How to Prepare Bone

Sean J. Barry
Davis, California
sjbarry@thegrid.net
January 2012 revision

2012 note: I wrote “Preparing Bone for Musical Instruments,” aka “Cleaning Bone for Musical Instruments” in about 30 minutes in 1999 and I posted it to the Banjo-L listserve. The brief treatise spread around by “net osmosis” and survives in numerous locations to this day, and folks still e-mail to me about it. Although the bone preparation methods of choice described in the original article remain unchanged, the article reflected the 30 minutes that I devoted originally which meant that it could benefit from careful editing, and some additional information. So I offer this revision which reflects more than 30 minutes of careful editing. Please feel free to contact me if you have questions or comments.

Bone is a remarkable natural material that is often used for string nuts and saddles in musical instruments, and is also occasionally used decoratively for inlay work. Bone is comprised of an inorganic matrix of hydroxylapatite ($Ca_{10}(PO_4)_6(OH)_2$ which lends mass and hardness, and an organic matrix of structural proteins such as collagen that lend strength and flexibility. This combination is very strong, a good thing for us and for all other vertebrates too. Living bone also has blood vessels, nerves, and cells with large fat vacuoles, and often has a large marrow cavity where blood cells are produced. This structural protein/inorganic heterogeneity also gives bone its useful qualities as nut and saddle material, and so it is important to protect and preserve all of the inorganic and as much of the structural protein components as possible when bone is processed to make nuts and saddles.

It's easy but involved to prepare bone properly for instrument work. The main problem in lutherie is to produce material that will do the job, last a long time, and not damage the instrument it was meant to enhance. That means that lutherie bone must be very clean and grease-free and therefore stable and harmless to nearby materials. Cleaning and degreasing are conceptually and technically easy, but natural materials are variable and sometimes frustrating. Don’t lose patience with the preparative process and accept "almost-right" material.

Source material is pretty easy--the best place to look is in a grocery store. Buy a fresh cow "knuckle" or a section of long bone, the type commonly sold for soup and not always on display but almost always available. You can also use other long bones and the bones of other mammalian species, but cow bone has the virtues of density, size, and limited (sometimes nonexistent) marrow cavity. Ask the butcher to saw the knobby ends from the bone, or do it yourself with a hacksaw. Extract as much soft tissue as possible from the exposed marrow cavity (a straightened wire coat hanger and compressed air work well together for this step), then immerse the bone in water or water with household ammonia or a little mild dish detergent added. Water with ammonia cleans best and fastest but requires a stovetop with an efficient exhaust hood. Water with detergent is not too far behind from an efficiency viewpoint, and pure water works but takes longer and tends to harden soft tissues somewhat. The advantage of pure water is that the resulting broth is soup. I use ammonia. Bring the liquid to a boil, then reduce heat and simmer for 30-40 minutes (ammonia in water), 50-90 minutes (detergent in water), or up to two hours (pure water). The objectives are to cook away the soft tissue and to begin the degreasing process. After the assigned time, remove and cool the bone, then use running water in combination with fingernails and a stiff brush to remove the remaining soft tissue. Don't be afraid to return the bone to the simmer pot.

After the bone is cleaned of soft tissue, air-dry for a day or so, then bandsaw or hacksaw the large bones into oversize blanks (bridge, nut, saddles, etc). Air-dry the blanks for at least 2-3 days, perhaps a week during humid times. To degrease properly they have to be bone-dry, so to speak.....

Degreasing is the most overlooked, under-done, but important step in bone preparation. Greasy bone will leach fat slowly but forever, and the grease will contaminate glue joints, make finish and wood part company, stain and degrade wood, and eventually destroy the bone itself through a process of slow combustion of the protein matrix that strengthens bone. I once attempted to repair a Martin D28 with a homemade bone saddle that had leached grease right through the ebony, so that it had seeped into the top, caused the bridge AND BRIDGE PLATE to separate partially from the top, and was almost impossible to remove completely so that a new bridge and bridge plate could be fitted and glued with assurance that they would remain glued through the following days and weeks, let alone through the decades and centuries. Grease and glue literally don’t mix. I still worry about that very tricky repair to a formerly fine instrument. Bone can *look* clean yet have a substantial grease content that won't manifest itself for years, and by then some of the insidious damage it caused will be impossible to repair. Don’t use greasy bone.

To degrease bone, immerse the very dry blanks in about ten volumes of white gas for 1-3 weeks. White gas, AKA Coleman fuel, is extremely flammable and so this step should be done in a glass container outdoors somewhere in the shade far from structures (even though Coleman fuel is supplied in a metal can, a small volume can be safely stored in a glass jar or bottle with a tight-fitting leakproof lid). Greasy bone will discolor the white gas after just a day or two so replace it at that time. Talk to your local fire marshal about legal methods for white gas storage and disposal.

The requisite degrease time can and should be extended if the bone shows any sign of residual grease, such as translucent spots that shrink over time. When the bone is degreased, remove the bone blanks from the gasoline, rinse once in clean gas, and air-dry. Degreased bone should dry quickly, typically in much less than an hour for nut and saddle blanks. If the blanks dry slowly, there is residual grease in the bone so return them to the (new) gasoline bath. Again, I can't over-emphasize the importance of thorough degreasing--you could badly damage someone's valuable instrument if you use greasy bone.

Next, shape the bone and final-fit, smooth with a mill file, sand with 320, 400, and 600 grit wet or dry paper each used dry and then wet with water, and finally buff with tripoli, then rouge. After all this the bone will be shiny and yellowish-white. If in your opinion the bone is not white enough, bleach it by immersing for 10 minutes in 3% (drug store) hydrogen peroxide in a glass jar without a lid. Longer immersion tends to over-whiten and makes the bone look flat. Air-dry the bone and glue or set in place. Do not use household (chlorine) bleach to clean or bleach bone! Bleach doesn't actually whiten the bone very much, and it seeps into bone and damages the protein matrix. Bleach-treated bone typically becomes friable (crumbly), much as greasy bone eventually does.

I realize this was much more than most want to know about where bone comes from, but like any preparative process for natural materials the bone cleaning process is involved* and requires non-compromising attention to detail if you want your nut/saddle/bridge to look nice, work well, last longest, and not damage its host instrument.

Sean Barry

*Also, if the process described above seems very involved and tedious, that's because it is, and that's why for most of my work I purchase bone and saddle blanks from the various lutherie suppliers. These are imported from Asia, and are marvelously clean, grease-free, and inexpensive. But if you need larger pieces of

bone than are available through that source you'll most likely need to clean and degrease it yourself.

**I've heard several times that cow bone available in pet stores for dogs is grease-free, though I don't know how the processor could degrease bone without also making it potentially toxic. Perhaps some is degreased but the pet store bones I've examined have contained some grease that becomes evident when the bone is warmed in the sun for an hour or two. Your pet store bone mileage may vary, but to me the stakes are much too high to risk using it.