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REVIEW

Development of techniques in podiatric surgery

Desarrollo de las técnicas en cirugía podológica

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ABSTRACT

Introduction: podiatric surgical procedures aim to provide solutions for each of the defects that affect the feet. Their constant updating leads to improved quality of care.
Objective: to describe the development of techniques in podiatric surgery.
Method: a bibliographic review of the current literature based on surgical techniques used in podiatry was conducted. To obtain information sources, a search strategy was applied in the Scielo and PubMed databases, as well as other prestigious and scientifically supported databases. Inclusion criteria were applied to select articles or information sources. 30 information sources were located; of these, 22 were used for the development of this review.
Development: multiple procedures can be performed within this definition, from basic techniques such as anesthetic injections, to individual skin, ligament, or tendon operations, to full-blown reconstructions. Among the advances seen in the management and care of foot pathologies using surgical techniques are the use of new technologies (implementation of 3D printing technology and artificial intelligence).
Conclusions: constantly updating operating protocols is key to improving medical care. Podiatric surgical procedures involve addressing each of the defects that affect biomechanics. In addition to the implementation of the traditional method, progress has been made with the use of minimally invasive techniques, artificial intelligence, and 3D printers.

Keywords: Podiatric Surgery; Surgical Techniques; Innovation; Minimally Invasive Surgery.

RESUMEN

Introducción: los procederes de cirugía podológica se encaminan a dar solución a cada uno de los defectos que repercuten en los pies. Su actualización constante deviene en mejoría de la calidad asistencial.
Objetivo: describir el desarrollo de las técnicas en cirugía podológica.
Método: se desarrolló una revisión bibliográfica de la literatura actual basada en las técnicas quirúrgicas empeladas en podología. Para la obtención de las fuentes de información se aplicó una estrategia de búsqueda en las bases de datos Scielo y PubMed y otras de prestigio y respaldo científico. Para la selección de los artículos o fuentes de información se aplicaron criterios de inclusiones. Fueron localizados 30 fuentes de información; de ellas se empelaron 22 para el desarrollo de la presente revisión
Desarrollo: son múltiples los procedimientos que pueden desarrollarse dentro de esta definición, desde técnicas básicas como infiltraciones anestésicas, operaciones de piel, ligamentos o tendones por separado hasta verdaderas reconstrucciones. Dentro de los avances evidenciados en el manejo y atención mediante técnicas quirúrgicas para las patologías podálicas se encuentran el uso de las nuevas tecnologías (implementación de la tecnología de impresoras 3D y de la inteligencia artificial).
Conclusiones: la actualización constante de los protocolos de actuación es clave para el perfeccionamiento de la asistencia médica. Los procederes quirúrgicos podológicos entrañan la resolución de cada uno de los defectos que atentan contra la biomecánica. Además de la implementación del método tradicional, se ha visto avance con la utilización de técnicas de mínimo acceso, inteligencia artificial e impresoras 3D.

Palabras clave: Cirugía Podológica; Técnicas Quirúrgicas; Innovación; Mínimo Acceso.

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INTRODUCTION

Standing or walking has been one of the basic functions of humans from an evolutionary point of view, allowing for their development. In addition to the elements that make up the biomechanics of the osteomyoarticular system (SOMA), the point of stabilization is key to the proper functioning of this system. In this case, the foot is key to performance, which is why any condition that disturbs its anatomical or physiological harmony can pose a risk to a person's daily performance: hence the interest in the timely diagnosis and treatment of these disorders.

Surgery (as with any surgical specialty) requires a high level of commitment from the healthcare team. This includes not only anesthesiologists, technicians, and nurses, but also the surgeon in charge of the procedure. Their scientific and technical training must enable them to resolve the clinical situation that led to the patient undergoing the procedure, as well as to resolve any complications that may arise during the intraoperative and postoperative periods.[1] The importance of constant training and updating on the part of the surgeon is emphasized.

Surgical treatment is considered one of the alternatives. According to the definition approved by the General Council of the College of Podiatrists, podiatric surgery is understood as "those surgical procedures performed by podiatrists using standardized techniques aimed at treating diseases and deformities of the feet for diagnostic, therapeutic, and/or prognostic purposes."[2]

There are many societies involved in research and updating protocols and guidelines in podiatric surgery. Such is the case of the Podiatric Surgery Research Strategy Group and the British Orthopaedic Foot and Ankle Society. They are responsible for evaluating and analyzing care and treatment protocols, as well as conducting research to update them based on the results obtained.[3]

Among the most commonly diagnosed and treated conditions in this area of knowledge are flexible valgus foot and rigid flat foot (which can be painful). These conditions generally have an incidence of 22 %.[4] This condition is associated with other conditions such as varus foot, nail lesions, and others.

Due to the rapid advances in medical science, constant updating is essential in healthcare and therapeutic work. For this reason, this research aims to describe the development of techniques in podiatric surgery.

METHOD

A review of the current literature was conducted based on the surgical techniques used in podiatry for the treatment of various conditions. To obtain the sources of information, a search strategy was applied in the Scielo and PubMed databases, as well as other prestigious and scientifically supported databases. In addition, search engines such as Google Scholar were used. Each of the terms was related according to the use of Boolean operators such as AND and OR.

Inclusion criteria were applied to select articles or sources of information, such as published sources relevant to the work, with less than five years of publication. In addition to those deposited in databases and institutional repositories, measures are taken to ensure the quality of the information. Similarly, the scientific articles used were taken from journals that had undergone a peer review process. Thirty sources of information were located, of which 22 were used for the development of this review.

DEVELOPMENT

Many procedures can be performed within this definition, from basic techniques such as anesthetic infiltrations, skin, ligament, or tendon operations to actual reconstructions. In this regard, a classification of standardized surgical methods has been proposed according to their level of complexity:[2]

Grade I includes procedures such as infiltrations, skin surgery, soft tissue reconstruction, debridement of ulcers, and other procedures performed in areas with low or no risk of bleeding. Grade II involves a higher risk of bleeding in procedures such as metatarsal surgery, osteotomies, and ligament transpositions. Grade III is based on procedures with greater surgical aggression and prolonged postoperative care, such as the use of prostheses, arthrodesis, and Achilles tendon surgery. Grade IV includes procedures such as Charcot foot reconstruction and Lisfranc dislocation reconstruction, which require critical and specialized care.[2]

Minor procedures in podiatric surgery include procedures performed on the nails. One of the conditions that benefits most from these procedures is onychocryptosis (especially of the big toe). Treatment is based on partial avulsion, which requires a complete anesthetic block. There are two variants of the block technique: H-block and V-block (developed in 2017).[5]

According to the results shown by Sánchez Hernández et al.[5], when comparing the two techniques, more than 60 % of patients were anesthetized in less than 10 minutes with the V technique, and 84 % after 20 minutes. Its benefit has been demonstrated through the application of a block using a single puncture in the patient's skin, with around 21 of the 25 patients being completely anesthetized.

On the other hand, according to the results presented by Sánchez Hernández et al.[6], conducted in 2021, a comparison of both anesthesia techniques is shown. According to the results, patients undergoing surgery with the H anesthesia technique achieved complete anesthesia in approximately 51 % of cases within 10 minutes; in addition, more than 27 % required a repeat procedure. On the other hand, patients who underwent the V technique showed better results, with approximately 58 %.

Anesthetic procedures are key to the development of any surgical procedure; together with the human body's ability to heal, they lay the foundation for the development of surgical specialties. In this sense, one of the bioethical foundations of medicine is not to harm; for this reason, the use of anesthetic techniques allows these foundations to be fulfilled. Considering that, from an anatomical point of view, nerve endings are more superficial in the distal regions of the body, the importance of these procedures in the phalanges is highlighted. For this reason, the use of the V-shaped anesthesia technique allows for greater analgesia of the surgical site, which guarantees a smooth procedure for the patient.

Onychocryptosis is caused by the nail plate becoming embedded in the bed (the skin covering it) due to the latter becoming

raised or the nail becoming more curved. One of the variants of this condition is the Cueto Bridge. To resolve this, the partial matricectomy technique can be used (using chemical substances or conventional surgical treatment).[7]

Injuries to the Achilles tendon (considered the strongest in the body) result in significant functional impairment for patients; these include ruptures, which are the most serious injuries and highly debilitating. They usually require major surgery with a lengthy recovery period to restore the tendon's strength and elasticity for everyday activities, although they can be treated conservatively. They can occur in patients who engage in extensive physical activity.[8]

Open surgery is one of the surgical options available. This procedure is considered the gold standard due to its long tradition (several years). It involves a large incision that allows the tendon to be exposed and repaired along its entire length, depending on the extent of the injury. Sutures or anchors are used to give the tendon greater strength. However, it carries a high risk of infection. (In contrast, minimally invasive procedures have gained popularity due to their benefits in reducing surgical time and infections and improving patient response.

The percutaneous technique is unique in that it involves small incisions in the skin that allow the tendon to be accessed using endoscopes, which guarantees suturing and repair of the tendon. Repair using a minimal incision requires only a single opening, which is smaller than the open incision that allows access.[8]

Without a doubt, minimally invasive procedures have revolutionized the surgical management of patients by reducing significant risks. Surgical time is shorter, as is exposure to anesthetic drugs, which ensures greater responsiveness during the postoperative period, reduced costs, and a faster return to normal activities for the patient. Similarly, they reduce the risk of infections and complications in the postoperative period (in each of its phases). These criteria are supported by the analysis carried out by Santiago Azagra in his review on innovation in minimally invasive surgery.[9]

According to the results shown by de la Espada López et al.[10], significant differences can be achieved in tendon repair, augmentation, and transfer for the resolution of the aforementioned podiatric pathologies using these surgical techniques. These results speak in favor of a better quality of life for patients, in addition to improving biomechanical function.

Congenital clubfoot deformity is caused by a combination of four essential components: equinus, cavus, varus deformity of the foot, and adduction of the forefoot. With an incidence of approximately 1 in every 1 000 newborns, it requires surgical treatment for correction. Treatment options include tenotomy, osteotomy, or soft tissue release, mostly using minimally invasive surgical techniques.[11,12] It is essential to emphasize the importance of postoperative follow-up to evaluate the patient's progress. Cases of recurrence of the defect have been reported in cases operated on by tenotomy, so close follow-up should be ensured.[13]

From an anatomical and functional point of view, flatfoot deformity is characterized by a three-dimensional deformity of the joints (dorsolateral periastragal subluxation), including alterations in the sagittal plane (with flattening of the medial arch), in the transverse plane (abduction of the forefoot), and the coronal plane (valgus of the hindfoot) in addition to other alterations, such as dysfunction of the posterior tibial muscle and the first cuneometatarsal joint. From a clinical point of view, it is classified into stages according to its evolution and manifestations.[14]

Surgical treatments for correcting this defect include tendon transfers. However, according to the authors cited [14] in their documentary analysis, these operations do not completely correct the deformity and can be considered variants. Other variants are related to solving the cause of the defect, such as lengthening the Achilles tendon or releasing the medial gastrocnemius to correct the defect caused by contracture of this muscle group. More complex procedures include the Strayer technique and percutaneous lengthening when several muscle groups are involved. Tensinovectorotomy is ideal in patients who have florid clinical symptoms as a result of the defect. Each of these variants is associated with procedures on soft tissues.

According to the results proposed by Lugo Pijuan et al.[4] in the implementation of the Calcaneal Stop technique for the treatment of flexible flatfoot, a significant improvement can be seen in the initial stages before surgical treatment. In addition, it is considered a satisfactory and aesthetic contribution for the patient. Similarly, in a similar study, there was considerable improvement after the development of the surgical technique, with a substantial improvement and increase in the number of patients without limitations compared to the preoperative period.[4]

On the other hand, another therapeutic option is arthrorrhysis, which is the treatment of choice for pediatric patients with flat feet. This procedure achieves significant improvement in each of the angles affected by the deformity.[15]

Pediatric patients are one of the special groups for the surgical treatment of foot injuries. In general, the treatment of these patients involves minor procedures such as onychocryptosis, warts, soft tissue injuries, or the correction of anatomical defects such as flat feet or varus deformity (usually congenital). However, it is essential to note that these patients should be evaluated for conservative management before undergoing surgical treatment.[16]

A comprehensive assessment of the patient is key to choosing the proper treatment (whether medical or surgical). Special attention should be given to specific groups for each condition. In this regard, infants have a high response rate to treatment, as well as greater anatomical and functional reserves that allow them to adapt better to their environment. As a result, the defect can often be corrected with conservative treatment. Unlike the elderly, who require more aggressive solutions, constantly assessing the patient's general condition, as they have significant concomitant pathologies that can complicate the intraoperative or postoperative procedures.

Metatarsal conditions are mainly characterized by severe pain in the central region of the foot. This pathology can be primary or secondary in origin. Secondary pain responds to structural alterations in the area that can be corrected with surgical treatment. However, preoperative evaluation is key to selecting the appropriate treatment and ensuring proper postoperative recovery. One of the variables that must be considered is the type of foot.[17] On the other hand, there are variants for metatarsal reconstruction. According to Rohun Gupta et al.[18], the "free fibular flap" technique is used." This technique has shown significant benefits in

patients with metatarsal injuries.

Similar to procedures for the treatment of foot deformities, interventions for the correction of defects such as hallux abducto valgus are frequently performed by medical personnel. One of the therapeutic options is osteotomy, based on the results shown by Sharon Clee et al.[19] According to their multicenter analysis, over 96 % of patients showed significant improvement after surgical treatment. On the other hand, a comparative study of two surgical techniques (amputation or partial resection) did not show substantial differences in the results of each method.[20]

Among the advances in the management and care of podalic pathologies using surgical techniques is the use of new technologies. One example is the intervention study developed by Fernández Ehrling et al.[21] on the design and implementation of a printed guide using 3D technology for the minimally invasive treatment of hallux valgus. According to the results presented, the authors successfully validated the implementation of this technique, particularly for podiatrists in the early stages of their development. This validation underscores the technique's high educational value, in addition to its healthcare value.

On the other hand, authors such as Lorca Andújar et al.[22] analyze the implementation of artificial intelligence technologies for the development of podiatric surgery. In their documentary review, data from multiple sources were analyzed, indicating a high feasibility and application potential of these tools in ankle surgery for the perioperative assessment of each patient in more complex surgeries such as open reduction and internal fixation. In addition, their high educational value is highlighted.

In both cases, the extensive development that podiatric surgery has undergone with the implementation of new technologies can be seen. New horizons have been opened up for developing the creativity of healthcare personnel, as well as improving patient outcomes. This is always based on a rigorous process of validation and evaluation of the new technique or instrument to be used.

CONCLUSIONS

The constant updating of protocols is key to improving medical care. Podiatric surgical procedures involve the resolution of each of the defects that affect biomechanics. In addition to the implementation of traditional methods, advances have been made with the use of minimally invasive techniques, artificial intelligence, and 3D printers.

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None.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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