

Rodding Surgery

Introduction

Rodding surgery is the placement of a metallic device called a rod or nail into the internal cavity (medullary canal) of a long bone. It is major surgery and the pros and cons should be carefully evaluated.

Rodding is most often used to treat children with moderate to severe osteogenesis imperfecta. In teens and adults it is usually reserved for difficult fractures that are not healing.

Purpose of Rodding

Not everyone with OI needs intramedullary (IM) rods. Children who do not fracture often and have straight bones do not need rods.

Rodding is recommended for children

- Who have curved bones
- Who repeatedly break a long bone.

A curved or bowed long bone is not *in itself* a reason for rodding unless it gets worse, repeatedly breaks, becomes painful, or interferes with function. Rodding does not always *prevent* fractures, but the rod will provide an internal splint that can reduce the risk of displacement of the bone. Rodding may allow the person to be more active after a break, and to avoid prolonged periods of casting and inactivity. This, in turn, can help break cycles of inactivity leading to fractures. Fractures may also occur in an area of the bone that grows beyond the end of the rod.

For people with OI, rods are preferred over plates and screws to repair fractures. Plates and screws create a very stiff, short segment within the bone. The bone is likely to break above or below the plate and long term use can lead to thinning of the bone underneath the plate.

Walking may be improved after rodding surgery in the child who is ready to walk but is held back because of repeated fractures. However, depending on the severity of OI, walking may not be an appropriate goal for every child. Rodding surgery by itself will not guarantee that the child with a severe form of OI will learn to walk.

Timing of Surgery

The timing of surgery and the type of rods to use will be affected by the size of the bone to be rodded. The bone must have a large enough diameter to accept a rod. Bones in OI may be thin and flat, so they often appear wider in diameter on x-ray than they actually are. Rodding the long bones in the legs is considered when a child with bowed legs pulls up to stand. Age is not an important factor in determining the need for rodding surgery.

Rodding is usually undertaken as a scheduled elective procedure. However, it can also be undertaken soon after a fracture to avoid a second period in a cast. The fracture may provide an opportunity to perform a rodding without opening the fracture site.

As the child grows, the decision about when to revise a rod in a bone that is not fractured is complicated and depends on the child's symptoms (whether the rod is painful or protruding) or the likelihood of the bone breaking in the unprotected segment.

Types of Rods

Two important considerations for selecting rods for children with OI are the small diameter and length of their bones and prospects for bone growth. The orthopedic surgeon matches the rod properties to the specific needs of the child or adult, considering bone size and demands placed upon the bone. The rod should be small enough to fit into the bone canal and stiff enough to support the bone. The rod should not be so large or stiff that it completely shields the bone from stress. Some stress on the bone is necessary for developing and maintaining bone density. Telescoping rods are chosen when there is growth potential. They are not indicated in adolescents or in children with "popcorn" physes because they have little growth potential. Rods can be made of stainless

steel or titanium. There are two major types of rods: non-telescopic and telescopic. Surgeons agree that no single rod is appropriate for all situations.

Non-telescopic rods do not expand. They are very versatile, and are made in many sizes. For children with very short, thin bones, they may be the only option. They are inserted to support the full length of the long bone. Since this type of rod does not grow with the child it may need to be replaced as the bone grows if bowing occurs beyond the point where the rod ends.

Telescopic rods consist of a thinner rod inserted into a larger hollow rod. They lengthen as the bone grows which may prevent or postpone the need for replacement. However, they are thicker than non-expanding rods, and are therefore only appropriate for larger bones. The bone must also be strong enough to allow the rod to be “anchored” at either end. This type of rodding surgery often requires incisions around the joints.

The Fassier-Duval rod system approved by the US Food and Drug Administration (FDA) in 2005 is the newest telescopic rod on the market. Developed by an orthopedist with extensive experience caring for children with OI it is designed to allow for a less invasive surgery and therefore a quicker recovery than other telescopic rods.

Surgery and Bisphosphonates

Research indicates that children receiving bisphosphonates should discontinue treatment before rodding surgery. Treatment can be resumed when healing is well established.

Surgery and Aftercare

Rodding procedures are most often undertaken in the thigh bone (femur) and shin bone (tibia). Occasionally, the arm bone (humerus) requires rodding as well. The spine may be rodded to reduce a scoliosis. With modern anesthesia, children can undergo surgery for longer periods of time, thereby enabling several bones to be rodded at one time (e.g., the femur and tibia of one leg). Prior to surgery key topics to discuss with your surgeon include:

- Physical activity prior to surgery
- The length of the operation
- Time in the hospital
- The length of recovery time at home
- The rehabilitation plan.

The question of whether or not to limit physical activity in young children prior to their first rodding surgery frequently comes up. Experience tells us that fractures cannot be prevented by being extra protective. It is also very difficult to stop a young child who wants to crawl, pull to stand or get into or out of sitting on their own. Exercise enhances bone formation and motor development of the child. It is OK to allow the child to continue his/her usual physical activities, including swimming, prior to surgery. But parents and caregivers are advised that they should not passively place a child who has severe bowing of the leg bones in a standing position.

When rodding surgery is scheduled, the family and surgeon should develop a plan for what to do if the bone breaks prior to surgery. Often the rodding can be done at the time of the fracture.

Osteotomy is a surgical procedure that is often part of rodding. It is used to correct curves or bowing of the long bones. It involves cutting and removing thin wedges of bone so that the bone can be straightened.

Casts or splints to support the rodded limb are often needed for about four weeks after surgery since healing time for OI bone is normal. Because people with OI face frequent periods in a cast due to surgery or fractures, steps should be taken to prevent immobilization osteoporosis. A guiding principal is to immobilize the broken or rodded bone with lightweight material for the shortest period of time possible.

An above-the-knee cast or splint is used following tibia surgery. The knee may be bent so that the child can sit in a wheelchair or stroller.

Casting following femoral surgery is more difficult with splinting, hip spica casts and A-frame casts (a bilateral long leg cast with a connecting bar that prevents rotation) as options. A spica extends from the ribs down the affected

leg. It is required if fixation in the bone needs external support to heal. Only the surgeon can decide during the surgery if this heavy, postoperative immobilization is necessary. Whenever possible surgeons experienced with OI prefer to avoid spica casts, choosing an above-the-knee splint or lightweight plaster or fiberglass splints instead.

Bracing may be used after the removal of the cast to provide added support for standing and walking. A brace is worn to protect the limb as the patient becomes more active. Children who have had surgery on their tibias often require a period of post-operative bracing.

Physical therapy is required for most children with OI after rodding surgery. Some physicians prescribe physical therapy during the recovery period to keep up muscle strength in limbs not affected by the surgery. Other times, physical therapy, sometimes beginning in the swimming pool, is employed after the cast is removed to help the individual regain strength.

The length of the recovery period is determined by the extent of the surgery, the type of rod, the patient's age and activity level. Painful muscle spasms are common after surgery and during recovery. Your doctor or physical therapist can suggest techniques for reducing their pain and frequency. For more information about preparing for surgery and caring for a child in a cast, splint or spica cast, see the OI Foundation fact sheet "Preparing for Your Child's Surgery: What Parents Need to Know Before, During and After Their Child is in the Hospital."

Potential Complications

Rodding is major surgery, and as with any major surgical procedure, there are potential complications. Complications from surgery include risks related to general anesthesia and the possibility of fractures during surgery from inserting an IV or positioning the child. Other issues related specifically to rodding surgery include bleeding, infection, rod migration, and mechanical failure of the rod. The more serious complications are rare, but should all be discussed with the surgeon beforehand. A key factor in minimizing complications is using a surgeon who has experience in the care of children with OI. Even in the absence of complications, rods may need to be changed as a child grows.

Rod Replacement

A rod that is not causing pain or interfering with function can be left in place for many years. The question of replacing a rod comes up

- When the rod migrates (moves) into the joint or outward
- When the rod becomes damaged or fails to elongate
- When the child grows
- When new bone deformity occurs

Whether the rod needs to be removed, replaced or trimmed depends on the quality of the bone seen on x-ray, as well as the presence of pain, or the appearance that a fracture is likely to occur. When a telescopic rod reaches its maximal length and the bones remain straight the rod may or may not need to be replaced. Two options are available.

- Wait until the bone breaks and replace the rod on an emergency basis. This will be painful for the patient and stressful for the family.
- Change the rod on an elective basis based on surgical need as indicated by the x-ray. This option requires thorough discussion between the family, patient and surgeon.

Adults often have rods that were placed during their teen years. It is not harmful to leave an old rod in the bone. It is still an important part of the support for that bone. Rods occasionally become painful in adults. If there is pain or significant deformity interfering with the person's ability to function, the rod should be trimmed or removed. Removal can be difficult. As part of preparing for this kind of surgery the surgeon will want to study old records from the original insertion of the rod and prior x-rays whenever possible. The bone probably still needs support, so in most cases a new rod will need to be placed. Sometimes the bone quality is good enough that a rod can be removed from an adult without replacement. If the adult is no longer walking, rod removal without replacement may be appropriate.

Some Terms Explained

IM rod	Intra-medullary rod; nail Rod in the internal cavity of a long bone.
Telescopic rods	A rod that can lengthen during growth Dubow-Bailey rod Fassier-Duval rod
Non-telescopic rods	Kirschner wires (K-wires) Rush rods Williams rods Elastic rods
Sliding rods	Two regular rods inserted one from the top, the other from the bottom of the bone, migrating away from each other during growth.
Spica	A plaster cast that extends to the hips. It not only immobilizes the leg but in fact the whole person.
Femur	The long bone in the upper leg

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