

Improved Ergonomics Based on Pipette Tip Selection

Rosalinda M. Savoy, PhD.

Abstract

Scientists and laboratory workers are constantly needing to pipette for long hours every day, moving tiny amounts of liquid over and over again. The need for ergonomic pipettes and pipette tips is quickly becoming a high priority for labs and scientists. To that aim, we studied the attachment and ejection forces for several 300 μ L pipette tips on a Thermo Scientific™ Finnpipette™ F1 Single Channel Pipette and Finnpipette F1 Multichannel Pipette. The Thermo Scientific™ Finntip™ Flex™ Pipette Tip consistently provides users with one of the lowest forces for attachment and ejection, thereby reducing user strain. The data illustrates the Finntip Flex Pipette Tip as an effective ergonomic tool to help scientists reduce repetitive strain injuries (RSIs).

Introduction

The consideration of ergonomics has become an important part of the laboratory. New tools and pipettes are being designed with the safety and comfort of the end-user as a high priority. Pairing these ergonomically designed pipettes with an ergonomic pipette tip can be just as important. Tip attachment can cause pain and inflammation in the wrist and elbow sometimes leading to tendonitis. Similarly, tip ejection can induce pain on the thumb side of the wrist, that sometimes leads to tenosynovitis. These injuries can hamper the precision required when long days of pipetting are necessary.

To avoid these injuries, selecting the best pipette tip can

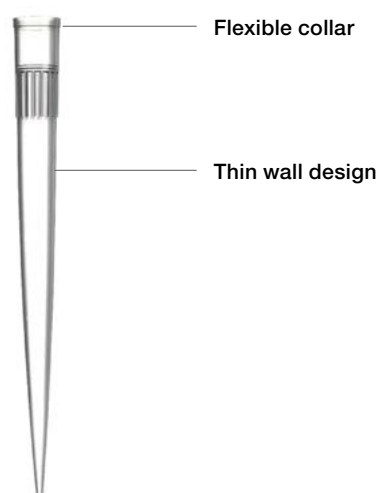


Figure 1: The thin wall and soft collar of the Finntip Flex Pipette Tip is optimally designed to fit Finnpipette Pipettes. This leads to lower attachment and ejections forces, making them more ergonomic.

be crucial. Thin-walled, soft, and flexible pipette tips are designed to fit the pipette cone securely while allowing for minimal attachment and ejection forces to be used. The purpose of this report is to highlight the lower forces needed when using the Finntip™ Flex™ Pipette Tip. To illustrate this, an independent lab was used to test the attachment and ejection forces of the Finntip™ Flex™ Tip and four alternative tips from other manufacturers on a 300 μ L Finnpipette™ F1 Single Channel Pipette and a 300 μ L Finnpipette™ F1 12-channel Pipette. For each variety of pipette tip, 50 tips were tested on each pipette to determine the

	Single channel attachment forces		Single channel ejection forces		Multichannel attachment forces		Multichannel ejection forces	
	Mean (kg)	Result	Mean (kg)	Result	Mean (kg)	Result	Mean (kg)	Result
Finntip Flex	0.938	C	0.696	B	2.958	C	0.686	D
Manufacturer I	1.068	B	0.576	C	2.918	C	0.758	D
Manufacturer II	1.002	B, C	0.692	B	2.61	C	0.932	C
Manufacturer III	1.066	B	0.63	B, C	5.4	A	1.346	A
Manufacturer IV	1.252	A	0.92	A	4.956	B	1.172	B

Table 1. Pipette tip attachment and ejection forces using the Finnpipette F1 Single- and Multichannel Pipettes. Pipette tips are ordered for best overall performance (best on top). Finntip Flex and Manufacturer I Pipette Tips are considered best overall. They are both statistically the best for the multichannel attachment and ejection forces, while the Finntip Flex Pipette Tip is the best for single channel attachment and the Manufacturer I Pipette Tip is the best for single channel ejection. Means that have the same letter are statistically the same and those that have different letters are statistically different.

Materials

- Thermo Scientific Finntip Flex 300µL Pipette Tip (Cat. No. 94060510)
- Manufacturer I 300µL Pipette Tip
- Manufacturer II 300µL Pipette Tip
- Manufacturer III 300µL Pipette Tip
- Manufacturer IV 300µL Pipette Tip
- 300µL Finnpipette F1 Single Channel Pipette (Cat. No. 15511895)
- 300µL Finnpipette F1 12-channel Multichannel Pipette (Cat. No. 15531935)
- ergoPAK™ Portable Analysis Kit, including miniature and universal load cell

Protocol for measuring force

Pipette tip attachment and ejection forces were tested using an ergoPAK Portable Analysis Kit. A circular, flat disc load cell test attachment was used to measure tip ejection force. A sample size of 50 was identified for each pipette tip. The pipette tips were consistent in volume, 300µL tips.

A single factor ANOVA was performed to identify if there were significant differences between tip types ($\alpha = 0.05$). Tests were run assuming equal variances. A Tukey *post hoc* analysis was performed to determine which pipette tips were significantly different.

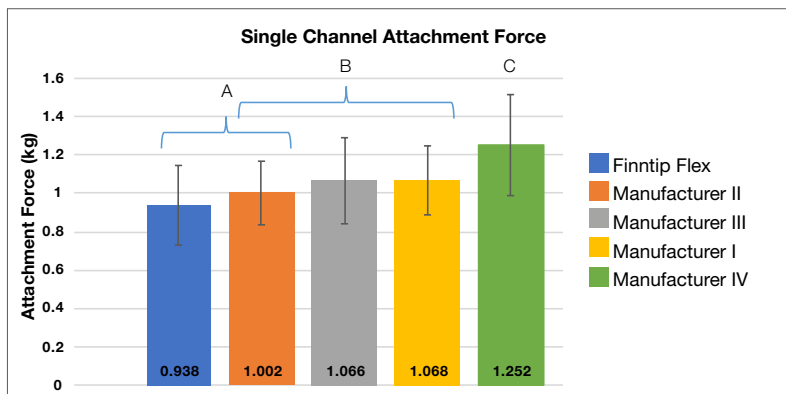
Results

The ergonomic design of the pipette tips was tested in four different ways: force needed for attachment using a 300µL Finnpipette F1 Single Channel Pipette, force needed for ejection using a 300µL Finnpipette F1 Single Channel Pipette, force needed for attachment using a 300µL Finnpipette F1 12-channel Pipette, and force needed for ejection using a 300µL Finnpipette F1 12-channel Pipette. The Finntip Flex Tip was evaluated in comparison to four alternative manufacturers. All forces were measured by an independent lab using an ergoPAK Portable Analysis Kit.

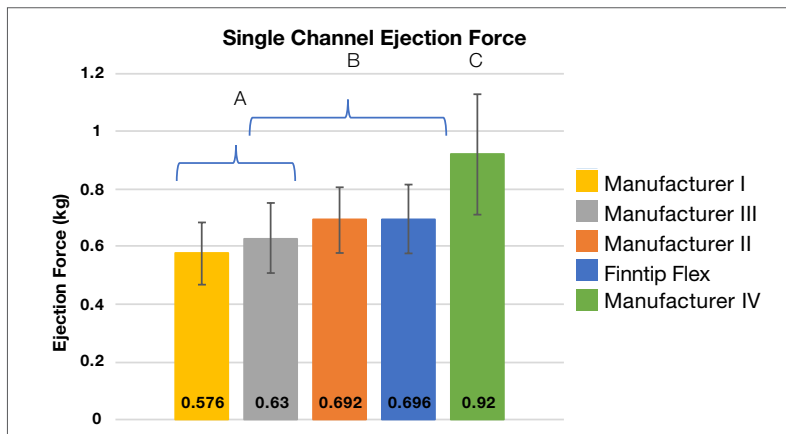
Table 1 shows the mean attachment and ejection forces for each of the pipette tips using the Finnpipette F1 Single Channel Pipette and the Finnpipette F1 12-channel Pipette. The results for each test are ranked using a green-yellow-red scale with green indicating the best and red indicating the worst performer.

For each test, a single factor ANOVA was performed to identify significant differences between tip types and a Tukey post hoc analysis was performed to determine which pipette tips were significantly different. Means that have the same letter are statistically the same and those that have different letters are statistically different.

The performance for testing the attachment force using a single channel pipette has the pipette tips ranked: Finntip Flex, Manufacturer II, III, I, IV (Graph 1). The performance for testing the ejection force using a single channel pipette has the pipette tips ranked: Manufacturer I, III, II, Finntip Flex, Manufacturer IV (Graph 2).



Graph 1. Mean attachment force for each pipette tip using a Finnipette F1 Single Channel Pipette. Pipette tips are ordered from least force to the greatest force. The mean is indicated on each bar with errors bars representing a single standard deviation. The letters and brackets indicate the statistical groups each tip resides in.

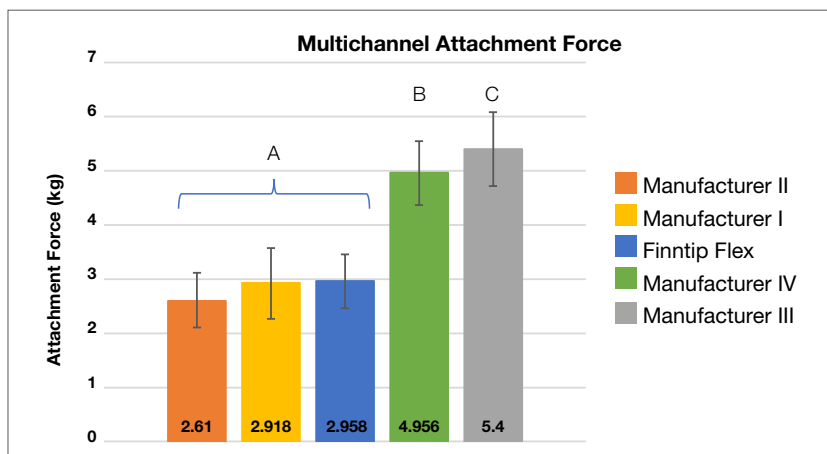


Graph 2. Mean ejection force for each pipette tip using a Finnipette F1 Single Channel Pipette. Pipette tips are ordered from least force to the greatest force. The mean is indicated on each bar with errors bars representing a single standard deviation. The letters and brackets indicate the statistical groups each tip resides in.

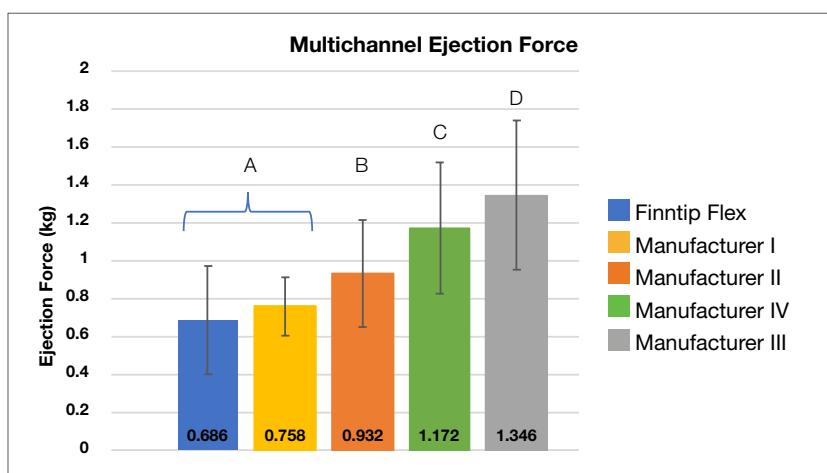
The performance for testing the attachment force using a 12-channel pipette has the pipette tips ranked: Manufacturer II, I, Finntip Flex, Manufacturer IV, III (Graph 3). The performance for testing the ejection force using a 12-channel pipette has the pipette tips ranked: Finntip Flex, Manufacturer I, II, IV, III (Graph 4). Taking into account the performance of each tip for each of the tests, the pipette tips are placed in order from best to least overall performance in Table 1: Finntip Flex, Manufacturer I, II, III, IV. Overall, the Finntip Flex and Manufacturer I pipette tips ranked the best. The Finntip Flex Tip had the lowest force for both single channel attachment and multichannel ejection, and for multichannel attachment the Finntip Flex pipette tip is statistically the same as the lowest force.



Figure 2. Finnipette™ F1 Multichannel Pipette



Graph 3. Mean attachment force for each pipette tip using a FinnpiPETTE F1 Multichannel Pipette. Pipette tips are ordered from least force to the greatest force. The mean is indicated on each bar with errors bars representing a single standard deviation. The letters and brackets indicate the statistical groups each tip resides in.



Graph 4. Mean ejection force for each pipette tip using a FinnpiPETTE F1 Multichannel Pipette. Pipette tips are ordered from least force to the greatest force. The mean is indicated on each bar with errors bars representing a single standard deviation. The letters and brackets indicate the statistical groups each tip resides in.

Conclusion

The Finntip Flex Pipette Tip was evaluated for its ergonomic design by measuring the attachment and ejection force needed when used with the FinnpiPETTE F1 Single Channel Pipette and FinnpiPETTE F1 Multichannel pipette. The Finntip Flex Tip had similar performance to the tip from Manufacturer I but was better than tips from Manufacturers II, III, and IV. Furthermore, the Finntip Flex Tip had the lowest force for single channel attachment and multichannel ejection. The Finntip Flex tip is designed to address ergonomic concerns. It has a softer collar that flexes and leads to lower attachment and ejection forces and is especially suited for multichannel pipettes. In addition to the ergonomic consideration of the Finntip Flex tip, the racks are also designed to help users. The hinged lid allows easy one-handed use while the stable rack base design with rubber feet prevents the rack from sliding on the countertop or flipping over, improving stability and consistency of tip attachment. Finntip Flex tips are designed and developed to work with the FinnpiPETTE Single and Multichannel Pipettes, ensuring optimal ergonomics and pipetting accuracy and precision.



Figure 3. FinnpiPETTE F1 300 rack has a hinged lid and stable rack base to enhance ergonomics

Ordering Information

Cat. No.	Product	Packaging Format
11863420	Finntip Flex 10	10x96/rack
11873420	Finntip Flex 10, Sterile	10x96/rack
11873430	Finntip Flex 10, Refill Starter Kit	20x96/refill+ 1x96/rack
11883430	Finntip Flex 10, Refill Kit	20x96/refill
11883420	Finntip Flex 10	Bulk, 1000 tips/bag
11833430	Finntip Flex Filter 10, Sterile	10x96/rack
11893420	Finntip Flex 200	10x96/rack
11803430	Finntip Flex 200, Sterile	10x96/rack
11893430	Finntip Flex 200, Refill Starter Kit	20x96/refill+ 1x96/rack
11803440	Finntip Flex 200, Refill Kit	20x96/refill
11813430	Finntip Flex 200	Bulk, 1000 tips/bag
11843430	Finntip Flex Filter 30, Sterile	10x96/rack
11853430	Finntip Flex Filter 100, Sterile	10x96/rack
11863430	Finntip Flex Filter 200, Sterile	10x96/rack
11738184	Finntip Flex 300	10x96/rack
11748184	Finntip Flex 300, Sterile	10x96/rack
11798184	Finntip Flex 300, Refill Starter Kit	20x96/refill+ 1x96/rack
11708194	Finntip Flex 300, Refill Kit	20x96/refill
11842703	Finntip Flex 300	Bulk, 1000 tips/bag
11852703	Finntip Flex Filter 300, Sterile	10x96/rack
11458479	Finntip Flex 1000	10x96/rack
11892703	Finntip Flex 1000, Sterile	10x96/rack
11865863	Finntip Flex 1000, Refill Starter Kit	16x96/refill+ 1x96/rack
11875863	Finntip Flex 1000, Refill Kit	16x96/refill
11872703	Finntip Flex 1000	Bulk, 1000 tips/bag
11802713	Finntip Flex Filter 1000, Sterile	10x96/rack
10059682	Finntip Flex 1200	10x96/rack
11742245	Finntip Flex 1200, Sterile	10x96/rack
11813440	Finntip Flex 1200, Refill Starter Kit	16x96/refill+ 1x96/rack
11823440	Finntip Flex 1200, Refill Kit	16x96/refill
10774994	Finntip Flex 1200	Bulk, 1000 tips/bag
11862703	Finntip Flex Filter 1200, Sterile	10x96/rack
10715305	Finntip Flex 10mL Extended	Bulk, 100 tips/bag
11425748	Finntip Flex 10mL Extended, Sterile	Bulk, 50 tips/bag
11475558	Finntip Flex Filter 10mL Extended, Sterile	Bulk, 50 tips/bag

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