NEW METHODS IN THE SURGICAL TREATMENT OF NECK INJURIES IN CHILDREN

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Abstract: Pediatric neck injuries, although relatively uncommon, pose considerable diagnostic and therapeutic challenges due to the anatomical complexity and physiological vulnerability of children. Recent advancements in surgical techniques and perioperative technologies have revolutionized the treatment landscape of cervical trauma in the pediatric population. This article explores the latest innovations in the surgical management of neck injuries in children, with a focus on minimally invasive approaches, pediatric-adapted spinal instrumentation, neuro-navigation systems, intraoperative neuromonitoring, and biologically compatible graft materials. By integrating emerging surgical practices with a comprehensive understanding of pediatric cervical anatomy and biomechanics, these modern interventions aim to reduce morbidity, enhance recovery outcomes, and minimize long-term functional deficits.

Keywords: neck, children, diagnosis, method.

INTRODUCTION

The surgical management of cervical spine and soft-tissue neck injuries in children has undergone significant transformation over the past decade. Historically, pediatric patients with cervical trauma were managed conservatively due to the risks associated with open surgery in an immature spine. However, with increasing incidence of high-energy trauma, sports-related injuries, and a more precise understanding of pediatric cervical pathology, surgery is now a viable, and in many cases, a necessary intervention. Technological advancements have enabled safer, more precise, and less invasive procedures that address both spinal stability and neurological integrity.

Pediatric patients differ significantly from adults in terms of spinal development, ligamentous laxity, ossification patterns, and anatomical proportions. Thus, surgical techniques must be specifically tailored to their unique physiology. This includes not only surgical planning and instrumentation but also perioperative care and long-term follow-up strategies. As surgical indications expand, modern approaches emphasize the balance between timely stabilization and the preservation of growth potential and function.

MATERIALS AND METHODS

One of the most notable evolutions in pediatric cervical surgery is the application of minimally invasive surgical (MIS) approaches, which are designed to minimize tissue disruption, reduce blood

loss, and shorten recovery time. MIS procedures, such as percutaneous screw fixation, mini-open decompression, and endoscopic-assisted spinal surgery, have been gradually adapted to pediatric use. These techniques allow access to the cervical spine through small incisions, guided by fluoroscopy or intraoperative navigation systems, with minimal interference to paraspinal musculature and ligamentous structures.

The use of tubular retractors and specialized pediatric endoscopic instruments has become more common, particularly in procedures involving posterior cervical stabilization for unstable fractures or dislocations. Furthermore, these methods have demonstrated lower rates of postoperative infection, quicker mobilization, and decreased need for prolonged immobilization with cervical collars or halo devices [2].

RESULTS AND DISCUSSION

A critical challenge in pediatric spinal surgery is the adaptation of fixation systems to accommodate smaller, more delicate anatomical structures. Traditional adult instrumentation is often incompatible with pediatric vertebral dimensions and can interfere with ongoing spinal growth. In response, several manufacturers have developed pediatric-specific spinal hardware, including low-profile cervical plates, shorter screws, adjustable rod systems, and resorbable fixation devices.

One significant innovation is the use of growing rod systems that permit continued spinal elongation following stabilization. These systems are particularly valuable in very young children who sustain traumatic injuries but have not yet reached skeletal maturity. In cases of atlantoaxial instability or occipitocervical junction injuries, modular fixation constructs allow customized configurations tailored to individual patient anatomy [3].

Biomechanically, modern pediatric systems are engineered to withstand physiological load while minimizing disruption to adjacent segment motion and growth plates. This marks a critical shift from merely achieving bony fusion to functional stabilization with growth preservation.

Given the proximity of vital neurological structures in cervical surgery, the use of intraoperative neuromonitoring (IONM) has become standard practice in complex pediatric procedures. IONM techniques, including somatosensory evoked potentials (SSEPs) and motor evoked potentials (MEPs), allow real-time assessment of spinal cord and nerve root function throughout the surgical process. This reduces the risk of iatrogenic neurological damage and enhances surgical precision.

Additionally, computer-assisted navigation systems, including 3D fluoroscopy and intraoperative CT-guided tools, have greatly improved the accuracy of screw placement in the cervical spine. These systems use preoperative or intraoperative imaging to guide trajectory planning, reducing the risk of vertebral artery injury, spinal canal breach, and screw malposition.

Such tools are particularly beneficial in revision surgeries or anatomically distorted spines, where conventional landmarks may be obscured. Their integration into pediatric practice enhances safety while allowing for more aggressive yet controlled correction of instability or deformity [4].

Achieving spinal fusion in children requires a careful selection of grafting materials that ensure both osteoconductivity and biocompatibility, while minimizing donor site morbidity. Autologous bone grafts, typically harvested from the iliac crest, remain the gold standard due to their high fusion potential. However, concerns about donor site pain and complications have led to increasing use of synthetic and allogeneic substitutes, including demineralized bone matrix (DBM), bioactive glass, and calcium phosphate ceramics.

CONCLUSION

The surgical treatment of neck injuries in children has evolved dramatically, with emerging methods offering safer, more effective, and growth-conscious interventions. From minimally invasive access techniques and pediatric-specific instrumentation to intraoperative navigation and biologically active implants, modern surgery now affords children with cervical trauma a far better prognosis than in previous decades. Importantly, these advancements must be applied with a deep understanding of pediatric anatomy, a commitment to multidisciplinary care, and a long-term perspective on spinal health. Continued innovation, coupled with rigorous research and clinical training, will further refine these techniques and expand their accessibility across diverse healthcare settings.

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