THE STATUS OF SPINE SURGERY

Even though the surgical treatment of spine disorders across the world has shown remarkable improvement in the last few decades, the indications to perform spine surgery and the subsequent clinical outcomes are still topics of debate (1, 2). Thanks, to a better understanding of spine pathologies, training and the application of new technologies today. Spine surgery is widely practiced with reasonable safety in Kenya as it's in many parts of Africa(2). In this part of the globe surgery of the spine is shared by surgeons of various backgrounds including orthopaedic spine surgeons, neurosurgeons orthopaedic surgeon's, paediatric orthopaedic surgeons and in some occasion's general surgeons. The development of modern surgical techniques, intraoperative spinal cord neuro-monitoring, improved spinal instrumentation; (3,4) allow surgeons to help their patients maximize their quality of life while striving to minimize the potential for complications. Advances in the past few decades have improved correction of spinal deformity and reconstruction procedures. The morbidity of surgical procedures has decreased allowing for earlier return to activity after surgery. Current research focuses on improving and developing motion preserving surgical techniques and less invasive surgical options (5).

Bracing, traction, spinal manipulation devices, bed rest and other conservative forms of treatment constituted the bulk of the approaches to treatment of spine pathologies during the pre-surgical era. These conservative forms of treatment are still practiced today as complimentary to surgical treatment and in some situations as alternatives. Operative intervention for spinal conditions was initially slow to develop because of difficulties with infections. This situation changed beginning in 1867 when antisepsis became a standard practice. The development of anaesthesia as well as radiological imaging and their continuous evolution are additional incentives to development of all surgical procedure types the spine included.

The first laminectomy in the United States was performed in 1829 when Dr. Alban Gilpin Smith removed a fractured spine bone to treat a patient with progressive leg weakness. In 1888, Dr. Smith successfully removed a spinal tumour(6) that was causing neurologic compression and was able to perform more involved surgeries to correct vertebral bones damaged by tuberculosis infections. However, as time progressed, surgery also began to be used for other conditions including spinal deformities, fractures, and tumours (4, 6).

Surgical techniques have been developed to correct spinal deformities from the front (anterior) as well as the back (posterior) of the spine. One of the most common techniques presently used by spine surgeons to correct spinal problems is spine fusion (7, 8). The purpose of a spinal fusion is to create a rigid union between two separate segments of the spine to correct misalignment or instability. Many different types of spinal instrumentation have been developed to help facilitate spine fusion, including devices such as rods, plates, hooks, wires and screws (7,8). Commingling of these approaches and the surgical procedure of fusion lead to descriptions such as PLIF posterior lumbar inter -body fusion, ALIF anterior lumbar inter-body fusion, TLIF transforaminal lumbar inter-body fusion.

The early benefit of surgeries performed through the front of the spine was that they allowed direct access to the bones and discs in the front of the spine and did offer the benefit of fewer total levels of the spine that needed to be fused in cases of scoliosis. As techniques improved for surgery on the front of the spine, implants were also developed to help fill bone defects resulting from infections or tumours. A variety of implants manufactured using stainless steel, pure titanium, and titanium alloys cages, bone grafts, and other devices have been developed for this purpose.

Advantages of titanium include its biocompatibility and the ability to do spinal imaging with magnetic resonance imaging without loss of signal secondary to metal artifact. Other advantages of titanium include very high corrosion resistance, excellent tissue compatibility, non-allergenic, tendency to increased infection resistance, better elasticity properties. Disadvantages of titanium include decreased material stiffness, strength, and hardness. Titanium is prone to notching after bending deformation or at attachment sites to pedicle screws, which makes it more subject to fatigue failure. Titanium alloys such as Prota-sul-100 also have increased fatigue strength (8-10).

Newer implants made from cobalt-chrome (Co-Cr) alloys are stiffer and have harder surfaces that may provide advantages in deformity and trauma care. Wrought Co-Cr is approximately 5

times stiffer than titanium alloy. Stainless steel is a balance between these two materials and has a Young's modulus about twice that of titanium (10).

The history of vertebral screw fixation dates back to 1944. King first described the placement of screws (three-quarters of an inch for women; one inch for men) parallel to the inferior border of the lamina and perpendicular to the facet joints of lumbar vertebrae (6,7).

Boucher was the first to describe the placement of screws through the pedicle (6). Screws were placed obliquely through the lamina and facet joint into the pedicle and vertebral body (or sacral ala).

The use of instrumentation to reduce the need for postoperative external immobilization and bed rest through immediate stabilization of the spine is attractive. The use of instrumentation also may improve the fusion rate. The evolution of modern spinal instrumentation systems began in the late 1950s with the development of the Harrington hook and rod system. At the time, this was a major medical breakthrough which allowed for enhanced stability and curve correction for patients with spinal deformity (6).

The Harrington rod and hook system consisted of a rod with a hook at either end (11-13). These hooks attached to the spine at the top and the bottom of the curvature. By distracting across the rod, surgeons were able to partially reduce spinal deformities. This technique was most commonly used to treat paralytic scoliosis resulting from poliomyelitis which was very common at that time. This system was limited in that it only attached to the spine in two locations. It was also limited in the fact that the rod was straight and this did not allow surgeons to accurately re-create a normal spinal alignment, particularly in the sagittal plane.

Vertebral screw and pedicle screw fixation have evolved and become increasingly popular among spine surgeons (11,12). Both methods are designed to provide immediate stability and rigid immobilization of the spine without sacrificing additional motion segments required by other forms of conventional instrumentation (e.g. Harrington, Luque). Pedicle screw fixation is more rigid than previous hook, rod or wire implants and has therefore allowed for improved correction of spinal curvatures and higher fusion rates. Another benefit of pedicle screw implants is that they require fewer segments to be instrumented and fused during deformity correction. The use of all pedicle screw implants has also allowed surgeons to perform more complex spinal reconstructions, including spinal osteotomies.

However, there are some disadvantages to the newer instrumentation systems. First, increased correction of spinal deformity can be associated with an increase in neurologic injuries. In addition, the initial instrumentation systems were more bulky than previous implants and were noted underneath the skin, particularly in very thin patients. Finally, as more implants are utilized for each surgery, the overall cost of each surgery is more expensive. Today spine surgery is commonly referred to as spine industry!

Current research is focused on the use of non-fusion techniques, particularly for young patients with spinal deformity. New techniques have been developed that allow for a partial correction of spinal deformity without a fusion until the completion of spinal growth. These techniques have included the use of vertebral stapling, growing rod and Vertical Expandable Prosthetic Titanium Rib (VEPTR) placement. Keith D Luk from Hong Kong with his colleagues from mainland China have reported their work on disc transplant (5,14).

Fazal *et al* (15) and Muteti *et al* (16) in this issue of the *East African Orthopaedic Journal* address the issue of spine surgery and attest to the practice of spine surgery in the region moreover both address safety of the procedure. One relates to the safety of implants in the presence of adverse conditions infection albeit tuberculosis, and the other relates to the safety of placement of pedicle screws.

Today spine surgery is practiced widely and locally it is available at the safety level acceptable with the rest of the world. The time honored concern of safety though markedly improved remains as it was at inception. While introducing spine surgery to his students my professor used to say; any novice who intends to plunge into practicing spine surgery is advised to begin with owning an alternative residence in a town way from where he currently resides! The relevance of the industry of spine surgery hangs on development of devices to preserve motion.

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REFERENCES

1. Aebi, M.,Etter, C.,Kehl, T. and Thalgott, J. Stabilization of the lower thoracic and lumbar spine with the internal spinal skeletal fixation system: Indications, techniques, and first results of treatment. *Spine*. 1987; **12**:544-551.
2. Africa spine meeting proceedings Agadir Morocco 2013.
3. Andrew, T.A., Brooks, S. and Piggott, H. Long-term follow-up evaluation of screw-and-graft fusion of the lumbar spine. *Clin Orthop Rel Res*. 1986; **203**:113-119.
4. Roy-Camille, R., Saillant, G., Bisserie, M., *et al*. Surgical treatment of spinal metastatic tumors by posterior plating and laminectomy. Proceedings of the 51st annual meeting of the American Academy of Orthopaedic Surgeons, 1984.
5. Ruan, D., He, Q., Ding, Y., Hou, L., Li, J. and Luk, K.D. Successful transplantations of intervertebral discautografts, fresh allografts. *Lancet*. 2007; **369**(9566):993-999.
6. Mark, B., Kabins, M.D., James, N. and Weinstein, D.O. The history of vertebral screw and pedicle screw fixation. *The Iowa Orthopaed J*. 1991; **11**: 127–136.
7. King, D. Internal fixation for lumbosacral fusion. *Am J Surg*. 1944; **66**:357-361.
8. Evans, M.J., Sullivan, M.F. and Kirwan, E.O'G. Screw arthrodesis of the lumbar. *Spine J Bone Joint Surg*. 1977; **59**-B:498.
9. Jacobs, R.R., Montesano, P.X. and Jackson, R.P. Enhancement of lumbar spine fusion by use of translaminar facetjoint screws. *Spine*. 1989; **14**:12-15.
10. Geiger, J.M., Udovic, N.A. and Berry, J.L. Bending and fatigue of spine plates and rods and fatigue of pedicle screws. Proceedings of the American Academy of Orthopaedic Surgeons annual meeting, 1989.
11. Guyer, D.W. and Wiltse, L.L. Pedicle screw fixation ofthe lumbar spine. *Surg R Orthop*. 1989; **2**:17-21.
12. Jacobs, R.R., Schlaepfer, F., Mathys, R., Jr., *et al*. A locking hook spinal rod system for stabilization of fracture-dislocations and correction of deformities of the dorsolumbar spine: A biomechanic evaluation. *Clin Orthop Rel Res*. 1984; **189**:168-177.
13. Harrington, P.R. and Dickson, J.H. Spinal instrumentation in the treatment of severe progressive spondylolisthesis. *Clin Orthop Rel Res*. 1976; **117**:157-163.
14. Keith, D.K. Luk and Rua D.K. Intervertebral disc transplantation: a biological approach to motion preservation. *Eur Spine J*. 2008; **17**(Suppl 4): 504–510.
15. Fazal, A. and Chaudry A. Does spinal surgery for spinal tuberculosis during active infection predispose to post operative surgical site infection?: Experience from Kenyatta National Hospital. *East Afr J Orthop Surg*. 2018; **12**(2): 49-51.
16. Muteti, E.N. and El Badawi, M.G.Y. Morphometry of the thoracic pedicle and the pedicle-rib unit: A review of literature. *East Afr J Orthop Surg*. 2018; **12**(2): 67-72.