

# INPLASY

## The Osseointegration Effects of Surface Modification Treatment on PEEK Dental Implant

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Lestari, FA<sup>1</sup>; Novianti, A<sup>2</sup>; Hariyani, N<sup>3</sup>; Nugraha, AP<sup>4</sup>; Sengupta, K<sup>5</sup>.

### Corresponding author:

Ninuk Hariyani

ninuk-h@fkg.unair.ac.id

### Author Affiliation:

Faculty of Dental Medicine,  
Universitas Airlangga, Surabaya,  
East Java, Indonesia.

### ADMINISTRATIVE INFORMATION

**Support** - Faculty of Dental Medicine, Universitas Airlangga, Surabaya, East Java, Indonesia.

**Review Stage at time of this submission** - Completed but not published.

**Conflicts of interest** - None declared.

**INPLASY registration number:** INPLASY202410017

**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 06 January 2024 and was last updated on 06 January 2024.

### INTRODUCTION

**Review question / Objective** A focused question was formulated in accordance with the Participants, Intervention, Control, and Outcomes (PICO) principle (Participants: Cells for invitro studies and animals for invivo studies; Intervention: Surface modification treatment on PEEK dental implant; Controls: PEEK or no treatment or pure PEEK; Outcomes: increased cell attachment, cell proliferation, ALP activity, mineralized bone nodule formation related to bone osseointegration). The focused question was:

1. 'What are the types of surface modification treatments on PEEK dental implants?'
2. 'What are the osseointegration effects of many types of surface modification treatments on PEEK dental implants?'

**Rationale** There are several disadvantages of titanium such as the potential for the release of

metal ions, too large elastic modulus difference in between the implant and bone, so that hypersensitivity reactions and local inflammation can occur, which then leads to peripheral bone loss. Polymer dental implant out as a promising candidate for replacing metal components. Poly ether ether ketone (PEEK) is one of polymer material that have the most high modulus elasticity among polyethylene, polyamide, polyethylene terephthalate, polymethylmethacrylate, polystyrene, polytetrafluorethylene, polyurethane and synthetic rubber. When compared to titanium and other materials, PEEK is a biocompatible polymer material with a modulus range that approximates the properties of dentine and cortical bone. It may reduce loads transferred on the abutment teeth and the cementation interface. PEEK, on the other hand, has a very hydrophobic and bioinert surface that inhibits osteoblast development and proliferation, resulting in implant failure. For this reason, there are several ways to

increase osseointegration through the addition of bioactive materials either as surface coatings or as composites and modifying the construction of the pore structure.

**Condition being studied** This review aims to summarize any surface modifications of PEEK material as a dental implant that can improve osseointegration.

## METHODS

**Search strategy** A systematic review protocol based on PRISMA 2020 was drafted. In addition, reporting was based on the PRISMA 2020 checklist. The following databases were searched: MEDLINE/ PubMed (<https://pubmed.ncbi.nlm.nih.gov>), Scopus (<https://www.scopus.com/>), Web of Science/ ISI-Web of Knowledge (<https://www.webofscience.com/>), Embase (<https://www.embase.com/>), Dentistry & oral Science source (<https://www.ebsco.com/products/research-databases/dentistry-oral-sciences-source>) and the Cochrane Library (<https://www.cochranelibrary.com/advanced-search>). The search process to get the results according to the purpose using the keywords surface modification treatment and polyetheretherketone and dental implant and osseointegration and its synonym using the Boolean "OR". Modification of the search on the database was done to get more relevant results. Manual searches were undertaken to support the accuracy of completed searches. The literature search process was carried out from September 2023 until October 2023.

**Participant or population** Cells for invitro studies and animals for invivo studies.

**Intervention** Surface modification treatment on PEEK dental implant.

**Comparator** PEEK or no treatment or pure PEEK.

**Study designs to be included** Cells for invitro studies and animals for invivo studies.

**Eligibility criteria** The following categories of articles were included in this review: in-vitro and in-vivo experimental articles that focused on the osseointegration effect of surface modification on PEEK dental implant. Open access (accessed through the Airlangga University's IP address) of full-text articles relevant to osseointegration effect of surface modification on PEEK dental implant were used as inclusion criteria. Reviews, short communications, editorial notes, processes, and

recommendations were not considered and excluded. All types of experimental and observational studies in English were included. Nevertheless, no duplicate studies were included in the analysis. Any species, gender or age are acceptable in in-vivo research. Surface modification and PEEK dental implant, as well as any additional treatment involving osseointegration, were included in the research as study factors or exposures. Cell attachment, proliferation, ALP activity, bone like nodule formation and any other measure of dental implant osseointegration were among the outcomes of the research examined. Articles in languages other than English, letters to the editor, and all types of reviews and commentaries were excluded. There were no restrictions on the year of publication, but only full papers could be accessed for free. The most recent search was conducted in October 2023.

**Information sources** The following databases were searched: MEDLINE/ PubMed (<https://pubmed.ncbi.nlm.nih.gov>), Scopus (<https://www.scopus.com/>), Web of Science/ ISI-Web of Knowledge (<https://www.webofscience.com/>), Embase (<https://www.embase.com/>), Dentistry & oral Science source (<https://www.ebsco.com/products/research-databases/dentistry-oral-sciences-source>) and the Cochrane Library (<https://www.cochranelibrary.com/advanced-search>).

**Main outcome(s)** This review aims to summarize any surface modifications of PEEK material as a dental implant that can improve osseointegration.

**Additional outcome(s)** To answer the focused question of: 1. 'What are the types of surface modification treatments on PEEK dental implants?' 2. 'What are the osseointegration effects of many types of surface modification treatments on PEEK dental implants?'

**Data management** Two reviewers (A.N, F.A.L) independently conducted the electronic literature search and selected the studies. All disagreements were resolved by discussion or consultation with the other reviewers (N.H., A.P.N.). Reviewers (A.N., F.A.L.) worked to replicate the screening, extraction, and summary data using Mendeley. Data were primarily extracted using the PICO protocol (participants: Cells (for in-vitro studies) or animals (for in vivo studies); intervention: surface modification treatments; control: PEEK or no treatment or pure PEEK. results: increased cell attachment, cell proliferation, ALP activity, mineralized bone nodule formation related to bone

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osseointegration. Data relevant to methodology, sample treatment, outcome of the studies, and the investigations carried out were extracted from each study. Results from the cells (in-vitro) and animal (in-vivo) studies were tabulated in the table using predetermined data collection forms by the two investigators independently.

**Quality assessment / Risk of bias analysis** This evaluation includes well-defined surface modification treatments, in vitro and in vivo experiments, standardized sample or subject preparation, sample or subject randomization, testing performed by a single blinded operator, and We evaluated the description of several quality evaluation parameters, such as specifications. Comprehensive report of test methods and results. Papers were labeled “Y” for a particular parameter if the author reported it, or “N” if no information was found. Articles were classified as high, medium, or low risk of bias based on the number of “Y” items included (1–2, 3–5, or 6–7).

**Strategy of data synthesis** The keywords yielded a total of 307 articles published, with 69 papers from PubMed, 73 papers from Scopus, 135 papers from the Web of Science, 0 papers from the Cochrane Library, 17 papers from the embase and 13 papers from the Dentistry and Oral Science Sou, respectively. The 134 suitable articles to evaluate after removing duplicates and 32 article after review excluded, We had 93 studies left after doing title and abstract reading. forty-eight full articles were assessed for eligibility. They read the complete texts of those 48 papers and eventually chose 33 that matched the inclusion requirements.

**Subgroup analysis** Nil.

**Sensitivity analysis** Microsoft Office Excel (2010, Microsoft) was used for descriptive statistics. Due to the heterogeneity of the papers, a pairwise meta-analysis could not be performed.

**Language restriction** English.

**Country(ies) involved** Indonesia and Denmark.

**Keywords** Surface modification treatment, polyetheretherketone, dental implant, osseointegration.

#### **Contributions of each author**

Author 1 - Feby Ayu Lestari - Conceptualization, methodology, resources, writing-original draft preparation.

Email: feby.ayu.lestari-2022@fkg.unair.ac.id

Author 2 - Aisyah Novianti - Conceptualization, methodology, resources, writing-original draft preparation.

Email: aisyah.novianti-2022@fkg.unair.ac.id

Author 3 - Ninuk Hariyani - Conceptualization, methodology, resources, writing-review and editing.

Email: ninuk-h@fkg.unair.ac.id

Author 4 - Alexander Patera Nugraha - Conceptualization, methodology, resources, writing-review and editing.

Email: alexander.patera.nugraha@fkg.unair.ac.id

Author 5 - Kaushik Sengupta - Collaborator.