

Hand forged surgical instruments superior in performance and durability as compared to conventionally produced German and Asian instruments



Authors: Engblom E. • Bern P.

Royal Institute of Technology. Institution of Material Science and Engineering. Stockholm, Sweden.

Abstract

Researchers at the Royal Institute of Technology, Stockholm, Sweden, conducted a study of different surgical scissors to evaluate performance and durability as a result of its material composition and production processes. Hand forged surgical scissors from Stille AB were compared to conventionally manufactured German and Asian instruments. The material properties of the scissors were examined and tested for hardness, durability, microstructure and through a compositional analysis. The scissors were then ranked based on performance. The researchers concluded that Stille's Metzenbaum scissors, thanks to its chemical and mechanical properties, offered superior performance and material qualities as compared to conventional German and Asian manufactured scissors.

Introduction

Stille AB is a Swedish manufacturer of surgical instruments and equipment founded in 1841. The product range of instruments includes products such as scissors, forceps and needle holders. The products are produced through a traditional handmade forging process using round steel bars. Conventional German and Asian grade instruments are typically produced by automated machining processes without the use of round steel bars. There are no standardized tests for evaluating surgical scissors, so the researchers of the Royal Institute of Technology (KTH), Stockholm, Sweden, conducted a number of studies to examine and compare the performance of different material properties.

Purpose

The purpose of the study was to determine and quantify if Metzenbaum scissors manufactured by Stille through its traditional hand forged processes ultimately leads to superior material composition and performance in relation to conventionally produced German and Asian instruments.

Material and Methods

The researchers at KTH performed four different studies to evaluate the scissors performance by evaluating material composition and production processes. Five different SuperCut Metzenbaum scissors were tested; Stille 1 (new Diamond coated), Stille 2 (new), Stille 3 (used), German (new) and Asian (new). The scissors were ranked in each test from 1 to 5 depending on performance, where 1 was considered the best. All scissors were made out of stainless martensitic steels with minor compositional differences. Unlike the others, Stille 1 had a DLC coating with a thickness of ~2 μm . Stille 3 was the only scissor that had been previously used in a surgical environment. It was not included in the durability test as it was the only scissor that wasn't newly manufactured.

Four studies were completed to examine differences in material and manufacturing quality. A Scanning Electron Microscope (SEM) was used to thoroughly examine the specimen and to perform an analysis of the composition. A Vickers hardness test was performed, as well as a Light Optical Microscopy (LOM) examination of the microstructure. The final test was a durability test, which was

designed to examine the scissors' resistance to abrasive and adhesive wear, and to see how well they performed after being put through severe stress.

The durability test was completed by examining the cutting edge following a number of cuts through layers of aluminum foil. Aluminum foil was chosen as a proper testing material because it heavily wears the material and it was simple to make the test harder by adding more layers. More layers of foil were added until the scissors began to show palpable signs of wear and reduced cutting ability. Macroscopic pictures were taken on the edges before adding layers. The test was made for 1, 4, 8, 16, 32, 64 and 164 layers. The edges were then examined in the SEM to determine how much the scissors had been deformed.

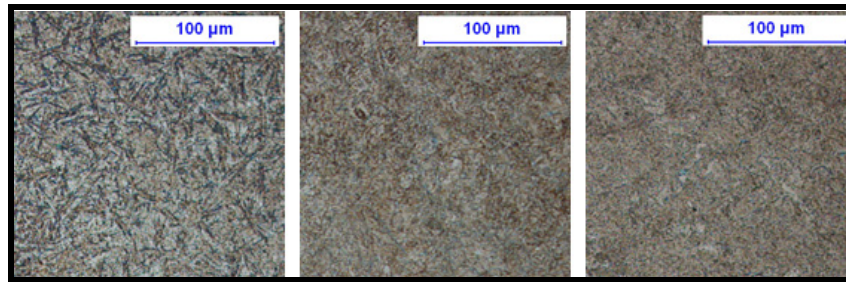


Figure 1: Microstructure of Stille 1 (left), Stille 2 (middle) and Stille 3 (right), (50x enlargement).

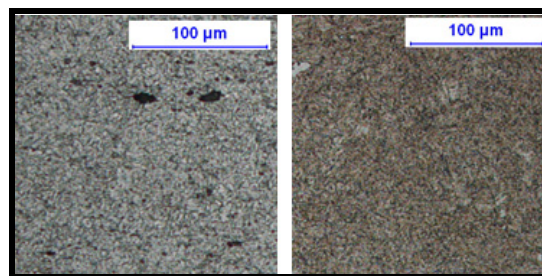


Figure2: Microstructure of German (left) and Asian (right), (50x enlargement).

Results

Table 1 presents the summary of the tests and the performance of every scissor compared to each other. The Stille scissors proved to have a fine martensitic microstructure that was superior to the competitors. This is advantageous for preventing mechanical and chemical wear. The durability test showed that Stille's scissors maintains a sharp edge after severe mechanical stress. Despite showing some wear, the Stille's scissors were able to cut without using excessive force. This was not the case for neither the German or Asian grade scissors.

Specimen	Composition	LOM	Durability	Hardness	Total
Stille 1	1	1	1	2	1
Stille 2	4	3	2	4	2
Stille 3	2	2	-	3	-
German	5	5	4	1	4
Asian	3	4	3	5	3

Table 1: The scissors were ranked from 1 to 5 depending on performance, where 1 is the best rank and 5 is the worst.

Conclusion

It is concluded that hand forged Metzenbaum scissors from Stille, thanks to its chemical and mechanical properties, offer superior performance and possess superior material qualities as compared to conventionally produced German and Asian scissors. The Stille Diamond SuperCut scissor outperformed the other instruments in the study.