Evaluation Report for GB Products International Corp.

Ergonomic Evaluation of the ErgoSafe® Stamp Handle

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Mr. Anthony Huhn
GB Products
1024 Shary Court
Concord, CA 94518

Dear Mr. Huhn,

Enclosed please find the second report of our study of the ErgoSafe stamp handle. The scientific measurement of hand posture and grip forces showed a **significant improvement** for the ErgoSafe® handle as compared to a traditional stamp handle. The finger forces are 76% lower, wrist motions are 35-36% lower, and wrist accelerations are 64-67% lower! The complete report with figures is in the mail.

I will continue to try to get one more in-the-field study during the summer, probably at the county courthouse. I will keep you posted.

Sincerely yours,

Andris Freivalds

Andris Freivalds, Ph.D.

1. Introduction

Recently, GB Products International Corporation (Concord, CA) developed a new handle for a self-inking stamp. The new model has a long cylindrical type handle (10cm long and 3.6cm diameter) with a sponge grip layer. The traditional stamp has a short circular wood handle (4.5cm long and 3.3cm diameter). Table 1 shows the specifications of the two stamps in detail. For the new stamp, the user can hold and press down the stamp using a power grip maintaining a wrist and forearm at a neutral posture while the traditional stamp is pressed down using a pinch grip with pronated-forearm by almost 80 degree.

The purpose of this study is to quantitatively evaluate the ergonomic effectiveness of these two handles.

Table 1. Comparison table of new and traditional stamps.

		New stamp	Traditional stamp
Dimension	Handle diameter	3.6 cm	3.3 cm
	Weight	2.3 kg	2.1 kg
	Handle height	10 cm	4.5 cm (1.5 cm circular and 3 cm taper part)
Handle material		Wood with sponge grip layer	Wood
Grip		Power grip	Pinch grip
Body posture	Shoulder	Adduction	Abduction
	Forearm	Neutral	Pronation
	Wrist	Neutral	Extension to Flexion

2. Method

2.1 Experimental procedure

Six male subjects participated in this study. Their ages ranged from 25 to 39 years old with an average of 29.8. All subjects preferred to use their right hand. They received an information sheet describing the purpose of the experiment and filled out a health questionnaire and informed consent form. No one had any history of musculoskeletal problems to the upper body.

The TouchGlove was attached to the subject's hand and calibrated. After setup and calibration, the subject's hand motions were monitored as they performed the stamping. The subject stamped along the right side of an A-3 size white drawing paper at three different frequencies (6, 12, and 24 times/min). A metronome was used to set and maintain the desired pace. The order of task condition was randomized and each task was repeated two times. An one minute of stamping was followed by two minutes of rest before the next condition was started.

2.2 Measurement

Three different dependent responses were measured with TouchGlove: (1) finger forces by force sensors placed on each fingertip, (2) Wrist flexion/extension and radial/ulnar deviation, and (3) wrist acceleration.

3. Results and Conclusion

The descriptive statistics (mean and standard deviation) of measurement variables averaged for all subjects are summarized in Table 1. An analysis of variance (ANOVA) was conducted on all dependent measures. Stamps and subjects had statistically significant effects on all measures ($p<0.01$). Task frequency had no significant effect on all measures ($p>0.05$). A large difference in mean finger forces was found between the new and traditional stamp (new stamp=2.3 ± 0.7 N, traditional stamp=9.7 ± 4.9 N) with new stamp being significantly lower than traditional stamp.

Table 1. Mean and standard deviation of measurement variables.

		Stamping frequency					
		6 times/min.		12 times/min.		24 times/min.	
	Stamp[†]	Mean	SD	Mean	SD	Mean	SD
Finger forces (N)[1]	1	2.3	0.6	2.4	0.7	2.2	0.6
	2	10.1	5.1	10.5	5.0	9.2	4.8
FE_Range (deg.)[2]	1	15.7	5.0	13.8	4.9	12.5	4.7
	2	21.9	9.0	20.5	8.1	20.7	8.5
RU_Range (deg.)[3]	1	13.7	5.7	13.0	5.3	12.6	6.8
	2	21.0	4.2	21.3	6.5	18.5	4.3
FE_Acc (deg/sec^2)[4]	1	209.4	101.9	206.5	95.8	191.8	77.6
	2	516.0	191.0	546.0	212.2	551.3	191.7
RU_Acc (deg/sec^2)[5]	1	164.2	52.0	177.7	62.9	177.2	51.2
	2	264.5	54.5	260.8	88.8	259.0	97.3

[†] Stamp 1 is new stamp; stamp 2 is traditional stamp
[1] Summation of finger forces (Unit: N)
[2] Range of flexion/extension angle: maximum flexion angle – maximum extension angle (Unit: degree)
[3] Range of radial/ulnar deviation angle: maximum radial angle – maximum ulnar angle (Unit: degree)
[4] Mean acceleration occurred during flexion/extension movement of the wrist (Unit: degree/sec^2)
[5] Mean acceleration occurred during radial/ulnar movement of the wrist (Unit: degree/sec^2)

Table 2. Average effects.

	Stamp			
	Traditional	New	% Decrease	Figure
Finger forces (N)[1]	9.7	2.3	76	1
FE_range (deg.)[2]	20.8	13.3	36	2
RU_range (deg)[3]	19.7	12.9	35	2
FE_Acc (deg/sec^2)[4]	544.7	198.5	64	3
RU_Acc (deg/sec^2)[5]	260.3	175.5	67	4

* all index are the same as in Table 1.

The average effects, across all subjects and frequencies are shown in Table 2. Note that mean wrist flexion/extension accelerations for the traditional stamp exceed 494 degrees/sec^2, a threshold for risk of cumulative trauma disorders as found by Marras and Schoenmarklin (1993). The acceleration levels for the new stamp are well below this critical level. It is believed that wrist motions contain the essential elements of the wrist posture and repetition risk factors. In summary, an average finger forces are 76% lower, wrist flexion/extension is 36%, wrist radial/ulnar deviation is 35% less, wrist flexion/extension acceleration is 64% lower and wrist radial/ulnar acceleration is 67% lower for the new stamp.

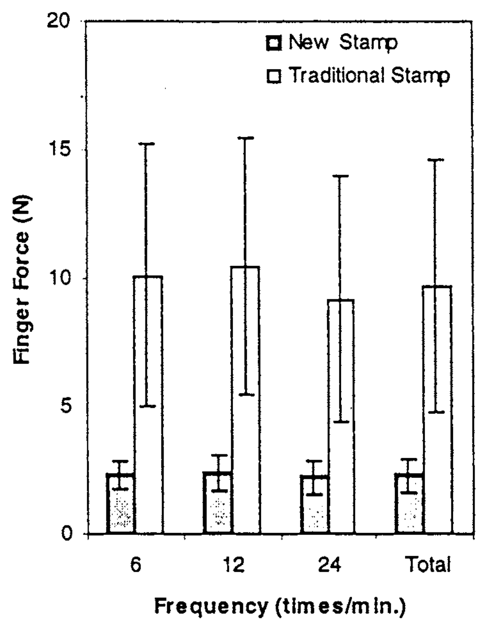

Figure 1. Variation of finger forces on each stamping frequency.

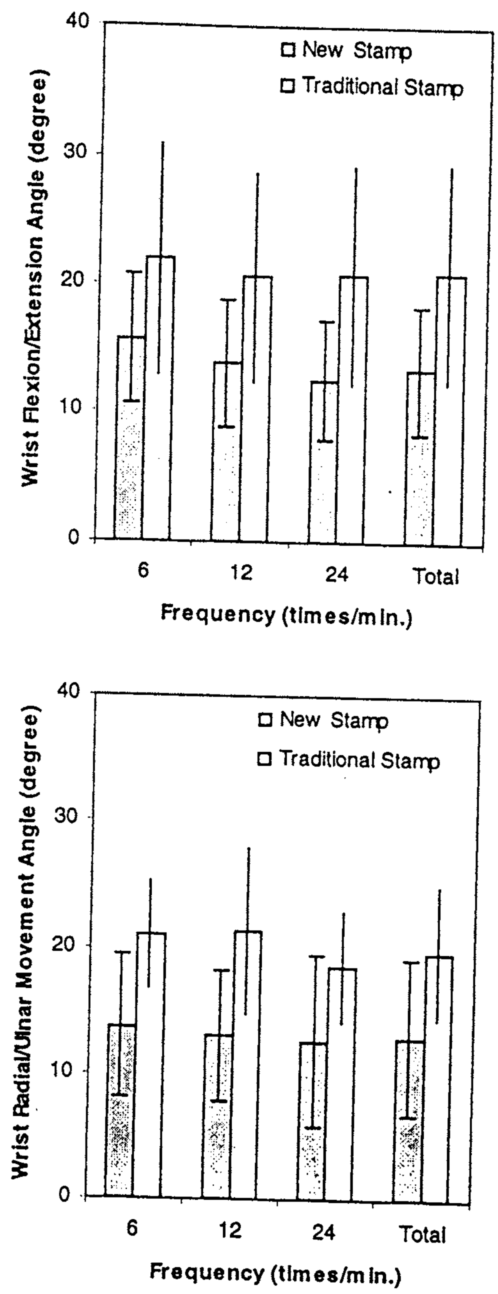

Figure 2. Variation of wrist movement angle on each frequency.

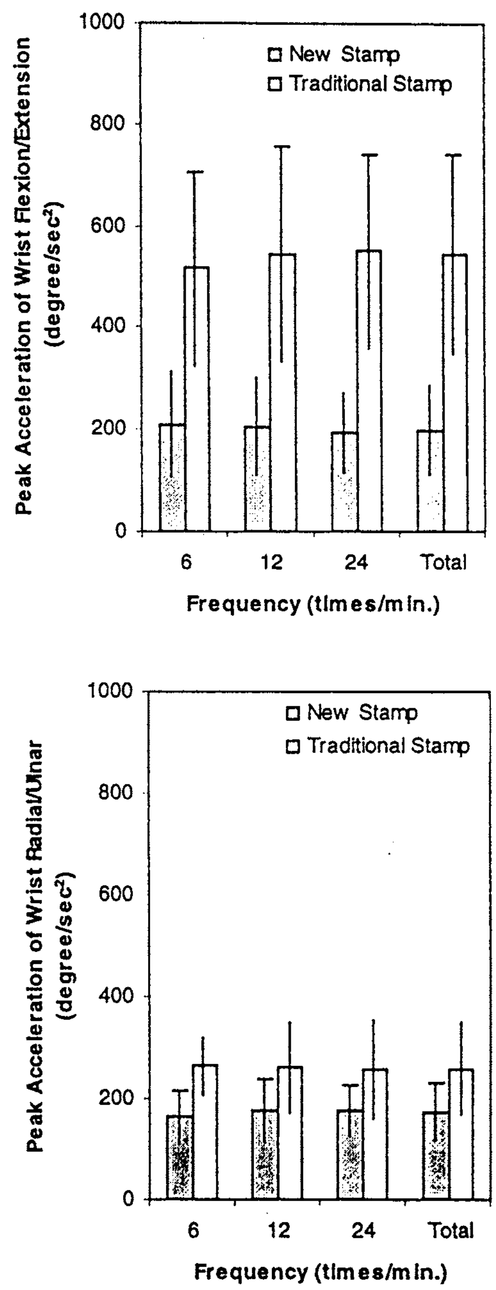

Figure 3. Variation of peak acceleration of wrist movement on each frequency.