Innovations in Orthopedics and Traumatology in China

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According to the latest data released by the National Bureau of Statistics, the total population of the mainland of China is 1.33 billion in 2010, including 177 million people aged 60 years or older, accounting for 13.25% of the total population, which increased to 15.53% in 2014. With the degree of growing aging population in our country, patients with musculoskeletal diseases increased greatly, which are the most common cause of severe chronic pain and physical disability among older people. Meanwhile, with the fast development of economy and industrialization in China, the number of patients of traffic injury and construction injury increases rapidly. Taken together, the expenses in orthopedics and traumatology will inevitably increase, challenging the existed medical and health system, presenting significant financial and emotional burden on the society. To address this challenge and improve the patient's care, the innovation of advanced concepts, surgical skills, and novel instruments for accurate diagnostic and treatment methods in orthopedics and traumatology has become more and more vital and imperative in our country.

In the field of orthopedics and traumatology, innovation requires orthopedic surgeons to break the traditional rules and think out of the box using critical thinking. In our clinical practice, we emphasize discovering the new application of existed treatment methods. The pilot study using proximal fibulectomy to treat patients with medial compartment osteoarthritis (OA) of the knee joint is a good example. The fibula is the long and thin bone in the lower leg, located parallel to the tibia. In a long time, it is only regarded as an ideal bone source to be grafted onto other bones without affecting the bearing capacity of the leg. However, based upon our clinical experience in the past 20 years, a theory of "nonuniform settlement of tibial plateau playing a key role in the development of knee joint OA" was raised creatively. In this theory, fibula is tubular cortical bone with high bone density, when compared with the proximal tibia, which consists most of cancellous bone with a large weight-bearing area without bony barrier in the medial side. As a result, the rigid fibular support in the lateral side to the osteoporotic proximal tibia could contribute to the non-uniform settlement of tibial plateau, a shift in the mechanical axis, aggravating weight-bearing in the medial plateau, and resulting in articular cartilage degeneration and knee varus.[1] According to this theory, a 2 cm long section of fibula with its periosteum 6–10 cm below the fibular head was resected to treat medial compartment knee OA. The retrospective study following 110 patients with postoperation more than 2 years revealed that the fibular osteotomy could correct the alignment of lower extremity and widen the medial joint space, thus significantly improving both the radiographic appearance and function of the affected knee joint, and also achieving long-term pain relief. When compared to the common treatment methods for medial compartment OA of knee joint, such as the total knee arthroplasty and the high tibial osteotomy, proximal fibulectomy is a safe, simple, economic, and effective alternative.

The research and development of minimally invasive surgery (MIS) techniques is an important and active area of innovation in orthopedics and traumatology. A lot of problems exist in the traditional orthopedic operation, with inaccurate fracture reduction and fixation, long exposure time of radioactive rays. At present, the concept of treatment for fractures has evolved from an emphasis on the anatomical reduction and rigid fixation to the indirect reduction and biological internal osteosynthesis with better local

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blood supply. MIS embodies the core concept of damage control orthopedics, which emphasizes the stabilization and control of the injury, avoiding the damage of "second hit" caused by orthopedic procedure and postponing the performance of fracture repair until an overall stable condition of the patient is maintained.[2] Based on the MIS theory, a series of minimally invasive percutaneous plate osteosynthesis instruments are developed and widely applied in the management of periarticular fractures, metaphyseal fractures, and diaphyseal fractures.[3,4]

A new trend in the development of MIS technique is to improve the ability of restoring both the anatomical and biomechanical features of fractured bones in a more safe and easy fashion by inventing new instruments, which are expected to be more suitable for the size, anatomical characteristics and biomechanical features of bones of Chinese. The anatomy and biomechanics of posterior pelvic ring are complex and difficult to restore once fracture occurs. In this consideration, a minimally invasive adjustable plate, which conforms to the irregular shape of posterior pelvic ring and simulates the structure and biomechanics of sacroiliac complex, was developed to reduce and stabilize the posterior pelvic disruptions. It has been demonstrated to have obvious advantage as compared to traditional fixation techniques, with no need of prebending, short surgical procedure, less blood loss, better anatomical reduction, more stable fixation, and less complications.[5] Another trend is to improve the accuracy and feasibility of MIS techniques in the field of orthopedic trauma by incorporating with intraoperative two-dimensional or three-dimensional (3D) fluoroscopic navigation. Fluoroscopy-based navigation is a relatively new technique with numerous potential advantages, such as increasing the precision of screw placement, significantly reducing iatrogenic soft tissue injury, and decreasing radiation exposure for both patients and surgeons.[6,7]

Bionic fixation will be a feasible treatment method for orthopedic patients. The bionic implants, including bionic flexible fixator, bionic prosthesis, and bionic cage, are designed to repair the injured bone ligament complex, replace the wearing joint or fix the adjacent vertebrae in a more natural way. Syndesmotic diastasis is a common injury, which can be treated with the use of syndesmotic bolt or tightrope. However, the syndesmotic bolt cannot permit a normal range of motion of the distal tibiofibular joint, and tightrope technique lacks the ability of reducing the syndesmotic diastasis. An assembled bolt-tightrope system (ABTS) was designed to combine the advantages of both syndesmotic bolt and tightrope techniques and simultaneously avoid their potential disadvantages. Clinical applications revealed that ABTS could reduce the syndesmotic diastasis and provide flexible fixation in a bionic fashion followed with satisfactory functional recovery of the lower extremities.[8] Orthopedic surgeons have also created many other novel bionic designs. However, some of these designs have been hindered from the clinical application due to the limited manufacturing capability of complex internal implants. The advent of 3D printing technique has greatly facilitated the transformation of novel and unique designs into fire new bionic and individualized implants in the field of orthopedics and traumatology. Currently, with this technology, a series of personalized prosthesis or implants with better performance and more bionic structure are produced. In 2014, researchers from Peking University Third Hospital have successfully completed the world's first application of the artificial customized vertebral body fabricated by 3D printing in the management of atlantoaxial tumors. 3D printing technique provides the Chinese orthopedic surgeons with a valuable chance to break through the limitations of traditional design and manufacture as well as operation methods and to realize their disruptive innovative ideas, staying current with the state of art technologies, and leading the new medical trend in the world.

With ongoing basic research and clinical investigation, minimally invasive and personalized treatment strategies assisted by computer aided design and manufacturing technology and 3D printing technology is the developing direction of future orthopedics and traumatology. Through the efforts of more and more domestic colleagues with innovation spirit and extensive communication with experts internationally, it is believed that we could provide higher-quality, more convenient and accessible cost-effective care to our patients, and greatly improve the level of orthopedic and traumatic management in China, gaining the leadership in the world.

References

1. Yang Z, Chen W, Li C, Wang J, Shao D, Hou Z, *et al*. Medial compartment decompression by fibular osteotomy to treat medial compartment knee osteoarthritis "preliminary report". Orthopaedics 2015;In Press.
2. Roberts CS, Pape HC, Jones AL, Malkani AL, Rodriguez JL, Giannoudis PV. Damage control orthopaedics: Evolving concepts in the treatment of patients who have sustained orthopaedic trauma. Instr Course Lect 2005;54:447-62.
3. Apivatthakakul T, Arpornchayanon O, Bavornratanavech S. Minimally invasive plate osteosynthesis (MIPO) of the humeral shaft fracture. Is it possible? A cadaveric study and preliminary report. Injury 2005;36:530-8.
4. Yin B, Chen W, Zhang Q, Wang J, Su Y, Xu G, *et al.* Tibial fracture treated by minimally invasive plating using a novel low-cost, high-technique system. Int Orthop 2012;36:1687-93.
5. Chen W, Hou Z, Su Y, Smith WR, Liporace FA, Zhang Y. Treatment of posterior pelvic ring disruptions using a minimally invasive adjustable plate. Injury 2013;44:975-80.
6. Kahler DM. Navigated long-bone fracture reduction. J Bone Joint Surg Am 2009;91 Suppl 1:102-7.
7. Lang Z, Tian W, Liu Y, Liu B, Yuan Q, Sun Y. Minimally invasive pedicle screw fixation using intraoperative three-dimensional fluoroscopy-based navigation (CAMISS Technique) for Hangman's fracture. Spine (Phila Pa 1976) 2015;[Epub Ahead of Print] DOI. 10.1097/BRS.0000000000001111.
8. Xu G, Chen W, Zhang Q, Wang J, Su Y, Zhang Y. Flexible fixation of syndesmotic diastasis using the assembled bolt-tightrope system. Scand J Trauma Resusc Emerg Med 2013;21:71.