

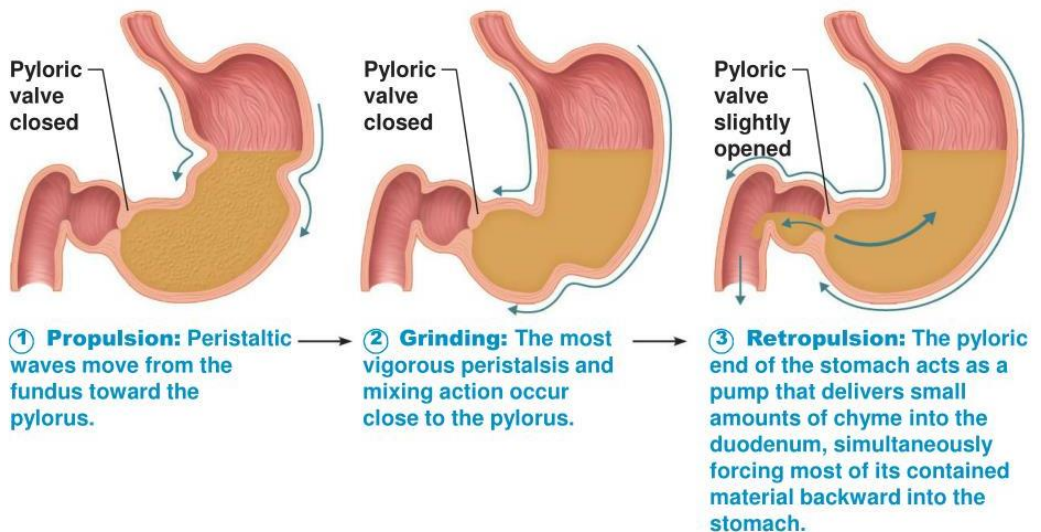
Bottom of Stomach/Pyloric Sphincter

Note: Not all Whipple procedures remove the bottom part of the stomach. Usually, modified Whipple Procedures keep the bottom of the stomach and the Pylorus (Pyloric Sphincter) intact.

1. Functions

Gastric emptying

The bottom part of the stomach, termed the Pylorus (or Pyloric Sphincter), is responsible for emptying gastric contents (called chyme) into the duodenum. The gastroduodenal junction separates the two and is a sphincter to regulate the flow of chyme.



Gastric emptying is a multifactorial process that involves smooth muscle contractions, innervation pathways, and hormonal regulation. The duodenum communicates with the stomach to inhibit or stimulate gastric emptying depending on its ability to accommodate incoming chyme.

Secretion of Intrinsic factor

Parietal cells of the stomach are responsible for secreting Intrinsic Factor (IF) which is needed for the proper absorption of Vitamin B 12. Vitamin B 12 is a component in many processes throughout the body, but notably is needed for red blood cell synthesis.

Stomach Acid Regulation

The stomach's production of acid is a major step in the process for digesting food by breaking down food components. Acid production is primarily done by tissues in the top of the stomach. Sensors in the bottom of the stomach sense the amount of acid present and are responsible for signaling when to start or stop acid production.

When the bottom of the stomach is removed, so is this signaling mechanism. The top of the stomach no longer receives the "stop" signal and acid is produced 24/7.

2. Problems Caused by Removal

Gastric emptying

Anyone who loses the bottom of the stomach and the pyloric sphincter to the Whipple surgery, will suffer from a loss of coordinated gastric emptying. This significantly complicates glucose and insulin management.

Everyone who takes or administers insulin with meals is instructed to take the insulin 15 to 20 minutes before each meal. This way, the insulin will enter the bloodstream at roughly the same time as glucose enters it from food in the digestive tract. Insulin counteracts the glucose and keeps your blood sugar within target.

However, this does not work for Type-3c diabetics who experience delayed gastric emptying from a loss of the bottom of the stomach and the pyloric sphincter.

With delayed gastric emptying, insulin taken before the meal goes to work right away...even though the food has not yet left the stomach. This forces the blood glucose (BG) to go down. Unfortunately, the higher the carb count calculated for a particular meal, the lower the BG will drop. For some patients, the delay in gastric emptying can be anywhere from 30 minutes to 3 hours. By then, the insulin has done its job and there's none in the body to counteract the glucose it does begin getting absorbed. Result? The patient's BG can rapidly go very high. Few medical personnel appear to be aware of this situation.

The cause for delayed gastric emptying has to do with the way the small intestine is attached to the remaining bottom of the stomach...after the bottom of the stomach, pyloric sphincter, and duodenum are removed. This procedure creates a smaller hole for food from the stomach to pass through. In addition, the muscles that normally push food into and through the digestive system are also gone. Gravity is now the primary mechanism for moving food from the stomach into the small intestines.

Secretion of Intrinsic factor

A partial gastrectomy can result in a loss of Parietal cells, leading to diminished secretion of Intrinsic factor. Without IF, Vitamin B12 cannot be absorbed properly and may result in anemia.

Stomach Acid Regulation—Osteopenia/Osteoporosis

As mentioned above, when the bottom of the stomach is removed, the control mechanism for regulating acid production is broken. The stomach now produces acid 24/7.

The current solution for this is to take acid reducing medications such as Prilosec (omeprazole) or Pantoprazole...proton pump inhibitors (PPI).

However, gastric acid is important for the breakdown of food and release of micronutrients, and some studies have shown possibilities for interference with absorption of iron, calcium, magnesium, and vitamin B12. Low levels of magnesium can be found in people on PPI therapy, and these can be reversed when they are switched to H2-receptor antagonist medications.

Difficulty absorbing calcium can also become a serious problem for three reasons:

1. Acid production is not coordinated for efficient food processing so less calcium is prepared for absorption.
2. PPI's interfere with the body's ability to metabolize or use any calcium it does get.
3. All of the organs/tissues capable of absorbing calcium are removed by the Whipple surgery. For this reason, taking dietary supplements does not work.

High dose or long-term use of PPIs carries an increased risk of bone fractures which was not found with short-term, low dose use; the FDA included a warning regarding this on PPI drug labels in 2010. This calcium deficiency eventually leads to osteopenia and potentially osteoporosis.

3. Strategies for Mitigating Problems

Gastric emptying

To help with delayed gastric emptying, smaller, frequent meals can be employed. There are a variety of prokinetic medications available. Prokinetic agents are drugs that stimulate contractions along your gastrointestinal tract to help move food along. However, most studies with these drugs have shown inadequate data or only a very small beneficial role.

Until an insulin pump, programmed specifically for type 3C diabetics is available, you may need to delay insulin delivery to better match the arrival of food into the intestine. Start by calculating the total carbs for a meal, eat the meal without taking any insulin, and wait until you see the blood glucose begin to rise. Then, enter only one-half of the carbs into the pump and wait for it to rise again before entering the final amount. This way, my insulin delivery will better match your actual glucose absorption.

Secretion of Intrinsic factor

In regard to Vitamin B12, there are intramuscular injections available to help increase levels. Your physician will likely order a lab work up to check your levels of Vitamin B12 to see if an injection is necessary. A high-dose B complex supplement may also work for some patients.

Stomach Acid Regulation—Osteopenia/Osteoporosis

When you lose the bottom of the stomach to the Whipple, you also lose the duodenum...which is the primary organ for calcium absorption. Oral calcium supplements don't help because the body is no longer able to absorb calcium from the digestive system.

With the loss of the bottom of the stomach you also lose any control over acid production. PPI's like Prilosec can bring this under control, but then causes a secondary problem of calcium utilization.

These two organ losses put patients in a position of not being able to absorb or utilize calcium. This will lead to osteopenia, and potentially osteoporosis.

Reclast (sometimes called zoledronate) is a bisphosphonate medicine that alters bone formation and breakdown in the body. This can slow bone loss and may help prevent bone fractures.

Reclast is used to treat or prevent osteoporosis caused by the Whipple surgery, menopause, or steroid use. This medicine also increases bone mass in men with osteoporosis. Reclast is for use when you have a high risk of bone fracture.

Reclast can cause serious kidney problems, especially if you are dehydrated, if you take diuretic medicine, or if you already have kidney disease. Call your doctor if you urinate less than usual, if you have swelling in your feet or ankles, or if you feel tired or short of breath. Also call your doctor if you have muscle spasms, numbness or tingling (in hands and feet or around the mouth), new or unusual hip pain, or severe pain in your joints, bones, or muscles.

Your doctor may recommend you have a dental exam for preventive tooth and gum care before you start your treatment with zoledronic acid. This is especially important if you have cancer, if you are undergoing chemotherapy or using steroids, or if you have poor dental health.

Some people using medicines similar to Reclast have developed bone loss in the jaw, also called osteonecrosis of the jaw. Symptoms of this condition may include jaw pain, swelling, numbness, loose teeth, gum infection, or slow healing after injury or surgery involving the gums. You may be more likely to develop osteonecrosis of the jaw if you have cancer or have been treated with chemotherapy, radiation, or steroids. Other conditions associated with osteonecrosis of the jaw include blood clotting disorders, anemia (low red blood cells), and pre-existing dental problems.