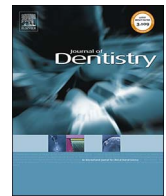




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# Quantitative discoloration assessment of peri-implant soft tissue around zirconia and other abutments with different colours: A systematic review and meta-analysis

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## ABSTRACT

**Objectives:** The implant abutments, which had their own colour, might cause the discoloration of peri-implant mucosa. We aimed to appraise trails comparing the discoloration of peri-implant soft tissue around zirconia and titanium or golden abutments, the tints of which were vastly different.

**Data:** We included randomized controlled trials (RCTs), controlled clinical trials (CCTs), cohort studies with patients rehabilitated with zirconia, titanium or golden implant abutments, quantitatively comparing the discoloration of peri-implant soft tissue according to CIE-Lab colour scale.

**Sources:** A systematic search was conducted in PubMed, EMBASE, CDSR, and CENTRAL databases without any restriction on September 23, 2017. “Grey” literatures were also searched. A manual search was carried out as well.

**Study selection:** Of 584 articles initially retrieved, eight were eligible for inclusion. After data extraction, meta-analyses with mean differences (MDs) and their 95% confidence intervals (CIs) were employed. Moreover, the risk of bias within or across studies was assessed by Cochrane Collaboration’s tool for assessing risk, the Newcastle-Ottawa scale, funnel plots, or Egger’s test.

**Results:** Four RCTs and four cohort studies were included. Soft-tissue discoloration around zirconia abutments was significantly less likely compared to that around titanium abutments (MD = −1.84; 95% CI = −3.62 to −0.07; P = 0.04 < 0.05) or golden abutments (MD = −0.90; 95% CI = −1.60 to −0.20; P = 0.01 < 0.05).

**Conclusions:** Zirconia abutments with white tint compared to grey titanium or golden abutments seem to restore a more appropriate colour match between peri-implant mucosa and natural teeth.

**Clinical significance:** Based on the present evidence, the “nature-like” zirconia abutments should be applied more often in the clinic.

PROSPERO registration number: CRD42017075930.

## 1. Introduction

It has been consistently reported that implant therapy has high survival rates and thus is widely used in tooth replacement treatment [1–6]. However, the criteria of successful implant therapy have broadened beyond functional parameters, such as bone integration, survival, and complications [7–9], to include the aesthetic attributes of coronal restorations and especially the peri-implant soft tissue [10–12]. In 1999, Moon et al. proved that the morphogenesis of supporting structures results in a longer “biologic width” around the artificial

implant compared to a natural tooth [13], which implies that maybe only the soft tissue covers the underling abutment. Moreover, the peri-implant soft tissue has been reported to be particularly more translucent than other gingival tissues due to its reduced vascularization [14–16]. The colour of the underlying abutments may shine through the translucent mucosa, impairing the optical aesthetic outcome [17]. Thus, the colour of abutments may cause discoloration of the peri-implant soft tissue, which may satisfy or dissatisfy the patients as well as the clinicians [18–20].

Titanium abutments are consistently considered the “gold-standard”

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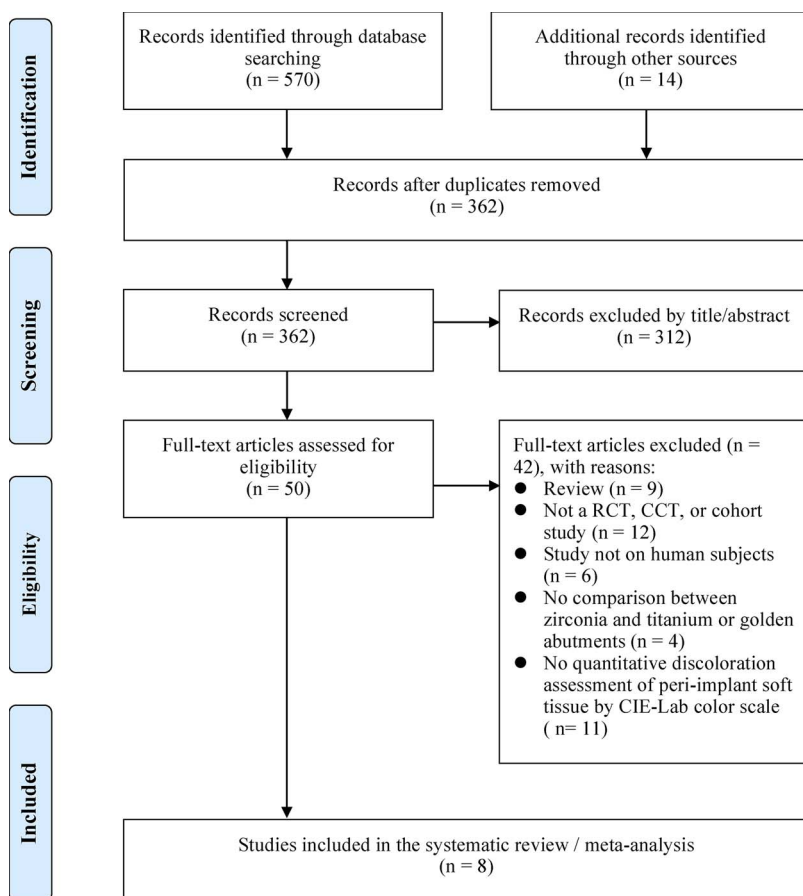


Fig. 1. PRISMA flow program for study selection for this systematic review and meta-analysis.

for implant-borne reconstructions [21]. However, the titanium abutments can lead to a dull greyish discoloration of the peri-implant soft tissue due to its grey colour [18,22,23]. There are several other available metal materials, such as titanium nitride, gold, gold-hued titanium, pink-hued titanium, and so on, most of which provide a “golden” appearance for the abutment to differ from the grey tint of titanium so as to mitigate the “greying effect” [24–26].

To seek a tooth-coloured abutment, all-ceramic abutments made of zirconia as well as alumina have been introduced to fabricate the implant abutment due to their semi-translucency [27], which provide a significant aesthetic improvement [28,29]. Moreover, both the flexural strength and the fracture toughness of zirconia have been reported to be almost twice as high as those of alumina [30,31]. Thus, zirconia is commonly used for implant abutments, especially in aesthetically demanding regions.

Several objective spectrophotometric analyses for the colour of the peri-implant soft tissue around abutments with different tints (zirconia, titanium, gold, and so on) have been completed [21,32,33]. Quantitative evaluation of discoloration was facilitated by the Commission Internationale de l’Eclairage L\*, a\*, and b\* (CIE-Lab) colour scale system, and the  $\Delta E$  represented the value of discoloration of peri-implant soft tissue [34]. However, the results were conflicting. Sailer et al. [32], as well as Zembic et al. [21] found that the amount of soft tissue discoloration, interestingly, had no significant difference between zirconia and titanium abutments. Contrarily, Bressan et al. [33] found titanium abutments indicated significantly greater discoloration compared to zirconia or gold abutments.

To further validate the soft tissue colour change around zirconia and other abutments with different tints, a systematic review and meta-analysis are needed. Hence, the purpose of this paper is to quantitatively investigate the difference between “tooth-like” zirconia abutments and “greyish” titanium abutments or abutments with “golden

appearance” (gold, gold-hued titanium, or titanium nitride) on peri-implant soft tissue discoloration.

## 2. Materials and methods

The present meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [35]. The protocol for this meta-analysis was registered in the International Prospective Register of Systematic Reviews (PROSPERO) ([www.crd.york.ac.uk/PROSPERO/](http://www.crd.york.ac.uk/PROSPERO/)) (registration number: CRD42017075930).

### 2.1. PICOS question

As recommended by the Centre for Evidence-Based Medicine (University of Oxford, Oxford, UK), the focused participants, interventions, comparisons, and outcomes (PICO) question was as follows: How do zirconia and other abutments with different tints affect the colour of peri-implant soft tissue?

Participants: edentulous patients restored with implant abutments

Interventions: insertion of zirconia abutments, which connected the implants and the upper crowns and were surrounded by the peri-implant soft tissue

Comparisons: titanium abutments and golden (containing gold, gold-hued titanium, and titanium nitride) abutments, which connected the implants and the upper crowns and were surrounded by the peri-implant soft tissue

Outcomes: quantitative discoloration assessment of peri-implant soft tissue around the abutments using the CIE Lab colour space coordinates, in which the  $\Delta E$  is the most important parameter for evaluating the discoloration [34,36]

Study design: randomized-controlled clinical trials (RCTs),

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