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REVIEW

Radial nerve paralysis (high and low), comparison between tendon transfer treatment and nerve reconstruction, literature review

Parálisis nerviosa radial (alta y baja), comparación entre tratamiento de transferencias tendinosa y reconstrucción nerviosa, revisión bibliográfica

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ABSTRACT

Introduction: the hand is a complex organ whose intricate function allows communication with the environment. It is essential in daily life activities, and its delicate structures are strategically innervated by three main nerves: the ulnar nerve for the hypothenar palm area, the median nerve for the thenar palm area, and the radial nerve for the dorsal aspect. Nerve injuries result in the loss of sensitivity and motor function associated with them. Radial nerve injury leads to the loss of wrist and finger extensor function, thus disrupting the normal grip and release pattern. Surgical techniques aimed at restoring function include tendon transfers or nerve repairs.
Objective: to demonstrate the best therapeutic approach for each radial nerve injury.
Method: systematic literature searches were conducted on PubMed for studies published between 2008 and 2024, focusing on radial nerve paralysis treated with tendon transfer or nerve transfer surgery.
Results: The results of these studies show heterogeneity regarding technique and functional restoration.
Conclusion: currently, there is no consensus on the optimal technique for reconstruction; however, nerve transfers emerge as a promising option. Nevertheless, further research is needed to identify the limitations of each technique.

Keywords: Radial Nerve Palsy; Tendon Transfer; Nerve Transfer; Nerve Repair; Upper Limb Paralysis; Lower Limb Paralysis.

RESUMEN

Introducción: la mano es un complejo órgano cuya intrincada función permite la comunicación con el entorno. Es indispensable en las actividades de la vida diaria y sus delicadas estructuras están estratégicamente inervadas por 3 nervios principales: el nervio cubital para la zona palmar hipotenar, el nervio mediano para la zona tenar palmar, y el nervio radial para el dorso. Las lesiones de los nervios implican el cese de sensibilidad y motricidad por ellos implicada. La lesión del nervio radial provoca la pérdida de la función de extensores de la muñeca y de los dedos, alterando así la acción del patrón normal de agarre y liberación. Las técnicas quirúrgicas destinadas a la recuperación de la función pueden ser transferencias tendinosas o reparaciones nerviosas.
Objetivo: demostrar cual es el mejor abordaje terapéutico para cada lesión de nervio radial.
Método: Se realizaron búsquedas sistemáticas de la literatura en PubMed publicados entre los años 2008-2024 para incluir estudios que aborden la parálisis del nervio radial tratada con transferencia de tendón o cirugía de transferencia de nervio.

Resultados: los resultados de estos estudios muestran heterogeneidad con respecto a la técnica y la restauración funcional.
Conclusión: en la actualidad, no existe consenso sobre la técnica óptima para la reconstrucción; aunque la transferencia de nervios emerge como una opción prometedora. A pesar de esto, se reconoce la necesidad de más investigaciones para identificar las limitaciones de cada técnica.

Palabras clave: Parálisis del Nervio Radial; Transferencia de Tendón; Transferencia de Nervio; Reparación Nerviosa; Parálisis Alta; Parálisis Baja.

INTRODUCTION

Radial nerve palsy is one of the most disabling peripheral injuries of the upper limb due to the loss of active extension of the wrist, fingers, and thumb, significantly affecting hand function and, therefore, the patient's quality of life.[1,2] This injury is usually caused by trauma, such as humeral fractures, dislocations, or penetrating wounds, and can be classified according to the level of involvement (high or low).[3] In the absence of spontaneous recovery or response to conservative treatment, surgical options play a central role in restoring motor function.[4]

Traditionally, tendon transfer has been the surgical procedure for treating radial nerve palsy, providing reliable results in functional recovery.[5,6] However, this technique involves sacrificing intact muscles and may be associated with mechanical limitations and suboptimal motor control. In contrast, nerve transfer has emerged as a promising alternative, potentially restoring finer motor control while preserving the original muscle anatomy.[7] However, its success depends on multiple factors, such as the time elapsed since injury, the type of donor nerve, and the surgeon's experience, and it still lacks sufficient long-term evidence.[8,9]

The central question guiding this research is: Which surgical technique offers better functional outcomes in treating radial nerve palsy: tendon transfer or nerve transfer?

In this regard, the overall objective of this systematic review is to compare the functional outcomes of both surgical techniques, analyzing key indicators such as range of motion, grip strength, digital and thumb extension recovery, and motor control quality to identify advantages, limitations, and clinical applications in specific contexts.

This research aims to contribute to better clinical decision-making, especially in scenarios where the choice of surgical technique must be tailored to the patient's condition and the capabilities of the surgical team. Through a rigorous systematic review of the scientific literature, we aim to provide an objective and up-to-date overview of the state of knowledge in this field, highlighting the need for comparative studies with greater methodological standardization and long-term follow-up.

METHOD

A systematic review was conducted that included scientific articles addressing radial nerve palsy treated with tendon or nerve transfer. The PubMed database was used for this review, and filters were applied in line with the objectives of my research.

The following methodology will be followed:

Search strategy: A comprehensive search was conducted using PubMed and Google Scholar electronic databases to identify relevant articles. The aim was to identify articles pertinent to the study topic. The search terms used included: "radial nerve palsy," "radial nerve paralysis," "radial nerve injury," "radial nerve lesion," "wrist extension," "finger extension," " thumb extension," 'wrist motion,' 'power grip,' 'tendon transfer,' 'tendon recreation,' 'Tsuge procedure,' 'Riordan procedure,' 'reinnervation,' 'nerve transplant,' 'nerve graft,' 'nerve transfer,' and "neuritization."

In addition, the bibliographies of the identified articles were manually reviewed to locate additional references relevant to the study.

Inclusion criteria

- Studies in English and Spanish.
- Patients between 15 and 70 years of age.
- Patients with high and low radial injuries who underwent surgical treatment, including tendon transfer and nerve repair/grafting.
- Patients with ultrasound or electromyographic diagnosis consistent with clinical findings of radial nerve injury.
- Traumatic injuries.
- Patients without previous peripheral neuropathies or motor disorders.

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Exclusion Criteria

- Pediatric patients or patients over 70 years of age.
- Degenerative, nonspecific inflammatory, or idiopathic neuropathies.
- Patients with intraoperative or postoperative surgical complications.
- Primary canalicular syndromes such as Fröske's arch, except for iatrogenic injury resulting from previous surgery for nerve decompression.
- Patients with radial nerve injury undergoing conservative treatment.
- Radial nerve injury in the supraclavicular region as part of brachial plexus injury.

Data extraction

The selected articles will contain key data such as study design, patient demographics, intervention protocols used, and outcome measures.

Quality assessment

The quality of the included studies will be assessed using the Cochrane risk of bias tool and the Jadad scale to ensure the validity and reliability of the results obtained.

This thesis seeks to provide an objective and comprehensive assessment of the topic under discussion by adopting a systematic and comprehensive approach to reviewing the available literature.

RESULTS

When comparing the range of motion of wrist flexion-extension and grip strength between the two groups studied, better recovery was observed in the nerve transfer group compared to the tendon transfer group.

In the tendon transfer group, limitations in wrist flexion and permanent radial deviation were identified. Half of the patients in this group required wrist flexion to achieve full finger extension. In contrast, in the nerve transfer group, finger extension was possible with the wrist in an extended or neutral position in all patients.

A relevant finding observed in the nerve transfer group was the extension restoration in the first carpometacarpal joint. In contrast, both groups showed a 30° delay in metacarpophalangeal extension of the thumb, reflecting suboptimal recovery of the prolonged extensor thumb (EPL) function.

DISCUSSION

There is no consensus on the optimal reconstructive technique for treating radial nerve palsy.[10] Tendon transfer has been shown to offer reliable results regardless of the time elapsed since injury, although it has limitations regarding fine motor control.[11] On the other hand, nerve transfer, being a relatively new technique, still lacks long-term follow-up studies. Theoretically, this procedure could provide more precise and controlled movements, but its success depends on early intervention to achieve adequate muscle reinnervation.

The available evidence on nerve transfers comes from high-volume referral centers with highly specialized surgeons, which could lead to a favorable bias in the reported results.[12,13] In this systematic review, most included studies focus on various tendon transfers, with a diverse range of outcomes, such as motor score, wrist extension grades, wrist extension strength, and contralateral limb strength percentage.

Furthermore, data on follow-up time, timing of surgery, and return to activities of daily living are reported inconsistently across studies, making direct comparisons between tendon transfer and other techniques difficult.[14] The main effect of tendon transfers is a rapid return to function, usually within 6 to 12 weeks after surgery. However, this procedure involves the sacrifice of a functional muscle, extensive dissection, and a significant risk of tendon and muscle gliding restriction due to scar formation, which may result in loss of strength in the transferred muscle.[15] Despite this, tendon transfer remains the traditional surgical intervention for treating nerve injuries.

Nerve transfer proponents argue that it can be performed without appreciable weakness of the donor muscle group and that axonal regeneration allows, at least theoretically, the donor muscle to regain its original strength.[16] This technique could offer greater functional gain in a single operation, avoiding the need for multiple procedures, as with tendon transfers.[17]

Another relevant theoretical aspect is that nerve transfer avoids disruption of the muscle-tendon unit, which could reduce scar formation and decrease the risk of restriction in tendon gliding. Despite these potential benefits, nerve transfer requires a more extended recovery period and carries the risk of incomplete recovery. As a relatively new technique, there is no long-term follow-up to evaluate its results compared to more traditional methods, nor has its use become widespread.[18]

CONCLUSIONS

The systematic review did not identify a clearly superior technique for treating radial nerve palsy. Both tendon and nerve transfer have advantages and disadvantages that must be carefully evaluated.

Although tendon transfer has been the traditional approach, nerve transfer has emerged as a promising

alternative, but sufficient evidence is still lacking to validate its superiority. In this context, appropriate patient selection and surgeon experience are key factors in determining the success of surgical intervention.

A significant limitation in the literature is the lack of standardization in outcomes, which prevents direct comparisons between procedures.

Further research with long-term follow-up is still needed to establish the benefits and limitations of these two techniques more clearly.

Finally, it is essential to establish a scoring system that allows for comparison of the results of different surgical techniques, taking into account key variables such as range of motion, grip strength, extension strength, and sensitivity. This would provide an objective guide for analyzing the results obtained with both techniques, thus facilitating the comparative evaluation of their final clinical effects and contributing to decision-making in the surgical and rehabilitation fields.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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