptive analysis was performed. The Repeated Measures ANOVA test was used to compare the overall OHIP-14 score before and 6 months after implant placement and possible differences between placement sites. The Two-Way Repeated Measures ANOVA test was used to compare the QST values over time (8-level factor) and implant placement sites (2 level-factor), and when necessary, the Tukey post-hoc test was performed to evaluate any between-subject factor difference. Finally, in relation to QualST, the Cochran Q test was applied to assess the frequency of sensory abnormalities over time.

RESULTS

Forty subjects were initially selected according to the inclusion and exclusion criteria. The mean age of the participants was 41.45 ± 10.12. The sample was comprised of 31 (77.5%) women and 9 (22.5%) men. Participants were followed up for a period of 1 year. During this

time, 7 patients were excluded from the sample (2 abutment fractures and 5 implant losses). There were no dropouts and all patients attended follow-up visits (Figure 2).

The presence of pain, whether nociceptive or neuropathic, occurred only in the first month of evaluation at 3 days: 24 (72.7%), at 7 days: 16 (48.4%), at 15 days: 6 (18.1%); and at 1 month: 3 (9.09%) (Figure 3A). In addition, only three patients at 3 days and 7 days and one at 15 days had features suggestive of neuropathic pain. From 3 months onwards, there were no reports of any type of pain (Figure 3B). When analyzed by implant site, in the maxilla 12 (85.71%) and in the mandible 14 (73.68%) individuals presented some type of pain, being suggestive of neuropathic pain 3 (21.42%) in the maxilla found until 15 days and 3 (15.78%) in the mandible, being over until 7 days (Figure 3C).

Regarding the QST, at the ipsilateral site, in the extraoral region, 17 individuals (51.51%) on CDT, 16 (48.48%) on WDT, 12 (36.36%) on CPT and 14 (42.42%) on HPT showed gain of function over 1 year of follow-up. On the intraoral region, 9 (37.50%) on CDT, 6 (25.0%) on WDT, 10 (41.60%) on CPT and 7 (29.16%) on HPT presented gain of function as well. It is seen in Tables 1 and 2, the QST mean values for all thermal parameters (CDT, WDT, CPT and HPT) ipsilateral and contralateral, respectively. At the operated side, CPT decreased over time, in the extraoral region, being more evident after 1 month compared to the first postoperative moment ($p=0.030$), but without difference between implant sites (maxilla or mandible) ($p=0.684$). In the intraoral region, the cold parameters, CDT ($p<0.001$) and CPT ($p<0.001$) thresholds decreased overtime, when comparing the first postoperative moment (3 days) to the subsequently moments (7 days to 1 year), without difference between implant sites (maxilla or mandible) (CDT, $p=0.975$ and CPT, $p=0.178$). In the contralateral region, CDT ($p=0.024$) and WDT ($p=0.026$) maxilla extraoral thresholds decreased, when comparing the initial postoperative moments (7 days) to later postoperative moments (3 and 6 months). Overall extraoral CPT thresholds also decreased overtime when compared to baseline ($p<0.001$). In the intraoral site, a similar pattern was observed: CDT ($p=0.031$) and WDT ($p=0.047$) in the maxilla decreased overtime and CPT decreased overtime ($p<0.001$).

In relation to QualST analysis, Table 3 evidenced sensory alterations in the extraoral region only for pinprick stimuli, at the initial postoperative moment, when compared to baseline ($p=0.032$). In the intraoral region, statistically significant alterations were found for all stimuli, mainly in the mandible (V3), at the initial postoperative moments as well, normalizing over time (Table 4).

Table 5 shows a reduction of OHIP-14 scores 6 months after implant-supported rehabilitation, with a statistically significant difference in the overall sample ($p<0.001$). When comparing the implant sites, both patients rehabilitated in maxilla and mandible also had a significant reduction after 6 months ($p<0.001$), but with no statistical difference when comparing both arches ($p=0.687$).

DISCUSSION

The current assessment of neuropathic pain screening and thermal sensory alterations, as well as the OHRQoL, in patients receiving immediately loaded implant-supported single crowns in the posterior area showed that: 1) Reports suggestive of neuropathic pain were scarce, and did not persist beyond the first month after surgery; 2) Thermal pain thresholds decreased over time, without differences between implants placed in the maxilla or mandible; 3) QualST showed predominantly intraoral alterations, with an increase in the frequency evident in the early postoperative periods, mainly at the mandible; and 4) OHRQoL significantly increased after implant rehabilitation;

DN4 and postoperative pain screening

This study is the first in the literature to assess the presence of neuropathic pain after implant-supported rehabilitation through DN4. A total of 24 (72.7%) individuals presented some type of pain, which lasted only until the first month after rehabilitation. The reports suggestive of neuropathic pain were only manifested in 3 (9.0%) individuals, being suppressed until 15 days after surgery. These data show a very low frequency of possible neuropathic pain, with the majority considered as nociceptive pain, which did not exceed 1 month as similarly reported before [31]. Additionally, according to a recent study [32], of these 24 individuals that presented any type of pain, 10 (30.3%) present characteristics of acute neuropathic pain according to its criteria, with sensory disturbances perceived over time. Even with a higher frequency reported in the literature of neuropathic pain associated with inferior alveolar nerve injuries [10,11,13,14,16], the frequencies in both maxilla and mandible were similar in this study. The inclusion of individuals who had a sufficient height and bone thickness, the single implant rehabilitation, all planned by CBCT scans and a well-established postoperative medication protocol, along with surgeries carried out by an experienced professional, likely decreased the chances of iatrogenic nerve injuries [14]. It is important to emphasize that other conditions such as age, sex, operative techniques and psychological status of each patient can directly influence pain frequency [14,16]. Those variables were not evaluated in the present study.

Thermal QST

Only thermal QST parameters were used in this study, due to its capacity to provide important information of nerve injures itself [33]. CPT alterations were the most commonly found after implant-supported rehabilitation at the operated side. CPT decreased overtime in both extraoral and intraoral sites, suggesting a slight thermal pain gain of function. This alteration became more evident in later postoperative period, after 1 month, with no differences between maxilla (V2) and mandible (V3). At the intraoral site, CDT have also shown a decreased threshold overtime (7 days to 1 year), when compared to the baseline. These findings indicate that neuroplastic changes that affect both Aδ and C fibers up to a period of one year [12,33,34] may be manifested in subtle threshold changes. These gain of function to cold was seen on the contralateral side of implant placement as well. These alterations on the non-operated side may infer a process of central sensitization, but this association is still not clear in the literature and may just be a variation of the sample [35,36]. All alterations found when evaluating the largest range, in absolute degrees (3.9ºC – CPT) were minimal. This information, added to the fact that all patients presented painful symptoms only within the first month after surgery, shows that these data may not contain relevant clinical information. On the other hand, studies in the literature found a greater presence of hypoalgesia and hypoesthesia to thermal stimuli in the postoperative period of maxillofacial surgeries [36–38], and implants only [39]. Some studies even found no differences in sensory alterations of implant surgery [40–42]. Furthermore, the studies found in the literature present several different surgical techniques and postoperative controls, which may explain the divergence in the results found [14,37,38,40–42].

QualST

QualST was applied in the extraoral and intraoral regions ipsilateral to the implant, using the contralateral side as a comparison. A higher frequency of sensory alterations (either hypersensitivity or hyposensitivity) related to pinprick was observed in the extraoral region at the first moment of postoperative evaluation (T1 – 3 days), normalizing until T2 (9 days). In the intraoral region, there was sensory alteration in the first postoperative moments, with a statistically significant difference ($p<0.001$) for all stimuli (pinprick, cold and touch), evidencing touch allodynia, hyper- and hypoalgesia to cold and prick. All alterations disappeared after one month.

When analyzed by implant site, the mandible (V3) in the intraoral region showed statistically significant differences for all stimuli, following the overall pattern. Although

quantitative and qualitative sensory tests have a good agreement, QualST has low sensitivity, which increases its false positives [28,43]. This may explain the higher frequency of alterations when compared to the QST. In addition, the presence of few neuropathic pain reports and mainly gain of function, which is more commonly reverted overtime due to its association to lighter damage to the nerve [16], indicates that the only minor somatosensory alterations take place following single-unit implant placement.

Oral health-related quality of life (OHRQoL)

Some authors have evaluated the patient's OHRQoL after single-unit [2,3,7] and multiple unit [1,6,44–46] implant-supported rehabilitations through several instruments, such as OHIP-14 [2,3,7,44,45], OHIP-20 and 21 [1,6] and General Oral Health Assessment (GOHAI) [46]. Most reported results corroborate our findings ($p<0.001$). The studies reported an improvement in the perception of OHRQoL of these patients already two weeks after rehabilitation [6,44], in the first month [3], 3 months [5], and until 5 years after the rehabilitation [2]. The present study applied the OHIP-14 immediately before surgery and after 6 months of rehabilitation, obtaining results similar to the aforementioned. When comparing the implant placement site, no differences between rehabilitations in the maxilla or mandible have been previously reported [7,44,46], as observed herein ($p=0.687$).

This study was conducted with a relatively small sample and did not evaluate other QST test (such as mechanical pain and detection, mechanical allodynia, wind-up ratio, vibration detection and pressure pain threshold). Also, some psychosocial variables (such as anxiety, depression, catastrophizing pain thoughts, sleep impairment and surgical fear) that are known to be associated with higher frequencies of neurosensory disturbances and persistent pain after surgical procedures [36] were not included. Furthermore, studies evaluating more complex implant reconstructions rather than single-unit implant rehabilitations, should be performed to analyze these variables.

CONCLUSION

Minor somatosensory abnormalities are commonly found in patients that undergo implant surgery, even when a single-tooth rehabilitation is performed. Overall, these alterations such as thermal and mechanical gain of function are not clinically relevant, since the oral health quality of life increases after implant rehabilitation, and signs and symptoms suggesting either post-operative or neuropathic chronic pain are not observed. This indicates that implant-

supported rehabilitation with immediate loading with final prostheses in cases of posterior single-tooth loss presents with a low risk of persistent somatosensory alterations and chronic.

REFERENCES

1. Nickenig HJ, Wichmann M, Terheyden H, Kreppel M. Oral health-related quality of life and implant therapy: A prospective multicenter study of preoperative, intermediate, and posttreatment assessment. J Cranio-Maxillofacial Surg. 2016;44(6):753-757. doi:10.1016/j.jcms.2016.02.014

2. Raes S, Raes F, Cooper L, et al. Oral health-related quality of life changes after placement of immediately loaded single implants in healed alveolar ridges or extraction sockets: a 5-year prospective follow-up study. Clin Oral Implants Res. 2017;28(6):662-667. doi:10.1111/clr.12858

3. Raes F, Cooper LF, Tarrida LG, Vandromme H, De Bruyn H. A case-control study assessing oral-health-related quality of life after immediately loaded single implants in healed alveolar ridges or extraction sockets. Clin Oral Implants Res. 2012;23(5):602-608. doi:10.1111/j.1600-0501.2011.02178.x

4. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NHJ. Tooth loss and oral health-related quality of life: A systematic review and meta-analysis. Health Qual Life Outcomes. 2010;8(126):1-11. doi:10.1186/1477-7525-8-126

5. Farzadmoghadam M, Mohammadi TM, Goudarzi R, Mohammadi M, Hasheminejad N. Is there a relationship between general and oral health-related quality of life in partially edentulous patients before and after implant treatment? A quasi-experimental study. Clin Oral Implants Res. 2020;31(6):557-564. doi:10.1111/clr.13593

6. Menassa M, de Grandmont P, Audy N, Durand R, Rompré P, Emami E. Patients' expectations, satisfaction, and quality of life with immediate loading protocol. Clin Oral Implants Res. 2016;27(1):83-89. doi:10.1111/clr.12515

7. Hattingh A, De Bruyn H, Vandeweghe S. A retrospective study on ultra-wide diameter dental implants for immediate molar replacement. Clin Implant Dent Relat Res. 2019;21(5):879-887. doi:10.1111/cid.12759

8. Van Lierde K, Browaeys H, Corthals P, Mussche P, Van Kerkhoven E, De Bruyn H. Comparison of speech intelligibility, articulation and oromyofunctional behaviour in subjects

with single-tooth implants, fixed implant prosthetics or conventional removable prostheses. J Oral Rehabil. 2012;39(4):285-293. doi:10.1111/j.1365-2842.2011.02282.x

9. Raja SN, Carr DB, Cohen M, et al. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. Pain. 2020;161(9):1976-1982. doi:10.1097/j.pain.0000000000001939

10. Al-Sabbagh M, Okeson JP, Bertoli E, Medynski DC, Khalaf MW. Persistent pain and neurosensory disturbance after dental implant surgery: Prevention and treatment. Dent Clin North Am. 2015;59(1):143-156. doi:10.1016/j.cden.2014.08.005

11. Selvido DI, Bhattarai BP, Rokaya D, Niyomtham N, Wongsirichat N. Pain in Oral and Maxillofacial Surgery and Implant Dentistry: Types and Management. Eur J Dent. 2021;15(3):588-598. doi:10.1055/s-0041-1725212

12. Costigan M, Scholz J, Woolf CJ. Neuropathic pain: A maladaptive response of the nervous system to damage. Annu Rev Neurosci. 2009;32:1-32. doi:10.1146/annurev.neuro.051508.135531

13. Conti PCR, Bonjardim LR, Stuginski-Barbosa J, Costa YM, Svensson P. Pain complications of oral implants: Is that an issue? J Oral Rehabil. 2021;48(2):195-206. doi:10.1111/joor.13112

14. Vázquez-Delgado E, Viaplana-Gutiérrez M, Figueiredo R, Renton T, Gay-Escoda C, Valmaseda-Castellón E. Prevalence of neuropathic pain and sensory alterations after dental implant placement in a university-based oral surgery department: A retrospective cohort study. Gerodontology. 2018;35(2):117-122. doi:10.1111/ger.12326

15. Hillerup S. Iatrogenic injury to oral branches of the trigeminal nerve: Records of 449 cases. Clin Oral Investig. 2007;11(2):133-142. doi:10.1007/s00784-006-0089-5

16. Al-Sabbagh M, Okeson JP, Khalaf MW, Bhavsar I. Persistent pain and neurosensory disturbance after dental implant surgery: Pathophysiology, etiology, and diagnosis. Dent Clin North Am. 2015;59(1):131-142. doi:10.1016/j.cden.2014.08.004

17. Renton T, Dawood A, Shah A, Searson L, Yilmaz Z. Post-implant neuropathy of the trigeminal nerve. A case series. Br Dent J. 2012;212(11):1-6. doi:10.1038/sj.bdj.2012.497

18. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The strengthening the reporting of observational studies in epidemiology (STROBE) statement:

Guidelines for reporting observational studies. Int J Surg. 2014;12(12):1495-1499. doi:10.1016/j.ijsu.2014.07.013

19. Ottoni JMP, Oliveira ZFL, Mansini R, Cabral AM. Correlation between placement torque and survival of single-tooth implants. Int J Oral Maxillofac Implants. 2005;20(5):769-776. http://www.ncbi.nlm.nih.gov/pubmed/16274152

20. Del Fabbro M, Testori T, Francetti L, Taschieri S, Weinstein R. Systematic review of survival rates for immediately loaded dental implants. Int J Periodontics Restorative Dent. 2006;26(3):249-263. http://www.ncbi.nlm.nih.gov/pubmed/16836167

21. Sennerby L, Rocci A, Becker W, Jonsson L, Johansson LÅ, Albrektsson T. Short-term clinical results of Nobel Direct implants: A retrospective multicentre analysis. Clin Oral Implants Res. 2008;19(3):219-226. doi:10.1111/j.1600-0501.2007.01410.x

22. Esposito M, Mg G, Maghaireh H, et al. Interventions for replacing missing teeth: different times for loading dental implants. Cochrane Database Syst Rev. 2013;(3). doi:10.1002/14651858.CD003878.pub5.www.cochranelibrary.com

23. Bouhassira D, Attal N, Alchaar H, et al. Comparison of pain syndromes associated with nervous or somatic lesions and development of a new neuropathic pain diagnostic questionnaire (DN4). Pain. 2005;114(1-2):29-36. doi:10.1016/j.pain.2004.12.010

24. Santos JG, Brito JO, de Andrade DC, et al. Translation to Portuguese and Validation of the Douleur Neuropathique 4 Questionnaire. J Pain. 2010;11(5):484-490. doi:10.1016/j.jpain.2009.09.014

25. Rolke R, Baron R, Maier C, et al. Quantitative sensory testing in the German Research Network on Neuropathic Pain (DFNS): Standardized protocol and reference values. Pain. 2006;123(3):231-243. doi:10.1016/j.pain.2006.01.041

26. Costa YM, de Araújo-Júnior ENS, Fiedler LS, et al. Reproducibility of quantitative sensory testing applied to musculoskeletal orofacial region: Site and sex differences. Eur J Pain (United Kingdom). 2019;23(1):81-90. doi:10.1002/ejp.1287

27. Pigg M, Baad-Hansen L, Svensson P, Drangsholt M, List T. Reliability of intraoral quantitative sensory testing (QST). Pain. 2010;148(2):220-226. doi:10.1016/j.pain.2009.10.024

28. Baad-Hansen L, Pigg M, Ivanovic SE, et al. Chairside Intraoral Qualitative Somatosensory Testing: Reliability and Comparison Between Patients with Atypical

Odontalgia and Healthy Controls. J Orofac Pain. 2013;27(2):165-170. doi:10.11607/jop.1062

29. De Oliveira BH, Nadanovsky P. Psychometric properties of the Brazilian version of the Oral Health Impact Profile - Short form. Community Dent Oral Epidemiol. 2005;33(4):307-314. doi:10.1111/j.1600-0528.2005.00225.x

30. Slade GD. Derivation and validation of a short-form oral health impact profile. Community Dent Oral Epidemiol. 1997;25(4):284-290. doi:10.1111/j.1600-0528.1997.tb00941.x

31. Renton T, Yilmaz Z. Profiling of patients presenting with posttraumatic neuropathy of the trigeminal nerve. J Orofac Pain. 2011;25(4):333-344. http://www.ncbi.nlm.nih.gov/pubmed/22247929

32. Doshi TL, Dworkin RH, Polomano RC, et al. AAAPT Diagnostic Criteria for Acute Neuropathic Pain. Pain Med. 2021;22(3):616-636. doi:10.1093/pm/pnaa407

33. Kim H-K, Kim K-S, Kim M-E. Thermal Perception as a Key Factor for Assessing Effects of Trigeminal Nerve Injury. J Oral Facial Pain Headache. 2017;31(2):129-138. doi:10.11607/ofph.1732

34. Kim H-K, Kim K-S, Kim M-E. Influence of Test Site and Baseline Temperature on Orofacial Thermal Thresholds. J Orofac Pain. 2013;27(3):263-270. doi:10.11607/jop.1030

35. Van der Cruyssen F, Van Tieghem L, Croonenborghs TM, et al. Orofacial quantitative sensory testing: Current evidence and future perspectives. Eur J Pain (United Kingdom). 2020;24(8):1425-1439. doi:10.1002/ejp.1611

36. Pillai RS, Pigg M, List T, et al. Assessment of Somatosensory and Psychosocial Function of Patients with Trigeminal Nerve Damage. Clin J Pain. 2020;36(5):321-335. doi:10.1097/AJP.0000000000000806

37. Said-Yekta S, Smeets R, Esteves-Oliveira M, Stein JM, Riediger D, Lampert F. Verification of nerve integrity after surgical intervention using quantitative sensory testing. J Oral Maxillofac Surg. 2012;70(2):263-271. doi:10.1016/j.joms.2011.03.065

38. Said Yekta S, Koch F, Grosjean MB, et al. Analysis of trigeminal nerve disorders after oral and maxillofacial intervention. Head Face Med. 2010;6(1):24. doi:10.1186/1746-160X-6-24

39. Kim H-K, Kim M-E. Quantitative and qualitative sensory testing results are associated with numbness rather than neuropathic pain in patients with post-implant trigeminal neuropathy: a cross-sectional pilot study. Somatosens Mot Res. 2019;36(3):202-211. doi:10.1080/08990220.2019.1645000

40. Hartmann A, Welte-Jzyk C, Seiler M, Daubländer M. Neurophysiological changes associated with implant placement. Clin Oral Implants Res. 2017;28(5):576-581. doi:10.1111/clr.12837

41. Hartmann A, Welte-Jzyk C, Seiler M, Daubländer M. Neurophysiological changes associated with implant-associated augmentation procedures in the lower jaw. Clin Implant Dent Relat Res. 2017;19(4):725-732. http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L622399024%0Ahttp://dx.doi.org/10.1111/cid.12500

42. Porporatti A, Bonjardim L, Stuginski-Barbosa J, Bonfante E, Costa Y, Rodrigues Conti P. Pain from Dental Implant Placement, Inflammatory Pulpitis Pain, and Neuropathic Pain Present Different Somatosensory Profiles. J Oral Facial Pain Headache. 2017;31(1):19-29. doi:10.11607/ofph.1680

43. Agbaje J, De Laat A, Constantinus P, Svensson P, Baad-Hansen L. Agreement between quantitative and qualitative sensory testing of changes in oro-facial somatosensory sensitivity. J Oral Rehabil. 2017;44(1):30-42. doi:10.1111/joor.12455

44. van Eekeren PJA, Aartman IHA, Tahmaseb A, Wismeijer D. The effect of implant placement in patients with either Kennedy class II and III on oral health-related quality of life: A prospective clinical trial. J Oral Rehabil. 2016;43(4):291-296. doi:10.1111/joor.12370

45. Paul S A, Simon S S, Kumar S, Chacko RK. Assessing perceptions of oral health related quality of life in dental implant patients. Experience of a tertiary care center in India. J Oral Biol Craniofacial Res. 2018;8(2):74-77. doi:10.1016/j.jobcr.2018.05.003

46. Nagahisa K, Arai K, Baba S. Study on Oral Health–Related Quality of Life in Patients After Dental Implant Treatment with Patient-Reported Outcome. Int J Oral Maxillofac Implants. 2018;33(5):1141-1148. doi:10.11607/jomi.6496

FIGURE LEGENDS

Figure 1. Outcomes evaluation timeline.

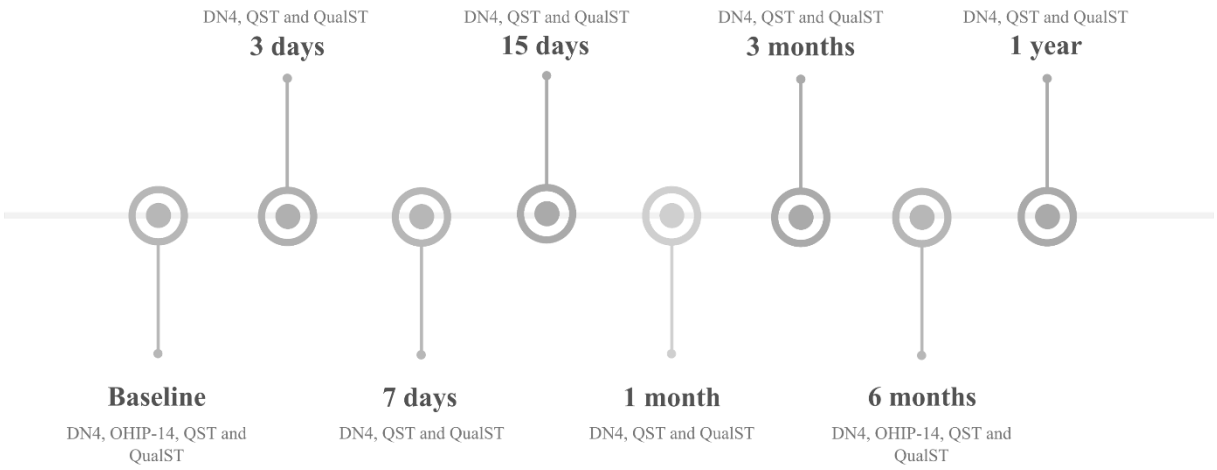


Figure 2. Sample eligibility flowchart.

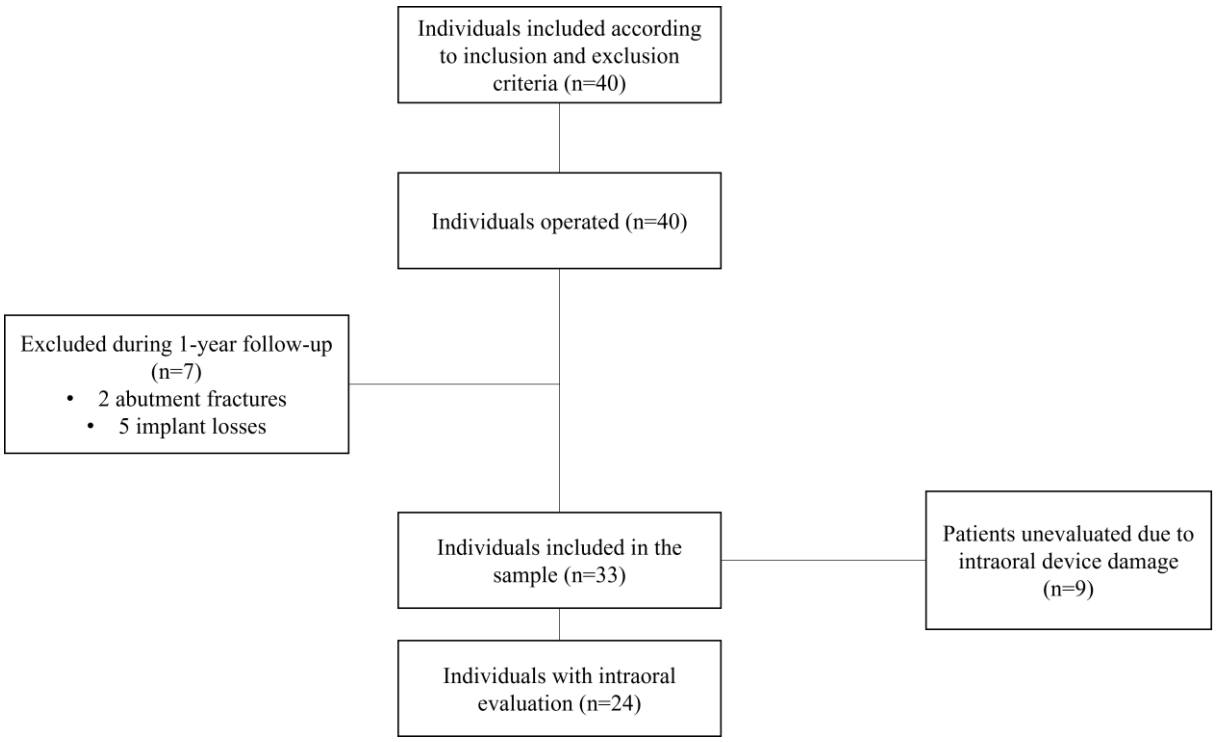
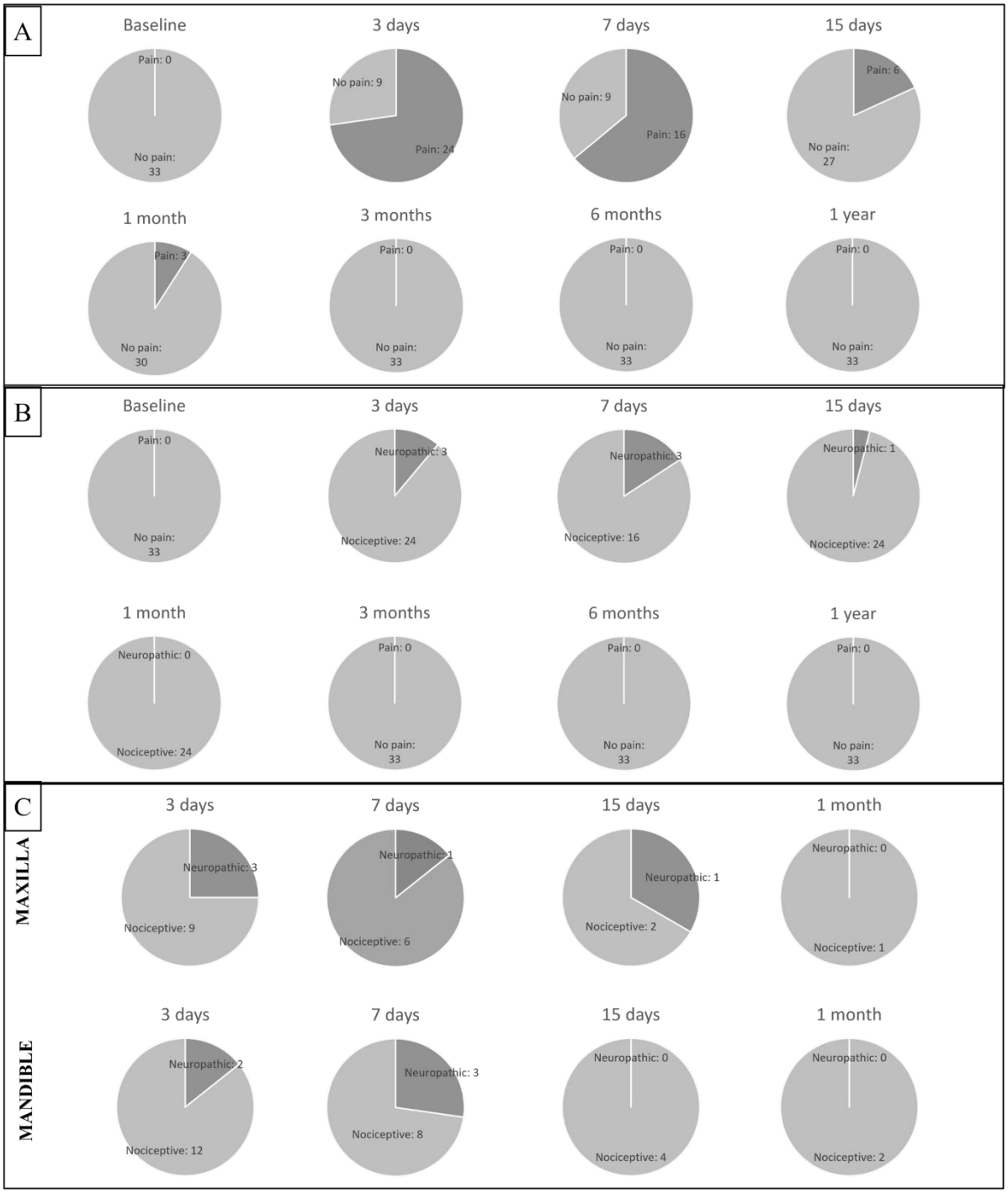


Figure 3. Frequency of patients with pain at the 8 times evaluated: T0, baseline; T1, 3 days; T2, 7 days; T3, 15 days; T4, 1 month; T5, 3 months; T6, 6 months; and T7, 1 year. **A.** Frequency of patients with or without pain over time. **B.** Frequency of patients with neuropathic and nociceptive pain over time. **C.** Frequency of pain at the different implant sites, when any type of pain was manifested (T1, T2, T3 and T4).



TABLES

Table 1. Ipsilateral thermal QST mean (standard deviation).

			Baseline	3 days	7 days	15 days	1 month	3 months	6 months	12 months	p-value
Extraoral	**CDT**	**Maxilla (n=14)**	29.1 (1.6)	28.6 (2.1)	27.9 (2.1)	28.2 (2.3)	28.1 (3.3)	28.2 (2.6)	28.6 (2.5)	28.6 (2.2)	[1]p=0.115

		Mandible (n=19)	28.7 (2.3)	28.8 (1.4)	28.5 (1.5)	28.6 (1.6)	28.4 (2.2)	29.1 (1.6)	30.0 (3.5)	28.9 (1.5)	[1]p=0.290
		Overall (n=33)	28.9 (1.1)	28.7 (1.2)	28.3 (2.1)	28.4 (1.5)	28.3 (1.6)	28.7 (2.8)	29.5 (7.1)	28.8 (1.8)	[1]p=0.155
									Maxilla x Mandible		[1]p=0.930
	WDT	**Maxilla (n=14)**	35.5 (1.3)	34.8 (1.1)	35.4 (1.6)	36.0 (1.5)	35.4 (1.6)	35.5 (0.9)	36.1 (2.3)	34.0 (3.7)	[1]p=0.325
		Mandible (n=19)	38.3 (1.9)	38.4 (1.4)	38.0 (1.6)	38.1 (1.6)	38.1 (2.2)	39.3 (3.1)	39.2 (1.9)	39.0 (1.9)	[1]p=0.056
		Overall (n=33)	35.6 (1.7)	25.5 (1.4)	25.4 (1.5)	35.7 (1.5)	35.5 (2.0)	36.2 (2.6)	36.4 (2.0)	35.5 (2.9)	[1]p=0.309
									Maxilla x Mandible		[1]p=0.106
		Maxilla (n=14)	23.3 (7.9)	25.3 (14.3)	24.7 (7.4)	25.2 (13.5)	24.9 (9.97)	26.5 (8.87)	26.2 (8.91)	27.1 (9.53)	[1]p<0.001*
	CPT	**Mandible (n=19)**	22.1 (13.9)	21.4 (15.1)	23.5 (9.1)	24.3 (13.5)	24.1 (9.9)	24.8 (8.8)	23.9 (8.9)	25.6 (9.5)	[1]p=0.101
		Overall (n=33)	18.7 (8.2)	18.1[a] (9.1)	19.7 (7.5)	18.7[b] (8.3)	21.6[b] (6.2)	21.4 (6.7)	21.6 (6.4)	21.6[ab] (6.5)	[1]p=0.030*
									Maxilla x Mandible		[1]p=0.684
		Maxilla (n=14)	43.4 (4.1)	42.8 (5.8)	41.5 (3.8)	43.1 (3.7)	40.2 (3.9)	39.8 (3.2)	39.8 (1.9)	40.8 (1.8)	[1]p=0.034*
	HPT	**Mandible (n=19)**	42.0 (4.9)	43.2 (5.1)	41.6 (4.4)	43.1 (5.7)	41.5 (4.3)	41.9 (4.5)	42.1 (4.3)	42.5 (4.7)	[1]p=0.334
		Overall (n=33)	42.5 (4.5)	43.0 (5.2)	41.5 (4.0)	43.1 (4.8)	41.0 (4.0)	41.1 (4.0)	41.2 (3.6)	41.9 (3.8)	[1]p=0.110
									Maxilla x Mandible		[1]p=0.202
		Maxilla (n=9)	20.1 (7.7)	20.4[a] (3.9)	20.1[a] (3.8)	23.2[a] (4.2)	23.8[a] (4.4)	22.8[a] (4.0)	22.4[a] (4.1)	22.5[a] (4.0)	[1]p<0,001*
	CDT	**Mandible (n=15)**	22.4 (8.0)	19.9[a] (7.8)	20.8 (7.9)	23.7 (5.7)	24.8 (6.7)	23.5 (5.9)	23.6[a] (5.8)	23.7 (5.7)	[1]p=0,003*
		Overall (n=24)	19.9 (7.8)	18.9[a] (6.6)	20.5 (6.6)	22.0[a] (5.1)	22.5[a] (5.9)	22.7[a] (5.2)	22.8[a] (5.2)	22.7[a] (5.0)	[1]p<0,001*
Intraoral									**Maxilla x Mandible**		[1]p=0.975
		Maxilla (n=9)	44.8 (5.1)	44.5 (4.9)	43.1 (5.7)	42.8 (4.8)	44.1 (5.7)	43.5 (5.6)	43.8 (5.5)	43.7 (5.3)	[1]p=0.355
	WDT	**Mandible (n=15)**	42.9 (5.2)	44.4 (5.2)	41.8 (5.7)	42.6 (5.2)	42.8 (6.0)	41.5 (5.9)	44.3 (5.9)	41.8 (5.4)	[1]p=0.861
		Overall (n=24)	44.8 (5.1)	44.5 (4.9)	43.1 (5.7)	42.8 (4.8)	44.1 (5.7)	43.5 (5.6)	43.8 (5.5)	43.7 (5.3)	[1]p=0.355
									Maxilla x Mandible		[1]p=0.645

CPT	**Maxilla (n=9)**	10.4 (7.0)	12.4 (8.2)	14.1 (6.0)	13.6 (7.9)	14.3 (5.7)	14.9 (5.6)	15.1 (5.6)	15.1 (5.4)	[1]p=0.003*
	Mandible (n=15)	13.3 (8.5)	13.0[a] (7.1)	13.4[b] (7.2)	14.7 (7.0)	16.4[abc] (6.4)	17.5[abc] (6.3)	17.6[abc] (6.6)	17.0[ab] (5.8)	[1]p<0,001*
	Overall (n=24)	12.2 (8.0)	12.8[a] (7.4)	13.7[b] (6.7)	14.3 (7.2)	15.6[c] (6.1)	16.5[ac] (6.1)	16.7[abc] (6.3)	16.3[b] (5.7)	[1]p<0,001*
								Maxilla x Mandible		[1]p=0.168
HPT	**Maxilla (n=9)**	48.7 (3.3)	49.3 (2.4)	48.1 (5.3)	49.3 (2.1)	49.3 (1.7)	48.7 (1.8)	49.1 (1.6)	49.0 (2.0)	[1]p=0.906
	Mandible (n=15)	48.3 (4.0)	47.6 (3.4)	47.1 (4.1)	47.0 (4.9)	48.0 (3.4)	47.6 (3.1)	47.9 (3.6)	47.9 (2.7)	[1]p=0.821
	Overall (n=24)	48.5 (3.7)	48.3 (3.1)	47.5 (4.5)	47.9 (4.2)	48.5 (2.9)	48.0 (2.8)	48.3 (3.1)	48.3 (2.5)	[1]p=0.978
								Maxilla x Mandible		[1]p=0.535

[1]Two-Way Repeated Measures ANOVA; [abc]Tukey post-hoc test

Table 2. Contralateral thermal QST mean (standard deviation).

			Baseline	**3 days**	**7 days**	**15 days**	**1 month**	**3 months**	**6 months**	**12 months**	**p-value**
Extraoral	**CDT**	**Maxilla (n=14)**	28.8 (1.5)	28.7 (1.3)	29.6[a] (1.2)	29.1 (1.2)	29.0 (1.5)	28.4[a] (1.0)	28.7[a] (1.2)	28.4 (1.7)	[1]p=0.024*
		Mandible (n=19)	28.7 (2.2)	29.2 (1.1)	28.5 (2.0)	28.7 (1.2)	27.9 (2.7)	28.5 (1.6)	28.6 (1.5)	28.4 (1.4)	[1]p=0.291
		Overall (n=33)	28.7 (2.2)	28.8 (1.6)	28.4 (1.7)	28.5 (1.7)	28.5 (2.3)	28.9 (1.8)	29.4 (2.6)	28.8 (1.6)	[1]p=0.257
									Maxilla x Mandible		[1]p=0.577
	WDT	**Maxilla (n=14)**	35.6 (1.5)	36.2 (1.3)	35.5 (1.8)	35.5 (1.0)	35.9 (2.6)	35.9 (2.0)	36.4 (3.2)	36.9 (3.0)	[1]p=0.026*
		Mandible (n=19)	34.9 (1.3)	35.6 (2.6)	36.0 (3.1)	35.1 (0.9)	35.4 (1.5)	35.2 (1.1)	35.3 (1.4)	35.4 (1.1)	[1]p=0.460
		Overall (n=33)	35.2 (1.4)	35.9 (2.1)	35.8 (2.6)	35.2 (1.0)	35.6 (2.0)	35.5 (1.6)	35.8 (2.3)	36.0 (2.3)	[1]p=0.160
									Maxilla x Mandible		[1]p=0.264
	CPT	**Maxilla (n=14)**	21.8 (8.1)	22.7 (8.0)	21.6 (7.5)	22.2 (7.1)	23.6 (7.0)	23.9 (6.2)	23.9 (6.0)	24.1 (5.6)	[1]p=0.007*
		Mandible (n=19)	17.8 (9.1)	17.0[a] (8.7)	19.4[b] (7.7)	20.0 (6.7)	22.8 (5.2)	23.0 (4.9)	23.1[a] (5.3)	23.4[ab] (5.6)	[1]p<0.001*
		Overall (n=33)	20.1[a] (8.6)	20.3[b] (8.6)	20.7[c] (7.5)	21.3[d] (6.9)	23.3[abc] (6.2)	23.5[abc] (5.6)	23.6[abc] (5.7)	23.8[abcd] (5.5)	[1]p<0.001*
									Maxilla x Mandible		[1]p=0.341

Intraoral	**HPT**	**Maxilla (n=14)**	43.4 (5.6)	44.5 (4.8)	42.9 (4.9)	42.3 (5.5)	41.5 (4.2)	41.5 (4.1)	41.4 (3.8)	42.3 (3.8)	[1]p=0.013*
		Mandible (n=19)	40.9 (4.9)	40.5 (4.5)	39.5 (4.7)	39.9 (4.5)	38.6 (4.6)	39.5 (4.2)	39.8 (4.2)	40.5 (4.4)	[1]p=0.153
		Overall (n=33)	41.9 (5.3)	42.2 (4.9)	41.0 (5.0)	40.9 (5.0)	39.8 (4.6)	40.4 (4.2)	40.5 (4.0)	41.3 (4.2)	[1]p=0.001*
									Maxilla x Mandible		[1]p=0.076
	CDT	**Maxilla (n=9)**	19.5 (7.2)	20.8 (7.7)	21.6 (6.6)	22.6 (7.0)	20.6 (6.4)	21.4 (6.3)	21.1 (6.5)	21.0 (6.3)	[1]p=0.031*
		Mandible (n=15)	20.5 (6.9)	22.0 (7.4)	22.5 (6.1)	22.4 (7.2)	21.4 (6.4)	22.3 (6.0)	22.0 (6.5)	21.7 (5.8)	[1]p=0.744
		Overall (n=24)	20.0 (7.0)	21.4 (7.5)	22.2(6.0)	23.3 (6.5)	21.2 (5.8)	22.1 (5.6)	21.7 (5.9)	21.7 (5.7)	[1]p=0.449
									Maxilla x Mandible		[1]p=0.841
	WDT	**Maxilla (n=9)**	43.7 (5.5)	43.5 (5.5)	45.2 (6.3)	40.3 (5.6)	43.8 (4.1)	44.6 (3.4)	44.8 (3.9)	44.1 (3.7)	[1]p=0.047*
		Mandible (n=15)	43.3 (5.1)	43.7 (4.7)	44.4 (5.4)	42.0 (6.5)	41.8 (5.6)	42.2 (5.1)	43.3 (5.5)	42.3 (4.8)	[1]p=0.182
		Overall (n=24)	43.4 (5.1)	43.6 (4.9)	44.7 (5.6)	41.4 (6.1)	42.6 (5.1)	43.1 (4.6)	43.8 (5.0)	43.8 (5.0)	[1]p=0.277
									Maxilla x Mandible		[1]p=0.755
	CPT	**Maxilla (n=9)**	11.6 (8.6)	10.0 (9.0)	12.5 (8.4)	17.4 (7.9)	14.9 (5.4)	15.5 (5.2)	15.6 (4.8)	15.9 (5.5)	[1]p<0.001*
		Mandible (n=15)	15.7 (8.2)	15.8 (7.7)	16.7 (6.5)	17.7 (5.8)	18.1 (5.3)	18.1 (5.3)	18.9 (5.4)	18.9 (5.5)	[1]p<=0.008*
		Overall (n=24)	14.2 (8.4)	13.6 (8.5)	15.1 (7.4)	17.6 (6.7)	16.7 (5.7)	17.1 (5.3)	17.7 (5.3)	17.8 (5.6)	[1]p<0.001*
									Maxilla x Mandible		[1]p=0.132
	HPT	**Maxilla (n=9)**	48.3 (2.3)	47.7 (3.4)	47.3 (3.7)	46.4 (3.5)	47.0 (3.2)	46.7 (3.4)	47.1 (2.9)	47.6 (2.8)	[1]p=0.613
		Mandible (n=15)	47.6 (3.1)	47.3 (3.0)	46.4 (4.1)	47.6 (3.7)	47.6 (3.7)	47.3 (3.2)	47.3 (3.2)	48.8 (2.5)	[1]p=0.059
		Overall (n=24)	47.9 (2.8)	47.5 (3.1)	46.7 (3.9)	47.1 (3.6)	47.4 (3.1)	47.1 (3.2)	47.3 (3.0)	48.3 (2.6)	[1]p=0.209
									Maxilla x Mandible		[1]p=0.593

[1]Two-Way Repeated Measures ANOVA; [abcd]Tukey post-hoc test

Table 3. Frequency of sensory alterations from QualST, in the extraoral region, ipsilateral to the implant placement over time.

				Baseline	3 days	7 days	15 days	1 month	3 months	6 months	12 months	p-value
Maxilla (n=14)	**Touch**	Abnormal	Hyper	0	0	1	0	0	0	0	0	p=0.333
			Hypo	1	0	1	1	1	1	1	1	
		Normal		13	14	12	13	13	13	13	13	
	Cold	Abnormal	Hyper	1	1	0	1	0	0	0	0	p=0.660
			Hypo	0	1	2	0	2	2	2	2	
		Normal		13	12	12	13	12	12	12	12	
	Pinprick	Abnormal	Hyper	2	1	1	0	1	1	1	1	p=0.429
			Hypo	0	0	1	1	1	1	1	1	
		Normal		12	13	12	13	12	12	12	12	
Mandible (n=19)	**Touch**	Abnormal	Hyper	1	3	1	1	1	1	1	1	p=0.517
			Hypo	0	0	1	0	0	0	0	0	
		Normal		18	16	17	18	18	18	18	18	
	Cold	Abnormal	Hyper	1	2	3	1	2	2	2	2	p=0.954
			Hypo	1	0	0	1	1	0	0	0	
		Normal		17	17	16	17	16	17	17	17	
	Pinprick	Abnormal	Hyper	0[a]	4[a]	4	2	2	2	2	2	p=0.001*
			Hypo	0[a]	2[a]	0	0	0	0	0	0	
		Normal		19	13	15	17	17	17	17	17	
Overall (n=33)	**Touch**	Abnormal	Hyper	1	3	2	1	1	1	1	1	p=0.729
			Hypo	1	0	2	1	1	1	1	1	
		Normal		31	30	29	31	31	31	31	31	

	Cold	Abnormal	Hyper	2	4	2	1	3	3	3	3	p=0.829
			Hypo	1	1	2	2	0	0	0	0	
		Normal		30	29	29	30	30	30	30	30	
	Pinprick	Abnormal	Hyper	2[a]	4[a]	5	2	3	3	3	3	p=0.032*
			Hypo	0[a]	2[a]	1	1	1	1	1	1	
		Normal		31	27	27	30	29	29	29	29	

Cochran's Q test; * p<0,05

Table 4. Frequency of sensory alterations from QualST, in the intraoral region, ipsilateral to the implant placement over time.

				Baseline	**3 days**	**7 days**	**15 days**	**1 month**	**3 months**	**6 months**	**12 months**	**p-value**
Maxilla (n=14)	**Touch**	Abnormal	Hyper	2	5	3	2	3	3	3	3	p=0.492
			Hypo	1	1	2	2	1	1	1	1	
		Normal		11	8	9	10	10	10	10	10	
	Cold	Abnormal	Hyper	7	6	4	3	3	5	5	5	p=0.788
			Hypo	1	3	5	7	6	4	4	3	
		Normal		6	5	5	4	5	5	5	6	
	Pinprick	Abnormal	Hyper	7	6	6	5	6	7	7	6	p=0.087
			Hypo	2	6	7	5	3	3	2	2	
		Normal		5	2	1	4	5	4	5	6	
Mandible (n=19)	**Touch**	Abnormal	Hyper	0	4	4	5	4	2	2	2	p=0.010*
			Hypo	4	6	6	5	5	4	3	3	
		Normal		15	9	9	9	10	13	14	14	
	Cold	Abnormal	Hyper	6[a]	6	6[ab]	8[ac]	6	5[c]	3[bc]	3[bc]	p=0.000*

			Hypo	2[a]	8	10[ab]	9[ac]	8	4[c]	5[bc]	4[bc]	
		Normal		11	5	3	2	5	10	11	12	
	Pinprick	Abnormal	Hyper	2[a]	8[a]	8[a]	4	4	7	6	5	p=0.005*
			Hypo	5[a]	9[a]	7[a]	7	7	5	6	6	
		Normal		12	2	4	8	8	7	7	8	
Overall (n=33)	**Touch**	Abnormal	Hyper	2[a]	8[a]	8[a]	7	7	5	5	5	p=0.002*
			Hypo	5[a]	7[a]	8[a]	7	6	5	4	5	
		Normal		26	18	17	19	20	23	24	23	
	Cold	Abnormal	Hyper	9[a]	12	10[ab]	12[ac]	8	10	8[c]	8[bc]	p=0.000*
			Hypo	7[a]	11	15[ab]	15[ac]	14	8	9[c]	7[bc]	
		Normal		17	10	8	6	11	15	16	18	
	Pinprick	Abnormal	Hyper	9[a]	14[ab]	14[a]	10	10	14	13	11[b]	p=0.000*
			Hypo	7[a]	15[ab]	14[a]	12	10	8	8	8[b]	
		Normal		17	4	5	11	13	11	12	14	

Cochran's Q test; * p<0,05

Table 5. Mean ± standard deviation OHIP-14 score values before and after 6 months of implant-supported rehabilitation.

	Preoperative	**6 months follow-up**	**[1]p-value**
Maxilla (n=14)	5.30 ± 4.10	1.75 ± 1.39	p<0.001*
Mandible (n=19)	5.00 ± 3.01	1.81 ± 1.12	p<0.001*
[1]p-value	p= 0.995	p=0.999	
Overall (n=33)	5.13 ± 3.46	1.78 ± 1.22	p<0.001*

[1]Repeated Measures ANOVA

REFERÊNCIAS

AGBAJE, J. et al. Agreement between quantitative and qualitative sensory testing of changes in oro-facial somatosensory sensitivity. **Journal of Oral Rehabilitation**, v. 44, n. 1, p. 30–42, 2017.

AL-SABBAGH, M. et al. Persistent pain and neurosensory disturbance after dental implant surgery: Prevention and treatment. **Dental Clinics of North America**, v. 59, n. 1, p. 143–156, 2015a.

AL-SABBAGH, M. et al. Persistent pain and neurosensory disturbance after dental implant surgery: Pathophysiology, etiology, and diagnosis. **Dental Clinics of North America**, v. 59, n. 1, p. 131–142, 2015b.

BAAD-HANSEN, L. et al. Chairside Intraoral Qualitative Somatosensory Testing: Reliability and Comparison Between Patients with Atypical Odontalgia and Healthy Controls. **Journal of Orofacial Pain**, v. 27, n. 2, p. 165–170, 2013.

BOUHASSIRA, D. et al. Comparison of pain syndromes associated with nervous or somatic lesions and development of a new neuropathic pain diagnostic questionnaire (DN4). **Pain**, v. 114, n. 1–2, p. 29–36, 2005.

CONTI, P. C. R. et al. Pain complications of oral implants: Is that an issue? **Journal of Oral Rehabilitation**, v. 48, n. 2, p. 195–206, 2021.

COSTIGAN, M.; SCHOLZ, J.; WOOLF, C. J. Neuropathic pain: A maladaptive response of the nervous system to damage. **Annual Review of Neuroscience**, v. 32, p. 1–32, 2009.

FARZADMOGHADAM, M. et al. Is there a relationship between general and oral health-related quality of life in partially edentulous patients before and after implant treatment? A quasi-experimental study. **Clinical Oral Implants Research**, v. 31, n. 6, p. 557–564, 2020.

GENNAI, S. et al. Impact of rehabilitation versus edentulism on systemic health and quality of life in patients affected by periodontitis: A systematic review and meta-analysis. **Journal of Clinical Periodontology**, n. June, p. 1–31, 2021.

GERRITSEN, A. E. et al. Tooth loss and oral health-related quality of life: A systematic review and meta-analysis. **Health and Quality of Life Outcomes**, v. 8, n. 126, p. 1–11, 2010.

HARTMANN, A. et al. Neurophysiological changes associated with implant-associated augmentation procedures in the lower jaw. **Clinical implant dentistry and related research**, v. 19, n. 4, p. 725–732, 2017a.

HARTMANN, A. et al. Neurophysiological changes associated with implant placement. **Clinical Oral Implants Research**, v. 28, n. 5, p. 576–581, 2017b.

HATTINGH, A.; DE BRUYN, H.; VANDEWEGHE, S. A retrospective study on ultra-wide diameter dental implants for immediate molar replacement. **Clinical Implant Dentistry and Related Research**, v. 21, n. 5, p. 879–887, 2019.

HILLERUP, S. Iatrogenic injury to oral branches of the trigeminal nerve: Records of 449 cases. **Clinical Oral Investigations**, v. 11, n. 2, p. 133–142, 2007.

KIM, H.-K.; KIM, M.-E. Quantitative and qualitative sensory testing results are associated with numbness rather than neuropathic pain in patients with post-implant trigeminal neuropathy: a cross-sectional pilot study. **Somatosensory & Motor Research**, v. 36, n. 3, p. 202–211, 2019.

MAGERL, W. et al. Reference data for quantitative sensory testing (QST): Refined stratification for age and a novel method for statistical comparison of group data. **Pain**, v. 151, n. 3, p. 598–605, 2010.

MARTINS, A. et al. The effect of complete dentures on edentulous patients' oral health-related quality of life in long-Term: A systematic review and meta-Analysis. **Dental Research Journal**, v. 18, n. 1, p. 1–21, 2021.

MENASSA, M. et al. Patients' expectations, satisfaction, and quality of life with immediate loading protocol. **Clinical Oral Implants Research**, v. 27, n. 1, p. 83–89, 2016.

NICKENIG, H. J. et al. Oral health-related quality of life and implant therapy: A prospective multicenter study of preoperative, intermediate, and posttreatment assessment. **Journal of Cranio-Maxillofacial Surgery**, v. 44, n. 6, p. 753–757, 2016.

PAUL S, A. et al. Assessing perceptions of oral health related quality of life in dental implant patients. Experience of a tertiary care center in India. **Journal of Oral Biology and Craniofacial Research**, v. 8, n. 2, p. 74–77, 2018.

PIGG, M. et al. Reliability of intraoral quantitative sensory testing (QST). **Pain**, v. 148, n. 2, p. 220–226, 2010.

PILLAI, R. S. et al. Assessment of Somatosensory and Psychosocial Function of Patients with Trigeminal Nerve Damage. **Clinical Journal of Pain**, v. 36, n. 5, p. 321–335, 2020.

PORPORATTI, A. et al. Pain from Dental Implant Placement, Inflammatory Pulpitis Pain, and Neuropathic Pain Present Different Somatosensory Profiles. **Journal of Oral & Facial Pain and Headache**, v. 31, n. 1, p. 19–29, 2017.

RAES, F. et al. A case-control study assessing oral-health-related quality of life after immediately loaded single implants in healed alveolar ridges or extraction sockets. **Clinical Oral Implants Research**, v. 23, n. 5, p. 602–608, 2012.

RAES, S. et al. Oral health-related quality of life changes after placement of immediately loaded single implants in healed alveolar ridges or extraction sockets: a 5-year prospective follow-up study. **Clinical Oral Implants Research**, v. 28, n. 6, p. 662–667, 2017.

RAJA, S. N. et al. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. **Pain**, v. 161, n. 9, p. 1976–1982, 2020.

ROLKE, R. et al. Quantitative sensory testing: A comprehensive protocol for clinical trials. **European Journal of Pain**, v. 10, n. 1, p. 77, 2006a.

ROLKE, R. et al. Quantitative sensory testing in the German Research Network on Neuropathic Pain (DFNS): Standardized protocol and reference values. **Pain**, v. 123, n. 3, p. 231–243, 2006b.

SAID-YEKTA, S. et al. Verification of nerve integrity after surgical intervention using quantitative sensory testing. **Journal of Oral and Maxillofacial Surgery**, v. 70, n. 2, p. 263–271, 2012.

SAID YEKTA, S. et al. Analysis of trigeminal nerve disorders after oral and maxillofacial intervention. **Head and Face Medicine**, v. 6, n. 1, p. 24, 2010.

SCHOTT, G. D. Penfield's homunculus: A note on cerebral cartography. **Journal of Neurology Neurosurgery and Psychiatry**, v. 56, n. 4, p. 329–333, 1993.

SELVIDO, D. I. et al. Pain in Oral and Maxillofacial Surgery and Implant Dentistry: Types and Management. **European Journal of Dentistry**, v. 15, n. 3, p. 588–598, 2021.

VAN DER CRUYSSEN, F. et al. Orofacial quantitative sensory testing: Current evidence and future perspectives. **European Journal of Pain (United Kingdom)**, v. 24, n. 8, p. 1425–1439, 2020.

VAN EEKEREN, P. J. A. et al. The effect of implant placement in patients with either Kennedy class II and III on oral health-related quality of life: A prospective clinical trial. **Journal of Oral Rehabilitation**, v. 43, n. 4, p. 291–296, 2016.

VAN LIERDE, K. et al. Comparison of speech intelligibility, articulation and oromyofunctional behaviour in subjects with single-tooth implants, fixed implant prosthetics or conventional removable prostheses. **Journal of Oral Rehabilitation**, v. 39, n. 4, p. 285–293, 2012.

VANDENKERKHOF, E. G. et al. Sensitivity of the DN4 in Screening for Neuropathic Pain Syndromes. **Clinical Journal of Pain**, v. 34, n. 1, p. 30–36, 2018.

VÁZQUEZ-DELGADO, E. et al. Prevalence of neuropathic pain and sensory alterations after dental implant placement in a university-based oral surgery department: A retrospective cohort study. **Gerodontology**, v. 35, n. 2, p. 117–122, 2018.

ANEXOS

ANEXO A – Parecer consubstanciado do CEP

FACULDADE DE ODONTOLOGIA DE BAURU DA UNIVERSIDADE DE SÃO PAULO - USP

PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: Análise comparativa de parâmetros clínicos e moleculares em próteses sobre implantes reabilitados com coroas metalocerâmicas e de cerâmicas híbridas
Pesquisador: Estevam Augusto Bonfante
Área Temática:
Versão: 6
CAAE: 50811015.0.0000.5417
Instituição Proponente: Universidade de São Paulo - Faculdade de Odontologia de Bauru
Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 5.874.430

Apresentação do Projeto:
Trata-se de projeto de pesquisa cujo objetivo será a avaliação de próteses sobre implantes reabilitados com coroas metalocerâmicas ou de cerâmicas híbridas. Serão avaliados os seguintes parâmetros: 1) sintomatologia dolorosa e mobilidade dos implantes; 2) tecidos peri-implantares; 3) prótese; 4) avaliação radiográfica e 5) quantificação de marcadores ósseos e inflamatórios; 6) perfil somatossensorial por meio dos testes quantitativos sensoriais (QST, sigla em inglês) e testes qualitativos sensoriais (sensação tátil dinâmica, térmica e dolorosa).Os resultados obtidos serão comparados entre os grupos por meio dos testes: Kruskal-Wallis (parâmetros peri-implantares), Wilcoxon signed-ranks (perda óssea), tabela de vida (sobrevivência do implante), método de Kaplan-Meier (tempo estimado entre a instalação das coroas e a incidência de complicações protéticas), Friedman e Mann-Whitney (marcadores ósseos e marcadores inflamatórios), análise de variância 3 critérios (testes quantitativos e qualitativos sensoriais), todos com nível de significância, $p<0,05$

Objetivo da Pesquisa:
O objetivo deste estudo clínico, randomizado e controlado será a avaliação de próteses sobre implantes reabilitados com coroas metalocerâmicas ou de cerâmicas híbridas. Serão avaliados os seguintes parâmetros: 1) sintomatologia dolorosa e mobilidade dos implantes; 2) tecidos peri-implantares; 3) prótese; 4) avaliação radiográfica e 5) quantificação de marcadores ósseos e

Endereço: DOUTOR OCTAVIO PINHEIRO BRISOLLA 75 QUADRA 9
Bairro: VILA NOVA CIDADE UNIVERSITARIA **CEP:** 17.012-901
UF: SP **Município:** BAURU
Telefone: (14)3235-8356 **Fax:** (14)3235-8356 **E-mail:** cep@fob.usp.br

inflamatórios; 6) perfil somatossensorial por meio dos testes
quantitativos sensoriais (QST, sigla em inglês) e testes qualitativos sensoriais (sensação tátil dinâmica, térmica e dolorosa).

Avaliação dos Riscos e Benefícios:

Riscos:

Essa pesquisa pode implicar em riscos e complicações, sendo que os mais comuns são falhas mecânicas nas coroas (como desaperto de parafuso, fratura do parafuso ou de componentes protéticos, fratura da porcelana, fratura do implante) ou falhas biológicas nos tecidos ao redor dos implantes (como inflamações, infecções, perda óssea, perda da osseointegração, perda dos implantes).

Benefícios:

Essa pesquisa trará benefícios como melhora na mastigação, qualidade de vida e acompanhamento direto por profissionais especializados da sua condição de saúde bucal, com o correto diagnóstico e tratamento adequado.

Comentários e Considerações sobre a Pesquisa:

Descritos item "Conclusões ou Pendências e Lista de Inadequações"

Considerações sobre os Termos de apresentação obrigatória:

Descritos item "Conclusões ou Pendências e Lista de Inadequações"

Conclusões ou Pendências e Lista de Inadequações:

Conforme constata-se pelos documentos anexados, em análise a emenda anterior foi considerada "pendente" (parecer consubstanciado de nº 5.836.219), com solicitação para que foi atualizado o cronograma do projeto de pesquisa.

Com apresentação de nova emenda, apresenta o pesquisador CRONOGRAMA ATUALIZADO, realizando a retificação dos documentos pertinentes, razão pela qual sou de parecer favorável a APROVAÇÃO.

Considerações Finais a critério do CEP:

A emenda apresentada pelo(a) pesquisador(a) foi considerada APROVADA na reunião ordinária do CEP de 01/02/2023, via Google Meet, com base nas normas éticas da Resolução CNS 466/12. Ao término da pesquisa o CEP-FOB/USP exige a apresentação de relatório final. Os relatórios parciais deverão estar de acordo com o cronograma e/ou parecer emitido pelo CEP. Alterações na metodologia, título, inclusão ou exclusão de autores, cronograma e quaisquer outras mudanças que sejam significativas deverão ser previamente comunicadas a este CEP sob risco de não

FACULDADE DE ODONTOLOGIA DE BAURU DA UNIVERSIDADE DE SÃO PAULO - USP

aprovação do relatório final. Quando da apresentação deste, deverão ser incluídos todos os TCLEs e/ou termos de doação assinados e rubricados, se pertinentes.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_1148252_E3.pdf	04/01/2023 12:21:40		Aceito
Outros	emenda_cep_PENDENCIA_cronograma.docx	04/01/2023 12:19:27	Estevam Augusto Bonfante	Aceito
Cronograma	CRONOGRAMA_atualizado.docx	04/01/2023 12:18:36	Estevam Augusto Bonfante	Aceito
Projeto Detalhado / Brochura Investigador	Projeto_cronograma_atual.docx	04/01/2023 12:12:22	Estevam Augusto Bonfante	Aceito
Outros	emenda_cep_matheus.docx	17/11/2022 15:15:06	Estevam Augusto Bonfante	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TERMO_DE_CONSENTIMENTO_LIVRE_E_ESCLARECIDO_emenda_2.pdf	11/07/2017 21:30:48	Estevam Augusto Bonfante	Aceito
Outros	declaracao_de_compromisso_resultados.pdf	09/11/2015 13:41:41	Estevam Augusto Bonfante	Aceito
Outros	Carta_de_encaminhamento.pdf	09/11/2015 13:37:10	Estevam Augusto Bonfante	Aceito
Outros	termo_aquiescencia_tratamento_pacientes.pdf	29/10/2015 21:01:28	Estevam Augusto Bonfante	Aceito
Outros	termo_aquiescencia_encaminhamento_pacientes.pdf	29/10/2015 21:00:24	Estevam Augusto Bonfante	Aceito
Outros	Questionario_tecnico_pesquisador.pdf	29/10/2015 20:58:28	Estevam Augusto Bonfante	Aceito
Folha de Rosto	Folha_de_rosto.pdf	28/10/2015 09:50:50	Estevam Augusto Bonfante	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

Endereço: DOUTOR OCTAVIO PINHEIRO BRISOLLA 75 QUADRA 9
Bairro: VILA NOVA CIDADE UNIVERSITARIA **CEP:** 17.012-901
UF: SP **Município:** BAURU
Telefone: (14)3235-8356 **Fax:** (14)3235-8356 **E-mail:** cep@fob.usp.br

FACULDADE DE ODONTOLOGIA DE BAURU DA UNIVERSIDADE DE SÃO PAULO - USP

Continuação do Parecer: 5.874.430

BAURU, 02 de Fevereiro de 2023

Assinado por:
CASSIA MARIA FISCHER RUBIRA
(Coordenador(a))

Endereço: DOUTOR OCTAVIO PINHEIRO BRISOLLA 75 QUADRA 9
Bairro: VILA NOVA CIDADE UNIVERSITARIA **CEP:** 17.012-901
UF: SP **Município:** BAURU
Telefone: (14)3235-8356 **Fax:** (14)3235-8356 **E-mail:** cep@fob.usp.br