# A Survey of Disinfection of Irreversible Hydrocolloid and Silicone Impressions in European Union Dental Schools: Epidemiologic Study

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> Purpose: The objective of this cross-sectional study was to describe corresponding procedures for irreversible hydrocolloid and silicone impressions taught and used in European Union dental schools. Materials and Methods: A self-administered questionnaire requesting information about rinsing and disinfection methods was sent to each of the 373 heads of prosthodontic, pedodontic, and orthodontic departments in the 131 European Union dental schools. Response rate was 94%. Statistical analysis included chi-square or Fisher exact tests, and ANOVA or Kruskall-Wallis tests. *Results:* Of the responding departments, 92% systematically rinsed their impressions. Fifteen percent of the departments, mostly orthodontics, never disinfected irreversible hydrocolloid impressions, and 11% never disinfected silicone impressions. The immersion method was used by 65% for irreversible hydrocolloid impressions (73% for silicone), with a disinfection time of  $10.3 \pm 6.3$  minutes ( $11.8 \pm 7.4$  for silicone). The disinfected impressions were not rinsed by 16% for irreversible hydrocolloid and 14% for silicone. Most departments used brand-name products. Conclusion: The same disinfection procedure for both irreversible hydrocolloid and silicone impressions was used by 78% of departments. There was great diversity, however, between departments in the procedure used for each impression material. Int J Prosthodont 2004;17:165-171.

n view of the infectious carrier state of a significant proportion of the population and current trends in crossinfection control, the routine disinfection of dental impressions has become crucial to prevent the transmission of infectious diseases.<sup>1–9</sup> In clinical practice, the different disinfection procedures raise a special problem affecting the dimensional accuracy or surface detail of impressions. Different authors have evaluated the possible damage to the quality of the impression according to the disinfectant methods, products, and time used.<sup>10–31</sup> Unfortunately, their results were often contradictory for the same impression material. If a disinfection time of fewer than 30 minutes is, for example, considered with irreversible hydrocolloid (IH) impressions, some authors indicate the immersion method,<sup>20–26</sup> while others prefer the spray method depending on the disinfection product.<sup>14,15,17–20,23,32–34</sup> In the case of silicone (S) impressions, some authors indicate an immersion time of 30 minutes or less,<sup>11–13,16,20,21,23,27–29,31,34–36</sup> while others<sup>12,22,37</sup> differ depending on the disinfection products tested; these were mostly a sodium hypochlorite (SH) or glutaraldehyde (G) solution used with different concentrations. Moreover, the decontamination efficacy has rarely been evaluated considering the large number of possible procedures.<sup>9,30,38–43</sup>

Therefore, no consensus exists for the disinfection procedures that should be used depending on the dental impression material. At the moment, the few national recommendations are not precise enough. The American Dental Association (ADA) only advises an immersion method in any compatible disinfecting product, with a disinfection time of less than 30 minutes.<sup>44,45</sup> However, most manufacturers do not mention the disinfection action of their products in the particular case of dental impressions. The Canadian Dental Association

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	Ped	Pedodontics		odontics	Prosthetics		
Country	Response	No response	Response	No response	Response	No response	
Austria	3	0	3	0	3	0	
Belgium	6	0	6	0	6	0	
Denmark	2	0	2	0	2	0	
Finland	3	0	3	0	3	0	
France	16	0	15	0	16	0	
Germany	32	0	29	0	32	0	
Greece	2	0	2	0	2	0	
Ireland	2	0	2	0	2	0	
Italy	19	4	20	3	21	7	
Portugal	4	0	4	0	4	0	
Spain	6	2	7	1	6	4	
Sweden	4	0	4	0	4	0	
Netherlands	3	0	3	0	3	0	
United Kingdom	15	0	15	0	16	0	
Total	117	6	115	4	120	11	

 Table 1
 Departments of the 131 EU Dental Schools

recommends either immersion or spray methods, without any indication of the time.<sup>46</sup> The Health Department of the French Ministry of Employment and Solidarity indicates the same disinfection time (10 to 15 minutes) for all impression materials, whatever their properties (hydrophylic IH and hydrophobic S).<sup>47</sup>

The aim of the present study was to describe the disinfection procedures for IH and S impressions currently taught and used in the European Union (EU) dental schools. This could contribute to establishing a consensus.

### **Materials and Methods**

This cross-sectional study involved each of the 131 EU dental schools. The study population was represented by the professors in charge of the prosthetic, pedodontic, and orthodontic departments regularly making dental impressions. Since pedodontic or orthodontic departments did not exist in all the EU dental schools, the study population involved only 373 heads of department instead of 393 (Table 1).

Each head of department of prosthetics, pedodontics, and orthodontics received, by mail, the same self-administered questionnaire aimed at procuring information regarding their current disinfection procedures. This questionnaire had been pretested in a pilot study carried out in the French dental schools.<sup>48</sup> In an effort to increase the response rate, up to 10 separate mailings were sent to these heads of department according to the swiftness of their answers. This questionnaire covered information in four areas: department, first stage of impression rinsing, and second stage of disinfection for IH and S impressions. Details were requested regarding the disinfection methods (immersion, spray, intermediate), products, and time used according to the impression material. Three hundred fifty-two heads of department returned the questionnaires. Since two were unreadable (Italian prosthetic departments), results concerned 350 departments.

The categoric variables (rinsing and disinfection methods) were analyzed using chi-square or Fisher exact tests when at least one of the expected numbers was less than 5. Analysis of variance (ANOVA) or nonparametric tests (Mann-Whitney or Kruskall-Wallis tests) were used to analyze the quantitative variables (time of rinsing and disinfection). These variables were compared according to groups corresponding to departments, disinfection methods, and countries. However, when comparing countries, only France, Germany, Italy, and the United Kingdom were considered because the others did not have enough dental schools. Statistical analysis was performed with SPSS 11.5 for Windows (SPSS).

#### Results

## **Rinsing of Dental Impressions**

Three hundred twenty-one departments systematically rinsed their impressions (Table 2). Only in the Italian departments was this first stage systematized (Table 3). Seventeen departments rinsed impressions occasionally, restricting this gesture to those soiled by blood or concerning patients at risk. Using cold, soapy, or lukewarm water, the protocol of the departments did not differ significantly according to specialty. One hundred thirty department heads reported a rinsing time ranging from 0.08 to 5.00 minutes (Table 2). The other 208 heads just selected the option on the questionnaire, "Rinse until the disappearance of any debris or trace of blood." Even if the time did not differ significantly between the type of water used–cold ( $0.78 \pm 0.79$  minutes), lukewarm (0.79 $\pm$  0.63 minutes), or soapy water (1.38  $\pm$  1.03 minutes)– a tendency for a longer time with soapy water was

	All departments		Pedodontics		Orthodontics		Prosthetics		
	n	%	n	%	n	%	n	0⁄0	Р
Rinsing of impressions									.47
None*	12	3	2	2	7	6	3	3	
Occasional	17	5	6	5	6	5	5	4	
Systematic	321	92	109	93	102	89	110	93	
Water									.78
Cold	273	81	94	82	83	77	96	84	
Lukewarm	29	8	9	8	11	10	9	8	
Soapy	36	11	12	10	14	13	10	8	
<b>Disinfection of IH impress</b>	sions								.03
None <sup>†</sup>	52	15	12	10	27	24	13	11	
Occasional	36	10	10	9	12	10	14	12	
Systematic	262	75	95	81	76	66	91	77	
Method									.88
Immersion	193	65	69	66	54	61	70	67	
Sprav	79	26	26	25	27	31	26	25	
Intermediate	26	9	10	9	7	8	9	8	
Disinfectant									.75
G	23	8	6	6	9	10	8	7	
SH	71	24	27	26	18	21	26	25	
Brand products	204	68	72	68	61	69	71	68	
Rinsing									.01
Yes	250	84	89	85	66	74	95	89	
No	48	16	16	15	22	26	10	11	
Disinfection of S impress	ions								.67
None <sup>‡</sup>	23	11	11	10	_	_	12	10	
Occasional	16	7	6	6	_	-	10	9	
Systematic	181	82	89	84	_	_	92	81	
Method									.86
Immersion	144	73	68	72	_	_	76	74	
Sprav	44	5	22	23	_	-	22	22	
Intermediate	9	22	5	5	_	_	4	4	
Disinfectant									.77
G	23	12	11	12	_	_	12	12	
SH	35	18	15	16	_	_	20	20	
Brand products	139	70	69	72	_	_	70	68	
Rinsing									.41
Yes	170	86	80	84	_	_	90	88	
No	27	14	15	16	_	_	12	12	
Time of rinsing <sup>¶</sup>	130 (0.84	4.0.82)	49 (0.93	3 0.93)	42 (0.8	0 0 80)	39 (0 7	7.0.70)	65
Time of disinfecting <sup>¶</sup>	(0.0	.,,		.,	(0.0	-,,	00 (0.7	.,,	.50
IH	273 (103	32, 6 25)	100 (11 1	0 7 42)	75 (9.5	1 5 12)	98 (10	16.567)	24
S	183 (11.7	78, 7,42)	89 (12.4	42. 8.26)	_	,,	94 (11.	18. 6.51)	.34

 Table 2
 Characteristics of Rinsing and Disinfection According to Specialty in the 131 EU Dental Schools

\*Nine departments in Germany; and one each in UK, Finland, and France.

<sup>1</sup>Thirteen departments in France; eight in Italy; five each in Germany, Netherlands, and Belgium; four in Sweden; three each in Denmark and Greece; two each in Spain and UK; and one each in Austria and Portugal.

<sup>‡</sup>Five departments in Italy; four in France; three each in Sweden and Netherlands; two each in Denmark, Germany, and Greece; and one each in UK and Belgium.

<sup>¶</sup>Mean, standard deviation in parentheses.

Occasional = because of traces of blood, at-risk patient; IH = irreversible hydrocolloid; G = glutaraldehyde solution 2%-10%; SH = sodium hypochlorite solution 0.1%-12.0%; S = silicone.

observed (P=.06). The 12 departments that did not rinse their impressions disinfected them systematically.

# Disinfection of Irreversible Hydrocolloid Impressions

Fifty-two departments never disinfected their impressions, but they rinsed them. Occasional disinfection, in relation to the health of the patient (high risk) or to impressions soiled by blood, was reported by 36 department heads. The impressions were less often disinfected in orthodontic departments and in France (Tables 2 and 3). Disinfection time depended on the method used: immersion, spray, or intermediate, where the impression is dipped for a few seconds in disinfectant solution and then covered with gauze dampened with the same solution for the disinfection time. The intermediate method was only used in Germany and the UK (Table 4). Most departments, and all German departments, used brand-name products. The sprayed impressions or those that were dipped in the disinfectant for a few seconds (intermediate method) were put into a sealed plastic bag immediately by 47% of the departments using these methods. Twenty-three departments used a

	France		Ger	Germany		Italv		United Kingdom	
	n	%	n	%	n	%	n	%	Р
Rinsing of impression	s								.01
None	1	2	9	10	-	-	1	2	
Occasional	6	13	4	4	_	_	1	2	
Systematic	40	85	80	86	58	100	44	96	
<b>Disinfection of IH imp</b>	ressions								.01
None	13	27	5	5	8	14	2	4	
Occasional	6	13	6	7	2	3	1	2	
Systematic	28	60	82	88	48	83	43	94	
Disinfectant									.01
G	4	12	_	_	14	28	_	_	
SH	11	32	_	_	11	22	19	43	
Brand products	19	56	88	100	25	50	25	57	
Rinsing									.03
Yes	28	82	81	92	42	84	32	73	
No	6	18	7	8	8	16	12	27	
<b>Disinfection of S impre</b>	essions								.03
None	4	13	2	3	5	14	1	3	
Occasional	4	13	2	3	1	3	_	_	
Systematic	22	74	59	94	30	83	30	97	
Disinfectant									.01
G	4	15	_	_	8	26	_	_	
SH	8	31	_	_	7	22	13	43	
Brand products	14	54	61	100	16	58	17	57	
Rinsing									.22
Yes	23	89	56	92	23	74	25	83	
No	3	11	5	8	8	26	5	17	

 Table 3
 Characteristics of Impression Disinfection in Four Countries

Occasional = because of traces of blood, at-risk patient; IH = irreversible hydrocolloid; G = glutaraldehyde solution 2%-10%; SH = sodium hypochlorite solution 0.1%-12.0%; S = silicone.

Table 4	Characteristics	of Impression	Disinfection	According to	Method Used
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	Imme	Immersion		Spray		Intermediate	
	n	0⁄0	n	%	n	%	Р
Material							.08
IH	193	65	79	26	26	9	
S	144	73	44	22	9	5	
Disinfection of IH impressions in							.01
France	12	34	23	66	_	_	
Germany	76	86	6	7	6	7	
Italy	33	66	17	34	_	_	
United Kingdom	29	66	9	20	6	14	
Disinfectant							.01
G	16	8	7	9	_	_	
SH	46	24	12	15	13	50	
Brand products*	131	68	60	76	13	50	
Rinsing							.02
Yes	176	91	54	68	18	69	
No	17	9	25	32	8	31	
Disinfection of S impressions in							.01
France	12	46	_	_	14	54	
Germany	55	90	3	5	3	5	
Italy	21	68	_	_	10	32	
United Kingdom	23	77	2	6	5	17	
Disinfectant							.12
G	19	13	4	9	_	_	
SH	30	21	3	7	2	22	
Brand products*	95	66	37	84	7	78	
Rinsing							.02
Yes	130	90	34	77	6	67	
No	14	10	10	23	3	33	
Time of disinfecting <sup>†</sup>							
IH	189 (10.0	), 5.8)	61 (11.	61 (11.3, 8.2)		23 (10.3, 2.7)	
S	141 (11.6	141 (11.6, 6.9)		35 (13.2, 9.6)		7 (8.9, 3.0)	

\*In descending order: Impresept, MD 250, Dimenol, Sporicin, Virkon, Aseptoprint, Perform, Cidex plus, Sanitex plus, Biocide, Sporex, Zefirol, Mucalgin, Instrunet, Chloramine, Mikrozid . . . <sup>†</sup>Mean, standard deviation in parentheses. IH = irreversible hydrocolloid; S = silicone; G = glutaraldehyde solution 2%–10%; SH = sodium hypochlorite solution 0.1%–12.0%.

special device for the spray decontamination (Hygojet, Dürr Dental). Some departments did not rinse the disinfected impressions under tap water (Tables 2 to 4).

#### **Disinfection of Silicone Impressions**

In this particular case, the orthodontic departments were not considered. Among the 220 departments that used S, 7% applied the disinfection procedure occasionally (trace of blood or high-risk patients). Most departments, except the French ones, used the immersion method (Table 2). The time of disinfecting did not differ with the method (immersion, spray, or intermediate) (Table 4). The sprayed impressions or those that were dipped in the disinfectant for a few seconds were then put into a sealed plastic bag for the disinfection time in 38% of the cases. Twenty-three departments used Hygojet. Rinsing was significantly more often practiced after the immersion method (Table 4).

Finally, IH and S impressions were disinfected using the same procedure in 78% of the departments. One department did not disinfect IH impressions, but systematically disinfected those made of S. Four departments changed occasional disinfection of IH for systematic disinfection of S. Twelve departments using spray for IH changed to immersion for S materials. The others lengthened the disinfection time (P < .02; Table 2).

### Discussion

The response rate (94%) was higher than that obtained in a previous study carried out in the UK dental schools.<sup>4</sup> It corresponded with those obtained in more recent studies in the UK dental hospitals and US dental laboratories.<sup>1,6</sup> Thus, we met the conditions to find a consensus. The bias associated with nonparticipation, however, should be considered. Based on how data were collected, with no face-to-face bias, the probability of differential misclassification appeared to be low. Information bias may have occurred at random, independent of type of department or country.

Most departments (97%) reported rinsing their impressions, and very few did so only in particular situations (traces of blood or high-risk patients). This percentage was twice that observed in UK dental schools more than 15 years ago.<sup>4</sup> This increase is no doubt related to a universal recommendation to rinse dental impressions immediately after removing them from the patient's mouth.<sup>6,44–47,49</sup> Rinsing is only a first stage, even if around one of seven departments did not practice a second stage of disinfection. On the contrary, 3% of the heads of department advocated immediated disinfection only, without prerinsing; they were mostly in Germany. Only 39% of departments indicated the precise rinsing time, from 5 seconds to 5 minutes, but most

were above the 15 seconds recommended.<sup>49</sup> Moreover, this time was very variable with reference to its standard deviation. Other respondents only reported following the usual advice: "Rinsing until visible saliva, blood, and debris were completely removed from the impressions."<sup>6,44-47</sup> Routinely rinsing in cold water was reported by 81% of the heads of department, confirming that impressions are usually washed under cold tap water,<sup>1,4</sup> not with lukewarm or soapy water.<sup>48</sup>

Most departments (75%) reported routinely carrying out some kind of IH impression disinfection. One in eight departments disinfected only the impressions of highrisk patients or those soiled by blood. Therefore, 15% of the departments, mostly orthodontics or French, never disinfected their IH impressions. If orthodontists could justify their practice by the age of their patients, why was this not observed among the pedodontic departments?

In concordance with former studies,<sup>1,4,6,48</sup> a wide range of procedures were reported. Most departments used the immersion method with their chosen solution, as recommended by the ADA and Centers for Disease Control.<sup>5,44</sup> Almost one in three departments used the spray method, probably because it is well-known that IH imbibes water and swells.7 In addition, different studies suggest that surface quality of this hydrophilic material is adversely affected by immersion.<sup>15,17,18,32,39</sup> Accordingly, the spray method is recommended by the French Ministry,47 and this could explain its widespread use among the French departments. Unfortunately, bacteriologic studies are infrequent and have only considered disinfection times of up to 10 minutes.<sup>10,30,41,42</sup> Moreover, a disadvantage of the spray method is the possibility that the spray does not reach some parts of the impression.<sup>1,48</sup> Nevertheless, this may easily be countered with the use of the intermediate method.<sup>48</sup> In both spray and intermediate methods, a sealed plastic bag in which to put the impression for the disinfection time should be used systematically to increase the efficacy of the disinfecting product.15,30,46,48

Products to decontaminate did not significantly differ according to department. The brand products were the most commonly used, particularly in Germany; a wide range of brand-name products were reported, even if some are not specifically recommended for impression disinfection by dental associations or manufacturers. Even though the disinfectant properties of these products were tested on hard surfaces, few studies assess their efficacy or dimensional consequences on dental impressions.<sup>9,26,30,34,39</sup> Contrary to the dental laboratories in US and UK hospitals,<sup>1,6</sup> where SH solution was more frequently used, it was only used by 24% of the present departments overall.

IH impressions disinfected for 10 minutes or more have been shown to undergo significant dimensional and surface quality change when immersed in a  $\ge 0.5\%$ 

SH solution.<sup>18,21,25,30</sup> Nevertheless, some authors agree with a 10-minute immersion in a 0.5% SH solution.<sup>20,24</sup> Decontamination efficacy has also been discussed according to the pH value of the solution.<sup>22,40</sup> Disinfection with a 5.25% SH solution for 10 minutes, 14, 19, 22, 23, 33 or with 1% SH for 30 minutes,<sup>20</sup> appears to have minimal effects and a satisfactory bactericidal action.<sup>22,38</sup> Frequent contradictions among these studies are often difficult to consider in clinical practice. Moreover, statistically significant effects were considered without clinically relevant effects because IHs are rarely used for precision impressions.<sup>20,25,26</sup> G solution with a concentration of 2% or more was used in only 8% of departments, less than that recorded in previous studies.<sup>1,4,6,48</sup> Unfortunately, concentrations of 2% or more cause deterioration of immersed IH and do not have a bactericidal action in under 10 minutes.<sup>17,19,20,25,33,39</sup> Only a few authors recommend a disinfection time up to 60 minutes.<sup>21</sup>

In the EU, almost 50% of the departments that did not rinse impressions after disinfection were those in orthodontics. Probably, precision or surface quality was not a priority for them. No rinsing was often associated with the spray method, so the disinfection time was longer. Without distinction in procedures, 20% of the department heads did not know how long the impressions had been disinfected. Others indicated times that were shorter than the disinfection time recommended by the ADA and equivalent to that recommended by the French Ministry.<sup>44,47</sup> Unfortunately, studies that focus on the determination of disinfection efficacy with equivalent times and previously described procedures are rare.<sup>30</sup>

All departments that never disinfected their S impressions adopted the same behavior with IH impressions. On the contrary, some that never or occasionally disinfected IH impressions changed their procedure and systematically disinfected S impressions. The immersion method was the most often used. The surface quality and dimensional changes of S impressions, which are hydrophobic, have always been better, after immersion with equivalent disinfection times, than those observed with IH. Thus, it is not surprising that the disinfection time of the S impressions was greater than for IH impressions. This was always below 30 minutes, as recommended by the ADA,45 but the period of less than 30 minutes does not correspond to a real consensus; it is probably due to the variations in solutions used. In some studies, impressions were immersed for 10 to 60 minutes in 0.05%<sup>27</sup> to 5.25%<sup>11,22,29</sup> SH without exhibiting any loss of dimensional accuracy or surface detail.<sup>11,12,20,21,23,27-29,36</sup> Contradictory results have, however, been yielded by other authors.<sup>22,37</sup> Whatever the procedure, the efficacy of decontamination has not been evaluated. In the case of a G solution, some authors found that S exhibits dimensional changes after a 30-minute immersion in 2% solution,<sup>21</sup> contrary to other investigators.<sup>11–13,16,20,28,31,35,36</sup> For a disinfection time of more than 30 minutes, some agree with the immersion method, 13, 16, 28 contrary to others.<sup>21</sup> A 30-minute immersion in 0.13% G is unanimously contraindicated,12,38 and an immersion in 3.5% G for 30 to 60 minutes is indicated.<sup>16</sup> Even with the large variability of these results, the small number of bacteriologic studies carried out to evaluate the disinfection procedures using SH or G solution is regrettable.43 Furthermore, if these disinfectant products have been specifically tested for harmlessness to impression quality, a very large number of different-brand products was rarely evaluated with IH or S.<sup>26,30,34</sup> In all these cases, the ADA recommends following the manufacturer's recommendations to obtain proper disinfection, even if no precise information for the disinfection of IH or S impressions exists.

### Conclusion

The results highlighted diversity in the disinfection methods and solutions for the same material both within and between departments and EU countries. Few differences were noted between the two materials within the same department. Only some lengthened the time of disinfection. This study demonstrated that there are no universally recognized impression disinfection procedures. This situation can be explained by the lack of dental literature that provides precise guidance about how specific impression materials should best be disinfected to balance the goals of safety and accuracy. The lack of bacteriologic studies concerning the efficacy of disinfection procedures and larger studies focused on the possible damage to the quality of the registration has encouraged department heads themselves to decrease disinfection times to prioritize the quality of impressions. In fact, there was only a consensus for the first stage of rinsing under tap water until saliva, blood, and debris were completely removed from the impressions. More appropriate standardized research is needed to assess greater efficacy of procedures in terms of disinfection while maintaining quality of impressions. The results will contribute to developing and implementing universal disinfection guidelines.

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