The Tripod Speleothem Repair System

Al Collier

To secure the speleothem while an approved adhesive or epoxy dries, a simple system of multiple tripods, cross bars, and counterweights is employed. Using tripods to support speleothem repair is not a new idea. Through years of trial and error, I have developed a number of innovative stabilizing concepts based on tripods. While any photographic tripod with a periscoping center leg will work, the Slik® 1200-G tripod is ideal because it is designed to be adaptable and works well with aluminum crossbars and counterweights.

A camera plate sits on a fulcrum and provides flexibility when attaching assorted crossbars and adjustable pads. Counterbalance is easily achieved by filling small laundry bags with rocks, which are typically found along the trail (when possible, use rocks found inside the cave).

The variations on this technique and its applications are endless. This section illustrates simple tripod systems for supporting repaired speleothems while the epoxy cures.

Crawlway Stalactite and Drapery Repair

Place a short tripod with the crossbar centered on the fulcrum under the stalactite and apply the appropriate counterweight (Figure 2). To protect the surface of the speleothem, pad the end of the crossbar that supports the stalactite. Place the counterbalance on the opposite end of the crossbar.

Position the broken piece on the padded end and manually align the apparatus directly underneath the intact remnant of the stalactite. Apply epoxy to the lower break joint and then mate the two pieces by gently allowing the counterweight to apply pressure.

Once the epoxy has set sufficiently, slowly elevate the counterweight to release the upward pressure on the stalactite, and then remove the entire fulcrum assembly.

Tall Passage Stalactite and Drapery Repair

This technique works for repairing stalactiles in passageways up to 8 feet (approximately 2.5 meters) high. Extend the center leg of the tripod vertically from the lower fulcrum and reverse the leg 180 degrees from standard (Figure 4).

Install an adjustable mini tripod head of compatible size on the extended end to create an upper fulcrum. Then install a shorter aluminum crossbar on the upper fulcrum. (Add extra weight to the center of the tripod to help stabilize it while making above-the-head repairs.) Place the tripod with the crossbar centered on the fulcrum under the stalactite with appropriate counterweight.

Pad the end of the crossbar that supports the stalactite to protect the surface of the speleothem. To secure the speleothem while an adhesive dries, employ a simple system of multiple tripods, cross bars, and counterweights.
Figure 2. In this crawlway, Al Collier places a short tripod with the crossbar centered on the fulcrum under the speleothem and applies the appropriate counterweight to reattach the stalactite.

Figure 3. Use a basic photographic tripod that has a reversible periscoping center leg. Adapt the tripod to use with camera plates, adjustable pads, and rock-filled counterbalance bags.

Figure 4. For overhead repairs in tall passages, extend the center tripod leg vertically from the lower fulcrum. Create an upper fulcrum with a mini tripod head and short padded crossbar.

Figure 5. Al Collier repairs a short stalactite tip with Hot Stuff Super T cyanoacrylate adhesive, a spring-loaded tube, and a plumb bob.

Figure 6. Reverse the tripod system and apply downward pressure instead of overhead bracing.

Figure 7. Use a similar technique for stalactite repairs in inaccessible locations.
Put the counterweight on the opposite end of the crossbar. Position the broken stalactite section on the padded end and manually align it directly beneath the intact remnant overhead. Apply epoxy to the break joint of the broken piece. Then mate the two pieces by gently allowing the counterweight to apply pressure.

Once the epoxy has set sufficiently, elevate the counterweight to slowly release the upward pressure on the stalactite. Complete the repair by removing the entire fulcrum assembly.

**Inaccessible Location Stalactite Repair**

Use this method to repair stalactites in areas of the cave that are not readily accessible (such as under ledges.) Extend the center leg of the tripod horizontally from the main fulcrum and position it approximately 90 degrees from standard (Figure 7).

Install an adjustable mini tripod head of compatible size on the extended end, which creates a second fulcrum. Next, install a small aluminum pad on the second fulcrum.

Place the aluminum pad under the stalactite with appropriate counterbalance applied to the opposite end at the position of the primary tripod head. (Extra weight added to the center of the tripod helps to stabilize it while making this type of repair.) Place the broken piece on the padded end and manually align it directly beneath the intact remnant of the stalactite. Apply epoxy to the surface of the broken piece and mate the two pieces by gently allowing the counterweight to apply pressure.

Once the epoxy has set sufficiently, the counterweight is slowly elevated to gently release the upward pressure on the stalactite.

**Standard Helictite Repair**

Support helictite repairs in much the same way as stalactites, with a few minor modifications. Extend the center leg of the tripod horizontally from the main fulcrum and position it approximately 90 degrees from standard.

Install an adjustable mini tripod head of compatible size on the extended end, which creates a second fulcrum. Then install a small aluminum crossbar on the second fulcrum. The crossbar has an aluminum pad on one end, which is used to protect the speleothem.

Place the aluminum pad against the helictite and apply appropriate counterweight to the opposite end at the position of the primary tripod head (only for the purpose of balancing). (Extra weight added to the center of the tripod helps to stabilize it while making this type of repair.)

Place the broken piece near the padded end and manually align it directly in front of the intact remnant of the helictite. Apply epoxy to the surface of the broken piece and mate the two pieces by hand. Use a small bungee connected to one end of the aluminum crossbar to create tension on the opposite, padded end. Then gently place the padded end against the epoxied speleothem.

Once the epoxy has set sufficiently, manually shift the bungee end of the crossbar to release the gentle pressure from the helictite.

**Stalagmite and Multi-break Stalactite Repairs**

Use this technique to repair stalactites that have been broken into multiple pieces. It is also effective for small stalagmite repairs. Adjust the tripod to the appropriate height for the size of the speleothem being repaired (Figure 6).

The center leg is 180 degrees from normal with the large camera head pointing straight down. Attach a long aluminum crossbar to the camera head. At the opposite end, attach an aluminum pad.

Align the various parts of the speleothem directly underneath the pad. Apply epoxy to one of the broken surfaces. Match to the corresponding
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Part of the speleothem. Place the pad on the upper piece. Then place appropriate weight on the bar and apply pressure to the speleothem to assure a tight epoxy joint.

Once the epoxy has set sufficiently, remove the weight from the bar and gently lift the pad from the speleothem. Repeat this process for each of the broken sections.

Repairing Short Tips on Stalactites
Repair short stalactite tips in just minutes with a spring-loaded tube and a plumb bob (Figure 5). First, compare the alignment of the broken tip to the stalactite for proper fit. Then, move the tip down and add a drop of adhesive. Reattach the tip to the stalactite and hold in place with the spring-loaded tube and use the plumb bob to maintain vertical pressure until the epoxy dries. Finally, remove the tube very slowly.

Conclusion
Cave softly—don’t break it and it won’t need to be fixed. We can clean, renovate, refurbish, and repair some speleothems. We can come close to making some look pristine. However, chipping a name into flowstone or removing broken speleothems from a cave causes damage that can never be reversed. We can protect and restore cave environments for future generations or we can make them into mud-filled holes devoid of speleothems and life. The choices and the responsibilities belong to all of us.