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Original Research Article

A Clinical and Microbiological Evaluation of the Disinfection Efficacy of Orthodontic Pliers

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Abstract: Disinfection and sterilization are, nowadays for dento-facial orthopedics as for all medical professions an unavoidable obligation, its objective is to prevent infectious risks both for the patient and the health care team. ***Objective*:** Checking the effectiveness of the disinfection process of orthodontic pliers. ***Material and Methods*:** This is a serial case study, carried out at the Zabana Dental Clinic of Blida University Hospital Centre and the Microbiology Unit of the Central Laboratory of the University Hospital centre unit Frantz Fanon. The study involved 54 orthodontic pliers. Each instrument was swabbed three swabs, one directly after contact with the patient's oral cavity, and two after 10 and 15 minutes of disinfection. ***Results*:** Microbiological analysis showed that: 100% of the instruments orthodontic pliers collected not disinfected are contaminated by bacteria with polymicrobial cultures mainly composed of Streptococci, Neisseria and Micrococcus. 43.75% of Orthodontic pliers disinfected for 10 minutes are contaminated with bacteria. 24.07% of orthodontic pliers disinfected for 15 minutes are contaminated with bacteria. The disinfection rate of orthodontic pliers was 35.18% after the first disinfection time, and 75.92% after the second disinfection time with $p < .05$, the difference is significant. In the fight against infections associated with care and to reduce cross-infections transmission, sterilization of reusable instruments, and the use of medical to Single use is the best way to ensure the safety of patients and staff from infectious risk.

Keywords: Disinfection, Sterilization, Infectious Risks, Microbiology, Orthodontic Pliers.

INTRODUCTION

In the management of orthodontic patients, clinicians require both consumable and non-consumable materials. Orthodontic pliers are among the semi-critical reusable instruments that require intermediate-level disinfection to ensure the safety of both patients and healthcare personnel, and to protect them from cross-contamination that may occur during routine handling in healthcare settings. This makes disinfection control essential for managing infectious risk and preventing cross-contamination. With this objective in mind, we conducted a study involving a sample of 54 orthodontic pliers collected from the Zabana Dental Clinic and analyzed at the central microbiology laboratory of the Frantz Fanon University Hospital Center in Blida.

MATERIALS AND METHODS

1. Study Design: This is a case series study conducted on 54 orthodontic pliers. Each instrument underwent three swab samplings: one immediately after contact with the patient's oral cavity, and two after undergoing disinfection for 10 and 15 minutes, respectively.

2. Objective: To evaluate the effectiveness of the disinfection process applied to orthodontic instruments (orthodontic pliers).

3. Inclusion Criteria: All patients presenting at the Department of Dentofacial Orthopedics at Blida University Hospital during the study period, who were undergoing placement of orthodontic appliances (ODF), and whose treatment required the use of orthodontic pliers, were included.

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4. Exclusion Criteria: Patients whose orthodontic instruments (orthodontic pliers) did not undergo both disinfection steps were excluded from the study.

5. Study Population: This study involved 162 swab samples from orthodontic pliers (54 before disinfection, 54 after the first disinfection step, and 54 after the second disinfection step). These samples were taken from 21 patients, including 6 males and 15 females (sex ratio M/F = 0.4), with a mean age of 14 years (range: 9–22 years).

6. Study Protocol: The study material consisted primarily of samples collected from orthodontic pliers subjected to microbiological analysis.

In the treatment of dental anomalies, the placement of fixed orthodontic appliances requires the use of several orthodontic pliers. These instruments must be properly disinfected to allow for safe reuse. Each plier underwent three swab samplings: the first without prior disinfection, and the subsequent two following the first and second disinfection steps.

STUDY RESULTS

1. Distribution of Samples According to Culture Positivity Rate: The distribution of the samples based on the positivity rate of microbial cultures is presented in the table below:

Table 1: Distribution of Orthodontic Pliers Samples According to Culture Positivity Rate

Struments	Sampling Time	Positive Culture	Negative Culture	Positivity Rate
Orthodontic Pliers	Samples collected before disinfection	54	0	54/54 100%
	Samples collected after the first disinfection step	35	19	35/54 64,81%
	Samples collected after the second disinfection step	13	41	13/54 24,07%

We observed that all samples collected before disinfection yielded positive cultures. It is noteworthy that a high positivity rate was also recorded after the first disinfection step, with 35 out of 54 samples, corresponding to 64.81%.

Furthermore, the positivity rate significantly decreased after the second disinfection step, with 13 out of 54 samples, corresponding to 24.07%.

2. Results of the Microbiological Analysis of Orthodontic Pliers before Disinfection

Bacteriological analysis of the 54 samples collected prior to disinfection revealed positive cultures in all cases, with 53 samples showing polymicrobial growth, involving 2 to 5 bacterial species per sample. The most frequently isolated bacterial genera were: Streptococcus, followed by Neisseria, and then Micrococcus. It is also worth mentioning that Corynebacterium and Haemophilus were isolated at non-negligible rates.

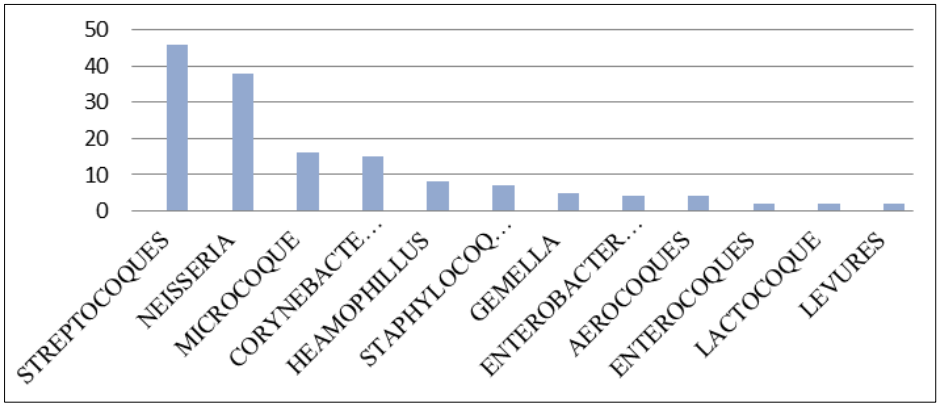

Figure 1: Distribution of Microorganisms Isolated from Orthodontic Pliers Samples before Disinfection

3. Results of the Microbiological Analysis of Orthodontic Pliers after Disinfection

Among the 35 positive samples collected after the first disinfection step, 15 showed polymicrobial cultures, with 2 to 3 bacterial species identified per sample. Among the 13 positive samples collected after the second disinfection step, 5 revealed polymicrobial cultures, each containing 2 bacterial species.

The most frequently isolated bacterial genera were: Streptococcus, followed by Gemella, and then Neisseria.

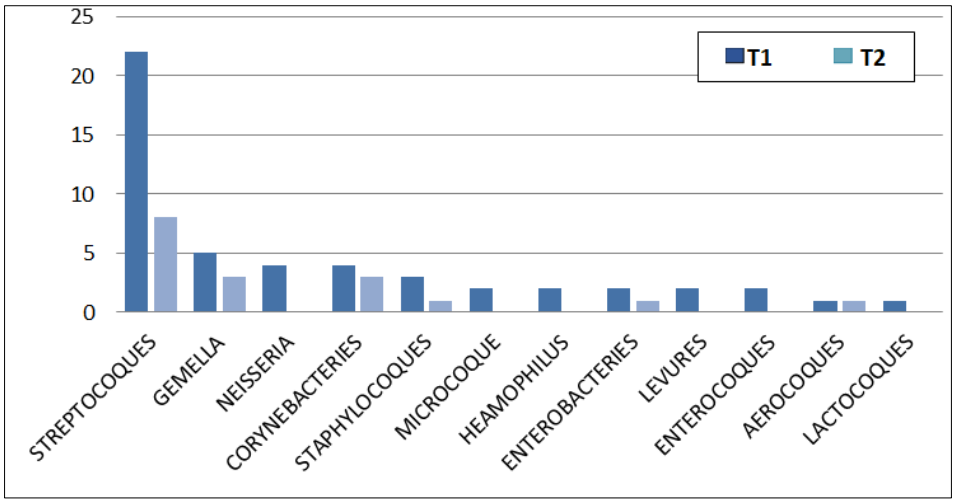

Figure 2: Distribution of Microorganisms Isolated from Orthodontic Pliers Samples

4. Distribution of Streptococcus Species Isolated from Orthodontic Pliers Samples Before and After Disinfection:

Streptococci were the most frequently isolated microorganisms from the orthodontic plier samples. Therefore, we focused on analyzing the distribution of the isolated Streptococcus species by type.

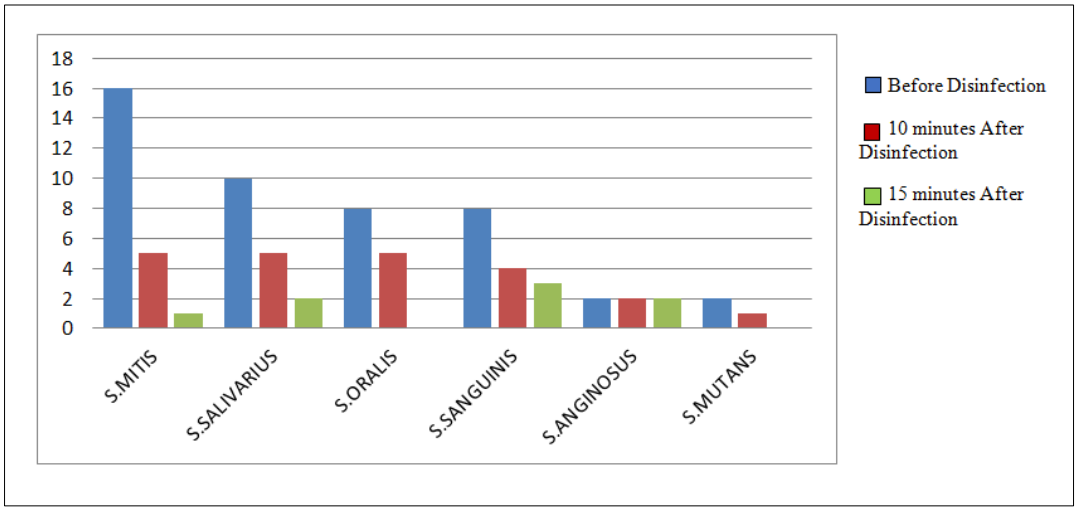

Figure 3: Distribution of Streptococcus Species Isolated from Orthodontic Pliers Samples Before and After Disinfection

The most frequently identified Streptococcus species before and after disinfection were Streptococcus mitis, followed by Streptococcus salivarius, and then Streptococcus oralis.

5. Disinfection Rate of Orthodontic Pliers:

The disinfection rate of orthodontic pliers was 35.18% after the first disinfection stage and 75.92% after the second stage. This difference was statistically significant ($p < 0.05$).

Table 2: Disinfection Rate of Orthodontic Pliers According to Disinfection Time

	Disinfected	Not disinfected	Disinfection Rate	P
1st Stage	19	35	35,18%	
2nd Stage	41	13	75.92%	< 0,05

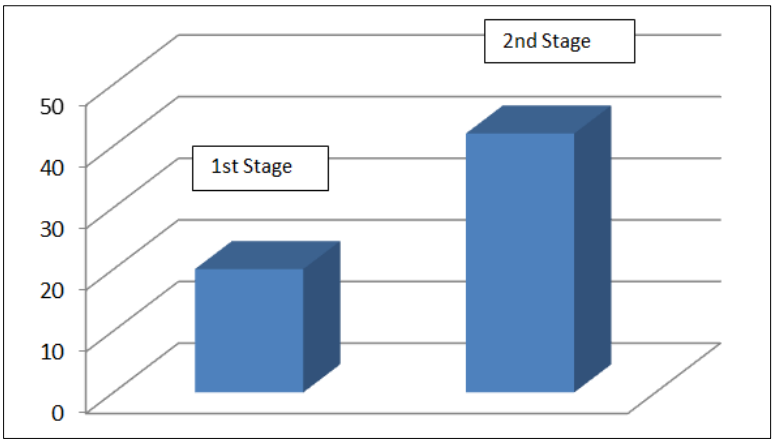

Figure 4: Disinfection Rate of Orthodontic Pliers According to Disinfection Time

DISCUSSION

64.81% of orthodontic pliers disinfected for 10 minutes and 24.07% of those disinfected for 15 minutes were contaminated with bacteria. A similar contamination rate was reported by Reggiani M *et al*., in 2015, where 25% of pliers treated with 70% alcohol (an intermediate-level disinfectant) showed positive bacterial cultures at the end of the treatment [1].

Contrasting results were reported by Vencatachalam N. *et al*., in 2020 in a study involving 10 pliers artificially contaminated with known microorganisms and then disinfected with benzalkonium chloride for 5, 10, and 15 minutes. In their study, all instruments showed negative bacterial cultures after 10 minutes of disinfection [2].

This discrepancy may be explained by several factors:

- A low initial bacterial load on the instruments;
- A small number of pliers treated;
- Differences in bacterial detection methods, as we used a qualitative presence/absence method with enrichment, which enabled the detection of low levels of bacterial contamination.

Following disinfection, we observed that Streptococci were the most frequently isolated bacteria from the instruments. This can be attributed to the strong adhesive capacity of Streptococci on stainless steel orthodontic instruments, as demonstrated by Mei L *et al*., in 2009 [3]. The predominant species included S. sanguinis, S. mitis, and S. oralis, which are commonly involved in cariogenic plaque formation, while S. mutans, the primary agent of dental caries, was not detected [4].

CONCLUSION

The disinfection rate of orthodontic pliers was 35.18% after the first disinfection stage and 75.92% after the second stage, with $p < 0.05$. This statistically significant difference indicates that a 15-minute disinfection time is more effective.

Our study demonstrated that the disinfection rate remains low for these semi-critical instruments, which come into contact with mucous membranes and can serve as vectors for cross-contamination between patients.

Considering the critical nature of these instruments—and the fact that certain orthodontic pliers (such as debonding pliers and band-removal pliers) can cause bleeding in some cases—there is a significant risk of infection. This risk is heightened by the presence of both pathogenic and opportunistic microorganisms among those resistant to disinfection.

In the context of infection prevention and control in healthcare settings, sterilization remains the ideal method to eliminate the risk of cross-contamination and transmission of pathogens associated with the use of orthodontic instruments. Therefore, the availability of multiple sets of orthodontic pliers is essential. Ideally, one set of pliers should be dedicated to each patient [5].

This Study Has Several Limitations:

- Short study duration;
- Absence of testing for anaerobic bacteria, mycobacteria, and viruses;
- Lack of resources for quantitative analysis and complete identification of all isolated bacteria.

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