Reducing common embedding errors through automation: Manual embedding versus automated embedding using the Tissue-Tek AutoTEC® *a120* Automated Embedding System and the Tissue-Tek® Paraform® Sectionable Cassette System

Joshua Greenlee MBA HT/HTL (ASCP)^{cm}, Scott Webster PhD, Howard Gray BS MT (ASCP), Erico von Bueren PhD MOR

Introduction

Until the last decade, tissue embedding has been performed using a manual process. At grossing, tissues are described and often inked for orientation and dissected before being placed into a cassette for tissue processing. The grosser must take care not to submit tissues that are too large, and for smaller tissues the grosser must often use wraps, bags, or sponges to secure the tissue in the cassette. These options may increase reagent carryover during processing, reducing reagent life and increasing replacement frequency.

During processing, the tissue is dehydrated, cleared and infiltrated. If tissues are grossed too thick, this process may be incomplete, leaving "raw," uninfiltrated tissue that may require reprocessing. Tissues like skin shaves may curl or shrink while other tissues like cores may become tangled or break.

After processing, the responsibility for proper orientation lies with the embedding technician. This process involves multiple risks. Each cassette must be reopened, subjecting the tissue to the risk of being lost. Manual manipulation of tissue also presents the risk of tissue cross-contamination. Technicians must be diligent to reduce the potential for incorrect orientations that at a minimum may require rework or at a maximum could lead to tissue loss at microtomy, jeopardizing the diagnosis.

With the use of the Tissue-Tek® Paraform® Sectionable Cassette System (Sakura Finetek USA) and the Tissue-Tek AutoTEC® *a120* Automated Embedding System (Sakura Finetek USA), tissues are placed in their correct orientation during grossing by using the unique features of the six (6) Paraform Cassettes. Furthermore, these features help conform to a tissue size and thickness that provides improved reagent penetration. Once the lid is closed, it is never opened again, thus preserving the orientation from grossing to microtomy and eliminating the risk of tissue loss and cross-contamination from opening the cassette.

Materials & Methods

The quality issues of tissues, their orientation, and cassette status were compared between the traditional manual embedding process and the automated process using Paraform Cassettes and the AutoTEC *a120*.

A hospital laboratory evaluated the quality issue occurrences for six (6) months using their current validated manual embedding process that was accustomed to them. Eight (8) relevant quality issues for processes at embedding were recorded: "Tissue under-processed, clips/staples/sutures in tissue, unreadable barcode, tissue chunked out, improper orientation, cassette received opened, no tissue in cassette after processing, section too large for base mold." During the 6-month evaluation, the laboratory tracked 99,112 cassettes.

After the implementation and validation of the Paraform Cassettes and AutoTEC *a120* automated system solution, the laboratory tracked the same group of issues for 6 months. During these 6-months, the laboratory tracked 105,373 cassettes.

The pre- and post-implementation data sets were evaluated. The percentage change in quality issue occurrences after implementation of the new process was calculated to determine the effects on quality when implementing an automated embedding system.

Conclusions

After a 1-year evaluation involving 204,485 blocks, the implementation of the automated embedding solution utilizing the Paraform Cassettes and the AutoTEC *a120* demonstrated a substantial decrease of 44% in the occurrence of errors compared to the traditional, manual embedding process, creating safer, higher-quality, and more predictable blocks.

Results

After implementing the automated embedding solution, the quality issues decreased by 44% overall. Besides barcode readability, the count of all issue occurrences decreased even though the number of total blocks increased by 6%. Every quality characteristic recorded saw a significant percentage decrease when comparing the actual counts to the total blocks counted, including the unreadable barcodes (4%). Cassettes opening during processing or no tissue evident after processing decreased by 44% and 64%, respectively. Improper orientations were reduced by 80%. Under-processed tissues, a significant quality issue causing lengthy rework, was reduced by 75%, and tissues being too large for the base mold was completely eliminated. Non-embedding related issues like clips/staples/sutures and tissue chunked out at microtomy were reduced 8% and 31%, respectively (Figure 1).

	Quality issue occurrence 6 months pre-implementation	% Quality issue occurrence 6 months pre-implementation	Quality issue occurrence 6 months post-implementation	% Quality issue occurrence 6 months post-implementation	% Change in quality issues
Tissue under processed	321	0.32%	84	0.08%	-75%
Clips/staples/sutures	158	0.16%	154	0.15%	-8%
Unreadable barcode	119	0.12%	121	0.11%	-4%
Tissue chunked out	179	0.18%	132	0.13%	-31%
Improper orientation	19	0.02%	4	0.00%	-80%
Cassette received open	5	0.005%	3	0.003%	-44%
No tissue after processing	26	0.03%	10	0.01%	-64%
Too large for base mold	33	0.03%	0	0.00%	-100%
Total issues:	**860**	**0.87%**	**508**	**0.48%**	-44%
Total blocks:	**99,112**		**105,373**		6%

Figure 1: Occurrence of quality issues both pre- and post-implementation in total counts, percentage of total, and the overall reduction in quality issues post-implementation.

Contact information

Sakura Finetek USA, Inc. | 1750 West 214th Street, Torrance, CA 90501 | T. +1 310 972 7800 | F. +1 310 972 7888 | E. info@sakuraus.com

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