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CONSERVING STRINGED SCULPTURE: THE TREATMENT OF HENRY MOORE'S *MOTHER AND CHILD*, 1939

NICOLE LEDOUX

ABSTRACT

Objects with tensioned string elements are found in many types of collections, ranging from fine arts sculpture to scientific and historic models. Deterioration and damage to these vulnerable elements in the form of fraying, breakage, and loss of tension can render these pieces undisplayable. This article presents the treatment of Henry Moore's stringed sculpture *Mother and Child* in the collection of the Harvard Art Museums.

Upon entering the collection, the string elements of *Mother and Child* were in very poor condition, with 11 of the 12 strings broken and one missing. This article discusses aspects of the sculpture's fabrication and outlines the various considerations involved in deciding whether to replace or repair the damaged strings. It also describes in detail the development and execution of a treatment technique for repairing the original strings using wheat starch paste and Japanese tissue paper.

1. INTRODUCTION

Stringed sculpture, and objects with tensioned strings in general, frequently pose significant conservation challenges. This is due to the inherent vulnerability of the string elements, which deteriorate and are easily damaged as they age. Despite their impermanence, the preservation of their physical integrity and appearance is of critical importance to the work as a whole. This poses a predicament for conservators and curators of these collections: Do we opt to replace strings in poor condition, or do we make it our goal to preserve the originals until no longer feasible? For this particular piece, we chose the latter approach, and in this article, I describe the decision-making process and technical challenges involved in doing so.

Henry Moore's (1898–1986) stringed sculpture *Mother and Child* dates to the early half of his career in 1939. The sculpture is cast in solid lead and rests on a stone base. A continuous length of linen thread, now broken in numerous places, was originally laced tightly back and forth across the sculpture 12 times. Figure 1 shows the condition of the sculpture when it entered the collection over a decade ago.

The sculpture came to the museum from a private collection, and unfortunately we do not have any information about when, or how, the strings came to be broken. The piece has been in storage virtually ever since, awaiting treatment in its fragile and unexhibitable state; however, its planned inclusion in the inaugural exhibit of the new Harvard Art Museum's facility, which opened in November 2014, provided the opportunity to finally give this object the full time and attention it deserves.

2. STRINGED SCULPTURES BY HENRY MOORE

Henry Moore was a British artist who had a very long and prolific career that spanned much of the 20th century. Mother and child figures, like the one in Harvard's collection, were a frequent subject of his works, in addition to reclining figures and other abstract human forms. He worked in a variety of media throughout his career, but is perhaps most well-known for his large-scale bronze sculptures, which can be found in public settings all across Europe and North America. Moore's experimentation

Fig. 1. Before treatment. Henry Moore, *Mother and Child*, 1939, lead and string on stone base, 13.5 × 18.8 × 5.1 cm (Courtesy of Harvard Art Museums, 2003.40.19)

with stringed forms coincided with his use of lead as a casting medium between 1938 and 1940. Moore made a series of 16 sculptures in lead, seven of which were strung (Tate Gallery 1988). Moore and his assistant cast these pieces themselves from wax originals using an improvised kiln at his bungalow in Kent; however, not all of his stringed sculptures were made in lead. Some were carved in wood and many were cast in bronze. Moore was not the only artist of his time to use tensioned string elements in his sculpture. In the 1930s and 1940s, both Barbara Hepworth and Naum Gabo were also producing string sculptures.

The stringed sculptures by Moore are very reminiscent in form to mathematical string models. Moore credits these objects, on display at the Science Museum in London, as an important source of inspiration (Toland et al. 2012). Mathematical string models date back to the late 18th century when they were used by mathematicians in the emerging field of descriptive geometry, allowing the viewer to visualize the intersections of surfaces in three dimensions. Moore states that "it wasn't the scientific study of these models but the ability to look through the strings as with a bird cage and see one form within another which excited me" (Hedgecoe and Moore 1968, 105). Moore's string sculptures were strung, and likely many of them restrung, using strings in a variety of colors, materials, and thicknesses.

3. *MOTHER AND CHILD*, 1939

3.1 BACKGROUND

By using a casting process for fabrication, Moore was able to produce multiple editions of his works. Editions of *Mother and Child* were cast in both lead and bronze. Although it is possible that the Harvard Art Museum's edition in lead is unique, there are some interesting differences between this sculpture and the lead edition published in Moore's first catalogue raisonné. In the catalog image, the sculpture rests on a different base that is oval and appears to be made of wood; furthermore, the catalog description lists the materials as "lead and wire," which may also suggest that it is a different edition, or could be evidence of an earlier stringing that used a different material (Moore 1944, 130). The bronze version of the sculpture was produced in an edition of seven (Dyer 1992, 79).

3.2 MATERIALS AND FABRICATION FEATURES

The sculpture was cast in solid lead, and there are several surface features that relate to its fabrication. The lighter spots shown in figure 2 are solder plugs.

These plugs fill the back ends of the holes and notches where the string was threaded over and into the adjacent hole. Without these plugs, the knotted ends and loops of string would have been visible on the outer surface. The solder also serves to lock the strings in place so that they cannot shift. While these plugs are soft like the surrounding lead, their lighter appearance suggests that they are a different alloy composition that did not develop the same dark patina as the rest of the sculpture. It seems unlikely that this contrast was intended, as evidenced by some other solder fills in the surface that appear to be covering small casting defects.

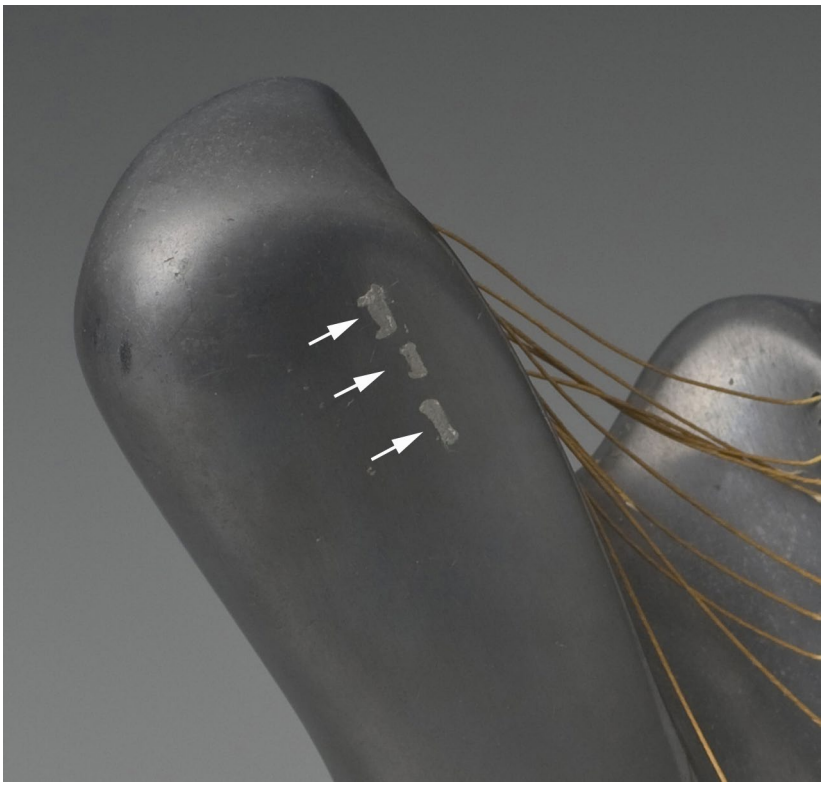

Fig. 2. View of solder plugs, visible as light grey spots on the surface (Courtesy of Nicole Ledoux)

The sculpture is anchored to a light-colored stone base by a threaded rod, which is secured by a nut at the bottom. The string is a three-ply linen thread with an unidentified waxy coating. The overall dimensions of the sculpture are 13.5 (w) × 18.8 (h) × 5.1 (d) cm.

3.3 CONDITION

In addition to the obvious breaks, the strings exhibit other signs damage and aging. It seems likely that the strings were once lighter in color and have darkened significantly with age. The areas of string that once passed through the perforated ridge at the center of the sculpture preserve this lighter yellow appearance, while the areas exposed to light over the years appear more amber to brown in color. Overall, the strings have stiffened over time and retain the shape of their original configuration. The ends of the strings are frayed, and at some points the plies have loosened and have begun to unravel. The lead itself also has signs of age and wear. The surface is dulled by grime, fingerprints, and a faint white bloom in some areas, in addition to scattered abrasions and a few isolated deep gouges.

Given all these complexities of both construction and condition, I felt the best way to understand and document the piece was to create my own diagram, which I could then use to map the locations of the breaks and losses, and visualize how the strings should come together. I began with a tracing of the sculpture and numbered the holes according to how the string ends match up, using the catalogue raisonné image as an additional source of information. By connecting these numbered holes, I produced an image of the original string configuration. I then used this diagram to map out where the breaks and losses are specifically (fig. 3).

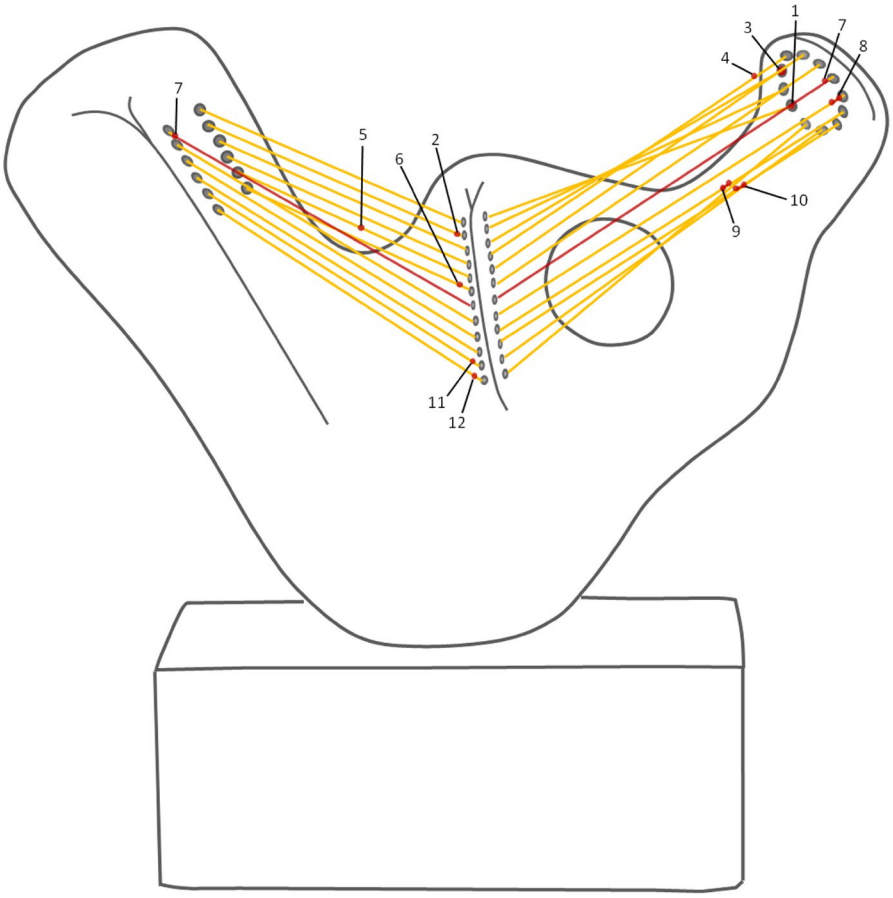

Fig. 3. Condition diagram showing the locations of breaks and losses in the string (Courtesy of Nicole Ledoux)

There are eight strings broken where the ends still meet up, three strings broken with small losses at the break ends, and one string that is missing almost entirely. This diagram also shows patterns in the locations of the breaks, which are located mainly on the proper left side and along the perforated ridge at the center.

4. DEVELOPING A TREATMENT APPROACH

4.1 REPAIR OR RESTRING?

The information gathered through background research and examination provided a basis for deciding on an appropriate treatment approach in consultation with Mary Schneider Enriquez, Houghton Associate Curator for Modern and Contemporary Art. If we decided to restring the piece, it would require the destructive and irreversible step of removing and replacing the solder plugs, in addition to the string itself; however, repair would require that the mends be made seamlessly to preserve the artist's intent and not be visually distracting. In addition, repairs would need to be strong enough to withstand handling and movement associated with packing, transit, and installation. Weighing these factors, we both agreed that, despite the obvious challenges, repair should be attempted before resorting to restringing. Ms. Schneider Enriquez, in particular, appreciated the aged appearance of the strings, since it corresponds well to the overall patina and wear on the lead surfaces. We decided to first attempt repair and reevaluate if necessary.

4.2 ADHESIVE AND SUPPORT MATERIALS

An acceptable repair method for the strings needed to meet high standards for both stability and aesthetics. In proceeding to develop a suitable technique, I first reached out to the greater conservation community via the AIC Objects Specialty Group listserv for advice. I received many helpful suggestions from those who had worked with stringed sculptures and other objects, such as mathematical string models and ship models. The conservation literature on woven materials, such as textiles and basketry, also provided a great source of techniques for the repair of fiber-based objects. Synthesizing all of this information, I decided to test my materials and methods using mock-ups. To make these, I stretched lengths of modern linen thread tightly across a board using push-pins and sliced them at the center to replicate the kind of tensioned repairs I would making on the sculpture itself.

Although there were multitudes of potential conservation materials, I decided to test three different adhesives, which I selected on the basis of my experiences, background research, and recommendations from colleagues. These were Paraloid B-72, for its tack and fast-drying properties, Lascaux 498 HV, a water-based acrylic dispersion that is frequently used in the conservation of textiles and other organic objects, and wheat starch paste, for the same reason (Hillyer et al. 2011). Very early on in my testing, it became clear that a support material would also be necessary to strengthen the joins, so I tested two: Stabiltex threads and twists of fine Japanese tissue paper fibers, which I created by rolling small torn-off sections of tissue between two fingers (fig. 4).

I have to say all of these materials were capable of making adequate joins, but there were differences in their appearance and compatibility with the substrate. Both of the acrylic-based adhesives had a very synthetic appearance and did not impart the join with the flexibility I had hoped for. The wheat starch paste, on the other hand, bonded well, and was much more invisible. As for the support, the Japanese tissue twists, though thicker than the Stabiltex, gripped the thread much better and was much less likely to come undone when the string was pulled or flexed. It is also very compatible with the wheat

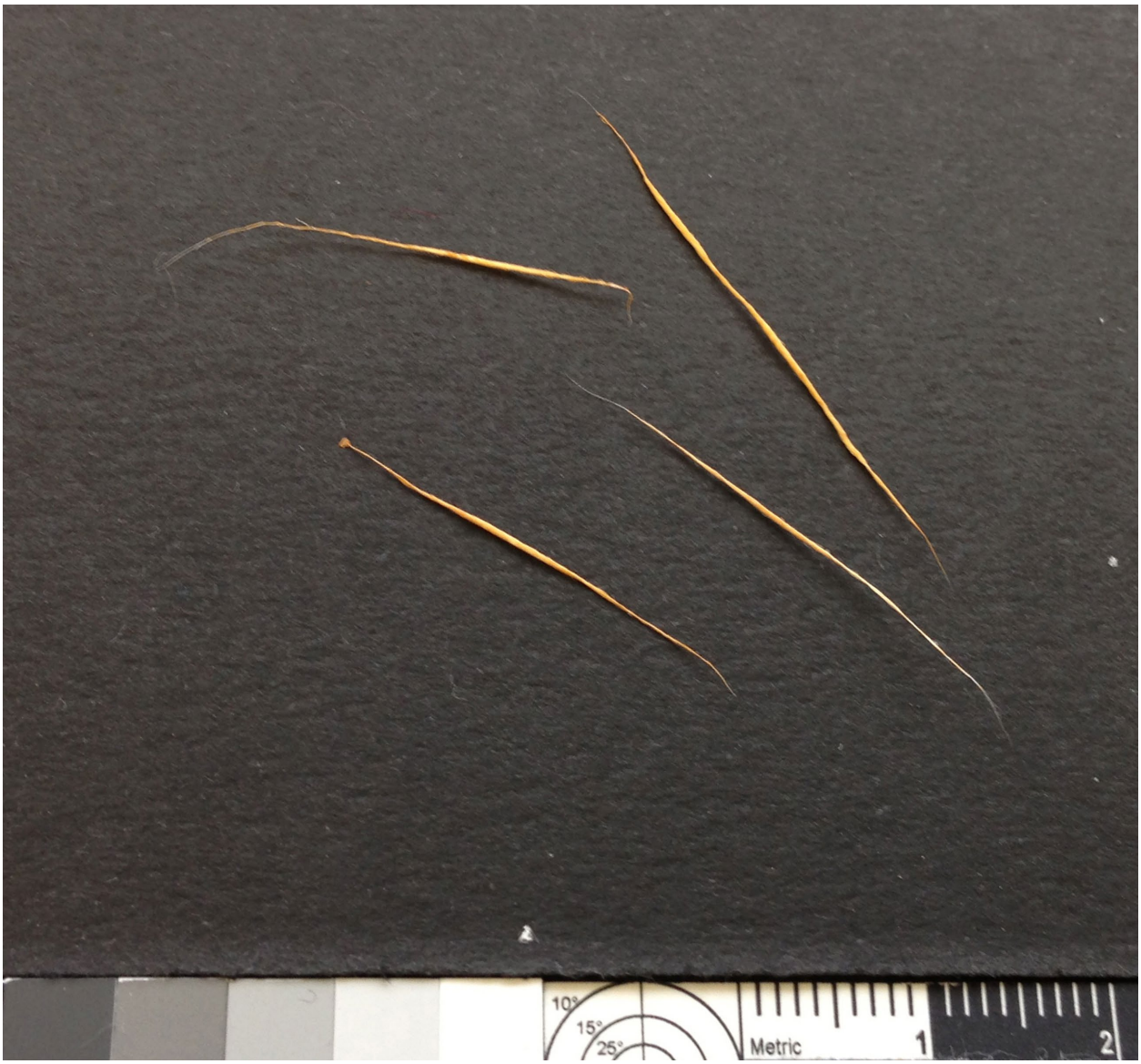

Fig. 4. Japanese tissue twists toned with fluid acrylic paints (Courtesy of Nicole Ledoux)

starch paste, and each twist can be custom-toned to match the coloration of the string at a specific location.

4.3 CLAMPING SYSTEM

Finding an adequate clamping system (fig. 5) was important to the success of this treatment and involved a great deal of trial and error.

Making the thread joins required precision alignment, and due to the tension on the strings, the ends needed to be held firmly in this alignment until the adhesive was completely dry. Rob Napier, a local ship model restorer, suggested that I try electrical wire test clamps (fig. 6), which have small spring-loaded hooks for capturing wire (Napier 2012).

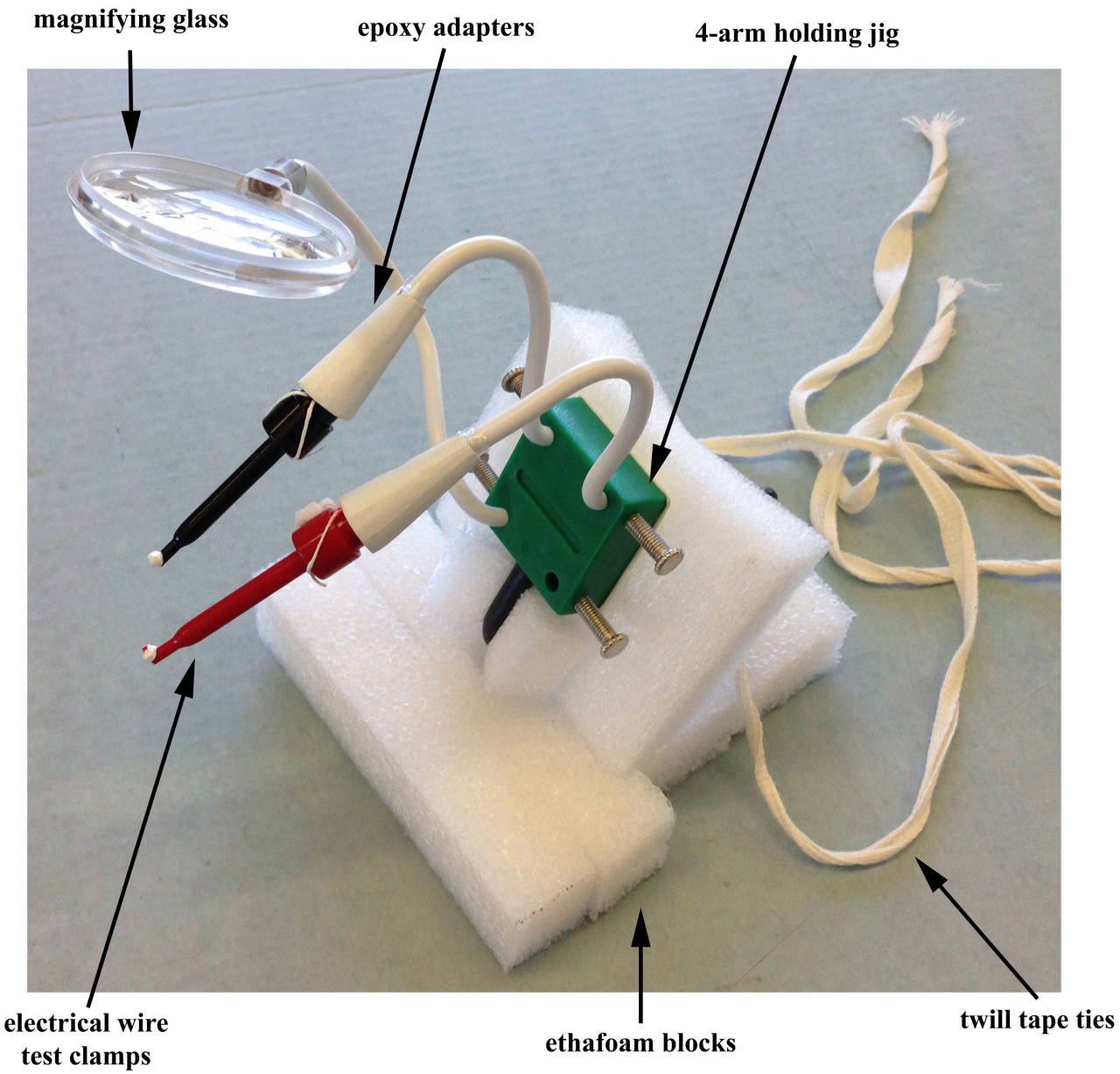

Fig. 5. Diagram of clamp components (Courtesy of Nicole Ledoux)

At first, I found the hooks placed excessive pressure on my test strings and created deformations, but by compressing the spring mechanism with thread ties, I was able to make the space inside the hook just right for my string thickness. I then made custom adapters out of epoxy to connect the clamp ends to the arms of the holding jig, which I clamped to foam blocks to orient the jig vertically. The advantage of using foam was that I could use it to secure bamboo skewers, which can support the wire arms of the jig when necessary during clamping. I then tied the entire contraption around the sculpture base, so that there was no potential for movement. I used a lazy Susan to rotate the entire setup as needed during treatment (fig. 7).

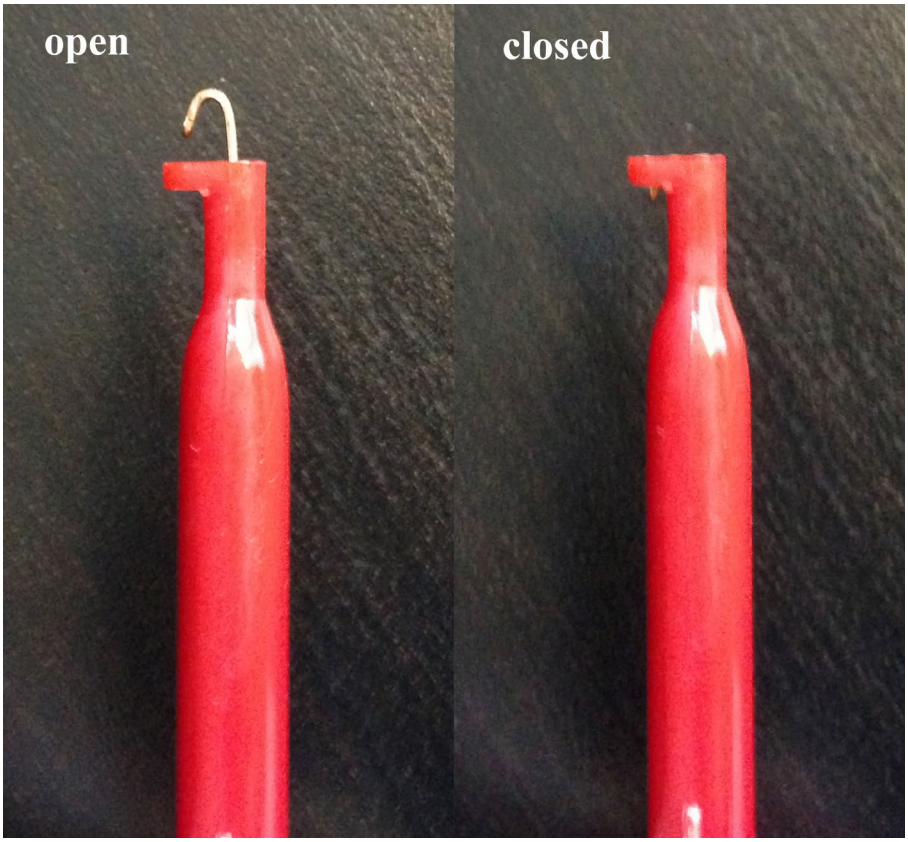

Fig. 6. Electrical wire test clamp shown in open and closed configurations (Courtesy of Nicole Ledoux)

Fig. 7. Clamping setup during treatment (Courtesy of Nicole Ledoux)

5. TREATMENT TECHNIQUES

5.1 PRELIMINARY TREATMENT STEPS

With a working technique in place, I was ready to proceed with the treatment. But before beginning the string repairs, there were a few other treatment steps that I completed. First, the entire sculpture, including the base, was cleaned lightly overall with saliva and ethanol to remove surface grime and the white bloom. The surface of the lead was then coated with Renaissance wax (a proprietary mixture of microcrystalline and polyethylene wax) to protect the surface and produce a more even appearance. The solder plugs were toned with graphite powder mixed with acrylic medium to integrate them with the surrounding lead. Finally, the areas of the strings that were frayed and unraveled were consolidated with methyl cellulose in deionized water to impart some strength before mending.

5.2 STRING REPAIR

I proceeded with the string repairs sequentially according to the numbering scheme on my diagram. Each string repair followed one of three basic techniques, each based on the location of the break (fig. 8): near or adjacent to the end sockets, near or adjacent to the center holes, or along a visible span of stretched string.

These were approaches that generally worked well, though each individual string repair required some tweaking of these techniques.

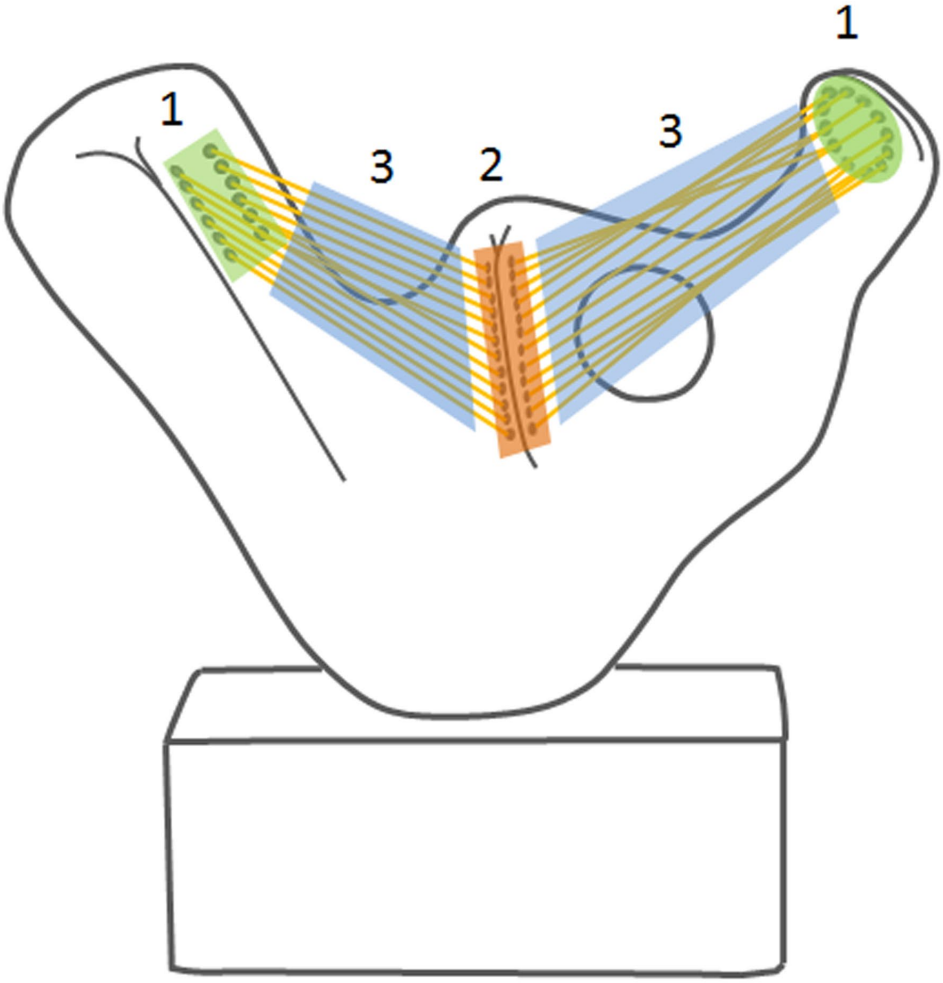

Fig. 8. Repair techniques used according to location of break (Courtesy of Nicole Ledoux)

5.2.1 Repairs Inside or Adjacent to the End Cavities

My first method involved securing one end of the string into an end socket. End sockets tended to have either a small stub of a string protruding or, as shown in figure 9, nothing inside.

Where no string protruded from the socket, I first reinforced the end of the string by adhering a small piece of Japanese tissue around the end of the string to form a sheath, which further supported the end and gave it some added thickness and surface area for bonding to the cavity (fig. 10).

If the end of the string was especially fragile, I also supported the area with a twist of Japanese tissue, which I wet with wheat starch paste and then wound around the compromised section of string, following the direction of the plies. Once dry, I adhered the reinforced string end directly into the lead socket with a small dot of Paraloid B-72, using a clamp to hold it in place as it dried (fig. 11).

I sometimes inserted Volara and Teflon tape inside the clamp to cushion the string and adjust the pressure, particularly in areas where the string is especially thin or fragile.

In cases where a small stub of string protruded from the end cavity, I modified the technique so that the long portion of the string would be secured to the protruding stub in addition to the inside of the cavity. This way, if one of the bonds fails, the other would provide a back-up. To begin, I adhered part

Fig. 9. Empty socket with no string protruding (Courtesy of Nicole Ledoux)

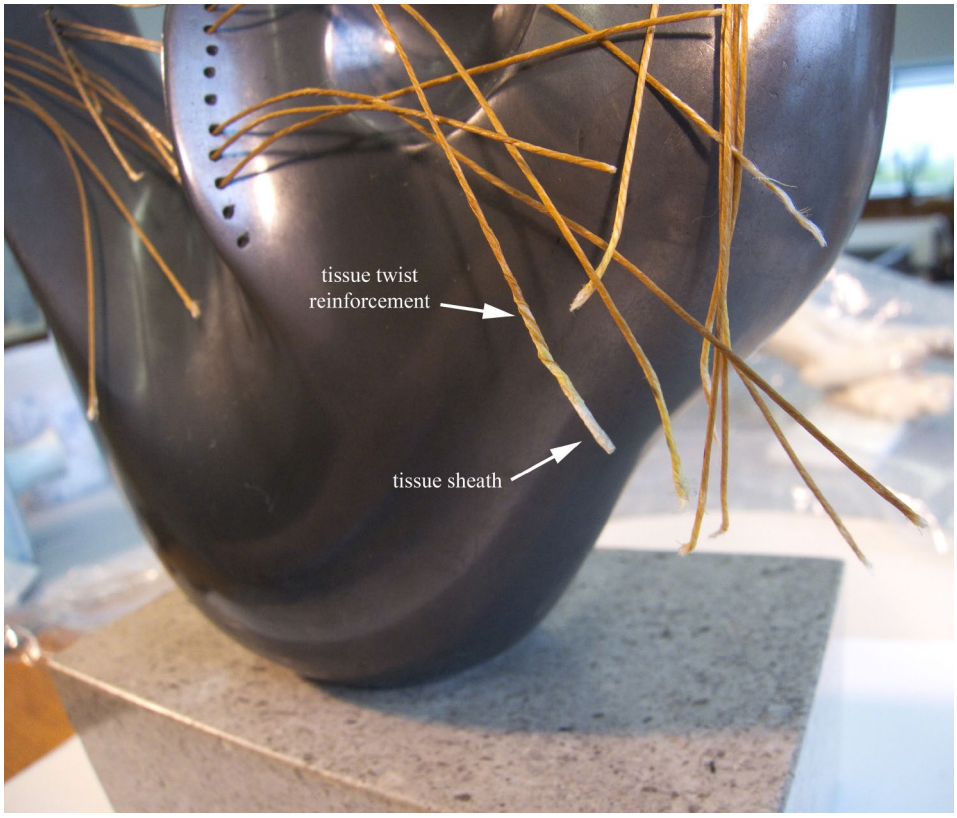

Fig. 10. String end reinforced by Japanese tissue and wheat starch paste supports (Courtesy of Nicole Ledoux)

Fig. 11. String adhered into empty socket with Paraloid B-72 and held in place by clamp (Courtesy of Nicole Ledoux)

Fig. 12. Tissue twist tails attached to end of string (1) and protruding stub of string in socket (2, 3) Courtesy of Nicole Ledoux)

of two tissue twists to the protruding stub of string, leaving the ends of the tissue twist extending to form tails (fig. 12).

I then adhered a third tissue twist to the long portion of string in a similar manner, with one part of the twist wrapped around the string in the direction of the plies and the remaining part left extending. After the wheat starch paste dried, I adhered the tissue twist tail extending from the long portion of string to the side of the lead cavity with a drop of Paraloid B-72, using a clamp to hold it in place as it dried. When dry, I secured the two tails attached to the protruding stub of string to the long portion of string with wheat starch paste.

5.2.2 Repairs Inside or Adjacent to the Center Holes

My second method of repair involved strings that had broken at points either inside or adjacent to the perforated ridge at the center. See figure 13 for a video showing the process of joining a string at a breakpoint located inside a hole at the center of the sculpture. These, and the following repairs, are string-to-string bonds and use wheat starch paste as the sole adhesive. I started these mends by first attaching tails of Japanese tissue twists to each end of the string: two on one end, one on the other (fig. 14).

As described earlier, half of each twist is wrapped around the string in the direction of the plies, and the other half, at least a centimeter long, is left extending. Once the starch paste was dry, I threaded

Fig. 13. Video showing the process of joining string at breakpoint located in hole at center of sculpture (Courtesy of Nicole Ledoux) https://youtu.be/RYkyrBWvM5M

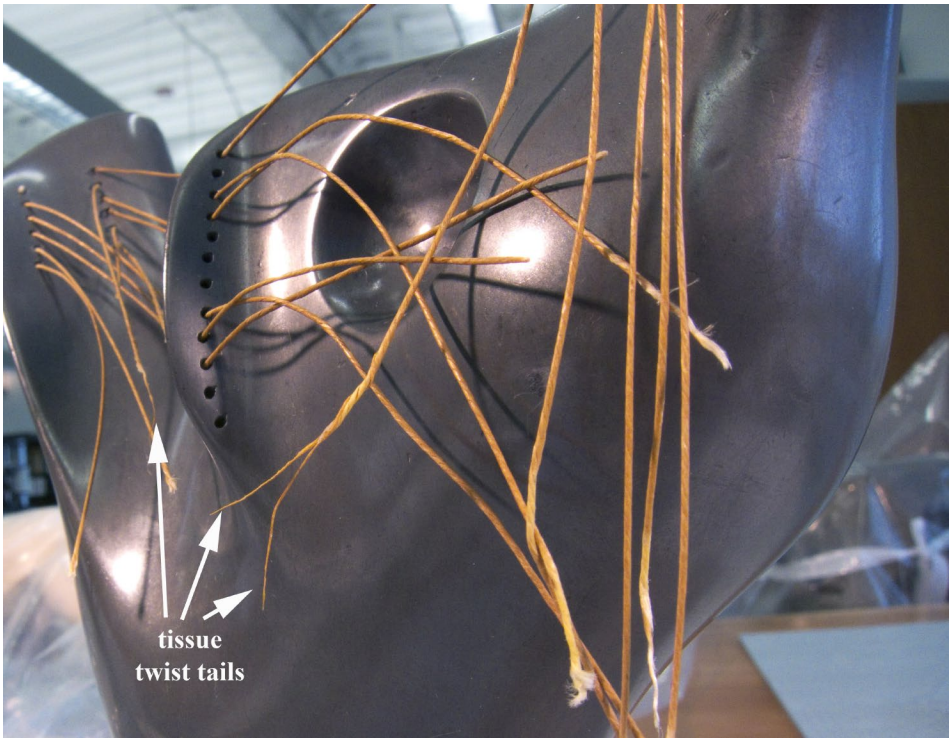

Fig. 14. Tissue twist tails attached to string ends in preparation for joining at middle of sculpture (Courtesy of Nicole Ledoux)

each of the three tissue twist tails through the hole, and used the clamps to pull on the tails, bringing the ends of the string together (fig. 15).

While the clamps held the alignment of the strings, I secured the third tissue twist to the opposite string by winding it around the string in the direction of the plies (fig. 16).

Once it was dry, I secured a tissue twist from the opposite string in same manner (fig. 17), and when that was dry, I secured the final tissue twist.

By this method, each string mend is supported by three tissue twists, each wrapped securely around both ends of the string.

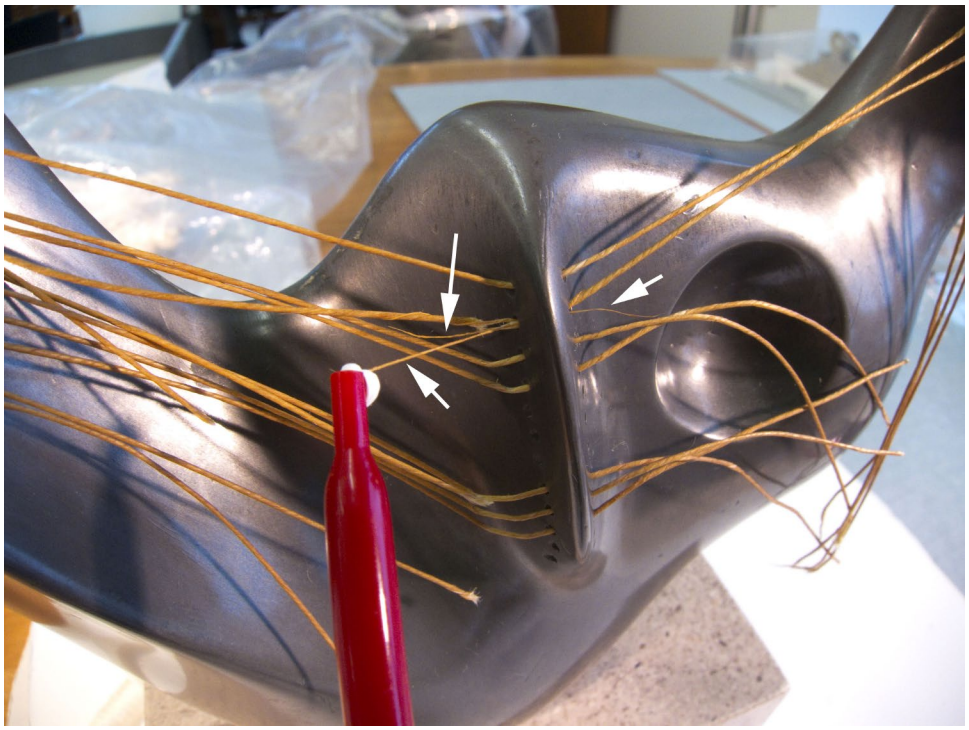

Fig. 15. Three tissue twist tails (shown by arrows) threaded through center hole, with one held under tension by clamp (Courtesy of Nicole Ledoux)

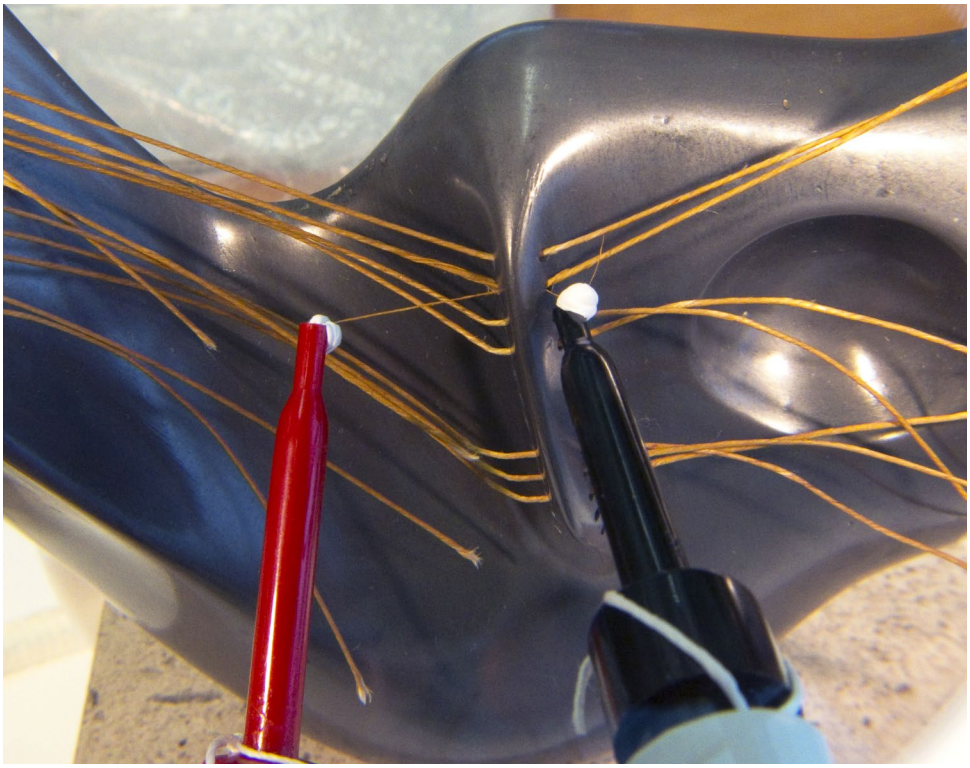

Fig. 16. Strings held together under tension by clamping a tissue twist from each side of string. Third tissue twist is secured to opposite string with wheat starch paste. (Courtesy of Nicole Ledoux)

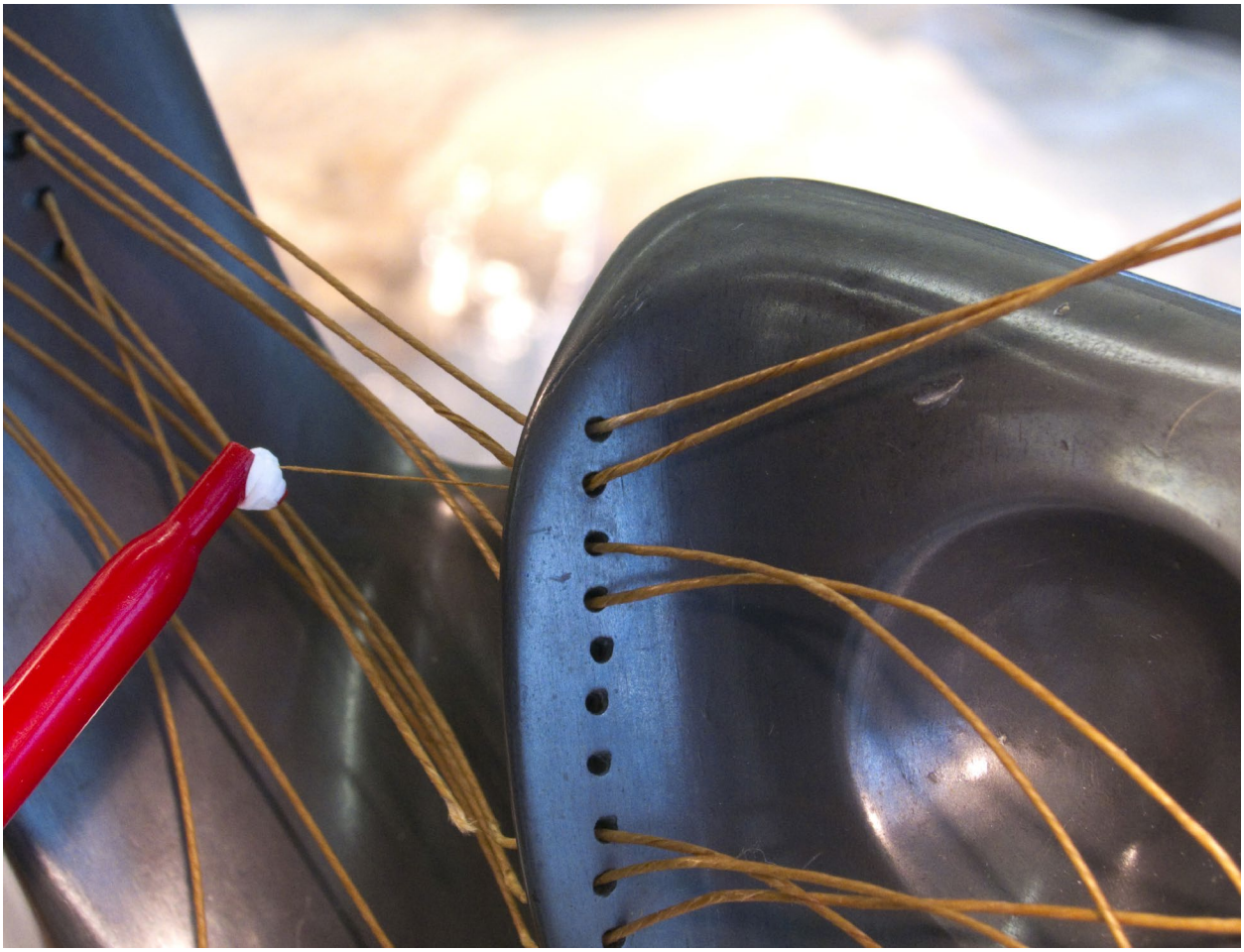

Fig. 17. On the right side, the clamp (shown in fig. 15) has been released and the tissue twist it held is now adhered to the string (Courtesy of Nicole Ledoux)

5.2.3 Repairs along a Visible Span of String

My third method, used where the break occurred in the middle of a span of string, is very similar to the second technique described earlier. The only difference is that aligning the ends is more difficult, because there is no hole nearby to act as a guide. I still used three tissue twists for these mends, but instead of being able to just pull on their tails during clamping, I often had to clamp and pull on both the tissue twist tails and the string itself to get the alignment just right (fig. 18).

In a few of these cases, the ends of strings did not meet up due to small losses. This did not prevent me from making the joins using this technique, but it did leave a noticeably thinner area where only the tissue twists bridge the gap (fig. 19).

In these cases, I placed an additional small tissue twist across the gap to provide the added width.

5.2.4 Replacing the Missing String

An additional aspect of this treatment that I would like to discuss is the replacement of one long section of missing string. In this case, there were short broken string ends protruding from the cavity on either side of the loss, with no remaining string in between. First, I created a replacement string by stretching the linen thread I used in my trials, and then toning it with fluid acrylic paints. Fortunately, the width of this string was nearly identical to that of the original. Another great aspect of this thread is that it is Z-twist, meaning that it twists in the opposite direction of the original threads, which are S-twist.

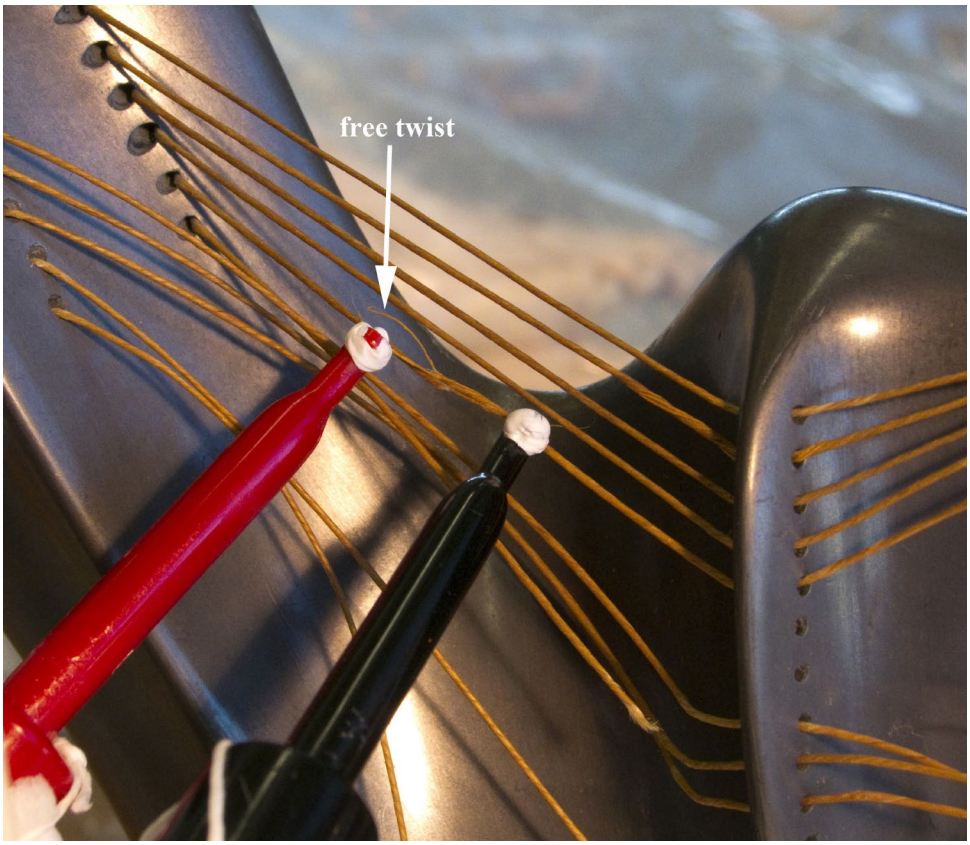

Fig. 18. Clamps holding ends of string together under tension. One tissue twist is left free for joining. (Courtesy of Nicole Ledoux)

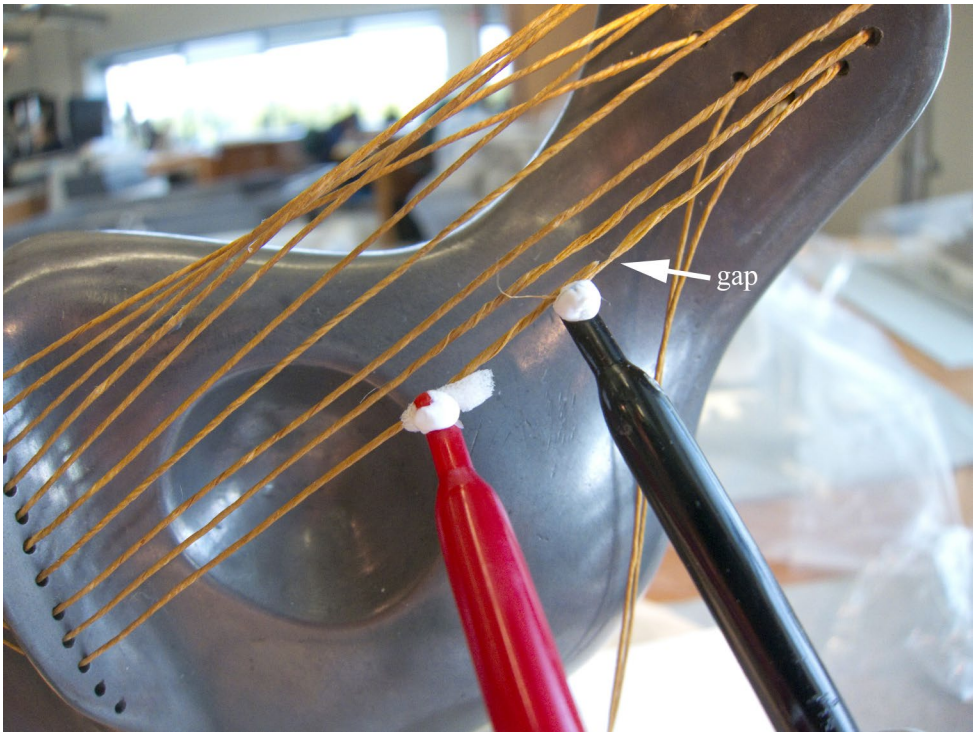

Fig. 19. Gap between string ends spanned by tissue twist supports during joining (Courtesy of Nicole Ledoux)

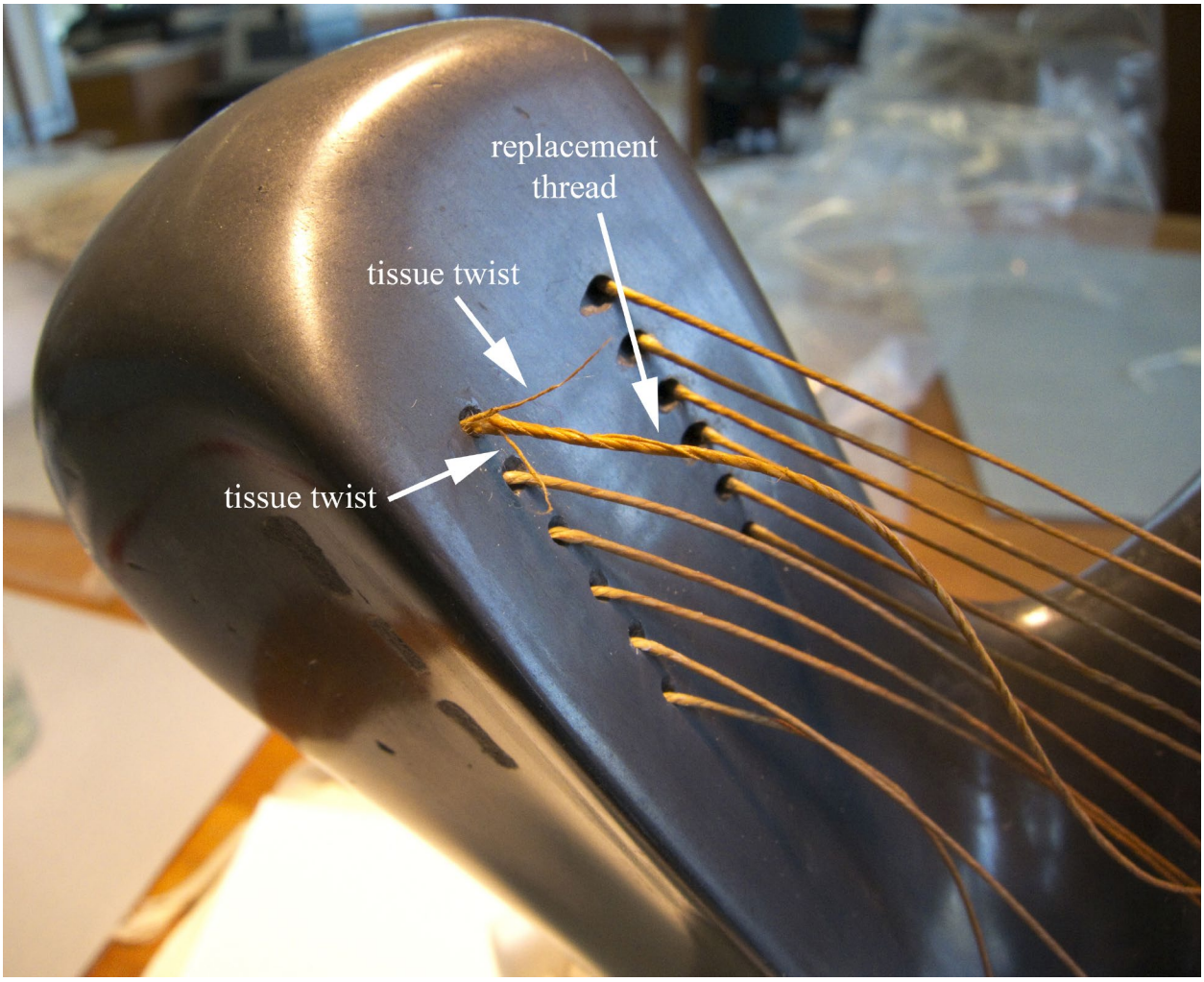

Fig. 20. Attachment of replacement string (Courtesy of Nicole Ledoux)

This provides a very easy way of distinguishing replacement from original and is only noticeable on close inspection. The replacement string was secured to the corresponding sockets at each end of the sculpture using the method described in section 5.2.1 for repairs with small stubs of string protruding (fig. 20).

6. CONCLUSIONS

After over 50 hours of documentation and treatment, the strings of *Mother and Child* are now returned to their original, intact configuration (figs. 21, 22).

The chosen approach and execution has satisfied the goals identified at the outset of the treatment: to stabilize and repair the original strings in a way that is strong, seamless, and consistent with the artist's aesthetic intent. On close inspection, the mends can be identified as areas that appear slightly thicker than the surrounding string due to the added volume of the tissue twists (fig. 23).

This feature is, however, overall consistent with the inherent variations of the original thread, and a viewer is unlikely to notice from normal viewing distance. Since completion of the treatment, the sculpture has withstood packing, transportation, and installation in the new museum facility without failure of the joins.

It is my hope that these repairs will carry this object through the next phase of its exhibitable life. It is difficult to predict how long these mends will last, as the strings will undoubtedly continue

Fig. 21. *Mother and Child*, front after treatment (Courtesy of Nicole Ledoux)

Fig. 22. *Mother and Child*, back after treatment (Courtesy of Nicole Ledoux)

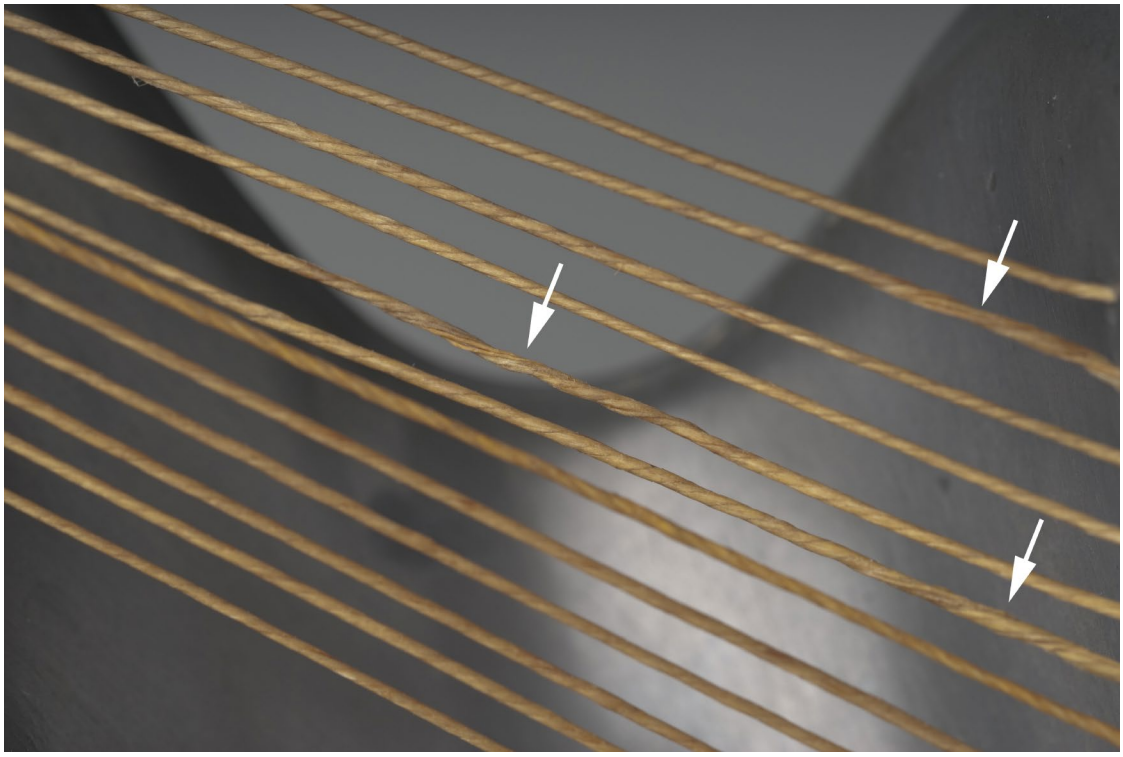

Fig. 23. Close-up view of string repairs after treatment (Courtesy of Nicole Ledoux)

to weaken with age; however, with the museum carefully monitoring and controlling the object's light exposure, we can expect the weakening of the threads to proceed at a slower rate than in the past. Restringing may very well become the only solution at some point in the future, but for now these repairs are an approach that has proven successful.

ACKNOWLEDGMENTS

I would like to thank the Samuel H. Kress Foundation for supporting this fellowship, as well as my colleagues at the Harvard Art Museums who provided valuable input on this treatment. I also am grateful to the many colleagues in the wider conservation community who took time to share their experiences and thoughts on conserving stringed objects of all kinds.

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Toland, J., B. Phipps, and J. Wess. 2012. *Intersections: Henry Moore and stringed surfaces*. London: The Royal Society.

SOURCES OF MATERIALS

4-arm Holding Jig
Micro-Mark
340 Snyder Ave.
Berkeley Heights, NJ 07922
888-263-7076
www.micromark.com

Electrical Wire Test Clamps
RadioShack Co.
300 RadioShack Circle
Fort Worth, TX 76102
800-843-7422
www.radioshack.com

Japanese Tissue Paper (Light Weight Kozo, White)
New York Central Art Supply
62 Third Ave.
New York, NY 10003
212-473-7705
www.nycentralart.com

Lascaux 498HV; Methyl Cellulose; Paraloid B-72; Renaissance Wax; Stabiltex (product discontinued)
Talas
330 Morgan Ave
Brooklyn, NY 11211
212-219-0770
www.talasonline.com

Wheat Starch Paste (Zin Shofu)
Museum Services Co.
385 Bridgepoint Dr.
South Saint Paul, MN 55075
651-450-8954
www.museumservicescorporation.com

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