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Immunology for Dentistry

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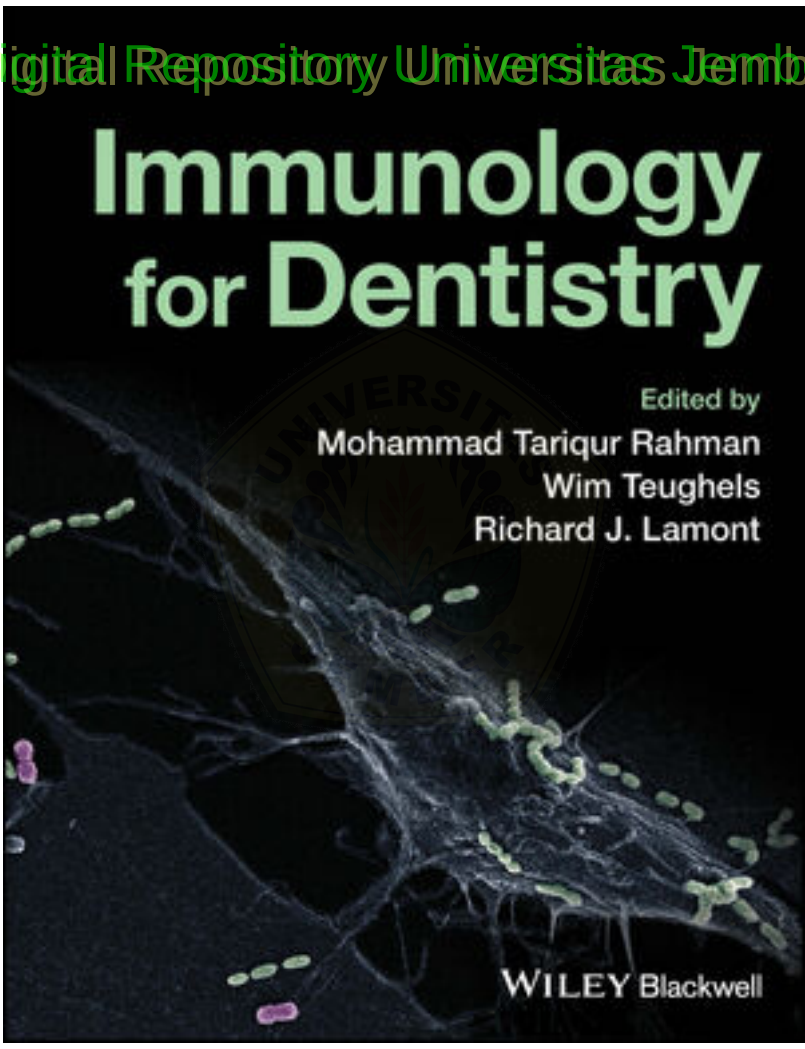

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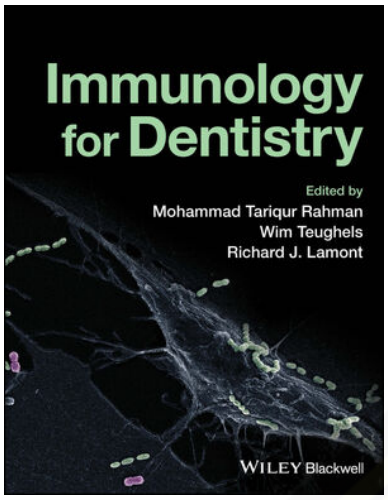

Immunology for Dentistry

Mohammad Tariqur Rahman (Editor), Wim Teughels (Editor), Richard J. Lamont (Editor)

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DESCRIPTION

Immunology for Dentistry

Understand the fundamentals of oral immunology with this accessible reference

Immunology for Dentistry fulfils the need for a comprehensive overview of oral immunology and its key aspects for dental medicine. Its broad-based and accessible coverage introduces readers to all essential elements of oral immunology, from mechanisms of the immune system through to specific diseases and pathogens and their interactions with the immune system. This thorough text will provide an understanding of the link between the oral immune system and oral microbiome as contributors to oral health.

Readers will also find:

• A thorough introduction to the basic principles of immunology and immune response

• Detailed coverage of subjects including stem cell immunology, periodontitis, hormone modulation in periodontal inflammation and more

• Color diagrams demonstrating key concepts

Authored by a team of international experts, *Immunology for Dentistry* provides a valuable approach to the fundamental and clinical aspects of immunology. It is a useful reference for dental students, teachers, and researchers, and will also be of interest to practicing dentists and specialists.

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ABOUT THE AUTHOR

The Editors

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12. Dental Alloys-associated innate immune response

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12.1. Introduction

The number of metals to which humans are exposed has sharply increased during the 20th century. In dentistry usually alloys are mixture of two or more metals. Alloying allows for combining different metals in order to get the best properties for particular purposes e.g. inlays, long span bridges, removable partial denture framework, full denture bases, and implants. Pure metals are rarely used in dentistry since these lack sufficient physical and mechanical resistance against masticatory forces. Precious metals such as gold, palladium and platinum have been used for decades in high noble or noble alloys as materials for dental constructions due to their corrosion and tarnish-resistance as well as their relatively good biocompatibility (Anusavice et al. 2013).

Classification of dental alloys has recently been renewed after the introduction of titanium (Ti) and titanium alloys (Table 1). The latter have been located in between high noble and noble alloys because of their excellent biocompatibility which makes these particularly suitable for dental implants and prostheses (ADA 2003). The costs of such alloys are, however, still relatively high as compared to other alloys with similar physical and mechanical properties such as nickel chromium (Ni-Cr) and cobalt chromium (Co-Cr) alloys (Sakaguchi and Powers 2012). The development of these predominantly base metal-based alloys (non-noble or non-precious alloys) has gained weight since the last twenty years, not only because of cost-effectiveness concerns, but also because of the necessity to develop dental alloys with even better physical and mechanical properties (Al-Hiyasat and Darmani 2005)

Base metal alloys contain no or less than 25% noble metal i.e. gold (Au), silver (Ag), platinum (Pt) and palladium (Pd) (ADA 2003). Compositions have now been defined that make alloys not only cheaper, but also corrosion and color resistant, with hardness and elasticity twice higher than most precious alloys. However, the incidence of metal allergies and other side effects from these alloys are reportedly higher than from noble alloys (Anusavice et al. 2013)
.

Table 12. 1. Classification of dental alloys based on ADA classifications (ADA 2003)

Classification	Composition	Type of alloy	Usage
High noble alloys	≥ 60% (Au + Pt group*) or ≥ 40% Au	Au-Pt Au-Pd Au-Cu-Ag	metal-ceramic restorations crowns, bridges crowns, bridges
Titanium Alloys	≥ 85% Ti	cpTi (Commercial pure titanium) Ti-6A1-4V (Ti alloys)	Implants metal-ceramic FDPs
Noble Alloys	≥ 25% (Au + Pt group*)	Ag-Au-Cu Pd-Cu Ag-Pd	crowns, bridges crowns, bridges crowns, bridges
Predominantly Base Alloys	< 25% (Au + Pt group*)	Ni-Cr Co-Cr Stainless steel	crowns, bridges, orthod. braces crowns, bridges pediatric crowns, orthod. braces

*Pt group: platinum, palladium, rhodium, iridium, osmium and ruthenium

In this chapter, the effects of a broad panel of orally applied metals and alloys on the human immune system are described, with a focus on innate responsiveness and early inflammatory events. Of note, these might eventually facilitate the development of allergy and autoimmunity. Knowledge of the relation between oral metal exposure and allergy or

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Table 2. Reported metal ion **release *in vitro/in vivo* from dental alloys**

	Type of alloy	Methods & conditions of exposure [a]			Release			Reference [b]
	(name/brand)	device/ specimen quantification	fluid volume	duration	µg/cm²/ day	Ppb/day (µg/L/day)	nM/day	
Ti	Ti–6Al–4V Zimmer (Sulzer Orthopedics)	dental implant Ø 22 mm x 2mm	MEM [c] 100ml	28 days	<< [d]	<<	<<	(Höhn S and Virtanen S 2015)
	Ti (Ormco)	20 orthodontic brackets 4 buccal molar tubes *(in vitro)*	MEM 30 ml	30 days	n.d. [e]	0.18	3.73	(Ortiz et al. 2011)
Cr	Stainless steel (Ultraminitrim, Dentaurum)	20 orthodontic ckets 4 molar tubes *(in o)*	MEM 30ml	30 days	n.d.	0.3	5.76	(Ortiz et al. 2011)
	Ni-Cr (Remanium CS)	cast alloy cimen Ø 5mm x 3mm *vitro)*	artificial saliva 11.5ml	60 days	0.0001	0.01	0.192	(Oyar et al. 2014)
	Ni-Cr (Vera Bond II)	cast alloy cimen + electrolysis 40x20x3mm *(in o)*	artificial saliva 50ml	2 days	0.085	33.25	639.42	(Galo et al. 2012)
	Co-Cr-Mo (Wironit ®)	cast alloy cimen Ø 8mm x3.2mm *vitro)*	artificial saliva 7.5 artificial saliva 1 5ml	6 eks	0.036 0.042	13.09 15.47	251.73 297.5	(Dimic Ivana D et al 2014)
	Co-Cr (Remanium)	cast alloy cimen + electrolysis 40x20x3mm *(in o)*	artificial saliva 50ml	2 days	0.5	18.95	364.5	(Galo et al. 2012)
	Stainless steel (Preform arch wires, Ortho-Organizers)	orthodontic wire 0.017 × 0.025 ı 100 mm length *vitro)*	Artificial saliva 100ml	28 days	0.018	0.39	7.57	(Gopikrishnan et al 2015)
	Stainless steel (American Orthodontics, 3M Unitek)	2 orthodontic es 20 ortho ckets 2 ligatures *(in o)*	artificial saliva flow, 0.5ml/min 19.41 L (flow)	28 days	n.d.	0.01	0.192	(Mikulewicz et al. 2014)
Co	Stainless steel (Ultraminitrim,	20 orthodontic ckets	MEM 30ml	30 days	n.d.	0.05	0.84	(Ortiz et al. 2011)

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