Microwave Heating as an Alternative to Conventional Drying Ovens for Histological Section Adhesion: Evaluation Across Different Tissue Types

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Introduction

Histological Sections and Adherence

Histological sections are essential in clinical diagnostics[1].

The quality of the sections and their proper adhesion are critical factors that directly influence microscopic analysis[2].

Initially, adhesion was accomplished through the utilization of drying ovens operating at regulated temperatures to ensure[3]. However, nowadays, ovens are frequently integrated in automated staining equipments.

Introduction

Drying oven limitations[4]

High energy consumption

Requires significant laboratory space

(eg.: Immunohistochemistry)

Extends processing time

Introduction

Microwave oven applications

- Tissue fixation[10,11]
- Antigen retrieval[10–13]
- Bone and tooth decalcification[14,15]
- Fluorescence in situ hybridisation (FISH)[16]
- Special staining methods[17]

Percy Spencer
1945[5,6]

The MW enables uniform heating of the tissue by generating heat from within the sample through the rapid excitation of water molecules[7–9]

Introduction

Aims of the study

General Objective

To assess the adhesion of histological sections from different tissue types using a MW.

Specific Objectives

- To assess the adhesion of histological sections by comparing the use of the drying oven and the microwave oven, using 3min40s and 4min20s as incubation times.
- To study the quality of adhesion using breast, bone, brain and appendix, comparing them through a macroscopic assessment.

Materials and Methods

Data Collection and Processing

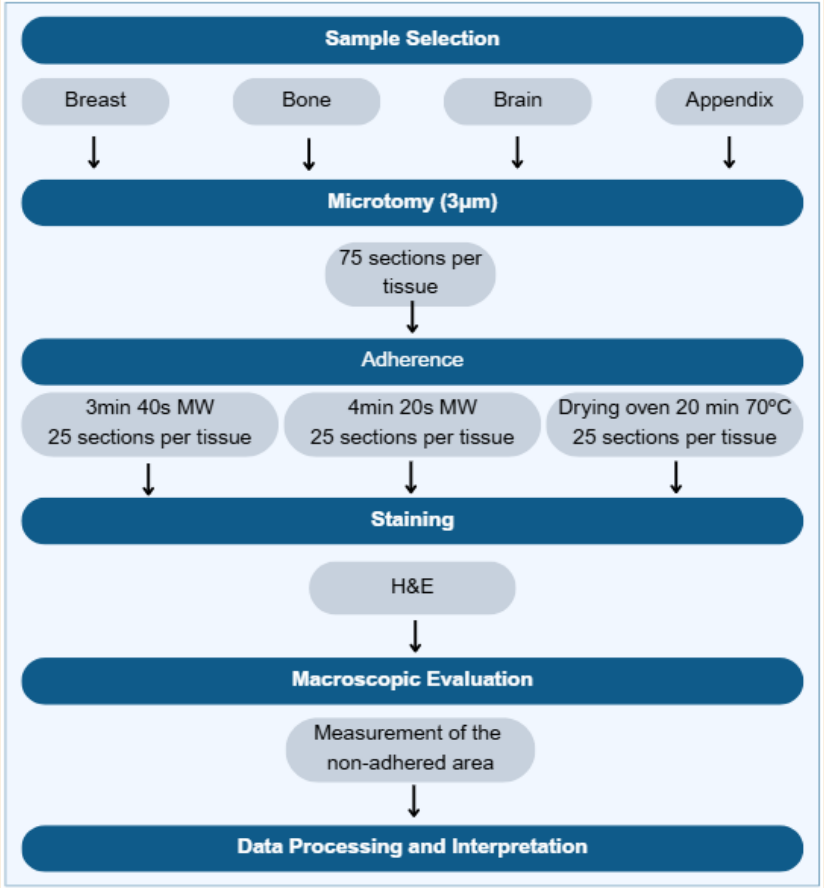


Figure 1: Schematic representation of the study methodological approach.

Dependent variable:
Percentage of non-adhered area

Independent variable:
MW exposure time

Materials and Methods

Preliminary Tests

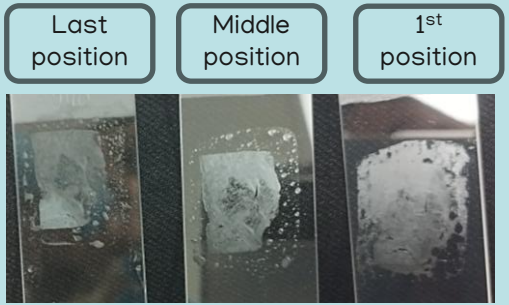


Figure 2: Preliminary slides of breast tissue (3 min 40 s)

Macroscopic assessment

Figure 3: Measurement of the non-adhered area.

Calculation formula:

$$\frac{Non\ adhered\ area}{Mean\ area\ of\ control\ group} \times 100$$

Results/Discussion

Descriptive Statistics

3min 40s

7,49% ± 13,47% SD

4min 20s

8,81% ± 14,01% SD

Drying oven

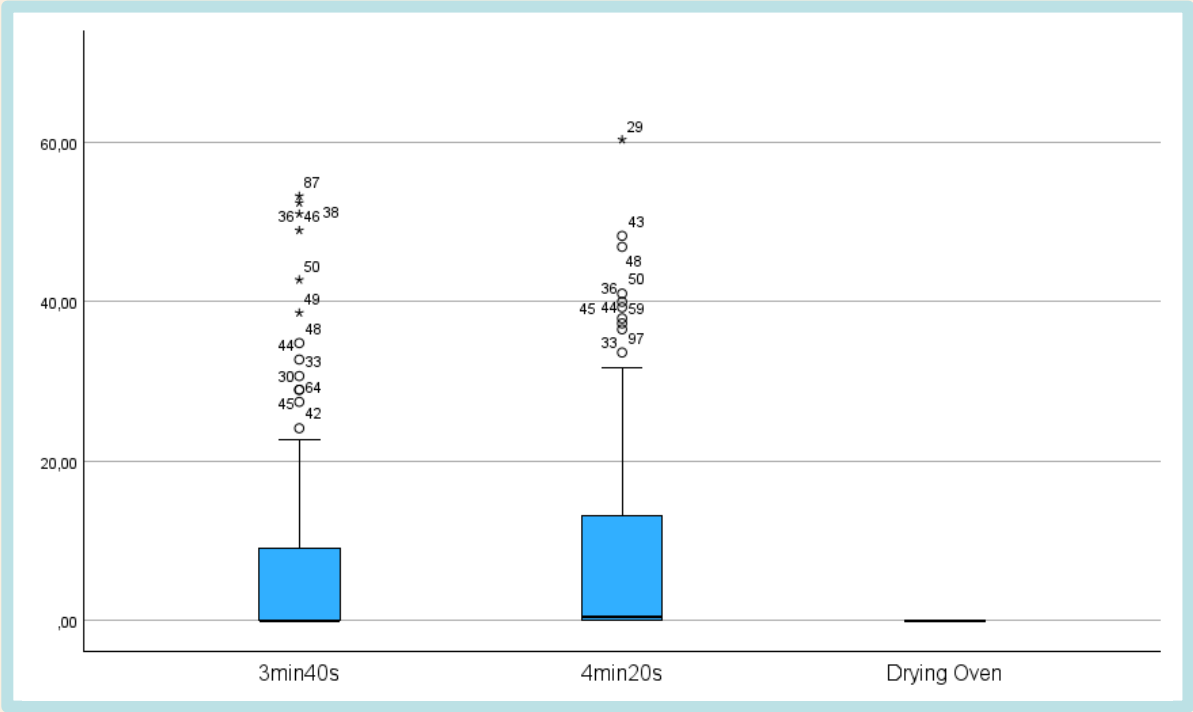
0% ± 0% SD

Table 1: Means of the percentage of non-adhered area and respective standard deviations for each tissue and adhesion method.

Tissues	Adherence method	N	Mean % non-adhered area	Standart desviantion
Breast	3min 40s - MW		0.14	0.71
	4min 20s -MW		0.00	0.00
	Drying Oven		0.00	0.00
Bone	3min 40s - MW		20.08	17.96
	4min 20s -MW		25.46	15.67
	Drying Oven	25	0.00	0.00
Brain	3min 40s - MW		7.61	7.81
	4min 20s - MW		6.26	7.97
	Drying Oven		0.00	0.00
Appendix	3min 40s - MW		2.13	10.65
	4min 20s - MW		3.51	9.77
	Drying Oven		0.00	0.00

Results/Discussion

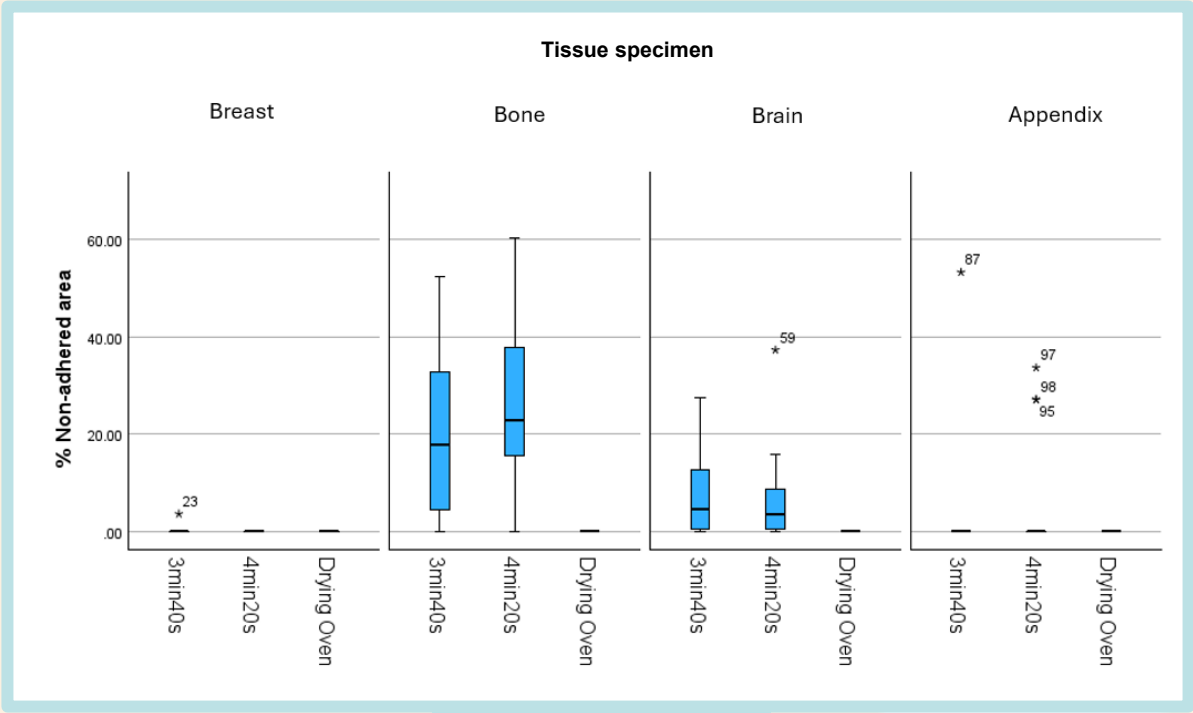
Overall comparison between the different adhesion methods



Graph 1: Representation of the dispersion of results – Percentage of non-adhered area across different methods.

Results/Discussion

Comparison between the different adhesion methods for each tissue type

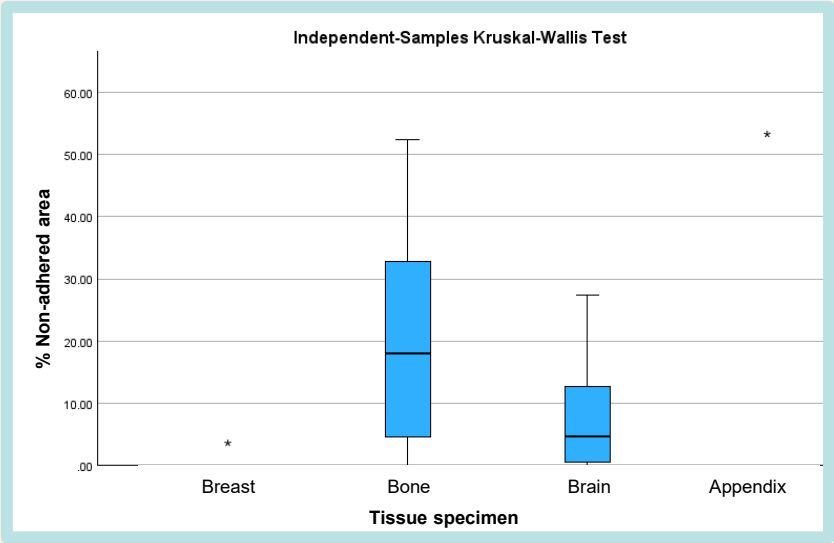


Graph 2: Representation of the dispersion of results – Percentage of non-adhered area across different methods for the same tissue type.

Results/Discussion

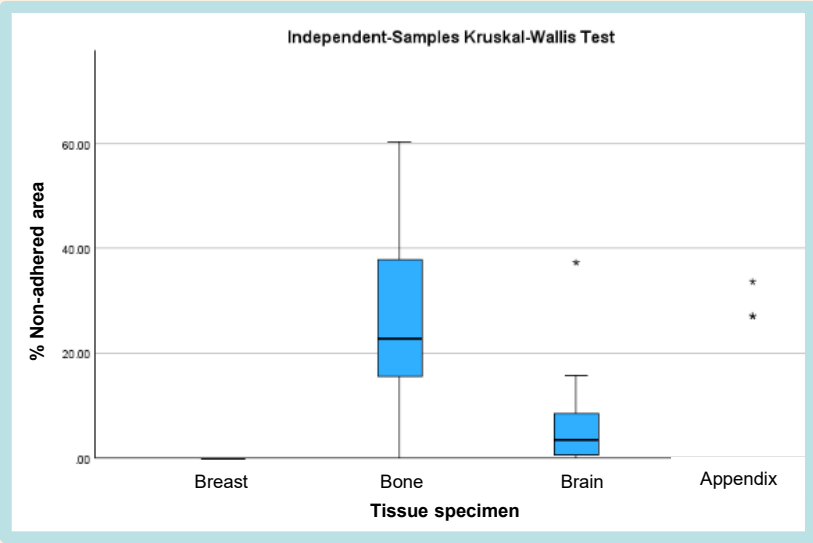
Comparison between different tissue types for each adhesion method

3min 40s



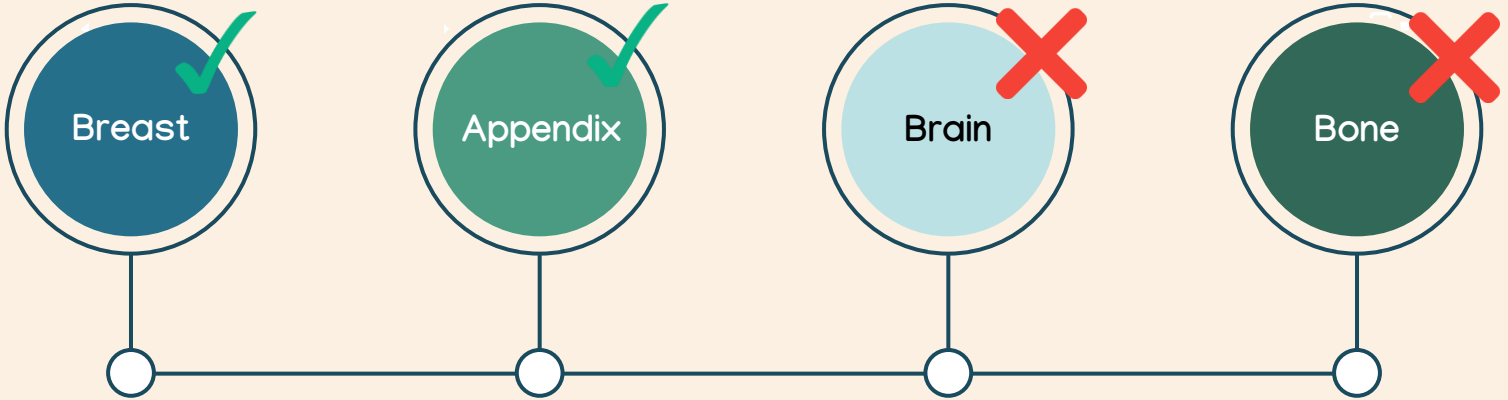
Graph 3: Representation of the dispersion of results – Percentage of non-adhered area in tissues at 3min and 40s using the MW.

4min 20s



Graph 4: Representation of the dispersion of results – Percentage of non-adhered area in tissues at 4min and 20s using the MW.

Results/Discussion



Adipose tissue

Expected to show a tendency to detachment [18–21]

Muscular and glandular composition[22,23]

No significant detachment were recorded

Poorly cohesive tissue

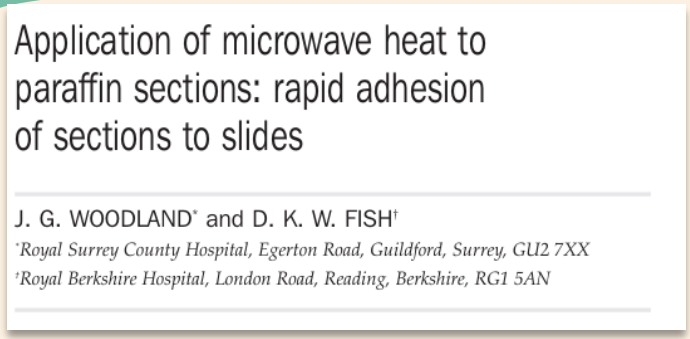
Less consistent adhesion

Mineralized tissue[23–25]

Higher detachment tendency

Results/Discussion

Relevant Publications



Application of microwave heat to paraffin sections: rapid adhesion of sections to slides

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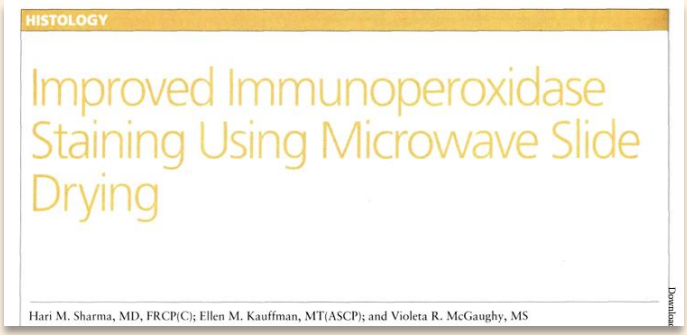
Figure 4: Woodland and Fish article (2008) – Application of microwave heat to paraffin sections: rapid adhesion of sections to slides.



HISTOLOGY

Improved Immunoperoxidase Staining Using Microwave Slide Drying

Hari M. Sharma, MD, FRCP(C); Ellen M. Kauffman, MT(ASCP); and Violeta R. McGaughy, MS

Figure 5: Sharma et al. article that mentions the improved imunoperoxidase staining using microwave slide drying.

Satisfatory adhesion at 60s[3]

Incomplete information (power, number of slides, thermal control) [3]

Satisfatory adhesion with 600W, at 60s[27]

Adhesive slides, humid chamber and H_2Od[27]

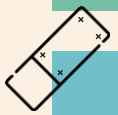
Unspecified number of slides[27]

Results/Discussion

Improvement suggestions

Increase MW exposure time

Use higher-power MW ovens



Adhesive slides

MW designed and certified for medical applications

Conclusions

- This method may optimize the traditional technique
- MW may be a viable alternative to the oven for certain tissues but cannot yet replace it at this step.
- Trere are some limitations:
  - Tissue Specimen
  - Technique used
- This approach is still at an initial stage
- Further studies with optimizations are recommended

Ethical Statement and Financial Support

Ethical statement

This study complies with the current guidelines of the Ethics Committee of ESSL.

Positive approval from the Department of Pathology at Hospital Professor Doutor Fernando Fonseca (ULS Amadora/Sintra)

Financial support

All monetary costs associated with laboratory materials were covered by Hospital Professor Doutor Fernando Fonseca (ULS Amadora/Sintra), which supplied all necessary materials.

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