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NEUROSURGERY

Advanced Technology for Better Outcomes

a new approach to

MINIMALLY INVASIVE SPINE SURGERY

ORIGINS AND ADVANCEMENTS

Since 1981 when Dr. Kurt Semm performed the first laparoscopic appendectomy, surgeons across disciplines have been working diligently to progress minimally invasive surgical techniques to treat their patients. Over the years, this incremental progress has been intertwined with advancements in surgical technology. For example, surgeons performing procedures in pelvic, abdominal and chest regions of the body have been able to make huge strides due to innovations like the Da Vinci Robot. While progress in minimally invasive surgery has been made in the neurosurgical space with developments like Kirschner wire (K-wires), it's been a much slower progression due to the delicate intricacies of the spine and nerves—until now.

Today, we're at a turning point in the field of neurosurgery.

Thanks to advancements in interbody fusion techniques, intraoperative imaging and navigation systems, neurosurgeons can now perform pedicle screw placements that are not only minimally invasive but wireless as well. It's a big leap forward in providing spine patients with a less painful, less risky surgical option that yields a faster recovery time and ultimately a better outcome.





A BETTER WAY

Pedicle screw-rod fixation has long been the standard of care for a number of spine diseases of degenerative, traumatic, infectious and neoplastic origin. Spinal fusion and fixation are often performed to relieve pain, stabilize the spine or correct a spinal deformity. While traditional, open surgical methods are still successfully performed today, intense postoperative pain, longer hospital stays and a higher instance of improper screw placement are often associated with these methods. Additionally, even long-standing minimally invasive approaches that leverage Kirschner wires (K-wires) are not without their disadvantages.

This new, innovative, minimally invasive wireless technique leverages the O-arm cone beam CT intraoperative imaging system integrated with Medtronic's StealthStation navigation system

and instrumentation to deliver a more calculated and precise screw placement.

COMPARING TECHNIQUES

In **traditional open surgeries**, a standard incision is made and muscle and bone are cut away—exposing the spine and nerves for direct visualization. Then, using a combination of X-rays, MRIs and a fair bit of guesswork, the angle, trajectory and length of the screws are calculated. While greater precision results over time with experience, placement is not always perfect and often requires follow-up surgeries to reposition screws.

Minimally invasive spinal procedures using Kirschner wires (K-wires) and surgical tubes eliminate the need to scrape away muscle tissue—resulting in less pain after surgery. Guided by a continuous X-ray machine for more precise placement and trajectory, k-wires are driven into the bone to provide a placeholder position for pedicle screws. Despite improving screw placement accuracy, the wires are not without their risks. Wire breakage, going too deep into the bone and puncturing the bowel or other surrounding arteries and nerves are all possible complications associated with the use of k-wires. Additionally, due to use of continuous X-ray, pedicle screw placement with K-wires places the patient at greater radiation exposure than with the use of Stealth.

LAYERS OF TECHNOLOGY

The O-arm and StealthStation are not new to spinal surgery or, specifically, pedicle screw placement. Used independently by surgeons for years, what's new about this surgical approach is the fact that both are used in tandem throughout the procedure along with Medtronic instrumentation and special optical cameras.

QUALITY CHECK: *an extra layer*

While the O-arm and StealthStation yield near-perfect results when combined, a final quality-check provides an added layer of certainty prior to closing the patient. A final scan with the O-arm is done after the procedure but before the patient is closed in order to make sure the pedicle screws and interbodies are properly positioned. This extra quality check helps mitigate the small risk of follow-up surgery for screw repositioning. It's just another way patient outcomes can be improved through layers of technology.

A **Special Optical Camera** is used to communicate images via special pin sensors affixed to the patient back to the O-arm and StealthStation. A single reference frame of the patient is taken at the beginning of the procedure using this camera, and reference frames are also assigned to each surgical instrument.

The **O-Arm** acts as a special CT scanner that uses these reference frames to show a virtual image of the patient's spine and instruments on screen for the surgeon. This virtual representation enables the surgeon to get full visualization and multiple images, slice by slice, of the spine.

The **StealthStation** works cooperatively with the O-arm, pairing its detailed, play-by-play view of the spine with precise measurements using its powerful navigation technology and the reference frames taken by the optical camera. This constant communication provides real-time calculations to the surgeon on the position of the **Medtronic instruments** relative to the

spine, enabling them to guide and affix pedicle screws with the utmost precision and certainty.

Disc preparation and interbody placement, which can augment a patient's fusion, often poses a risk to surrounding nerves. By using a special **operating microscope** often used in delicate brain surgeries, the surgeon has enhanced visualization of the disc space and the surrounding nerves for the utmost in safety and precision.

PATIENT BENEFITS

This new, minimally invasive approach to pedicle screw placement offers patients a range of benefits to provide a better experience and outcome.

- **Less pain and faster recovery:** As a minimally invasive approach, this approach requires less cutting of the muscle and bone. This means less blood loss and overall trauma to patients. This leads to less postoperative pain and ultimately a faster recovery.
- **Wireless:** The enhanced imaging and navigational assistance provided by the O-arm and StealthStation eliminate the need for K-wires. This eliminates the risk for wire breakage and reduces the risk of damaging the bowel, arteries, and delicate nerves near the surgical area.
- **Greater precision:** The O-arm and StealthStation speak the same language. They're natural partners for providing surgeons precise calculations for pedicle screw angle, position and trajectory. Additionally, the operating microscope enhances safety and precision during interbody placement. Greater precision means greater comfort post-op and a lower risk of follow-up procedures to adjust screw placement.

COMMON QUESTIONS

Are certain patient populations ineligible for this procedure?

Historically, elderly, clinically obese, and patients with other underlying health conditions were not always eligible for open spinal surgery due to its inherent risks and trauma. However, this new, minimally invasive wireless approach is providing new treatment options to patients of all ages and at all stages of health. With that being said, while this approach does eliminate and reduce a number of risk factors, every patient is unique and will need to be fully evaluated by their surgeon to guarantee this surgical approach is right for them.

Can patients who have had spinal surgery before have this surgery?

Typically, yes. This surgery has been performed successfully on patients who have undergone a variety of spinal surgeries previously. Their medical history will need to be reviewed before their eligibility can be confirmed.

What risks are involved with this surgery?

As with any surgery, there are always risk factors to consider. However, most studies have shown that minimally invasive spine fusion has a lower chance of both medical and surgical risks than traditional open spine surgery.

Have any studies been done to test the success of this approach?

In a recent clinical study conducted by Houston Methodist Neurosurgical Spine Center, 42 patients underwent surgery using this technique. 188 pedicle

screws were placed with 18 total breaches, for a total breach rate of 9.9% without any complications, revealing a safe, accurate, and reproducible method.

Is the cost of minimally invasive spine surgery greater than open spine surgery?

The cost of the advanced technology is never passed on to the patient or the insurance company. Due to fewer complications and shorter hospital stays, most studies have confirmed that the overall cost for minimally invasive spine surgery is significantly less than that of open spine surgery.

