Efficacy of Disinfectants on Silicone Maxillofacial Prostheses - a Systematic Review

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Introduction

Silicone prostheses are replaced frequently on an average of two years due to degradation of its properties. Therefore, maintenance of maxillofacial prostheses are important, but there are no consensus regarding the best method to clean and disinfect the prostheses. This study reviewed articles to assess the efficacy of disinfectants and their potential adverse effects on accelerating the deterioration of prostheses, and to develop a standard disinfecting instruction to maximize the lifespan of prostheses.

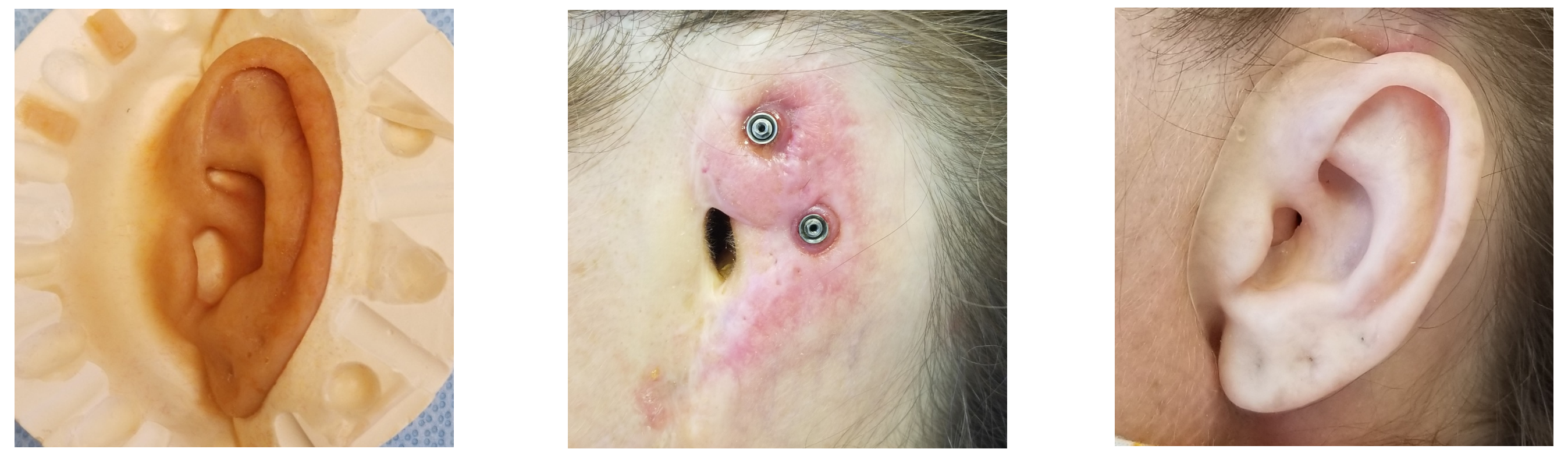
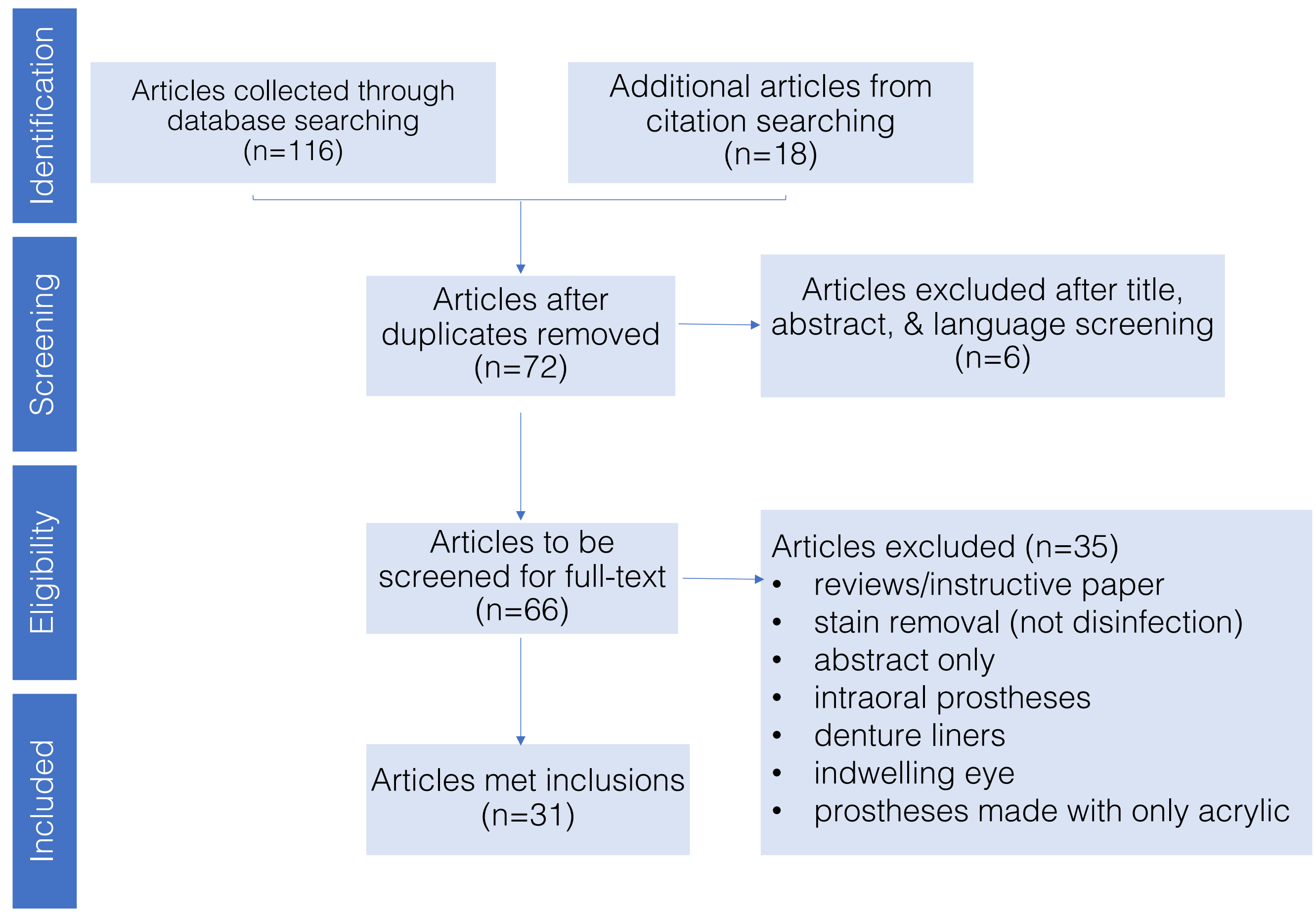


Figure 1. Implant-supported silicone maxillofacial prosthesis.
Clinical photo provided by Dr. Seelaus

Methods

- Database: PubMed, Embase, Cochrane Library, Web of Science, and Scopus, published in English without date restrictions.
- MeSH terms and research strategy: (silicone OR silicone elastomer) AND (maxillofacial prostheses OR extraoral prostheses) AND (disinfection OR hygiene OR cleaning OR decontamination)



Identification

Articles collected through database searching (n=116)

Additional articles from citation searching (n=18)

Screening

Articles after duplicates removed (n=72)

Articles excluded after title, abstract, & language screening (n=6)

Eligibility

Articles to be screened for full-text (n=66)

Articles excluded (n=35)
- reviews/instructive paper
- stain removal (not disinfection)
- abstract only
- intraoral prostheses
- denture liners
- indwelling eye
- prostheses made with only acrylic

Included

Articles met inclusions (n=31)

Figure 2. Flow chart of research strategy and data selection process

Results

- Chlorhexidine, soap, and effervescent tab most frequently used.
- Most studies were simulated up to 1 clinical service year.
- Intrinsic changes in its physical property regardless of disinfectant use.
- Some essential oils reported to be as effective as CHX, soap, and sodium hypochlorite.

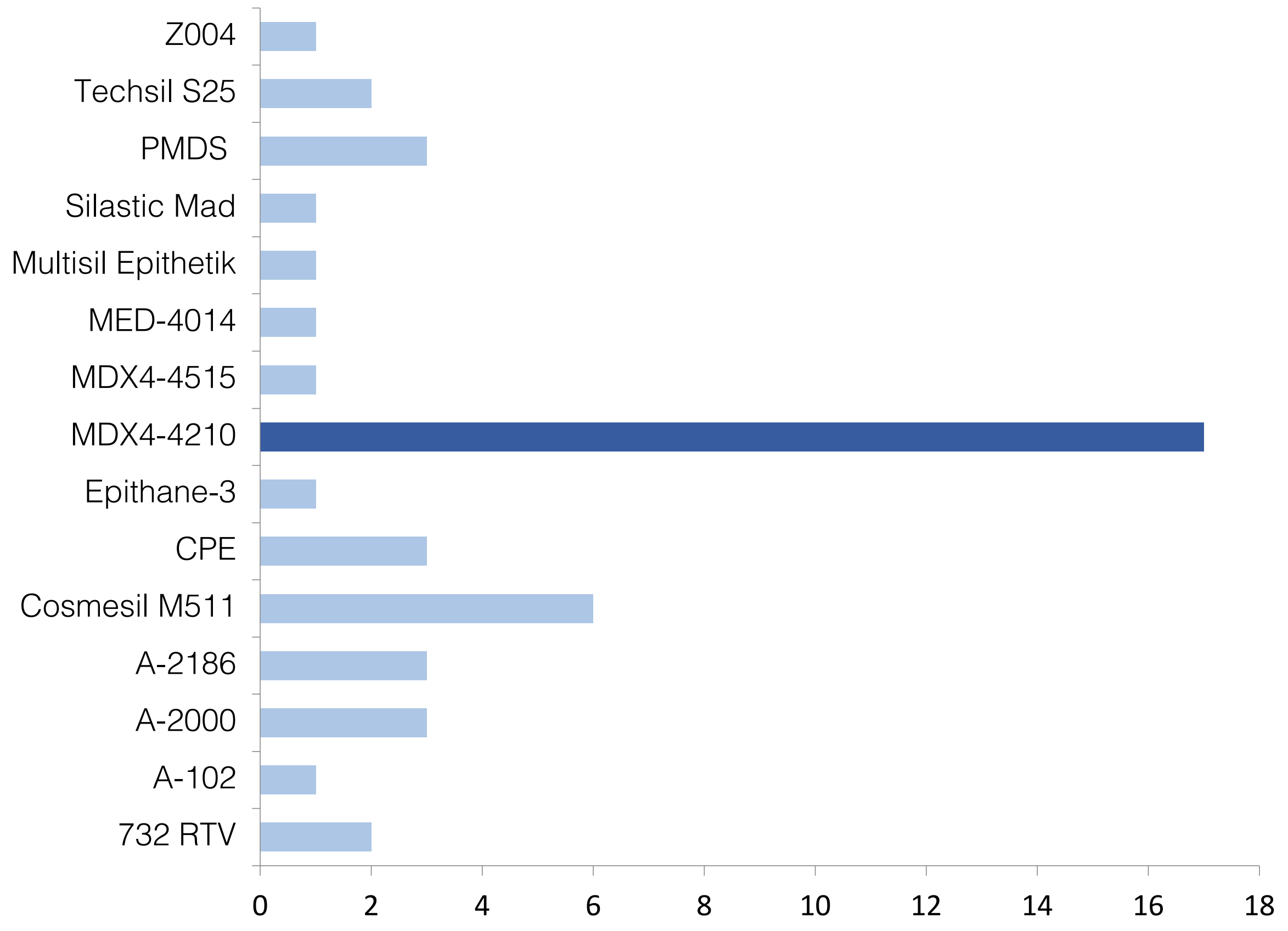


Figure 3. Types of silicone material tested in studies. 15 different silicone materials were tested in studies, and MDX4-4210 was the most tested silicone material.

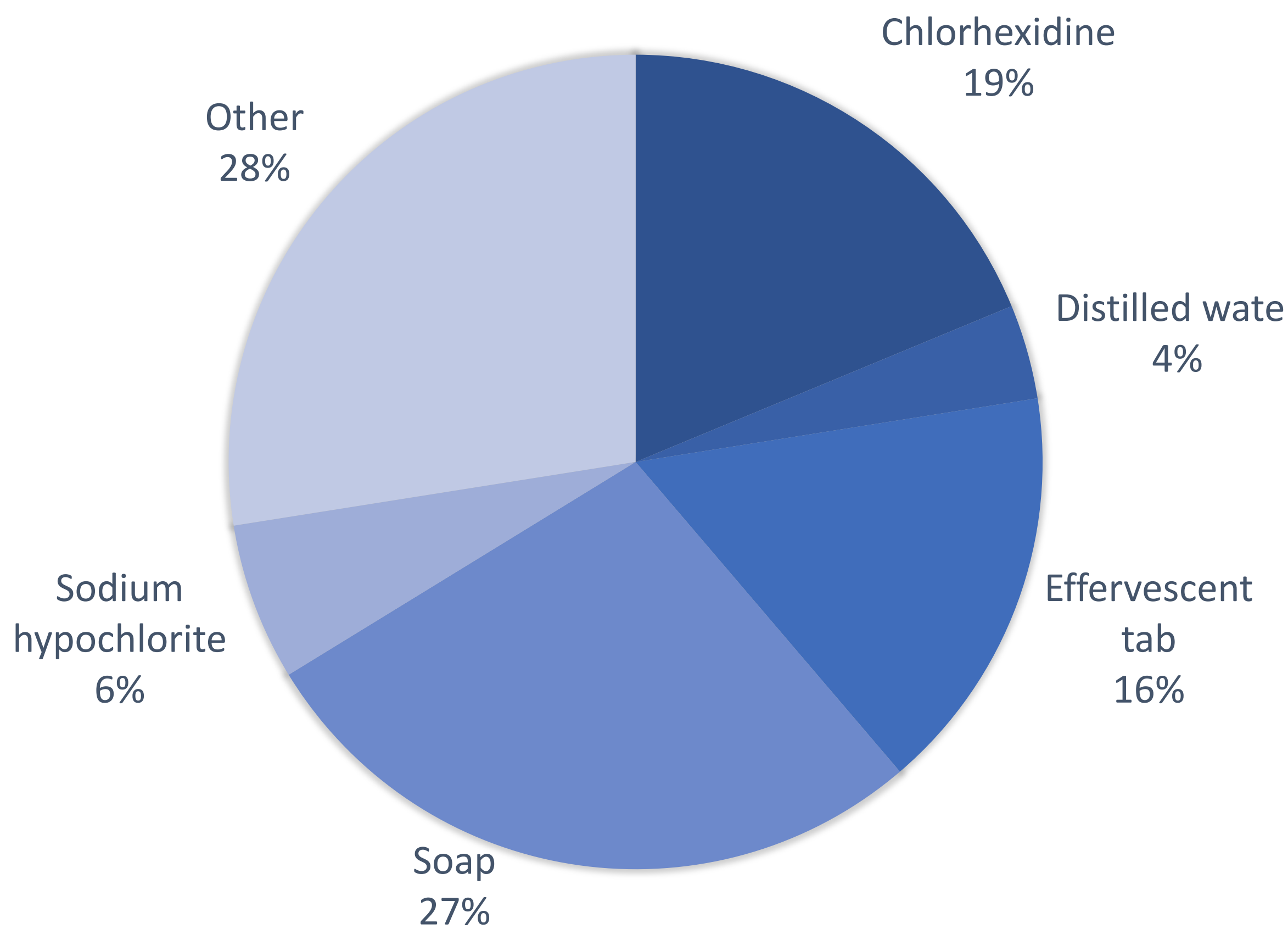


Figure 4. Types of disinfectants reported in studies

Table 1. Effects on physical properties.

Property	ref	CHX	Soap	ET	Other			
bond strength (Si-urethane)	23	-	🟦▨ hot/warm	-				
color changes	2	🟩 2%	-	-	🟩 11% PAQ	🟥 11% PGL	🟥 11% PAL	🟩 DI
	4	🟩 2%	🟥 antimicrobial	-	🟩 DI			
	5	🟥▨	🟥▨	-	🟥▨ Saline	🟥▨ HC	🟥▨ CN	
	8	-	🟩	-	🟩 ethanol 95°	🟩 DI		
	10	-	-	-	🟩 ASCS			
	11	🟩	🟩	🟩				
	12	🟩	🟩	🟩				
	15	-	🟩	🟩				
	19	-	🟥▨	-	🟨 SH	🟥▨ CDSn		
	20	-	🟨▨	🟩				
	26	-	-	-	🟨 alcohol			
	31	-	🟩	🟥				
color stability	1	🟦▨	🟦▨	🟦▨				
detail reproduction	6	🟩	🟩	🟩				
	13	-	🟩	🟩				
	14	🟩	🟩	🟩				
deterioration	32	-	🟩	🟩				
glass transition temperature	24	-	🟨	-	🟥 SH	🟨 CDSn		
marginal deterioration	22	🟩	-	-				
optical density	26	-	-	-	🟨 alcohol			
surface roughness	1	🟦▨	🟦▨	🟦▨				
	21	-	🟦▨	🟦▨				

▨	significant changes
🟩	clinically acceptable
🟨	clinical acceptability depends on material
🟥	clinically unacceptable
🟦	clinical acceptability unknown

Table 2. Effects on mechanical properties

Property	ref	CHX	Soap	ET	Other			
dimensional stability	6	🟩	🟩	🟩				
	13	-	🟩	🟩				
	14	🟩	🟩	🟩				
elongation	7	-	-	-	🟦 ASCS			
	27	-	-	-	🟦▨ TTO	🟦▨ MO		
microindentation	17	-	🟩	-	🟩 CAS	🟩 SH		
Shore A hardness	1	🟩	🟩	🟩				
	2	🟩	-	-	🟩 11% PAQ	🟩 11% PGL	🟩 11% PAL	🟩 DI
	5	🟩	🟩	-	🟩 saline	🟩 water	🟩 HC	🟩 CN
	7	-	-	-	🟩 ASCS			
	19	-	🟩	-	🟩 SH	🟩 CDS		
	21	-	🟩	🟩				
	25	🟩	🟩	🟩				
	27	-	-	-	🟦▨ TTO	🟦▨ MO		
	29	🟩	-	-				
	30	🟩	-	-	🟩 SP 10%	🟩 SP 15%		
	32	-	🟩	🟩				
tear strength	7	-	-	-	🟦▨ ASCS			
	27	-	-	-	🟦 TTO	🟦 MO		
tensile modulus	7	-	-	-	🟦▨ ASCS			
tensile strength	7	-	-	-	🟦 ASCS			
	17	-	🟩	-	🟩 CAS	🟩 SH		
	27	-	-	-	🟦 TTO	🟦 MO		

ASCS: antimicrobial silicone-cleaning solution **CAS**: commercial antimicrobial soap. **CDSn**: commercial disinfecting solution **CHX**: chlorhexidine (4%, otherwise noted) **CN**: *C. nardus* **ET**: effervescent tab **HC**: *H. canadensis* **NS**: neutral soap **PAQ/PGL/PAL**: propolis in aqueous, glycolic, and liquid **SH**: sodium hypochlorite **TTO**: tea tree oil. **MO**: Manuka oil **SP**: *S. persica L*

Table 3. Antimicrobial performance

Silicone	Microorganism	ref	Disinfectant
A-2186	*S. aureus* *C. albicans*	3	🟩 rHBD3 (30+ min) 🟩 5.25% SH (30+ min)
Cosmesil M511	C. tropicalis	16	🟩 *C. citratus* 🟥 *C. cyminum* 🟥 *C. limon* 🟩 *C. verum*
	mixed bacteria Mixed yeast (24-hour and 2-week old)	18	🟥 water 🟩 antibacterial soap 🟩 essential-oil-containing mouth rinse 🟩 ethanol 27% 🟩 CHX 🟥 buttermilk
	S. epidermis	27	🟩 Tea tree oil 🟩 Manuka oil
MDX4-4210	*S. aureus* *C. albicans*	9	🟩 neutral soap 🟨 CHX 4% 🟥 *C. nardus* 🟨 *H. canadensis*

🟩	Effective
🟨	Somewhat effective
🟥	Poor

Discussion

- If change in color, ΔE, exceeds 1.1, it is detectible with human eyes, and if exceeds 3, it is considered as clinically unacceptable.
- Clinically acceptable Shore A hardness of silicone material is 25~35.
- Generally, all the disinfectants caused changes in physical and mechanical properties. Most of the changes in the mechanical properties were still clinically acceptable, whereas disinfectant use substantially affected the physical properties.

Conclusion

- 4% Chlorhexidine is suggested to be the best disinfecting agent with antimicrobial activity without causing huge negative effects on silicone properties.

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